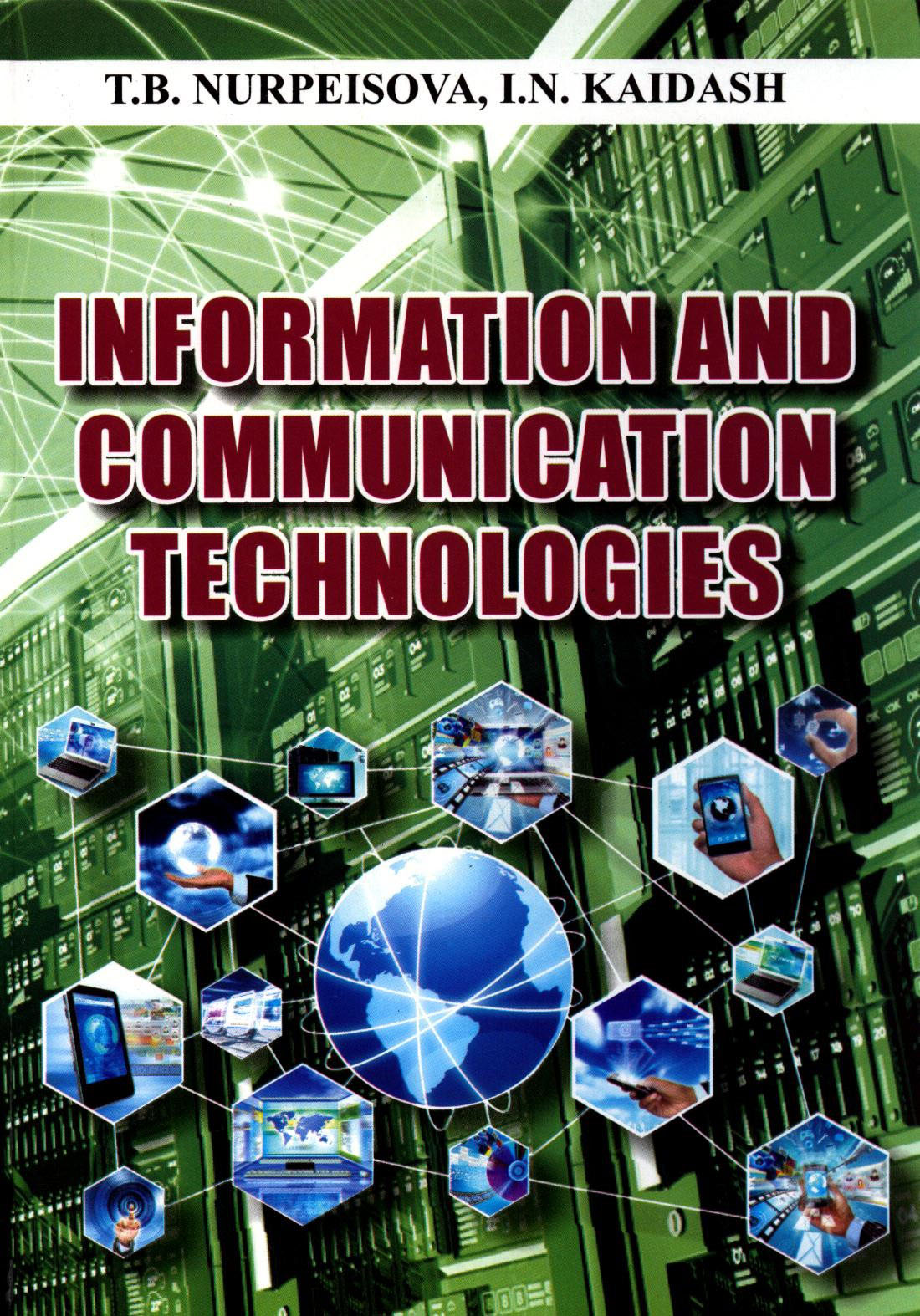


**T.B. NURPEISOVA, I.N. KAIDASH**

# **INFORMATION AND COMMUNICATION TECHNOLOGIES**



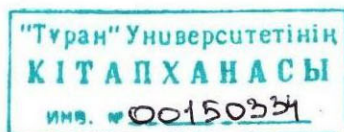
# INFORMATION AND COMMUNICATION TECHNOLOGIES

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MINISTRY OF EDUCATION AND SCIENCE OF THE  
REPUBLIC OF KAZAKHSTAN

**T.B. NURPEISOVA, I.N. KAIDASH**

# **INFORMATION AND COMMUNICATION TECHNOLOGIES**



Almaty, 2017

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N 98

*Recommended by Educational and Methodical Counsel  
of L.B. Goncharov Kazak Road Academy*

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The textbook on the mandatory course «Information and Communication Technology» is intended not only for undergraduate students of all specialties, postgraduate students, teachers who ensure an educational process on disciplines, associated with the use of computer technologies, but for all users wishing to improve their intellectual and professional level in the field of modern information and communication technologies.

The textbook is a set of educational materials that includes a theoretical course, a laboratory practicum, a glossary, self-examination questions, a list of used sources.

Studying the course, the students will receive theoretical background in innovative, information and communication technologies, necessary for their future professional activities. The content of the training manual meets the requirements of the State Compulsory Educational Standards of the RK for the discipline «Information and Communication Technologies».

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## Introduction

Globalization and the development of the «information society» rapidly change the face of the modern world. Information sphere becomes a system-forming factor and covers all branches of science and technology, economics and industry, state management and social life. Information and communication technologies become meaningful for all components of the world technological development in one way or another, and the global information infrastructure which was created on their basis is present in any form of development.

The President of the Republic of Kazakhstan N.Nazarbayev noted in his Address of January 31, 2017 that the development of the digital industry in Kazakhstan will give impetus to all other sectors of the economy. In connection with this he set the task to create a new model of economic growth, based on new promising technologies and innovations.

Due to various information and communication technologies, there are basic aspects that are based on global and local trends and that are mandatory and inevitable. These are:

1) Coverage of the country by all types of communications and the universal access to information throughout the country.

2) Maximum integration of a person into computer networks in the broadest sense. This integration should not be only in organizational and technical terms, but also in the whole social and cultural environment. A person surrounded by sensors and other detectors becomes an active element of the Network.

3) A wide penetration of artificial intelligence technologies into all branches of industry, public administration, and social life. Many daily operations of the primary and secondary level should be automated. This is not a simple automatic execution of routine procedures. There will be a real substitution of some of the functions performed by a person, intellectual operations based on artificial intelligence.

Steady saturation with means of communication enables each person to be involved in the global information and network space. New information and communication technologies contribute to an increase in global e-commerce, improvement of the quality of life, health, an ability to assist in emergency situation, international understanding, and building of a knowledge-based society potentially contributing to the emergence of more conscious, humane and better informed citizens.

It is necessary to use this trend of saturation of the information environment with new Kazakhstani applications, especially mobile ones and with mandatory integration into global networks and systems.

At the same time, the use of innovative technologies may lead to a division of society into those who own them and those who do not have the ability to use them, that is, to what is called «digital inequality».

In this regard, proactive steps and measures are required to parry and reduce the impact of negative aspects of this phenomenon. Moreover, society as a whole, including state and corporate governance bodies, will inevitably be transformed into a network management form. The emergence of networked and mobile organizations will entail changes even in such conservative organizations as scientific societies that will be network-centric in the short term.

A possible solution to this objective trend is the development of human capital, including through the increase in the level of knowledge of computer technologies. It is proved that the level of technological development influences the structure of demand in the labor market. Now the demand for highly qualified specialists is growing.

Today, the priority task is to train specialists who can acquire new knowledge and skills, quickly adapt to the demands and requirements of a dynamically changing world, to make decisions and act on their basis, relying on their professional competence. The very nature of these functions, as well as the expansion of spheres of activity, where during the period of labor activity of a person there is a change of several generations of technology, requires from him an ability and readiness to act in the conditions of uncertainty and changing of socio-cultural environment.

***Today's student should be well informed about ICT, know the purpose, technical, innovative and consumer characteristics of computing devices, modern software, understand the processing of numerical, graphic and multimedia information, master the basics of programming languages, take advantage of «cloud», mobile and social technologies, as well as technologies of analysis of large amounts of data.***

The presented textbook is intended for bachelor students, undergraduates, teachers, and those who want to study modern information and communication technologies and tendencies of their development.

# 1. ROLE OF ICT IN THE KEY SECTORS OF SOCIAL DEVELOPMENT. ICT STANDARDS

## 1.1. Definition of ICT.

### Role of ICT in the Key Sectors of Social Developme

Information and Communication Technology (ICT) have been taking a stronger position in the society during the last decade penetrating not only into the everyday life of the world population, but practically into all economic and social sectors. According to the definition adopted by UNESCO, Information and Communication Technology is a set of interrelated scientific, technological, engineering that study the methods of effective labor organization of people engaged in processing and storing of information, the methods of interaction of people with computers and production equipment, their practical applications, as well as the social, economic and cultural aspects of the problem. In accordance with ISO / IEC 38500: 2008, ICT is technologies necessary for collection, processing, storage, and spread of information.

According to I.V. Robert, «ICT means are software, hardware and technical equipment and devices that operate on the basis of microprocessor computer equipment, as well as modern means and systems for broadcasting of information, information exchange, providing collection, accumulation, processing, storage, production, transmission and use of information, an ability to access information resources of computer networks, including the global ones» [5].

The ICT definitions vary greatly depending on the content and conditions of use. Talking about ICT, we shall take a definition stated in the United Nations Development Program (UNDP): *ICT is basically an information processing tool – a wide range of products, software, and services that are used for the production, storage, processing, distribution, and exchange of information. They also include the «old» ICT such as radio, television, and telephone, as well as the «new» ICT: computers, satellite systems and wireless technologies, and the Internet. These various tools are now able to work together, and as a complex they constitute our «networked world», a gigantic structure of integrated telephone networks, standardized computer hardware, the Internet, radio and television, it is easy to get an access to anywhere in the world with the help of these tools.*

ICT can be broadly classified as digital and analogue, synchronous and asynchronous. Analogue data are collected in a continuous mode, while

digital devices «read» the analogue data in the form of zeros and ones. The older television and radio broadcasting systems, as well as videocassette recorders, were the analogue devices. But these hardware devices quickly turned into digital, and now the information recorded on them can easily be used with the help of other digital devices, such as DVD players. Computers are capable of processing only digital data, and therefore the most of the information is currently stored digitally. Table 1 lists various ICT used in the modern world.

Table 1

Classification of Modern ICT

<b>Synchronous ICT</b> <i>(require simultaneous work of both suppliers and users of information, although they can be located in different parts of the world)</i>	<b>Asynchronous ICT</b> <i>(allow both suppliers and users be in different places and work at different time)</i>
Audio-graphic	Computer training
Computer conferences (synchronous)	Computer conferences (asynchronous)
Electronic advertisement boards	Computer files transmission systems
Radio communication	Correspondence material
Satellite communication	Electronic advertisement boards
Television classes	Electronic mail
Teleconferences	Facsimile communication
Television	Multimedia products such as CD Rom Internet Technologies (e.g. websites)
Broadcasting systems – Radio broadcasting – Cable broadcasting	Tele-training (Computer-assisted instruction – CAI)
Telephony	Video tapes, disks

**Advantages and disadvantages:** Both old and new digital technologies promote individualization of their use and can serve multiple needs, perform various functions for different groups of users. But there are also significant differences in the level of their capabilities. The exact choice of specific technologies depends on understanding their strengths and limitations, as shown in Table 2.

Table 2

## Advantages and Disadvantages of Different ICT

<b>ICT</b>	<b>Advantage</b>	<b>Disadvantage</b>
1	2	3
Printing Technologies	Popularity. Possibility of multiple use. Possibility to increase printing volume. Control over the distribution scale. Possibility to unify the content and the used standards.	Literacy limitations. Static in time. Difficult to change. Passiveness, one-way technology with a limited level of interactivity.
Analogue Broadcasting Technologies (radio and television)	Popularity. Fast delivery to users. Possibility of stereotyped impact on users. Control of the distribution scale. Possibility to unify the content and the used standards. Easy to use.	Limited access. Static in time, synchronous. Difficult to clarify. No specialization on specific problems and geographical areas. Unified content for all population groups. High commissioning, production and operating costs.
Digital Technologies (computers and Internet technologies)	Interactivity. Low unit costs. Control over implementation scale. Possibility to unify the content and the used standards. Easy to change. Possibility to specialize on specific problems and geographical area.	Intractable limited use. High development cost. Dependence on the suppliers' capabilities. Need of high computer literacy for wide implementation in the market. Insufficient local information.

A series of studies on the use of ICT for the development purpose were undertaken, they discovered both advantages and disadvantages of ICT use. The studies showed an enormous diversity of approaches and experiences

in the use policy, design, implementation, and application of technologies taking into account different national circumstances. But these studies also showed quite clearly that digital ICT differ significantly from the older ones. A layout, production, and regulation of the content and delivery methodologies remained centralized and one-sided when using the old technologies such as printing, radio, and television. The new digital ICT are potentially more open and can be owned and operated by different individuals or social groups - that is, the property rights are transferred into the hands of an individual who has a remote control, a mouse, or a mobile phone. Hardware is used within personal needs and desires, and within an individual private space. It leads to an increase in diversity of both forms and content, and to a possibility of localization based on linguistic and cultural characteristics, design, content, and methods of use.

The primary means of accelerating the use of digital technologies is a process of convergence. Convergence is the process of imperceptible consolidation of telecommunication technology with all media, text, graphics, animation, and video in such a way that they are delivered from a single platform, and, at the same time, allow a user to choose any combination of information means for interactivity. It also refers to a grouping of data in different network technologies in such a manner that sometimes it is difficult to distinguish them from each other. For example, one means of telecommunication – a mobile phone – can be used as a means for transmitting text, audio, video, email, SMS-messages and a means of connecting to the Internet from one point to another (from a sender to a recipient), from a single source of origin to many destinations and from multiple points to any number of recipients.

Convergence allows content providers to create and deliver cognitive products so that «one process can give multiple results» – information and knowledge can be created and transmitted in electronic form as data, graphics, audio, video, either individually or together. This convergence of technologies simplifies the production process and extends the scope of coverage of information, thereby eliminating one of the most significant disadvantages of the old analog technologies.

Historically, Information and Communication Technology began to actively develop in the 1960s, with the advent and the development of the first information systems. The Internet development, as well as investments in infrastructure and services, caused a rapid growth of IT industry in the late 1990s.



The modern development of human civilization is characterized by a further stage of the technological revolution – an introduction of Information and Communication Technology (ICT) into all spheres of life, which changes the way people live, it has become a foundation and a material basis for the transition to information society, a society with a high socio-economic, political, and cultural development. The developed and many developing countries take an active role in the development of the ICT sector as one of the key directions of the state policy, realizing the importance of having the information society and the development of Information and Communication Technology in determining a long-term economic growth. The countries which have applied considerable efforts to the development of Information and Communication Technology ensured the growth of labor productivity and the quality of governance. Moreover, accessibility of a number of information services to general public has had a positive impact on the development of the human capital, contributing to the growth of competitiveness of these countries [1].

Everywhere in the world the following tendencies have been observed:

- 1) Transformation of all public institutions and spheres of human activity under the influence of ICT;
- 2) A progress in all areas of development, production, and introduction of modern technologies;
- 3) A desire to form a developed information environment, adequate to the tasks of socio-economic development of the countries;
- 4) Ensuring an equitable guaranteed access of the population to information resources;
- 5) Training of citizens, public institutions, businesses, and public authorities at all levels to live in conditions of information society.

Implementation of the above basic trends is the construction of an intellectual society based on information and knowledge, which already now uses these technologies:

**1) *Communication systems «at any time, from anywhere»:***

- Intelligent sensor telecommunication networks;
- The Internet of things;
- High-speed multimedia;
- The next generation information systems.

**2) *Cognitive technologies of robotization:***

- Coexistence of people and robots;
- Robotization under conditions of aging of the population;

- Manipulative technologies;
- Robots in the entertainment system;
- Home robots;
- Cyborgization, exoskeletons, built-in medical sensors;
- Cars without drivers.

**3) *New sensory and cognitive technologies of the computer and human interface:***

- Technology of reading emotions;
- A new generation of displays;
- Automated translation into all languages;
- Technologies for controlling postures and movements;
- The motion control technology;
- Development of the chips technology for recognition of mood;
- The next generation of computers with the android interface.

**4) *Virtual world:***

- Experimental training systems based on virtual reality;
- Virtual avatars;
- Virtual systems of life;
- Automated system of identification;
- Network economy and life in the net.

**5) *Smart city, intelligent production, smart transport:***

- Supercomputers, including quantum computers;
- Digital factories;
- Global robotic distributed production systems;
- Products, using 3D printing;
- Transition to cloud technologies of a new generation;
- Cloud mobile enterprises.

Today, it can be argued that in addition to Information and Communication Technology, the world technological development will be determined by the development of the following innovative technologies related to ICT:

- 1) Technologies for creating new materials (including nano-industry);
- 2) Biotechnology (including environmental management technologies).

In most of the advanced countries of the world, such as Canada, Korea, Malaysia, Singapore, the United States, strategies or comprehensive information development programs have been developed or implemented both at the level of the society as a whole and of the separate spheres of activity.

The states, formed in the post-Soviet space, are no exception. For example, a long-term strategic purpose of the state information policy of the Russian Federation and the state policy of the Republic of Belarus in the field of information is the transition to a new stage of development – building information society and entering the global information community.

At the first stages of the ICT development in the Republic of Kazakhstan, the main emphasis was made only on one of the components of the information society – on the formation and the development of «e-government», which was successfully implemented, as evidenced by the high international ratings. However, the task of forming the information society is certainly wider than the development of only «e-government» and the telecommunications industry.

Therefore, to create all necessary conditions that will facilitate a transition to the information society, and to implement the instruction of the Head of State given in the strategy «Social Modernization of Kazakhstan: Twenty Steps to the Society of Universal Labor» of July 10, 2012, the State Program «Informational Kazakhstan-2020» was developed. It takes into account the main provisions of the Okinawa Charter of the Global Information Society (Okinawa, Japan, 2000), Declaration of the Principles for Building the Information Society (Geneva, Switzerland, 2003), the Tunis Commitment Action Plan (Tunis, Tunis Republic, 2005), other international documents, as well as the Strategic Development Plan of the Republic of Kazakhstan until 2020, approved by Presidential Decree No. 922 of February 1, 2010. The Program identified four key areas:

- 1) Ensuring the effectiveness of the public administration system;
- 2) Ensuring the availability of information and communication infrastructure;
- 3) Creation of an information environment for the socio-economic and cultural development of the society;
- 4) Development of the national information space.

The program provides for the creation of opportunities for citizens to learn and gain skills in information technologies through e-education, lifelong learning and training, working remotely, receiving affordable e-health services. Also in order to build a more open, affordable and competitive economy of our country, the Program provides for the maximum implementation of

Intellectual systems in the main branches of the economy [2].

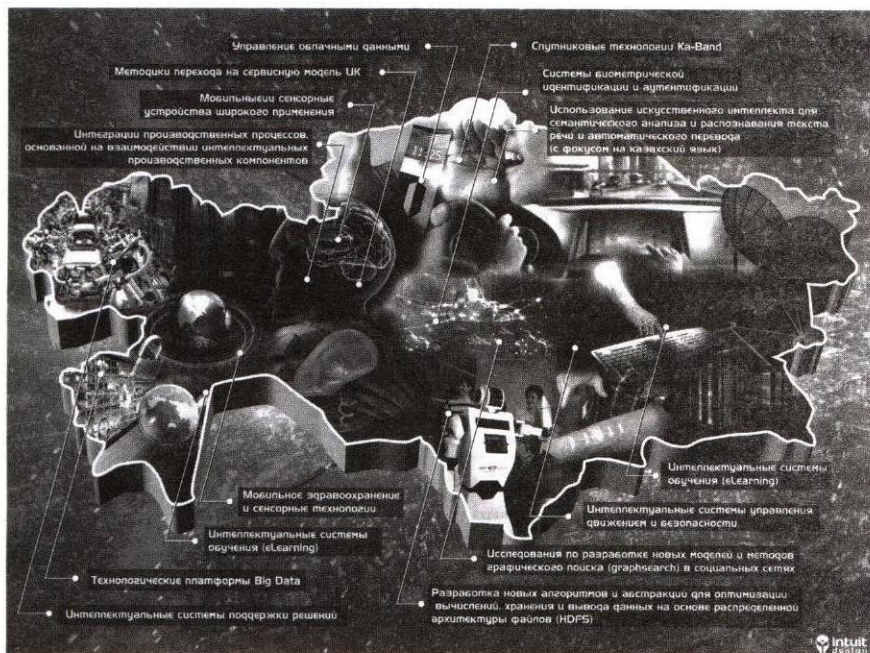


Figure 1. The Map «Informational Kazakhstan»

## 1.2. Standardization in Information Communication Technologies

Introduction of information and telecommunication technologies of different levels and purposes, integration of information, computing, telecommunication resources and the use of the technology of open systems is a complex, complicated, inter-industrial, multifaceted, and multidimensional problem. Standardization in the field of ICT, and primarily the introduction of methods of functional standardization, is the key to solving this problem. These methods allow using functional standards and profiles to identify groups of basic standards in different specific areas of activity.

Currently, the vast majority of information systems (IS) of all classes and assignments are built on the basis of an open systems technology. Its essence is to use standard interfaces between heterogeneous hardware and software components of various systems. The open systems technology

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underlies the creation of an infrastructure of all levels – from an enterprise and an industry to a national information infrastructure. In addition, it provides integration with the global information space and, thus, with the world economy. Implementation of the principles of the open systems at all stages of the life cycle of an IS design is based on the standardization of information technologies, which is an integration mechanism and a powerful tool for managing the development processes of informatization [4].

### ***International Standardization***

The main role in the development of the information society belongs to international standards, created on the basis of six principles defined by the World Trade Organization (WTO): openness, transparency, impartiality and consensus, efficiency and appropriateness, coherence and development orientation.

A strong cooperation has been formed between organizations developing ICT standards at the international level, among which, first of all, are the ISO (the International Standardization Organization), the IEC (the International Electro-Technical Commission) and the ITU (the International Telecommunication Union).

The ITU Telecommunications Sector (ITU T) has been an assignee of the CCITT since 1993 (the International Telegraph and Telephone Consultative Committee). In 1987, the ISO and the IEC combined their standardization activities in IT, creating the ISO / IEC / STC 1 «Information Technology», the main task of which is the development of basic IT standards, regardless of their specific applications. In the structure of ISO / IEC / STC 1 there are over 20 sub-committees (SCs) and working groups (WG) covering almost the whole spectrum of standardization in the field of information technologies and developing standards in the following main areas: character sets and encoding information; telecommunications and information exchange; software engineering; programming languages; machine graphics and image processing; interconnection of information technology equipment; methods of protection of information; office equipment; encoding of audio, video, multimedia and hypermedia information; methods of automatic identification, coding and fixation of data; data management and exchange; languages for description and processing of documents; user interfaces; teaching methods. There are over 1600 international standards on ISO / IEC / STC 1, which are grouped into functional groups and directions in official catalogs.

In recent years, ISO / IEC / STC 1 have been actively interacting with a number of ISO technical committees, including:

TC 46 «Information and Documentation».

TC 68 «Banking, Protection and other Financial Services».

TC 130 «Graphic Technology.»

TC 154 «Processes, Data Elements and Documents in Trade».

TC 171 «Applied Presentation of Documents».

TC 176 «Quality Management and Quality Assurance».

TC 184 «Industrial Automation Systems and their Integration».

TC 204 «Transport Information and Control Systems».

TC 215 «Informatics in Health Care».

In recent years, the activity on the development of international standards has been intensified (more than 100 international standards were developed) within the framework of ISO / TC 184

«Industrial Automation Systems and their Integration» with regard to the regulation of provisions and requirements for the continuous information support during the life cycle of complex high-tech products (CALS- (IPI) technologies), including such stages as design and analysis of business processes, creation and operation of products, logistics.

In addition to the ISO, the IEC and the ITU, a number of authoritative international, regional, national and specialized organizations, consortia and groups has been involved into the development of standards in the field of information technology and, in particular, in the field of open systems. These are, for example, the Internet Society, the CEN (European Committee for Standardization) and the CENELEC (European Committee for Standardization)(ETSA), the ETSI (European Open Systems Working Group), the ETSI (European Telecommunications Standardization Institute), the IEEE (Institute of Electrical and Electronics Engineers), the X / Open Group organized by suppliers of computer equipment, the OSF (Open Software Fund), the OMG (Object Management Group), the NMF (Network Management Forum) and others.

### ***Standardization in the Republic of Kazakhstan***

The policy in the field of standardization of information technologies in Kazakhstan is as follows:

1) Development of necessary up-to-date basic national standards and other normative documents (through the direct application of international and foreign standardization documents) defining fundamental general procedures, regulations and requirements that can be used in various areas of activity;



2) Development of functional standards (profiles) that determine appropriate subsets or sets of basic national standards used to support the implementation of specific ICT processes, functions and tasks, and which will be the basis for the development of certification tests for testing and confirmation of the conformity of components and means of information systems.

The Republic of Kazakhstan is a member of the ITU. In this regard, in Kazakhstan, the importance and urgency of the work on the development and the improvement of the domestic regulatory framework in information technology and information and telecommunication systems have become important.

In the industry of Information and Communication Technology of the Republic of Kazakhstan there are two technical committees for standardization:

TC 34 «Information Technologies» on the basis of ALE «Kazakhstan Association of IT Companies».

TC 63 «Systems, Facilities and Info-Communications Services» on the basis of ALE «National Telecommunication Association of Kazakhstan».

Technical committees for standardization take part in the development of national, provisional national, international, regional, interstate standards, as well as in the formation of the national standardization program [5].

However, in Kazakhstan there are difficulties with the use of the ITU Recommendations. It's connected with:

- 1) Existence of a gap in the ICT standardization in Kazakhstan in comparison with the developed countries;
- 2) Spreading of the national standards only on a fee basis;
- 3) Absence of observance of copyrights on standards and their distribution in domestic practice.

Inequality between Kazakhstan and the developed countries in the field of standardization includes five components of inequality:

- 1) Voluntary standardization;
- 2) Mandatory technical regulations;
- 3) Conformity assessment;
- 4) Qualified human resources;
- 5) Effective use of the ITU recommendations.

The sphere of ICT is international; therefore we can rely on the Western standards, translate, and use them. However, here it is required to change the methodology of the direct application of the international standards as national. It is necessary to synchronize the development processes of the

international and the national standards, beginning with the early (proposals for new types of work, draft international standards – CD, DIS) and finishing with the final stages, so that by the time an international standard is adopted, the country will prepare its actualized authentic translation as the basis of a corresponding national standard. Such methodology will ensure an adoption of an up-to-date harmonized national standard within a few months from the date of the approval of the relevant international standard.

The measures taken by the ITU have helped to narrow the gap in the ICT standardization, since it opened free online access to the ITU publications in pdf format starting from 2010, as opposed to the paid access to the ISO, the IEC and the ST RK standards. The Unified State Fund of Normative Technical Documents of the Republic of Kazakhstan (the USFNTD) includes 68 530 standards, including 6118 of RK. (Source: <http://www.kazinst.kz>)

 <b>Стандарты Республики Казахстан</b> Количество: 6 118	 <b>Межгосударственные стандарты</b> Количество: 22 695	 <b>Стандарты Российской Федерации</b> Количество: 11 630
 <b>Стандарты Международной организации по стандартизации</b> Количество: 16 081	 <b>Стандарты Международной электротехнической комиссии</b> Количество: 1689	 <b>Стандарты Международной организации законодательной метрологии</b> Количество: 224
 <b>Американские стандарты</b> Количество: 2 246	 <b>Стандарты Британии</b> Количество: 5 697	 <b>Немецкие стандарты</b> Количество: 160

Table 3 provides a list of the ICT standards of the Republic of Kazakhstan. A complete list is given in Appendix A.

Table 3

List of the ICT Standards

№	The Standard
1	2
1	Development of the ST RK «Information Technologies. Programming Languages, their Environment and Interfaces of the Software Systems. Extensions to the C ++ Library and to the Mathematical Special Support Functions».

Continuation of the table 3

1	2
2	Development of the ST RK «Information Technologies. Interaction of Open Systems. Part 1. An Object Identifier Authorization System».
3	Development of the ST RK «Information Technology. Interaction of Open Systems. Part 2. Procedures for an Operational Agency of an Object Identifier Authorization System».
4	Development of the ST RK «Information Technologies. Evaluation of a Software Product. Part 3. The Process for Developers».
5	Development of the ST RK «Development of Systems and Programs. Requirements for Purchasers and Suppliers of Documentation for Users».
6	Development of the ST RK «Information Technologies. Programming Languages, their Environment, and System Programming Interfaces. Extensions to the Library C. Part 2. Functions of Dynamic Assignments».
7	Development of the ST RK «Information Technologies. Development of Systems and the Software. User's Guide to the Requirements to Engineering Tools Capabilities».
8	Development of the ST RK «Information Technologies. Analysis of Accessibility for People with Disabilities. Part 1. Overview of the User's Needs».
9	Development of the ST RK «Quality of Official Information. Rules for Presentation of Information Technology for Certification».
10	Development of the ST RK «Information Technologies. Information and Computing Systems. Stages and Phases of the Life Cycle, Types and Completeness of Documents».
11	Development of the ST RK «Information Processing Systems. User Documentation and Label Information for Consumer Software Packages».
12	Development of the ST RK «Information Technologies. Guidance on the Application of GOST R ISO / IEC 12207 (Life Cycle Processes of Software Tools) ».
13	Development of the ST RK «Information Technologies. Guide to Managing Software Documentation».
14	Development of the ST RK «The Web Standard for Government Bodies».
15	Development of the ST RK «Accessibility of an Internet Resource for People with Disabilities».

1	2
16	Development of the ST RK «Internet Resource, Internet Portal, Intranet Portal. Definitions and Technical Requirements».
17	Development of the ST RK «Recommended Practice for Developing Mobile Web Applications».
18	Developing the ST RK «Requirements to the Security of Web Applications in Government Agencies».
19	Development of the ST RK «Information Technologies. Methods of Ensuring Safety. Guide on Implementation of Information Security Management».
20	Development of the ST RK «Information Technology. Methods and Means of Ensuring Security. Information Security Management. Measurements».
21	Development of the ST RK «Information Technologies. Methods of Ensuring Safety. Confidentiality Framework».
22	Development of the ST RK «Information Technology. Methods and Means of Ensuring Security. Safety Assessment Systems».

### 1.3. Application of ICT and the Development

The link between Information and Communication Technology (ICT) and the achievement of the Millennium Development Goals (MDGs), on the one hand, seems obvious, and on the other hand, is unclear. But this link still exists, and it requires certain efforts to develop it and study it. The main task is to deepen understanding of the possibilities of using ICT for stimulating social and economic development, as well as providing politicians and managers with a system of ICT applications aimed at stimulating development, as well as opportunities to practically implement the ICT in a number of social sectors [6].

The Millennium Declaration of the United Nations was adopted on September 8, 2000 by the UN General Assembly (Resolution No. A/RES/52/2). In the Millennium Declaration, the UN member states committed themselves to achieving the Millennium Development Goals in the field of peace and security; development; environmental protection; human rights, democracy and governance; protection of the vulnerable; meeting the needs of Africa; strengthening the UN. Some goals, especially

in the field of development, are formulated specifically indicating figures and terms (mainly 2015 and 2020). The UN Secretary-General in his reports and speeches regularly reports on the actual fulfillment of the obligations assumed.

ICT, by its nature, is interrelated, and its application can be cross-sectoral and multi-purpose. There are two approaches to the ICT application. One of them is the direct application, which is aimed at end users and, at the same time, ICT is used to organize a direct connection between them and service providers. The second approach is the indirect application, which is ancillary, that is, it is aimed at developing policies, infrastructure, support systems, and content, which, in turn, are expected to benefit end-users. Lets us consider both types of the application, but taking into account the achievement of the MDGs in the selected sectors.

### **1.3.1. ICT and Eradication of Reduction**

ICT play an important role in stimulating economic growth, which in turn affects the fight against poverty. Countries with a high level of economic development also have a high level of ICT penetration. This indicates that business and industry, in the first place, take advantage of the information revolution. The ICT infrastructure and human resources, as well as their development, provided a high level of economic growth in such countries as India and China, turning them into powerful powers in the information community. A reforming impact of ICT is the most noticeable in the small and medium-sized business sector (SME). With the help of ICT, small businesses have the opportunity to improve their work by reducing the costs associated with organizing internal communications (between the units of a company) and external communication with clients, exploring new markets, developing a global client network and increasing consumption volumes, as well as improving inventory of internal resources, thereby reducing unforeseen costs and increasing profits. While public investment in communication infrastructure is essential for economic growth, the best incentives that governments can provide to SMEs with the help of ICT for the subsequent increase of their productivity, are the elimination of obstacles and the creation of an enabling environment for work by simplifying registration and legal requirements, provision of training opportunities in special courses on doing business and securing financing, ensuring the connection of SMEs with larger companies and the provision of tax incentives. The growth of the industry and the private sector with the

support of ICT contributes to poverty reduction in some cases. However, the poor have received fewer benefits from this type of development than non-poor. Governments must address the problem of poverty directly, and not only through intervention in the economy to promote growth, which is expected to ultimately benefit the poor. Poverty is of many faces. It includes a lack of income, a lack of land for farming, credit and services, a constant hunger, lack of access to primary education and / or health care, especially for infants and mothers, high mortality and low life expectancy, exposure to HIV / AIDS, malaria and tuberculosis, lack of available means of subsistence and employment for young people, increased vulnerability to natural disasters and conflict. For all of the above, both a direct and indirect impact through ICT is important strategies to alleviate poverty (for example, the use of ICT to provide a service to the poor, or a more significant impact like a compilation of maps of natural resources). As an example, consider the project Thread Net Hunza, which is a local project with external funding for a remote region of Pakistan, designed to facilitate an access to the world market for local weavers and traders, thereby increasing their productivity, income, and standards of living. This project is a direct impact approach where ICT is used to connect poor people and the markets [7].

*The possibilities of using Information and Communication Technology in the sphere of employment of the population of Kazakhstan can be considered through the prism of the Internet portal «Rabota». The main objective of the portal is to help job seekers in the job search, and employers – in the search of qualified personnel. Every day visitors from different parts of Kazakhstan visit the site to place their vacancy announcement or resume. In an extensive database of vacancies, only current advertisements are kept in all fields of activity, of various professions and with different levels of salary.*

### **1.3.2. ICT and Education**

The right to education is recognized as one of the fundamental human rights, at least because education is a vital and an important need in combating poverty and other forms of inequality in society. However, social and economic inequality created a situation where the majority of children in the world are not able to use their fundamental right. For some countries, a major challenge is the provision of quality education for all sectors of the society, given the limitations in their resources, which in relation to education, among other things, is expressed in the lack of educational



facilities, textbooks, and teachers. ICT play an important role in overcoming these difficulties. More specifically, ICT can provide access to schools and educational resources, improve the quality of teaching and learning, increase the effectiveness of leadership and teaching (Table 4).

Table 4

Opportunities and Advantages of Using ICT in Education

Opportunities	Advantage
Access to high-quality learning materials regardless of location. Communication between students. Elimination of spatial constraints. Organization of the educational process.	Any training materials developed anywhere can also be accessed anywhere. Collaborative learning Interactivity of ICT connected via networks provides a possibility of interaction between students, as well as between teachers and students. Long distances, isolation are no longer decisive factors for determining quality education or training costs. Organization of admission for training, evaluation, and certification can reduce administrative costs of training.

ICT can be and are already being used to provide access to education for those who are unable to attend school because of poverty, disability, geographic location, gender, conflict, occupational commitments, or cultural restrictions. For example, in countries such as China and Mexico, television and radio have been used to conduct lessons for children and young people living in remote regions. In communities with predominance of male technological innovations are inexpensive means of organizing women's schools, providing education for girls and women. In Bangladesh, India, Pakistan Sri Lanka schools were opened experimenting with different ICT from a variety of print materials to audio and video materials and e-learning, to provide the poor with an access to primary and secondary education.

Since the use of ICT implies a minimum level of computer literacy, the use of ICT was originally promoted in the educational sector as a tool supporting higher education. Distance education, in particular, increased the access to higher education, especially in countries with large populations. Currently, distance education programs are available at real-time, in the so-called e-learning mode. However, the digital inequality limits the access to such programs, even for those who have money, infrastructure, and the

skills to use ICT. To correct this deficiency, small countries formed an alliance with countries that do not have access to the sea to place a request to establish a virtual university, the main task of which would be to solve the problems of these countries with the help of modern technologies. For example, the Virtual University for Small States of the Commonwealth member countries of the Pacific region (VUSSC) was established.

Another area of education, where ICT can be used widely, is a non-formal education (NFE). Currently NFE is an integral part of the concept of continuous education, when young people and adults may increase and maintain their professional skills in the continuously changing world. In developing countries, a major component of NFE is to improve the basic literacy program, and many of these programs are taught directly to students by an instructor in a classroom.

An important area of ICT application in education is teachers training. ICT is an important means of training of a large number of teachers, who, in turn, are engaged in training of the general population. Since the effectiveness of the use of ICT in classes depends on them, teachers should develop both pedagogical and technical skills to teach using ICT. This is especially important in the new knowledge economy, where the goal of education is not just the training of a fixed set of knowledge and sciences, but the development of the «21st century skills» – critical thinking, information literacy, problem solving ability, training collaboration skills, an ability to learn new skills and to apply knowledge in new situations. The impact of ICT on education is the second after the impact on business practices around the world [7].

*Introduction of modern Information and Communication Technology corresponding to international educational standards, as well as provision of all necessary conditions for a fruitful work of teachers, masters of industrial training are strategic priorities in the field of education of the Republic of Kazakhstan.*

*For the first time, the Ministry of Education and Science of the Republic of Kazakhstan placed electronic versions of textbooks on its website. Now every teacher, parent, or student has a free access to these electronic educational resources and an opportunity to use them at any convenient time. Electronic versions of textbooks are provided for posting on the site by Kazakh publishing houses. Modern methods of interactive provision of the educational material make it possible to make the study interesting and fascinating for schoolchildren of any age. Now, thanks to the opportunity to use e-books, the youngest Kazakhstani students will be able to greatly*

*ease their school backpacks and briefcases with the help of teachers and parents.*

*In order to promote the state language and to implement tri-lingualism among citizens of our country, a remote training of the Kazakh language is introduced. On the official site [www.kazakhtest.kz](http://www.kazakhtest.kz) you can check your knowledge of the Kazakh language in on-line mode. Recently an Internet portal «Soyle.kz» was launched; it teaches the state language in on-line mode free of charge. It is a platform for development of spoken language. The course will help to easily speak the Kazakh language and understand the interlocutor in a diverse communicative situation. A 30-volume inter-branch Russian-Kazakh dictionary, a terminological Russian-Kazakh dictionary were developed. Now the work on the development of the next 10 volumes is under way. A Remote and on-line training is provided on the State language portal of the Committee on Languages of the Ministry of Culture and Information of the Republic of Kazakhstan. Students can also use the site «Learning to Speak Kazakh», which was developed by teachers and methodologists of the Department for Language Development of the East Kazakhstan region.*

*The educational programs recommended by JSC «NCPC «Orleu» provide theoretical and methodical training of educators aimed at achieving a new quality of education using Information and Communication Technology. Distance learning is introduced into upgrading courses, which implement the key landmark «Affordable Training to Everyone». Many teachers in the Republic of Kazakhstan improve their qualifications annually through distance learning.*

### **1.3.3. ICT and Gender Equality**

Gender inequality is not just a problem of women and girls. As long as almost a half of the world population will be diminished in rights and opportunities, so that these people are not able to fully contribute to society, economic and social development will remain uneven in the best case scenario. In the world, this is an officially recognized fact, since gender inequality is included in the MDG. Many programs and projects, that promote the development of society, continue to ignore gender inequality, and ICT application projects are not the exception. According to a study carried out by the Swedish International Development Agency, most ICT projects, while in many areas contributing to overcoming poverty, have focused on «the poor» as a general category, not paying enough attention

to the aspects related to women. As a result, such projects do not take into account the interests of women. This issue is a separate issue, since ICT become the main tool of participation in social life and economic productivity, and the inability of women to acquire knowledge and skills in ICT further deepens their marginalization.

ICT can benefit women both directly when women use technology to improve their own status, or indirectly, when the technology is used to improve the efficiency of information and services for women. ICT offer women opportunities to participate directly in e-commerce, access to education and to exercise governance over the Internet, avoiding the social and cultural barriers, closing access to economic benefits. Work through the Internet (telework) and electronic commerce enabled women to work directly from home. Such opportunities, given by the use of ICT, become much more successful when they are designed, operated and managed directly by women, as in the case of the Malaysian project eHomemakers. The use of ICT by women's groups has enabled women to organize a campaign in defense of their rights, increased their participation in public life by means of a new communication forum to express their views, and increased the level of understanding of women's problems [7].

*In the first half of 2016 in Kazakhstan women constituted 40% of the managers of registered small and medium enterprises, of whom 50-65% owned enterprises in hotels and catering sectors, wholesale and retail trade, education and agriculture. In Kazakhstan women-entrepreneurs have the highest level of physical access and ownership of ICT skills compared with the countries of Central Asia and Azerbaijan. The mobile phone is the most commonly used ICT device.*

*Most women entrepreneurs have the Internet access and a computer. Almost half of them have the Internet access from a mobile phone. These data are confirmed by the available statistics of ICT in Kazakhstan, which show that, as of 2015, 155.7% of the population were mobile phone subscribers, which is 92.4% higher than in other middle-income countries. The same study showed that 46% of households have a computer, and of these, 44% were connected to the Internet. However, the data on the location of businesses showed that the rural population is still lagging behind. The majority of respondents with businesses in rural areas said that they either did not use a computer (86%) or the Internet from a computer (70%). Conversely, all urban respondents and 97% of respondents from the suburbs said they used a computer or the Internet in the previous 12 months.*

*According to the Statistics Agency, there is a small gap between men-users (54%) and women (46%), which is encouraging. Women-entrepreneurs of Kazakhstan quite often use the Internet from computers for various tasks. Most of these tasks relate to basic or personal issues, such as the use of social networking, buying or ordering goods or services, sending e-mail. In Kazakhstan Internet, newspapers, television, and oral channels were the most effective channels for the promotion of training programs and informing women-entrepreneurs about them.*

#### **1.3.4. ICT and Health**

ICT promote the exchange of health information between rural isolated communities and urban areas, which enable to establish effective health development monitoring systems, provide access to the latter discoveries in the field of medicine and allow creating an effective system of continuous professional training for physicians. There are two key categories of health professionals that can benefit from the introduction of ICT. *The first category* includes ordinary people who use health services, especially those who are restricted in access to health services and related information, including vulnerable groups of people, victims of natural disasters and military conflict, and people with disabilities. *The second category* of stakeholders includes health professionals: physicians, professionals at the top level of health care, such as doctors, nurses, and specialists caring for the elderly people; researchers and administrators of the health system; and even those who formulate health policy.

The use of ICT can be carried out directly for the first group, providing communication of patients with the expert medical services. For the second group of participants, the application of ICT can be indirect and supportive through the creation of monitoring systems or the provision of continuous professional training. Telemedicine is the most common field of application of ICT in healthcare. Also it is known under the name of E-Health, in which case it is essential to use the technologies with satellite or broadband connection to provide communication between patients living in rural areas and remote settlements with medical specialists in cities. One of the forms of telemedicine is broadcasting of interactive videoconferences, when geographically separated doctors and patients hold joint consultations. A camera in the examination room allows a doctor to present a patient to a specialist who can be located at a great distance, thereby significantly reducing the cost of delivering the patient to the examining specialist or the

cost of transportation of the specialist to remote human settlements. These measures also expand access to health care even in the acute shortage of medical professionals [7].

The appearance of gadgets, the availability of cellular communications and the Internet, including mobile 3G and 4G, changes the appearance of medicine. If twenty years ago there were mainly telephone consultations, then in time even such free software as Skype allowed the patient to talk face to face with a doctor even from a pharmacy. Moreover, the look of telemedicine is changed by the wearable gadgets. Pulse meters, first appearing in the 1970s, have now become an integral part of many «smart» watches. This is another source for collecting information, which is useful for doctors to diagnose and develop recommendations.

*On August 1, 2016, the project «The Second Opinion» was successfully launched in Almaty. Now you can get information and purchase the «Second Opinion» service in 8 pharmacies of the southern capital. The International Department of GHP Pulse regularly organizes video consultations with German professors who are on the TOP 100 list of the best practicing doctors in Germany. The second opinion of a doctor of high qualification allows you to hear another point of view about the diagnosis, decipher the tests and results of the examinations, and discuss the prescribed drugs. This is a real opportunity to get a second expert opinion before a complex treatment or an upcoming operation, in the necessity of which the patient is not sure. In case the proposed therapy is not relevant, the patient learns about an alternative way of solving the problem and, if necessary, the cost of treatment in Germany.*

Another important area of ICT use in healthcare is the deployment of ICT-based surveillance systems to prevent, report, and control diseases such as HIV / AIDS, malaria, tuberculosis and leprosy. The availability of such systems allowed both international organizations and state bodies to control the spread of diseases across international borders. For example, targeted protection and combating rapidly spreading diseases, such as SARS and avian influenza, have only been made possible through the availability of health surveillance systems using ICT.

### **1.3.5. ICT and Sustainable Use of Natural Resources**

Inequitable distribution of resources and unbridled exploitation of natural resources have led to the emergence of the global crisis of monumental proportions. Different parts of the world have become increasingly sensitive

to global climate changes, including global warming, drought and floods. Island states are particularly vulnerable to the effects of global warming and rising ocean levels, while isolated and mountainous states are exposed to melting glaciers, soil erosion, and avalanches. And this is just some of the natural exposures. The most vulnerable victims of climate change are poor people, wherever they are located, since the scale of global changes lead to loss of livelihood. The evidence of this is the large number of suicides among Indian farmers. ICT plays an important role in environmental issues, for example, through geographic information system (GIS) used to draw up the natural resources maps or to attract attention to the consequences of deforestation. Islands and other remote regions can largely benefit from integrated planning and management system, created with the use of ICT.

Mobile interactive geographic information system is used in China (MIGIS – Mobile Interactive Geographic Information System) in a joint agricultural research «for combining the best local practical knowledge and scientific information in order to optimize the planning process» and for using natural resources at the community level. MIGIS converts graphic information, gathered through joint training and exercises, to digital format. Restoration of Loess Plateau in China is a joint effort of several parties to fully change damages associated with its long-term operation. The project uses various ICT for registration of environmental damage, data collection, as well as for raising awareness about the measures that could prevent further environmental damage [7].

*An important contribution to the development of agro-industrial complex of the Republic of Kazakhstan is made by modern space technology. The use of remote sensing data for monitoring agricultural land is of particular relevance for Kazakhstan with its vast open spaces. During the past 15 years JSC «National Center for Space Research and Technology» have been creating the Kazakhstan National Space Systems of monitoring of the Republic of Kazakhstan. It consists of the complex GIS technology to solve the problems of space monitoring of agricultural production in Kazakhstan. The list of issues includes mapping of acreage of spring crops, controlling the pace and the scope of basic agronomic work, assessment of the crop and the forecast of cereals yield [8].*

*Spatial analysis with GIS and remote sensing technologies (geographic information systems and remote sensing) is one of the few high-tech industries, where Kazakh companies operate at the advanced level – LLP «KMG-Consulting», LLP «Centre for Remote Sensing and GIS «Terra»,*



*LLP «Kazakhstan Agency of Applied Ecology», JSC «KazNIPImunaygas», LLP «Batysekoproekt», LLP «Eco-Audit-NC», and the other.*

### **1.3.6. ICT, Government, and Public Administration**

Government is a superstructure that develops rules, makes and executes decisions that become visible as the results of its activities. Government processes include many internal interactions between individual officials and state organizations long before the final results in the form of the taken decisions reach public opinion and affect the entire system of public administration. Government management takes into account the interactions between government and citizens of a country, and therefore this process is multifaceted and complex. Governance includes functionality, processes, goals, activities and their coordination, and it has visible results in the process of interaction between government and citizens. Now most of the governments of countries recognize the fact that a stable democratic government and well-managed public organizations are an integral part of raising the standards of living of society and fighting poverty. There are many evidences that have been confirmed in many countries, showing a strong link between good governance and increased investments, higher loan rates, better economic governance, increased literacy of the adult population, lower levels of state corruption and improved quality of services. There is also a growing recognition that to ensure the quality provision of public services to its citizens it is not enough to just have a well-functioning and managed state – it must also be responsive and responsible to its citizens. Government-to-Government (G2G), Government-to-Business (G2B) and Government-to-Citizens (G2C) relations form the basis for the application of ICT in the system of government and public administration. Main idea is to create a government that provides efficient and efficient provision of public services (electronically) and at the same time, making them more transparent, responsible and responsive to the participation of citizens in the democratic processes. The terms «electronic government» (e-government) and «electronic state governance» (e-governance) often interchange and supplement one another, which leads to some confusion. Governance is a broader aspect that unites a broader range of relationships between government and citizens, while the government relates to the day-to-day functioning of the government in providing services to society in such areas as education, health, taxation, land management and so on. If the government is the official apparatus of the effective management system,

governance is the result of the activity felt by the participants at the end of the process.

E-government can be a more effective application of the government support as a whole if it is effectively managed and operated, while e-governance can become a joint government if it receives support in the form of appropriate principles, objectives, programs, and structures.

*As an example, consider the pilot project «Electronic House Book.» Currently, there is no state agency in Kazakhstan that can freely provide information about the number of people registered in residential premises. As it turned out, this defect in the republic has existed for several years. However, this problem became acute precisely at the time of innovations in registration. According to the Ministry of Internal Affairs, the process of integrating databases of government agencies «Address Register «(Ministry of Information and Communications of the Republic of Kazakhstan),» Real Estate Register «(Ministry of Justice of the Republic of Kazakhstan) and «Registration Item «Documentation and Population Registration» (MIA RK) is close to completion. By checking the correctness of the addresses between the databases, the address information on codes, directories and owners (owners) dwellings will be updated. Owners of dwellings will be able to check the number of registered citizens at a specific legal address and take measures to remove them from registration, which in turn will identify citizens who fall under administrative responsibility and oblige owners of the housing to register such citizens at their actual place of residence.*

A popular model for providing electronic public services is the use of portals, but even a glance at many similar portals shows that there is a one-sided transmission of information with minimal or no interaction. Some countries have established common service delivery centers in urban areas where operators work with computer terminals and provide services to customers in real time. In India, some services are accessible even to rural poor people who can benefit from such organization of work. In another part of the developing Asia, the Mongolian Government benefited from the use of ICT to simplify the procedure for paying taxes by its citizens.

*The acquisition of state independence by the Republic of Kazakhstan and the transition to a market economy predetermined the need for global changes in the existing mechanism of the management and changes in tax relations between taxpayers and the budget. The foundation for the establishment of an effective tax administration system was laid, the necessary prerequisites for an integrated approach to the implementation of the diverse functions and tasks assigned to the tax authorities were*

*created. In respect to the development of electronic services the application «Taxpayer Web-Cabinet» was implemented on the website of the Tax Committee for the convenience of taxpayers, it provides the taxpayer with the following opportunities: filling in and submitting tax returns; search and review previously submitted reports; submitting a tax application for carrying out credits / refunds of taxes and other mandatory payments, penalties and fines; submitting a tax application for obtaining information about the absence and (or) existence of tax debt, arrears on mandatory pension contributions and social contributions; presenting a tax application for a documentary audit; receiving notifications of tax authorities; viewing of registration data, personal accounts, information on registered objects of taxation, etc.*

*It should be noted that the Tax Committee was one of the first state bodies to initiate and conduct active work on establishing an open dialogue with taxpayers, electronic Tax Committee through the site [www.salyk.kz](http://www.salyk.kz), e-mail, blogs - where each taxpayer can apply to the leadership of the Tax Committee, send suggestions, complaints, etc. Mechanisms to pay taxes and other mandatory payments to the budget through the ATM network, the Internet, Web-kiosks and «Taxpayer's terminals» were introduced, they are mainly introduced in rural districts where there are no tax authorities. It is impossible not to note such innovations as the construction of centers for the receiving and processing of information of tax authorities, an access to information on tax legislation through the Call-center.*

*The Tax Committee, in close cooperation with the World Bank, carried out a series of joint reforms, most in IT area. Interaction with this development institute in terms of taxation is one of the steps to implement the Strategies of Kazakhstan to enter the 30 most competitive countries in the world.*

*The e-government system is one of the most effective ways to combat corruption. Electronic voting, for example, can smooth out anomalies in the voting process. When all government procedures and processes are open to close scrutiny by society in real time, the media, citizens' associations and civil society organizations can monitor actions or inactions of the government.*

*An electronic procurement system can serve as a good example of how ICT can help to improve public administration. The introduction of automated procurement systems led to the standardization of the tendering process, the increase of its effectiveness, the reduction of bureaucratic interference, it also guaranteed the objectivity of the taken decisions and*

made the procurement process transparent. Elimination of contacts between the buyer and the supplier at the stage of preliminary evaluation of proposals and after the evaluation process guarantees objectivity in obtaining and evaluating procurement proposals and significantly reduces opportunities for bribery. In order to ensure transparency, tender documents containing all detailed information are stored on the website and can be downloaded by interested suppliers for free. At any time during the bidding process, a bidder has access to any information he needs, including names and information about his competitors, price lists, evaluation of the results, and activities carried out by the interested government agency. [7]

*In 2016, in Kazakhstan all government purchases were transferred into electronic format. To simplify procedures of public procurement, the law provides for the introduction of a tender process using pre-qualified selection as well as for simplification of the tender and the auction process. The Portal “Public Procurements of the Republic of Kazakhstan” (goszakup.gov.kz) provides a single point of access to electronic services in public procurement and allows you to participate in public procurement as a customer, an organizer and a supplier from any computer connected to the Internet.*

Electronic government allows other forms of involving the public in public administration. The state Internet sites and portals may include civil statutes for citizens wishing to know about their rights with regard to specific services. Web sites can organize public discussions and conduct online voting on specific aspects, which will make the decision-making process more extensive. Internet sites can help interested government bodies monitor public discontent and respond more quickly and effectively to citizens' complaints. Citizens, in turn, can get an opportunity to interact with government officials, drawing attention to public issues, getting a quick response to their questions and complaints, and even developing report inquiries and implementing other measures of public control over the effectiveness and quality of government work. All of the above measures can be implemented at a relatively low cost and with greater efficiency compared to the previous years. Using appropriate infrastructure for access to information at affordable prices (for example, public telecentres), governments can guarantee that the poor can benefit from introduction of e-government. The effective, qualitative, and stable functioning of the government in an atmosphere of peace with wide public involvement will enable countries to more effectively carry out the objectives of the MDGs.

### 1.3.7. ICT and Peace

No development is impossible without peace. This is the simplest concept. Development and prosperity are possible only in the case of a peaceful and stable situation in the region. Regions that are in conflict necessarily have low development indicators. Decades of successful work of many countries and international organizations can be destroyed in weeks in case of a conflict. The return on financing of the conflict prevention process or on the process of building a reliable peace significantly exceeds the capital investments needed to restore peace in countries emerging from conflicts.

ICT4Peace (ICT for Peace) is a new promising field of ICT application, which currently has only a very general definition. It includes various types of activities where it is possible to use ICT that need to be implemented to prevent the emergence of conflicts and monitor their development, peacekeeping operations, humanitarian assistance and natural disasters, and the construction and restoration of peace. Below is a brief description of some examples.

*ReliefWeb*, 50 is a service of the United Nations Office for the Coordination of Humanitarian Affairs (JAGO), which is an Internet resource for the collection of humanitarian information. The Internet site offers an online information service («Web feed»), which provides specific information to partner websites. Users can create password-protected profiles to monitor the materials of interest. About 150 maps and documents from more than 2,000 sources are sent daily with its help, its offices are located in three time zones to provide round-the-clock updates of news data.

*Alertnet52* is a project of the Reuters Foundation, which pays special attention to rapidly developing humanitarian disasters and early warning of future problem situations. For example, through their urgent news service, photographic gallery of natural disasters and the service of providing news for aid («Aid Agency News Feed») Alertnet provides timely, reliable and objective information to aid agencies.

The Government out of the Box (GooB) project is an example of how ICT can be used to restore the situation after the conflict. The GooB project is aimed at finding new approaches and tools that arise in overcoming the difficulties of state building. The project includes a set of tools aimed at the rapid restoration of administrative functions in countries in crisis, thereby allowing them to provide their citizens with public services. These instruments should be at the disposal of international players whenever they

work in post-conflict situations and countries after the end of a conflict. This toolkit should accelerate and improve support and assistance to newly formed government bodies. Available tools should be standard, but at the same time with the ability to scale and where possible they have to be flexible in order to adapt them to different circumstances.

In the post-conflict recovery process, ICT can be used to disseminate the terms of the ceasefire agreement concluded among belligerents and local communities and in the process of clarifying the situation and organizing support. ICT can also be used to increase the awareness of military tribunals and investigative commissions about military commotions, enhancing public understanding of the processes necessary for the triumph of the legitimacy of the Campaign, supported by ICT and aimed at building peace. ICT can influence political leaders and stimulate the exchange of information and building dialogue between local communities. In the final analysis, there should be an environment for dialogue and direct conversation between people; this is a long process to create an atmosphere of benevolence, which should stimulate the process of the construction of peace [7].

The use of ICT to achieve the MDGs creates an opportunity for a more integrated approach to the development of society. Such an approach is necessary, since in the course of the development of the society, failures in one sector can have a negative impact on other sectors (for example, an inability to provide universal education will mean a minimal success or a complete absence in the process of combating poverty). However, while some countries have made a progress in using ICT for development, there are many countries where the process of involving ICT in the development process of society is still at a low level.

## **1.4. The use of Information and Communication Technologies in the Republic of Kazakhstan**

### **1.4.1. Regulatory Framework**

In accordance with the Law of the Republic of Kazakhstan No. 418-V «On Informatization» of November 24, 2015, the government of the Republic of Kazakhstan adopted a resolution «On Formation of the National Development Institute in the Field of Information and Communication Technology». The National Development Institute in the field of Information and Communication Technology formed a joint stock company «National

Info Holding «Zerde». The Law lists the functions of this National Institute, namely:

- 1) to realize measures of state support for the development of the Information and Communication Technology industry;
- 2) to provide information and analytical and advisory services in the field of Information and Communication Technology;
- 3) to invest into industrial and innovative projects in the field of Information and Communication Technology by participating in the charter capitals of the subjects of industrial and innovative activity, in the creation of legal entities, including with foreign participation, and in other ways provided by the legislation of the Republic of Kazakhstan;
- 4) to cooperate with international organizations and foreign legal entities to attract informational, educational, financial and other resources to stimulate the development of the Information and Communication Technology industry in the Republic of Kazakhstan;
- 5) to provide the subjects of informatization with access to information on implemented industrial-innovative projects in the field of Information and Communication Technology;
- 6) to issue expert opinions and (or) recommendations in the field of Information and Communication Technology to an authorized body and the state bodies at no cost;
- 7) to collect information and analyze the effectiveness of measures of the state support in the development of Information and Communication technology;
- 8) to support the development of investment funds for risky investments;
- 9) to carry out analysis of the development of the Information and Communication Technology industry;
- 10) to support the development of local content in the Information and Communication Technology industry;
- 11) to develop normative documentation on standardization in the field of Information and Communication Technology;
- 12) to submit to the authorized body proposals for the formation of a state educational order for training, advanced training and retraining of specialists in the field of Information and Communication Technology at organizations of technical, professional and higher education, as well as proposals for standard curricula and model curricula in the field of Information and Communication Technology;



- 13) to issue an expert opinion on the provision of innovative grants in the field of Information and Communication Technology.

In addition, Article 61 of the Law provides the norms of the state support of the development of the Information and Communication Technology industry. According to this article, the state support of the development of the Information and Communication Technology industry is carried out by the authorized state bodies, the national development institute in the field of information and communication technologies and other national development institutions to stimulate the development of the Information and Communication Technology industry in the Republic of Kazakhstan. At the same time, the National Institute carries out its activities in accordance with the Law and the legislation of the Republic of Kazakhstan on the state support of industrial and innovative activity. The main principles of the state support of the development of the Information and Communication Technology industry are:

- 1) the development of the Information and Communication Technology industry based on private entrepreneurship and public- and private partnership;
- 2) the priority of domestic legal entities in obtaining orders on the development of information and communication technology, information systems;
- 3) the stimulation of development of domestic software production, software products and production of technical means;
- 4) the development of the structure of the Information and Communication Technology market;
- 5) the support of fair competition in the Information and Communication Technology market.

In accordance with the principles of the state support, the measures to stimulate the growth of the Information and Communication Technology sector, in addition to measures envisaged by the legislation of the Republic of Kazakhstan on investments and on state support of the industrial and innovative activity are:

- 1) the formation and the development of the regulatory and methodological framework of the activities in the field of Information and Communication Technology, including the implementation of international standards;
- 2) the implementation and the improvement of the system of state (quasi-public) orders on the development and supply of innovative software, software products with a high proportion of local content;

- 3) extra-budgetary on-lent and gratuitous financing of projects in the field of Information and Communication Technology aimed at increasing the share of local content;
- 4) harmonization of the cost structure of informatization of state legal entities and subjects of quasi-public sector, aimed at increasing the share of services in the field of information;
- 5) the creation of conditions for venture and other off-budget on-lent financing of projects in the field of information and communication technologies;
- 6) the development of proposals to stimulate the development and the increase of the investment attractiveness of the Information and Communication Technology industry [9].

#### **1.4.2. General Information on the National Selective Statistical Observation of ICT**

The RK Statistics Committee prepared a report on the use of Information and Communication Technology in Kazakhstan in 2015. On the basis of data from 21,000 households the Agency estimated the number of Internet and PC users, as well as the purpose of use of the World Wide Web.

According to the Statistics Committee of the Republic of Kazakhstan, we can say that by the results of 2015 the level of Internet penetration in the republic was recorded as 77% – almost 13 million Kazakhstanis have the opportunity to access the World Wide Web, and respectively, have the skills to work in the Internet. During the crisis in 2012-2014 the growth rate of Kaznet audience stagnated, but in 2015 it reached almost a two-digit level again. One of the reasons why it had happened was blooming of e-commerce in Kazakhstan. The people of Kazakhstan are actively using all the advantages of on-line purchases and actively exploiting the newly acquired experience.

In 2015 the total costs on ICT amounted to 375 600.4 (million KZT). If we compare this figure with the data of 2014, there is a 36% increase (275 bn. in 2014). Let us consider the structure of these costs in detail. It expected that the cost of the acquisition of computer equipment (including installation and commissioning) are dominant in all ICT costs. They accounted for almost 123 billion KZT at the end of the year. This represents 33% of all ICT expenditures. The growth was almost 64% from year to year. This figure is almost a direct correlation to the dollar, as it is characterized by almost 100% -import dependency. By analogy with the above position,

we observe a very significant growth of the position «Costs for the purchase of software used on the basis of the license agreement.» It costs amounted to 69 billion tenge – this is more than twice as high as in 2014 (32.9 billion KZT). At the same time, the cost of creating our own information systems

significantly decreased. They used to be small (in 2014 – 5.2 billion KZT), and in 2015 it completely fell to 3.6 billion KZT (-31%). This figure is a kind of «litmus test» of the software industry in Kazakhstan. The costs of purchasing services of maintaining our own information systems stayed virtually unchanged – 11.6 billion KZT in 2015 against 11.5 billion KZT in 2014.

Another interesting figure is «the costs of an independent software development within an organization». It grew to 8.7 billion KZT in 2015 compared to 3.3 billion KZT in 2014. The conclusions drawn from this growth are quite interesting. In conditions, when imported software had risen in price in proportion to the depreciation of the tenge against the US dollar, companies focused on their own software development.

The Costs of Communication Services and the Internet. It is the second most important figure in terms of the volume of expenditure, it reached 74 billion tenge. Compared to 2014, these expenses increased by 56%. The explanation of growth of these services costs is the transformation processes in companies and the public sector. The growth was also observed in the «costs for the creation and maintenance of Internet resources». This increase was more than 2 times - up to 5 billion tenge. In the same list there are the costs of employee training related to the development and use of ICT.

In 2015 they fell to KZT1.5 billion (-18%). The cost of rental of computer hardware (computers, servers, printers, scanners, equipment for local area networks, and others) decreased to 3.8 billion tenge against 8.7 billion tenge in 2014. It is less by 56%.

The main purpose of the use of the Internet by households is the membership in social networks (Odnoklassniki, Facebook, Twitter Etc) – 56.0%; downloading movies, images, music, watching videos, listening to music, playing or downloading games is 52.4%; sending and receiving e-mails is 37.8%; receiving information about products and services is 1.4%; posting information or instant messaging is 25.7%.

The share of computer users in 2015: at the age of 6-74 years it is 74.2%; at the age of 6-15 years it is 60.5%; at the age of 16-74 years it is 77.2%.

Distribution of users according to computer literacy skills at the age of 6-74 years: a novice user – 26%; a normal user – 66.9%; an experienced user – 7.1%.

The share of organizations: having computers – 66.3%; having access to the Internet – 61.2%; having the Internet resources – 20.5%; having an Intranet – 18.2%; receiving orders over the Internet – 11.5%; placing orders on the Internet – 15.3%; having local area network – 28.3%; have extra-net – 1.3%.

Exports and imports of goods related to Information and Communication Technology is presented in Table 5.

Table 5

Exports and Imports of ICT Goods (mln USD)

	<b>2015</b>	
	<b>Export</b>	<b>Import</b>
<b>Total in the ICT Sector</b>	<b>104,3</b>	<b>1 938,1</b>
Including		
Telecommunication equipment	45,3	755,3
Computer and related equipment	8,5	403,0
Electronic parts	9,4	177,2
Audio and video equipment	12,8	259,2
Other ICT goods	28,3	343,4

### 1.4.3. ICT Development Index in the Republic of Kazakhstan

Information and Communication Technology Development Index (ICT Development Index) is a combined indicator characterizing the achievements of the countries of the world from the point of view of the development of Information and Communication Technology (ICT). It is calculated using the methodology of the International Telecommunication Union – IMS (International Telecommunication Union), a specialized UN unit that defines world standards in the field of ICT. The index was developed in 2007 on the basis of 11 indicators which the International Telecommunication Union uses in its assessments of the development of ICT. The index converts these indicators into a single criterion that is designed to compare the achievements of the countries of the world in the development of ICT and can be used as a tool for conducting comparative analysis at the global, regional and national levels. These indicators are related to the access to ICT, the use of ICT, as well as skills, that is, the practical knowledge of

these technologies by the people of the countries, covered by the study. The authors of the study emphasize that today the level of ICT development is one of the most important indicators of the economic and social well-being of a state. The organization publishes the Index on a regular basis, which allows the countries to monitor changes in dynamics [11].

In the ITU report «Measuring the Information Society» of 2015 Kazakhstan ranks 58th out of 167 countries of the world on the ICT Development Index.

On July 6, 2016, the World Economic Forum published the annual «Global Report on the Development of Information Technologies for 2016». Countries were assessed according to four categories of indicators:

- 1) Common environment for the creation and the use of technology.
- 2) Network availability in terms of the availability of the ICT infrastructure.
- 3) The use of new technologies by government, private sector and private individuals.
- 4) The new technologies economic and social impact.

The network readiness index is a comprehensive indicator of the development of ICT, which is also measured by the international school of business INSEAD. Since 2002, within the framework of the special annual series of reports on the development of the information society in the countries of the world. The top three have not changed compared with the last year - Singapore, Finland, Sweden. Kazakhstan holds a leading position among the CIS countries and tops the regional rating.

According to the network readiness index, Kazakhstan ranks 39th out of 139 countries, in particular, the «cellular subscribers» index – the 6th place, «fixed broadband network Internet access tariffs» – the 20th place, mobile Internet subscribers – 46 place, according to the number of broadband access to the Internet it ranks the 59th.

According to the indicator «Development of Legislation in the field of ICT» for 2016, Kazakhstan took the 38th place, which is 10 positions higher than the level of 2015 (48th place). In terms of «Access to the Internet in schools», our country has risen by 15 positions in the ranking for the year, ranking the 41st.

According to the United Nations report on the level of e-government development in 2016, Kazakhstan ranked 7th among the countries of Asia. Higher up are South Korea, Singapore, Japan, Israel, Bahrain and the United Arab Emirates.

At the same time, in the UN global rating, Kazakhstan is on the 33rd line, ahead of all the CIS countries.

This year the first place in terms of e-government development was taken by the United Kingdom, right behind it is Australia, the last years leader was the South Korea which was on the third place, the United States is on the 12th place in the global rating, Russia is on the 35th position, China – the 63d, Uzbekistan and Kyrgyzstan – the 80th and the 97th positions respectively.

The UN Global e-Government Development Index (EGDI) is a comprehensive indicator, which assesses the willingness and ability of the states to use Information and Communication Technology to provide citizens with public services. Thus, in 2016 the consolidated index of Kazakhstan was 0.7250, for comparison, the global EGDI is 0.4922. This index is made up of indicators on development of human capital, telecommunications infrastructure and on-line services, and the rating of the countries is compiled by the UN experts every two years [11].

#### **1.4.4. Prospects of ICT Development**

In accordance with the State program «Informational Kazakhstan 2020», ICT is one of the sectors of the «future economy», which will take the leading positions at the global level in the next 15-20 years.

Target indicators of ICT in the RK are:

- 1) Kazakhstan in the Doing Business rating of the World Bank should be on the list of the first 35 countries in 2020;
- 2) «e-government» index (according to the UN methodology) should be among the first 25 countries in 2020;
- 3) accessibility of information and communication infrastructure by households of the Republic of Kazakhstan – 100%;
- 4) the number of Internet users in 2020 – 75%;
- 5) the coverage of the people of Kazakhstan by digital broadcasting – 95%;
- 6) the share of the Information and Communication Technology sector (hereinafter – ICT) in the country's GDP – 4%;
- 7) the share of the health organizations connected to the single Health care network – 100%;
- 8) the share of the scientific and educational institutions connected to the unified national scientific and educational network – 100%;
- 9) the level of computer literacy – 80%;

- 10) the share of the electronic mass media (hereinafter – the media) to the total number of mass media registered in Kazakhstan – 100%;
- 11) the share of turnover of online stores in Kazakhstan in the total turnover of goods and services paid electronically – 40%;
- 12) the share of public services provided in electronic format – 50%;
- 13) the share of electronic public services rendered in the total number of services received in the traditional form – 80%.



## 2. INTRODUCTION INTO COMPUTER SYSTEMS. COMPUTER SYSTEMS ARCHITECTURE

Today the entire world communicates with the help of computers. High-tech machines are in every family, there is no company operating without them. But not everyone can talk to a computer in its language and make it understand the language of a person. ***Being an expert in computer systems means being one step ahead of time.*** After all, nothing in the world develops as quickly as the computer technology. No wonder they say: «A computer has become obsolete as soon as it went on sale».

In order to understand how computers convert data into information, it is necessary to learn about the various components of computer systems and how computers work. Regardless of their size, computers represent and process data, using the same basic principles.

### 2.1. Computer System

The components of the computer system (in the broad sense of the word) are hardware, operating system, application software, users - people and other computers on the network.

The modern computer system contains a central processing unit, primary and secondary storage devices (memory), input and output devices, and communication devices.

In a modern computer, there are six main components. The CPU processes the data and controls other computer devices; the primary memory stores the programs currently running and the data being processed; the secondary memory stores programs and data for later use; the input devices convert data and instructions in a form suitable for processing in the computer; the output devices represent information processed by the computer in a form suitable for human perception; communication devices control the reception and transmission of data in local and global networks.

In computer systems, the binary system is used, that is, all numbers are represented by zeros and ones in the computer, so the computer can only process information presented in digital form. To convert numerical, text, graphic information to digital, you need to apply the encoding. Encoding is the transformation of one type data via another type. In computer systems, a binary coding system is based on the representation of data by the sequence of two characters: 1 and 0, which are called binary digits (abbreviated *bit*).

Thus, the unit of information in the computer is one bit, that is, a bit that can take the value of 0 or 1. Eight consecutive bits make up a *byte*. In one *byte*, you can encode the value of one character from 256 possible ( $256 = 2^8$ ). Larger units of information are kilobytes (KB), equal to 1024 bytes ( $1024 = 2^{10}$ ). Even larger units of measurement data are magabytes, gigabytes, terabytes (1MB – 1024 Kbytes; 1 GB = 1024 MB; 1 TB = 1025 GB).

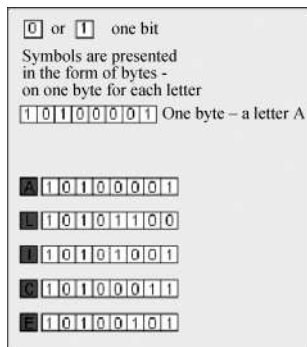


Figure 2.1. The name “Alice” is represented as a set of binary numbers

In the decimal system each number can be represented by a binary number and vice versa. Let us consider how this transformation is carried out.

### ***Translation from Binary to Decimal***

How shall we know what the nine-digit binary number  $N = 111110100_2$  equals to? Let us sign each digit 876543210 on top – digits (degrees of two) 1111101002. In the binary system, two and its degrees play a special role. Thus,  $111110100 = 1 \cdot 2^8 + 1 \cdot 2^7 + 1 \cdot 2^6 + 1 \cdot 2^5 + 1 \cdot 2^4 + 0 \cdot 2^3 + 1 \cdot 2^2 + 0 \cdot 2^1 + 0 \cdot 2^0 = 1 \cdot 256 + 1 \cdot 128 + 1 \cdot 64 + 1 \cdot 32 + 1 \cdot 16 + 0 \cdot 8 + 1 \cdot 4 + 0 \cdot 2 + 0 \cdot 1 = 256 + 128 + 64 + 32 + 16 + 0 + 4 + 0 + 0 = 500$ .

### ***Translation of Numbers from the Decimal Number Systems into the Binary System***

For translation, the whole decimal number is divided by the basis of the system into which it is translated. The division is continued until the remainder of the division is less than the ground. Then the obtained remains are recorded from the bottom up or from the right to the left.

Let us translate the number 26 into the binary system. Divide 26 consecutively by 2 and remember the remainders, not forgetting about zero.

26:2 = 13 + remainder 0	↑ 11010
13:2 = 6 + remainder 1	
6:2 = 3 + remainder 0	
3:2 = 1 + remainder 1	
1:2 = 0 + remainder 1	

To encode non-numeric information, the following algorithm is used: all possible values of the encoded information are numbered, and these numbers are coded using the binary code. For example, to present textual information, a symbol numbering table or a character encoding table is used, in which each symbol corresponds to an integer (a sequence number). Eight binary digits can encode 256 different characters.

The existing ASCII standard (8-bit coding system) contains two coding tables – basic and extended. The first table contains 128 basic symbols, it contains English character codes, and the second encoding table contains 128 extended characters.

Since this standard does not include the symbols of the national alphabets of other countries, in each country 128 codes of extended symbols are replaced by symbols of the national alphabet. Currently, there are many character encoding tables in which 128 codes of extended characters are replaced by symbols of the national alphabet.

For example, the encoding of the Russian characters Widows-1251 is used for computers that run under Windows. Another encoding for the Russian language is KOI-8, which is also widely used in computer networks.

Currently, there is a universal system UNICODE, based on 16-bit character encoding. This 16-bit system provides universal codes for 65536 different characters, that is, this table can accommodate the characters of the languages of the most countries in the world.

For encoding graphics data, for example, such a coding method as *raster* is used. The coordinates of points and their properties are described with the help of integers, which are encoded using the binary code. Thus, black and white graphic objects can be described by a combination of points with 256 gradations of gray color, that is, an 8-bit binary number is enough for encoding of the brightness of any point.

The mode of representing color graphics in the RGB system using 24 bits (8 bits for each of the three primary colors) is called full color. It is necessary to have 32 bits (four colors of 8 bits) for a full color mode in the CMYK system.

## 2.2. Evolution of Computer Systems

***First Generation Systems.*** The origins of some of the fundamental concepts that underlie modern computers can be found even in the late 30's – early 40's. One of the first computers, which can rightfully be called programmable, was created by German engineer Konrad Zuse. He built several counting machines and computers for performing complex engineering calculations.

Zuse machines were controlled with a perforated tape made of defective film (a very ingenious reaction to the deficit of paper during the years of war). Electromechanical relays, similar to those used in telephone switches, were used as the main elements of the machines. In addition, Zuse was one of the first among the inventors of computers to build an operating machine (Z3, 1941), in which the binary system was used instead of the usual decimal number system. Because of the war, the work of Zuse remained unknown outside of Germany for a long time. But on both sides of the Atlantic there were other scientists, fascinated by the pursuit of illusive luck – the creation of programmable machines. Some of them, like Zuse, understood the efficiency of the binary system of numeration and symbolic logic for carrying out calculations using electrical circuits. However, the transition from decimal to binary was not immediately recognized.

While Zuse continued his research in Germany, American scientists worked on two projects that left a notable mark in the history of programmable computers.

At Harvard University mathematician Howard Aiken with the group of IBM engineers completed the work on the machine «Mark-1». This was the first software-controlled computer weighing 5 tons which cost 500 thousand dollars; it was intended for ballistic calculations of the US Navy. Like the Zuse machine, it was built on an electromechanical relay and was controlled by commands encoded in paper punched tape.

The machine multiplied two 23-digit numbers in 3 seconds and could easily adjust to a variety of tasks of the defensive nature that arose in the course of the war. Although soon the machines surpassed “Mark-1”, he nevertheless continued to use the Harvard University Computing Laboratory up to 1959. However, the most important, probably, is that this machine served as a kind of «training ground» for the preparation of many pioneers in the development of computers, which subsequently made a significant contribution to the development of a new scientific direction.

The first electronic computer, ENIAC (ENIAC), appeared in 1946. This machine was created by the workers of the High Technical University of Pennsylvania John William Mauchly and Presper Eckert. Like Mark-1, it operated on decimal, not binary numbers, but instead of electromechanical relays it used electronic lamps, which increased its speed by 1000 times in comparison with the machine of the Harvard University. When creating the ENIAC, Mauchly and Eckert exceeded the technological limit of reliability, for before this no one used in any machine more than 2 thousand electron tubes. In the ENIAC machine there were almost 9 times as many as in previous machines. A frequent burnout of lamps was a significant problem. For a year of work of the machine about 19 thousand lamps had to be replaced, more than 100% of the total set. And yet the machine demonstrated that the future belongs precisely to electronic computing devices.

Mauchly and Eckert understood well that the main advantage of electronic computers lies in their potential ability to store a large amount of information. Rotating spindles and gears of the electromechanical computers were of little use to build sufficiently large storage devices capable of storing a significant amount of data. With the advent of electronics, this internal memory has become almost real.

By itself, the ENIAC machine was just the first herald. Developed in the conditions of the preemptive haste due to the war time, it had a very limited internal memory. Although this machine very quickly performed complex programs, its adder (internal memory on electronic lamps, intended for storage of the processed data) could remember only 20 10-digit decimal numbers. And although the content of the internal memory could be quickly changed, the replacement of the control commands themselves required a lengthy fuss with connecting cables and switches.

In the Soviet Union, computers were also developed and manufactured. Element base of computers of this generation were electronic lamps – diodes and triodes. The machines were designed to solve relatively simple scientific and technical problems. This generation of computers include: MESM, BESM-1, M-1, M-2, M-Z, Strela, Minsk-1, Ural-1, Ural-2, Ural-3, M-20, «Setun», BESM-2, «Hrazdan». They were of considerable size, consumed a lot of power, had low reliability and weak software. Their speed did not exceed 2-3 thousand operations per second, RAM capacity – was 2K or 2048 machine words (1K = 1024) with 48 binary digits. In 1958, a machine of M-20 with 4K memory with a speed of about 20 thousand operations per second appeared. The basic logical principles of constructing electronic computing machines and the concept of John von Neumann, concerning

the work of the computers based on the program entered into its memory and the initial data (numbers) were implemented in the machines of the first generation. This period was the beginning of the commercial application of electronic computers for data processing. In computers of this time, electrovacuum lamps and external memory on a magnetic drum were used. They were entangled by wires and had access times of  $1 \times 10^{-3}$  sec. Production systems and compilers had not yet appeared. At the end of this period, memory devices on magnetic cores began to be manufactured. The reliability of this generation of computers was extremely low.

***The Second Generation Systems.*** In the 50's, computer systems appeared, the elemental base of machines of this generation was semiconductor devices. The machines were designed to solve various labor-intensive scientific and technical problems, as well as to control technological processes in production. The appearance of semiconductor elements in electronic circuits significantly increased the capacity of RAM, reliability and speed of the computer. Dimensions, weight and power consumption were reduced. The sphere of the use of electronic computers expanded considerably with the advent of second-generation machines, mainly due to the development of software. There were also specialized machines, for example, computers for solving economic problems, for managing production processes, information transmission systems, etc. The second-generation computers include:

- 1) M-40 computer, -50 for anti-ballistic missile defense systems;
- 2) Ural-11, -14, -16 – general-purpose computers focused on solving engineering, technical and economic planning tasks;
- 3) Minsk -2, -12, -14 for solving engineering, scientific and design problems of mathematical and logical nature;
- 4) Minsk-22 is designed to solve scientific and technical and planning economic problems;
- 5) BESM-3 -4, -6 general purpose machines focused on solving complex problems of science and technology;
- 6) M-20, -220, -222 a general-purpose machine oriented to solving complex mathematical problems;
- 7) MIR-1 small electronic digital computer designed to solve a wide range of engineering and design mathematical problems;
- 8) «Nairi» is a general-purpose machine intended for solving a wide range of engineering, scientific and technical, as well as certain types of planned economic and accounting and statistical tasks and a number of other computers.

The computers BESM-4, M-220, M-222 had a speed of about 20-30 thousand operations per second and RAM – 8K, 16K and 32K, respectively. Among the machines of the second generation, BESM-6 was especially interesting, it had a speed of about a million operations per second and the RAM from 32 K to 128 K (in most cases machines two memory segments of 32 K each are used).

This period is characterized by a wide application of transistors and improved memory circuits on the cores. A big attention was paid to the creation of system software, compilers and I/O. At the end of this period there appeared universal and quite effective compilers for Cobol, Fortran and other languages. The access time was already  $1 \times 10^{-6}$  sec, although most of the elements of the computer were still connected by wires.

The computing machines of this period were successfully used in areas related to the processing of data sets and the solution of problems, usually requiring routine operations in factories, institutions, and banks. These computers worked on the principle of batch processing of data. Essentially, manual methods of data processing were copied. The new possibilities provided by computers were practically not used.

It was during this period that the profession of the computer science specialist arose, and many universities began to provide an opportunity of education in this field.

**Third Generation Systems.** By the early sixties, computers had entered the next phase. Third generation systems continued to gain in power and efficiency, and what, perhaps, even more importantly, is that they opened the way for the new computer languages, which made it possible to achieve a much greater effect with much smaller efforts. Element base of the computer was the small integrated circuits (SIC). The machines were intended for wide use in various fields of science and technology (calculations, production management, mobile objects and others). Thanks to the integrated circuits, it was possible to significantly improve the technical and operational characteristics of the computers. For example, the third-generation machines, in comparison with the second-generation machines, had a larger amount of RAM, increased speed, increased reliability, and power consumption, the size, and the weight decreased. The universal computers of the third generation of the EU were compatible both with each other (medium and high-performance computers of the EU computer), and the third-generation of the foreign computers (IBM-360 and others – the US). The specialists of the USSR, the People's Republic of Bulgaria (NRB), the Hungarian People's Republic (Hungary), the Polish People's Republic



(PNR), the Czechoslovak Soviet Socialist Republic (Czechoslovakia) and the German Democratic Republic (GDR) took part in the development of these machines. At the same time, multiprocessor and quasi-analog computers were created in the USSR, mini-computers «Mir-31», «Mir-32», «Nairi-34» were produced. To manage the technological processes, the computers of the ASVT M-6000 and M-7000 series were created. Desktop mini-computers on integrated microcircuits M-180, «Electronics-79, -100, -125, -200», «Electronics DZ-28», «Electronics NC-60», etc were developed and manufactured. «Dnepr-2», unified systems computers (EC-1010, EU-1020, EU-2022, EU-1030, EU-1040, EU-1050, EU-1060 and several of their intermediate modifications – EU-1021 and others), MIR-2, Nairi-2» as well as a number of other systems belonged to the computer systems of the third generation.

A characteristic feature of this period was a sharp decline in prices for hardware. This was achieved mainly through the use of integrated circuits. Conventional electrical connections with the help of wires were integrated into the microcircuit. This allowed getting the access time up to  $2 \times 10^{-9}$  sec. During this period, the user-friendly workstations appeared in the market, which, due to the network integration, made it much easier to obtain a small access time, usually inherent in large machines. A further progress in the development of computer technology was associated with the development of semiconductor memory, liquid-crystal screens and electronic memory. At the end of this period, there was a commercial breakthrough in the field of microelectronic technologies.

The increased productivity of computers and only the emerging multi-machine systems made it possible in principle to implement such new tasks, which were quite complex and often led to unsolvable problems in their software implementation. There were effective methods of software development. The creation of new software products was now increasingly based on planning methods and special programming methods.

This period is associated with the rapid development of the real-time computers. There was a tendency, according to which there is a place for the use of small machines to address management issues along with the large computers. Thus, it turned out that the minicomputer coped exceptionally well with the functions of managing complex industrial installations, where a large computer often failed. In the beginning software for small computers was quite elementary, but by 1968, the first commercial real-time operating systems, specially developed for them high-level programming languages and cross-systems appeared. All this ensured the availability of small machines for a wide range of applications. Minicomputers began to be used

to solve engineering problems related to design. The first experiments were carried out, they showed the efficiency of using computers as design tools. The use of distributed computing systems was the basis of decentralization of finding solution to tasks related to data processing in factories, banks and other institutions. At the same time, this period was characterized by a chronic shortage of personnel trained in the field of electronic computers. This was especially true for the tasks related to the design of distributed computing systems and the real time systems.

***Systems of the Fourth Generation.*** In 1971, the computers began to resemble the machines we use now. Many of them worked on the basis of microprocessors – advanced integrated microcircuits, able to combine the majority of basic functions of the computers in one module. It is thanks to the microprocessors that the computers got so reduced in size that they could be placed on the table, on your knees and even in your hand. The development of the systems of the fourth generation led to the birth of personal computers «Apple 1» and «IBM».

***Systems of the Fifth Generation – the Computer of the Future.*** This class of machines, embodying the latest advances in computer technology, is at the center of attention in the development of artificial intellect and other advanced achievements. One of the most significant properties of these computers is their ability to parallel processing, when a complex task is divided into parts between several processors, and each processor performs its part as if ten students would do ten parts of the homework at a time. The speed of these fifth-generation computers finally gives us a hope for the most courageous projects, for example, climate modeling around the globe [14]. Even now the computers are able to distinguish information from a handwritten or printed text, from forms, from a human voice, to recognize a user by voice, to translate from one language to another. This allows all users to communicate with computers, even those who do not have special knowledge in this area. Many of the successes achieved by artificial intellect are used in industry and the business world. Expert systems and neural networks are effectively used for classification tasks (SPAM filtering, text categorization and so on). Genetic algorithms (used, for example, to optimize portfolios in investment activities), robotics, industry, production, everyday life, as well as multi-agent systems conscientiously serve a person. Other areas of artificial intellect are being developed, for example, the distributed knowledge representation and the problem solving in the Internet: thanks to them in the next few years, one can expect a revolution in a number of areas of human activity.

## 2.3. Computer Systems Architecture and Components

*The architecture of computer systems* is their logical organization, structure and resources, that is, the means of the computer system, which can be allocated to the process of data processing for a certain time interval. Figure 2.2 shows the architecture of the CS.

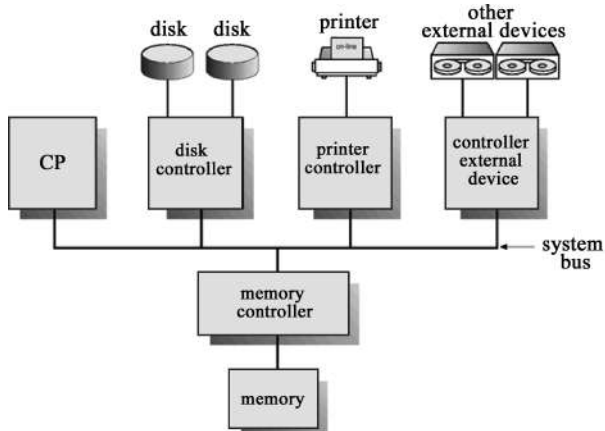


Figure 2.2. The Architecture of a Computer System

A computer system has a modular structure. There is a special control device for each device (memory, external devices) in the system, called **the device controller**. All modules (CPU, memory and memory controller, external devices and their controllers) are interconnected by **a system bus** through which they exchange signals.

The work of each controller is controlled by a driver – a specialized low-level program that is a part of the operating system (OS). Let us consider the typical structure of a modern desktop or portable computer system, indicating the most common types of devices and their characteristics.

**The central processor** is a device that executes the commands (**instructions**) of the computer system. As a rule, it is **multi-core** in modern computers, that is, it consists of from 2 to 32 cores (copies) of the processor, running on the shared memory, or a **hybrid**, consisting of a central and a graphics processor. The performance of each core is 3-3.2 GHz. In this particular case, performance is **the clock speed of the processor (the core)** – the time it takes the processor to perform the simplest machine command. However, there are other important factors that determine the

overall performance of the system, the clock frequency of the memory and the system bus. In fact, the total system performance can be estimated from the slowest of these parts of the system (usually a system bus). These characteristics shall be taken into account when choosing and buying a computer.

**The operative (main) memory**, or simply the **memory**, is the operation that stores the processed data. The amount of memory is 1-16 gigabytes or more; it is not recommended to use less memory, as this can lead to a significant slowdown of the system. *The memory clock frequency* is 667 MHz – 1.5 GHz.

**A system bus** is a device to which all modules of the computer are connected and through which they exchange signals, for example, about interrupts. The clock speed of the bus is 1-1.5 GHz (this is actually some kind of total system performance).

Typically, a **PCI bus (Peripheral Component Interconnect)** is used. It can be connected to the processor, memory, disks, a printer, a modem and other external devices.

Ports are devices with connectors for connecting external devices to a computer. Each port has its own controller (and, accordingly, its driver).

The most commonly used port is USB (Universal Serial Bus), with a typical flat connector, about 1 cm in size, with a trident image. USB ports can connect to most types of devices, and it is not necessary to disconnect the computer and the connected device, which is very convenient. There are several USB standards with different speed. The most common now is the *USB 2.0* standard, which provides *a port speed of 240-260 megabits per second*. For comparison, the previous standard – *USB 1.0* – provided only *10-12 megabits per second* (as they say, feel the difference). The newest standard USB 3.1, the implementation of which has just started, will provide a speed of *at least 10 GB per second*. You can connect a keyboard, a mouse, a printers, scanners, external hard drives, flash drives and even TV tuners – devices for receiving a television signal from an antenna and displaying a television image on a computer via the USB port.

**COM ports (communication ports)** are ports for connecting various communication devices, for example, modems – devices for accessing the Internet and transmitting information over an analog or digital telephone line. The older name of the COM-port standard is RS-232. In computers 10-15 years ago, a mouse was often connected to the COM port (now, of course, it is connected via USB). The COM ports have two formats – «large» (with 25 pins) and «small» (with 9 contacts). In modern computers often

there are no COM ports, but the operating system, by tradition, simulates the presence of virtual COM ports in the system – imaginary COM ports that the OS installs into the system when installing, for example, drivers for communicating via *Bbluetooth* or through a computer cable with a *mobile device*. At the same time, a mobile phone or an organizer can be physically connected to a USB port (or connected to a computer by wireless communication), but it still uses a virtual COM port, usually with a large number (for example, 10 or 15) to communicate with it. The COM port is also called **serial port**, since, from the point of view of the OS and drivers, the COM port is a character serial device.

**The LPT port** (from *the line printer*), or the **parallel port**, is now an outdated type of port for connecting a printer or scanner, with a thick cable and a large connector. All new models of printers and scanners work through USB-ports. However, sometimes you have to solve the problem of connecting an old printer to a new computer. If the computer does not have an LPT port, you have to buy a special adapter that connects to USB or other ports. It is best to have one old computer with an LPT port in it and connect old printers to it, providing access to them from other computers through a home local area network. The disadvantage of the LPT port is that it requires pre-unloading the OS and shutting down the printer, and only then connecting to the computer, otherwise a *failure* of the printer or computer is possible.

**SCSI Ports and SCSI Devices.** SCSI (Small Computer System Interface, pronounced «**skAzi**», with emphasis on the first syllable) is an *interface*, adapters and ports for connecting a wide range of external devices – hard drives, CD-ROM / DVD-ROM, scanners and other devices. The SCSI standard was proposed in the early 1980s and was widely used, thanks to a company *Sun*, which used it extensively in its workstations. A typical convenient feature of SCSI is the ability to connect **a string of SCSI devices** (up to 10) to a single SCSI port, each of which has a unique SCSI ID – a number from 0 to 9, usually installed on the back panel of the SCSI device. The advantage of SCSI, in addition to the possibility of using device garlands, is its speed, as well as reliability.

**The VGA port (Video Graphic Adapter)** is used to connect a **monitor (display)** controlled by a graphics controller (processor).

**IEEE 1394 (FireWire)** are ports for connecting digital video cameras or cameras. A characteristic feature is a small flat connector with a width of 3-5 mm (there are two of its standard). The port operates in a duplex

mode, that is, it allows you to control not only the input of information from the camera to the computer, but also the settings of the camera itself using a computer program (for example, *Windows Movie Maker*). A TV with a FireWire interface can also be connected with the help of the same port. A characteristic feature of modern computers is that *FireWire-ports* are mounted directly on the **motherboard** – the main computer circuit board on which the processor and memory are installed, – computer manufacturers pay such a great attention to ports for the exchange of multimedia information. In such cases, the technical characteristics of the computer usually indicate: «**FireWire on board**».

**HDMI (High Definition Multimedia Interface)** is an interface and a port that allows you to connect a TV or other video equipment that provide the best quality of playback (HD – High Definition) to your computer. The HDMI connector looks like a USB connector. *HDMI-Port* is included in the complete set of all modern portable computers.

**Bluetooth** is devices for wireless connection (via radio) to a computer of mobile phones, organizers, as well as headphones, players and many other useful devices. Convenience of *Bluetooth* in that, a computer and a telephone are connected, even if you move away from the computer with the phone for some distance (for example, to another room), but not more than for 10-15 meters. The new standard *Bluetooth 5* will increase the range of the signal, the transmission speed, as well as the amount of data transferred per unit of time. This will expand the capabilities of the devices that will be connected to the Internet of things. Also, it will make it possible to bring the use of various beacons and sensors to the next level, that yield useful information. Connections using Bluetooth LE technology will be able to work at a distance of 4 times more than now. In this case the speed will double. As for the volume of messages that are transmitted without connection, it will increase 8 times.

**Infrared port (IrDA)** is a port for connecting a laptop to a mobile phone (or two laptops to each other) through the infrared communication. Disadvantages of the IrDA ports are a need to install two connected devices side by side, at a distance of 20-30 cm from each other, without physical obstacles between them. The transmission speed of information is *10-12 megabits per second*.

Modern laptops are no longer equipped with IrDA ports. There are also network devices – ports and adapters, for connecting the computer to the local network.

## Memory Structure

**The main (operative) memory** is the only large part of the memory to which the processor has a direct access. As you know, the content of the main memory is not saved after the system is rebooted or after the computer is turned off.

**The external (secondary) memory** is an extension of the main memory that provides the functionality of a stable (saved) memory of the large volume.

**Hard disks** are most often used as a secondary memory. Physically, they consist of solid plates of metal or glass, covered with a magnetic layer for recording. The surface of the disk is logically divided into **tracks**, which, in turn, are divided into sectors. The disk controller determines the logic of the interaction between the device and the computer.

The hard drive is shown in Figure 2.3.

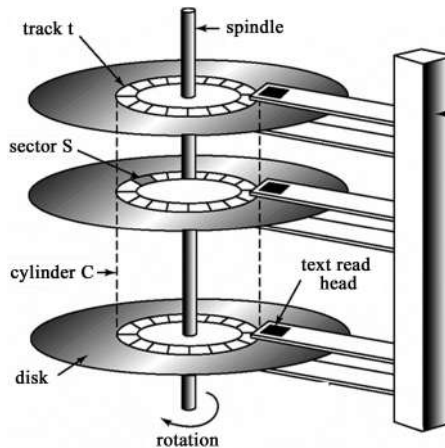


Figure 2.3. Hard Disk Drive

As can be seen from the figure, the **cylinder** is a group various of magnetic disks sectors located vertically of under each other with the same track number. Memory systems are organized in a **hierarchy**, based on their speed, cost and capability to preserve information (sustainability).

To optimize the performance of the memory of any kind, associative memory (cache) is used, located in the faster-speed memory systems and storing the most commonly used elements of slower memory. From this point of view, RAM can be considered as a *cache* for external memory.



Cache memory is, in essence, an associative list of pairs (**Address, Value**), and the hardware search occurs by an address as by a key in it. Thus, before accessing the slow external memory, a search is first performed at a given address in the cache, and only if it is not successful, the standard access to the external memory is performed. The principle of caching is very important and allows you to significantly accelerate the work with the external memory. However, it requires implementation of a special cache management policy, since caching introduces an additional level in the hierarchy of the memory and requires the consistency of data stored simultaneously at different memory levels. The hardware and the OS support **the cache instructions, data cache, hard disk cache**, etc. – for all types of memory.

The hierarchy of the memory devices (in a simplified form) is shown in Figure 2.4.

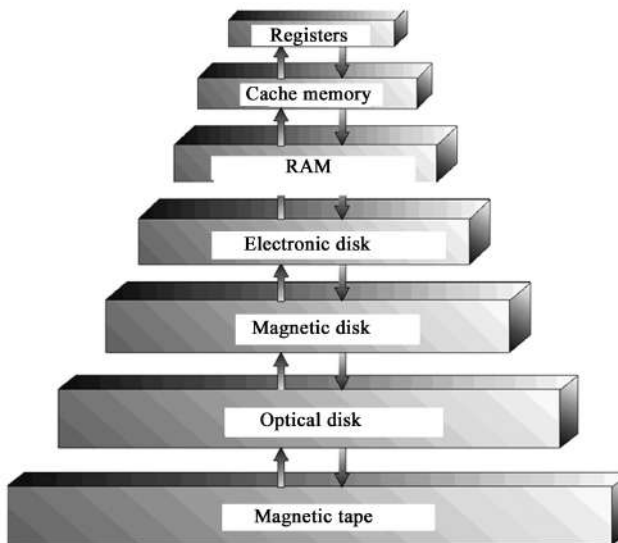


Figure 2.4. Hierarchy of Storage Devices

On the diagram the faster memory types are at the higher levels, the slower ones are at the lower level. Below are some commonly used types of external memory:

- 1) **flash memory (flash drive)** is an external memory of a compact size, the module of which is connected via a USB port. Parameters:

volume – up to *128 gigabytes* or more; port exchange rate USB 2.0: *240-260 megabits per second*;

- 2) **external hard drive (ZIV drive and others)** – volume up to 1 terabyte; works also via USB port;
- 3) **BluRay disks** are a new kind of high-capacity compact discs (one-sided – *25 gigabytes*, two-sided – *50 gigabytes*). For comparison, the standard capacity of a DVD disc is *4.7 gigabytes*.

## 2.4. Modern Computer Systems

**Super-computers** are powerful multiprocessor computers, the most modern of which have performance up to several **petaflops** ( $10^{15}$  real operations per second, the abbreviation **flops** stands for **floating point operations per second**). Since 1993, supercomputers are ranked by performance in the world list of top 500. The list is made according to the results of the LINPACK test, which is based on the solution of a system of linear algebraic equations. As of June 21 2016, the leader is the new Chinese supercomputer *Sunway TaihuLight*. The speed of the calculations produced by the new Chinese supercomputer is 93 petaflops. According to this indicator, it is twice as fast and three times as effective as the previous record holder – Tianhe-2, also developed in China. Sunway TaihuLight consists of 10.65 million cores, which are almost 41 thousand knots. The new Chinese supercomputer was developed by the National Research Center for Parallel Computing Technology and Technology of the People's Republic of China. The supercomputer is located in the National Supercomputer Center in Wuxi (Jiangsu Province). Sunway TaihuLight is equipped with ShenWei processors.

There are also machines manufactured in America, Germany, Japan and Russia in the top ten. At the same time, the rate of technological progress is today so high, that the current leader can easily become tomorrow's outsider. The competition is very serious in the market. For example, the largest Russian company producing super-computers, JSC «T-Platforms» (founded in 2002), has already released more than 250 supercomputers, and only in 2013 managed to sell its first personal supercomputer in the US (the State University of New York at Stony Brook, SBU).

Having chosen the way to enter the TOP-30 of the most competitive countries in the world, the leadership of our country took the liberty of starting the implementation of supercomputer technologies in Kazakhstan. Usually, they are created on the basis of large universities. So, the

supercomputer of KazNTU after K.Sataev took the 35th place in 2015, among the CIS countries as per the Russian rated, becoming the only non-Russian supercomputer in the ranking and is the first supercomputer of the open access in Kazakhstan. During its operation, the resources of the supercomputer were used by various organizations, such as ENU, JSC «Scientific Center of Anti-Infective Drugs», KazNAU, JSC «Kazakhfilm», LLP «Orda Build Groups» and others [15]. The KazNTU supercomputer attracts the Kazakh community for resource-intensive calculations in engineering, hydro and gas dynamics, water resources modeling, quantum chemistry and molecular biology, providing access to software of MSCSoftware, STARCCM +, Mike21, Gaussian 09 and Autodesk 3dsMax.



*Figure 2.2. Supercomputer of KazNTU after K.Satpayev*

The disadvantage of such computer systems is high energy consumption, which is about 2 MW and higher, which is very difficult to provide, because energy is necessary not only for the organization of calculation processes, but also for the equipment of the room, cooling systems, fire extinguishing, power supply [13].

**Computer clusters** are groups of computers physically located side by side and connected to each other by high-speed buses and communication lines. Computers clusters are used for high-performance *parallel computing*. The most famous computer clusters in the world are located in the research

center CERN (Switzerland) – the very one where there is a large hadronic collider.

**Desktop computers** are the most common computers currently used at home or at work by all people, from schoolchildren and students to housewives. Such a computer is placed on the desktop and consists of a monitor, a system unit, a keyboard and a mouse. The parameters of the modern (2010) **desktop computer**, the most suitable for using modern OS are: *the processor speed 1-3 GHz, RAM – 1-8 gigabytes or more, the hard disk volume (hard Disk drive – HDD) – 200 Gb – 1 TB or more (1 teB, Tb = 1024 Gb).*

**Portable computers** (laptops, notebooks) are miniature computers that are not inferior to desktop computers by their parameters, but in size they freely fit into a small bag or a backpack or, for example, on the laps of a user flying in an airplane on a business trip and not wanting to lose time. Laptops are usually several times more expensive than desktop computers with similar characteristics. The same operating systems are used in the laptops as in the desktop computers (for example, Windows or MacOS). Typical features of portable computers are all kinds of built-in ports and adapters for wireless communication: Wi-Fi (officially IEEE 802.11) – a kind of radio communication that allows you to work in a wireless network with a capacity of 10-100 megabits per second (used usually at conferences, hotels, train stations, airports – that is, within a radius of several hundred meters from the source of the transfer); Bluetooth is also a radio connection at shorter distances (10-100 m for Bluetooth 3.0), used for interaction of a computer with a mobile phone, headphones, a player and others. Today almost every student has a portable computer. One of the critical parameters of the laptop is the time its batteries work without recharging. A popular type of laptop is a **netbook** – a laptop designed for networking, usually less powerful and therefore cheaper, as well as more miniature.

**Handheld laptops and organizers (PDA, handhelds, personal digital assistants (PDA))** are miniature computers, which can be placed in the palm of your hand or in your pocket, but sometimes they are inferior to the laptops in speed. Despite all the attractiveness, there are serious disadvantages of the PDA – it is an inconvenience to enter information, you have to use a stick-stylus, as well as the inconvenience of reading information on a small screen.

**Mobile devices (mobile phones, communicators)** are devices that each of us uses constantly for voice communication, less often for recording or processing of any information or for access to the Internet. The

most important parameters of a mobile device are the quality of voice communication and battery life. However, the digital photo and video cameras built into them get a more and more importance.

***Wearable computers*** are rather exotic devices for everyday life, but they are vital for special applications (for example, built into an astronaut's space suit or a pacemaker).

Of course, their memory and speed are much smaller than of the desktop computers, but the critical factor is their ultra-high reliability, and the minimum possible **response time** of their operating systems and other software – the interval during which the system processes information from sensors, from the user or from a network, the excess of which is catastrophic.

***Real-time systems*** are computer systems designed to control various technical, military and other objects in real time. They are characterized by the basic requirement for hardware and software, including the operating system: **the inadmissibility of exceeding of the response time** of the system, that is, the expected time for performing a typical operation of the system.

### 3. ПРОГРАММНОЕ ОБЕСПЕЧЕНИЕ. ОПЕРАЦИОННЫЕ СИСТЕМЫ

#### 3.1. Программное обеспечение

Совокупность программ, предназначенная для решения задач на ПК, называется программным обеспечением (ПО). Программное обеспечение, можно условно разделить на три категории:

*Системное ПО* (программы общего пользования), выполняющие различные вспомогательные функции, например, создание копий используемой информации, выдачу справочной информации о компьютере, проверку работоспособности устройств компьютера и так далее.

*Прикладное ПО*, обеспечивающее выполнение необходимых работ на ПК: редактирование тестовых документов, создание рисунков или картинок, обработка информационных массивов и прочее.

*Инструментальное ПО* (системы программирования), обеспечивающее разработку новых программ для компьютера на языке программирования. На рисунке 3.1 показаны категории программного обеспечения.

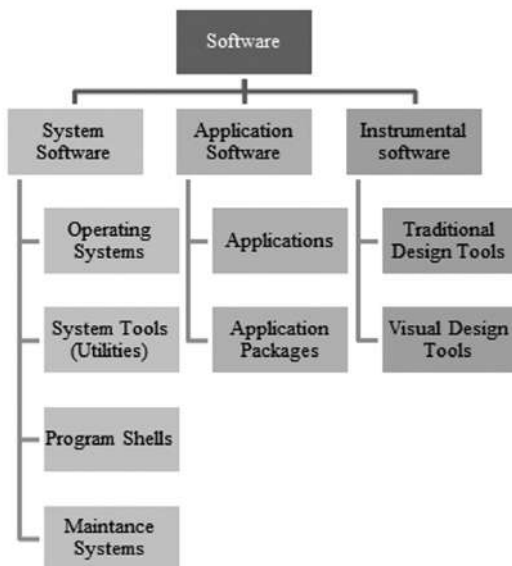


Figure 3.1. Software Categories

**System Software.** These public programs are not associated with a specific PC application and perform traditional functions: planning and task management, I / O management and so on. System programs perform various auxiliary functions, for example, making copies of the information used, issuing help information about the computer, checking the health of the computer devices, and the like. System software includes:

- 1) operating systems (this program is loaded into RAM when the computer is turned on);
- 2) shell programs (provide a more convenient and intuitive way to communicate with the computer than the command DOS strings, such as Norton Commander);
- 3) operating shells – interface systems that are used to create graphical interfaces, multiprogramming, and so on;
- 4) drivers (programs designed to control ports of peripheral devices are usually loaded into RAM when the computer starts);
- 5) utilities (auxiliary or utility programs that provide a number of additional services to the user). Utilities include: file managers or file managers; means of dynamic data compression (allow to increase the amount of information on the disk due to its dynamic compression); viewers and playbacks; diagnostic tools; control means allow you to check the configuration of the computer and to check up operability of devices of the computer, first of all hard disks;
- 6) means of communication (communication programs), designed to organize the exchange of information between computers;
- 7) computer security tools (backup, antivirus software application software).

Can be used autonomously or as part of software packages or packages.

Application software

**Application Software.** Application software are programs that directly provide the execution of the necessary work on the PC: editing text documents, creating spreadsheets, creating drawings or pictures, and so on. Packages of application programs are a system of programs that are divided into problem-oriented, general-purpose packages and integrated packages. Modern integrated packages contain up to five functional components: test and table processor, DBMS, graphic editor, telecommunications. Application software include:

- 1) Office applications MS Office;
- 2) Accounting systems;
- 3) Financial analytical systems;



- 4) Integrated workflow packages;
- 5) CAD-systems (computer-aided design systems);
- 6) HTML editors or Web editors;
- 7) Browsers – a means of viewing Web pages;
- 8) Graphic editors;
- 9) Expert systems and others.

### ***Archive Software***

One of the most widespread types of service programs are programs designed for archiving, packing files by compressing the information stored in them.

*Compression of information* is the process of converting and storing information stored in a file to a form in which redundancy is reduced in its representation and accordingly less memory is required for storage. Compression of information in files is done by eliminating redundancy in various ways, for example, by simplifying the codes, excluding constant bits from them, or by representing repetitive symbols or a repeating sequence of symbols in the form of a repetition factor and the corresponding symbols. Various algorithms of the compression of information are used. A single file can be compressed, as well as several files that are compressed into a so-called an archive file or an archive.

*An archive file* is a specially organized file containing one or more compressed or uncompressed files and service information about the file names, the date and time of their creation.

The purpose of file packing is usually to provide more compact disk space allocation, reduce time and, respectively, the cost of information transfer via communication channels in computer networks. In addition, packing in one archive file of the group of files greatly simplifies their transfer from one computer to another, reduces the time of copying files to disks, helps to protect information from unauthorized access, helps to protect against infection with computer viruses.

The degree of compression depends on the program used, the compression method and the type of the source file. The most well compressed files are graphic images, text data files for which the compression ratio can reach 5-40%, executable files and boot modules less compressed – 60-90%. Archive files almost do not compress. The programs for archiving are distinguished by the compression methods used, which affects the compression ratio accordingly.

*Archiving (packaging)* is the placing (loading) of the source files into an archive file in a compressed or uncompressed form.

*Unarchiving (unpacking)* is the process of recovering files from the archive exactly as they had been before uploading to the archive. When unpacking, the files are extracted from the archive and are placed on disk or in RAM.

Currently, several dozens of programmers are used, which differ in the list of functions and parameters of work, but the best of them have approximately the same characteristics. Among the most popular programs are: ARJ, PKPAK, LHA, ICE, HYPER, ZIP, PAK, ZOO, EXPAND, developed abroad, as well as AIN and RAR developed in Russia. Usually the packaging and unpacking of files are performed by the same program, but in some cases this is done by different programs, for example, the PKZIP produces the packing of files, and PKUNZIP - the extraction of the files.

Archive programs allow you to create such archives, which do not require an additional program to extract the files from them, since the archive files themselves can contain an unpacking program. Such archive files are called self-extracting files.

*A self-extracting archive file* is a bootable, executable module that is capable of self-extracting files in it without using an archiving program. The self-extracting archive was named SFX-archive (SelfEXtracting). Archives of this type in MS DOS are usually created in the form of an .EXE file.

**Antivirus programs** are designed to prevent the infection of a computer by viruses and eliminate the consequences of the infection with the virus. Representatives of the anti-virus program family are Kaspersky Antivirus, DrWeb, Norton Antivirus.

**Communication programs** are designed to organize the exchange of information between computers.

**Instrumental software** or programming systems are systems for automation of the development of new software in the programming language. To create software in the chosen programming language, you need to have the following components:

- 1) Text editors to create a file with the source code of the program;
- 2) The compiler or interpreter. The source code is translated into the intermediate object code using the compiler. The source code for a large program consists of several modules. Each module is compiled into a separate file with the object code, which then must be combined into one;
- 3) Linker or collector, which performs binding of object modules and generates a workable application on the output – executable code.

Executable code is a complete program that can be run on any computer where the operating system is installed, for which this the program was created. As a rule, the resulting file has the extension .EXE or .COM.

Recently, a visual method of programming (using scripting languages), aimed at creating Windows applications, has become widely used. This process is automated in fast design environments. In this case, ready visual components are used, which are customized with the help of special editors. The most popular editors (programming software systems using visual aids) of the visual design are:

- 1) Borland Delphi is intended for solving practical any problems of application programming;
- 2) Borland C ++ Buider is a tool for developing Windows applications;
- 3) Mirosoft Visual Basic is a tool for creating Windows-programs;
- 4) Mirosoft Visual Basic C ++ C # is a tool for developing applications that run in an OS environment such as Microsoft Windows.

### **3.2 Evolution of Operating Systems**

*Operating system (OS)* is a set of programs that control the hardware and software of the computer for the purpose of execution of a user's tasks.

Evolution of the OS is the time difference in the implementation of certain principles for the organization of individual operating systems before their common recognition.

There are also different approaches to determining the generations of the OS. The most expedient is the identification of the stages in the development of the OS in the framework of individual generations of computers and computer systems.

The first stage in the development of the system software is the use of library programs, standard and service subroutines and macros. The concept of libraries of subroutines is the earliest and dates back to 1949 [17]. Automated tools for their maintenance evolved with the advent of libraries – download programs and link editors. These means were used in the first-generation computers, when operating systems as such did not yet exist.

The desire to eliminate the discrepancy between the performance of processors and the speed of the operation of electromechanical input-output devices, on the one hand, and the use of the fast enough drives on magnetic tapes and drums (MTD and MDD), and then on magnetic disks (MDD), on the other hand, led to the need to solve the tasks of buffering and

blocking-releasing of the data. There were special programs of the methods of access that were introduced into the objects of the link editors modules (later the principles of polybufferization began to be used). To maintain the operability and facilitate the operation of the machines, diagnostic programs were created. Thus, the basic system software was created.

With improved of the computer performance and increased productivity, early batch processing operating systems appeared – monitors. Within the batch processing system during the execution of any work in the package (translation, assembly, execution of the finished program), no part of the system software was in the RAM, since all the memory was provided to the current work. Then there were monitor systems in which the RAM was divided into three areas: a fixed area of the monitor systems, a user's area, and the shared memory area (for storing data that can be exchanged between object modules). An intensive development of the data management methods began, an important OS function such as implementation of input-output without participation of the central process – the so-called spooling (from the English SPOOL – Simultaneous Peripheral Operation on Line) appeared.

The emergence of the new hardware developments (1959-1963) – interrupt systems, timers, channels – stimulated the further development of the OS. There were executive systems that represented a set of programs for the allocation of computer resources, communications with the operator, control of the computing process and I/O management. Such executive systems made it possible to implement a rather effective form of operation of the computing system - one-program batch processing. These systems gave the user such tools as control points, logical timers, the ability to build programs of the overlay structures, detection of software violations by the restrictions adopted in the system, file management, collection of accounting information and others [17].

However, with the increasing computer performance, a single-program batch processing could not provide an economically acceptable level of machine operation. The solution was multiprogramming - a way to organize the computing process, in which there were several programs in the computer memory, alternately executed by one processor, and to start or continue the account by one program it was not required to complete the others. The problems of resource allocation and protection became more acute and difficult to solve in a multi-program environment.

In this period the theory of the construction of the operating systems was enriched by a number of fruitful ideas. There appeared different forms

of multiprogram operation modes, including *sharing of time* – a mode that ensures the operation of a *multi-terminal system*. The concept of virtual memory and then of virtual machines was created and developed. *The time-sharing mode* allowed the users to interact interactively with their programs, as it had been before the advent of the batch processing systems.

One of the first operating systems using these newest solutions was the operating system MCP (main control program), created by Burroughs for its B5000 computers in 1963. Many concepts and ideas were realized in this OS, that later became a standard for many operating systems:

- 1) multiprogramming;
- 2) multiprocessing;
- 3) virtual memory;
- 4) the possibility of debugging programs in the source language;
- 5) writing an operating system in a high-level language.

The well-known time sharing system of that period was the *CTSS* (*Compatible Time Sharing System*) – a compatible time sharing system, developed at the Massachusetts Institute of Technology (1963) for the IBM-7094 computer. This system was used to develop in the same institute, in conjunction with a *Bell Labs* and *General Electric* time-sharing system of the next generation *MULTICS* (*Multiplexed Information and Computing Service*). It is noteworthy that this OS was written mainly in the high-level language EPL (the first version of the language *PL / I of IBM*) [17].

One of the most important events in the history of operating systems is the appearance of a family of computers called IBM's System / 360, and later System / 370 in 1964. This was the first in the world implementation of the concept of a family of software and information compatible computers, which later became a standard for all firms in the computer industry.

It should be noted that a multi-terminal regime became the main form of computer use, both in time-sharing systems and in *batch processing systems*. In this case, not only the operator, but also all users were able to formulate their tasks and manage their implementation from their terminal. Since soon it was possible to locate the terminal complexes at considerable remote distances from the computer (thanks to modem telephone connections), remote task entry systems and data teleprocessing appeared. Modules that implement communication protocols were added to the OS.

By this time, there was a significant change in the distribution of functions between the hardware and software of the computer. *The operating system* becomes an «integral part of the computer», as if the continuation of the equipment. A privileged (Supervisor in OS / 360) and

a user (Task in OS / 360) modes of operation appeared in the processors, a powerful interrupt system, memory protection, special registers for quick switching of programs, virtual memory support tools and more.

In the early 70's, the first networked OS appeared that allowed not only to distribute users as in data teleprocessing systems, but also to organize distributed storage and processing of data between computers connected by electrical connections. There was a project ARPANET MO USA. In 1974 IBM announced the creation of its own network architecture *SNA* for its mainframe, which provided interoperability such as *terminal-to-terminal*, *terminal-to-computer*, *computer-to-computer*. In Europe, the technology of building packet-switched networks based on X.25 protocols was actively developed.

By the mid-1970s, along with mainframes, mini-computers (PDP-11, Nova, HP) were widely used. The architecture of mini-computers was much simpler; many functions of multiprogram OS mainframe were truncated. The operating systems of the mini-computers began to be made specialized (*RSX-11M – time sharing*, *RT-11 – real-time OC*) and not always multi-user.

An important milestone in the history of mini-computers and, in general, in the history of operating systems was the creation of the UNIX operating system. This system was written by Ken Thompson, one of the computer specialists at BELL Labs, who worked on the MULTICS project. Actually, its UNIX is a truncated single-user version of MULTICS System. The original name of this system is UNICS (*UNIPLEXED Information and Computing Service – primitive information and computer service*).

Since the mid-1970s, the massive use of UNIX OS, written by 90% in the C language, began. The widespread use of C compilers made UNIX a unique portable OC, and since it was supplied with the source code, it became the first open operating system. Flexibility, powerful functionality, and openness allowed it to take a strong position in all computers classes – from personal computers to super computers

The availability of mini-computers served as an incentive for the creation of local networks. In the simplest LAN, computers were connected through serial ports. The first network application for UNIX OS was the UUCP program (Unix to Unix Copy Program), it appeared in 1976.

Further development of the network systems with the TCP / IP protocol stack: in 1983 it was adopted by the US MO as a standard and used in the ARPANET network. In the same year, ARPANET was divided into MILNET (for the US military department) and a new ARPANET, which became known as the *Internet*.

All eighties were characterized by the appearance of more and more advanced versions of *UNIX*: *Sun OS*, *HP-UX*, *Irix*, *AIX*, etc. To solve the problem of their compatibility, POSIX and XPG standards were adopted, defining the interfaces of these systems for applications. Another significant event for the history of operating systems was the appearance of personal computers in the early 80's. They served as a powerful impetus for the distribution of local networks, as a result, the support of the network functions became a necessary condition for the PC OS. However, both the user-friendly interface and the network functions appeared on the PC OS not immediately [17].

The most popular version of the early stage of the development of personal computers was Microsoft's MS-DOS – a single-program, single-user OS with a command line interface. Many functions that provide user-friendliness in this OS were provided by additional programs – the *Norton Commander shell*, *PC Tools* and others. The most important factor in the development of PC software was the *Windows* operating system, the first version of which appeared in 1985. The network functions were also implemented using network shells and appeared in *MS-DOS version 3.1*. At the same time, Microsoft's network products appeared – *MS-NET*, and later – *LAN Manager*, *Windows for Workgroup*, and then *Windows NT*.

Novell took another way: its product NetWare is an operating system with built-in network functions. The NetWare operating system was distributed as an operating system for the central server of the local network and, due to the specialization of the file server functions, provided high speed of remote access to files and increased data security. However, this OS had a specific *programming interface (API)*, which made it difficult to develop applications.

In 1987, the first *multitask OS for PC* – *OS/2* appeared, it was developed by Microsoft in conjunction with IBM. This was a well-designed system with virtual memory, a graphical interface, and the ability to execute *DOS*-applications. For it, the network shells *LAN Manager* (Microsoft) and *LAN Server* (IBM) were created and distributed. These shells were inferior in performance to the file server NetWare and consumed more hardware resources, but had important advantages. They allowed executing any programs developed for *OS/2*, *MS-DOS* and *Windows* on the server, in addition, you could use the computer, on which they worked, as a workstation. The unfortunate market fate of *OS/2* did not allow *LAN-Manager* and *LAN-Server* systems to capture a significant market share, but



the principles of these network systems were largely embodied in the OS of the 90s – *MS Windows NT*.

In the 1980s, the basic standards for communication technologies for local networks were adopted:

- in 1980 – *Ethernet*;
- in 1985 – *Token Ring*;
- in the late 80's – *FDDI (Fiber Distributed Data Interface)*, a distributed interface of the transmission over a fiber-optic channel;
- double ring with a marker.

This allowed to ensure the compatibility of the network operating systems at the lower levels, and also to standardize the operating systems with the network adapter drivers.

Not only the specially developed OS (*MS-Dos*, *NetWare*, *OS/2*) were used for PC, but also the existing OS, in particular UNIX. The most famous system of this type was the UNIX version of *Santa Cruz Operation (SCO UNIX)*.

In the 90th, almost all operating systems, occupying a prominent *place* in the market, became networked. Network functions are built into the core of the OS, being its integral part. multiplexing of several protocol stacks are used in the OS, due to which computers can support simultaneous work with heterogeneous servers and clients. There were specialized OS, for example, the network OS *IOS* of Cisco System, working in routers. In the second half of the 90s, all OS vendors strengthened the support for interfaces. In addition to the *TCP / IP* protocol stack, utilities that implement popular Internet services were included: *telnet*, *ftp*, *DNS*, *Web* and others.

In the last decade a particular attention was paid and is currently being paid to corporate network operating systems. This is one of the most important tasks in the foreseeable future. Corporate operating systems should work well and sustainably in large networks that are typical for large organizations (enterprises, banks, etc.) that have branches in many cities and, possibly, in different countries. The corporate OS should interact without problems with OS of different types and work on different hardware platforms.

### 3.3. Classification of Operating Systems

The main objectives of the operating system are as follows:

1) **Provision of convenience, efficiency, reliability, safety of execution of the user programs.** The most important thing for a user is the work

of his program, its predictability, correct results, reliability, and not being subjected to external attacks. The computing environment for such program execution is provided by the operating system.

2) **Provision of convenience, efficiency, reliability, security of the computer in use.** The operating system provides maximum benefits and efficiency of using the computer and its resources, it processes the interrupts, protects the computer from failures, shut-downs and hacker attacks. This OS activity may be not so noticeable to the user, but it is carried out constantly.

3) **Provision of convenience, efficiency, reliability, security of the use of the network, disks and other external devices connected to the computer.** A special function of the operating system, without which it is impossible to use a computer, is an ability to work with external devices. For example, the OS processes any access to the hard disk, ensuring the operation of an appropriate driver (a low-level program to exchange information with the disk) and a controller (a specialized processor that executes I/O commands with the disk). Any «USB flash drive» inserted into the USB slot of the computer is recognized by the operating system, gets its logical name (in the Windows system it is in the form of a letter, for example, G) and becomes a part of the computer's file system for the entire time until it is removed (dismounted).

4) **Reliability and data protection** is of particular importance among the functions of the modern OS. It should be borne in mind that the computer and the operating system are working in a networked environment in which the attacks of hackers and their programs, aimed at breaking the computer, «hacking» confidential user data stored on it, abduction of logs, passwords, use of the computer as a «robot» for the distribution of advertisements or viruses and other things are possible. In this regard, in 2002, Microsoft announced the initiative for reliable and secure computing (trustworthy computing initiative), which goal is to increase the reliability and security of all software, primarily of operating systems.

The operating system is usually stored in the external memory of the computer. When you turn on the computer, it is read from the disk memory and is placed in RAM. This process is called booting the operating system. When the computer is turned on, the BIOS program is started, which is stored in the computer's permanent memory (ROM). The work of programs written in the BIOS chip is displayed on the black screen of the monitor with running white lines. At this point, the RAM is checked (it is volume and condition), the presence of hard disks, and the presence of a keyboard.

In addition, the basic input / output system contains a program for starting the operating system loader.

*The operating system loader* is a special program designed to initiate the boot process of the system. After the operating system is loaded, all work with the processor and other devices is performed by means of special programs that are parts of the operating system. If for some reason the operating system does not boot from the hard disk, then it is impossible to work with the computer. This happens if, for example, the hard disk or the operating system is damaged. In this case, the operating system can be downloaded from an external storage medium.

Operating systems can differ in the features of implementing internal algorithms for managing the main computer resources, types of hardware platforms, areas of use and many other properties. In terms of the number of concurrent users, the OS is divided into: single-user (MS DOS, earlier versions of OS/2) and multi-user (Windows NT, UNIX,). In multi-user OS, each user configures a user interface for himself, that is he can create his own sets of shortcuts, groups of programs, set an individual color scheme, move the taskbar to a convenient place, and add new items to the Start menu. In multi-user operating systems, there are means of protecting information of each user from unauthorized access by other users.

Operating systems are divided into single-tasking (MS DOS) and *multitasking* (Windows, UNIX, OS/2) by *the number of simultaneously running programs (tasks)*.

In single-tasking systems, peripheral devices management tools, file management facilities, and means of communication with the users are used.

Multi-tasking OSs organize parallel execution of several tasks of the user, managing the sharing of the shared resources such as a processor, RAM, files and external devices.

Multi-tasking Oses are divided into batch processing systems, time-sharing systems, real-time systems. In *batch processing systems* (EU OS), a package of several tasks is formed. Execution of tasks occurs in a certain sequence with the help of the operating system commands. Batch processing systems are designed to solve tasks that do not require fast retrieval of results. The main purpose of the batch processing OS is the maximum throughput or solving the maximum number of tasks per unit of time. These systems provide high performance when processing large amount of information, but reduces the effectiveness of the user's work in an interactive mode.

*Time sharing systems* (Unix, Linux, Windows) organize the operation of the computer in such a way that the processor sequentially switches from one task to another, with a short time being allocated to each task, so that the user thinks that the tasks are performed in parallel. For example, in the time split mode, you can simultaneously work with a text editor, print a file and receive data on the network. The time-sharing mode is implemented on UNIX and Windows operating systems.

*The real-time systems* (RT11) are used to control various technical objects (satellite, scientific experimental installation of a machine with numerical program control) or technological processes (blast-furnace process, galvanic line). In all these cases, there is a time during which this or that program that controls the object must be executed, otherwise undesirable consequences may occur. Some OS can combine the properties of the operating systems of different types, i.e. some tasks can be performed in the batch mode, while others can be performed in the time-sharing mode or in the real-time mode.

*Multiprocessor and uniprocessor operating systems.* One of the important properties of the OS is the availability of means of supporting multiprocessor data processing in it. Such tools exist in the OS/2, NetWare, Windows NT. These OS can be divided into asymmetric and symmetric by the way of organization of the computing processes.

One of the most important signs of the classification of computers is the separation of them into local and networking. Local OS are used on standalone PCs or PCs, which are used in computer networks as a client. The local OS includes the client part of the software for accessing the remote resources and services. The network OS designed to manage the resources of PCs included in the network for the purpose of sharing resources. They represent powerful means of delineating an access to information, its integrity, and other possibilities of using the network resources.

### **3.4. Overview of Modern Operating Systems**

#### **3.4.1. Windows Operating System**

*The first versions of Windows* were not full-fledged operating systems, but were add-ons to the DOS operating system and were in fact a multi-functional extension, adding support for new processor modes, multitasking support, standardizing the hardware interface and uniformity for user interface programs. They provided built-in tools GDI and USER for creating

graphic interface. The first versions of Windows generally consisted of three modules – KERNEL, GDI and USER. The first one provided memory management, starting executable files and loading dynamic DLLs, the second one was for graphics, and the third one - for windows. They worked with the processors starting with Intel8086.

1) Windows 1.0 (1985)

2) Windows 2.0 (1987) – the system had the ability to run DOS-based applications in graphic windows, and each application had a full 640 KB memory. Support of the processors 80286 was improved. Support of the processors 80386 appeared in version 2.03 (2.0 / 386).

3) Windows 2.1 (1988) – full support of all the features of the processors 80286 and 80386.

4) Windows 3.0 (1990) – improved support for processors 80386 and protected mode.

5) Windows 3.1 (1992) – seriously reworked Windows 3.0: fixed UAE (fatal errors of application programs), added OLE mechanism, printing in WYSIWYG mode («you will get what you see»), true type fonts, the file manager was changed, multimedia functions were added. Processor 8086 and the real regime ceased to be supported.

6) Windows for Workgroups 3.11 (1993) – Windows for Workgroups, the first version of the OS family with the support of the local networks. The system also tested individual improvements of the kernels, which were later used in Windows 95. The support of Processor 80286 and of the standard mode was stopped with this version.

**Windows 9x** is a common name for Windows operating systems 4.x: Windows 95, Windows 98 / 98SE, and Windows ME from Microsoft. Since the architecture of these systems is very similar, the term Windows 9x is often used to refer to all of them (for example, when comparing these systems with Windows NT systems).

Below are all versions of Windows 9x are listed:

Windows 95

– Windows 95;

– Windows 95 A (OEM Service Release 1);

– Windows 95 B (OEM Service Release 2);

– Windows 95 B USB (OEM Service Release 2.1);

– Windows 95 C (OEM Service Release 2.5).

– Windows 98;

– Windows 98 Second Edition (Second Edition) or shortly Windows 98 SE  
Windows ME (Millennium Edition) or shortly Windows Me.

### ***Windows NT Family***

All operating systems of this family are fully 32- or 64-bit operating systems. The operating systems for servers were presented only in this family. Prior to Windows 2000, inclusive, they were released under the same name as the similar version for workstations, but with the addition of a suffix, for example, «Windows NT 4.0 Server» and «Windows 2000 Datacenter Server». Starting with Windows Server 2003, the server operating systems have been called by adding the suffix «Server» and the year of the release. For example, Figure 3.2 shows the Windows logo.



*Figure 3.2. Windows logo 10*

The following are all versions of Windows NTx.

- 1) Windows NT 3.1 (1993)
- 2) Windows NT 3.5 (1994)
- 3) Windows NT 3.51 (1995)
- 4) Windows NT 4.0 (1996)
- 5) Windows 2000
- 6) Windows NT 5.0 (2000)
- 7) Windows XP – Windows NT 5.1 (2001)
- 8) Windows XP 64 bit – Windows NT 5.2 (2003)
- 9) Windows Server 2003 – Windows NT 5.2 (2003)
- 10) Windows XP Professional x64 Edition – Windows NT 5.2 (2005)
- 11) Windows Vista – Windows NT 6.0 (2006)
- 12) Windows Home Server – Windows NT 5.2 (2007)
- 13) Windows Server 2008 – Windows NT 6.0 (2008)
- 14) Windows Small Business Server – Windows NT 6.0 (2008)
- 15) Windows 7 – Windows NT 6.1 (2009)
- 16) Windows Server 2008 R2 – Windows NT 6.1 (2009)
- 17) Windows Home Server 2011 – Windows NT 6.1 (2011)
- 18) Windows 8 – Windows NT 6.2 (2012)
- 19) Windows Server 2012 – Windows NT 6.2 (2012)
- 20) Windows 8.1 – Windows NT 6.3 (2013)
- 21) Windows Server 2012 R2 – Windows NT 6.3 (2013)
- 22) Windows 10 – Windows NT 10.0 (2015)
- 23) Windows Server 2016 – Windows NT 10.0 (2016)

The Windows NT family is based on the separation of address spaces between the processes. Each process has the opportunity to work with the memory allocated to it. However, it does not have the rights to write in the memory of other processes, drivers and system code.

The Windows NT family refers to the operating systems with preemptive multitasking. The separation of the processor time between threads occurs on the basis of the «carousel» principle. The kernel of the operating system allocates a time quantum (in Windows 2000 the quantum is approximately 20 ms) to each of the threads in turn, provided that all threads have the same priority. A stream can refuse the time quantum allocated to it. In this case, the system intercepts its control (even if the allocated time quantum is not complete) and transfers the control to another thread. When transferring the control to another thread, the system saves the state of all the processor registers in a special structure in the RAM. This structure is called the flow context. Saving the context of the flow is sufficient for the subsequent continuation of its operation.

### **3.4.2. Unix Operating System**

*UNIX* is a family of the operating systems (Mac OS X, GNU / Linux). The first system was developed in 1969 by Bell Laboratories, a former American corporation.

UNIX operating system is a set of programs that controls the computer; it communicates between a user and a computer and provides the tools to help to do the work. It is designed to provide ease, efficiency and flexibility of the software, the UNIX system has several useful functions:

- 1) the main purpose of the system is to perform a wide range of tasks and programs;
- 2) an interactive environment that allows you to communicate directly with your computer and get immediate answers to requests and messages;
- 3) the multi-user environment, which allows you to share computer resources with other users without reducing performance. This method is called the time sharing. The UNIX system interacts with users in turn, but so quickly that it seems that the interaction is happening with all users at once;
- 4) the multitasking environment that allows the user to perform more than one task at the same time. Currently, there are many OSs built on the UNIX kernel, such as SCO Unix (Santa Cruz Operation), Novell



UnixWare, Interactive Unix, Linux, the BSD family (BSDI, FreeBSD, NetBSD, OpenBSD), Solaris, AIX, IRIX, Digital Unix, HP-UX and others. UNIX consists of a kernel with drivers included in it and utilities (external to the kernel of the programs). If you need to change the configuration (add a device, change the port or interrupt), then the kernel is reassembled (rewritten) from the object modules.

UNIX is the most multiplatform OS. The portability of the programs from one version of Unix to another is limited. An inaccurately written program that does not take into account the differences in Unix implementations may require a major redesign. Yet, it's much easier than moving it from OS/2 to NT. Unix can be used both as a server and as a workstation.

Virtually all protocols (rules for exchanging information on the network) on which the Internet is based have been developed under Unix, in particular the TCP / IP protocol stack is invented at Berkeley University. An important property of Unix, which brings it closer to mainframes, is its multi-terminal nature, many users can simultaneously run the programs on one Unix machine.

Unix functions both on PCs and on powerful workstations with RISC-processors, really powerful CAD and geoinformation systems are written under Unix. Because of its multiplatform Unix's scalability is much superior to any other operating system.

### 3.4.3. LINUX Operating System

**Linux** is an operating system, which, in fact, is the only alternative replacement of Windows today. Linux origin began in 1991, when a young programmer from Finland Linus Torvalds took up the work on the very first version of the system, which was named after his name. The exact name is *GNU / Linux*, but «Linux» is used much more often. GNU / Linux is not a product of any one company, many companies and groups contribute to it. The GNU / Linux system is in fact the basis on which many different products are built. They are called **distributions**. Each of the distributions completely changes the look and function of the Linux system. Distributions are large, fully functional and supported systems.

The availability of Linux source code makes it possible to use and modify the code as desired. It is possible at any moment to correct any mistakes or shortcomings of the system, as well as to expand its functionality, by writing add-ons or programs operating under its management. At the moment, a huge community of programmers has formed around Linux,

which is constantly improving the system. They develop new versions of this OS, write a variety of programs running under Linux.

Linux runs on a variety of processors of various architectures, such as x86, x86-64, PowerPC, ARM, Alpha AXP, SPARC, Motorola 680x0, SuperH, IBM System / 390, MIPS, PA-RISC, AXIS CRIS, Renesas M32R, Atmel AVR32, Renesas H8 / 300, NEC V850, Tensilica Xtensa and many others.

There are several main areas where you can often find Linux:

- 1) Servers that require high uptime.
- 2) Computers of non-standard architecture (for example, supercomputers) – because of the possibility of rapid adaptation of the kernel of the operating system and a large number of software for non-standard architecture.
- 3) Military systems - for security reasons.
- 4) Computers embedded in various devices (ATMs, payment terminals, mobile phones, routers, and even unmanned military devices) – because of the wide possibilities for configuring Linux for the task performed by the device, as well as the absence of payment for each device.
- 5) Mass specialized workplaces (for example, thin clients, netbooks) – also due to the absence of payment for each workplace and because of their limited computing power, which may be not enough for proprietary operating systems.
- 6) Old computers with limited resources for performance and RAM, they use fast working environments or window managers which are not demanding resources (for example, LXDE, Openbox, Xfce, Fluxbox).

Linux is a key component of the LAMP server software suite (Linux, Apache, MariaDB / MySQL, Perl / PHP / Python), which has gained popularity among developers and has become one of the most common platforms for hosting Websites.

There are practically no viruses in Linux. Unlike MS Windows, the architecture of the operating system excludes the operation of malicious programs. And so you can do without anti-virus programs that slow down the computer and interfere with the work. You do not need to update the anti-virus databases all the time and check the hard disk for viruses.

**Fedora** («*soft felt hat*» is pronounced «*Fedora*», formerly Fedora Core) is a distribution of the GNU / Linux operating system. This distribution is sponsored by the company “Red Hat” and is supported by the community.

The goal of the Fedora project is to build an integrated operating system from the free software.

### 3.4.4. Operating Systems for Mobile Devices

To mobile devices normally **include mobile phones, smartphones and communicators**. In connection with the active development of the mobile devices, their operating systems have great prospects for development. The main directions of the further development of the OS for mobile devices are:

- 1) Improved and simplified user interface.
- 2) Improved graphics.
- 3) Broader multimedia capabilities.
- 4) Development of a set of service and game programs.
- 5) Ensure full compatibility with desktop computers and the file formats used on them.
- 6) Continuation and development of the use of the Java platform for mobile devices; all leading mobile devices manufacturers support the Java platform, which is a guarantee of the development of the Java technology itself.
- 7) Development of the mobile devices themselves: improved screen resolution, faster processors, increased memory, implementation of new fast communication technologies, and support of these new features in the OS for mobile devices.

OS developers for mobile devices are working to bring the capabilities of these OS closer to the OS's capabilities for desktop and laptop computers.

Currently, the market of mobile devices uses several dozen of the most common operating systems. Some of them are developed on the basis of a freely distributed Linux kernel. Leading manufacturers of mobile devices support their own OS or the OS, purchased together with their development companies. The most common OS for mobile devices are as follows:

- Nokia Symbian OS
- Google Android
- Windows Mobile
- Blackberry OS.
- Apple iPhone OS
- Samsung Bada
- PalmOS.

### ***Symbian OS***

Symbian OS is the most common mobile OS currently developed by the Symbian consortium (Nokia, Ericsson, Psion, Motorola), founded in 1998. Nokia is funding the Symbian Foundation, which aims to develop and support a single (for mobile devices of various companies) mobile platform based on Symbian OS.

Symbian OS is based on Psion EPOC32 (Psion). The language of the implementation of the system is C ++; there is also support of Java. The most common versions are Symbian OS Series 60 2nd edition; 3rd Edition. According to statistics, 47% of smartphones in the world use Symbian OS. For comparison, the performance of other OSes: Blackberry OS - 20%, Windows Mobile - about 9%, Google Android - about 5%.

**Symbian OS Features.** Symbian OS supports a convenient user interface and has a significant number of service programs, including those developed by the manufacturer Nokia. The main features for the user are as follows:

- Menu with application icons.
- Contact list.
- Supports built-in photo and video camera, image gallery and video clips.
- File processing, memory management (SmartMedia).
- Web browser.
- Email.
- Messaging SMS and MMS.
- Support for GPS navigation.
- Photo and video editors.
- Support for Java Micro Edition - downloading and executing midlets.
- Nokia application library.

### ***Google Android***

Google Android is a stack of applications for mobile devices, which includes an operating system (based on the Linux kernel), middleware and service programs. The android system is developed by Android, Inc., acquired by Google (2005). Currently, this is the fourth most popular OS for smartphones in the US. An important feature of Google Android is that the utility programs and libraries of this system are written in Java.

**Google Android features.** First of all, Google Android attracts users with its convenient and aesthetic user interface, which is developed using two-dimensional and three-dimensional graphics (the OpenGL library). The main features of the system are as follows:

- SQLite DBMS for data storage.
- Supported network technologies: GSM / EDGE, IDEN, CDMA, EV-DO, UMTS, Bluetooth, Wi-Fi, WiMAX, Bluetooth.
- Messaging SMS and MMS.
- Web-browser based on WebKit Application Framework.

*Multimedia Support.* Google Android system has codecs for all common multimedia standards, software for processing multimedia files and interacting with video and audio devices.

*Support to Application Development.* Google Android has its own integrated application development environment, Android SDK, which includes a mobile device emulator, debugging, profiling tools, and a plug-in to the popular Eclipse environment for developing Java applications.



Figure 3.3. Google Android User Interface

### ***Windows OS for Mobile Devices***

This family of the real-time operating systems was specifically designed for mobile devices. It supported processors ARM, MIPS, SuperH, x86. Unlike other operating systems, Windows are sold only as part of the ready devices, such as smartphones, PDAs, GPS-navigators, MP3-players and others. The first version of *Windows Mobile* was released in 1996.



Figure 3.4. Windows Phone logo

*Windows Mobile OS* provides a variety of features and software. Currently, the term «Windows CE» means only the kernel of the operating system for Windows Mobile [19]:

- 1) Office Mobile – an analogue of Microsoft Office for mobile devices; full format compatibility;
- 2) Windows Media Player – media player, an analog player for the desktop version of Windows;
- 3) Internet Explorer Mobile – Web browser, an analog Internet Explorer for the desktop version of Windows;
- 4) Software to support Bluetooth and Wi-Fi – modern types of communication;
- 5) Microsoft ActiveSync software for synchronizing data with desktop computers.

Below all versions of Windows Phone are Listed6

- *Windows Mobile Classic* – for PDA
- *Windows Mobile Professional* – for communicators
- *Windows Mobile Standard* – for smartphones.



Figure 3.5. *Windows Mobile User Interface*

As you can see from the figure, it is very similar to the user interface of the desktop versions of Windows, which greatly facilitates the work of users.

### 3.5. Desktop Applications

A desktop application is a computer program used in everyday work. The application can be run directly from a desktop computer or a laptop. It is advisable to use not integrated programs, but integrated packages for the main tasks of computer data processing, since they not only integrate large stand-alone programs into packages, but also integrate them into application programs, which means their complete unification. Application programs have a common user interface and uniform approaches to solving common tasks for managing files, formatting, printing, working with e-mail and so on. Currently, Microsoft Office packages dominate the software market. The latest versions of these office complexes contain tools for teamwork, closer integration of components, as well as tools for interacting with the Internet.

Microsoft Office is a set of office activity automation software. The package includes many applications, each of which is designed to perform certain functions and can be used independently and separately of the others. The entire set of office applications can be divided into ***main and additional***. The set of applications included in MS Office may differ depending on the version. It

allows you to select the distribution package most appropriate to the current tasks.

#### 3.5.1. Main Components of Microsoft Office

The list and purpose of the main components that make up Microsoft Office are shown in Table 3.1.

Table 3.1

ОСНОВНЫЕ КОМПОНЕНТЫ Microsoft Office

Application Name	Functional Purpose of the Application
1	2
Microsoft Word	Text processor
Microsoft Excel	Table processor
Microsoft PowerPoint	Presentation preparation system
Outlook	Personal information management system
Microsoft Binder	File management system

Продолжение таблицы 3.1

1	2
Microsoft FrontPage	Web-node management system
Microsoft PhotoDraw	Graphic editor
Microsoft Publisher	Desk publishing system
Microsoft Project	Project management system
Microsoft Team Manager	Human resource management system
Microsoft Team Manager	Система управления персоналом

### 3.5.2. Additional Components of MS Office

In addition to the main components, the Microsoft Office family includes a large number of auxiliary applications that are installed (or not installed) along with the main ones. They can

be used either from the main applications or independently. Table 3.2 lists some of the additional applications.

Table 3.2

Some Additional Applications of Microsoft Office

<b>Application Name</b>	<b>Functional Purpose of the Application</b>
Microsoft Query	Interpreter of inquiries to external databases
Microsoft Organization Chart	Block-diagram drawing program
Microsoft WordArt	Program for creating figured texts
Microsoft Equation	Mathematical formula editor
Microsoft Map	Program of reflecting data on geographical maps
Microsoft Graph	Diagram building program
Microsoft Photo Editor	Graphic editor
Microsoft Draw	Drawing tool
Microsoft Find Fast	Document indexing service
Microsoft Extended Finder	Document search in the file system and email folders
Microsoft Script Editor	Scenario editor
Microsoft ClipArt	Collection of pictures and clips
Panel Microsoft Office	Quick access tool for office applications



In addition to the main and additional applications, various extensions can be installed and used. They can be divided into three groups:

- 1) *Standalone applications* developed by Microsoft, which are components of the Microsoft Office family, but are not formally part of the package. Examples are Microsoft Project and Microsoft Team Manager.
- 2) *Add-ins* for components of Microsoft Office, developed by Microsoft and representing additional functions. As a rule, add-ins are not designed in the form of ready-made programs, but in the form of documents of a special type: templates, workbooks, dynamic link libraries (DLLs), and so on.
- 3) *Third-party applications* developed for the users of Microsoft Office. This class includes both third-party products and users own development. These could be OCR, automatic text translation, control of large document arrays (these tasks are not implemented or poorly developed in the MS Office package itself).

The above list of the main components is conditional, since the composition of the package depends on the following factors:

- 1) *Installable set (or edition) of a package*. The package is issued in several editions, and the composition of the applications in different editions is different.
- 2) *Installation source*. The installation can be performed from a CD-ROM or from a network server. The sets of files that are installed on the computer vary significantly.
- 3) *Operating system*. Microsoft Office can run under various operating systems: MS Windows and Mac OS. These operating systems may have different versions and modifications, which also affects the composition of the installed components.
- 4) *Presence of the previous versions on the computer at the time of installation*. Some components of older versions are automatically included in the updated version of Microsoft Office (if they are already installed on the computer).
- 5) *Parameters set during the installation*. In case of the so-called selective (that is, user-selectable) installation, you can specify several dozen independent parameters that affect the composition of the package.

Despite the large number of different applications in the package, they all together form a single whole. Each application of MS Office is characterized by the presence of the following distinguishing features:

- 1) Data compatibility;
- 2) Unified interface;
- 3) Unified programming tools.

### 3.5.3. Microsoft Office Documents

The data unit of the highest-level structuring in Microsoft Office is called a document.

Documents are classified by type, depending on what kind of information they store. As a rule, documents of different types are processed by different Microsoft Office applications. The main types of documents that Microsoft Office programs work with are listed in Table 3.3.

Based on the table below, we can draw the following conclusion: the applications included in the MS Office package are able to interact closely when solving application problems; they create a single information environment and allow the exchange of objects. Microsoft Office documents are examples of objects. Therefore, Microsoft Office is *a document-oriented package* (environment).

Table 3.3

Main Microsoft Office Document Types

Name	Extension	Application	Short Description
1	2	3	4
Document	doc	Word	Main type of Word document. Contains formatted text, that is the text with additional information about fonts, space, intervals etc., as well as drawings, tables and other elements.
Work Book	xls	Excel	Main type of Excel document. Contains different type of data: formulas, diagrams, and macros.
Data Base	mdb	Access	Main type of Access documents. Contains both its own database – a set of tables, as well as some inquiries, macros, modules, forms and reports.

Continuation of the table 3.3

1	2	3	4
Presentation	ppt	PowerPoint	Main type of PowerPoint documents. Contains presentation made of slides, notes of a speaker, hand-outs and other information.
Publications	pub	Publisher	Main type of Publisher documents. Contains formatted texts, drawings, tables etc.
Project Plan	mpp	Project	Main type of Project documents. Contains a calendar plan of the project, task description, resources and their links.

### 3.5.4. Support by Third-Party Developers

Support of the formats discussed above is available in most software products of this category, both for desktop systems and for mobile devices (smartphones, communicators and so on). You can find several dozens of office applications for various mobile platforms that support documents of Microsoft Office Word, PowerPoint and Excel (in particular, OfficeSuite PRO for Android or QuickOffice for Symbian). A free office package LibreOffice is an example of supporting the import / export of MS Office documents among the desktop applications.

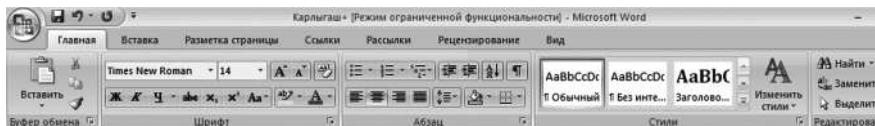
#### ***The Software Environment***

The main tool for developing applications in MS Office is a comprehensive solution based on the Visual Basic language, namely Visual Basic for Application (VBA). This technology includes a macro recorder, a Visual Basic interpreter, an integrated development environment with a built-in debugger, runtime libraries, and type libraries that represent package objects. These tools allow you to extend the functionality of the package and adapt it to the solution of specialized tasks.

#### ***MS Office Interface***

Microsoft Office applications have a unified interface, the essence of which is as follows: similar functions have the same designation (team name or icon on the button), and dissimilar functions have different designations. To a greater extent, unification touched the interfaces of applications such as Microsoft Word, Microsoft Excel and Microsoft PowerPoint. In Figure

3.4, the unified application interface is Microsoft Word, Microsoft Excel and Microsoft PowerPoint.



*Figure 3.4. Unified Interface of Applications Microsoft Word, Microsoft Excel and Microsoft PowerPoint*

One of the advantages of Microsoft Office is the consistent use of the graphical user interface (GUI), represented by the operating system and various controls. Typically, individual elements are grouped into larger structures, such as windows, toolbars, menus. Let us consider the characteristic of each of these groups.

### ***Window Interface***

The window interface is such a way of organizing the user interface of a program, when each integral part is located in a window - in its own sub-screen space, located at an arbitrary location «above» the main screen. Several windows simultaneously located on the screen can overlap, being «higher» or «lower» relative to each other. In MS Office, there are four types of windows:

- 1) application window;
- 2) document window;
- 3) dialog box;
- 4) frames.

### ***Toolbars***

Toolbars are user interface elements that can contain controls such as shortcut buttons and drop-down lists. Toolbars for different applications can contain buttons that are similar in function and appearance, which makes it easier to learn the Microsoft Office interface.

Toolbars can be:

- 1) docked along the border of the application window;
- 2) floating, that is located in any part of the application window;
- 3) presented in separate windows, in this case the shape and dimensions of the toolbar can be changed arbitrarily.

### ***Menu***

The menu represents an access to hierarchical lists of available commands. The result of selecting a command from the menu can be:

- 1) direct performance of some action;
- 2) opening of another menu;
- 3) opening of a dialog box or a frame.

The menu of the Microsoft Office interface, in addition to the menu bar of any application, can be divided (by the method of switching to them) to expandable and contextual (or pop-up).

### ***Controls***

Control elements are window interface objects that perform typical operations with the interface: mouse click, select from the list, select options, scroll and so on. The controls include the following: buttons, text fields (or input fields), check boxes, switches, lists and drop-down lists, scroll bars, palettes, counters and others, specific to certain applications or conditions.

### ***Enterprise Portal Development Application***

Microsoft Office 2010 uses a new server program SharePoint Server 2010 for corporate portals, on the basis of which a unified document storage is created and shared.



*Figure 3.5. SharePoint Server interface*

SharePoint Server 2010 is a server product that uses SharePoint Foundation technology. SharePoint Foundation is the technology on which all SharePoint sites are based. Office SharePoint Server 2010 is an integrated platform for organizing corporate portals. Corporate portals include:

- 1) Intranet portals (internal company sites), resources, and applications that are accessible only to employees of the enterprise, to the internal users;
- 2) Extranet portals (internal company sites), resources, and applications that are available for interaction with external users, such as customers, business partners and so on.

Microsoft has developed a Web version of Microsoft Office 2010 or Office Web Apps for online access to a data storage hosted on a corporate portal and collaborative file processing, the corporation, which is an add-on to Microsoft SharePoint Server 2010. The Web version of Microsoft Office 2010 gives you an ability to edit documents directly on the server.

## 4. HUMAN-COMPUTER INTERACTION

Computer systems become more simple and understandable even for people who are not specialists in the field of information technology. This is possible primarily because both users and software interact with the computer using the operating system. The OS provides interfaces for both users and applications.

*Interface*, in the broadest sense of the word, is the way (standard) of interaction between objects. The interface in the technical sense of the word defines the parameters, procedures and characteristics of the interaction of objects.

There are a *user interface*, a *programming interface* (a set of methods for interaction between programs) and a *physical interface* (the interaction of physical devices).

*User interface* is a set of software and hardware that support user interaction with a personal computer. The basis of this interaction is dialogue – the exchange of information between a person and a computer, produced in real time for the joint achievement of a specific goal. Each such dialog consists of I/O processes physically providing the user and the PC communication. Exchange of information is carried out by sending a message (Figure 4.1).

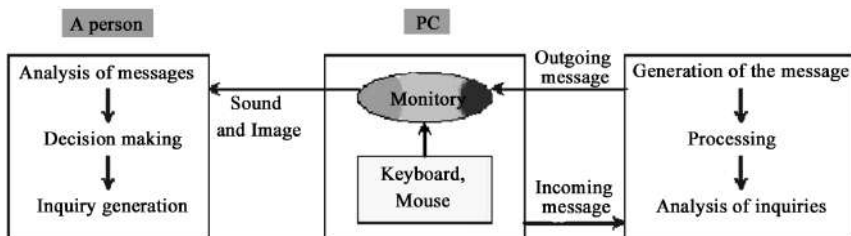


Figure 4.1. Exchange of Information is Carried out by Sending a Message

A PC user transmits the following types of messages:

- 1) request for information;
- 2) request for assistance;
- 3) request for an operation or function;
- 4) input or modification of information.

In response, the computer gives, for example, any help, error messages, messages that require a response, orders for actions. Figure 4.2 shows an example of a message. The user interface (UI) is sometimes understood as an external graphical view of the application. But in fact the user perceives the program as a whole through the interface. And this means that such an understanding of the term is not entirely accurate. In practice, PI combines the entire structure and elements of the program, which affect the user's connection to the application itself.

And these *elements* are not only a screen, but also:

- 1) system imagery (for example, desktop in Windows);
- 2) visual design of windows and applications;
- 3) means of information display (formats and so on);
- 4) input and output devices are different.

#### 4.1. Types of User Interface

- 1) Procedural-oriented interface;
- 2) Object-oriented interface.

***Procedural-oriented interfaces are*** when all the work with the application is reduced to the choice of an action to be performed, to the input of data and the processing of the results. Such interfaces can be divided into several subtypes: *console, menu and with free navigation*.

A *console interface* organizes interaction with the user on the basis of alternate I/O data in the form of text according to the scheme «question – answer». For example, *input of information – solution of the problem – output of the result*. Such interfaces are now used in the process of learning programming or in those cases when the program produces only one function (for example, in system utilities).

An *interface-menu* allows you to select the necessary operations from the list displayed by the program. There are *single-level* and *multi-level menus*. The former are used for relatively simple cases, when there are few variants of operations (for example, **Create, Open, Close**). The latter are used with a large number of options (for example, the various complexity of operations with files). The interface with free navigation helps the user to perform operations, access to which is possible through interface elements, such interface is familiar and understandable to any user. Figure 4.2 shows an example of some common interfaces for Windows [20].



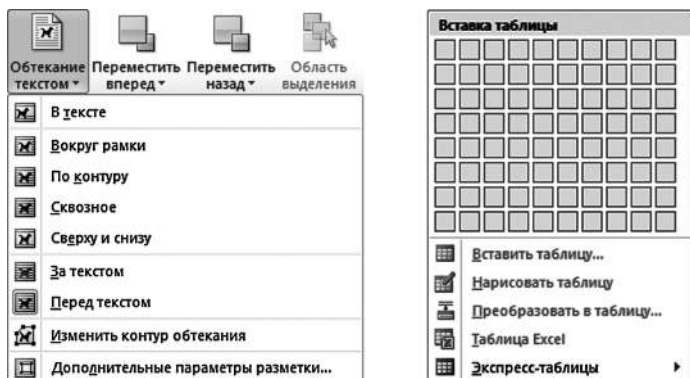


Figure 4.2. Appearance of Some Common Interface Elements for Windows

An important feature of such interfaces is the property to change in the process of interaction with the user, while offering only operations that make sense in a particular situation.

**Object-oriented interfaces** are aimed at manipulating objects. For example, this interface is the Windows Explorer program. Control objects in this case are files and catalogues (folders). Such actions occur approximately like this: a file or folder is selected (or, to be more precise, an object of the interface, corresponding to a file or folder) and «dragged» to another folder, thus initiating the movement of the «physical» file on the disk.

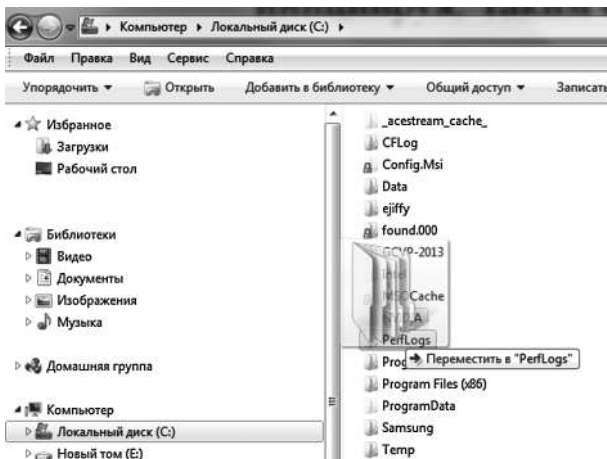
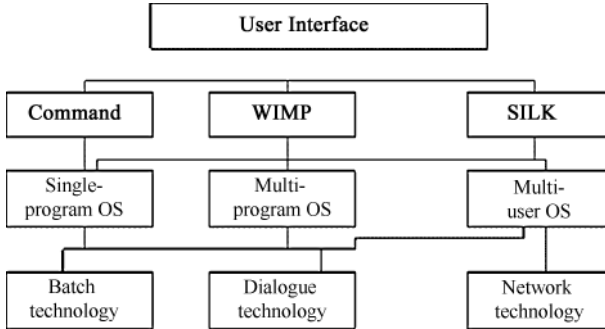


Figure 4.3 Process of Dragging of a Catalogue in the Object-Oriented Interface

## 4.2. Types of User Interfaces

Modern operating systems support the following types of interfaces:



**Command Interface.** It is called so because in this form of the interface a person submits «commands» to the computer, and the computer executes them and gives the result to the person. The command interface is implemented in the form of batch technology and command line technology.

**Batch Technology.** Historically, this type of technology appeared first. It existed already on the relay machines of Zyus and Chuse (Germany, 1937). The idea is simple: a sequence of characters is sent to the computer's input, in which the sequence of programs launched for execution is indicated according to certain rules. After one program is executed, the next one starts and so on. The computer, according to certain rules, finds commands and data for itself. This sequence may be, for example, a punched tape, a punched card stack, a sequence of pressing the keys of an electric typewriter (type CONSUL). The machine also sends its messages to a puncher, an alphanumeric printer (ATSPU), a tape of a typewriter. Such a machine is a «black box», which is constantly fed with information and which also constantly «informs» the user about its status (Figure 4.4) A person has little impact on the operation of the machine - he can only suspend the machine, change a program and restart the computer [21]. Disadvantages of this mode is low efficiency of decision-making and isolation of the user from the system.

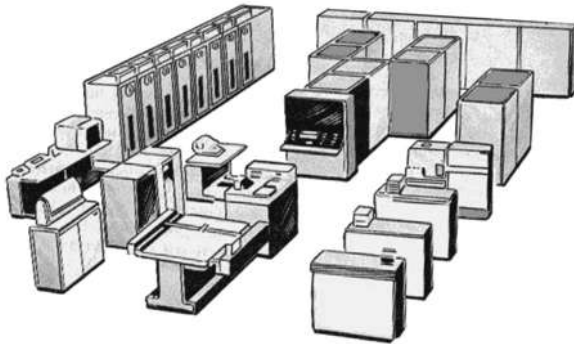


Figure 4.4. View of the Mainframe of the EC Computer Series

*Command-Line Technology.* This technology implies that the only way to enter information from a person to a computer is the keyboard, and the computer outputs information to the person using an alphanumeric display (monitor). This combination (monitor + keyboard) was called a terminal, or console. Commands are typed on the command line. The command line is an invitation symbol and a flashing rectangle – a cursor. When you press a key, symbols appear on the cursor position, and the cursor moves to the right (Figure 4.5). It's very similar to typing a command on a typewriter. However, unlike it, the letters are displayed on the display, not on paper, and the incorrectly typed character can be erased. The command ends with a key Enter (or Return). Then, you can move to the beginning of the next line. It is from this position that the computer displays the results of its work on the monitor. Then the process repeats.

```

Administrator: Command Prompt
C:\Program Files (x86)\WAMI 2.0>wami /?
List of commands available:
/? Lists all available commands
/cmd /? Shows help and usage information for a command
/a: Adds computers discovered by the query specified and refreshes the computers
/c: Applies the confirmation ids obtained from Microsoft to the respective products.
/d: Online activates the non-GULK and non-OEM product key products.
/e: Adds the specified product key to the product key list.
/m: Merges two CIL files.
/p: Installs the product key on the products listed in the input file.
/r: Refreshes the status of products in the given CIL file.
/s: RMS activates the products that were installed with a GULK.
/t: Token activates the products installed with GULK.
/x: Acquires Confirmation Ids from Microsoft.
/y: Exports the installation Ids for the products eligible for proxy activation,
i.e., non-GULK and non-OEM product key installed products.
C:\Program Files (x86)\WAMI 2.0>

```

Figure 4.5. Command Line Interface

The command line technology has already worked on monochrome alphanumeric displays. Since only letters, numbers and punctuation were allowed, the technical characteristics of the display were not significant. As a monitor it was possible to use a television receiver and even an oscilloscope tube.

These technologies are implemented in the form of a command interface – input commands are sent to the machine, and it seems to «respond» to them.

The predominant type of files when working with the command interface were text files – they and only they could be created using the keyboard. The most extensive use of the command line interface is the emergence of the operating system DOS, UNIX and the appearance of the first eight-digit personal computers with a multi-platform operating system CP / M.

**WIMP – interface** (Window, Image, Menu, Pointer). Although in this interface the computers are given commands, this is done «indirectly», through graphic images. The graphical interface appeared in the mid-1970s, when at the Xerox Palo Alto Research Center (PARC). The concept of the visual interface was developed. The prerequisite for the graphical interface was a decrease in the response time of the computer to the command, an increase in the amount of RAM, and the development of the technical base of computers.

The hardware basis of the concept was the appearance of alphanumeric displays on computers, and these displays already had such effects as «flickering» of symbols, color inversion (changing the outline of white symbols on a black background, that is, black symbols on a white background), underlining symbols. These effects did not spread over the entire screen, but only to one or more characters.

The next step was the creation of a color display that allowed to display, along with these effects, symbols in 16 colors on a background with a palette (that is, a color set) of 8 colors. The first system with a graphical interface 8010 Star Information System of the PARC group appeared four months before the release of the first computer of IBM in 1981. Initially, the visual interface was used only in programs. Gradually, it began to migrate to operating systems, computers Atari and Apple Macintosh, and then on IBM-compatible computers.

This kind of interface is implemented on two levels of technology: *a simple graphical interface and a WIMP interface.*

*Simple Graphical Interface.* Distinctive features of this interface are:

- 1) Selection of areas of the screen.

- 2) Redefinition of the keyboard keys depending on the context.
- 3) Using the manipulators and keyboard gray keys to control the cursor.



Figure 4.6. Manipulators

The appearance of this type of interface coincides with the wide distribution of the MS-DOS operating system. It was it which introduced this interface to the masses, thanks to which the 80s passed under the sign of improving this type of interface, improving the characteristics of the characters display and other monitor parameters. A typical example of using this type of interface is the Nortron Commander file shell (see the file shells below) and the text editors Multi-Edit, Lexicon, ChiWriter and the Microsoft Word for Dos word processor [21].

*WIMP.* This subtype of the interface is characterized by the following features:

- 1) All the work with programs, files and documents takes place in the windows.
- 2) All programs, files, documents, devices and other objects are represented in the form of icons.
- 3) All actions with objects are performed using the menu.
- 4) Wide use of manipulators to point to objects.

It should be noted that WIMP requires a color raster display with high resolution. Also, the programs oriented to this kind of interface have increased requirements for computer performance, the amount of memory, bandwidth, and the like. But this kind of interface is most easy to learn and intuitive. A vivid example of programs with a graphical interface is the Microsoft Windows operating system.

***SILK-interface*** (Speech, Image, Language, Knowledge).

*Speech Technology.* Since the mid-1990s, after the advent of inexpensive sound cards and the widespread use of speech recognition technologies, so-called «speech technology» has appeared. Using this technology, commands are given by voice by pronouncing special reserved words –

commands. The computer finds commands for itself, analyzing human behavior. Words should be pronounced clearly, at the same pace.

*Biometric Technology.* This technology arose in the late 90s of the XX century. To control the computer, the human face expressions are used – the direction of his / her eyes, the size of the pupil and other signs. To identify the user, the iris drawing of his eye, fingerprints and other unique information are used. Images are read from a digital video camera, and then the commands are highlighted based on the image using special image recognition programs. This technology takes its place in software products and applications where it is important to accurately identify the user of the computer.

*Tactile Interface.* A new kind of user interface has begun to be widely used – tactile (sensations). The tactile interface is the interface with feedback (resistance to the user's efforts in accordance with the events occurring on the screen). You can not only manage the interface objects, you can feel them. Reverse tactile communication is present in gadgets. Most often it is presented in smartphones and Joysticks of game consoles in the form of «vibrating alert» and response vibration in response to the user's actions.

There are several directions of using this method of interaction and obtaining information from devices. The first way to apply reverse tactile communication is to expand the range of tactile sensations from using gadgets. The second way is the transmission of specific template information. The third way is communication. Let's consider each of them in more details.

*Expansion of the Spectrum of Tactile Sensations.* As an example, let us consider the device «reader». On both sides of the screen, which surface texture resembles paper, sensory areas for page turning are located. Self-paging is initiated not by the usual touch or gesture of slip, but by the light compression of these sensory zones. When the page is «turned over», the device accompanies it with a vibration similar to the one that occurs when paper pages slide over each other. In Kazakhstan, there was a free mobile kitap application that contains more than 4000 books in the Kazakh language. The developer of the mobile application is the public fund «WikiBilim» with the support of the mobile operator «Kcell».



*Transmission of Specific Template Information.* As an example, consider the functioning of the Apple watches iWatch, in which the mechanism of transmission of specific template information is implemented. For example, if a person walks along a route laid out in a map application, the clock will warn him about the need to turn, vibrating with the right or left side, so that the user does not even have to look at the screen. Wearable devices like smart glasses will mildly vibrate, warning the user about getting into the field of view of any specific information.

*Communication.* This is one of the most interesting ways to apply reverse tactile communication. And here we again consider an example of the functioning of Apple iWatch. If a user selects someone's contact from the favorites list and then turns off the screen, that person will experience this touch through the specific vibration of their Apple iWatch. You can even send a heartbeat to another person, while the sender and the recipient will see a pulsating heart on the screen, and both will feel its rhythm on its wrists.

*Semantic (Public) Interface.* This type of interface appeared in the late 70-ies of the XX century along with the development of artificial intelligence. It is difficult to call it an independent type of interface – it includes both a command line interface, and a graphical, and a speech, and a mimic interface. Its main distinguishing feature is the lack of commands when communicating with a computer. The inquiry is formed in a natural language, in the form of the related texts and images. In its essence, it is difficult to call it an interface – this is a simulation of «communication» between a person and a computer.

*Touch Interface.* (Touch, Multi-touch). Multitouch is an interface developed for sensory devices. Control is done with a finger, sometimes with a stylus. The touch interface allows multiple users to work with the device at the same time. Multitouch allows not only to determine the relative position of several points of contact at each point of time, but it also defines a pair of coordinates for each point of contact, regardless of their position relative to each other and the boundaries of the touch panel. Proper recognition of all touch points increases the capabilities of the interface input. The range of tasks to be solved with the use of the multitouch function depends on the speed, efficiency and intuitiveness of its application. The most popular form of multicast devices are mobile devices, multi-table tables and multi-purpose walls. There are also spherical multitouch screens (Microsoft Sphere Project). The touch interface can be found in payment terminals. The abundance of modern sensory mobile devices and tablets created a

whole new category of specialists – the developer of touch interfaces. In Figure 4.8 there are examples of the devices with touch screens.



*Figure 4.8. Electronic Devices with Touch Interfaces*

### **4.3 User Interface Development Methods and Tools**

Interface is important for any software system and is its an integral part, focused primarily on the end user. It is through the interface that a user judges the application program as a whole; moreover, often the user makes a decision to use the application program or not by the extent to which it is convenient and understandable for him. At the same time, the complexity of designing and developing an interface is big enough. According to experts, on average, it takes more than half of the time of the project itself.

#### ***Usability of Interfaces***

*Usability* is a scientific and applied discipline that deals with increasing efficiency, productivity, and convenience of using the activity tools. When developing user interfaces, the word usability refers to a general concept of their convenience when using software, logic, and simplicity in the arrangement of controls. The term «usability» can be considered as a synonym of the word «ergonomics» with the difference that the latter



determines the minimis of specific physical efforts when using a thing, and the first is the final total degree of convenience, the measure of the intellectual effort necessary to obtain the useful qualities of this thing, and the speed of achieving a positive result in managing it [22].

A user interface is a factor that influences three main quality indicators of a software product: its functionality, aesthetics, and performance.

*Functionality* is the factor that application developers often focus on. They try to create programs so that users can perform their tasks, and it is convenient for them to do it. Functionality is important, but it is not the only indicator that should be taken into account in the course of the development.

*Aesthetic appearance* of an application itself and the way it is presented makes it possible to form a positive opinion about a program. However, the aesthetic characteristics are subjective, and it is much more difficult to quantify them than the functional requirements or performance indicators. The whole aesthetics of the application often come down to a simple choice: whether the colors used are related to each other, whether the elements of the interface convey the purpose and the meaning of the operations presented, what the person feels when using certain controls and how successfully he uses them.

*Performance*, as well as reliability, also affects the prospects of the use of a program. If an application looks good, it has simple and convenient controls, but, for example, it slowly draws screens, regularly «hangs» for a few seconds, or ends with a critical error due to incorrect user actions, it probably will have little chance to be used for a long time. In turn, fast and stable operation of an application can partly compensate for not being the most stylish or a lack of any secondary functions.

#### 4.3.1. Stages of User Interface Development

To ensure the successful operation of a user, interface developers must balance the above factors throughout the life cycle of the application development. This is achieved by the consistent and thorough elaboration of details of interactive interaction at each stage of the user interface development (Figure 4.9), including:

##### 1) **Design**

- Functional requirements: definition of the development objective and the initial requirements.
- User analysis: defining user needs, developing scenarios, assessing the suitability of scenarios to user expectations.

- Conceptual design: modeling of the process for which the application is developed.
- Logical design: definition of information flows in the application.
- Physical design: selection of the platform on which the project and development tools will be implemented.

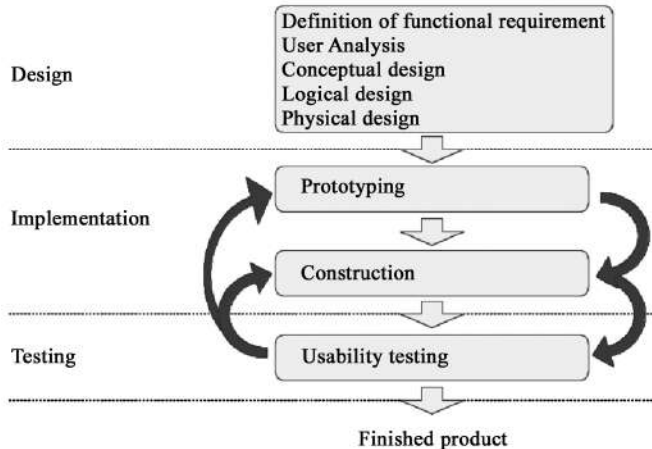


Figure 4.9. User Interface Development Stages

## 2) Implementation

- Prototyping: development of paper and / or interactive layouts of screen forms.
- Design: creation of an application, taking into account a possibility of changing its design.

## 3) Testing

- Usability testing: testing an application by various users, including users with disabilities (accessibility testing).

### 4.3.2. Interface Development Tools

An important moment in the development of interfaces is the availability of high-level tools. Software for developing a user interface can be divided into two main groups – *a toolkit for developing a user interface (toolkits)* and *higher-level interface development tools (higher-level development tools)*.

*The toolkits for developing a user interface*, as a rule, includes a library of primitives for the interface components (menus, buttons, scrollbars, etc.) and is intended for use by programmers.

The high-level development tools can be used by non-programmers and are equipped with a language that allows you to specify I/O functions, as well as interface elements using direct manipulation techniques. Such tools include dialogue constructors (Interface builders) and UIMS – User Interface Management Systems. In addition to UIMS, some authors use terms such as User Interface Development Systems (UIDS), User Interface Design Environment (UIDE) and others.

Developing an application as a whole as well as creating a user interface for it is an iterative process. It is unlikely that such steps as prototyping, designing and testing an interface can be completed in a single pass. Therefore, if as a result of usability testing flaws are revealed, then, they are eliminated by re-engineering when possible; otherwise a new prototype of the interface is developed.

#### **4.3.3. User Interface Standardization**

The first evaluation of an interface is made by an end user (or tester) by summing up the results of the work with the program in the framework of the following indices ISO 9241-10-98 Ergonomic requirements for office work with visual display terminals (VDTs). P.11. Guidance on usability specification:

- 1) Effectiveness – the effect of the interface on the completeness and accuracy of the user's achievement of the target results;
- 2) Efficiency or the influence of the interface on the performance of the user;
- 3) The degree of (subjective) satisfaction of the end-user of this interface.

Effectiveness is a criterion of the functionality of the interface, while the degree of satisfaction and efficiency are the criteria of ergonomics. The measures introduced here correspond to the general pragmatic concept of quality assessment by the «target / cost» ratio.

During the second testing attempt, we try to establish which (the guiding ergonomic) principles the user interface should satisfy to in terms of the optimality of human-machine interaction. The development of this analytical approach was caused by the needs of software design and development to formulate guidelines for the organization and the characteristics of an optimal user interface. This time experts do the evaluation of the quality

of the developed user interface by the degree of implementation of the main guidelines or specific graphic and operational features of the optimal «human-oriented» user interface resulting from them.

When designing a user interface, the initial decision is to select the basic standards for typical interface management tools, which must take into account the specificity of the relevant subject area.

Specifications of the style of the user interface are reflected in normative documents of an industry and a company level. It is possible to further detail the design of the interface for a certain group of software products of the developer.

When developing a user interface, it is necessary to take into account the characteristics of the intended end users of the software. Specification of the type of the user interface defines only its syntax. The second direction of standardization in the field of design is the formation of a specific system of leading ergonomic principles. The decision on their choice should be worked out jointly by all members of the design team [21]. This system must be consistent with a relevant core standard (or a group of standards). In order to become an effective design tool, the guideline system should be brought to the level of specific instructions for programmers. When developing the instructions, normative documents on the type (style) of the interface are taken into account, and the regulatory documents on the design of the user interface must be included in the profile of the standards of the software project and in the technical assignment.

It is appropriate to relate the standards of the user interface to other qualities of the software product, such as replaceability (ISO IEC 9126-93).

## 5. DATABASE SYSTEM

For the prompt, flexible and efficient management of enterprises, firms and organizations of various forms of ownership, Telecommunication means of civil and military use, information-computational, ecological, radar and radio navigation systems, automated control systems are widely implemented, the core of which are databases (DB). With a large amount of information and the complexity of the operations performed with it, the problem of the effectiveness of the means of storing, accessing and processing data becomes particularly important.

Automated information systems (AIS), based on databases, appeared in the 60s of the twentieth century in the military industry and business – where significant amounts of useful data were accumulated. Initially, AIS were focused only on the work with factual information Character – numerical or text characteristics of objects.

Then, as the technology developed, it became possible to process textual information in a natural language.

**Data bank** is a type of IS, in which functions of centralized storage and accumulation of the processed information organized in one or several databases are realized. Basics of database construction: the database of data banks (BDs) generally consists of the following components - a database (several databases), a database management system, a data dictionary, an administrator, a computer system and maintenance personnel.

**Database (DB)** is a collection of specially organized data stored in the memory of the computer system and displaying the state of objects and their relationships in the subject domain. DBs are centralized (stored on one computer) and distributed (stored On several computers of some network) [22].

**Database management system (DBMS)** is a complex of language and software tools designed to create, maintain and share databases with many users. Typically, the DBMS is distinguished by the data model used. The number of modern database management systems is thousands.

**An application** is a program or a set of programs that automate the processing of information for Application task. Applications can be created in an environment or outside the DBMS environment – using a programming system that uses database access tools, such as Delphi or C++ Builder. Applications developed in the DBMS environment are often called DBMS applications, and applications developed outside the DBMS are external applications. Applications are developed mainly in cases where

It is required to make user work more convenient or to automate routine operations with the database.

**Data dictionary (DD)** is a subsystem of the BD intended for centralized storage of information about data structures, interrelations of database files with each other, data types and formats of their representation, data belonging to users, security codes and access control, and the like.

**Database administrator (DBA)** is the person or group of persons responsible for developing database requirements, designing, creating, using and maintaining it. In the process of operation, the DBA usually monitors the functioning of the information System, provides protection from unauthorized access, Controls redundancy, non-contradictoriness, security and reliability of information stored in the database.

**Operational personnel** perform the functions of maintaining technical and software facilities in the efficient state. It carries out preventive, regulatory, restorative and other scheduled work, and also as necessary [22].

## 5.1. Information System Architecture

In many respects the effectiveness of the ISA depends on its architecture. Currently, a *client-server* architecture is the most promising. It assumes the existence of a computer network and a distributed database including a corporate database (CDB) and a personal database (PDD). A CDB is located on the server computer; the PDDs are located on the computers of employees that are clients of the corporate database.

A *server of a separate resource* in a computer network is a computer (program) managing this resource, a client is a computer (program) using this resource. Databases, file systems, printing services, postal service can act as resources of a computer network. Server type is determined by a type of resource that it manages. For example, if a managed resource is a database, then the corresponding server is called *the database server*. The advantage of organizing an information system on using the client-server architecture is a successful combination of the centralized storage, maintenance, and collective access to common corporate information with an individual work of the users to personal information. The client-server architecture allows various implementation options.

Historically, distributed file-server IS appeared the first. In such ISs, the database files are transferred to personal computers (PCs) upon request of the users, where they are processed. The disadvantage of this type of the architecture is the high transmission rate of the processed data. Often

unnneeded excessive data is transferred: no matter how many records from the database are required by the user, the database files are transferred in their entirety.

The structure of the distributed IS, built on the client-server architecture using a database server is such that the database server provides for the processing of the bulk of the data. The requests that are generated by the user or an application come to the database server in the form of SQL statements. The database server searches and retrieves the desired data, which is then transferred to the user's computer. The advantage of this approach in comparison with the previous one is a noticeably smaller amount of data transmitted.

Depending on the size of the organization and the features of the tasks being solved, the information system can have one of the following configurations:

- 1) computer-server containing corporate and personal databases;
- 2) computer-server and personal computers with PDBs;
- 3) several computer-servers and personal computers with PDBs.

The use of the client-server architecture makes it possible to gradually increase the information system of an enterprise, first, as the enterprise develops; second, as the information system itself develops [22].

## 5.2. Data Models and Types

The data stored in the database has a certain logical structure, which is described by some model of data representation (data model) supported by the DBMS.

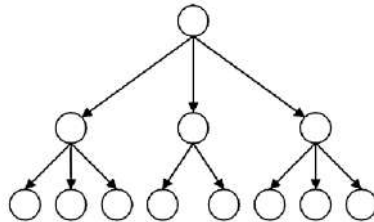
The following data models are classified as classical: ***hierarchical, network and relational***. In addition, in recent years, the following data models have emerged and become more actively implemented in practice: ***post-relational, multi-dimensional, object-oriented***.

We also develop all possible systems based on other data models that extend the known models. Among them there are ***object-relational, deductive-object-oriented, semantic, conceptual and oriented models***. Some DBMSs are supported simultaneously by several data models.

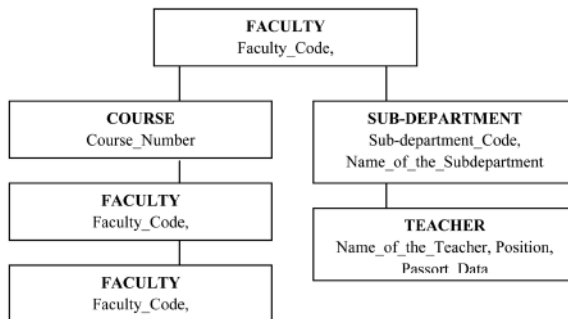
### 5.2.1. Hierarchical Model

In a hierarchical model, the relationship between data can be described using an ordered graph (or a tree). A simplified representation of the

relationships between the data in the hierarchical model is shown in Figure 5.1. The type «tree» is similar to the data types «structure» of the programming languages PL/I and C and «recording» of Pascal. They allow nesting of types, each of which is located at a certain level. The type «tree» is composite. It includes subtypes («subtrees»), each of which, in turn, is a «tree». Each «tree» type consists of one «root» type and an ordered set (possibly empty) of subordinate types. Each of the elementary types included in the type «tree» is a simple or composite type «record». A simple «record» consists of one type, for example a numeric type, and a composite «record» combines a certain set of types, for example, an integer, a string of characters and a pointer (link). An example of the «tree» type as a collection of types is shown in Figure 5.2.



*Figure 5.1 Representation of Links in Hierarchical Model*



*Figure 5.2 An Example of the Type "Tree"*

The advantages of the hierarchical data model include the effective use of the computer memory and good performance indicators for basic data operations. A hierarchical data model is useful for working with hierarchically ordered information. The drawback of the hierarchical model



is its cumbersomeness for processing information with fairly complex logical connections, as well as the complexity of understanding for an average user [22].

### 5.2.2. Network Model

A network data model allows displaying various interrelationships of data elements in the form of an arbitrary graph, thereby generalizing the hierarchical data model (Figure 5.3). The concept of the network databases was most fully described in the Proposals of the KODASYL Group. Two groups of types are used to describe the scheme of the network database: «record» and «link». The «link» type is defined for two types of «record»: ancestor and descendant. Variables of the «link» type are the samples of links.

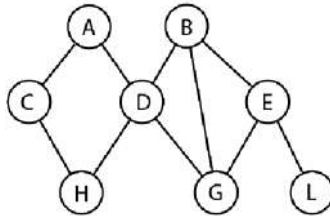


Figure 5.3. Links in the Network Model

A network DB consists of a set of records and a set of corresponding links. There are no special restrictions on the formation of links. If in hierarchical structures a descendant-record could have only one ancestor record, in the network data model, a descendant record can have an arbitrary number of ancestor records (step-ancestors). An example of a simple network database is shown in Figure 5.4. The types of links are indicated by the inscriptions on the lines connecting the types of records.

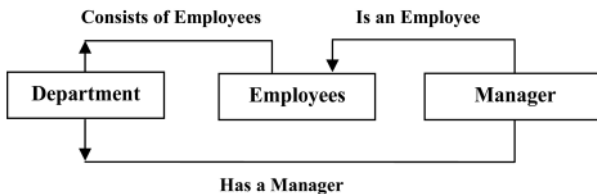


Figure 5.4. Example of a Network Data Base

The advantage of the network data model is the ability to effectively implement it from the point of view of memory use and operational efficiency. In comparison with the hierarchical model, the network model provides great opportunities in the sense of permissibility of the formation of arbitrary links. The disadvantage of the network data model is a high complexity and rigidity of the database scheme built on its basis, as well as a complexity for understanding and executing information processing in the database by an ordinary user. In addition, in the network data model, the control of the integrity of the links is weakened due to the permissibility of establishing arbitrary relationships between the records.

### 5.2.3. Relational Model

The relational data model is proposed by an IBM employee Edgar Codd and is based on the concept of a relation. A relation is a set of elements called tuples. A visual representation of a relation is a two-dimensional table habitual for human perception (Figure 5.5).

	Field	Field
	↓	↓
	Name	Record Number
	Khusainov R.T.	562001
A record →	Ivolgina T.B.	573802
	Kosherbayev E.T.	562312
	Isanov N.P.	562215

*Рисунок 5.5. Пример реляционной таблицы*

The table has rows (records) and columns (fields). Each row of the table has the same structure and consists of fields. The rows of the table correspond to tuples, and columns to relational attributes. Using one table, it is convenient to describe the simplest kind of relationships between data, namely the division of one object (a phenomenon, an entity, a system, etc.), the information about which is stored in a table, into a set of sub-objects, each of which corresponds to a row or a record of the table. In this case, each of the sub-objects has the same structure or properties, described by the corresponding values of the record fields.

Because one table does not manage to describe more complex logical data structures from the domain, table linking is used (Figure 5.6).

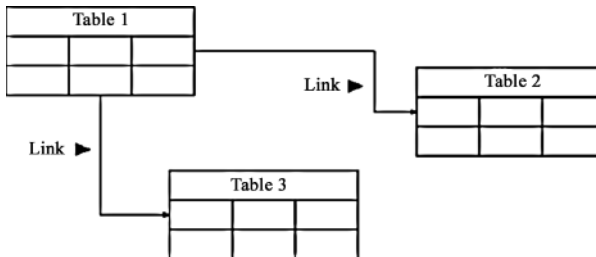


Figure 5.6. Example of Table Linking

Between the tables, binary (between two tables), ternary (between three tables) and, in the general case, paired links can be established. Consider the most common binary relationships. When you link two tables, you select the primary and the secondary (subordinate) tables.

Logical linking of tables is done using a communication key. The essence of the linking is to establish the correspondence of the connection fields of the primary and secondary tables. Linking fields of the main tables can be ordinary and key. In the subordinate table the key fields are most often used as the linking fields. Depending on how the communication fields of the primary and the secondary tables are defined (how the key fields relate to the linking fields), the following four main types of links can generally be set between the two tables: one – one (1: 1); one – many (1: M); many – one (M: 1); many – many (M: M or M: N) [22].

A “one-to-one” relationship occurs when one entry in the main table corresponds to one entry in the secondary record. This relationship is much less common than the “one-to-many”.

A “one-to-many” relationship takes place when a single record of the main table can correspond to several records of the secondary table.

“One-to-many” link is sometimes called a “many-to-one” relationship. “One-to-many” link is the most common one for relational databases.

“Many-to-many” relationship is applied in the following cases:

- 1) one record in the main table corresponds to more than one entry in the secondary table;
- 2) one record in the secondary table corresponds to more than one entry in the main table.

The physical placement of data in relational databases on external media is easily accomplished by using conventional files. The advantage of the relational data model is in the simplicity, comprehensibility and convenience of physical realization on a computer. It was simplicity and clarity for the user that were the main reason for their widespread use. The main drawbacks of the relational model are the following: the lack of standard means of identifying individual records and the complexity of describing hierarchical and network relationships.

#### 5.2.4. Post-Relational model

A classical relational model assumes indivisibility of data stored in the fields entries of a table. There are a number of cases where this restriction interferes with the effective implementation of applications. The post-relational data model is an extended relational model that removes the indivisibility of the data, stored in the records of the tables. The post-relational model of data admits multi-value fields – fields which values consist of sub-words. A set of values for multi-valued fields is considered a separate table embedded in the main table (Figure 5.7).

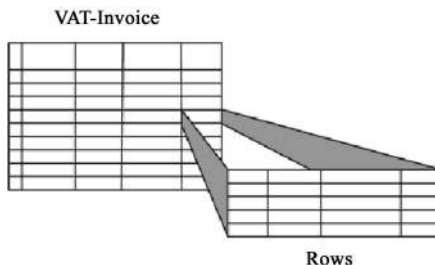


Figure 5.7. An example of a Post-Relational Model

The advantage of the post-relational model is the ability to represent a set of related relational tables by one post-relational table. This provides a high visibility of the presented information and increases the efficiency of its processing. The disadvantage of the post-relational model is the complexity of solving the problem of integrity and consistency of the stored data.

### 5.2.5. Multidimensional Model

A multidimensional approach to presenting data in the database appeared almost simultaneously with the relational one. Since the mid-90's the interest in them began to acquire a massive nature. The push to it was a programmatic article of one of the founders of the relational approach E. Codd published in 1993. It outlines 12 main requirements to the systems of the OLAP class (OnLine Analytical Processing), the most important of which are related to the possibilities of conceptual representation and processing of multidimensional data. Multidimensional systems allow you to quickly process information for the analysis and decision making. In the development of IS concepts, the following two areas can be identified: operational (transaction) processing systems; analytical processing systems (decision support systems). Relational DBMSs were designed for the information systems of operational information processing and in this area they have been very effective. In analytical processing systems, they proved to be somewhat slow-moving and not flexible enough. Multidimensional DBMSs (IMSBs) are more effective here [22]. Multidimensional DBMSs are highly specialized DBMSs, intended for interactive analytical processing of information. These DBMS use the basic concepts: aggregability, historicity and predictability of data (Figure 5.8).



*Figure 5.8. Example of a multidimensional model*

The main advantage of the multidimensional data model is the convenience and efficiency of analytical processing of large amounts of data related to time. When processing similar data on the basis of the relational model, there is a non-linear increase in the laboriousness of the perforations,

depending on the dimensionality of the database and a significant increase of the RAM used for indexing. The disadvantage of the multidimensional data model is its cumbersomeness for the simplest tasks of ordinary operational processing of information.

### 5.2.6. Object-Oriented Model

In the object-oriented model, when presenting data, it is possible to identify individual records of the database. Relationships between database records and their processing functions are established with the help of mechanisms similar to the corresponding tools in the object-oriented programming languages. Standardized object-oriented models are described in the recommendations of the ODMG-93 standard (Object Database Management Group). The logical structure of an object-oriented database looks like a hierarchical database structure. The main difference between them is the methods of manipulating data. To perform actions on the data in the considered database model, logical operations are applied, enhanced by *object-oriented mechanisms of encapsulation, inheritance, and polymorphism*.

Let us consider briefly the concepts of encapsulation, inheritance, and polymorphism with respect to the object-oriented database model.

*Encapsulation* can limit the scope of the name visibility to the limits of the object in which it is defined. Inheritance, by contrast, extends the scope of the property to all descendants of the object.

*Polymorphism* in the object-oriented programming languages means the ability of the same program code to work with different types of data. In other words, it means permissibility in objects of different types to have methods (procedures or functions) with the same name.

The search in the object-oriented database consists of finding out the similarities between the object specified by a user and the objects stored in the database. The user-defined object, called the target object, in general, can be a subset of the entire hierarchy of objects stored in the database.

An object is a sample of an object class or just a class. For example, the car Audi A6 is a sample of the class of cars of this model, the receiver Sony SW-7600G will also be a representative of the class of receivers of the same name. Thus, a class is an abstract concept. In UML, the unified modeling language, the class is displayed as a rectangle divided into three parts. The first contains the name of the class, the second contains the attributes, the third contains the methods (Figure 5.9, a).

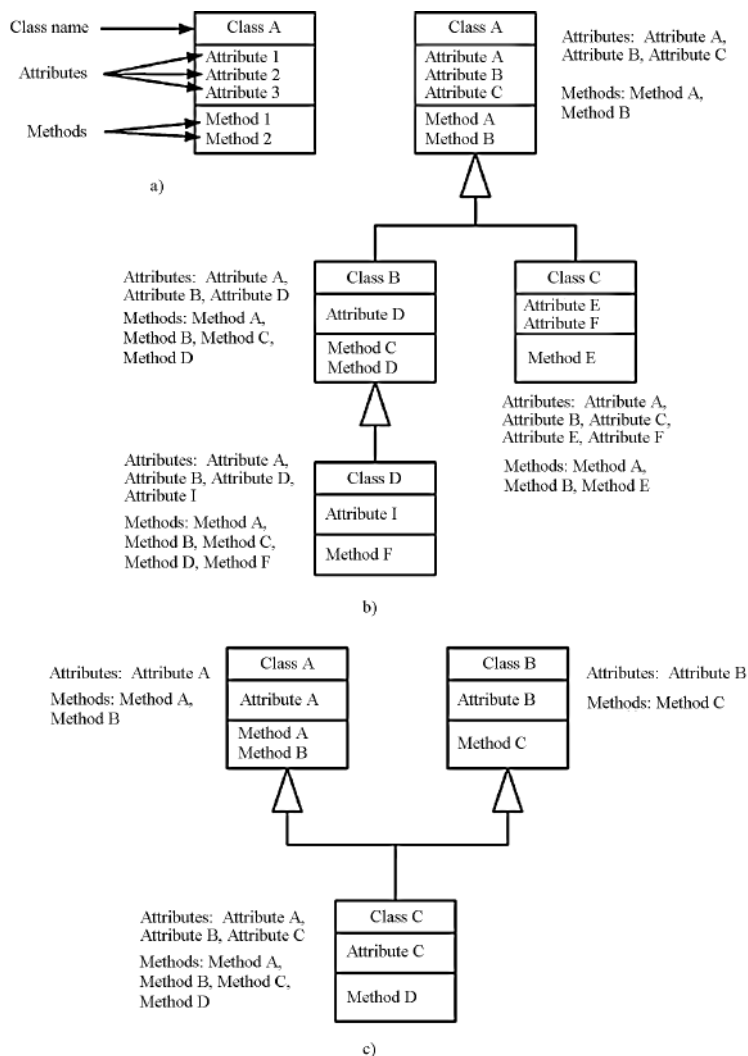


Figure 5.9. The image of the class and generalization relations:  
*a – the image of the class; b – single inheritance; c – multiple inheritance*

Classes can be connected with each other by different types of relations. One of the main types of such relation is a class-subclass relation, known in the object-oriented programming as inheritance. For example, the class of cars Audi A6 is a subclass of cars, which in turn is included in a

larger class of cars, and the latter is a subclass of the vehicle class, which besides cars includes airplanes, trains, ships and so on. An example of such relations is the classification systems in botany and zoology. The relation opposite to inheritance is generalization. It indicates that a certain class is a more general (generalized) class of another class. The class of vehicles, for example, is the generalization of the classes of cars, aircrafts, and ships (Figure 5.9, b).

In addition to the single, there is multiple inheritance, when a class inherits several classes at once (Figure 5.9, c). In this case, it inherits the properties of all classes, of which it is a descendant.

The main advantage of the object-oriented data model in comparison with the relational one is the ability to display information about complex relations of objects. The object-oriented data model allows you to identify a single record of the database and to determine the functions of its processing.

Disadvantages of the object-oriented model are high conceptual complexity, inconvenience of data processing and low speed of query execution.

### 5.3. Normalization of Relations

*Normalization* is a process of organizing data in a database, including the creation of tables and the establishment of relations between them in accordance with the data protection rules and the rules that make the database more flexible, eliminating *redundancy* and *uncoordinated dependencies*. Redundancy of data results in unproductive consumption of free disk space and makes it difficult to maintain databases. For example, if the data stored in several places needs to be changed, it will be necessary to make the same changes in all these places.

The process of normalization consists of decomposition of the initial DB relations into simpler relations. At the same time, the relations scheme is brought to normal forms at the each step of this process. For each normalization step, there are sets of constraints that the DB relations must satisfy. This removes excessive non-key information from the database tables. The normalization process is based on the concept of *functional dependence* of attributes: the attribute A depends on the attribute B ( $B \rightarrow A$ ), if each value of the attribute B corresponds to no more than one value of the attribute A at any point of time.



The dependency in which each non-key attribute depends on the entire composite key and is independent of its parts is called a complete functional dependence. If the attribute A depends on the attribute B, and the attribute B depends on the attribute C ( $C \rightarrow B \rightarrow A$ ), but the inverse dependency is absent, then the dependence of C on A is called transitive.

The general concept of normalization is divided into several normal forms.

### ***The First Normal Form***

The information object (entity) is in the first normal-form (1NF), when all its attributes have a single value. If any attribute has duplicate values, the object (entity) is not in 1NF, and at least one more information object (one more entity) is missed.

For example, the following relation is given:

SUBJECT (Subject code, Title, Cycle, Number of hours, Teachers).

This relation is not in 1NF, since the Teachers attribute implies the possibility of having several names of teachers in a record pertaining to a particular subject, which corresponds to the participation of several teachers in one discipline. We transfer the attribute with duplicate values into a new essence, assign it a primary key (Teacher's code) and connect it with the original essence referring to its primary key (object code). As a result, we get two essences, and the second essence receives its characterizing attributes:

SUBJECT (Subject code, Name, Cycle, Number of Hours);

TEACHER (Teacher's code, Name, Position, Salary, Address, Object Code).

The obtained results correspond to the case when several teachers can teach one subject, but each teacher cannot lead more than one discipline. And if you consider that in fact one teacher can read more than one discipline, as well as one and the same discipline can be read by several lecturers, it is necessary to decline the rigid linking of the teacher to the subject in the essence TEACHER, creating an additional essence STUDY that will show how teachers and subjects are related:

SUBJECT (Subject Code, Title, Cycle, Number of Hours);

TEACHER (Teacher's Code, Name, Position, Salary, Address);

STUDY (Subject Code, Teacher's Code).

### ***The Second Normal Form***

An information object is in the second normal form (2NF), if it is already in the first normal form and each of its non-identifying (descriptive)

attribute depends on the entire unique identifier of the information object. If a certain attribute does not depend entirely on the unique identifier of the information object, it means that it has been included in the composition of this information object by mistake and it must be deleted. Normalization in this case is done by finding an existing information object to which this attribute belongs, or by creating a new information object into which the attribute should be placed. Returning to the last example, we note that the attribute Cycle in the essence SUBJECT, characterizing the belonging of the subject to the cycle of humanitarian, natural science, general professional or special disciplines, is not entirely dependent on the unique identifier Code of the subject, since different objects can have the same value of the attribute Cycle. We will transfer this attribute to the new entity CYCLE and get four interconnected entities:

SUBJECT (Subject Code, Title, Number of Hours, Cycle Code);  
CYCLE (Cycle code, Cycle name);  
TEACHER (Teacher's Code, Name, Position, Salary, Address);  
STUDY (Subject Code, Teacher's Code).

### ***The Third Normal Form***

The information object is in the third normal form (3NF), if it is already in the second normal form, and none of its descriptive attributes are dependent on any other descriptive attributes. Attributes that depend on other non-identifying attributes are normalized by moving the dependent attribute and the attribute, on which it depends, to a new information object. In this case, the non-key attributes Position and Salary are in a transitive relationship. The danger of such dependence is that several people can work in the same position. If you change the salary, you will need to change the data in each entry that contains this entry, therefore, you want to create a new entity POSITION with the attributes in the transitive dependency Job Title and Salary, and create a link from the entity of the TEACHER to the entity POSITION:

SUBJECT (Subject code, Title, Volume of Hours, Cycle Code);  
CYCLE (Cycle Code, Cycle Name);  
EACHER (Teacher's Code, Name, Position Code, Address);  
POSITION (Position code, Job title, salary);  
STUDY (Subject Code, Teacher Code) [24].

## 5.4. Data Integrity Constraints

Integrity constraints can be defined as special tools in databases, the main purpose of which is not to allow invalid data to enter the database (for example, to prevent user errors when entering data).

All integrity constraints can be divided into three broad categories:

- 1) the first category is the means to ensure the domain integrity. They are responsible for ensuring that only valid values are in the appropriate field of the database. For example, a surname, as a rule, should consist of letters, and a postal code – of figures. In databases, such integrity is usually provided by the conditions on the value, by the ban of empty values, by triggers and stored procedures, as well as keys;
- 2) the second category is the entity integrity. The main task here is to make sure that data about one entity is not included in the database twice. It is provided by the limitation of uniqueness and the primary key;
- 3) the third category is the referential integrity, it is provided by a system of primary and external keys. For example, with the help of these tools you can guarantee that we will not have orders for customers who are not in the database.

Two more large categories, which the integrity ensuring means could be split into are the means of *declarative and procedural nature*. Means of *declarative nature* are created as the component parts of the objects when they are defined in the database (for example, a condition for a value when defining a table in the database). *Procedural tools* (triggers and stored procedures) are implemented as separate program modules. Triggers are the procedures stored in the database written in the language of the corresponding DBMS and automatically run when an event starts. With the help of the triggers, you can check any conditions and prohibit the execution of any operation, or make additional changes to other tables. Triggers have three main functions:

- 1) to prohibit certain actions that contradict the integrity of the database.
- 2) to make changes to other database tables or database structures along with the operation.
- 3) to log certain actions in the database.

In addition, when creating integrity constraints, database developers must ensure that errors that occur in integrity violations are intercepted by the client application.

## 5.5. Optimization of Requests and their Processing

There are two different aspects to optimizing relational queries. First, it is an internal task of the DBMS, which consists of determining the most optimal (effective) way to perform relational queries. Secondly, it is the task of a programmer (or a qualified user): it consists in writing such relational queries for which the DBMS could use more efficient ways of finding data. Let us first consider the first aspect.

### *Processing Request in Relational DBMS*

Each command of the data manipulation language can be executed in different ways. Definition of the most optimal plan of query execution is called **optimization**. An optimizer – a special component of the DBMS, is the one to choose this plan.

The execution of a query consists of a series of steps, each of which either physically extracts data from the memory, or does a preparatory work. The sequence of steps that the optimizer builds is called **the execution plan**.

Processing a request that has entered the system and is submitted in a certain query language consists of the stages or phases presented in Figure 5.10.

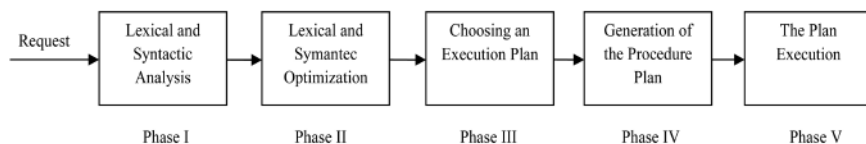


Figure 5.10. Sequence of Execution of Queries in Relational DBMSs

*At the first phase*, a request, represented in the query language, is subjected to lexical and syntactic analysis. This generates its internal representation, reflecting the structure of the request and containing information that characterizes the database objects mentioned in the query (relations, fields, and constants). The information about the objects stored in the database is selected from the database catalogs (dictionary-data directory). The internal query representation is used and transformed at the next stages of the request processing.

*At the second phase*, the query in its internal representation undergoes logical optimization. In this case, various transformations that «improve» the initial representation of the query can be applied. Among these transformations there may be equivalent transformation, after the execution

of which an internal representation takes place, semantically equivalent to the initial (for example, converting the query to some canonical form). Transformations can be semantic, when the resulting representation is not semantically equivalent to the initial one, but it is guaranteed that the result of the converted query is the same as the result of the query in the initial form subject to integrity existing in the database. In any case, after the second phase of the query processing, its internal representation remains non-procedural, although it is in some sense more efficient than the initial one.

*The third stage* of query processing consists of choosing a set of alternative procedural plans based on the information available to the optimizer for the implementation of this request in accordance with its internal presentation, received in the second phase. The basis is the information about existing ways of access to data. The only access path that is possible in any case is sequential reading (FULL). A possibility of using other access paths depends on the ways in which data are stored in the memory (for example, data clustering), the availability of indices, and the formulation of the query itself. At the same stage, the estimated cost of fulfilling the request for each plan is estimated. When estimating, either statistical information on the state of the database available to the optimizer or information on the mechanisms for implementing different access paths is used. From the obtained alternative plans, the most optimal one is selected from the point of view of some (pre-selected or given) criterion. The internal representation of this plan now corresponds to the query being processed.

*At the fourth stage*, a procedural presentation of the plan is formed according to the internal presentation of the most optimal plan for fulfilling the request. The implementation of the plan can be a program in machine codes, the system is focused on compiling queries into machine codes, or being machine-independent, but more convenient for interpreting queries.

Finally, at the last, *fifth stage* of the request processing, it is actually executed in accordance with the executed request plan. This is either the execution of a corresponding subprogram, or calling the interpreter with passing it to it to interpret the executed plan.

There are two fundamentally different approaches to query optimization. If the optimizer uses the information about the mechanisms for implementing access paths, then the optimization method is based on the syntax (on the rules). If the basis is statistical information about the distribution of the data, then this is an optimization method based on cost (at costs).

Consider what the cost of the request is. The following components of this concept stand out:

- 1) *communication cost* – the cost of transferring data from their location to the secondary memory (there is a memory, from which the data for calculation is loaded) plus the cost of moving the result to its location;
  - 2) *cost of access to the secondary memory* – the cost of loading portions of data from the secondary memory into the main memory used in the calculation;
  - 3) *cost of memorization* – the cost of using the secondary memory and the buffer memory;
  - 4) *cost of calculation* – the cost of time used directly for calculation.
- Thus, «optimization of processing» of queries is a non-trivial multicriterial problem.

## 5.6. SQL Basics

SQL stands for *Structured Query Language*. This is the language that makes it possible to create and work in relational databases that are the sets of related information stored in tables.

The information space becomes more uniform. This led to the need to create a standard language, which could be used in a large number of different kinds of computer environments. A standard language will allow users who know one set of commands to use them to create, find, change and transfer information regardless of whether they work on a personal computer, a network workstation, or on a general-purpose computer.

Independence from the specifics of computer technologies, as well as its support by industry leaders in the field of relational database technology, made SQL (and probably in the foreseeable future will leave it) the basic standard language.

The SQL standard is defined by ANSI (*American National Standards Institute*) and is also now being adopted by ISO (*International Organization for Standardization*). The SQL language is intended for manipulating data in relational databases, determining the structure of the databases, and for managing access rights to data in a multi-user environment.

Therefore, the SQL language include the following components:

- 1) Data Manipulation Language (DML);
- 2) Data Definition Language (DDL);
- 3) Data Control Language, (DCL).

This division was made only from the point of view of the various functional purposes of these teams.

The language of data manipulation is used, as its name suggests, to manipulate data in the database tables. It consists of 4 main commands:

**SELECT** (select)  
**INSERT** (insert)  
**UPDATE** (refresh)  
**DELETE** (remove)

*The data definition language* is used to create and change the structure of the database and its components – tables, indexes, views (virtual tables), as well as triggers and stored procedures. Its main commands are:

CREATE DATABASE (create a database)  
CREATE TABLE (create a table)  
CREATE VIEW (create a virtual table)  
CREATE INDEX (create an index)  
CREATE TRIGGER (create a trigger)  
CREATE PROCEDURE (create a saved procedure)  
ALTER DATABASE (modify the database)  
ALTER TABLE (modify the table)  
ALTER VIEW (modify the virtual table)  
ALTER INDEX (modify the index)  
ALTER TRIGGER (modify the trigger)  
ALTER PROCEDURE (modify a stored procedure)  
DROP DATABASE (delete the database)  
DROP TABLE (delete the table)  
DROP VIEW (delete the virtual table)  
DROP INDEX (delete the index)  
DROP TRIGGER (delete the trigger)  
DROP PROCEDURE (delete the stored procedure)

Consider the operators of the SQL language for working with a relational database.

*Creating a relational database* means specifying the composition of fields: specifying a name, a type and a length of each field (if necessary). Each table must have a unique name.

The syntax for creating a new table is as follows:

CREATE TABLE table (field1 type [(size)] [index1]  
[, field2 type [(size)] [index2] [, ...] [, composite index [, ...]

Here the table is the name of the table being created; field1, field2 – table field names; type – field type; size – the size of the text field; index 1, index2 – directives for creating simple indexes; composite index – the directive for creating a composite index. Each index has a unique name within the given table. To create a simple index, use the following phrase (located behind the field name):

```
CONSTRAINT index name {PRIMARY KEY | UNIQUE |  
REFERENCES external table [(external field)]}
```

The directive for creating a composite index (located anywhere after the definition of its elements) has the following form:

```
CONSTRAINT name {PRIMARY KEY (key1 [, key2  
[, ...]) | UNIQUE (unique! [, ...]) | FOREIGN KEY (reference1 [,  
reference2 [, ...]) REFERENCES external table [(external field1 [,  
external field2 [, ...])]}
```

Meanings of the service words:

UNIQUE – a unique index (there cannot be two records in the table that have the same value of the fields included in it);

PRIMARY KEY – a primary key of the table, which can consist of several fields (it organizes records of the table);

FOREIGN KEY – a foreign key for communication with other tables (can consist of several fields);

REFERENCES – a reference to an external table.

Example – Creating a table:

```
CREATE TABLE Student  
([Name] TEXT,  
[Surname] TEXT, [  
Date of birth] DATETIME,  
CONSTRAINT Adr UNIQUE ([Name]), [Surname], [Date of birth]))
```

As a result of this request, the STUDENT table will be created, which will include:

- two text fields – First name, Last name‘,
- one field of the date / time type – Date of birth.



You will also create a composite index named Adr by the values of the specified fields, which will have a unique value, because in the table there cannot be two records with the same field values forming it.

*Change the structure of the tables.* If necessary, you can change the structure of the table:

- delete existing fields;
- add new fields;
- create or delete indexes.

In this case, all these actions affect only one field or one index:

ALTER TABLE table

ADD {[COLUMN] field type [(size)] [CONSTRAINT index  
CONSTRAINT composite index} |

DROP {[COLUMN] field i CONSTRAINT index name}}

The ADD option adds a table field, and the DROP option deletes it. Adding the CONSTRAINT option means the similar actions for table indexes.

Example – Changing the table structure:

```
ALTER TABLE Student ADD COLUMN [Group] TEXT (5)
```

To create a new index to an existing table, you can also use the following command:

```
CREATE [UNIQUE] INDEX index
```

```
ON table (field [, ...])
```

```
[WITH {PRIMARY | DISALLOW NULL | IGNORE NULL}]
```

The WITH phrase provides a condition overlay on the values of the fields included in the index:

DISALLOW NULL – to forbid empty values in the indexed fields of the new records;

IGNORE NULL – to include records in the index that have null values in the indexed fields.

Example – Creating a table index:

```
CREATE INDEX Gr ON Student ([group]) WITH DISALLOW NULL
```

*Deleting a table.* To delete a table (both the structure and the data), use the following command:

```
DROP TABLE table name
```

To delete only the index of the table (the data itself is not destroyed) you need to run the following command:

```
DROP INDEX index name ON table name
```

Example – Deleting only the index Adr of the table:

```
DROP INDEX Ad ON Student
```

Deleting the entire table:

```
DROP TABLE Student
```

Data entry in the table. Creation of a new record in the table is performed by the following command:

```
INSERT INTO table [(field1 [, field2 [, ...])  
VALUES (value1 [, value2 [, ...])
```

Here you specify the name of the table to which the entry is added, and the composition of the fields for which values are entered.

Example – Entering Data into the Table:

```
INSERT INTO Student ([Surname], [Name], [Date of birth])  
VALUES (Sadykov, Askar, 25/6/93)
```

It is also possible to enter group records (batch mode), which are the result of a selection (query) from other tables:

```
INSERT INTO table [IN external database  
SELECT [source.] field1 [, field2 [, ...  
FROM expression  
WHERE condition
```

In this case, the operator of the sub-query SELECT is executed first, which generates a sample for adding data. The phrase SELECT specifies the

structure of the data of the source of the transmitted records – the names of the table and fields that contain the source data to load into the table.

The FROM clause allows you to specify the names of the source tables participating in the generated sample, and the WHERE phrase specifies the conditions for the execution of the sub-query. The data structure of the sample must correspond to the data structure of the table to which the data are added.

Adding (reloading) of records is also possible in an external database, for which the fully specified name is specified (disk, directory, name, extension). In this case, the structures of the tables must coincide.

Example – Entering Data into the Table:

```
INSERT INTO Student SELECT [Student-external student]. * FROM  
[Distance-learning student]
```

With this phrase, all entries of the DISTANCE-LEARNING STUDENT table will be added to the STUDENT table.

Example – Entering Data into the Table:

```
INSERT INTO Student SELECT [Distance-learning Student]. * FROM  
[Distance-Learning Student] WHERE [Date of Birth]>= # 01/01/95 #
```

In this case, the records of the DISTANCE-LEARNING-STUDENT table are added to the STUDENT table if the student's date of birth is greater than or equal to the specified.

Operation “Joining the tables”. The INNER JOIN operation can be used in any FROM clause. It creates a symmetrical union - the most common type of internal unification.

The records from two tables are combined if the binders of their fields contain the same values:

```
FROM the table! INNER JOIN table2 ON table!., field1 = table2.field2
```

This operator describes the symmetrical connection of these two tables by the communication keys (field1; field2). A new record is formed if the tables contain the same values of the communication keys.

The following options for joining tables are available:

LEFT JOIN (left-side) connection is when all records of the left table are selected and only those entries of the right table, that contain the appropriate communication keys;

RIGHT JOIN (right-side) connection is when all records of the right table are selected and only those records of the left table that contain the corresponding communication keys.

Example – Joining the Tables:

```
SELECT Student. *, Grade. * FROM Students INNER JOIN Grade ON
Student. [No. grade book] = Grade. [No. grade book]
SELECT Student. *, Grading. * FROM Students LEFT JOIN
Evaluation ON Student. [No. book title] = Evaluation. [No. Books]
SELECT Student. *, Grade. * FROM Students RIGHT JOIN Grade ON
Student. [No. grade book] = Score. [No grade Book].
```

In the first case, a symmetrical join of two tables is created in the field [No. grade book]. The records are not output if the value of their communication keys (the indicated field) is not represented in both tables.

In the second case all records of the STUDENT table and the corresponding records of the GRADE table are displayed.

In the third case, on the contrary, all the records of the GRADE table and the corresponding records of the STUDENT table are displayed.

The JOIN operation can be nested for the serial connection of several tables.

Example – Connecting Tables:

```
SELECT Student. *, Grade. *, Discipline. [Name of the discipline]
FROM (Student INNER JOIN (Grade INNER
JOIN (Discipline ON Grade. [Code of the discipline] = Discipline.
[Code of the discipline]) ON Student. [No. grade book] = Grade. [No
grade book])
```

Here, first the joining of the tables GRADE and DISCIPLINE by the communication key [Code of the discipline] is taking place. The connection is symmetrical, that is, if the discipline codes do not match, the records of

these tables are not connected. Then the connection of the STUDENT tables and the GRADE table by the communication key [No. grade book] occurs.

Thus, under the condition of identity of the communication keys at the output of the query, the connection of the three tables occurs.

Delete records in the table. In the source table, you can delete individual records or all records, while retaining its structure and indexes. When you delete records in an indexed table, its indexes are automatically updated:

DELETE [table. \*] FROM clause WHERE selection conditions

The complete cleaning of the table from the records and the cleaning of the indexes are performed by the following operation:

DELETE \* FROM table

Example – Deleting all Records in the Table:

DELETE \* FROM Student

Deletes only those records in which the [Date of birth] are greater then the specified date:

DELETE \* FROM Student WHERE [Date of birth]> # 1.1.81 #

Deleting the records from the table associated with another table (the conditions Delete records can refer to the fields of the linked tables):

DELETE table. \* FROM table INNERJOIN other table ON table. [field N] = [other table]. [Field M] WHERE condition

Example – Delete Records in the STUDENT Table for which there are Associated Entries in the DISTANCE-LEARNING STUDENT Table:

DELETE Student. \* FROM Student INNER JOIN [Student Out-of-School] ON Student. [Group] = [External correspondence student]. [Group

Updating (changing) the values of the recording fields. Changing the values of the several fields of one record or a group of table entries that satisfy the selection conditions are made by the following phrase:

UPDATE table SET new value WHERE selection conditions New value is specified as field name = new value

Example – Selection of Students whose Names begin with the Letter B and the Date of Birth does not Exceed the Specified Date, for Transfer to Group 1212:

```
UPDATE Student SET [Group] = «1212»  
WHERE [Surname] LIKE 'B *' AND [Date of birth] <= # 01/01/88 #
```

Change of training group numbers in the STUDENT table by adding the letter «a» to them, if these groups are found in the table DISTANCE-LEARNING STUDENT:

```
UPDATE Student INNER JOIN [Student-external student] ON Student.  
[Group] = [External student]. [Group] SET [Group] = [Group] & »a»
```

### Organization of Queries in the Form of SQL

The Syntax of the SELECT Operator. Sampling with the SELECT operator is the most common command when working with the relational database. This operator has great opportunities for specifying the structure of output information, indicating sources of the input information, a way of ordering of the output information, generating new values, and the like.

The universal SELECT statement has the following structure:

```
SELECT [predicate] { * | table. * | [Table.] Field1 [,  
[table.] field2 [, ...}  
[AS alias1 [, alias2 [, ...  
FROM expression [, ... [IN external database]  
[WHERE ...  
[GROUP BY ...  
[HAVING ...  
[ORDER BY ...  
[WITH OWNERACCESS OPTION
```

The syntax of the SELECT statement implements complex query algorithms.

The word SELECT defines the structure of the output information; these can be the table fields and computed expressions).

The calculated expression includes:

- tables fields;
- constants;
- operations signs;
- built-in functions;
- SQL group functions.

Example – Using the SELECT statement:

1. SELECT [Name], [Last Name] FROM Student
2. SELECT TOP5 [Surname] FROM Student
3. SELECT TOP5 [Surname] FROM Student ORDER BY [Group]

In the first case, all records of the STUDENT table are selected in the specified fields. And, if all the fields are selected in the same order as in the table structure, you can use the dot symbol.

In the second case, the first five students are selected.

In the third case, the first five students' surnames are selected, and the ordering of the records is carried out by the training groups.

## 5.7. Parallel Processing of Data

Any computer system (supercomputer or personal computer) achieves its highest performance due to the use of high-speed elements and parallel execution of a large number of operations. It is the possibility of parallel operation of various devices of the system that is the basis for accelerating the basic operations.

Embodying the idea of simultaneous execution of several actions, the parallel processing of data has two varieties: pipeline and parallelism. Both types of parallel processing are intuitively understandable, therefore we will make only small explanations.

**Parallel Processing.** If a certain device performs one operation per unit of time, then it will execute a thousand operations per thousand units. Assuming that there are five the same independent devices capable of working simultaneously, then a system of five devices can perform the same one thousand operations not for a thousand, but for two hundred units of time. Similarly, a system of N devices will perform the same work for

1000 / N time units. The pioneer in the parallel processing of data flows was Academician A.A.Samarskii, who in the early 1950s carried out calculations necessary for modeling nuclear explosions.

**Pipeline Processing.** The basis of pipelining is the separate execution of an operation by several stages (using several steps) with the transmission of data from one stage to the next. Thus productivity increases due to the fact that several operations are performed simultaneously on different stages of the pipeline. Pipelining is effective only when the pipeline loading is close to full, and the speed of feeding of new operands corresponds to the maximum performance of the pipeline. If there is a delay, then fewer operations will be performed in parallel and the total performance will decrease.

Let's consider the directions the development of high-performance computing at the present time. There are four main directions.

1) Vector-pipeline computers. Pipeline functional devices and a set of vector commands are two features of such machines. Unlike the traditional approach, vector commands operate with entire independent data arrays, which effectively loads available pipelines, that is, a command of the form  $A = B + C$  can mean the addition of two arrays, not two numbers. A typical representative of this direction is the family of vector-pipeline computers CRAY.

2) Massively parallel computers with the distributed memory. The idea of building computers of this class is trivial: to take serial microprocessors, to equip each with its local memory, to connect them by means of some communication environment. There are many advantages of such architecture: if you need high performance, you can add more processors, if the finance is limited or the required computational power is known in advance, it is easy to choose the optimal configuration and the like. Disadvantages of these computers are inter-process communication in the computers of this class is slower than local processing of data by the processors themselves. That is why to write an effective program for such computers is very difficult, and is sometimes impossible for some algorithms. This class includes computers Intel Paragon, IBM SP [22].

3) Parallel computers with shared memory. All RAM of such computers is divided by several identical processors. This removes the problems of the previous class, but adds new ones - the number of processors with access to the shared memory cannot be larger for purely technical reasons. This direction includes many modern multiprocessor SMP- Computers or, for example, individual HP and Sun computers.



4) The last direction is a combination of the previous three. A computing node is formed of several processors (traditional or vector-pipeline) and their common memory. If the obtained computing power is not sufficient, then it is possible to combine several nodes by high-speed channels. Such architecture is called cluster architecture, CRAY SV, HP Exeplar, Sun, NEC, the latest IBM models and others are built according to this principle. This direction is currently the most promising for the construction of computers with record performance indicators.

## **5.8. Designing Databases**

There are many varieties of database design, but most often the ANSI / SPARC methodology are followed, which is shown in Figure 5.11. The figure shows a set of procedures for designing a centralized database, which can be combined into four stages.

At the stage of formulation and analysis of requirements, the objectives of an organization are established, and the requirements for the database are determined. They consist of the general requirements, as defined above and specific requirements. To form the specific requirements, the technique of interviewing personnel of the various management levels is usually used. All requirements are documented in a form that is available to the final user and the database designer.

The stage of conceptual design is to describe and synthesize the information requirements of the users in the initial database project. The initial data can be a set of the user's documents using the classical approach or an application algorithms (business algorithms) using the modern approach. The result of this stage is a high-level representation (in the form of a system of the database tables) of information requirements of the users on the basis of different approaches.

First, a database model is selected. Then, using the data description language (DDL), a database structure is created which is filled with data using the data manipulation language (DML) commands, menu systems, screen forms, or in the database tables view mode. It also provides protection and integrity (including reference) of the data using DBMS or by creating triggers.

In the process of logical design, a high-level representation of the data is transformed into the structure of the DBMS used. The main goal of the stage is to eliminate the data redundancy using special normalization rules.

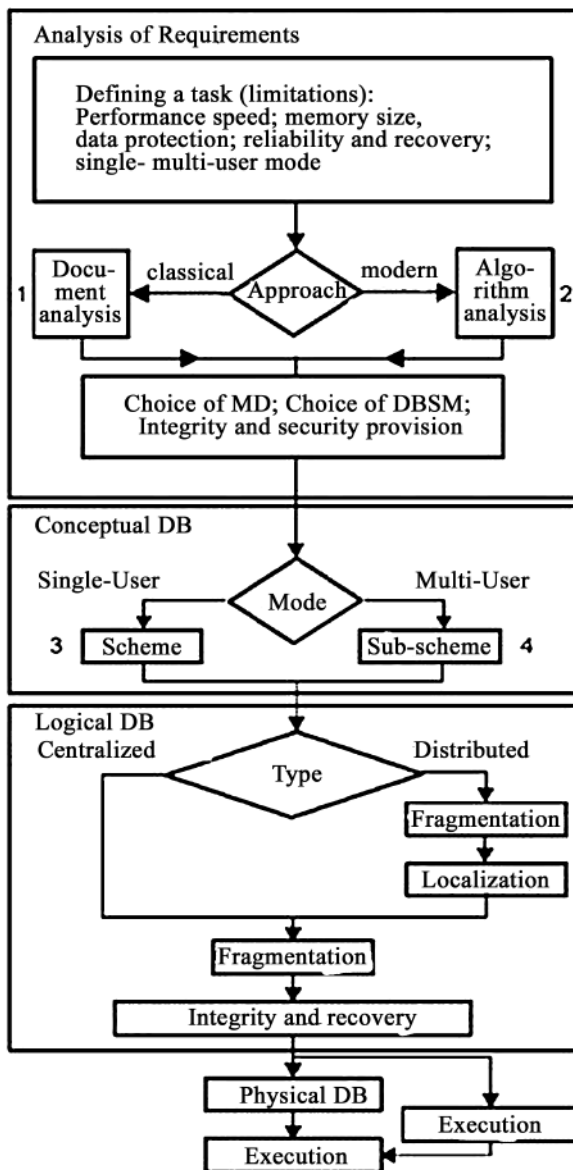


Figure 5.11. Database Design Stages

The goal of normalization is to minimize repetition of data and possible structural changes to the database during update procedures. It is achieved by dividing (decomposing) one table into two or more and then using the navigation operation for queries.

The resulting logical structure of the database can be evaluated quantitatively using various characteristics (the number of calls to logical records, the amount of data in each application, the total amount of data). Based on this evaluation, the logical structure can be improved to achieve greater efficiency.

The procedure of managing the database deserves a special attention. It is very simple in the single-user mode. In the multiuser mode and in distributed databases, the procedure is greatly complicated. If several users are simultaneously accessing without taking special measures, there may be a violation of integrity. To eliminate this phenomenon, a transaction system and the mode of locking the tables or individual records are used.

**Transaction** is a process of changing a file, a record, or a database, caused by the transmission of one input message.

At the stage of physical design, issues related to system performance are addressed; data storage structures and access methods are defined.

The interaction between the design stages and the vocabulary system must be considered separately. Design procedures can be used independently in the absence of a dictionary system. The dictionary system itself can be regarded as an element of the design automation.

Design tools and evaluation criteria are used at all stages of the development. At present, uncertainty about the choice of criteria is the weakest point in the design of the database. This is due to the difficulty of describing and identifying a large number of alternative solutions.

Qualitative criteria may include flexibility, adaptability, availability for new users, compatibility with other systems, the ability to convert to another computing environment, the ability to restore, the ability to distribute and expand.

The design process is lengthy and time consuming and usually lasts several months. The main resources of the database designer are his own intuition and experience, so in many cases the quality of the solution may be low.

The main reasons for the low efficiency of the projected database can be:

- 1) Inadequate analysis of the requirements (initial stages of the design), including their semantics and the relationship of data;
- 2) Long duration of the structuring process, making this process tedious and difficult to perform with manual processing.

In these conditions, the issues of the development automation are becoming paramount.

### ***The Main Stages of the Database Development***

#### ***Stage 1. Refinement of Tasks***

At the first stage, a list of all the main tasks is compiled, which in principle should be addressed by this application, including those that are not needed today, but may appear in the future. «Basic» tasks are functions that are to be represented in the forms or reports of the application.

#### ***Step 2. Sequence of Tasks***

For the application to work logically and conveniently, it is best to combine the main tasks into thematic groups and then to order the tasks of each group so that they are located in the order in which they are performed. It may happen that some tasks will be associated with different groups or that the performance of some task must precede the execution of another belonging to another group.

#### ***Step 3. Data Analysis***

After the formation of the task list, the most important step is to compile a detailed list of all the data needed to solve each task. Some data will be needed as the source data and will not be changed. Other data will be checked and changed in the course of the task. Some data items can be deleted or added. Finally, some data will be obtained by computation: their output will be part of the task, but they will not be entered into the database.

#### ***Step 4: Determination of Data Structure***

After preliminary analysis of all necessary data elements, it is needed to organize them by objects and to correlate objects with the tables and the database queries. For relational databases like Access, a process called normalization is used, which results in the most efficient and flexible way to store data.

#### ***Step 5. Development of Application Model and User Interface Layout***

After specifying the structure of the application tables, in Microsoft Access it's easy to create its layout using forms and link them together using simple macros or event processing procedures.

Preliminary working layout is easy to demonstrate to the customer and get his approval even before the detailed implementation of the application tasks.

#### ***Step 6: Creation of Application***

In the case of very simple tasks, the created layout is an almost finished application. However, quite often it is necessary to write procedures that allow to fully automating the solution of all tasks planned in the project.

Therefore, you will need to create special binding forms that provide the transition from one task to another.

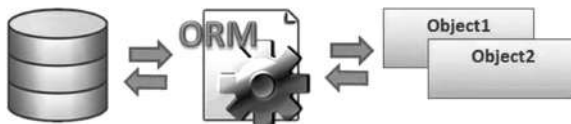
#### *Stage 7. Testing and Improvement*

After completion of the work on individual components of the application, one needs to check the operation of the application in each of the possible modes. It is necessary to check the operation of macros by using a step-by-step debugging mode, which will execute one specific macro. When using Visual Basic for Applications, the designer has a variety of debugging tools to test the application, identify, and correct errors.

While developing the standalone sections of the application it is desirable to transfer them to the customer to verify their functioning and to obtain an opinion on the need to make those or other changes. After the customer gets acquainted with the work of the application, he almost always has additional suggestions for improvement, no matter how thorough the preliminary study of the project was. Users often find that some of the points about which, in the process of setting tasks, they spoke as very important and necessary, in fact do not play a significant role in the practical use of the application. Identifying the necessary changes in the early stages of the application development can significantly reduce the time for subsequent rework.

### **5.9. ORM Programming Technology**

**ORM or Object-Relational Mapping** is a programming technology that allows converting incompatible types of models into OOP, in particular, between the data storage and the programming objects. ORM is used to simplify the process of storing objects in a relational database and retrieving them, at the same time ORM itself takes care about transformation of the data between the two incompatible states. Most ORM tools rely heavily on the database and the object metadata, so the objects do not need to know anything about the structure of the database, and the database does not need to know anything about how the data are organized in the application. ORM provides a complete separation of tasks in well-designed applications, in which both the database and the application can work with data each in its original form.



*Figure 5.12. Schematic of ORM Programming Technology*

The use of ORM solves the problem of the so-called «discrepancy» paradigm, which states that the object and relational models do not work very well together. Relational databases represent data in a table format, while the object-oriented languages represent them as a linked object graph. The main problems and inconsistencies arise during the storage of this graph of objects in the relational database or its loading:

- 1) the relational model can be much more detailed than the object model, that is, several tables are used to store one object in the relational database;
- 2) Relational DBMSs do not have anything like inheritance – a natural paradigm of the object-oriented programming languages;
- 3) There is only one parameter for comparison of records in DBMS – the primary key. While OOP provides both an identity check of the objects ( $a = b$ ) and their equality ( $a.equals(b)$ );
- 4) DBMS uses the concept of foreign keys in object-oriented languages for linking objects, the relationship between the objects can be only one-way. If you want to organize a bidirectional relationship, you will have to define two unidirectional associations. In addition, there is no possibility to determine the multiplicity of the relationship, looking at the domain model;
- 5) The principle of access to data in the OOP is radically different from the access to data in the database. To access data in OOP, successive transitions from a parent object to the properties of the derived elements and the initialization of the objects as needed are used. This approach is not considered an efficient way to extract data from the relational databases. As a rule, the number of requests to the database should be minimized, the necessary entities should be loaded as soon as possible using JOINS.

**Principle of ORM Operation.** A key feature of ORM is the mapping that is used to bind an object to its data in the database. ORM creates a «virtual» database schema in the memory and allows you to manipulate data already at the object level. The display shows how the object and its properties are associated with one or more tables and their fields in the database. ORM uses the information of this mapping to control the process of data conversion between the database and the object forms, and also to Create SQL queries to insert, update, and delete data in response to the changes that the application makes to these objects.

**Advantages and Disadvantages of Use.** Using ORM in the project eliminates the need for the developer to work with SQL and writing a lot

of codes, often monotonous and error-prone. The entire generated ORM code is supposedly well tested and optimized, so you do not need to think about testing it. This is clearly a plus, but at the same time, one should not forget about the minuses. The main one is the loss of productivity. This is because most ORMs are designed to handle a wide range of data usage scenarios, much more than any single application will ever be able to use. The question of the appropriateness of using ORM by and large is addressed only in large projects that face a high load; at this point one has to choose, what is more important – convenience or productivity? Of course, working with databases using a well-written SQL-code will be much more effective, but do not forget about such a parameter as time – something that is easily written using ORM for a week, can be achieved by you with your own efforts for much longer than a month. In addition, most modern ORMs allow a programmer, if necessary, to set the code of SQL-queries. For small projects, the use of ORM is more justified than the development of your own libraries for working with databases [26].

## **5.10. Distributed Databases**

### **5.10.1. The Concept and the Architecture of a Distributed Database**

*Distributed database (DDB)* is a set of logically connected separated data and their descriptions, which are physically distributed over several computers (nodes) in some computer network. Each table in the DDB can be divided into a number of parts, called *fragments*.

In order to improve the availability of data and improve system performance for individual fragments, replication can be organized which is in fact a support an up-to-date copy of a fragment on several different nodes. *Replicators* are many different physical copies of a database object for which synchronization with some main copy is supported in accordance with the rules defined in the database.

There are several alternative strategies for data placement in the system: *separate (fragmented) placement, full replication placement, and selective replication placement*.

*Separate (Fragmented) Placement.* In this case, the database is divided into disjoint fragments, each of which is located on one of the nodes of the system. In the absence of replication the cost of data storage will be minimal, but the level of reliability and availability of data in the system

will also be low. Failure on any of the nodes will cause the loss of access only to that part of the data that were stored on it.

*Full Replication Placement.* This strategy involves placing a complete copy of the entire database on each of the nodes of the system. Consequently, the reliability and availability of data, as well as the level of the system performance will be maximized. However, the cost of data storage and the level of costs for data transmission will be the highest in this case.

*Selective Replication Placement.* This strategy provides a combination of the methods of fragmentation, replication, and centralization. Some data sets are divided into fragments, while others are replicated. All other data are stored centrally. The purpose of this method is to combine all the advantages that exist in the existing models, with the simultaneous exception of inherent disadvantages. Because of its flexibility, it is this strategy that is used more often.

### **5.10.2. Distributed DBMS**

Distributed DBMS allow the work with DDB. Distributed DBMS (DDBMS) is a set of programs designed for management of the distributed database and allowing making the information distribution «transparent» for the end user. RDBMS definitions suggest that the end user should completely hide the fact that the distributed database consists of several fragments that can be hosted by several computers located on the network and that multiple users can access it concurrently. The purpose of ensuring «transparency» is that the distributed system behaves outwardly in the same way as the centralized one. This distribution of data allows, for example, storing the network the data in the node that is most often used in this node. This approach facilitates and accelerates the work with these data and leaves the opportunity to work with the rest of the database, although to access them it requires some time to transfer the data over the network.

The main task of DDBMS is to provide means for integrating local databases located in some nodes of a computer network so that a user working at any node of the network has access to all these databases as a single database. In other words, for client applications, the DDB is not provided by a set of databases, but by a single entity. Each fragment of the database is stored on one or several computers that are connected by communication lines and each of them works under the control of a separate DBMS.



Users interact with the DDB through applications. Applications can be classified as those that do not require access to data on other nodes (local applications), and those that require such access (global applications).

### **5.10.3. Homogeneous and Heterogeneous Distributed Databases**

DDB can be classified as homogeneous and heterogeneous.

*A homogeneous DDB* is managed by the same type of DBMS. *Heterogeneous DDBs* are managed by different types of DBMS, using different data models – relational, network, hierarchical or object-oriented DBMS.

Homogeneous RABBS are much easier to design and maintain. In addition, this approach allows for a step-by-step increase of the size of the DDB, sequentially adding new nodes to the already existing DDB. Heterogeneous DDBs usually arise when independent nodes are managed by their own DBMS and are integrated into the newly created DDBMS.

## 6. DATA ANALYSIS. DATA MANAGEMENT

### 6.1. Basics of Data Analysis. Methods of Collection, Classification and Forecasting

**Data Analysis** is a field of mathematics and computer science that deals with the construction and research of the most common mathematical methods and computational algorithms for extracting knowledge from data; the process of researching, filtering, transforming and modeling data in order to extract useful information and make decisions.

Data are human-readable facts, events, messages, measured characteristics, recorded signals.

The specificity of the data is that, on the one hand, it exists independently of the observer, and on the other – it becomes «data» only when there is a subject purposefully collecting it. As a result: the data should be the basis on which all conclusions, and decisions are built. It is secondary to the purpose of the study and the domain, but is primary in relation to the methods of processing and analysis extracting from the data only such information that is potentially available within the selected material. The data are obtained as a result of measurements.

There are 4 types of measurement scales:

- 1) *Scale of Names*. This scale is used only for classification. Each class of data is assigned its own designation so that the designations of different classes do not match. For example, the classification of people by sex M and F or the category yes / no.
- 2) *Ordinal Scale*. This scale allows not only to break the data into classes, but also to order the classes themselves. Each class is assigned different notations so that the order of the notations corresponds to the order of the classes. If the classes are numbered, then the classes are in numerical order; if we denote classes by means of letters, then the classes are in alphabetical order. *For example, it is necessary to identify individuals in three socio-economic categories – low, medium, high: 1 – low, 2 – medium, 3 – high; or X – low, Y – medium, Z – high.* Any of the designations of numbers or letters can be used.
- 3) *Interval Scale*. This scale allows not only to classify and organize data, but also to quantify the difference between classes. To perform such comparisons, it is necessary to enter a unit of measurement and an arbitrary reference point (zero point). For example, the temperature

in degrees by Fahrenheit  $F^{\circ}$  belongs to the interval scale, where 0 F is the unit of measurement  $^{\circ}$  with the beginning, 1.

- 4) *Relations Scale*. This scale differs from the interval scale only in that the absolute origin is given in it. That is, in this scale, you can determine how many times one dimension exceeds the other. For example: a person's height in inches belongs to a relationship scale in which 0 inches is a fixed origin, and 1 inch is a unit of measure [28].

Data analysis is the science studying the baseline data in order to draw conclusions about this information. Data analysis is used in many industries, services to enable companies and organizations to make better business decisions and in science to confirm or disprove existing models or theories.

Data analysis differs from data mining in the scope of application, purpose and focus of the analysis. Intelligent data analysis operates with huge data sets, using sophisticated software to identify hidden templates and establishing implicit links. Data analysis focuses on inferences, the process of obtaining conclusions based solely on what is already known to the researcher.

Data analysis, as a rule, is divided into:

- 1) Search Data Analysis (SDA), search for opportunities in the data;
- 2) Confirmatory Data Analysis (CDA), to confirm or disprove hypotheses;
- 3) Qualitative Data Analysis (QDA) is used in social sciences to draw conclusions from non-numeric data, such as words, photos or videos.
- 4) Big Data Analysis in most cases uses the same methods and methods that for analysis of conventional data, the difference begins in technologies, mechanisms of parallelization.
- 5) Data Insight (Understanding of Data) – in this study the emphasis is not on mathematical data processing, but on expert evaluation (allocation of links, impact assessment).

### ***General Characteristics of Data Collection Methods***

Methods of data collection can be classified into two groups: quantitative and qualitative.

*Quantitative research* is usually identified with conducting various surveys based on the use of the structured closed-type questions, which a large number of respondents answer. The characteristic features of such studies are: a clearly defined format of the data collected and the sources of their receipt, processing of the collected data is carried out using ordered procedures, mostly quantitative in nature. Data processing is performed using statistical procedures [28].

*The basic statistical methods* can be conditionally divided into 6 groups:

- 1) Statistical Observation, which can be continuous or selective. Continuous observation is usually limited to specific frameworks and is used very rarely;
- 2) Summary and Grouping of Primary Data;
- 3) Descriptive Analysis. It is based on the use of measures such as mean, standard deviation, dispersion and other indicators of the central trend and variation;
- 4) Inference Analysis, which is based on testing of statistical hypotheses in order to generalize the results obtained. It is used, for example, to compare the results of the study of two groups (or market segments), as well as to determine the differences between them;
- 5) Link Analysis is aimed at determining the relationship between two or more variables. Here, methods of dispersion, correlation-regression, and multivariate analysis are used;
- 6) Predictive Analysis.

*Qualitative research* includes collection, analysis, and interpretation of data. Observations and conclusions are of quality character and are implemented in a non-standardized form. The conducted studies do not have data that can be investigated quantitatively. The first qualitative methods were used in the XVIII century. Qualitative data can be translated into quantitative form, but this is preceded by special procedures. There are the following methods of qualitative research: observation, focus groups, in-depth interviews, protocol analysis, projection, physiological measurements [28].

## **6.2. Decision Trees**

The rapid development of information technologies, in particular, the progress in the methods of data collection, storage, and processing allowed many organizations collect huge amounts of data that need to be analyzed. The volumes of these data are so large that the capabilities of experts are no longer sufficient, which has led to a demand for methods of automatic data analysis, which is constantly increasing every year.

Decision trees are one such method for automatic data analysis. The first ideas for creating decision trees go back to the works of Hoveland and Hunt in the late 50s of the 20th century.

However, the fundamental work, which gave impetus to the development of this direction, was the book of Hunt E.B., Marin J. and Stone P.J. «Experiments in Induction» 1966.

Decision trees are a way of presenting rules in a hierarchical, consistent structure, where each object corresponds to the only node giving the solution. A rule is understood as a logical construction, represented as «if ... then ...».

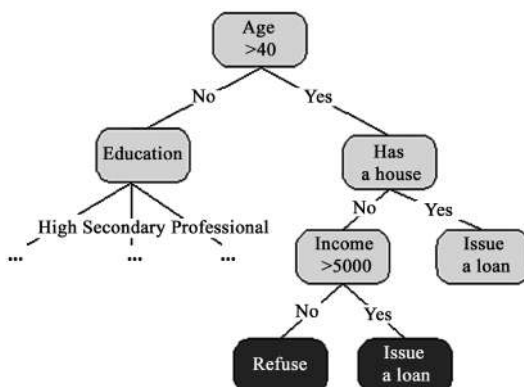


Figure 6.1 Decision Tree «Issue a loan?»

The area of application of the decision trees is now wide, but all tasks solved by this device can be combined into the following three classes:

- 1) **Description of the Data.** Decision trees allow you to store information about data in a compact form, instead of them you can store a decision tree that contains an exact description of objects.
- 2) **Classification.** The decision trees perfectly cope with the tasks of classification, that is, assigning the objects to one of the previously known classes. The target variable must have discrete values.
- 3) **Regression.** If the target variable has continuous values, decision trees allow you to determine the dependence of the target variable on the independent (input) variables. For example, this class includes problems of numerical prediction (prediction of the values of the target variable).

### Example of Constructing a Tree

A certain training set  $T$  containing objects (examples), each of which is characterized by  $m$  attributes (attributes), one of which indicates the belonging of the object to a certain class. The idea of constructing decision trees from the set  $T$ , first expressed by Hunt, is given by R.Quinlan.

Let  $\{C_1, C_2, \dots, C_k\}$  denote classes (class label values), then there are 3 situations:

- 1) The set  $T$  contains one or more examples belonging to the same class  $C_k$ . Then the decision tree for  $T$  is a sheet defined by dividing the class  $C_k$ ;
- 2) The set  $T$  does not contain any examples, that is, an empty set. Then this is again a sheet, and the class associated with the sheet is selected from another set different from  $T$ , let say, from the set associated with the parent;
- 3) The set  $T$  contains examples related to different classes. In this case it is necessary to partition the set  $T$  into certain subsets. For this, one of the characteristics having two or more different values  $O_1, O_2, \dots, O_n$  is selected.  $T$  is divided into subsets  $T_1, T_2, \dots, T_n$ , where each subset  $T_i$  contains all examples having the value  $O_i$  for the selected characteristic. This procedure will be recursively continued until the finite set consists of examples related to the same class.

The above procedure underlies many modern algorithms for constructing decision trees, this method is also known under the name of division and conquest (to divide and to conquer). It is obvious that using this technique, the decision tree will be built from top to bottom. Since all objects were previously assigned to known classes, such a process of building a decision tree is called supervised learning. The learning process is also called inductive learning or tree induction.

To date, there are a significant number of algorithms that implement decision trees: ID3 algorithm, where the choice of attribute occurs on the basis of information growth, or on the basis of the Gini index; algorithm C4.5 (improved version of ID3), where the choice of the attribute occurs on the basis of a normalized increase in information; the CART algorithm and its modifications – IndCART, DB-CART; MARS: Expands decision trees to improve the processing of digital data.

*Advantages of using decision trees:*

- 1) Fast learning process;
- 2) Generation of rules in areas where it is difficult for an expert to formalize his knowledge;
- 3) Extraction of rules in natural language;
- 4) An intuitively clear classification model;
- 5) High accuracy of the forecast, comparable with other methods (statistics, neural networks);
- 6) Construction of nonparametric models.

Due to these and many other reasons, the methodology of the decision trees is an important tool in the work of each specialist, engaged in the analysis of the data, regardless of whether he is a practitioner or a theoretician [29].

#### *Decision Tree Applications*

Decision trees are an excellent tool in systems supporting decision making, intellectual data analysis (data mining). Many packages designed for data mining already include methods for building decision trees.

Decision trees are successfully applied to solve practical problems in the following areas:

- 1) **Banking**. Assessment of the creditworthiness of the bank's customers when granting loans.
- 2) **Industry**. Control over the quality of products (detection of defects), tests without destruction (for example, quality control of welding) and so on.
- 3) **Medicine**. Diagnosis of various diseases.
- 4) **Molecular Biology**. Analysis of the structure of amino acids.

This is not a complete list of areas where you can use decision trees.

### **6.3. Intellectual Data Analysis (Data Mining)**

Data mining is a special method of data analysis that focuses on modeling and discovery of data, not on their description.

With the help of the intellectual data analysis, new, correct, and potentially useful knowledge is determined based on large data sets. Extracted knowledge as a result of intellectual analysis is called pattern.

Large amounts of accumulated data constantly have to be modified because of the rapid change of hardware and software databases, while loss and distortion of information are inevitable. One of the means to overcome such difficulties is the creation of data warehouses, access to which will not depend heavily on changes in data over time and on the software used. Another approach is focused on compression of large amounts of data by finding some general patterns (knowledge) in the accumulated information. Both directions are relevant from a practical point of view.

The availability of an information repository is a prerequisite for the successful implementation of the entire Data Mining process. Information storage is called a subject-oriented, integrated, time-bound, unalterable collection of data used to support the process of making managerial

decisions. Object orientation means that data are grouped into categories and is stored in accordance with the areas they describe, rather than according to the applications that use them. This storage principle ensures that the reports generated by different analysts will be based on the same set of data. Attachment to time means that the repository can be viewed as a collection of historical data, that is, the specific values of the data are uniquely related to certain points in time. The data stored in the repository does not change anymore, unlike the operational systems where there are only the latest, constantly changing versions of the data [30].

In DM technologies, various mathematical methods and algorithms are used: classification, clustering, regression, time series prediction, association, consistency.

*Classification* is a tool of generalization. It allows us to pass from the consideration of single objects to generalized concepts that characterize some sets of objects and are sufficient to recognize objects belonging to these sets (classes). The essence of the process of formulating concepts is to find the regularities inherent in classes. a lot of different attributes (attributes) are used for description of the objects.

*Clustering* is the distribution of information (records) from the database to groups (clusters) or segments with the simultaneous definition of these groups. In contrast to the classification, there is no need to pre-define classes for analysis here.

*Regression Analysis* is used in this way, if the relationship between the attributes of the objects in the database is expressed by quantitative assessments. The constructed regression equations allow you to calculate the values of the dependent attributes by the given values of the independent signs.

*Time Series Forecasting* is a tool for determining trends in the attributes of the objects under consideration over time. Analysis of the behavior of the time series allows you to predict the values of the characteristics studied.

*Association* allows us to identify stable groups of objects, between which there are implicitly given links. The frequency of the appearance of an individual object or a group of objects, expressed as a percentage, is called prevalence. A low prevalence level (less than one thousandth of a percent) indicates that such an association is not significant.

*Sequence* is a method of identifying associations over time. In this case, the rules that describe the successive appearance of certain groups of events are identified. Such rules are necessary for the construction of scenarios.



## ***DM Scope***

***Banking.*** Achievements of DM-Data Mining technology – are used in banking to solve the following common tasks:

*Identify Fraud with Credit Cards.* By analyzing past transactions, which later turned out to be fraudulent, the bank reveals some of the stereotypes of such fraud.

*Customer Segmentation.* By breaking customers into different categories, banks make their marketing policy more focused and effective, offering different types of services in different ways to different groups of customers.

*Forecasting Changes in the Clientele.* DM helps banks to build predictive models of the value of their customers, and to serve each category accordingly.

***Business.*** DM can be used in the following areas:

*Market Segmentation.* All industries can take advantage of the DM methods to identify specific segments of their clientele. DM gives enterprises a possibility to take into account many more parameters than it has been done on the basis of the traditional methods of storing the unstructured information.

*Development of the Automotive Industry.* When assembling cars, manufacturers must take into account the requirements of each individual client, so they need the ability to predict the popularity of certain characteristics and gain the knowledge of what characteristics are usually ordered together.

*Guarantee Policy.* Manufacturers need to predict the number of customers who will file warranty claims, and the average cost of applications.

*Encouraging Frequent Flyers.* Airlines can find a group of customers who can be encouraged to fly more with these incentive measures.

***Medicine.*** There are many expert systems for setting medical diagnoses. They are built mainly on the basis of the rules that describe a combination of various symptoms of various diseases. With the help of such rules they learn not only that the patient is sick, but also how to treat him. The rules help to choose means of medical treatment, to define indications - contraindications, to be guided in medical procedures, to create conditions for the most effective treatment, to predict the outcomes of a prescribed course of treatment. DM technology allows you to detect the templates in the medical data that form the basis of these rules.

***Molecular and Genetic Engineering.*** The problem of detecting regularities in experimental data in molecular genetics and genetic

engineering is the most acute. It is formulated as the identification of the so-called markers, which are the genetic codes controlling these or other phenotypic signs of a living organism. Such codes can contain hundreds, thousands or more related items.

Large funds are allocated for the development of genetic research. Recently, the application of the DM methods in this area has become of a particular interest. There are several large firms that specialize in applying these methods to decipher the genome of humans and plants.

**Retail.** Today retailers collect detailed information about each individual purchase, using credit cards with a store brand and computerized control systems. Below are the typical problems that can be solved using DM in the retail industry:

*Analysis of the Shopping Basket* (similarity analysis). Designed to identify the goods that buyers are trying to acquire together. Knowledge of the shopping basket is necessary to improve advertising, develop a strategy for creating stocks of goods and methods of their layout in the trading rooms.

*Study of Temporary Patterns.* It helps the trade enterprises make decisions about creating inventories. It gives answers to such questions as «If today the buyer has purchased a video camera, in what time is he likely to buy new batteries and film?»

*Creation of Predictive Models.* It enables traders to learn the nature of the needs of different categories of customers with a certain behavior, for example, buying goods of famous designers or attending sales. This knowledge is needed to develop precisely targeted, cost-effective promotion of goods.

*Insurance.* Insurance companies accumulate large amounts of data over a number of years. Insurance is an extensive field of activity for DM methods:

*Identifying Fraud.* Insurance companies can reduce the level of fraud by looking for certain stereotypes in claims for insurance compensation that characterize the relationship between lawyers, doctors and applicants.

*Risk Analysis.* By identifying combinations of factors associated with the paid insurance cases, insurers can reduce their loss on liabilities.

*Telecommunications.* In the field of telecommunications, the DM methods help companies to more vigorously promote their marketing and pricing programs to keep existing customers and to attract new ones. Among the typical events we note the following:

*Analysis of Records of Detailed Characteristics of Calls.* The purpose of such analysis is to identify the categories of clients with similar stereotypes of using their services and to develop attractive sets of prices and services.

*Identifying Customer Loyalty.* Data Mining can be used to determine the characteristics of customers who once using the services of this company will most likely remain loyal to it. As a result, funds allocated for marketing, could be spent where the return is most.

### ***Examples of Using DM***

***The People's Bank of Kazakhstan*** uses the technology of Data Mining in methodology of forming a credit policy and as an advertising management tool.

***Kaspi Bank***, in its desire to offer really useful financial products and services for people, have been actively using the software of SAS in the last seven years. It allows collecting and analyzing large data (Big Data) and based on these results, to predict the behavior of customers. This knowledge helps to create simple, convenient and profitable products

***Subsidiary Banks of Sberbank of Russia in the Republic of Kazakhstan.*** Using this method, reveals what factors affect the creditworthiness of a person. The «decision tree» is one of the Automatic data analysis.

***LLP KazInTech Corporation*** provides a full range of services based on Data Mining technology. The company's customers are LLP "KazRosCement"; LLP «Agency» Central Asian Consultants»; LLP "Capital Investment LLC"; JSC DB «RBS (Kazakhstan)» (JSC «DAB» ABN AMRO Bank Kazakhstan»); LLP «Zhas Tau - Astana» (trademark «Water Crystal») and other organizations. Among the state bodies are the Committee for Judicial Administration under the Supreme Court of the Republic of Kazakhstan and JSC «National Holding «KazAgro».

## 7. NETWORKS AND TELECOMMUNICATION

Currently, personal computers in the offline mode are practically not used, they are usually combined into computer or computer networks.

A **computer network** is a set of computers and telecommunications equipment that provides information exchange of computers in a network. The main purpose of computer networks is to provide access to distributed resources.

**Telecommunications** (Greek tele – far, far and latin communicatio – communication) is the transmission and reception of any information (sound, image, data, text) on distance over various electromagnetic systems (cable and fiber channels, radio channels and other wired and wireless communication channels).

A **telecommunications network** is a system of technical means through which telecommunications are carried out.

Telecommunications networks include:

- 1) Computer networks (for data transmission).
- 2) Telephone networks (transmission of voice information).
- 3) Radio networks (transmission of voice information – broadcast services).
- 4) Television networks (voice and image transmission – broadcast services).

### 7.1. Computer Networks

Depending on the distance the computers connected in a network are located from each other; they are distinguished between local, regional, and global computer networks. While the *local* area network (LAN) usually combines computers located in one or the neighboring rooms within one or neighboring buildings at distances not exceeding one-two kilometers, and the *regional* one connects subscribers located at a considerable distance from each other within a city, a district or a region, the *global* network is a network in which computers are located in different countries or on different continents of the globe (an example is the Internet) [31].

In turn, information and computer networks can be divided into a number of types, depending on their purpose:

- 1) Public data networks providing users with basic services (access to message boards, a variety of reference services (city information service, Aeroflot and railways reference, various municipal services),

e-mail, file transfer, teleconferences, and the ability to access other networks);

- 2) Information centers of wide use, containing various databases, access to which is possible on a commercial basis;
- 3) Regional data networks (at a regional level) that are subnets of the public network, but are intended for the exchange of regional information, the volume of which reaches 70% of the total volume of information circulating in the regional network;
- 4) Restricted access information systems, for example, banking (oriented to customer service, credit cards and other), stock exchange, other similar systems;
- 5) Private networks, for example, a telecommunication system of a large bank, intended for the intra-bank information exchange between the central office of the bank and its branches within the same city, and also between the central office and the branches of the bank in other cities, regions or even other countries.

The networks of the last three types are so-called corporate networks, in which services are provided only to users who are part of a closed group (corporation).

## 7.2. Interaction of Computers in a Network

Computing networks can be divided into two groups – centralized and peer-to-peer depending on the ways of interaction of computers in them.

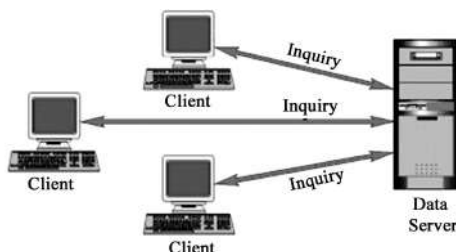


Figure 7.1. «Client-Server» Architecture

*Centralized networks* are built on the basis of a client-server architecture, which involves the allocation of the so-called «servers» and «clients» in the network. The clients are workstations (computers) of the network that do not have direct contacts with each other and can communicate only through

the server: consequently, one station cannot use a file located on another station unless the file is located on the file server. All local resources of workstations remain local and, therefore, cannot be used by any other workstation (see Figure 7.1).

Servers manage the shared network resources connected to them. There are the following types of servers:

- 1) File servers that are used to manage the file transfer, they allow sending large amounts of information (not necessarily textual, but also graphical);
- 2) Print servers (or print servers) are used to include a printer in a network that is accessible to users from all workstations of the network;
- 3) Communication (communication) servers are designed to manage and to establish communication between computers in a network;
- 4) Mail servers in the e-mail systems, are used for sending and receiving emails;
- 5) Archive servers are designed for archiving data and backup of information in large multi-server networks;
- 6) Fax servers are used for sending users fax messages from workstations, for receiving and further sending messages to users' personal boxes and other.

Either a normal personal computer or a specialized device that exercises one of the mentioned specified management functions can be used as a server. In this latter case, a specialized server may differ in its appearance from a conventional personal computer and, depending on the purpose, have different dimensions, as a rule, it does not include a monitor or a keyboard in its structure.

From the user's point of view, the client-server architecture provides them with a quick and easy access from the local workstation to information and functions contained somewhere on the network. Among other advantages that are important for the user, is the increase of productivity, the ability to freely select the necessary software, the ease of use of tools.

*Peer-to-peer LANs* are based on a peer-to-peer model of computer interaction. In such a network, each computer can act either as a station or as a server that provides access to other colleagues to their resources depending on the circumstances and the way they are used: drives on hard or floppy disks, a printer, a modem and other devices. In a peer-to-peer network, workstations can directly communicate with each other (as opposed to a centralized network structure) and share resources (files, printers, drives, etc.) that are defined as shared on this particular computer.

Networks of this type are inexpensive because they do not require the purchase of an expensive dedicated server, they are easy to operate and can be recommended for small groups of users who do not require large computing resources [31].

To connect computers electric – in the form of a «twisted pair» (two twisted shielded wires), or coaxial (similar to the cable of a television antenna), wires (Figure 7.2) and fiber optic cables are used.



*Figure 7.2. Network Cable: a) Twisted Pair b) Coaxial*

Fiber-optic cable is a glass or plastic thread used to transfer light within itself through total internal reflection. The structure of the fiber optic cable is very simple and is similar to the structure of a coaxial electrical cable, but instead of a central copper wire, a thin glass fiber (about 1-10 microns in diameter) is used, and instead of an internal insulation there is a glass or plastic sheath that does not allow the light to go beyond the glass fiber (Fig. 7.3).

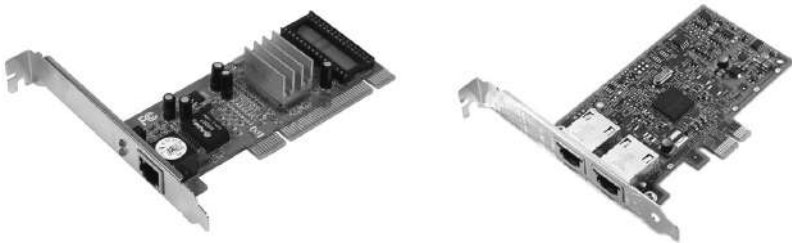


*Figure 7.3. Fiber Optic Cable*

Fiber-optic cable has significant advantages over the others:

- 1) A small attenuation of the light signal in the fiber. With an allowable attenuation of 20 dB, the maximum distance between amplifiers or repeaters is about 100 km or more.
- 2) A low level of noise in the fiber optic cable allows to increase the bandwidth by transmitting of signals using different modulation without protection and to control the correctness of the received information only in end terminals.
- 3) Protection from electromagnetic interference.
- 4) Light weight and volume. Fiber-optic cables have less weight and volume compared to copper cables of the same bandwidth.
- 5) High security against unauthorized access. Since the fiber optic cable does not practically radiate in the radio range, the information, transmitted over it, is difficult to overhear without violating reception / transmission.
- 6) Cheapness of fiber-optic cable. The fiber is made of quartz, which is based on silica, a widely distributed and therefore inexpensive, material unlike copper. It has a long service life. The fiber optic cable lasts about 25 years.

To connect a computer to a network, you need a so-called network adapter, which is inserted into the main (motherboard) card slot of the computer. The adapter has one or two connectors for connecting to the cable (Figure 7.4).

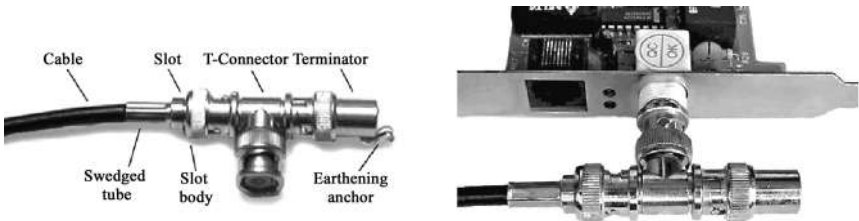


*Figure 7.4. AC Adapter*

In other cases, building a network does not require the use of special adapters – a network cable that connects computers, is connected directly to the serial port (similar networks, however, are only used in the simplest cases, for example, when a printer is shared by several computers and are characterized by low performance).



In addition, special connectors, tee-splitters and terminators (terminating matching resistors), as well as possibly repeaters (for amplification and signal generation, if the connection length is too large) are needed (Fig. 7.5, 7.6).

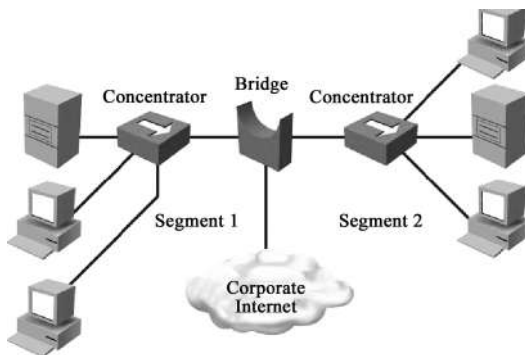


*Figure 7.5. Special Connectors for Coaxial Cable*



*Figure 7.6. Repeater*

To ensure interworking (see Figure 7.7), there are special devices - bridges, routers, switches and gateways (Figure 7.8).



*Figure 7.7. Example of an Interworking Scheme*

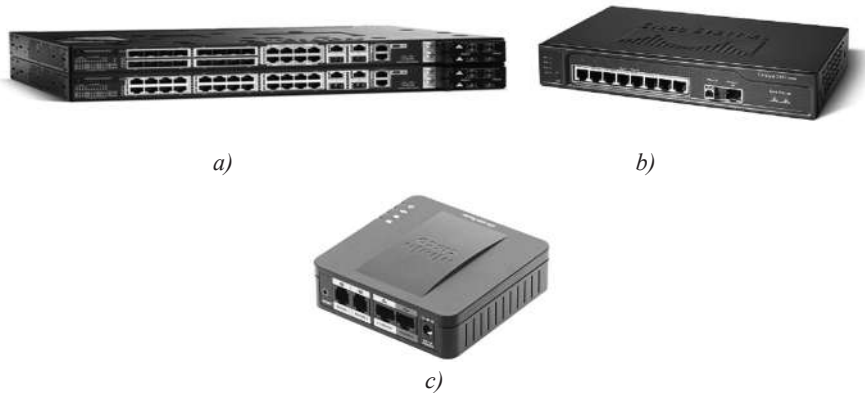


Figure 7.8. Networking Equipment: a) Router; b) Switchboard; c) Gateway

### 7.3. Wired and Wireless Networking Technologies

In the modern world there are practically no electronic devices not connected with each other or the global Internet network. Everything is connected to networks: from usual mobile phones to nuclear reactors and space vehicles. It is possible to link any device in an office or an apartment with a common network. Physically, the network can be wired and wireless.

#### ***Wired Networks***

The modern office wired networks use, as a rule, a twisted pair, and RJ-45 ports. The operation of wired networks is described by IEEE 802.3 standards. To date, two main standards are used:

IEEE 802.3u with a maximum bandwidth of 100 Mbps. Today it is found only in budget laptops, old computers, including network equipment, or in devices where high speed is not needed;

IEEE 802.3ab with the maximum bandwidth of 1000 Mbit/s is by far the most common – gigabit network cards are integrated into the most motherboards, the market has a wide range of network equipment, including inexpensive.

There is also the IEEE 802.3an standard, allowing reaching speeds of 10 Gb/s under certain conditions using a conventional copper twisted pair. The support of this standard can be found in workstations and servers. There are interim solutions - gigabit switches with 2-4 10-gigabit SFP +

connectors, which allows you to connect a server or other network segment via a 10-gigabit interface.

*The main advantage of a wired network is stability and reliability of operation.*

High speed and Stable Operation. Let us consider, for example, a common network configuration with a speed of 1 Gbit/s. This speed is available for each client on the network and is not shared between them, in addition, this is the speed to each side, that is, the total bandwidth can reach 2000 Mbps (IEEE 802.3ab). There is a support for large packages (Jumbo Frame, these are packets of 9kb and 16kb), which allows you to increase the speed when transferring large amounts of data by reducing the transfer of the service information, and also reduce the load on the processor. Another way to increase the network bandwidth is channel aggregation (IEEE 802.3ad), which allows you to get throughput above 1 Gb/s. Finally, the twisted pair effectively works with a wire length of up to 100 m without compromising stability and connection speed. One of the significant advantages of a wired network is security. First of all, physical, as to connect to the network, an attacker needs a physical access to the premises, to the outlet.

#### *Disadvantages of a Wired Network*

*Firstly*, the need to lay cables to each workplace, and in the future – the attachment of the employee to this workplace. The wiring is usually carried out during the repair of the premises, therefore, with any changes in the organization of the office, the network infrastructure will also have to be shifted. *Secondly*, only one device can be connected to one wire, and some devices (smartphones, tablets and so on) cannot be connected to the wired network.

#### **Wireless Networks**

##### **IrDA**

Infrared communication can be considered one of the very first standards of wireless data transmission between computing devices. The prototype of a modern infrared port appeared already in 1979 in the company Hewlett Packard (the capabilities of the standard calculator were extended by the introduction of the device in the transmitter – it allowed sending the results of calculations to the printer). This idea was replaced by manufacturers of household appliances (televisions, music centers and similar ones), which offered users a novelty in the form of remote control (remote control). But in the field of computer technology, the place for this know-how was found only in 1993. It was then that a non-profit organization called Infrared Data Association was set up, which began the work on the standardization of the

method of data transmission (development of a unified world specification). In 1994, a standard was developed on working in infrared frequencies, which was called IrDA.

The standard describes the method of data transfer (Serial Infrared Link – serial infrared link), access methods and their flow management (Link Access Protocol – IrLAP-access protocol and Link Management Protocol – IrLMP-control protocol). In 1995, the standard was recognized by Microsoft, which provided Windows 95 software for the implementation of infrared communication.

At the same time, the largest electronics manufacturers released products equipped with an infrared port to be connected to a computer. According to the transmission principles, the IrDA protocol is similar in many respects to the connection through the COM port, it also provides a speed of 2400 to 115200 bits per second. In 2005, the new IR Simple standard appeared, it is fully compatible with older versions of the protocol and may be embedded in the devices by simply updating the firmware.

The main *advantage of infrared communication* is, of course, the simplicity of the organization of the channel, which determines the cheapness of the method. With the help of IR it is easy to connect mobile devices with stationary ones or with each other. For example, this is often the case that «introduces» cell phones or mobile computers with a fixed periphery. A universal port eliminates the need to carry a data cable.

*The disadvantages of IrDA* are the need for direct visibility: any object that is comparable in size to the window of the infrared port, which falls on the line of «viewing», interrupts transmission; communication is carried out only in the «tet-a-tet» mode, that is, the receiver is capable of «communicating» with only one transmitter at a given instant; the standard does not provide for special encryption, which means that it is better to use additional security measures at the level of information preparation [32].

### **Bluetooth**

Bluetooth is a specification of wireless personal networks. Bluetooth allows information to be exchanged between such devices as handhelds and conventional personal computers, mobile phones, laptops, printers, digital cameras, mice, keyboards, joysticks, headphones, headsets at the universally available radio frequency for near communication. Bluetooth allows these devices to communicate when they are within a radius of 10-100 meters from each other (the range is very much dependent on obstructions and interference), even in different rooms. The technology, despite its prevalence, appeared relatively recently, in 1998, when a number

of well-known high-technologies companies – Ericsson, IBM, Intel, Toshiba and Nokia, organized a specialized research group Special Interest Group (SIG), whose tasks included the development and implementation of a new communication technology in various user devices.

The Bluetooth standard has a fully open specification. This means that any company without additional permissions and certification can incorporate it into their devices. To transmit radio signals, «Bluetooth» uses a frequency interval from the range of 2.402-2.480 GHz. Work on these frequencies does not require licensing, sometimes even called ISM (short for Industry, Science, Medicine), emphasizing that the «band» is left for the needs of industry, science and medicine. For the manufacturer and users, this means that no licenses are required to work with Bluetooth. The creators of the technology even take steps to expand the «preferential» range. Security of the wireless Bluetooth is almost equal to the connection «through the wire.» The fact that the frequencies are «open» does not at all mean the openness of data transmitted via Bluetooth. During operation, the receiver and transmitter in the random mode synchronously change the carrier frequency, which, together with the encryption algorithms, gives the level of secrecy necessary for its class. The main convenience of this standard is that there is no requirement for direct visibility between the devices. It became the base for connecting wireless keyboards, mice and printers to a computer, as well as for various «external connections»: with cellular phones, PDAs or, for example, GPS-receivers. The standard is compatible with the format of conventional network MAC addresses, which allows, for example, creating hybrid networks, some of which are laid by ordinary twisted pair, and the other is based on the use of Bluetooth. Today, this standard expands its capabilities and the scope of applications [32].

One of the advantages of Bluetooth is the possibility of a «conference» between more than two devices (for this purpose, «Multi-user» or «infrastructure» mode of operation), whereas, for example, when using an infrared port, you can connect only two (mode of operation «point» – «point»).

### **Wi-Fi**

Wi-Fi (wireless fidelity) is a set of communication standards for communication in a wireless local area network of 2.4, 3.6 and 5 GHz frequency bands. The Wi-Fi protocol was developed back in 1996. Initially it was intended for building local networks, but gained the most popularity as an effective method of connecting smartphones and other portable devices to the Internet (Figure 7.9).

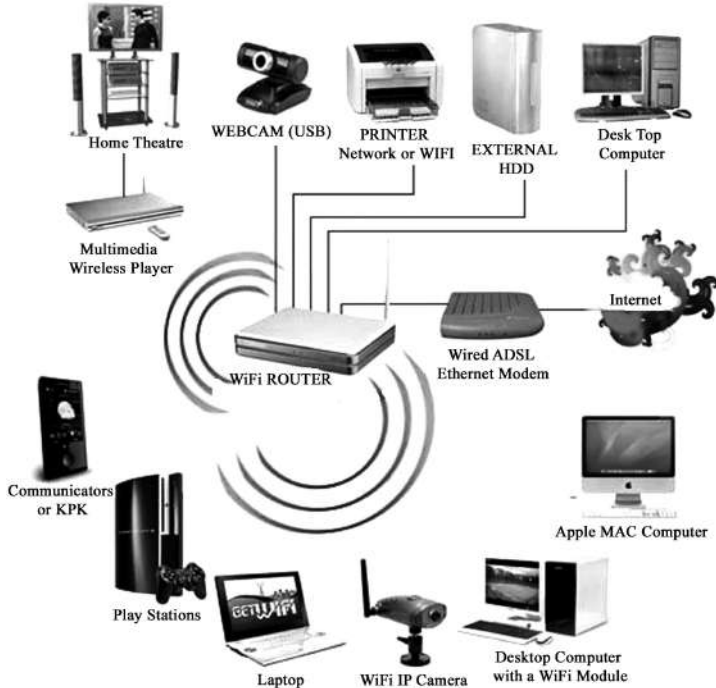


Figure 7.9. Technology Wi-Fi Connecting Various Devices to the Internet

For 20 years, several generations of connections have been developed that become more and speedier and functional each year. They are described by Standards 802.11 issued by the IEEE (Institute of Electrical and Electronics Engineers). The group includes several versions of the protocol, differing in the speed of the data transfer and support for additional functions.

The very first Wi-Fi standard had no letter designation. The devices supporting it exchanged data at a frequency of 2.4 GHz. The information transfer rate was only 1 Mbit/s. Also there were devices supporting speeds of up to 2 Mbps. It was actively used only 3 years, after which it was improved. Each subsequent Wi-Fi standard is designated by a letter after the general number (802.11a / b / g / n and so on).

#### *Wi-Fi Standard IEEE 802.11a*

It is one of the first updates to the Wi-Fi standard released in 1999. Due to doubling the frequency (up to 5 GHz), engineers were able to achieve

theoretical speeds of up to 54 Mbit/s. It was not widely distributed, as it is incompatible with other versions. Devices supporting it must have a dual receive / transmitter to operate in 2.4 GHz networks. Smartphones with Wi-Fi 802.11a are not very common.

#### *Wi-Fi Standard IEEE 802.11b*

It is the second interface update, released in parallel with the version A. The frequency remained the same (2.4 GHz), but the speed was increased to 5.5 or 11 Mbit/s (depending on the device). Until the end of the first decade of the 2000s, it was the most common standard for wireless networks. Compatibility with the older version, as well as a fairly large coverage radius, ensured its popularity. Despite being replaced by the new versions, 802.11b is supported by almost all modern smartphones.

#### *Wi-Fi Standard IEEE 802.11g*

A new generation of Wi-Fi protocol was introduced in 2003. The developers kept the data transmission frequencies the same, so the standard was fully compatible with the previous one (old devices operated at speeds up to 11 Mbps). The speed of information transfer increased to 54 Mbit/s, which was enough until recently. All modern smartphones work with 802.11g.

#### *Standard Wi-Fi IEEE 802.11n*

In 2009, there was a major upgrade of the Wi-Fi standard. New interface version received a significant speed increase (up to 600 Mbit/s), maintaining compatibility with the previous ones. In order to work with 802.11a equipment, as well as to combat the congestion of the 2.4 GHz band, support for 5 GHz frequencies (parallel to 2.4 GHz) was returned. The network configuration capabilities were expanded and the number of simultaneous connections was increased. There was a possibility of multi-threaded MIMO communication (parallel transmission of several data streams at one frequency) and the combination of two channels for communication with one device. The first smartphones supporting this protocol came out in 2010.

#### *Wi-Fi standard IEEE 802.11ac*

In 2014, the new Wi-Fi standard IEEE 802.11ac was approved. It became a logical extension of 802.11n, which provides a tenfold increase in speed. Due to the possibility of combining up to 8 channels (20 MHz each) simultaneously – the theoretical increase was up to 6.93 Gb/s., which is 24 times faster than 802.11n. The frequency 2.4 GHz was decided to be abandoned due to the busy range and the impossibility of combining more than 2 channels. The Wi-Fi standard IEEE 802.11ac operates in the 5 GHz band and is backward compatible with 802.11n devices (2.4 GHz frequency),

but work with earlier versions is not guaranteed. Today, not all smartphones support it.

### *Other standards*

There are versions of IEEE 802.11, marked with different letters. But they either make minor amendments and additions to the above standards, or add specific functions (like interoperability with other radio networks or security). It is worthwhile to highlight Standard 802.11y, which uses a non-standard frequency 3.6 GHz, as well as 802.11ad, designed for a range of 60 GHz. The first is designed to provide a communication range of up to 5 km, due to the use of a clean range. The second one (also known as WiGig) is designed to provide maximum (up to 7 Gb/s) communication speeds at very small distances (within the room).

All modern smartphones are equipped with a Wi-Fi module designed to work with several versions of 802.11. As a rule, all mutually compatible standards are supported: b, g and n. but the work with the latter can often be realized only at a frequency of 2.4 GHz. The devices, that are capable of operating in 802.11n 5 GHz networks, also feature the support for 802.11a as backward compatible.

The increase in frequency promotes an increase in the speed of data exchange. But, at the same time, the wavelength decreases, it is more difficult for it to pass through obstacles. Because of this, the theoretical communication range of 2.4 GHz will be higher than that of 5 GHz. However, in practice the situation is slightly different. The frequency of 2.4 GHz was free, so household electronics use it. In addition to Wi-Fi, Bluetooth-devices, transceivers of wireless keyboards and mice work in this range, and magnetrons of microwave ovens emit in it as well. Therefore, in places where several Wi-Fi networks function, the amount of interference levels the advantage of range. The signal will be caught in a distance of a hundred meters, but the speed will be minimal, and the loss of data packets is large.

The 5 GHz band is wider (from 5,170 to 5,905 MHz), and is less loaded. Therefore, the waves overcome obstacles worse (wall, furniture, human body), but in the conditions of direct visibility provide a more stable connection.

Based on this, smartphones supporting IEEE 802.11ac in the 5 GHz band are preferable for smartphones. They provide high speed transmission, signal quality is sufficient to cover the apartment, and the network is less susceptible to interference. Given that all smartphones with 802.11ac support work with earlier versions of the standard, in case of interference



the device will automatically connect to any access point. However, it should be remembered that in order to achieve the maximum speed, a router (router) operating with the same standard is also needed. Much depends on the router and its type of antenna. Antennas of adaptive type are located so that they determine the location of the smartphone and feed it with a directed signal that extends farther than other types of antennas.

### **GSM and GPRS**

The development of the GSM standard began in 1982 by the CEPT (European Conference of Postal and Telecommunications Administrations). In 1991, the first GSM network was put into operation in Finland. By the end of 1993, the number of subscribers using this standard exceeded one million. By this time, GSM networks were deployed in 73 countries around the world.

The networks of the GSM standard allow providing a wide range of services:

- 1) Voice connections
- 2) Data transmission services (up to 384 kbit / s due to EDGE technology)
- 3) Transmission of short text messages (SMS)
- 4) Transmission of faxes
- 5) Voicemail
- 6) Conference call and much more.

Thanks to this, GSM has gained a strong position in the cellular communications market. Moreover, we can say with certainty that this standard will be the leading one for the next few years.

Let's consider the basic elements that make up the GSM system (Figure 7.10).

The GSM network is divided into 2 systems. Each of these systems includes a number of functional devices, which in turn are components of a mobile radio network.

These systems are:

- 1) Switching System – Network Switching System (NSS)
- 2) Base Station System (BSS)

The NSS performs call and connection management functions, and is responsible for the implementation of all services assigned to the subscriber. NSS includes the following functional devices:

- 1) Mobile Switching Center (MSC)
- 2) Home Location Register (HLR)
- 3) Visitor Location Register (VLR)
- 4) Authentication Center (AUC)
- 5) User Equipment Identification Register (EIR).

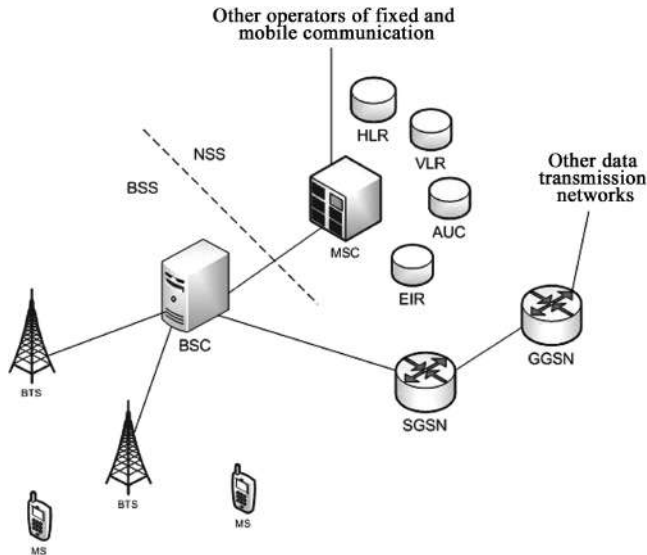


Figure 7.10. Structure of GSM Cellular Communication System

The BSS system is responsible for all functions related to the air interface. This system includes the following functional units:

- 1) Base Station Controller (BSC)
- 2) Base Transceiver Station (BTS)

MS (subscriber's phone) does not belong to any of these systems, but is considered as an element of the network.

Now consider the listed elements in more details:

### **The Structure of the NSS Switching System**

#### *Mobile Switching Center (MSC)*

The MSC is the main element of the GSM system, it monitors the BTS and BSC located in its service area. The main function of MSC is to establish a connection between subscribers of the network. It also provides an access to other communication networks: a fixed telephone network, long-distance communication networks, and other cellular networks.

#### *Home Location Register (HLR)*

HLR contains information about subscribers who are assigned to this MSC. It stores information about the services connected, its status (on, off, active connection), the location of the subscriber and some other information. Information about each subscriber is stored only in one HLR.

### *Visitor Location Register (VLR)*

The VLR stores information about active subscribers that are in the service area of this MSC. It includes data about home subscribers assigned to this MSC and about the so-called roamers – subscribers for whom this MSC is a guest. It can be subscribers of other communication operators, or the subscribers of the same operator, but from other regions. In VLR, information comes from the HLR.

### *Authentication Center (AUC)*

AUC is intended for subscriber authentication. This procedure is designed to prevent an unauthorized access to the network. Every time a subscriber turns on his phone, makes a voice call, sends SMS and the like, the network offers to pass the authentication procedure. It is carried out by the MSC on the basis of the data obtained from the AUC and from the MS.

### *User Equipment Identification Register (EIR)*

EIR is a database containing information about identification numbers of GSM mobile phones. This information is necessary for blocking stolen tubes. EIR is not a mandatory element of the network. In the world there are only several operators which implemented it in their network.

## **Composition of the BSS Base Station System**

### *Base Station Controller (BSC)*

BSC manages all functions related to an operation of radio channels on the GSM network. This is a high-capacity switch that provides such functions as MS handover, radio channel assignment and collection cell configuration data. Each MSC can manage multiple BSCs.

### *Base Transceiver Station (BTS)*

BTS controls the air interface with the MS. BTS includes such radio equipment as transceivers (transceivers) and antennas, which are necessary for servicing each cell in the network.

## **Elements of the Network Relating To Packet Data Transmission**

### *Subscriber service node GPRS (SGSN)*

Packet data, unlike voice traffic, is transmitted from the base station subsystem not to the MSC side, but to the SGSN side. This element is a router with expanded functions. It is responsible for establishing a packet data session, packet routing, charging for the rendered services.

### *Gateway Node GPRS (GGSN)*

GGSN is a network gateway. If the packets are routed outside the operator's network, then they fall into GGSN. This element is often structurally combined together with SGSN in one device [32].

## 7.4. Network Operating Systems

Network operating systems (OS) are to organize the work of the computer network. The network operating system forms the basis of any computer network. Every computer on the network is largely autonomous, so the network operating system, in a broad sense, is a system of individual computers interacting with the purpose of exchanging messages and sharing resources under the uniform rules - protocols. When choosing a network OS, several factors are taken into account: the requirements for network performance, reliability and the degree of its information security, the required memory resources; functional power; ease of operation, an ability to integrate with other networks; price.

### *Operating Systems of Network Devices*

A network operating system can be built into a router or a hardware firewall that works with functions of the network layer. The examples are:

- 1) JUNOS is used in routers and switches of Juniper Networks.
- 2) Cisco IOS (formerly Cisco Internetwork Operating System) for Cisco products.
- 3) RouterOS – software that turns a computer or MikroTik equipment into a dedicated router.
- 4) Extensible Operating System is used by Arista Networks switches and others.

Open network operating systems are:

- 1) Cumulus Linux from Cumulus Networks is a distribution that uses the full TCP / IP stack from Linux.
- 2) Dell Networking Operating System, or DNOS - the new name of the system for Dell Networking switches. It is based on NetBSD and others.

### *Network OS for Computer Networks*

The OS features support:

- Network Equipment;
- Network Protocols;
- Routing Protocols;
- Filtering Network Traffic;
- Access to Remote Resources: Printers, Disks Through The Network;
- Network Protocols of Authorization.

Network OS also includes network services that allow remote users to use certain resources of the computer.

Examples of network operating systems:

- Novell Net Ware

- LANtastic
- Microsoft Windows (NT, XP, Vista, 7,8,8.1,10)
- Various UNIX systems
- Various GNU / Linux systems

## **7.5. Telecommunications**

### **7.5.1. Means of Telecommunications**

When creating a global computer network, the question about the choice of means of communication between computers (telecommunications) arose. *First*, it was necessary to choose a method of communication that did not require the laying of new communications, but used existing ones. *Second*, the organization of communication should be simple and open (that is, connecting new subscribers to the network should not be associated with great difficulties). Out of the existing communications facilities there are only two - telephone and telegraph networks, which met these requirements. Subsequently, it became clear that the telegraph network with its relatively low data transfer rate is proved to be unsuitable for similar purposes.

As for telephone lines, they are used as switched or as dedicated (i.e., with a constant connection) communication channels for data transmission in computer networks.

*Switched public channels* are ordinary telephone lines used in the automatic mode of telephone subscribers through automatic telephone exchanges. Commuted channels are used in those cases when the volume of transmitted information is small and there is no special demands to the speed of data delivery.

In cases, when it is necessary to provide high speed and reliability when transmitting large amounts of information, it is necessary to rent (or even buy) separate telephone lines from a telephone network – *dedicated channels* that ensure a computer permanent access to the data network.

Along with telephone channels, fiber-optic communication lines, radio, infrared and satellite channels are also used as telecommunication facilities in regional and global networks [31].

### **7.5.2. Modems: Basic Concepts**

To transmit a digital signal from a computer via a telephone line, a modem is needed, it transfers the digital signal to an analog one, and also

performs the reverse procedure – converts the encoded analog signal to a digital one. The word «modem» is obtained by reducing the two words: Modulator / Demodulator. The modem forms a bridge between a computer digital code and an analog signal that goes to the telephone line.

When transmitting data, a modem receives data coming from a computer (in the form of a sequence of zeros and ones) and divides them into commands and information that must be transferred to a line. Then, the received commands are executed, and the data are converted into an analog signal using the modulator built-in into the modem (this analog signal can be heard through the built-in speaker of the modem as continuous noise). The modem transmits the analog signal to the line in two different frequencies, with ones - in the form of signals with a higher frequency, and zeros in the form of signals with a lower frequency. Another modem, at the receiving end of the line, «listens» to the analog signal and, having received it, performs the demodulation function, converting back to digital code and directing the data to the receiving computer, thus communication between computers is realized [31].

The main characteristic of the modem is the data transfer rate: it is measured by *the number of bits of information* transmitted to them for just a second; it can be 1200/2400/4800/9600/19200/28800 bit/s (and higher in the latest developments).

In order to ensure a possibility of simultaneous reception and transmission of information, the duplex mode of the modem is used. A typical example of a duplex channel is an ordinary telephone conversation between two interlocutors. Sometimes duplex communication is not needed, for example, when sending faxes. In this case, each time, information is transmitted only to one side; this mode of operation is called *half duplex*.

There are internal (built into the computer) and external modems (Figure 7.11). *Internal* is inserted into a connector inside the processor unit, connecting directly to the internal bus of the computer; *external* is connected to the serial communication port of the computer using a cable.

To control the operation of a modem, there is a special protocol containing a set of rules that regulate the format and the procedures of the information exchange. In particular, a protocol may contain a detailed description of how the connection is performed, the noise on the communication line is overcome, and an error-free data transfer between modems is ensured.



*Figure 7.11. Modems: a) external; b) internal (built into a computer)*

There is a number of standards that define commonly used protocols:

- V.22 and V22bis are duplex protocols with information data transmission rate 600/1200 and 1200/2400 bps respectively (two numbers indicated through a fraction mean that data reception and transmission can be carried out at two speeds);
- V.32 and V32bis are duplex protocols with information speed of 2400/4800/9600 and 7200/9600/12000/14400 bps, respectively;
- V34 is the standard that describes the data transfer protocols up with the speed of 28000 bps.

The speed of the modem can be increased by using special methods of data compression and automatic error correction. The essence of information compression is that the symbols frequently encountered in transmitted data blocks are encoded by smaller length of the bit strings than those rarely encountered. For many years, the de facto standard for error correction and data compression was the MNP (Microcom Network Protokol), proposed and first implemented by Microcom. The actual standard in this area is the MNP 5 error correction protocol. Recently it has been supplanted by the international standard V42bis, which allows data compression in the ratio of almost 1: 4, while in MNP 5 it is only 1: 2.

### **7.5.3. Communication Software**

Communication software includes programs that implement communication protocols, for example, the TCP / IP protocol is used on the Internet. Data transmission protocol is a set of rules that must be followed by the sending and receiving parties for data exchange.

TCP / IP protocol is a means of exchanging information between computers that are networked. It does not matter whether they are a part

of the same network or connected to different networks. It also does not matter whether one of them may be, for example, a super-computer Cray, and the other – a personal computer Macintosh; in other words, TCP / IP is a standard that does not depend on a platform (that is, on the specifics of hardware and software).

TCP / IP is an abbreviation for the term «Transmission Control Protocol / Internet Protocol». In the terminology of the computing systems, the protocol is a pre-agreed standard that allows two computers to exchange data. In fact, TCP / IP is not one protocol, but a set of protocols, among which TCP and IP are the two main ones. The reason why TCP / IP is so important today is that it allows independent networks to connect to the Internet or to join to create private intranets that have constant access to the Internet.

**TCP** is a high-level protocol that allows applications running on various host (HOST) computers on the network to exchange data streams (in the form of chains bytes, called TCP-segments).

**IP** is a low-level protocol that routes data packets to individual networks connected together with routers to form an intranet or connect to the Internet. Data are transmitted over the network in the form of packets called IP Datagram. An **IP address** is a unique address on a local network or the Internet, which consists of four digits separated by dots. For example: 168.10.1 or 68.12.55.12, etc. The numbers from 0 to 255 are used. The IP address is assigned by a network administrator. However, should a computer have an Internet access, the IP address is assigned by a provider. Each computer, regardless of whether it enters the local network or (and) the Internet, has its own IP address, different from the others. An exception are networks connected to the Internet through one IP address, for example, the server has an external IP and is connected to the Internet, the computers that access the Internet through this server will have an IP address identical to the server one.

Thus, just a few computers can have one IP address on the Internet. It is possible to determine which particular computer is using certain resources; to do this, it is requires to contact the provider directly. Knowing an IP address of a provider, you can determine whether the IP address belongs to a country and a city. IP addresses are divided into static and dynamic. A static IP address is issued by a provider that provides access to the Internet, and does not change when you connect to the Internet. Dynamic IP address can change when connected to the Internet, for example, using dial-up (modem connection) the last digit in the IP address will be changed.



Examples of IP-address: in Figure 7.12.

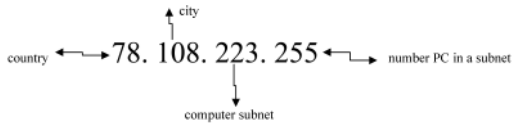


Figure 7.12. Example of IP-address

In addition, the TCP / IP protocol suite includes: the Address Resolution Protocol (ARP), the FTP Transfer Protocol (FTP), the User Datagram Protocol (UDP), and a number of other less visible but equally important. Figure 7.13 shows the TCP / IP protocol operation.

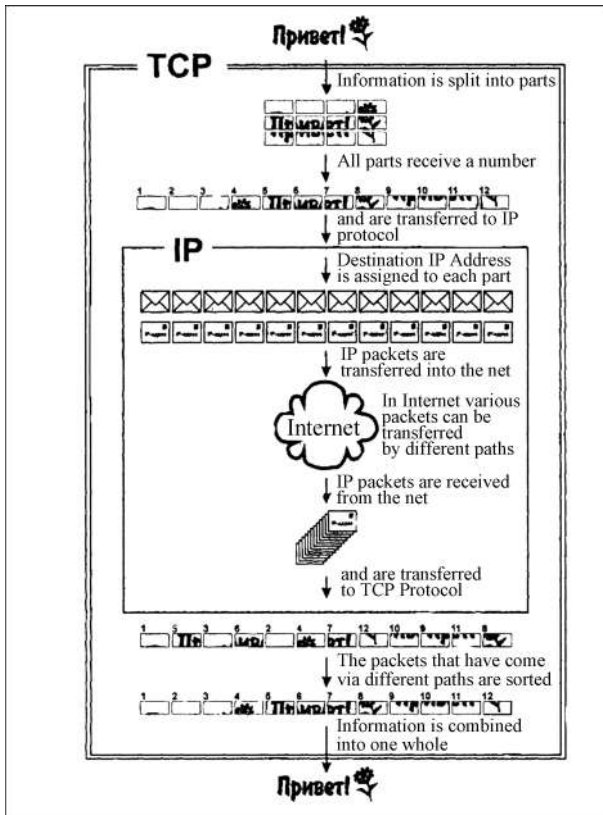


Figure 7.13. The TCP / IP Protocol Operation Scheme

TCP / IP uses a multi-level architecture (in accordance with the 7-level ISO / OSI model), which clearly describes what each individual protocol is responsible for – from the physical (formation and recognition of electrical or other signals) to the applied (API for information transfer by applications):

- 1) **Application Layer.** The upper (7th) level of a model provides interaction between a network and a user. The layer allows user applications to access network Services, such as a database query handler, file access, and e-mail forwarding. Also it is responsible for the transfer of the official information, provides applications with information about errors and forms queries to the presentation level. Example: HTTP, POP3, SMTP.
- 2) **Presentation Layer.** The 6th level is responsible for protocol conversion and data encoding / decoding. It converts application requests received from the application layer to a format for transmission over the network, and converts the data received from the network to a format that is understandable to the applications. At the presentation level, compression / decompression or data encoding / decoding can be performed, as well as redirecting requests to another network resource, if they cannot be processed locally.
- 3) **Session Layer.** The 5th level of the model is responsible for maintaining a communication session, which allows applications to interact with each other for a long time. The session layer controls creation / termination of the session, exchange of information, synchronization of tasks, determination of the right to transfer data, and maintenance of the session during inactivity of the applications. Synchronization of the transfer is provided by placing control points into the data stream, when the interaction is broken the process resumes starting from these points.
- 4) **Transport Layer.** The 4th level of the model is designed to deliver data without errors, loss and duplication in the same sequence as they were transmitted. It does not matter which data are transmitted, from where and where to, that is, it provides the transmission mechanism itself. It splits the blocks of data into fragments, the size of which depends on the protocol, short blocks are united into one, and the long ones are split. The protocols of this level are designed for point-to-point interaction. Example: TCP, UDP
- 5) **Network Layer.** The third layer of the OSI network model is intended for determining the data transmission path. Responsible for translating logical addresses and names into physical, Determination

of the shortest routes, switching and routing, tracking of problems and congestion in the network. At this level, there is a network device such as a router.

- 6) **Data Link Layer.** Often this level is called a channel level. This level is designed to ensure the interaction of the networks at the physical level and the control of errors that may occur. The data received from the physical layer is packed into frames, checked for integrity, if it is necessary is corrected from errors and is sent to the network layer. A link layer can interact with one or more physical layers, controlling and managing this interaction. IEEE 802 specification divides this layer into 2 sub-levels - MAC (Media Access Control) regulates access to a shared physical environment, LLC (Logical Link Control) provides the network layer service. Switches and bridges operate at this level. In programming, this level is represented by the driver of the network card, operating systems have a programming interface for the interaction of the channel and the network layers among themselves, this is not a new level, but simply implementation of a model for a particular OS. Examples of such interfaces are ODI, NDIS.
- 7) **Physical Layer.** The lowest level of a model is intended directly for the flow of data. It transmits electrical or optical signals to a cable or radio ether and, accordingly, receives them and converts them into data bits in accordance with the methods of encoding digital signals. In other words, it implements the interface between the network medium and the network device.

At this level, concentrators (hubs), repeaters (repeaters) of the signal and media converters work. Physical layer functions are implemented on all devices connected to the Network. On the computer side, the physical layer functions are performed by a network adapter or a serial port.

**DHCP (Dynamic Host Configuration Protocol)** is a protocol used to send TCP / IP stack parameters to system clients. The server rents out addresses to customers.

DHCP protocol is one of the protocols commonly used in everyday life. It allows you to automatically receive the settings of the network interface from the local network server, which monitors the issuance of IP addresses and contains their database for distribution. Using DHCP simplifies administration, in the event when the hard binding of the client computers to IP addresses is not required.

Principle of operation:

- 1) The client sends (Multicast) DHCP requests for the server search (the packet Discover) by broadcasting.
- 2) The server, after accepting such a packet, offers it an IP-address and parameters (the packet Offer).
- 3) Upon accepting the server's offer, the client asks to register this address behind it (the packet Request).
- 4) After completing the registration, the server confirms a possibility of using the IP-address (the packet ACK).

## 8. CYBER SECURITY

«Cyber security is a set of tools, strategies, security principles, security guarantees, guidelines, approaches to risk management, actions, professional training, practical experience, insurance and technology that can be used to protect the cyber environment, organization and user resources. The resources of an organization and an user include connected computer devices, personnel, infrastructure, applications, services, telecommunication systems and the entirety of transmitted and / or stored in a cyberspace information. Cybersecurity is an attempt to achieve and maintain the security properties of an organization or user's resources directed against the corresponding security threats in the cyberspace. Common security tasks include the following:

- 1) accessibility;
- 2) integrity, which may include authenticity and non-repudiation;
- 3) confidentiality «[33].

This definition is applied in the activities of the International Telecommunication Union (ITU) associated with building confidence and security in the use of ICT.

### 8.1. Threats to Information Security and their Classification

The threats to information security are potentially possible actions, phenomena or processes that may have an undesirable effect on the information system or on the information stored in it. Such threats, affecting resources, can lead to data corruption, copying, unauthorized distribution, restriction or blocking of access. At present time, a sufficiently large number of threats are known, which are classified according to various criteria.

- 1) **By the nature of the occurrence**, there are *natural* and *artificial* threats. The first group includes those the impact of which on the computer system is caused by objective physical processes or natural phenomena. The second group is those threats that are caused by human activities.
- 2) **By the degree of intentionality of manifestation**, threats are divided into *accidental* and *intentional*. The main *accidental* threats include:
  - unintentional disconnection of equipment;
  - unintentional damage to media;
  - use of software that can, if used improperly, lead to disruption of the system (hang) or to irreversible changes in the system (deleting files,

formatting, etc.);

- use of programs that are not necessary for the performance of official duties. These can include games, training and other programs, the use of which can lead to an unreasonable expenditure of system resources, in particular, RAM and processor;
- inadvertent infection of the computer with viruses;
- careless actions, entailing the disclosure of confidential information;
- input of erroneous data;
- loss, transfer to someone or the disclosure of identifiers, which include passwords, encryption keys, omissions, identification cards;
- building a system, data processing technology, creating programs with vulnerabilities;
- non-compliance with the security policy or other established rules of work with the system;
- disabling or incorrect use of protective equipment by personnel;
- transfer of data to the wrong address of the subscriber (device).

The main intentional threats include:

- physical impact on the system or its individual components (devices, carriers, people), leading to failure, destruction, disruption of normal functioning;
- disabling of subsystems that ensure the functioning of computing systems (power supply, cooling and ventilation, communication lines and the like);
- actions to disrupt the normal operation of the system (changing the operating modes of devices or programs, creating active radio interference at the operating frequencies of the system devices, and the like);
- bribery, blackmail and other ways of affecting the personnel or individual users who have certain powers;
- the use of eavesdropping devices, remote photo and video shooting;
- interception of data transmitted through communication channels and their analysis in order to find out the protocols of exchange, the rules of entering into communication and authorization of the user and subsequent attempts to imitate them for penetration into the system;
- theft of information carriers (magnetic disks, tapes, memory chips, memory devices and entire PCs);
- unauthorized copying of media;
- theft of industrial wastes (printouts, records, decommissioned storage media and the like);

- reading of residual information from RAM and from external storage devices;
- reading information from the areas of RAM used by the operating system (including the protection subsystem) or other users, in asynchronous mode using the disadvantages of multitasking operating systems and programming systems;
- illegal receipt of passwords and other details of access delimitation (by agent, using user negligence, by selection, by simulating the system interface and so on) with subsequent masking for the registered user;
- unauthorized use of user terminals having unique physical characteristics, such as the number of the workstation in the network, the physical address, the address in the communication system, the hardware coding unit;
- opening of cryptographic information encryption ciphers;
- introduction of hardware «special enclosures», program «bookmarks» and «viruses», that is, those sections of programs that are not needed to implement the declared functions but allow to overcome the protection system, covertly and illegally access to the system resources for registration and transmission of critical information or disruption of the functioning of the system;
- illegal connection to communication lines for the purpose of working during pauses of the legitimate user on his behalf, followed by the introduction of false messages or modification of transmitted messages;
- illegal connection to communication lines for the purpose of direct substitution of a legitimate user by physically shutting down after logging on to the system and successful authentication followed by misinformation and the imposition of false messages.

It should be noted that most often to achieve this goal, an attacker uses not one, but some combination of the above paths [34].

Consider other criteria for classification of threats.

- 3) **By the position against the controlled zone:** *internal* and *external* threats. An example of the external threats can be interception of data transmitted over the network. Internal threats include the theft of the carrier with confidential information, equipment damage, application of various types of bookmarks.
- 4) **By the degree of impact on the automated system (AS):** *passive* and *active*. Passive threats are threats that do not violate the composition and normal operation of the AS. An example is the copying of

confidential information, leakage through technical leak channels, eavesdropping and the like. The active threat, accordingly, violates the normal functioning of the AS, its structure or composition.

- 5) **By the type of the violated property of information** – confidentiality, accessibility, integrity (static and dynamic). The threats of accessibility include both *artificial* and *natural* threats.
- 6) **Threats to static integrity** include illegal change of information, falsification of information, as well as non-authorship. Threats to *dynamic integrity* include a violation of the atomicity of transactions, introduction of illegal packets into the information flow, and so on.
- 7) **By type of system to which the threat is directed:** systems based on an *autonomous work station* and a system that has a connection to *the public network*.
- 8) **By the way of implementation:** unauthorized access (including accidental) to the protected information, special impact on information, information leakage through technical leakage channels.

## 8.2. Malicious Programs

**Virus.** This is a self-replicating program code that is embedded in the installed programs without the user's consent. Viruses can be divided by the type of objects they infect, by methods of infection and the choice of victims. Viruses can be hooked in many ways: from clicking a malicious link or a file in an unknown letter before being infected on a malicious site. In this case, the virus can perform many different tasks, aimed primarily at harming the operating system. Currently, viruses are quite rare, as the creators of malware try to keep their programs and their distribution under control. Otherwise, the virus quickly gets into the hands of antivirus companies.

**Worm.** Worms are in some way viruses, as they are created on the basis of self-replicating programs. However, worms cannot infect existing files. Instead, the worm settles into the computer as a separate file and looks for vulnerabilities in the net or the system to further spread itself. Worms can also be subdivided by the method of infection (e-mail, messengers, file sharing and others). Some worms exist in the form of the stored on the hard disk files, and some are settled only in the computer's RAM.

**Trojan.** By its action it is the opposite of viruses and worms. It is loaded under the guise of a legitimate application. However, instead of the declared functionality it does what the attackers need. The Trojans derive their name



from the eponymous infamous mythological horse, because a destructive element penetrates in the system under the guise of a useful program or a utility. Trojans are not self-reproducing and do not spread by themselves. However, with the increase in the amount of information and files on the Internet, the Trojan can easily enter a personal computer. Today, the Trojans evolved to such complex forms as, for example, a backdoor (a Trojan trying to take over the administration of a computer) and a Trojan downloader (it installs malicious code on the victim's computer).

**Rootkit.** In the modern world, a rootkit is a special part of malicious programs designed specifically to hide the presence of a malicious code and its actions from a user and an installed security software. This is possible due to a tight integration of the rootkit with the operating system system. And some rootkits can start their work before the operating system boots. These are called bootkits. However, no matter how this type of malware evolved, sophisticated modern antivirus programs are able to detect and neutralize almost all existing versions of rootkits.

**Backdoor** (remote administration tool). Backdoor, or RAT (remote administration tool), is an application that allows a system administrator or an attacker to control a user's computer from a distance. Depending on the functionality of the specific backdoor, the hacker can install and run any victim software on the victim's computer, save all keystrokes, download and save any files, to turn on a microphone or a camera. In short, it is designed to take control of the computer and the victim's information.

**Loader.** This is a part of a code that is used to further download and install the full version of the malicious program. After the bootloader enters the system by saving an e-mail attachment or, for example, when viewing an infected picture, it connects to a remote server and downloads the entire malicious program [34].

### 8.3. Cyber Security and Internet Governance

Today, information technology enables people from different countries and continents to discuss their problems in real time. Modern information technologies allow you to receive information directly from the place of events or from persons who took part in them. However, thanks to these features, information technologies are simultaneously a unique environment for the development of various negative phenomena, such as a distribution of illegal content, a use of vulnerabilities of information systems to commit unlawful acts, including of course the distribution of SPAM messages.

To date, the situation with cybersecurity on the Internet is very serious. The first known incident involving security occurred in 1981 and was associated with the spread of computer viruses for the personal computer (PC) AppleII. And in the winter of 1984, the first anti-virus utilities appeared – CHK4BOMB and BOMBSQAD. New opportunities for cybercrime were obtained with the invention of HTTP, HTML and URL technologies in 1990 and the launch of the first «www» site on August 6, 1991. With the advent of commerce on the Internet, the goals of cybercriminals have also changed. The main task is to receive money. It should also be noted that Internet resources are used by various kinds by extremist groups, as well as by terrorist organizations. Unfortunately, modern technologies are not ignored by sects of various kinds. Cybercriminals of this type use information and services of social networks to recruit new followers and performers. Today we can highlight the following problems in the field of cybersecurity:

- 1) Protecting children in online communication.
- 2) Countering the manifestations of extremism, inciting ethnic hatred.
- 3) Protection of copyright.
- 4) Ensuring the security of electronic payments and trade transactions.
- 5) Countering the sending of spam.
- 6) Countering theft with the use of modern network technologies.
- 7) Ensuring the safety of the privacy of personal life in a networked interaction.

The emergence of cybersecurity and Internet governance in the international arena occurred at the meeting of the Preparatory Committee for the World Summit on the Information Society in February 2003. The World Summit on the Information Society (WSIS) was held two years later in two phases: in Geneva from 10 to 12 December 2003 and in Tunis from 16 to 18 November 2005, its culmination was the adoption of the WSIS outcomes documents, in which the commitment was made to «build a people-oriented, open-for-all and development-oriented information society in which everyone could create information, access, use and share information and knowledge» [37].

Today, a global culture of cybersecurity is being formed, developed and implemented in cooperation with all interested parties and competent international organizations. These efforts are based on expanding international cooperation. As part of this global culture of cybersecurity, it is important to improve security and data protection and privacy, while expanding access and scale of trade operations.

The Internet has become a public resource on a global scale, and the management of its use is becoming one of the main issues on the agenda of the information society. Internet governance is carried out at the international level in a multilateral, transparent and democratic manner with the full participation of governments, private sector, civil society and international organizations. This management is aimed at ensuring an equitable distribution of resources, facilitates access for all, guarantees the stable and protected operation of the Internet, taking into account multilingualism.

Internet governance covers both technical issues and public policy issues.

In order to better understand issues related to Internet governance and to promote transparent and open dialogue among stakeholders, it was decided to establish a Forum on Internet Governance, convened by the UN Secretary-General. The main purpose of the Forum is to discuss public policy issues related to the key Internet governance elements listed in the Tunis Agenda in order to contribute to sustainability, security, security, stability and development of the Internet in developed and developing countries.

In 2006, the UN Secretary-General established a Consultative Group, which provided a general idea of how the Forum should function and what problems it should solve. The Group meets three times a year under the chairmanship of the Special Adviser on Internet Governance. The Forum considers the following issues:

- 1) ensuring the sustainable nature, reliability, security, stability and development of the Internet;
- 2) availability and affordability of the Internet in the countries of the developing world;
- 3) emerging problems;
- 4) assessment of practical implementation of the principles of the World Summit on the Information Society in the process of Internet governance;
- 5) issues related to critical Internet resources;
- 6) issues arising from proper and inappropriate use of the Internet, which are of particular importance to everyday users;
- 7) issues, regulation of malicious Internet content.

The Forum has become an annual stakeholder conference, which is held around the world [37].

*High rates of development of information and communication technologies in Kazakhstan actualize the issues of protection of the*

*corresponding infrastructure, since its damage or destruction can have significant consequences for the country's security. According to experts, Kazakhstan ranks 18th in the world in terms of the number of spam received and the 7th in terms of the risk of web surfing. Almost half of Kazakhstan's Internet users became objects of attacks from hackers, and this figure increases year by year. According to Kaspersky Security Network, Kazakhstan became the target of 85% of Internet attacks in Central Asia. In the last three years there is a tendency of their growth in proportion to the development of digital infrastructure.*

In addition, the increase in the number of Internet users and the expansion of online services increased cyber crime, mainly in the financial sector. The most important peculiarities of the cyber crime in Kazakhstan are usually attributed to the particular complexity of disclosure and investigation, extremely high latency, the transparency of the national borders for criminals and the absence of a single legal framework for combating them, often very large amounts of damage, professional composition of persons committing such crimes.

There are facts of attacks on government websites. In particular, in January 2017, the Service for Responding to Computer Incidents of the RSE «STS» of the Ministry of Internal Affairs of the Republic of Kazakhstan recorded the hacking of 21 Internet resource [39]. The reason for the hacker attack on the websites of the Kazakh government agencies was associated with weak IT security. The Ministry of Information and Communications sent notices to the owners of Information resources to eliminate the consequences of hacking.

Such attacks remain a possible threat, but the problems are associated with information security in strategically important sectors of the economy – energy and transport, which can become the main victims of cyberattacks. Thus, the national «Kazakhstan Temir Zholy» gradually digitizes its complex operations; «KEGOC» is in need of a phase information from its networks to better manage energy flows.

A space program is being implemented, where the monitoring of communication satellites is of great importance. The Armed Forces are planning to develop mass electronic solutions in the aerospace industry. Similar technologies are used to monitor offshore fields, oil tanker shipping lines, environmental risks and contraband in the Caspian.

Along with this, the sphere of internal security is being digitized. Identity documents, video surveillance cameras, electronic inquiries on

criminal cases, interception of cellular communications, monitoring and information collection systems and so on.

All this not only actualizes the problem of information protection, but also makes it possible to use IT communications in the organization of public protests or terrorist acts, as well as in management of possible conflicts. That is why society needs firm guarantees of its resistance to cyber attacks and other critical situations regardless of the fact whether such attacks are directed against commercial enterprises or state bodies.

To organize cyber defense, a number of structures have been created (*Office «K» of the Criminal Police Committee of the Ministry of Internal Affairs, a similar specialized unit in the National Security Bureau, and the State Service for the Technical Protection of Information of the Ministry of Transport and Communications*) that take part in ensuring the information security of the state. They are engaged in the improvement of legislation, the study and certification of technical means, the provision of information protection systems to public authorities, the investigation of crimes and detected cyber attacks, and in taking measures to prevent them.

#### **8.4. Legislative Acts of the Republic of Kazakhstan Regulating Legal Relations in the Field of Information Security**

Protection of its own information space is the main task of the modern society, the development of which is conditioned, first of all, by information technologies. But it is quite difficult to withstand negative information, because the dynamic development of information technologies creates new threats to the established standards and norms in society every day.

First of all, the urgency of the problem of ensuring information security is due to the fact that in the modern world information has become a strategic national resource. In recent years, a number of measures have been implemented in the Republic of Kazakhstan to improve the information security system of the state. The main political and legal act that determines the principles and main directions of information security development is the Concept of Information Security of the Republic of Kazakhstan till 2016. This concept was approved by the Decree of the President of the Republic Kazakhstan No. 174 dated November 14, 2011 [40]. The Concept of information security of the Republic of Kazakhstan was developed in order to ensure the interests of the society and the state in the information sphere, as well as the protection of the citizen's constitutional rights. The Concept is in line with the main provisions of the Development Strategy of

the Republic of Kazakhstan till 2030 «Prosperity, Security and Improvement of the Well-Being of all Kazakhstan», in which the provision of information security as a component of national security is determined as one of the major long-term priorities. The concept is based on an assessment of the current situation and determines the state policy, prospects for the activities of the state bodies in the field of information security.

The Concept was developed in accordance with the Constitution of the Republic of Kazakhstan and the Laws of the Republic of Kazakhstan «On National Security of the Republic of Kazakhstan», «On State Secrets», «On Countering Terrorism», «On Electronic Document and Electronic Digital Signature», «On Informatization», «On Technical Regulation», «On Licensing», «On Mass Media», «On Communication».

During the development of the Concept, the existing international experience in the field of information security, in particular, of the United States, Great Britain, Canada, the Russian Federation, India, and Estonia was considered. The Concept reflects an integrated approach to the implementation of the issues related to information security, which includes legislative, regulatory, methodological, organizational, technological and personnel support.

The provisions of the Concept include the main directions of the Concept of Cooperation of the Member States of the Commonwealth of Independent States in the area of information security, signed in Bishkek on October 10, 2008, the Agreement between the governments of the member states of the Shanghai Cooperation Organization on Cooperation in the field of ensuring international information security, the ratified Law of the Republic of Kazakhstan dated June 1, 2010 «On Ratification of the Agreement between the Governments of the Member States of the Shanghai Cooperation Organization on Cooperation in the Field of Ensuring International Information Security».

The concept expresses a set of official views on the essence and content of the activities of the Republic of Kazakhstan to ensure information security of the state and society, their protection from internal and external threats. The concept defines tasks, priorities, directions and expected results in the field of Ensuring the information security of the individual, society and the state. It is the basis for constructive interaction of state authorities, business and public associations to protect the national interests of the Republic of Kazakhstan In the information sphere. The concept is designed to ensure the unity of approaches to the formation and implementation of

public policy Ensuring information security, as well as a methodological basis for improving regulatory legal acts, Regulating this sphere.

The growing degree of openness of economies, freedom of movement of goods, capitals and labor resources, interpersonal interaction blurs the line between internal and external

Political, economic and information processes. Technological evolution becomes a source of fundamentally new threats, providing not previously available opportunities for negative impact on the individual, society and the state. The role and influence of the media and global communication mechanisms is growing. Information technologies have found wide Use in the management of critical life support facilities that become more vulnerable to accidental and deliberate impacts. The concept of information security of the Republic of Kazakhstan until 2016 defines the main strategic goals, tasks and directions facing the country in order to ensure its information security [40]. Accordingly, the conceptual reflection of the political and legal aspects of the development of the information security is the result of a comprehensive analysis of the current threats, as well as the measures to eliminate them by the leading States of the modern world community.

The main normative-legal act regulating relations in the sphere of information security in Kazakhstan is the Law Republic of Kazakhstan «On National Security». It regulates legal relations in the field of the national security of the Republic of Kazakhstan and defines the content and the principles of ensuring the security of an individual and a citizen, the society and the state, the system, goals and directions of ensuring the national security of the Republic of Kazakhstan. Information security is listed as a separate element of the national security. Information security is the security of the information space of the Republic of Kazakhstan, as well as of the rights and interests of an individual and a citizen, the society and the state in the information sphere from real and potential threats, which ensures sustainable development and information independence of the country [42]. In Article 6 of this law, the following is defined among the main threats to the national security: reduction of the level of protection of the information space of the country, as well as of the national information resources from unauthorized access; information impact on the public and individual consciousness associated with the deliberate distortion of information and dissemination of unreliable information to the detriment of the national security. Accordingly, the level of security determines the quality of the national security, allowing assessing the effectiveness of measures to prevent

the modern threats and the measures for their prevention and elimination. In the field of the information space, these threats are especially dangerous, because it is through the information that an individual develops an idea of the world around him, his worldview, and motivation for certain actions

In the Decree of the Government of the Republic of Kazakhstan of 12.12.2016 No. 832 «On Approval of Unified Requirements in the field of Information and Communication Technologies and Provision of Information Security» unified requirements in the field of information and communication technologies and information security are set (hereinafter – ET). The provisions of the ET are related to the sphere of ensuring information security, they are obligatory for application by state bodies, local executive bodies, state legal entities, subjects of the quasi-public sector, owners and holders of non-governmental information systems that are integrated with the government information systems or the Intended for the formation of the State Electronic Information resources, as well as the owners and holders of critical information and communication infrastructures.

It should be noted that the main approaches to ensuring information security, awareness of the threats in this area bring the states closer in their aspirations to provide national security as a whole. This is due to the identity of the basic approaches to the national security and the principles of its implementation in Russia and Kazakhstan. Formation of the Customs Union is increasingly bringing Russia and Kazakhstan closer together, putting new threats on their way, which can only be eliminated through interstate cooperation.

## **8.5. Electronic Digital Signature**

Due to information technology, now we can get various services in electronic form. One of the important moments in obtaining electronic services is the electronic digital signature (EDS). It is used as a means of identification and confirmation of the legal significance of documents received in electronic form.

**An electronic digital signature** is an analog of a handwritten signature. EDS is used to give an electronic document a legal force equal to the legal force of a document on paper, signed by the handwritten signature of a competent person and sealed.

EDS is the props of an electronic document obtained as a result of cryptographic information conversion using the Electronic Registration



Certificate (Certificate) and the private EDS key. The Certificate and the private EDS key are issued on a SMART-card, which excludes violation of the integrity of this information and copying of the private EDS key. The SMART-card is protected by a PIN-code, which guarantees its use only by the owner of the Certificate. In order to identify the owner of the Certificate, the EDS help to protect the electronic document from forgery, and also determine the absence of distortion of information in it. The use of EDS is supposed to implement the following important directions in the electronic economy:

- 1) Full control over the integrity of the transmitted electronic payment document: in the event of any accidental or deliberate modification of the document, the digital signature becomes invalid, because it is verified according to a special algorithm based on the initial state of the document and corresponds only to it.
- 2) Effective protection from changes (falsification) of the document. The EP gives a guarantee that all types of counterfeits will be revealed when monitoring integrity. As a result, forging documents becomes to no purpose in most cases.
- 3) Fixing the impossibility of refusing the authorship of this document. This aspect arises from the fact that once again you can create a correct electronic signature only if you have used a private key, which, in turn, must be known only to the owner of this key (the author of the document). In this case, the owner cannot form a rejection of his signature, and hence – from the document.
- 4) Formation of evidence to confirm the authorship of the document: proceeding from the fact that it is possible to create a correct electronic signature, as indicated above, only knowing the private key, and by definition it should be known only to the owner-author of the document, then the owner of the keys can unambiguously prove his authorship of the signature under the document. Moreover, in the document only single document fields can be signed, such as «author», «changes made», «timestamp» and so on. That is, the authorship can be conclusively proven not for the whole document.

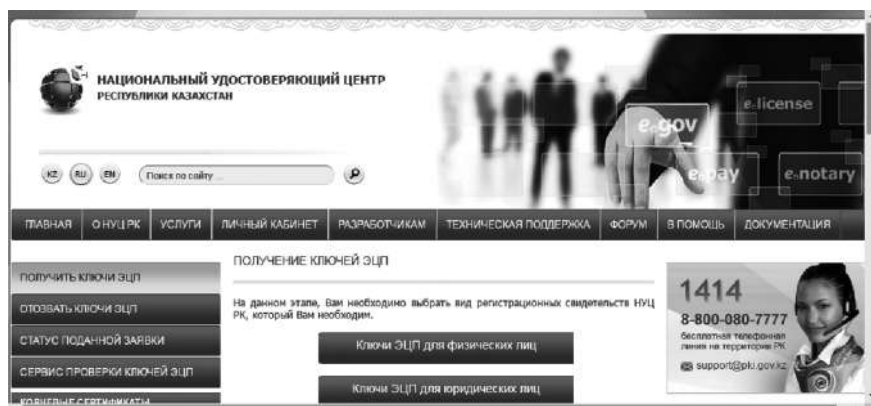
***Advantages of EDS:***

- 1) To carry out appeals to virtual reception offices of state bodies not only in the region, but also in the republic (this service provides the opportunity for citizens of the Republic of Kazakhstan to transmit their applications to state bodies and guarantees a response from the state body, which provides an opportunity to track the status of the

appeal: delivered to the state body, transferred for execution, and other);

- 2) To receive public services 24 hours a day, 7 days a week, without leaving home;
- 3) To present and select the most favorable price offer of goods and services in electronic auctions, auctions and tenders.

The electronic digital signature (EDS) can be obtained from the Registration Center of the National Certification Authority located at the Public Service Center or by filling out an online application on the website of the National Certifying Center of the Republic of Kazakhstan at the address: [www.pki.gov.kz](http://www.pki.gov.kz) (Figure 8.1).



*Figure 8.1. Home Page of the «National Certification Center» of the Republic of Kazakhstan*

Electronic digital signature can be obtained for the following types of storage:

- 1) **File system** – when this item is selected, keys and registration certificates will be stored on the user's personal computer as files;
- 2) **Kaztoken** – when choosing this media, keys and registration certificates will be stored on an external protected medium of the key information protected with a pin code;
- 3) **EDS on a Sim-Card** – when choosing this media keys and registration certificates will be stored on the sim-card of the client's phone. You can buy the corresponding sim card in sales departments of «Beeline»

and branches of the NAO «Government for Citizens» in the city Astana, Almaty.

- 4) **Identification card** – to write the EDS to an identity card chip (for individuals), it is necessary to apply to the nearest department of the NAO State Corporation «Government for Citizens» (CSC), presenting the identity card. For further work with EDS, recorded on the identity card, you must purchase a card reader.

Digital signatures are used at:

- 1) Information system «Public Procurement of MF RK».
- 2) The Electronic Government Portal.
- 3) The IC «Treasury-Client» of the Ministry of Finance of the Republic of Kazakhstan.
- 4) The Information Agency of the Republic of Kazakhstan on Statistics «Electronic Statistical Reporting».
- 5) The JS «Information and Registration Center» of the Depository of Financial Statements.

## 8.6. Encryption

Encryption is a method used to convert data into encrypted text in order for it to be read only by a user with the appropriate encryption key to decrypt the content. Encryption is used when an increased level of data protection is required – when storing data in non-trusted sources or transmitting data over unprotected communication channels.

It is necessary to distinguish *encryption* from *coding*. Coding also converts information, but only for convenience of storage and transmission, secrecy is not the main task. Typical methods of coding are the Morse code and binary encoding of letters for storage in a computer.

Depending on the structure of the keys used, there are symmetric encryption and asymmetric encryption methods. *Symmetric encryption* provides for the availability of an encryption algorithm to unauthorized persons, but the key (the same for the sender and the recipient) remains unknown. With *asymmetric encryption*, an algorithm of the encryption and the public key is known to outsiders, however, the private key is known only to the recipient.

The most convenient solution for encrypting files on a computer today is to create a «container» that is visible in the system as a separate disk. On this disk, you can save or copy any information, you can work with it from

any program, it does not essentially differ from a flash drive or hard drive partition, and it is convenient. In fact, the container is a separate large file on the hard drive of the computer, access to which is organized through a special program, for example, Kaspersky Crystal (Figure 8.2). Any file stored on this special disk will be instantly encrypted and written to a common container file.



Figure 8.2. Crystal Encryption Program Interface

The file-storage can be seen by any stranger, it can even be stolen (copied). But it does not give anything to the attacker or just an inquisitive one – there is only a mixed set of symbols inside the files, and you can spend many years trying to find the password that turns this file into a disk with readable files [44].

To ensure that the encrypted container has become an effective protection of information, you must follow a few simple rules:

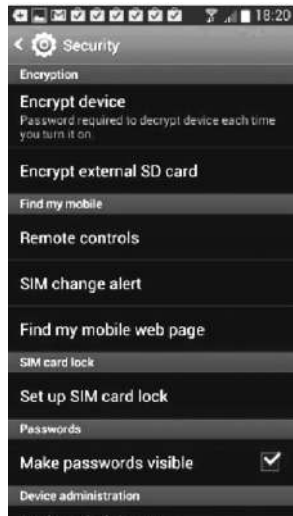
- 1) Encryption key (password) is the only protection of information from outsiders. It must be very long, difficult to be picked up – and sufficiently persistent;
- 2) You need to store all confidential information on the storage disk;
- 3) All information on the disk is available to a user who knows the password. If there are different groups of information for different users, you need to create several repositories with different passwords;
- 4) Do not keep the storage disk permanently connected, otherwise one can steal the files from it just like from a regular disk. It is necessary

to connect the disk while working with important data and disconnect immediately after the work is completed;

- 5) The information on the encrypted disk will be lost entirely if the container file turns out to be slightly damaged. You should regularly back up the container file;
- 6) Be sure to use comprehensive computer protection to protect your password from Trojan applications and «keyloggers». An acting spy reduces the password protection to none.

### ***File-Storage on Smartphones***

In connection with the increasing theft of smartphones, it became necessary to include encryption functions in modern mobile OS. The key information in a smartphone is permanently stored in encrypted mode and is always decrypted when the owner enters the password or an unlock PIN. Apple does not allow the user to deeply control this function, but a significant amount of information is encrypted when the PIN security code is activated to turn on the smartphone / tablet. In Android, the security settings have the option of fully encrypting the contents of the phone, which makes all the data on the device inaccessible without entering a password. For maximum reliability in both cases, fresh versions of the Mobile OS are recommended (Figure 8.3).



*Figure 8.3. Mobile OS Encryption Function*

### ***Cloud Defense***

Passwords require encrypted storage to the greatest extent among all types of information, – after all, to each site and service they must be different, remaining reliable, long and persistent.

That's why all high-quality «password-keepers» keep the database permanently encrypted. This allows to transfer it over the Internet, synchronizing between different computers and mobile devices without fears. Such services help keep all of their passwords at hand, without reducing the level of security [44].

## 9. INTERNET TECHNOLOGIES

The **Internet** (from English Inter – «between» and net – «network, web») is a collection of computer networks linking military, government, educational, commercial institutions, as well as individual citizens.

The Internet is a completely voluntary organization and is managed by a community of representatives from network users called the ISOC (Internet Society), which provides the organizational basis for various research and advisory groups engaged in the development of the Internet.

**The server** of the Internet (a web server or http-server) is a hardware and software complex installed on a computer connected to a high-speed Internet backbone. Such computers are also called servers. The main function of the server is the search and the transfer information to the user computer requested by client programs, in particular browsers.



The use of the term server is legitimate. Internet users call «a server» large *web-sites* with their content, web designers and programmers understand under the server *special programs for transferring data* from the Internet to the user's computer, system administrators and specialists serving local networks use this term to name *the computers themselves on which such programs installed* [45].

**Hosting** (from English hosting) is a service for providing disk space for physically placing information on a server, constantly being on the network. Typically, the hosting service includes providing a place for mail correspondence, databases, DNS, file storage and the like, as well as supporting the operation of the relevant services [45].




### 9.1. Browser

**A browser** is a client program for working on the Internet, installed on a laptop, a phone and other devices, and which accesses the server, reads the document, HTML, interprets the information received and displays the contents of a document. The number of browsers is hundreds. The most famous browsers are Internet Explorer, Opera, Netscape Navigator, Mozilla Firefox and others.

In 2016, a rating was made for the best browser that are used in Kazakhstan. The top 5 browsers are [46]:

Browser	Description
<p>Google Chrome</p>  <p>Website:  <a href="https://www.google.ru/chrome/browser/">https://www.google.ru/chrome/browser/</a></p>	<p>More than half of PCs, phones and tablets use this browser to surf the Internet.</p> <p><b>Benefits:</b></p> <ul style="list-style-type: none"> <li>– Good work speed;</li> <li>– Synchronization of bookmarks and settings;</li> <li>– Support for all popular Windows operating systems: 7, 8, 10 (32/64 bits);</li> <li>– Search from the address bar;</li> <li>– Tooltips;</li> <li>– Instant translation of the page (for example, from English to Russian);</li> <li>– Minimalism: in the browser there is nothing extra, «extra» settings are hidden from the novice users;</li> <li>– The ability to quickly block advertising (link to the article).</li> </ul> <p><b>Disadvantages:</b></p> <ul style="list-style-type: none"> <li>– Low speed on insufficiently powerful PC, as well as after installation of plug-ins (especially if there are a lot of them).</li> </ul>
<p>Yandex Browser</p>  <p>Website:  <a href="https://browser.yandex.ru/">https://browser.yandex.ru/</a></p>	<p>Yandex browser is rapidly gaining popularity due to its tight integration with the most popular search engine services Yandex. It is used on: PCs, phones, tablets.</p> <p><b>Benefits:</b></p> <ul style="list-style-type: none"> <li>– Turbo mode: allows you to accelerate opening of some Internet pages and speed up video playback on sites;</li> <li>– Synchronization of custom bookmarks and settings (if you reinstall the Windows OS - all your bookmarks will remain in place);</li> <li>– Convenient address bar: it can be immediately display the prompts for the search query;</li> <li>– The ability to change the look of the (for example, with the help of a large number of backgrounds);</li> </ul> <p><b>Disadvantages:</b> the rest of the browser copies of the Chrome feature in part.</p>



<p>Opera</p>  <p>Website: <a href="http://www.opera.com/ru">http://www.opera.com/ru</a></p>	<p>Once one of the most popular browsers, but now somewhat lost its audience.</p> <p><b>Pluses:</b></p> <ul style="list-style-type: none"> <li>– Opera turbo – allows you to compress the downloaded pages, thereby increasing the speed of opening sites. The Opera browser was one of the first to implement this technology;</li> <li>– The browser is well optimized for work on slow computers with not the most fast hard drives;</li> <li>– More than 1000 extensions to change the browser (change appearance + add new features to the functional);</li> <li>– High degree of safety;</li> <li>– In other respects, it has practically the same features as the previous browsers.</li> </ul>
<p>Firefox</p>  <p>Website: <a href="https://www.mozilla.org/ru/firefox/">https://www.mozilla.org/ru/firefox/</a></p>	<p>One of the most feature-rich browsers. The browser has thousands of plug-ins for a variety of tasks: downloading of video from different sites, images, password master and so on.</p> <p>Benefits:</p> <ul style="list-style-type: none"> <li>– A huge number of plug-ins and add-ons;</li> <li>– Convenient work with bookmarks (Ctrl + B), their synchronization (needed if Windows is reinstalled, for example);</li> <li>– High speed of work;</li> <li>– «Fine» setting – about: config;</li> <li>– Ability to edit the tools panel: you can only leave those which you need a user.</li> </ul> <p>It is recommended that you have this browser on your PC, if not as the main, but as a spare at least.</p>
<p>Internet Explorer</p>  <p>Website: <a href="http://windows.microsoft.com/ru-ru/internet-explorer/download-ie">http://windows.microsoft.com/ru-ru/internet-explorer/download-ie</a></p>	<p>The browser is popular in the first place because of it comes with Windows. At Windows 10 it was replaced by a much faster browser – Microsoft Edge.</p>

## *Prospective Browsers*

### **Maxthon**



Website: <http://ru.maxthon.com/>

A cloud browser Maxthon is developed on the basis of two platforms: Webkit and Trident. Thanks to this, the developers managed to achieve the fact that the browser opens pages, developed in a various programs, quickly enough.

#### *Benefits:*

- High speed, in some cases faster than Chrome;
- Low consumption of PC resources (relative);
- Reading mode and night view mode (allows you to conveniently browse the Internet pages, especially those where there is abundance of advertising, uncomfortable fonts, or dark background);
- Remove ads from a page in 1-2 clicks;
- Notepad for notes (quick notes that are synchronized in the cloud, along with bookmarks and settings, so you can quickly access them from any PC connected to the Internet);
- A large number of extensions;
- Ability to make screenshots;
- A good level of security [46].

### **CocCoc**



Developers' site: <http://coccoc.com/>

A Vietnamese browser, rapidly gaining popularity. Distributed for free, fairly fast, does not consume a lot of PC resources, allows you to bypass the blocking of sites, download files in multiple streams.

#### *Benefits:*

- Full support for the new html 5;
- The search string in the address bar;
- Downloading files to multiple streams (after closing and opening the browser downloading of files will resume from the point of stop);
- Support for all add-ons developed for the Chrome Browser;
- Incognito mode – allows you to visit sites anonymously;
- Its own platform for processing Java code (increases the speed of processing pages) [46].

## *Light Browsers (consume a minimum of resources)*

### **QupZilla**



Website: <http://www.qupzilla.com/>

Quite an interesting browser, especially for owners of not the most powerful PCs. It consumes not so much RAM as Firefox or Chrome.

#### *Benefits:*

- There is a portable version that does not need installation;
- Support by all modern versions of Windows (including Windows 10);
- Built-in locking option;
- Support for a huge number of platforms [46].

### **Palemoon**

#### **Pale Moon**

Your browser. Your way

Website: <http://www.palemoon.org/>

This is not an independent browser, but just a modified version of Firefox. But this browser was modified a lot to increase the speed of work (extended support for modern processors, new security patches). Most add-ons and plug-ins for Firefox will work in Pale Moon. The source code for the browser is open and freely distributed [46].

## **9.2. Website**

A **Web site** is a set of web pages linked together by links and stored on a single server. A set of Web sites that are linked together by links and stored on different servers is called a *Web portal*.

By content, the site is an independent logical unit, a complex of related documents and graphic illustrations. Small resources, usually not having their own domain name and representing information about a particular private entity, are called the *home page* (*Homepage*).

Pages can be *static*, the contents of which are constant, and *dynamic*, that is, responsive to the actions of a visitor. For example, a page where you can read the text of a new law, is static. If a user opens a chat room, a forum or even a search engine, then he is on a dynamic page that requires him to do something. In principle, most websites are dynamic, since they interact with the user.

For a person who has his own web resource (blog), an Internet project is an opportunity to share his information. The owner of the portal about cars tells his visitors about the achievements of the auto industry, a blogger such as an artist's blog shares his thoughts with readers, the musician publishes his writings, and the city administration reports on the progress of the improvement and so on.

If we talk about sites that distribute commercial information, then basically these are the resources that represent various organizations on the Internet. In other words, a company that wants to declare itself opens a website where it publishes information about itself, price lists, and specifies the details of the company. In addition, commercial sites are online stores or catalogs, where a visitor can not only learn about a product of interest, but also purchase it. In fact, a commercial resource differs from a general one only in that it contains only information that motivates the visitor to become a client.

You can create a website on your own. There are enough site builder programs. But it's better to turn to professionals and to order the development of a web-resource. There are a lot of companies in Kazakhstan that develop web sites. Their services include the design of websites, installation and configuration of scripts, connection to the database and so on.

### **9.3. DNS Service**

The functioning of the Internet technology directly depends on a protocol – a set of rules that specify everything related to working on the network. Above we have already considered the data transmission technology on the Internet, which is based on the TCP / IP protocol – IP (Internet Protocol), TCP (Transmission Control Protocol)), it is a generally accepted standard that describes the rules for sending and receiving information between several connected to a network computers. TCP / IP for each computer on the Internet determine its own IP address, consisting of four numeric sequences separated by a period (for example, 195.85.105.160). In any position, each value can vary from 0 to 255.

IP addresses are divided into classes according to the scale of the network to which a user is connected.

- Class A is used in large public networks.
- Class B – in medium-sized networks (networks of large companies, research institutes, universities).
- Class C – in local networks (networks of small companies and firms).

- Class D is designed to access groups of computers.
- Class E is reserved.

For the convenience of users, the Internet has developed a system of *domain names* – DNS (DNS – Domain Name System). It is a system for obtaining information about domains.

It is most often used to obtain an IP address by a host name (a computer or a device), obtaining information about the routing of the services and the serving nodes for protocols in the domain (SRV record). The Domain Name Service converts a domain name to *a numeric IP address*. Computers that perform such a conversion are called *DNS servers* [47].

According to a DNS specification, all Internet virtual space is divided into domains – logical zones controlled by one or several special computers. The hierarchy of domain addresses can be either regional or based on the type of activity of a business entity (Figure 9.1).

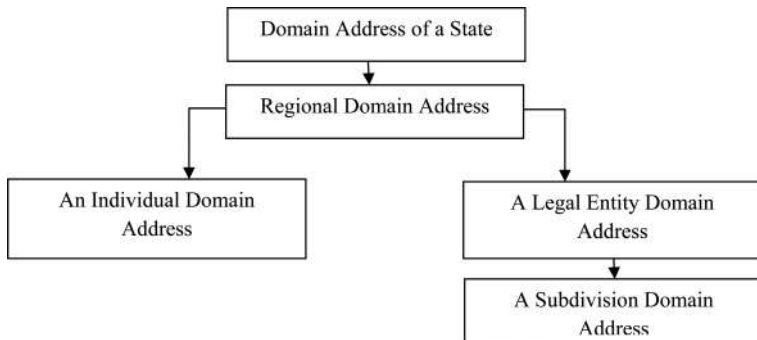


Figure 9.1. Regional hierarchy of domain addresses

The largest units of DNS are called first-level domains that cover the global Internet sections on the following grounds:

- .com, .biz – commercial enterprises;
- .net – originally assigned to organizations responsible for supporting the Internet, are now also used for commercial business entities;
- .edu – educational institutions;
- .org – non-profit and public organizations;
- .gov – government agencies;
- .mil – military establishments;
- .int – international organizations that are established on the basis of contracts or are a part of the Internet infrastructure;

.name – individuals;  
.info – is not limited;  
.kz, .ru and others – abbreviations for countries, adopted by the committee on ISO standards.

The lower level in the DNS hierarchy is the ***second-level domains***, which directly depend on the first-level domain. Second-level domains belong to municipal or commercial organizations (for example, webnavigator.kz.). A second-level domain can contain only 22 characters (letters, numbers and dashes). You cannot register an existing domain name.

There are also third-level domains that are part of the parent domain (for example, the conditional domain vasia.webnavigator.kz, petia.webnavigator.kz, nina.webnavigator.kz).

Domains of ***the 4-level*** are built on the same principle as the third-level domains, only the name is even longer. For example, video.vasia.webnavigator.kz, and so on. You can also find domains

of the fifth and so on levels. Domains of the 4th and subsequent levels are quite rare on the Internet.

A resource that does not have its own domain is found by its address, which can be written in a general form as: name.domain.zone/~folder/, where *name* is a name of the third-level domain, *domain* is the second, *zone* is the first, and *folder* is the name of the folder on the server computer that hosts the files that make up the resource.

The domain www is often used to point to a website. Usually such a domain is a third-level domain [48].

## 9.4. Universal Resource Identifier

URL (Uniform Resource Locator) is a generic indication of a location of a resource (eg egov.kz). Figure 9.2 shows an example of the URL address of internet.com.



Figure 9.2. Example URL URL

URL includes:

- 1) a method of accessing resources, that is, an access protocol (http, gopher, WAIS, ftp, file, telnet and others)

- 2) a network address of the resource (a hostname and a domain name)
- 3) a full path to a file on the server

In general, the URL format looks like this:

**Method: *//host.domain* [: *port*/ *path* / *filename***

where method has one of the values listed below in the table:

file	a file in the local system, or a file on an anonymous FTP server
http	a file on world wide web server
gopher	a file on gopher server
WAIS	a file on wais (wide area information server)
news	a group of news of a teleconference usenet
telnet	an access to telnet resources

The parameter *host.domain* is an address of the resource on the Internet.

The parameter *port* is a number to specify if the method requires a port number (individual servers can have their own distinct port number).

Standard ports are:

- 21 – FTP
- 23 – Telnet
- 70 – Gopher
- 80 – HTTP

## 9.5. Web Technologies

**Web-technologies** are a complex of technical, communication, software methods for solving problems of organizing joint activity of users using the Internet. The basic protocol for the Web hypertext network is the HTTP protocol.

It is based on the «client-server» interaction, that is, it is assumed that:

- 1) Consumer is a *client*, initiating a connection with a provider-server, sends a request to it.
- 2) The provider-*server* receives the request, takes the necessary actions and returns the response with the result to the client.

There are two possible ways to organize the work of the client computer:

- 1) A *thin client* is a client computer that transfers all tasks on processing of information to the server. An example of a thin client can be a computer with a browser, used to work with web applications.

- 2) A *thick client*, on the contrary, processes information independently from the server, uses the latter mainly for data storage only.

Before moving on to specific client-server web technologies, let's look at the basic principles and structure of the underlying HTTP protocol.

## HTTP

HTTP (*Hyper Text Transfer Protocol* – R FC 1945, R FC 2616) is an application layer protocol for the transmission of hypertext.

The central object in HTTP is a *resource* pointed to by the URL in a client's request. Typically, these resources are files stored on a server. The peculiarity of the HTTP protocol is an ability to specify the way of presenting the same resource by various parameters in the request and response: a format, an encoding, a language and so on.

All the *software* for working with the HTTP protocol is divided into three main categories:

- 1) *Servers* which are providers of storage and information processing services (Query Processing).
- 2) *Clients* which are the end users of the server services (sending requests).
- 3) *Proxy servers* the task of which is to support the work of transport services.

The main clients are *browsers*, for example: *Internet Explorer*, *Opera*, *Mozilla Firefox*, *Netscape Navigator* and others. The most popular implementations of the web servers are *Internet Information Services (IIS)*, *Apache*, *lighttpd*, *nginx*. The most known implementations of proxy servers are *Squid*, *UserGate*, *Multiproxy*, *Naviscope*.

The «classic» scheme of the HTTP session looks like this.

- 1) Establishing of a TCP connection.
- 2) Customer Query.
- 3) The server response.
- 4) TCP connection failure.

Thus, the client sends a query to the server, receives a response from it, after which the interaction is terminated. Typically, a client query is a requirement to send an HTML document or some other resource, and the server's response contains the code for that resource.

The HTTP request sent by the client to the server includes the following components:

- 1) A status bar (sometimes the terms «string-status» or «query string» are used).
- 2) Header fields.



- 3) An empty string.
- 4) A body of the query.

A *status bar*, along with the header fields, is also sometimes called «the request header». Figure 9.3 shows the structure of the customer query [49].

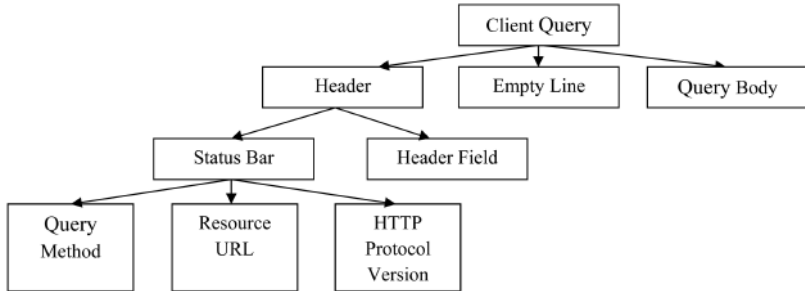


Figure 9.3. Structure of the Client's Query

The status bar has the following format:

***Query\_method URL\_of a resource a version of\_a protocol HTTP***

Let us consider the components of the status bar, with special attention to the query methods.

HTTP Method is a sequence of any characters except control and delimiters, pointing to a main operation over a resource. Usually the method is a short English word written in capital letters.

The name of the method is case sensitive. If the method is unknown to a server, it responds with a 501 (Method not implemented) error. If the method is known to the server but it does not apply to a particular resource, a message with code 405 (Method NotAllowed) is returned. The most commonly used methods are GET, HEAD and POST.

**GET.** It is used to query the contents of the specified resource. GET/path/resource?param1=value1¶m2 = value2 HTTP/1.1 According to the HTTP standard, multiple repetition of the same GET query should lead to the same results. This allows you to cache responses to GET queries.

**HEAD.** It is similar to the GET method, except that there is no body in the server response. The HEAD query is typically used to retrieve metadata, verify the existence of a resource (URL validation), and to find out whether it has changed since the last access.

**POST.** It is used to transfer user data to a specified resource. For example, in blogs, visitors can usually enter their comments on entries in

the HTML form, after which they are passed to the server by the POST method and it puts them on the page. In this case, the transmitted data (in the example with blogs – the text of a comment) is included in the body of the request. Similarly, the POST method usually loads files. Unlike the GET method, for the POST method, repeated transfer of the same POST requests can return different results (for example, after each comment is sent, one copy of this comment will appear). The server response message to the POST method is not cached.

There are also methods: PUT, PATCH, DELETE, TRACE, CONNECT, LINK, UNLINK.

**The HTTP protocol status code** is a numeric value of the protocol state, determined by the result of the processing of the last query.

Currently, there are five classes of the status codes.

**1xx Informational.**

**2xx Success.** A message of this class informs you of a successful acceptance and a processing of a client's request. Depending on the status, the server can still send headers and the body of the message.

**3xx Redirection.** The status codes of the 3xx class inform the client that for a successful execution of the operation, it is necessary to make the following request to another URI. In most of the cases, a new address is indicated in the location field of the header. In this case, as a rule, the client should make an automatic transfer.

**4xx Client Error.** The code of the class 4xx is intended to indicate errors on the part of a client. When using all methods except HEAD, the server must return a hypertext message to the user in the body of the message.

**5xx Server Error.** The 5xx codes are allocated for cases of unsuccessful operation through the fault of the server. For all situations, except when using the HEAD method, the server must include an explanation in the message body which the client will display to the user. An example of a dialog using the HTTP protocol inquiry is below:

*Query:*

*GET / wiki / HTTP HTTP / 1.1*

*Host: en.wikipedia.org*

*User-Agent: Mozilla / 5.0 (X11; U; Linux i686; ru; rv: 1.9b5) Gecko / 2008050509*

*Firefox / 3.0b5*

*Accept: text / html*

*Connection: close*

*Answer: HTTP / 1.0 200 OK*  
*Server: nginx / 0.6.31*  
*Content-language: en*  
*Content-Type: text / html;*  
*Charset = utf-8*  
*Content-Length: 1234*  
*Connection: close*  
*<Contents of the requested page>*

### ***Ensuring the Security of the HTTP Data Transfer***

Since the HTTP protocol is designed to transmit character data in an open (unencrypted) form, the users which have an *access* to the data transfer channel between the client and the server can easily view all traffic and use it to commit unauthorized actions. In this regard, a number of extensions of the basic protocol aimed at increasing the security of *Internet traffic* from unauthorized access are proposed.

The simplest is the *HTTPS* extension, in which the data transmitted over the HTTP protocol is «packaged» into the *SSL* or *TLS* cryptographic protocol, thereby protecting this data. Unlike *HTTP*, *HTTPS* silently uses *TCP port 443*. To prepare a *web server* for handling *HTTPS* connections, the administrator must obtain and install a certificate for this web server on the system.

### **DHTML**

*DHTML* – a dynamic HTML is a set of tools that allow you to create more interactive Web pages without increasing the server load, that is, certain visitor actions lead to changes in the appearance and content of the page without contacting the server.

DHTML is not a standalone language or a web standard. DHTML is built on the Document Object Model (**DOM**), which extends a traditional static HTML document. DOM provides dynamic access to content of the document, its structure and styles. In the DOM, each element of a Web page is an object that can be modified. It can be used to create an application in a web browser: for example, for easier navigation or for giving interactivity to forms. DHTML can be used to dynamically drag items around the screen. It can also serve as a tool for creating browser-based video games.

#### ***Dynamic HTML Events***

On WEB-pages you can provide a response to certain visitor actions or changes in the status of a document or a window that trigger certain events. The visitor generates events while moving the mouse, pressing the mouse buttons and the keyboard. Changes in the state of the document generate

events when the document, images or objects are loaded, when an error occurs on the page or the focus moves from one element to another.

DHTML event model is associated with the specific hierarchy of HTML containers and is based on event pop-ups and default actions.

**Pop-up of events** is that an event can receive a response not only from the source element of the event, but also from all its parent elements up to the body of the document and the document itself. The event can be processed at any level. In the example below, the mouse click handler on the link will also process the mouse clicks on the image.

### Example 1

```
<html>
<head>
  <meta http-equiv="Content-Type" content="text/html; charset=windows-1251">
</head>
<body>
  <H2>The Event Pop-up </H2>
  <b>To receive the information, click either the image or the text </b><br>
  <a href="be.htm">Who is it?</a>
</body>
</html>
```

R e s u l t :

### The Event Pop-up



To receive the information, click either the image or the text  
Who is it?

A *default action* is provided by the processing of the event built into the browser. For example, the default action on clicking the `<A href=»...»>` link is the transfer to the specified address and the page loading. Many events allow you to replace the built-in default actions with individual processing.

### Linking Events

Establishing a connection between a specific event and a script is called *linking events*. Events can be linked using special attributes of any element or using the **SCRIPT** tag.

Linking events to attributes is convenient, but requires an extension of the HTML language each time a new event is invented. And since HTML develops slowly, this approach is used only for a small set of built-in events. Mouse and keyboard events are represented as attributes of any element in DHTML.

### Example 2

## RESULTS:

### To change the practical object point it with the mouse



Sebastian Bach. Johann Sebastian Bach will replace Ludwig van Beethoven.  
Ludwig van Beethoven will replace Johann Sebastian Bach.

## CSS

*Cascading Style Sheets (CSS)* is the language of hierarchical rules (tables, styles) used to represent the appearance of a document written in HTML or XML. CSS describes how an item should be displayed on the screen, paper, voice or using other media. For example, CSS works with fonts, colors, fields, lines, height, width, background images, positioning elements, and many other things.

The main purpose of CSS development was to separate the description of the logical structure of a web page (which is produced using HTML or other markup languages) from the description of the appearance of this web page (which is now made using the formal CSS language) [50].

To date CSS is supported by all browsers. The emergence of CSS has become a revolution in the world of the web design. The specific advantages of CSS are:

- 1) control over the display of multiple documents using a single style sheet;
- 2) more precise control over the appearance of the pages;
- 3) different views for different media (screen, print, and so on);
- 4) sophisticated and well-developed design technique.

*Ways to Connect CSS to a Document.* CSS rules are written in the formal CSS language and are located in the style sheets, that is, style sheets contain CSS rules. These style tables can be placed both in the web-document, the appearance of which they describe, and in separate files that have

CSS format. That is, these style sheets can be connected, embedded in the web document in four different ways:

```
<!DOCTYPE html>
<html>
  <head>
    .....
    <link rel="stylesheet" href="style.css">
  </head>
  <body>
    .....
  </body>
</html>
```

1) when the style table is in a separate file, it can be connected to a web document via the `<link>` tag located in this document between the `<head>` and `</head>` tags. (The `<link>` tag will have an *href* attribute that has the

value of the address of this style table). All the rules of this table are valid for the whole Document;

2) when the style table is in a separate file, it can be connected to the web document via the @import directive, located in this document between the <style> and </ style> tags, (which, in turn, are located in this document between the <head> and </ head> tags) immediately after the <style> tag, which also indicates (in parentheses, after the word url) the address of this style table. All the rules of this table are valid throughout the document;

```
<!DOCTYPE html>
<html>
  <head>
    .....
    <style media="all">
      @import url(style.css);
    </style>
  </head>
</html>
```

3) when the style table is described in the document itself, it can be placed between the <style> and </ style> tags (which, in turn, are located in this document between <head> tags and </ style>head>). All the rules of this table are valid throughout the document;

```
<!DOCTYPE html>
<html>
  <head>
    .....
    <style>
      body {
        color: red;
      }
    </style>
  </head>
  <body>
    .....
  </body>
</html>
```

4) when the style table is described in the document itself, it can be placed in it inside any tag of this document via the attribute style. All the rules of this table are valid throughout the document.

```
<!DOCTYPE>
<html>
  <head>
    .....
  </head>
  <body>
    <p style="font-size: 20px; color: green; font-family: arial, helvetica, sans-serif">
      .....
    </p>
  </body>
</html>
```

***The CSS standard is divided into levels:***

- 1) **CSS1.** Among the opportunities provided by this recommendation there are the following opportunities:
  - Font settings. Possibilities for setting the headset and font size, as well as its style – usual, italic or bold.
  - Colors. Specification allowing you to define the colors of the text, its background, frames and other elements of the page.
  - Text attributes. The ability to specify an inter symbol interval, the distance between words and the height of the line (i.e., line spacing)
  - Alignment for the text, images, tables and other elements.
  - Block properties, such as height, width, padding, and margins and frames. The specification also included limited means for positioning of the elements, such as float and clear [50].
- 2) **CSS2.** Based on CSS1 with additional functions:
  - Block layout. There is relative, absolute and fixed positioning. It allows you to manage the placement of items on the page without tabulation.
  - Types of media. Allow you to set different styles for different media (for example, monitor, printer, PDA).
  - Sound style table. It defines voice, volume and so on for audio media (for example, for blind site visitors).
  - Page carriers. It allows, for example, to set different styles for elements on even and odd pages when printing.
  - Advanced mechanism of selectors (groups of elements).
  - Pointers.
  - Generated content. It allows you to add content that is not in the source document, before or after the desired item [50].
- 3) **CSS3.** It is a formal language implemented using markup language. It has the greatest volume of changes in comparison with CSS1, CSS2 and CSS2.1. The main feature of CSS3 is an ability to create animated elements without using JS, support for linear and radial gradients, shadows, smoothing and many more [50].
- 4) **CSS4.** CSS4 modules are built on the basis of CSS3 and supplement them with new properties and values [50].

## **JavaScript**

JavaScript was originally created in order to make web-pages «live». Programs in this language are called scripts. In the browser, they are connected directly to HTML and as soon as the page is loaded – are immediately executed. JavaScript programs are plain text. They do not



require any special training. In this respect, JavaScript is very different from another language, which is called Java. JavaScript can be executed not only in the browser, but anywhere, you need only a special program – the interpreter. The process of executing a script is called an interpretation. To execute programs, no matter what language they are written in, there are two ways: «compilation» and «interpretation».

- 1) *Compilation* is when a source code of a program is converted to another language, usually into machine code with the help of a special tool, another program called the «compiler». This machine code is then distributed and launched. The source code of the program remains with the developer.
- 2) *Interpretation* is when a source code of a program receives another tool, called the «interpreter», and executes it «as is». In this case, it is the source code (script). This approach is used in browsers for JavaScript.

All major browsers have a JavaScript interpreter built in, which is why they can execute scripts on the page. In the browser, JavaScript can do everything related to manipulating the page, interacting with a user and, to some extent, with a server:

- 1) Create new HTML tags, delete existing ones, change element styles, hide, show elements and the like.
- 2) Respond to user actions, process mouse clicks, move the cursor, press the keyboard, and the like.
- 3) Send requests to a server and download data without reloading the page (AJAX technology).
- 4) Receive and set a cookie (a small piece of data sent by a web server and stored on the user's computer), request data, display messages.

However, with all the appeal, JavaScript cannot read / write arbitrary files to the hard disk, copy them or start programs. It does not have direct access to the operating system. Modern browsers can work with files, but this possibility is limited to a specially allocated directory – «*sandbox*». Opportunities for access to devices are also worked out in the modern standards and are partially available in some browsers.

JavaScript, working in one tab, cannot communicate with other tabs and windows, except when it opened itself this window or multiple tabs from the same source (the same domain, port, protocol). There are ways to get around this, but they require special code for both documents that are in different tabs or windows. Otherwise, due to security reasons, you cannot enter from one tab to another with JavaScript.

You can easily send requests from JavaScript to a server from which the page has come. A request for a different domain is also possible. Therefore, JavaScript is the most common means of creating browser interfaces.

## 9.6. Internet Services

Users spend some time talking to each other being on the Internet. This becomes possible through the use of e-mail, instant messaging services, message boards, participation in forums, on-line conferences, web-communities.

**Web-forum or web-conference** is special software for organizing communication of visitors to a website. The term corresponds to the meaning of the original concept of a «forum». A forum offers a set of sections for discussion. The work of a forum is to create topics for users in sections and the subsequent discussion within these topics. A separately taken theme is a thematic guest book. A message and all the answers to it form a branch («thread»). The discussion should be relevant to the topic. Deviation from the initial topic of the discussion is often prohibited by the forum rules. The rules are followed by moderators and member administrators, endowed with the ability to edit, move and delete someone else's messages in a specific section or a topic, and also to control the access of individual participants to them. In Figure 9.4 there is an example of a page of a forum from Ust-Kamenogorsk.

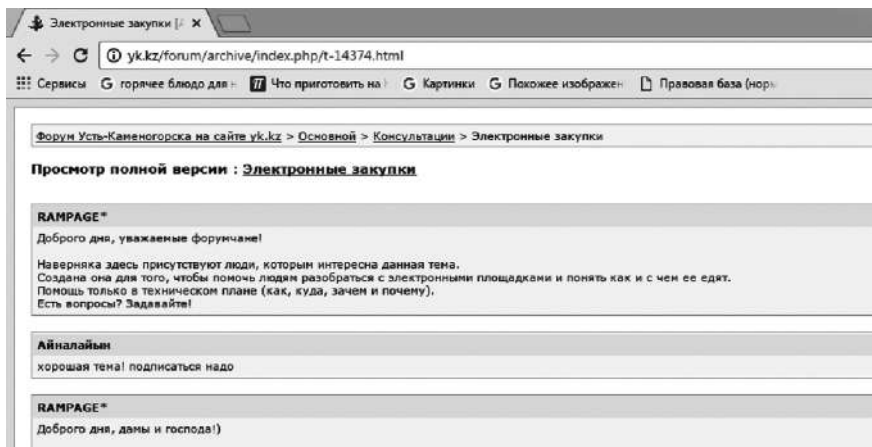
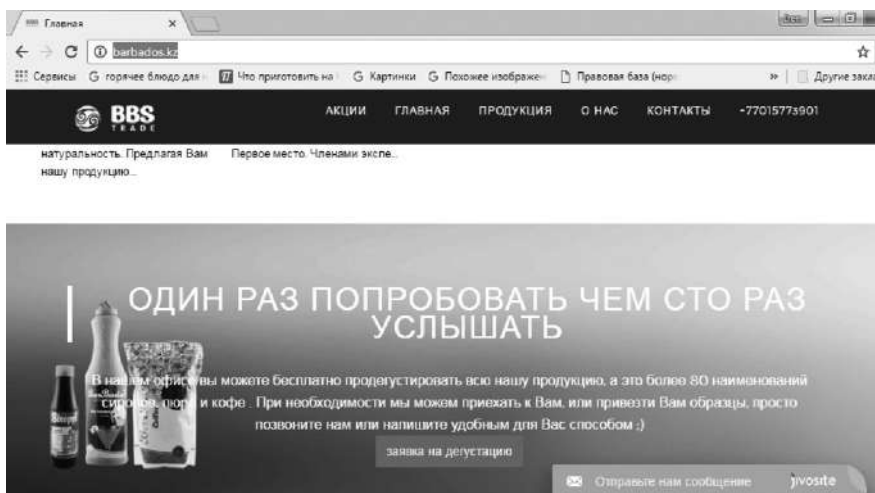


Figure 9.4 A forum page

**Bulletin Board System (BBS)** creates specialized network services, which activities are devoted to a specific topic. BBS usually contains files with information of interest to certain groups of users, as well as tools that allow users of the bulletin board to exchange information on issues of interest to them. Through BBS, maintenance is provided: users send questions, and staff responds to them. Below Figure 9.4. shows an example of the site <http://barbados.kz/>.



*Figure 9.4 An example of the site <http://barbados.kz/>*

**Electronic mail (E-mail)** is a means for transferring electronic messages between users of a network; it provides all subscribers of the network an opportunity to use their computers to conduct business and personal correspondence. A letter sent by a subscriber-sender in the form of a text file is transmitted (via a modem) to a telephone line for delivery to a recipient. This letter arrives to a mail server of the network host, which determines a route of the message forwarding it to the address of the recipient. Post machines are intermediaries between the subscribers providing exchange of letters in the e-mail system. The recipient-subscriber, having addressed to his mail machine (at a convenient time), receives all the correspondence into his mailbox that has been accumulated there for him since the previous connection.

In the simplest case, a message is transmitted in the following way: first, a modem of the sender establishes a connection (via a telephone line) with

a modem of the host computer - the mail machine (the familiar analogue is the post office of the communication) by a procedure initiated by the sender. When the connection is established, the computer of the subscriber-sender is identified, a password is checked and the prepared letters are loaded, after that the modem of the subscriber-sender «hangs up». Then the mail machine, having checked the correctness of the indicated address, will begin to prepare and transmit this message to the mail receiving-machine via the communication channels.

For the posted-mail to reach its addressee, it is necessary to make it up in accordance with the international standards and to have a standardized e-mail address. The common format of the message consists of a header and the message itself (an arbitrary compiled file containing a program, a text, or graphic data).

The heading looks approximately like this:

**From:** an email address of a sender of the message

**To:** a recipient's e-mail address

**Cc:** postal addresses of other subscribers who should also receive the letter

**Subject:** a subject of the message (in an arbitrary form)

**Date:** date and time when the message was sent

The **From:** and **Date:** header lines are formatted automatically by software. The e-mail address contains the subscriber identifier (similar to the line «TO:» on the postal envelope) and postal information that determine its location (by analogy – home, street, city, country on postal envelopes).

In order to separate the subscriber's identifier from the postal information in the postal electronic address, a special symbol @ is used (commercial «AT», called «dog» on the computer Jargon). In the Internet format, an e-mail address can look like: **info @ kurort-borovoe.kz**.

In this example, «info» is a subscriber's ID (user name). The part that is located to the right of the @ sign, is called a domain and uniquely describes the location of the subscriber. The constituent parts of the domain are separated by dots. The rightmost part of the domain indicates a country code of the destination – this is the top-level domain. These codes are approved by the international standard: the code of our country is «kz» (Kazakhstan). The next sub-domain is «kurort-borovoe» – the name of a computer registered on the mail host, on which the above-mentioned subscriber owns a mailbox.

Thus, each user of the network has a unique email address. E-mail services provide a wide range of services at our disposal, such as: sending

copies of letters to other subscribers (simultaneously with the letter to the main addressee), receiving a notification (confirmation) of the delivery of the correspondence, a possibility of thematic archiving of the letters, convenient editing tools, and many more.

Possessing advantages not only in front of the ordinary mail, but also in front of a telephone and facsimile communication with respect to the speed of message delivery, reliability, costs, and also providing its subscribers with a high-quality service when processing electronic information, e-mail is becoming an increasingly popular means of communication and interaction, especially during joint project discussions and research with the participation of experts from different regions of the world, opens a unique opportunity for joint editing of documents, ensuring the preservation of intermediate versions in the archives and so on.

The development of Internet technology has led to the emergence of modern protocols for messaging, which provide great opportunities for processing letters, a variety of services and ease of use.

### **SMTP**

*SMTP (Simple Mail Transfer Protocol)* is a network protocol designed for sending an e-mail in the TCP / IP networks, a transmission must be initiated by the transmitting system itself.

To deliver an e-mail via the Internet, a source machine establishes a TCP connection with port 25 of a receiving machine. This port is listened to by the mail daemon, and their communication occurs using the SMTP (Simple Mail Transfer Protocol). This domain accepts incoming connections and copies messages from them to the appropriate mailboxes. If the message cannot be delivered, an error message containing the first part of this message is sent to the sender.

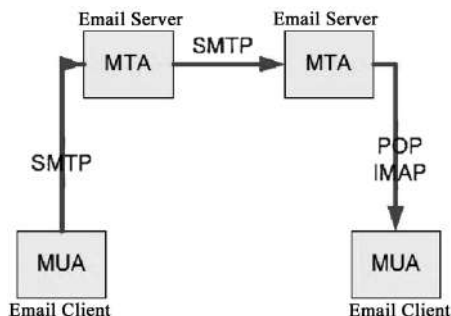


Figure 9.5. SMTP Protocol Communication Scheme

**MTA (Mail Transfer Agent)** is the main component of the Internet mail transfer system that represents this network computer for the networked email system. Usually users do not work with MTA, but with **MUA (Mail User Agent)** – an email client. Schematically, the principle of the interaction is shown in Figure 9.5.

The SMTP protocol is a simple ASCII protocol. Establishing a TCP connection to port 25, a sending machine, acting as a client, waits for a request from a host machine running in the server mode. The server starts a dialogue by sending a text string containing its identifier and informing about its readiness (or un-readiness) to receive mail. If the server is not ready, the client breaks the connection and continues trying later. If the server is ready to receive mail, the client declares from whom the mail arrived and to whom it is intended. If the recipient of the mail exists, the server gives the client permission to forward the message. Then the client sends the message. And the server confirms its receipt. Checksums are not checked, since the TCP protocol provides a reliable byte stream. If the sender has another mail, it also leaves the sending machine. After the transmission of all mail in both directions, the connection is disconnected [55].

### POP

POP, POP2, POP3 (Post Office Protocol) – three fairly simple noninterchangeable protocols, developed for mail delivery to a user from a central mail-server, delete it from it and to identify the user by name / password. POP includes SMTP, which is used to send mail emanating from the user. Mail messages can be received in the form of headers, without receiving the whole letter.

The protocol versions (POP, POP2) are obsolete. **Post Office Protocol Version 3** is the post office protocol used by an email client to receive the e-mail from the server. Typically it is used in conjunction with the SMTP protocol. There are implementations of POP3 servers that support TLS and SSL.

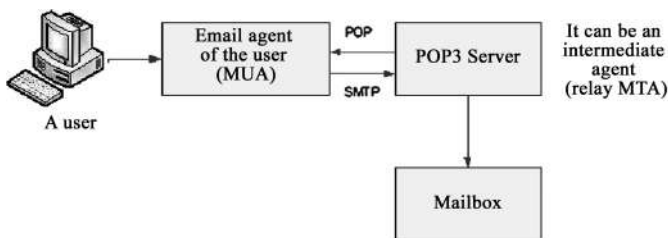


Figure 9.6. The POP3 protocol interaction scheme

After connection is established, the POP3 protocol passes three consecutive states:

- 1) Authorization, the client undergoes the authentication procedure.
- 2) Transaction, the client receives information about the status of the mailbox, receives and deletes mail.
- 3) Updating, the server deletes the selected messages and closes the connection.

Although the POP3 protocol does support the ability to receive one or more emails and leave them on the server, most email programs simply download all the emails and empty the mailbox on the server.

It is enough for a user who has one account from one provider and always connects to the provider from the same machine to have the POP3 protocol. This protocol is used everywhere due to its simplicity and reliability. But many users have one account in an educational institution or at work, but they want to have access to it from home, and from work (study), and during a business trip, that is from different places. Although the protocol POP3 allows you to resolve this situation, the problem is that when using e-mail in such a way, all user correspondence will be very quickly spread randomly between the machines from which the user has accessed the Internet, and some of these computers may not belong to the user at all. This inconvenience led to the creation of an alternative protocol for receiving mail, IMAP [53].

### ***IMAP***

*IMAP (Internet Message Access Protocol)* is an Internet application protocol for accessing e-mail. IMAP2, IMAP2bis, IMAP3, IMAP4, IMAP4rev1 (Internet Message Access Protocol).

IMAP provides a user with many opportunities to work with mailboxes located on the central server. A mail program that uses this protocol will access the correspondence storage on the server as if it were located on the recipient's computer. E-mails can be manipulated from the user's computer (client) without the need to constantly transfer files from the server and back to the full content of messages [54].

IMAP was designed to replace the simpler POP3 protocol and has the following advantages over the latter:

- 1) Letters are stored on the server, not on the client. You can access the same mailbox from different clients. It also supports the simultaneous access of multiple clients. In the protocol there are mechanisms by which the client can be informed about the changes made by other customers.

- 2) Support for multiple mailboxes (or folders). The client can create, delete and rename mailboxes on the server, and also move mail from one mailbox to another.
- 3) It is possible to create shared folders, which can be accessed by several users.
- 4) Information about the status of the letters is stored on the server and is available to all clients. Letters can be marked as read, important, and etc.
- 5) Support of the search on the server. There is no need to download a lot of messages from the server in order to find one you need.
- 6) Support for online work. The client can maintain a permanent connection with the server, while the server in real time informs the client about changes in mailboxes, including about new letters.
- 7) There is a mechanism for expanding the capabilities of the protocol.

The current version of the protocol has the designation IMAP4rev1 (IMAP, version 4, revision 1). The protocol supports the transfer of the user's password in an encrypted form. In addition, IMAP traffic can be encrypted using SSL.

### ***ICQ***

*ICQ* (an acronym for English «I seek you») is a service that allows network users to exchange messages in real time, as well as to organize a chat, transfer files and more. The oldest messenger is 20 years old.

The first version was issued on November 15, 1996 by four Israeli high school students. In fact, it could only exchange messages. A client could do it by connecting to the server [icq.mirabilis.com](http://icq.mirabilis.com), to port UDP 4000. A year later, in December 1997, there were client applications for Windows 3.1x, 95, NT and Macintosh. In 1998, ICQ 98 introduced a function of microblogging, in 98SE – a repeated sending of undelivered messages. In 2002, in version 99a, a set of the following functions was developed: saving a history of the correspondence, searching for users, sending emails, creating groups in the contact list and so on (Figure 9.5)

In ICQ 99b version, developers have implemented data encryption.

The sixth version of the protocol, which appeared in ICQ 2000b, was completely redesigned, encryption intensified. Thanks to the new protocol ICQ user could call phones, send SMS and paging messages, send requests for list of contacts to other users. In 2004, there was the first mobile version of ICQ (Figure 9.6), created for Symbian S60 [52].



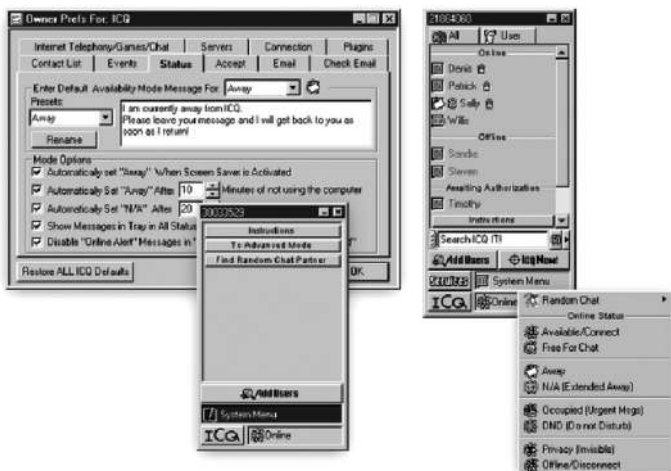


Figure 9.5. Interfaces of 99a ICQ Version



Figure 9.6. The First Mobile Version of ICQ

In 2009, ICQ appeared on Windows Mobile. In 2010, ICQ was acquired by Mail.Ru Group, and in January 2011 the 7th Version appeared, which included integration with Facebook, Twitter, Gmail, Youtube, Flickr and Mail.Ru.

At the end of 2012 ICQ 8 was released, this version made it possible to call mobile and city numbers, it also was integrated with social networks-Vkontakte and Classmates. Since 2016 in ICQ you can make tiny videos or collections of photos, which could be viewed in a general tape within 24 hours after the creation. ICQ has a built-in editor that allows you to add various effects to photos and videos, including texts, patterns and stickers.

Moreover, the program analyzes the coordinates when shooting, and offers by itself a number of thematic badges [52].

### **IP Telephony**

IP telephony refers to a set of communication protocols, technologies and methods that support dialing, dial-up and two-way voice communication traditional for telephony, as well as video communication over the Internet or any other IP-networks.

In IP-telephony information is transmitted via IP-networks (IP – Internet Protocol) through a regular or sip-phone. The signal is first converted to digital, and then it is transformed to reduction of volume and load, decoded, and transmitted to a respondent.

This method of communication has several advantages over the usual telephone communication:

- 1) Low price – the cost of IP- communication is much less than of telephone calls both within the same city, and between the distant regions and countries.
- 2) Ability to communicate with several people at the same time, which saves time, allowing users to make conferences in real time.
- 3) High quality of communication.
- 4) Security of the call and data transmission.
- 5) Ability to create a video call, creating the maximum effect of presence.
- 6) Routing the call.
- 7) Determination of the incoming call number, call forwarding.
- 8) Additional services within the framework of IP-telephony, with which you can find out whether a particular subscriber is available, edit and manage an address book and so on.

### ***Kazakhstan Voip-Operators***

«**Kazakhtelecom**» is a national telecommunications operator providing an extensive range of telephony services. IDPhone is the telephony service provided by the sip-protocol.

**Astel** is an operator of communication, which provides sip-numbers in all cities of Kazakhstan.

### ***Russian Voip-Operators***

**Telfin** is a voip-telephony operator that provides international communication services in Kazakhstan.

### **Skype**

Skype is free *proprietary* software with closed code, providing encrypted voice communication over the Internet between computers, as well as paid communication services with subscribers of the ordinary telephone network.

The creators of Skype are Niklas Zennstrom and Janus Friis. The first release of the program and the site appeared in September 2003. Proprietary software is private, proprietary software that is privately owned by authors or rightholders and does not meet the criteria of free (open source). Skype can be used on various devices: a computer, a mobile phone, a tablet, a TV and even a home phone, while staying in touch at home, at work or on the road.



*Figure 9.7. Skype Logo*

The program allows you to make conference calls (up to 25 voice subscribers, including the initiator), video calls (including video-conferences up to 10 subscribers), and also provides transmission of the text messages (chat) and file transfer. There is an opportunity to transfer an image from the screen of a monitor instead of the image from a web camera, and also to create and send video messages to users of desktop versions of the program.

Skype's software clients are released for Mac OSX, iOS, Windows, Linux, Windows Phone, Open webOS, Android, PSP, Maemo, Xbox 360, PlayStation Vita, BlackBerry. A version was also released For Java. Skype support is provided in many modern TVs: LG Panasonic, Philips, Samsung, Sharp, Sony, Toshiba.Vizio.

### **WhatsApp**

WhatsApp is a popular free instant text messaging system for mobile and other platforms with voice support. It allows you to send text messages, images, video and audio over the Internet.

The client works on Android platforms, iOS, Windows Phone, BlackBerry, Nokia Symbian, NokiaS40, as well as Windows.

WhatsApp Inc., which created the messenger, was founded by Jan Kum and Brian Acton on February 24, 2009 and is based in the US; since October 2014 it belongs to Facebook. Since 2016, the application has become free, a user pays only for the Internet traffic used by the application. The application has more than billion users. Because of the high popularity of WhatsApp, the revenue of the mobile operators for the transfer of SMS-messages between the phones is reduced. WhatsApp

uses a modified XMPP protocol. When installing, an account is created on the server s.whatsapp.net, using the phone number as the user as its name (Marat ID: [number Phone] @s.whatsapp.net).

Multimedia messages are sent by uploading an image, a sound or a video to the HTTP server and transferring the hyperlink to the object. WhatsApp automatically synchronizes the contact list with the phone book of the phone. This is possible due to the fact that all users are registered with their phone number.

The server software WhatsApp is written in Erlang; In January 2012, WhatsApp servers used OC FreeBSD. In 2015, the application got a backup function. Users can create backup copies of their conversations, photos, video and audio data.

Since April 2016 with the release of the updated version 2.16.12 WhatsApp has included end-to-end encryption for all users. Encryption applies to all types of messages: text, photos, videos and voice messages. Encryption is also available in group chats. According to the company, only the recipient can decipher such messages, the content is not available even to the WhatsApp servers.

## 10. CLOUD AND MOBILE TECHNOLOGIES

### *General Definition of Cloud Technologies*

The term «Cloud Computing» (CC) has been used in the IT market since 2008. The developers of cloud computing define it as an innovative technology of distributed data processing that provides dynamically scalable computing resources and applications via the Internet as a service under the control of a service provider. If we explain it in an accessible language, it is in some sense a user's work platform on the Internet, or rather on a remote server.

Let's consider an example to make sure that each of us has already faced a cloud technology one way or another. Virtually all Internet users have e-mail. Work with mail on any site-service (for example, gmail), which allows you to use this mail, is nothing but a cloud service. Or, for example, image processing. If a user reduces the size or turns a photo in a Photoshop graphics editor or in another special program, it has nothing to do with the cloud technology – everything happens and is processed locally on the user's computer. But, if you download an image, for example, through the service Picase (for processing digital images) and process it in a browser, then this is the «cloud».



*Figure 10.1. Cloud Technologies*

The only difference is the method of storing and processing of data. If all operations occur on the user's computer (using its capacities), then this is not a «cloud», but if the process takes place on a server on a network, then this is the technology that is commonly called «cloud technology». In other words, these are different hardware, software tools, methodologies, and instruments that are provided to a user by Internet services for the realization of their goals, tasks, projects.

## 10.1. Services Provided by Cloud Technologies

Cloud computing is usually called **aaS** – «**as a Service**», that is, «as a service», or «in the form of a service». Currently, the concept involves the provision of the following types of services to its users:

- 1) **Storage-as-a-Service**. This is the easiest of the SS-services, which is a provision of a disk space on demand. Sometimes a user can get a warning on the monitor: «*The logical disk is full. To free up space, delete unnecessary programs or data*». The service «Storage-as-a-Service» provides an ability to protect data in external storage, in the «cloud». For the user, it will look like an additional logical drive or a folder. The service is the base for the rest of the services, since it is a part of almost every one of them. An example is Google Drive and other similar services.
- 2) **Database-as-a-Service**. This service provides an opportunity to work with databases, as if the DBMS was installed on a local computer.
- 3) **Information-as-a-Service**. It allows you to remotely use any type of information that can change every minute or even every second.
- 4) **Process-as-a-Service** («process management as a service»). It is a remote resource that can link several resources (such as services or data contained within one «cloud» or other available «clouds») to create a single business process.
- 5) **Application-as-a-Service** or **Software-as-a-Service**, is positioned as «on-demand software» that is deployed on remote servers, and each user can access to it through the Internet, all issues of updating and licenses for this application are regulated by a provider of this service. Payment, in this case, is made for the actual use of the latter. An example is Google Docs, Google Calendar and similar on-line programs.
- 6) **Platform-as-a-Service**. A user is provided with a computer platform with an installed operating system and some software.
- 7) **Integration-as-a-Service**. It is an opportunity to receive a complete integration package from a «cloud», including program interfaces between the applications and the management of their algorithms. This includes such known services and functions as centralization, optimization and integration of enterprise application (EAI) packages, but which are provided as a «cloud» service.
- 8) **Security-as-a-Service**. This type of service provides an opportunity for users to quickly deploy products that allow secure use of web

technologies, e-mail, local networks, which allows the users of this service to save on the deployment and maintenance of their own security system.

- 9) **Management / Governance-as-a-Service** («administration and management as a services»). These are basically such parameters as topology, resource usage, virtualization.
- 10) **Infrastructure-as-a-Service**. The user is provided with a computer infrastructure, usually virtual platforms (computers) connected to a network, which he independently configures for his own goals.
- 11) **Testing-as-a-Service** («testing as a service»). It makes it possible to test local or «cloud» systems using test software from a «cloud» (no hardware or software is required at the enterprise).

Figure 10.2 shows the services of the cloud architectures.

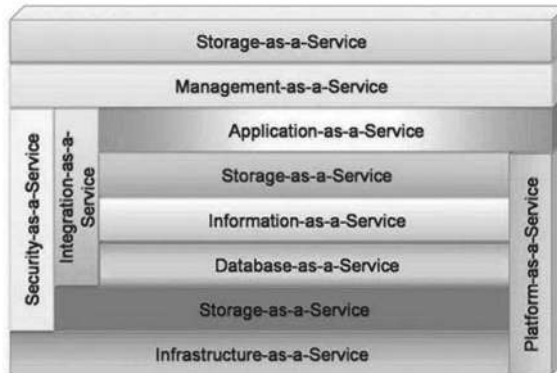


Figure 10.2. Services of «Cloud» Architectures

Consider some solutions, services, programs that exist in the IT market.

### Services.

**iCloud.** A «Cloud service» iCloud from Apple (which came to replace MobileMe) is fully automatic and free. This service stores user content (mail, calendar, contacts, documents, music, videos and images and so on) on servers, and then delivers it to all devices (iPhone, iPad, iPod Touch, Mac and PC) using the **Push** wireless technology.

**Google Play.** A «Cloud service» called Google Play, which is designed to accommodate users of movies, music, applications, and books on servers specially designed for storing digital information. An access to the service is provided directly from the browser, regardless of the OS, and therefore can

be carried out from both PCs and mobile devices based on Android. Each user has an opportunity to post and store thousands of music records on a free basis, as well as other digital products – movies, e-books, programs, music tracks, purchased or rented from the stores (*Android Market, Google Music and Google eBookstore*).

**OnLive.** It provides the ability to play modern games even on the simplest computer. Technically, it looks like this: a game itself is located on a remote server, and the graphics is also processed there, that arrives on the computer to the user already in the «ready» form. Calculations that, in a normal game, are performed on a computer by a video card, processor and other devices, are performed on the server, and the computer is used only as a monitor receiving the final picture.

### Software Solutions

**Google and Microsoft** have released sets of services that allow you to work with documents.

Google offers **Google Drive**. This is a free online office, including text, spreadsheet, presentation tools, Google Translate, Google Maps for mapping service, Google Talk messenger, as well as an Internet service of cloud storage of files with the file-sharing functions. You can open files in the drive from your smartphone, tablet, or computer. This is web-based software that runs within a web browser without installation on a user's computer – an alternative version of Word, Excel and other applications.



Figure 10.3. Office Web Apps



Microsoft offers **Office Online** (formerly Office Web Apps) is an online office application that allows users to create and edit files using lightweight Web versions of Microsoft Office applications: Word, Excel, PowerPoint, OneDrive (Figure 10.3). In addition to these applications, the package includes Sway, Outlook.com, People & Calendar.

A corporate version of a service called Office **Web Apps Server** can be installed on a private cloud storage with services such as Microsoft SharePoint, Microsoft Exchange Server, and Microsoft Lync Server.

## 10.2. Forms of Ownership the Cloud Computing Technology

According to the form of ownership, cloud technologies can be divided into three categories:

- 1) Public.
- 2) Private.
- 3) Hybrid.

A *«public cloud»* is an IT infrastructure used by many companies and services at the same time. Users do not have an ability to manage and maintain this «cloud», and all responsibility for these issues lies with the owner of the resource. Any company and individual user can become a subscriber of the services offered. Examples are online services: Amazon EC2, Google Apps / Docs, Microsoft Office Web.

A *«private cloud»* – this is a safe IT-infrastructure controlled and operated in the interests of a single organization. The organization can manage a private «cloud» independently or assign this task to an external contractor. The infrastructure can be located either in the premises of the customer, or the external operator (or partly at the customer and partly at the operator).

A *«hybrid cloud»* is an IT infrastructure that uses the best qualities of a public and private cloud when solving a given task. Often this type is used when an organization has seasonal activity periods, in other words, as soon as the internal IT infrastructure does not cope with the current tasks, some capacity is transferred to a public «cloud» (for example, large volumes of statistical information), as well as to provide access to users to the resources of the enterprise through a public «cloud».

### **Advantages and disadvantages of cloud computing**

*Advantages:*

- 1) An access to personal information from any computer connected to the Internet.

- 2) You can work with information from different devices (PCs, tablets, phones and the like).
- 3) Web-services work in the browser on any OS.
- 4) Multiple users can have an access to one information, they can view, edit it simultaneously from different devices.
- 5) Many paid programs can be used for free or at a lower price.
- 6) If technical devices are out of order (PC, tablet, phone, etc.), a user will not lose important information, since it is now not stored in the device memory.
- 7) A user uses up-to-date and updated information.
- 8) «Cloud» technologies always provide its users with the latest versions of programs, they do not need to monitor the release of new versions.
- 9) Users can combine information and share it.

*Disadvantages:*

- 1) **The need for a permanent connection.** To access the services of the «cloud» you need a permanent connection to the Internet.
- 2) **Software.** There are restrictions on the software, which can be deployed on the «clouds» and provide it to the user. The user has limitations in the software used and sometimes does not have an ability to customize it for his own purpose.
- 3) **Confidentiality.** Confidentiality of data stored in public «clouds» is currently very controversial, but in most cases experts agree that it is not recommended to store the documents most valuable to the company on a public «cloud», since there is currently no technology, which would guarantee 100% confidentiality of the data.
- 4) **Security.** «Cloud» in itself is a fairly reliable system, but when it is penetrated by an attacker he gets an access to a huge data. Yet one more minus is the use of virtualization systems in which, as a hypervisor, kernels of standard OS (for example, Windows) are used, which allows using viruses and vulnerability of the system.
- 5) **Expensiveness of equipment.** To build your own cloud of the company, you need to allocate significant material resources, which is not beneficial to the newly created and small companies.

### 10.3. Cloud Business Applications

Most of the software products are either foreign or Russian, there are few Kazakh developments. As a rule Kazakhs IT companies working in the field of business applications are integrators. This means that a

company does not develop software from scratch, but provides services for the adjustment (configuration) of existing solutions for specific business objectives (for example, based on the 1C platform).

In the segment of cloud technologies, such directions as introduction and integration of the business applications began to grow rapidly. These are increasing volumes of ERP, CRM, BI-projects, which far exceed the prospects of outsourcing and cloud computing. The market of Kazakhstan IT services is growing both due to the «classical» projects of implementing ERP and CRM-systems, and due to the rapidly growing projects – the creation of analytical systems of classes BI, ABM and EPM. A definite dynamics is demonstrated by the market of mobile application development services.

A significant share in the industry revenue structure is consulting in implementation and development of ERP-systems, and the development of specialized business applications. At the industrial enterprises, first of all at petrol-chemical plants, metallurgy and industrial sector there is a shifting of the demand from accounting systems to production systems – new technologies are actively being introduced at the level of MES-systems and automated process control systems.

IT management solutions are in demand. This is a whole complex of systems for consolidating infrastructure, integrating applications and data, providing business analytics and forecasting.

Today in Kazakhstan there are more companies engaged in their own development. It is connected with the growing popularity of web applications. In particular, there are Kazakhstan solutions for medicine, electronic document-turnover, solutions based on corporate portals. The company «Inside» specializes in software development for business process automation in such areas as restaurant business, trade, medicine. The company is the developer of a «cloud» application for medical centers – «Electronic Clinic MedElement». It is a full-featured medical information system working through the Internet. By connecting to the web service, a clinic can automate all the main processes: maintaining an electronic schedule of receptions, filling out medical records, creating and maintaining an electronic database of patients and receptions, automatic formation of economic and statistical reporting. There is no other software product with similar functions available in the «cloud» in Kazakhstan or in the Russian market.

There are already a number of private medical centers in Almaty, Astana, Atyrau, Semey using this application. An important plus of web applications

is that their functionality is constantly expanding, and all clients connected to the service receive updates free of charge in automatic mode.

In the near future it is planned to introduce an additional function of the «Electronic Clinic MedElement», such services as a web-cash desk, a web pharmacy, and a separate large project «The Patient's Electronic Cabinet». The patient's cabinet will simplify the communication between the clinic and its patients. Now the company is only planning to enter foreign markets.

#### **10.4. Basic Terms and Concepts of Mobile Technologies**

Several decades ago, at the beginning of its development, mobile technologies were not yet very mobile. Proud and very well-to-do owners needed a good physical form to operate comfortably enough with heavy and cumbersome gadgets. In addition, it was necessary to have an access to an electrical outlet to use the first mobile devices, since the batteries had not yet been built in.

Since then, technology has progressed incredibly, and especially during the past ten years. Mobile devices have become smaller, more powerful, and much more useful. They have penetrated into all spheres of our life, and their role continues to grow. The availability of all kinds of smartphones, tablets, electronic readers, now even smart watches and, in the near future, smart points, contributes to their rapid spread throughout the world. Of course, all these billions of mobile devices have a serious impact on the quality of our lives.

*The first mobile systems* were based on the principle of analog communication systems. The first cell phones were used exclusively as an alternative to the usual analog terminals. Over time, mobile technologies were supplemented by some basic services.

*The second generation systems*, as well as the GSM standard, differ from their predecessors with better transmission quality, signal protection, they include additional services and low speed data transmission. Mobile GSM technologies provide a user with roaming services for the convenience of a subscriber to move between the countries and the continents without changing the cellular operator. Almost immediately after the emergence of the second generation mobile systems, there was a need to design standards for the next-generation mobile communications. The research was carried out both at the global and the regional level. The new frequency range was chosen within the limits of 2 GHz, and, therefore, it was often designated as 2000.

There were various projects on the transition to third generation systems. Specialists distinguished two alternative ways of transition: a gradual transition from existing mobile technologies and a one-time «jump». A decision on gradual integration was made by the majority of votes, which has been reflected in the developments.

**Technologies of the third generation** provide high-quality transmission of sound (speech), images, multimedia content. In addition, 3G also means access to the Internet and the exchange of data between a personal computer and a cell phone. The transmission speed will be increased from 9.6 Kbps to 2 Mbps. The first priority of the third generation networks is to improve the quality of second generation networks, adding a lot of new services. The mobile technologies of the third generation include:

- IP-telephony;
- Voice calls;
- Video telephony;
- Audio / video streams (video, photography, television);
- Mobile office;
- Web browsing;
- Services related to the location of the subscriber (navigation in an unfamiliar place), guidebooks and maps, security);
- Games;
- Electronic mobile commerce (search and selection of goods, services, payment for products).

**The fourth generation** includes the advanced technologies that allow data transfer with speed, exceeding 100 Mb/s – mobile (with high mobility) and 1 Gb/s – fixed subscribers (with low mobility).

Mobile technologies have firmly entered the life of modern man, and therefore it is impossible to imagine a successful business without using advanced technology.

## 11. MULTIMEDIA TECHNOLOGIES

Multimedia (multiple environments, English) is the interaction of visual and audio information under the control of an interactive software using modern technical and software tools, they combine text, sound, graphics, photos, video in one digital representation. For example, text, sound, graphic, and video information could be placed in one object-container, a way of interactive use of it is also possible.

The term multimedia is also often used to designate storage media that allows you to store large amounts of data and provide fast enough access to them (the first carriers of this type were CD – compact disk). In this case, the term multimedia means that a computer can use such media and provide information to the user through all possible types of data, such as audio, video, animation, image and others in addition to traditional ways of providing information, such as text. The definition, given above, is actually a custom definition, that is, a general simplified definition of multimedia for understanding by a computer user. Scientific and technical definition of multimedia is a bit different.

**Multimedia** are multiple information environments – interfaces that provide input/output of information of various types into a computer, a computer creation, processing and display of information of different levels and structures for perception by different senses of a person at the same time. Multimedia is a set of information environments – channels, each of which has its own specific form, corresponding to its level and purpose.

- 1) Basic environments are ordered in ascending order as following: binary environments, including processor instructions, binary program and data files;
- 2) Contact media, which are tactile, strain-gauge, electrocontact, capacitive and other sensory media, serving for the input of mechanical, code and other spatially dependent information;
- 3) Text environments, which are text data for people, program texts for the operation of interpreters, other textual information;
- 4) Audio streams representing sound files, numbers of digitized sound, sets of music audio data and other types of digital sound;
- 5) Graphical environments, which are files of drawings, photographs and other two-dimensional graphic information;
- 6) Video streams representing video files, rows of dynamic graphic information;

7) Virtual reality, which is an interactive 3D-video stream.

The use of multimedia makes it easy for people to perceive information, because a person has completely different means and methods of information processing than a computer and have a form of perception that is convenient for a person.

If a computer is characterized by binary-discrete forms of information with electrical transmission of information signals (1/0), a person has multi modal-analog forms of predominantly non-electric nature (light, sound, pressure, etc.).

Without creating such environments, the perception of computer information by a person is extremely difficult, and even more difficult is the transfer of multi-modal information from one person to another through computer facilities. Therefore, technology and multimedia technology includes a wide range of different interfaces, such as input interfaces (sensors – video camera, microvon, touch screen and others; converters – ADCs, special processors for converting external information), and output interfaces (displays, sound sources and other) [56].

### **11.1. Multimedia Classification**

Multimedia can be divided into a linear (without feedback) and *interactive* environment.

An analogue of the *linear* representation method can be a movie. A person viewing this document in no way can influence its output.

An *interactive* (non-linear) way of presenting information allows a person, programs, networks to participate in the output of information, interacting in some way with the display medium, which displaces the multimedia data. Participation in this process of two or more parties is called «interactivity». Such a way of interaction of a human and a computer is most fully represented in the categories of computer games. Interactive way of presenting multimedia data is sometimes called «hypermedia».

As an example of a linear and interactive way of presenting information, let us consider a presentation. If a presentation was recorded on a tape or as a video file, and it is shown to an audience, those who view this presentation are not allowed to influence its progress.

In case of a live presentation, the audience has an opportunity to ask a speaker questions, interact with him in a different way, which allows the speaker to move away from the presentation topic, explaining some terms or detailing the controversial parts of the presentation. Thus, a

live presentation can be presented as an interactive (non-linear) way of submitting information.

### ***Local and Network Multimedia Capabilities***

Multimedia presentations can be conducted by a person on a stage, shown through a projector or on another local playback device. Broadcast of the presentation can be either «live» or pre-recorded. Broadcasting or recording can be based on analog or electronic technologies for storing and transmitting information. It should be noted that multimedia online can either be downloaded to the user's computer and reproduced in some way, or reproduced directly from the Internet with the help of technologies of streaming data transmission. Multimedia, reproduced using streaming technology can be as «live», and provided on demand.

*Multimedia games* are the games, in which a player interacts with a virtual environment built by a computer. Condition of the virtual environment is transmitted to the player through various ways of transmitting information (sound, visual, tactile). Currently, all computer games or games in add-on devices are related to multimedia games. It is worth noting that in this type of games you can play either alone on a local computer or on an add-on device, or with other players through a local or global network.

Different formats of multimedia data can be used to simplify the perception of information by a consumer. For example, it is possible to present information not only in a text form, but also illustrate it with audio data or a video clip. In the same way, contemporary art can represent everyday things in a new way.

Various forms of providing information make it possible for a consumer to interact with information. Online multimedia is increasingly becoming object-oriented, allowing the consumer to work on information without having specific knowledge. For example, in order to lay out a video on YouTube or Yandex.Video, the user does not need knowledge on editing video, encoding and compressing information, or the knowledge on how a web-server works. The user simply selects a local file, and thousands of other video-service users have the ability to view a new video.

*Multimedia Internet Resource* – it's an Internet resource, in which the basic information is presented in the form of multimedia. This is a modern and very convenient mechanism that does not replace the performance of classical functions, but complements and expands the range of services and news for visitors. Multimedia Internet resources is characterized by the following:



- 1) They can contain various types of information (not only text, but also audio, graphic, animation, video, and so on);
- 2) They have a high degree of visibility of materials;
- 3) They support various types of files: text, graphics, audio and video;
- 4) They can be used to promote creative works in the field of various arts;
- 5) By virtue of its visibility multimedia reduces the level of intellectual and psychological barrier between a user and information technology process.

A resource of this type makes it possible to quickly report on events that are organized, to demonstrate a view on an event, an institution or a creative team, to establish feedback with its visitors, to disclose goals and materials using modern information representation mechanisms and to facilitate the recognition of the represented object through the Internet.

## **11.2. Using Multimedia**

Multimedia finds its application in various fields, including, advertising, art, education, entertainment industry, technology, medicine, mathematics, business, scientific research and space-time applications and other information processes involving people.

### ***Education***

In education, multimedia is used to create computer training courses and reference books, such as encyclopedias and collection materials. Training courses allow a user to go through a series of presentations, thematic text and related illustrations in various formats for presenting information. Entertaining education (edutainment - the term used in the US) is an education uniting education and entertainment methods, especially multimedia entertainment.

The theory of education over the past decade has been significantly developed in connection with the advent of multimedia. Several directions of research, such as the theory of cognitive loading, multimedia training and others have appeared. The opportunities for education and upbringing are almost endless. The idea of media convergence is also becoming one of the most important factors in the field of education, especially in higher education. Media convergence, defined as separate technologies such as voice (and telephony functions), databases (and derived applications), video technologies, which now share resources and interact with each other, comprehensively creating new environments, is the rapidly changing

curriculum of disciplines taught at universities around the world. Newspaper companies are also trying to cover a new phenomenon by introducing its practices into their work [57].

### ***Hardware and Machinery***

Software developers can use multimedia in computer simulations of anything: from entertainment to learning, for example, in military or industrial training. Multimedia for software interfaces is often created as cooperation between creative professionals and software developers.

More friendly software is created, eliminating the barriers between a user and a program. Multimedia tools are actively used to develop identification systems in various fields: banking, trade, security, medical, research.

### ***Industry***

In the industrial sector, multimedia is used as a way of presenting information to shareholders, management and colleagues. Multimedia is also useful in organizing staff training, advertising and product sales around the world through virtually unlimited web technologies. Computer graphics combined with the technology of tomography allows you to open new deposits of minerals, to explore the internal state of technical objects, inaccessible in other ways.

### ***Mathematical and Scientific Research***

In mathematical and scientific research, multimedia is mainly used for modeling and simulation. For example: a scientist can look at a molecular model of a substance and manipulate it in order to obtain another substance. Model studies can be found in journals, such as the Journal of Multimedia.

### ***Medicine***

Doctors can also receive training with the help of virtual operations or simulations of a human body afflicted with a disease spread by viruses and bacteria, thus trying to develop methods for its prevention. Multimedia, combined with tomographic technology and using the graphic tools, can help to effectively study the human body, its organs.

## **11.3. Methods of Multimedia Data Compression**

Modern speed of data transfer on the World Wide Web in conjunction with the new technologies, as well as a constantly increasing rate of transfer to on-line activity dictate new conditions for multimedia data compression. Modern methods of video and audio data compression are the following:

First, we shall determine the degree of the data compression. We will classify compression types in terms of the quality loss.

1) **Compression without Loss of Data.** The image obtained after decompression will be exactly (bitwise) the same as the original. An example of such compression is the GIF format for static graphics and GIF89a for video.

### ***Compression Lossless in Terms of Perception***

After bit decompression the data does not coincide with the original data. Being a compression with the loss of quality, formally this compression scheme can be considered lossless from the point of view of its perception by a person. Most compression technologies with a formal loss of quality have a so-called compression quality factor (FCC), which characterizes the perception quality and ranges from 0 to 100. With a compression quality factor 100, the perception characteristics of the quality of a decompressed video are almost indistinguishable from the original by human perception [58].

2) **Compression with Loss of Quality.** Quality losses can be observed if information was lost during the compression process. However, from the point of view of human perception, compression with losses is only such compression which is noticeable by eye, you can see the result of the compression versus the original. Thus, in spite of the fact that two images – the original and the result of the compression due to using a particular compressor – may not coincide bit by bit, the difference between them will be completely invisible. Examples are JPEG compression algorithms for compressing static graphics and the MJPEG algorithm for video compression.

### ***Compression with Natural Loss of Quality***

Sometimes JPEG, MPEG, and other compression technologies with loss of quality are compressed, stepping over the edge of lossless compression in terms of perceiving video information. Nevertheless, compressed video and static images are quite acceptable for an adequate perception by a person.

In other words, in this case there is a so-called natural degradation of the image, in which some small details of the scene are lost. Similar can occur in natural conditions, such as rain or fog. An image in such conditions, as a rule, is discernible, but its detail is reduced.

### ***Compression with Unnatural Loss of Quality***

The low quality of compression, which largely distorts the image and brings into it artificial (not existing in the original) parts of the scene, is called unnatural compression with loss of quality. An example of this is some «blockiness» in strongly compressed MPEG and in other compressors

using the DPCT technology. The unnaturalness lies primarily in the violation of the most important characteristics of an image from the point of view of human perception – contours. Experience shows that it is the contours that allow a person to correctly identify one or another visual object. We should note, that all widely used video compressors use compression technologies with quality losses. The FCC at different values can give a video quality at the output both without lossless from the viewpoint of perception and with unnatural losses [58].

#### **11.4. 3-D View of the Virtual World and Animation**

Virtual reality (artificial reality, electronic reality, a computer model of reality, virtual reality, VR, 3D virtual reality) is an artificially created world in which a person is immersed. However, getting into a virtual world, he realizes that he is in an artificially created space, that is, he is capable to separate reality from virtuality.

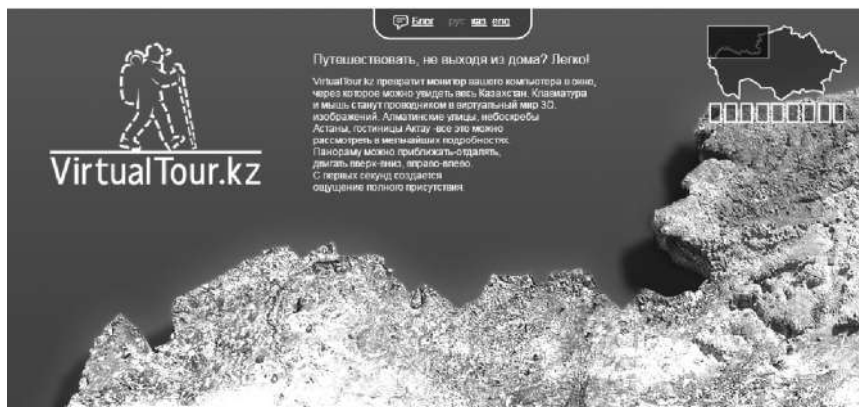
Virtual reality systems are used to create a virtual world, when using virtual reaction technology such as 3D displays / monitors, special glasses, virtual reality helmets and special software (Figure 11.1).



*Figure 11.1. Using Interactive VR Technologies*

Virtual reality is interesting for different business segments: presentation of goods and services, consumer, commercial markets, entertainment market. Virtual reality systems are used as virtual storefronts with a possibility of an interactive creation by a buyer of the goods.

*A virtual tour* is one of the most effective and convincing ways of presenting information, it allows to make a fascinating virtual 3D trip and creates a full illusion of presence. You create interactive, virtual 3D-image on a monitor screen surrounding the viewer with a 360 degrees sphere (Figure 11.2).



*Figure 11.2. Main Page of the Site «Virtual Tours in Kazakhstan»*

With the help of 3D virtual tours, you can visually demonstrate to a viewer the appearance of an office, a shop or an exhibition, show him inside and outside of a houses or cars for sale, to walk around the various halls of museums and exhibitions, show the main attractions of a tourist trip. Virtual 3D tours, as well as their individual 3D panoramas, can include flash-animation, soundtrack and other multimedia elements, and also be directly tied to sections of the site through hyperlinks.

A virtual spherical 3D panorama can be used for posting on an existing site in the form of an add-on for presentation or an independent promotional website.

Viewing of the tours on the Internet is usually done in a browser in which a FLASH player is installed. Virtual tours, oriented to a Web space, are small in size and are fast loaded. Virtual tours, recorded on a CD or DVD disc, are viewed using special tour browsers and are not limited by strict requirements in terms of their size, they can contain high-quality photo panoramas, and therefore are extremely effective.

To date virtual tours are popular all over the world. They became an indispensable attribute for those who seek to develop and maintain a leading position in the market, attracting new customers. Some companies and institutions in Kazakhstan already have similar 3D panoramas. For example, the site [http:// Almaty3d.kz](http://Almaty3d.kz) presents a catalog of virtual tours around Almaty (Figure 11.3) [59].

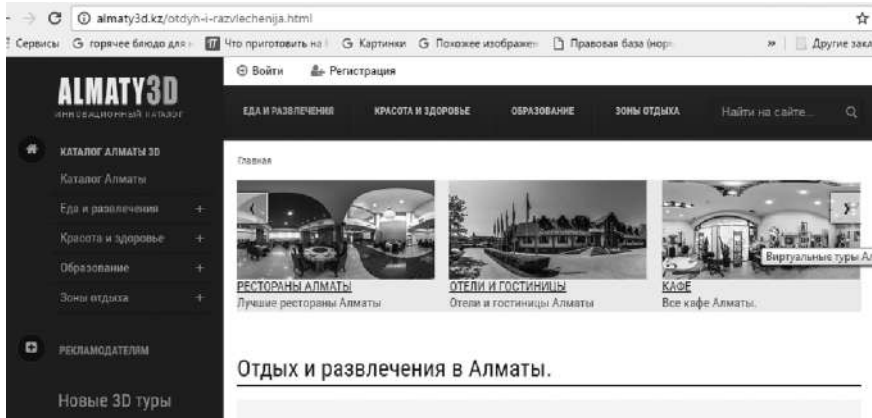


Figure 11.3. Almaty Website

## Animation

3D animation is an automation of moving and transforming 3D models in space over time. Basically, there are three ways of animating 3D objects. The first and simplest is the movement and rotation of the whole object, without changing its shape. The second is dynamic deformations (for example, a beating heart). The third, the most complex, it is usually used for character animation, is skeletal animation. In turn, three methods are most often used in 3D animation: keyframe animation, motion curve animation, and path animation.

**Animation by keyframes** in 3D is very similar to the work of traditional animators, when the main artist draws key poses of a character, and his subordinate artists-posers fill in the intermediate frames, drawing the proper transformations of the figure. The difference is that the role of the poser is already performed by the computer (or rather, the corresponding algorithms in the program editor). It's enough for the animator to fix a few key positions of the figure, interpolation will take place automatically [60].

Accordingly, the process looks like this: the first keyframe (A) is selected, we fix the initial position of the object in it; then the next keyframe (B) is selected, the object is transformed (moving, rotating, resizing), and is fixed. The program then calculates an intermediate process – the path of motion and rotation between frames A to B, and also – dimensional changes (but not shapes), displaying these changes in the form of motion curves (an example of key frames is in Figure 11.4).

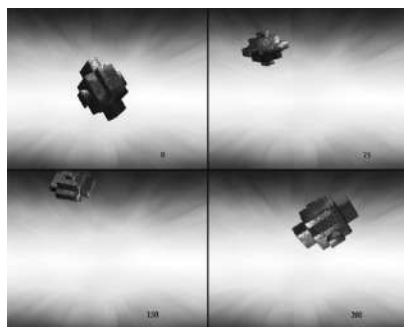


Figure 11.4. Four key frames

**Motion curves** are, in fact, a representation of the movement or transformation of an object in the form of graphs for each of its XYZ coordinates (Figure 11.5).

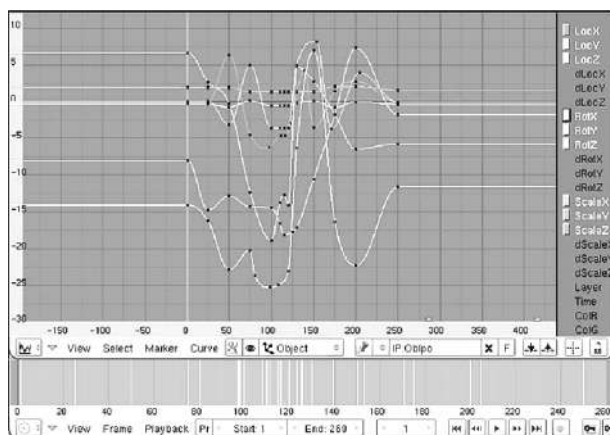


Figure 11.5. Motion Curves, Changes in Size, Rotation

Curves are very convenient to use for precise control over each parameter; Their management in modern packages is realized quite clearly. But without constantly taking into account a lot of all the parameters, high-quality 3D animation will not work.

**Trajectories** – this is the way of moving the object (with direction), its speed and possible changes in the orientation of the object in space are determined. The trajectory is usually regulated by the same aforementioned curves.

The described methods and methods, as a rule, are used in combinations, especially when it comes to more complex animation. They are also used for skeletal animation.

***Skeletal animation*** – this is an imitation of 3 D-figures and a relatively small number of control elements, which externally and according to the principle of operation are reminiscent of the skeleton or the structure of a puppet. There are two main types of skeletal motion planning: straight kinematics (Forward Kinematics – FK) and inverse, or inverse kinematics (Inverse Kinematics – IK). They are also chosen at the stage of rigging. *Rigging (rigging, animation setup). In 3D animation it is the process of preparing a character for animation, including creation and placement within a three-dimensional model of a rig (from English Rig – rigging), a virtual «skeleton» - a set of bones or joints, establishing a hierarchical relationship between them and possible transformations for each of these bones.* Actually, the structure of the joints of a virtual skeleton, even externally, is very similar to the joints of the skeleton in vertebrates. The complexity of this structure directly depends on its flexibility, and how realistic the animation will turn out to be. On the other hand, the more bones in the structure of the rig, the more difficult it will be to work with (Figure 11.6) [60].

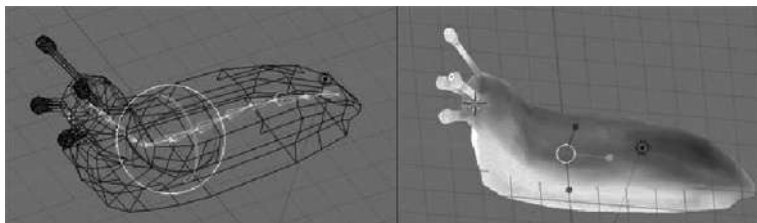


Figure 11.6. A 3D Model with Few Bones

## 11.5. Instrumental Development of Multimedia Applications

There is a lot of software for working with *multimedia* files. Such applications can be divided into several main categories:

- 1) Tools for creating and processing images.
- 2) Tools for creating and processing 2D and 3D graphics.
- 3) Tools for creating and processing video and animation.
- 4) Tools for creating and processing audio.
- 5) Means of creating a presentation.



Computer representation of graphic information is realized with the help of a raster or a vector approach. In the first case, the image is divided into pixels, the color of each pixel is encoded by a number of bits. *Vector* images are saved as a geometric description of the objects that make up the drawing.

*Graphic raster editors* are focused on manipulating existing images and have a set of tools that allow you to adjust any aspect of the image. Professional graphic editors support the work with layers and the export of objects from the vector graphics programs, they have a full set of tools for color correction, retouching, adjusting the contrast and color saturation, masking, creating various color effects that imitate certain artistic techniques. The most famous raster editors:

- 1) **Adobe Photoshop** is a multifunctional image editor developed and distributed by Adobe Systems. It mainly works with raster images, but it does have some vector tools. The product is the market leader in the field of commercial bitmap editing tools and the most famous product of Adobe
- 2) **Adobe Fireworks** – editing images for websites and applications. Fireworks provides web designers with simple and effective tools for creating graphical content of web pages without complex coding and using a variety of color palettes
- 3) **Corel Photo-Paint** – as well as MS Paint and Adobe Photoshop, belongs to the editors of raster graphics. It's almost in no way inferior to Photoshop. The program is part of the CorelDRAW software package and is used for processing photographs, posters, preparing elements of video clips and graphics for the Web.
- 4) **Corel PHOTO-PAINT** – makes an «electronic» photo, colors a black and white photo, corrects exposure, removes tears or folds, creates Photo collage. Its native CPT format supports objects, alpha channels and lenses. Together with the program, a library of 25,000 professional images and symbols is delivered, 1000 fonts, 2500 high resolution photos.
- 5) **GIMP** – the most popular multiplatform free editor, designed to work on an image. The GIMP program is multifunctional. It can be used as a simple graphical editor, as a professional photo retouch application, as a networked batch image processing system, as a program for reproducing images, as a converter of image formats and so on.

In *vector graphics* programs, objects and images that are saved as a geometric description exist independently of each other, which allows you to change the layer, location and any other attributes of the object at any time, creating an arbitrary composition. In such programs, illustrations are created using shapes of any shape, their scaling, rotation, deformation, as well as the degree of transparency and color filling. Modern vector graphics programs also contain tools for working with raster images and texts.

*Free Software:*

- 1) **Inkscape**; Inkscape is a freely distributable vector graphics editor, it is convenient for creating both artistic and technical illustrations. This was made possible largely thanks to the open format of SVG, developed by the W3C consortium. The SVG format allows you to create illustrations of various types, including animated ones. Since SVG Based on XML markup language, you can write extensions to it.
- 2) **OpenOffice.org Draw** is a fairly simple yet functional vector graphics editor that is part of the OpenOffice.org package. Undoubted merits of this editor include a user-friendly interface, common for all office applications and as a consequence, familiar to the user. The editor can be used to build diagrams, diagrams, create illustrations.
- 3) **Xara Xtreme for Linux**. Freely distributed Xara LX is positioned as an entry-level tool for artists and designers. The functions of the program are enough to create beautiful and colorful professional illustrations, polygraphic mock-ups and web-graphics. Xara Xtreme allows you to create quite realistic illustrations.

*Commercial software:*

- 1) **Adobe Illustrator** – vector graphics program is designed to create layouts of graphic documents, for the purpose of their publication on paper and in electronic form. The main differences of this program from other programs of this type Is its very broad functionality for the artistic design of the contents of the document.
- 2) **CorelDRAW** is a full-featured multifunctional vector and raster graphics editor. New versions of the program are released exclusively for Windows OS. As for the main functions of the program, it is most often used to create vector drawings. The main opportunities include: drawing vector graphics; text and work with it; work with photos; the functions of searching for graphics and images both on the user's computer and on the Internet.
- 3) **Macromedia FreeHand** is a unique multi-page environment for creating complex illustrations and layouts for publishing in Press

and in electronic media. Macromedia FreeHand – the best tool for creating illustrations for print, the Internet and projects Macromedia Flash. A powerful set of tools will help designers realize their creative intentions, and expanded The functions of illustrating, creating layouts and publishing provide an increase in the flexibility of the workflow.

- 4) **Xara Xtreme** – graphic editor Xara Xtreme Pro allows you to adjust photos, as well as to create a variety of illustrations for printing or publishing on the web. The program contains a large number of tools designed for processing of vector and raster graphics. Xara Xtreme Pro has a traditional interface for such programs.
- 5) **Strokes Maker** is designed to create black-and-white and color line vector images based on the original raster image. The program allows you to create analogues of etchings and engravings in a semiautomatic mode, giving the artist tools to automatically fill the dashed areas, manually drawing line strokes, and then automatically calculate strokes.

*3D graphics or three-dimensional graphics* – this is one of the sections of computer graphics, a set of techniques and tools that allow you to create three-dimensional objects using shapes and color. It differs from twodimensional images by implying the construction of a geometric projection of a three-dimensional model of a scene (virtual space) to a plane, this is done with the help of specialized programs. The resulting model can correspond to real-world objects (for example, a building, a person, a car, an asteroid) or be completely abstract (a projection of a fourdimensional fractal). Figure 11.7 shows examples of 3D graphics objects.



*Figure 11.7. Objects 3D graphics*

The category of «3D» graphics is formed by programs for creating and editing 3D models. This includes both professional packages for modeling, animation and 3D processing, as well as software for amateurs. Using the

proposed programs, you can create 3D-models of virtually any degree of complexity.

*Free 3D modeling programs:*

- 1) **Blender** is a free package for creating three-dimensional (3D) computer graphics that contains tools for modeling, animation, rendering, post-processing video, and creating games. Blender functions are quite enough for usual users, and for professionals.
- 2) **Sweet Home 3D** is a convenient free program for creating interior designs, with the ability to view them in 3D. Using Sweet Home 3D, you can easily create detailed plans for a separate room or even the entire house, and then place furniture and various objects (doors, windows, stairs, fences, etc.) at your discretion.
- 3) **SketchUp Make** is a free program for fast creation and editing of three-dimensional graphics. SketchUp Make is very convenient for beginners or just interested. SketchUp is intuitive and is easy to handle, because it is made exclusively for non-professionals.
- 4) **nanoCAD free** is a free version of the program for CAD systems, which allows you to design and produce drawings.
- 5) **Sculptris** is a free program for 3D modeling in the virtual «modeling» mode. The main advantages are easy mastering of the process of creating models, simple interface, an ability to work in it for users with almost any level of training.

*Commercial software:*

- 1) **ArtCAMPro** – a proprietary program for creating voluminous reliefs. To create a 3D relief, a raster image is initially created. For each color you can define initial height and type of surface. The image is converted to a 3D relief. In the process of work, you can change existing terrain: add, subtract, smooth, visually take away parts.
- 2) **Autodesk 3ds Max** (formerly 3D Studio MAX) is a full-featured professional software system for creating and editing 3D graphics and animations. Contains the most modern tools for artists and professionals in the field of multimedia. Works in Windows operating systems, Windows NT.
- 3) **Autodesk Maya** – an instrumental system of three-dimensional graphics and computer three-dimensional animation, which also has the functionality of a powerful three-dimensional graphics editor. Nowadays it is widely used in cinematography, television. Originally developed for the Irix OS, then it was ported to Linux, Microsoft Windows b Mac OS X.

- 4) **Cinema 4D** or abbreviated C4D from MAXON is a package for creating three-dimensional graphics and animation. Cinema 4D is a universal integrated program for creating and editing 3D effects and objects, supporting animation and high-quality rendering. It differs by a simpler interface than its counterparts, and by its built-in support for the Russian language, which makes it popular with the Russian-speaking audience.
- 5) **LightWave 3D** – a popular package for creating three-dimensional graphics, widely used in the production of video, television, film products. Lightwave contains a powerful polygonal modeling system. A powerful plug-in system expands the functionality of the package, and the LScript programming language allows you to write your own scripts.

There are a lot of software products *to edit video*. Professional video editors allow editing multiple video- audio channels and perform editing of video fragments in a single composition. They contain sets of transitions between frames, synchronize sound and image, and also support editing and saving of the most popular formats of video files. Programs for working with sound can be conditionally divided into two large groups:

- 1) sound editors focused on digital sound recording technology;
- 2) sequencer software.

*Sequencers* are designed to create music, they are used to encode musical compositions, they are used for arrangement, allowing you to prescribe individual parts, assign timbre to instruments, build levels and balances of channels, enter musical strokes.

*Sound editors* allow you to record audio in real time on your computer hard drive and convert it using digital audio processing and combining various channels.

From the set of applications for video editing, you need to choose the one that best suits the needs of the user. As an example, consider the most popular video editors for Windows. Among the discussed below, many programs for editing are free and in Russian:

- 1) **VIDEO EDITING** – a very simple and functional program, does not cause difficulties in mastering. Against the background of the majority of competitors, it has a unique feature of connecting a variety of video formats into one. The VideoEDITING program will help the user to edit any formats with the highest quality. The list of supported formats includes: AVI, MOV, VOB, FLV, MP4, MKV and others. In the editing process, you can apply a huge number of ready-made effects, screen savers, transitions and explanatory titles.

- 2) **Adobe Premiere** is a utility that allows you to perform non-linear editing of video recordings. To date, it is considered one of the most popular in the world. Moreover, many famous Hollywood directors and cameramen turn to software from Adobe Systems when creating their films.
- 3) **Video STUDIO.** The application contains a whole software package that is responsible for fast and comfortable creation, as well as processing of high-quality video content. First of all, the utility works with any video file formats, which gives it a clear advantage against competitors. Video films can be created with the help of photos. Moreover, each clip can be given its own musical accompaniment. In addition to its basic range of impressive editing capabilities, the program has the function of converting, as well as burning DVDs.
- 4) **Corel VideoStudio Pro** is a very popular program for video editing. It meets the high demands of users and deserves excellent ratings of critics. The integrated program for artistic processing has a friendly interface, suitable even for unprepared users.

*Means of creating presentations*, originally designed to create electronic slides that help illustrate a speaker's message, is now increasingly oriented towards the use of multimedia. There is a large number of such programs, differentiated by a set of visual and animation effects, by ways of managing presentations and supporting multimedia files for importing them as the slide content. In fact, the presentation is an information product that unites all multimedia formats into one whole.

Areas of application are constantly expanding, including, due to the emergence of new information technologies and methods of information processing. Competent combination of multimedia with other technologies will contribute to their more dynamic development and even greater integration in all spheres of society. Lately a lot of new programs for creating presentations have been added and the current programs have been significantly updated in an attempt to respond to changes in business communications formats. Among them are:

- 1) **MS PowerPoint** – the legendary software from Microsoft. MS Power Point, especially the 2013 version, is a powerful tool for a nondesigner. The program's arsenal includes all the necessary tools for creating static and animated slides. The interface contains many functions.
- 2) **AppleKeynote** is the main competitor of MS Power Point, which already is predicted to dominate both in business environment and in

personal use in the near future. The key difference is the ease of use of Apple.

- 3) **Google Presentations** – presentations can also be created in the free cloud office of Google Drive. In fact, creating presentations in Google Drive is like in Power Point, but only online and with a slightly modified and truncated interface. If the user has a licensed Power Point, then he can work together with other users, and the comments on the slides would be available both there and in Google Drive, designed to simplify the joint work on documents.
- 4) **Prezi** is a widely used software for creating flash presentations. The whole presentation is created on one single canvas, above which, figuratively speaking, the camera is spinning and moving away and bringing certain areas closer. Thus, the picture from a bird's-eye view is very clearly visible, that is, the view on the presentation as a whole, as well as the visual structure of the narrative. In Prezi there are many templates with ready visual metaphors for presentations, or you can create a visual skeleton yourself.

## 12. SMART TECHNOLOGIES

**SMART** is a well-known and effective technology for setting and formulating goals. The acronym SMART means a smart target and combines capital letters from English words indicating what the real goal should be: *Specific – Measurable – Attainable – Relevant (relevance – Time-bounded)*.



For 15 years, the number of Internet users has grown significantly and now stands at about 3 billion. But even more amazing is the number of connected to the Internet intelligent devices. According to analysts' estimates, by 2020 it can reach more than 30 billion devices. Data exchange via the Internet will generate 403 trillion gigabytes of data per year until 2018. Thanks to the success in the field of communications, sensory technologies, «smart devices» are now quite real and they work. With the increase in the number of connected devices, a wide range of possibilities opens.

However, for a «smart» device community to be viable, it is required to give each thing a certain intellect that helps it to recognize the context of its environment (location, state and position of the monitored object), and also to establish a dialogue with surrounding things and a control device.

### 12.1. Internet of Things

*Internet of things (IoT, Internet of Things)* is the ability of people and things to remotely interact through the Internet at any time and anywhere thanks to the merger of various technologies. Now you can identify objects, household items, equipment and much more just like people using the Internet. In fact, now things have come to the same level as people.

"Internet of things is the next generation of Internet content. Previously, we had people online, and now the Internet of things. If earlier people could



communicate via the Internet, now, things can do it", - says Nils Herzberg, the head of IoT, SAP SE.

The Internet of things is represented by a wide network of devices connected to the Internet, including smartphones, tablets and almost any «thing» equipped with sensors: cars, industrial equipment, jet engines, oil rigs, devices and much more. All these «things» collect data and exchange them.

The Internet of things and the underlying machine-to-machine (M2M) technology are capable to introduce an unusual transparency in any industry (Figure 12.1.).



*Figure. 12.1. Inter-Machine Interaction Technology*

The Internet of things is a system of sensors connected to computer systems. These systems can analyze and change the actions of real objects, for example, the Bosch Concept Car accommodates a wide range of innovative technologies: as soon as a driver seats, the face recognition system immediately adjusts the steering wheel, mirrors, cabin temperature and radio station according to his preferences. The system is controlled via a tactile display and an innovative gesture control solution – both support a tactile response when used. Due to the software installed via the Internet, you can record information about the technical condition of the machine, about how it was used.

Another example is taking care of your health. Portable sensors will constantly monitor the vital signs of the human body, which is especially important for people with chronic diseases. Devices send information about the state of health to the doctor, and the patient will not need to go to the clinic for an examination. The doctor will call before the patient feels

unwell. By 2025, the monitoring of the condition of chronically ill patients will bring the global economy to \$ 1.1 trillion a year.

Today, the requirements of industrial production are changing, customers are becoming more selective. Wishing to receive goods that meet their expectations, many companies face pressure from competitors. And in order to adapt to such conditions, they need to integrate modern technologies. Companies that use solutions for the Internet of things, achieve improvements in their business operations due to a faster response to customer requests, an improved service quality, reduced maintenance costs, trouble-free operation equipment. Business opportunities are almost limitless.

According to analysts, the introduction of IoT technologies can save \$ 500 billion at the world level, reduce the time of unplanned downtime by 23%, increase the margin associated with an effective supply chain and targeted marketing.

The potential of the Internet of things can be used in a wide variety of ways to improve people's lives. *An example is Shymkent's system of remote collection of utilities data «Strizh-Telematika», which allows to automate the work of the city services. Now the city's housing and utilities devices and other areas of activity are connected to the system: water meters, gas, electricity meters, heat meters, as well as parking and farmer gages. The system allows residents to monitor the sensors through the private office and send them to the management company, and the city services – to «monitor» the water or electricity use and prepare reports on the received data. According to the company's representatives, the base station, data «can serve up to two million devices», and its coverage area reaches 50 kilometers. The system is planned to be implemented both in apartment buildings, and in state institutions of the country, kindergartens and schools.*

*In Kazakhstan, «Orion Sistym» launched a wireless Internet network of things (data of the «Computerworld Kazakhstan»). The company sets up the network OrionM2M. The work is carried out on the basis of its own equipment and software. In January 2017, the network will be ready in the cities of Astana and Almaty.*

*Until the end of next year, it should appear in all regional centers. The OrionM2M network allows the implementation of various business solutions in the field of SmartCity: smart lighting, automated energy accounting systems in housing and communal services, safe city, «smart transport».*

*LLP «Smart House Domintell» introduces IoT technologies in the territory of Kazakhstan. Dozens of large and hundreds of small objects*

have been automated throughout Kazakhstan. The goal of a smart home is to maximize free time, attention of its inhabitants from everyday communication with various engineering systems and devices. To this end, automatics itself controls devices in most situations, and different systems of the house can work with regard to each other's modes. And in a situation where user participation is necessary, the smart house offers simple, intuitive remote controls and control panels – common for all equipment (Figure 12.2).



Figure 12.2. Management of the «Smart House»

*The system can turn the radiators on and off from the smartphone so that they do not heat the empty rooms. The owner simply needs to set the desired temperature for each room, and the system will support it automatically.*

The Internet of things today can fundamentally change our interaction with the world around us. The ability to manage physical objects with computers rationalizes new areas of human activity.

## 12.2. Big Data

**Big data** is a set of approaches, tools and methods for processing structured and unstructured data of huge volumes. According to the McKinsey Institute report «Big Data is a new frontier for innovation, competition and productivity». The term «big data» refers to data sets which

size exceeds the capabilities of typical databases (databases) for storing, managing and analyzing information.

«*Three Vs*» is noted as characteristics for large data: the **volume** (volume, in the sense of the physical volume), **velocity** (velocity in terms of both the growth rate and the need for high-speed processing and obtaining results), **variety** (in the sense of the possibility of simultaneous processing of various types of structured and semi-structured data).

The introduction of the term «big data» is attributed to Clifford Lynch, the editor of the journal *Nature*, who prepared a special issue by September 3, 2008 with the topic «*How can technologies that opened up the possibilities of working with large volumes of data affect the future of science?*» In this issue, materials on the phenomenon of explosive growth in volumes and the variety of processed data, as well as technological prospects in the paradigm of a probable jump from «Quantity to Quality» were collected; the term was suggested by analogy with the metaphors «*big oil*», «*big ore*» in the business English-speaking environment.

Already today working with big data is a serious challenge for companies of a wide range of industries, for example serving the mass sector – medical, insurance, telecommunications, banks and government structures, which use e-government systems.

According to IDC (International Data Corporation) analysts, in 2016 the world market of software, equipment and services in business intelligence and working with big data amounted to \$ 130.1 billion, which is 11.3% more than a year ago. Most of these costs – about 13.1% or \$ 17 billion – fell on the banking sector. The second and the third place was occupied by discrete and continuous production (11.9% and 8.4% respectively). The share of investments from government agencies and companies providing all sorts of professional services, was measured at about 7.5%.

It is expected that by 2020 the most rapidly growing sales of solutions for Big Data and business analytics will be in the banking sector. In addition, high growth rates will be observed in the telecommunications, utilities, insurance and transportation markets.

If we look at market segments, then the highest sales will be demonstrated by IT and business services, which account for more than half of the revenue in the Big Data technology market and business intelligence in the period from 2015 to 2020. The segment of services will grow by 14.9%, the equipment segment – by 8.7%. The latter will reach \$ 29.9 billion in 2020 against \$ 60 billion from the software vendors segment.

According to Dan Vesset, the Vice President of IDC Analytics and Information Management, the demand for technologies and services in working with big data and business intelligence is stimulated by such factors as increased data volumes, development of new technologies and cultural shift towards making decisions related to information. Experts expect that from 2015 to 2020, the market volume will grow by an average of 11.7% per year and exceed \$ 203 billion by the end of this period.

Thanks to the development of technologies for working with big data, in the near future business will be able to digitize almost all of its operational processes, store huge amounts of data and to receive from them new information and knowledge operatively. The main suppliers of solutions are:

Actian, Alteryx, Attitude, Attivio, Cloudera, CloudIQ, Concurrent, Cray, Datameer, DDN, Dell, Digital Reasoning, EMC, GridGain, Hadapt, Hortonworks, HP, HStreaming, IBM, Informatica, Jaspersoft, Karmasphere, Kitenga, KXEN, MapR, Microsoft, Mu Sigma, NetApp, Objectivity, Opera Solutions, Oracle, Pentaho, Platfora, Progress Software, RainStor, Revolution Analytics, SAP, SAS, SGI, Splunk, Syncsort, Talend, Teradata, TIBCO, Tidemark, Tresata, Versant, and Zettaset.

A typical example of big data is information coming from a variety of physical experimental installations – for example, from the Large Hadron Collider, which produces a huge amount of data and does it all the time. The installation continuously produces large amounts of data, and scientists solve a number of tasks in parallel with their help.

The appearance of big data in the public space was due to the fact that these data affected almost all people, and not only a scientific community, where such problems had been solved long ago. *Big Data* technology came out to the public sphere when a very specific number was reached – the number of inhabitants of the planet. 7 billion, gathering in social networks and other projects that aggregate people. *YouTube*, *Facebook*, *Vkontakte*, where the number of people is measured by billions, and the number of operations that they perform simultaneously is enormous. In this case the data flow is user actions. For example, the data of *YouTube* hosting, which flow over the network in both directions is huge. Processing is understood not only as an interpretation, but also as an opportunity to correctly process each of these actions, that is, to put it in the right place and make it so that each user can access this data quickly, because social networks do not tolerate expectations.

Another example that was discussed above is the Internet of things that processes very large amounts of Internet data of things in real time. In the coming years, Internet things will be important in the business world. Companies realize that this is a very effective tool. After all, technologies that allow you to connect billions of things, allowing them to generate the necessary information, help companies competently plan and build business processes.

### ***Methods for Analyzing Big Data***

There are many different methods of analyzing data sets, which are based on tools borrowed from statistics and informatics (for example, machine learning). It should be understood that researchers continue to work on the creation of new techniques and improvement of existing ones. In addition, some of the techniques listed below are not necessarily they are applicable only to large data and can be successfully used for smaller arrays. Of course, the more voluminous and diversity of the array is subjected to analysis, the more accurate and relevant data can be obtained at the output.

Let us consider some techniques for analyzing big data:

- 1) **A / B testing.** A technique in which the control sample is compared in turn to others. Thus, it is possible to identify the optimal combination of indicators to achieve, for example, the best response of consumers to a marketing proposal. Large data allows you to conduct a huge number of iterations and thus get statistically reliable result.
- 2) **Association Rule Learning.** A set of techniques for identifying relationships, that is, associative rules between variables in large data sets. It is used in data mining.
- 3) **Classification.** A set of techniques that allows you to predict the behavior of consumers in a certain segment of the market (making purchasing decisions, outflow, volume of consumption and so on). It is used in data mining.
- 4) **Cluster Analysis.** Statistical method of classifying objects into groups by identifying previously unknown common features. It is used in data mining.
- 5) **Crowdsourcing.** Methods for collecting data from a large number of sources.
- 6) **Data Fusion and Data Integration.** A set of techniques, which allows you to analyze the comments of users of social networks and compare with the results of sales in real time.
- 7) **Data Mining.** A set of techniques that allows you to identify the most susceptible to the promoted product or service category of

consumers, identify the features of the most successful workers to predict the behavioral model of consumers.

- 8) **Simulation.** Modeling the behavior of complex systems, often used to predict, forecast, and study various scenarios in planning.
- 9) **Visualization.** Methods for graphically representing the results of analysis of large data in the form of diagrams or animated images to simplify the interpretation of the ease of understanding the results.

### ***Standardization in the Field of Big Data***

The use of big data technology in a variety of areas, such as healthcare, banks, retail, telecom operators and so on, many of which are standardized or being actively standardized both at the national and international levels, naturally raises questions about the introduction of standards in the field of big data.

Currently, several major standardization institutions are involved in the development of standards for big data – International Organization for Standardization and the International Electrotechnical Commission (ISO/IEC), International Telecommunication Union (ITU), British Standards Institute (BSI), USA National Institute of Standards and Technology (NIST).

The International Organization for Standardization and the International Electrotechnical Commission (ISO/IEC) have created 3 working groups aimed at standardizing the following technologies: Big Data (ISO/IEC JTC1/WG 9 «Big Data»), Internet of things (ISO/IEC JTC1/WG 10 «Internet of Things») and smart cities (ISO/IEC JTC1/WG 11 Smart Cities).

In accordance with the ISO standard, the Big Data Working Group will serve as a definer for the main topic of a large program for standardizing data and identifying gaps in standardization. It will develop fundamental standards – including a reference architecture. Currently, the ISO/IEC JTC1/WG international standardization «Big Data» Working Group 9 develops the following draft of the international standards: a set of standards for the big data architecture (ISO/IEC 20547 series of standards) and a standard for terms and definitions (ISO / IEC 20546).

In ITU, you can mark several areas of activity relating to big data. The ITU documents specify the following areas of activity: highly reliable, flexible and scalable network infrastructure with high throughput and low latency. Aggregation and anonymization of data sets. At the end of 2015, the ITU members agreed on an international standard for big data. A new standard – Recommendation ITU-TY.3600 «Big Data – Requirements and



Opportunities Based on Cloud Computing». The standard describes how cloud computing systems can be used to provide Big Data services. Mostly, it describes the requirements for cloud computing based on large amounts of data (requirements for data collection, data preprocessing and data storage, analysis, visualization and management, data security and data protection, collection and storage).

The USA National Institute of Standards and Technology (NIST) offers a stack of standards for big data – NIST Big Data Interoperability Framework V1.0.

Among other institutions that have initiatives related to big data, are the Institute of Electrical and Electronics Engineers (IEEE); the International Electrotechnical Commission (IEC); the Internet Engineering Task Force (IETF); the World Wide Web Consortium (W3C); the Open Geo-consortium (Open Geospatial Consortium – OGC) and others.

Within the framework of the national standardization in accordance with the State program «Information – Kazakhstan 2020» works on the development of the project of the ST RK «Big Data. Cloud Computing Based on Requirements and Capabilities» (based on Y.3600: Big Data – cloud computing based on requirements and capabilities) have been carried out this year. The Project provides an approach for using cloud computing to meet the existing problems in the use of big data. In addition, TC 34 «Information Technologies» under the JSC «National Infocommunication Holding "Zerde" have sent its proposals to the State Standardization to carry out harmonization of the the following standards for data processing: for 2017:

- ST RK "Information Technology. Data Processing Centers. Key Performance Indicators. Part 1. Overview and General Requirements" based on ISO / IEC 30134-1: 2016;
- ST RK "Information Technology. Data Processing Centers. Key Performance Indicators. Part 2. Energy Efficiency Factor (PUE)" based on ISO / IEC 30134-2: 2016;
- ST RK "Information Technology. Data Processing Centers. Key Performance Indicators. Part 3. Renewable Energy (REF)" based on ISO / IEC 30134-3: 2016; For 2018-2020:
- ST RK "Information Technology. Sustainability for IT and IT. Control and Management of the Intellectual Resources of the Data Centers" based on ISO / IEC 19395: 2015;



- ST RK «Information Technologies. Telecommunications and Information Exchange between Systems. High-level Data Link Control Protocols» based on ISO / IEC 13239: 2002;
- ST RK «Information Technologies. Document Processing and Related Data Transfer. Verification of the Conformance of Systems of the Standard Generalized Document Description Language» based on ISO / IEC 13673: 2000;
- ST RK «Information Technologies. Document Description and Data Processing Languages. Hypertext Markup Language» based on ISO / IEC 15445: 2000;
- ST RK «Information Technologies. Identification of Radio Frequency (RFID) for Frequency Management. System Infrastructure Software. Part 2. Data Management».

### ***Development of BigData in Kazakhstan***

At the third all-Russian forum in the field of information and communication technologies «IT Dialogue 2016», a project on the use of big data technologies in Kazakhstan was presented.

The work on the project is carried out by JSC «NIT» in cooperation with EMC within the framework of the specially created Center for Expertise in Data Analysis. The goal is to analyze the loyalty of the recipients of public services on the basis of information from Internet sources. As it was noted during the presentation, large data allows to optimize many operations, manage risks more effectively and introduce innovations. In particular, the results of the implemented project provided an opportunity to develop recommendations for improving the quality of public services and e-government services in Kazakhstan. In the course of the project implementation, data is downloaded from the Internet sources and structured (parsed), then the information is tabulated, indexed, machine learning is conducted, and data corresponding to the relevance and tonality is extracted. After that, the highlighted data is visualized and used directly for the development of recommendations and further work.

### ***Data Center***

Data center (from the English data center), or the center (of storage and) processing (DPC) is a specialized building for a hosting server and network equipment connecting subscribers to Internet channels.

Data Center is a high-tech protected area, where servers of different companies are located. Data centers provide an uninterrupted supply of fast and efficient processing of large, and sometimes colossal information flows.

In the age of information technology, often for the purpose of stealing, information DC is subjected to all sorts of attacks. Implementation of special disaster-proof solutions, organization of data backup in the data cents will protect the data from the risks of loss. It is accepted that the services of the Data Center are in demand only by large companies, but in fact there is the trend of using these services by developing companies, especially when it comes to start-ups with foreign investment.

In fact, the purpose of a commercial Data center is to provide customers with services related to ensuring the reliability and fault tolerance in storing and processing of information (text, graphics, digital and other data), to ensure the performance of large Internet portals for volumetric calculations.

A Data Center provides special secure channels for international communications. Guaranteed security, reliability of the data center, as well as the maximum speed are now commercially demanded in the world market. Main services of the Data Center are:

- Rental of racks
- Rent of servers
- Colocation (physical hosting of servers)
- VPS
- Shared hosting

There are also a number of additional services:

- Backup
- Cloud Solutions
- Administered server
- Remote Desktop

#### *Technologies Used in Data Centers*

High-tech infrastructure that ensures the uninterrupted operation of equipment in the data center is the main characteristic of a modern data center. For this purpose, the Data Center sites are equipped with climate control systems, uninterrupted power supply, safety and other life support systems.

The creation of data centers is primarily of an economic benefit. Consolidation of computing resources and data storage in the data center can reduce the total cost of operating IT resources. Experts identify the following ways to optimize financial costs, provided that the equipment is placed in a commercial data center:

- 1) the lack of the need to create its own infrastructure;
- 2) discounts on Internet connection, since the data center has its own connections to the main Internet sites;

- 3) reduction of administration costs due to servers servicing by the data center;
- 4) reduction of rent due to lack of occupancy in the servers of the area;
- 5) redistribution of loads in order to more quickly solve business problems.

In other words, the location of servers in reliable Data Centers not only ensures the integrity and protection of data, but also optimizes the financial costs of each individual company.

In 2015, Almaty opened the Data Processing Center of JSC «National Information Technologies». This is the last company's data center, built as part of the project «Creation of a Server-Based Internet Platform for Providing Hosting Services to the Public Bodies of the Republic of Kazakhstan». This project is an infrastructure platform for the development of e-government in the Republic of Kazakhstan and is intended to provide hosting services to public bodies, colocation (equipment placement and leasing of infrastructure), software as a service (software on demand) and system-technical Maintenance of the software and hardware complex.



*Figure 12.3. Datacenter Racks*

It is reported that the new data center is built in accordance with the international quality standards, it meets the second level security. This means that the center works around the clock, 7 days a week, 365 days a year, is protected from unauthorized access and physical damage, and the fault tolerance of the hardware and software systems reaches a level of more

than 99%. The center is equipped with CCTV, fire alarm, automatic gas fire, uninterrupted power supply, air conditioning, as well as an integrated monitoring and control system.

To date, such centers operate in all regional centers of Kazakhstan. Total capacity of the data centers of JSC «NIT» is 140 racks.

*The largest in the CIS Data Center, which is a joint project of Kazakhtelecom JSC and Hewlett-Packard Company, was launched in Pavlodar.* It provides hosting services, as well as services built on the basis of the cloud computing concept (cloud storage, virtual backup of the Data processing center, business software, interactive communication and information exchange system, cloud server platform). The Data Center in Pavlodar is the first Data Center of Tier III class in Central Asia, meaning a level of reliability that allows to carry out maintenance and preventive works without stopping the entire facility. In the Data Center of JSC Kazakhtelecom, all supporting systems, including power, are backed up, as well as air conditioning and fire extinguishing systems (Figure 12.4).



Figure 12.4. Data Center Building in Pavlodar

### 12.3. Blockchain Technology

At the present stage, a person's life is connected with new information, money and numerous papers. To achieve these or those tasks, many intermediaries have to be attracted, cooperation with which implies dozens of different operations. One have to believe them for lack of alternatives. But recently there are more and more companies and individuals who abuse their official position. **Blockchain** task is to

correct the problem, which is associated with significant material (paid intermediary services) and time costs (paper and other red tape in the preparation of documentation).

The essence of **Blockchain** technology is the distributed storage of information relating to any vital issues. For example, the Blockchain chain can store data about transactions and about who, to whom and in what volume transferred the money. Innovative technology is an example of how modern technologies can change not only financial standards, but the whole world for the better.

With respect to the crypto currency, Blockchain is the foundation of Bitcoin's financial strength. It guarantees the fixation of information about the money transfers made between the participants of the system, carried out for the entire period of existence of the alternative monetary unit and Bitcoin payment system.

In addition, Blockchain technology allows you to store information about property rights, earlier granted loans, violations of SDA, marriage and so on. It turns out that Blockchain records everything that can be stored on paper. The only difference is that you can not change or forge information. Mankind appreciated the unlimited possibilities of innovation technology and makes attempts to use it in almost all spheres of life.

#### *Blockchain Chain Construction*

By structure Blockchain is a chain of blocks, which contains certain information (Figure 12.5). Each block has a header consisting of a checksum, one-of-a-kind, fixed creation time and a link to a previous block. In this case, all the blocks of the chain are connected with each other. The block is filled with a group of records, and the newly emerging blocks are always added to the end of the chain and duplicate the information contained in the previously created structural units of the system, adding a new one to it.

Building of a Blockchain chain occurs on the basis of three main principles – *distribution, openness and protection*. Users of the system form a computer network. In this case, each of the PCs stores a copy of each of the blocks. This principle makes the system almost invulnerable – to disable it is unrealistic. The only option is the failure of all computers at the same time, which, considering the total number of computational hosts scattered unevenly over the entire planet's surface, is not possible.

In reality, each subsequent network user only reinforces Blockchain, making it resistant to damage. There are no monitoring structures, moderators or administrators in the system. Here, everyone is responsible for their actions.



geographically it does not matter where the user and his computer are. It can be a city, a modern metropolis or a small town. After receiving the information, the recipient identifies it and verifies the validity of the received data, stores it and sends it further.

The Blockchain is designed so that there are two types of participants in the network:

- 1) «Builders». Their peculiarity is the creation of new blocks. Such people are called «miners».
- 2) Simple participants, as a rule, form usual records about transactions from one point to another. However, all records are available for study, but they are encrypted.

The task of the miners (they get a certain number of virtual coins for this) is to collect the records of ordinary users, form them into blocks and send them through the network. After this, ordinary participants receive ready-made blocks and store them on their own PC for later verification of their own and others' data.

#### *Possible Field of Application*

One of the non-financial areas of application of the block system is a voting system using this technology. In the election or in a referendum Electronic transactions are used in the form of signing digital messages when voting. The Australian postal corporation is trying to use blocking technology to modernize the postal services infrastructure. Basic directions of the development are identification of users and use of drones for delivery of parcels.

In the banking sector, it is planned to use a block for the exchange of currencies across all countries to attract technology for other banking services and legal support for financial transactions.

In the field of insurance, blocking technology will help increase the speed of payment of contributions and compensation for damage. There are good prospects for it to be used to translate in information flows and business processes into digital form.

In the entertainment sphere with the help of a blockbuster one can solve the problem of free copying of works and payment of authors' remuneration for the sale of their content through legal points of sale.

## **12.4. Artificial Intelligence**

The concept of intelligence comes from the Latin concepts *intellego* (notice, understand, imply) and *intellectus* (understanding, cognition).

Over time, the *intellect* was identified with all the possibilities of human consciousness – mind, reason, – in general, with the thinking abilities of man. Until now, natural (natural) *intelligence* is attributed only to man. But this can be done only with extreme caution. So, zoopsychology ascribes the intellect (along with the person) to higher animals (primates, dolphins and others). There are works devoted to the mind of fish, birds, insects [65].

Signs of natural intelligence:

- 1) the ability to solve not formalized or poorly formalizable tasks (for example, in art or in everyday life);
- 2) the ability to learn how to effectively solve new problems (for example, thanks to curiosity);
- 3) the ability to generate information (not to transfer other people's information, but to create, create a new one);
- 4) the ability to adapt psychologically (adapt) to the environment in a wide range of conditions;
- 5) the ability to classify phenomena, events, situations, objects;
- 6) the ability to analyze (deduction) and synthesis (induction) as methods of cognition;
- 7) sense of humor as the ability to find a contradiction in unity, unity in contradiction and dissimilarity, as the ability to generate information from dissimilar elements.

These signs are to some extent manifested in the behavior (and communication) of not only a person. Therefore, we can consider (with great probability) that intelligence is a common property of biological systems (for each such system the intellect is present to a greater or lesser extent – depending on the degree of brain development). Informatics deals with ***artificial (machine) intelligence*** of cybernetic systems of nonbiological origin. If in biological systems natural *intelligence* is a great gift of genetics and life, then the *artificial intelligence* of machines has the right to exist only insofar as the natural intellect of people have delegated (transferred, entrusted) the above signs of intelligence to machines. In this regard, not only a computer, but also an excavator, a water tap can have elements of *artificial intelligence*, for example, after all, modern washing machine have become «smart».

Artificial intelligence is a scientific direction developing methods that allow an electronic computer to solve intellectual problems, as if they are solved by a person. The term «artificial intelligence» refers to the functionality of the machine to solve human problems. Artificial intelligence



is aimed at increasing the effectiveness of various Forms of mental labor rights. The use of a computer for storing information is a new stage in the development of what psychologists call «Artificial memory of mankind». There are different approaches to building artificial intelligence systems. At the moment, there are 4 different approaches:

1) Logical Approach. The basis for a logical approach is the Boolean algebra (or, lie, truth). Virtually every artificial intelligence system, built on a logical basis, is a machine of the proof of theorems. In this case, the original data is stored in the database in the form of axioms and the rules of logical inference as relations between them. In addition, each such machine has a goal generation block, the output system tries to prove this goal as a theorem. If the goal is proved, tracing of the applied rules allows you to obtain a chain of actions necessary to implement the delivered goals (such a system is known as expert systems). The power of such system is determined by the capabilities of the goal generator and the machine for proving theorems.

2) Structural Approach is an attempt to build artificial intelligence by modeling the structure of the human brain. One of the first such attempts was a Perceptron of Frank Rosenblatt. The main modeled unit in perceptrons (as in most other options of brain modeling) is a neuron. Later, there were other models known by the term neural networks. These models differ in the structure of individual neurons, the topology of the connections between them and the learning algorithms. Among the most well-known variants of neural networks are HC with backward propagation of error, Hopfield network, stochastic neural networks. In a broader sense, this approach is known as connotivism (one of the approaches in the field of artificial intelligence, cognitive science).

3) Evolutionary Approach. In the construction of artificial intelligence, this approach focuses on the construction of an initial model, and the rules by which it can change (evolve). Moreover, the model can be composed by a variety of methods, it can be a neural network and a set of logical rules and any other model. After that, the computer starts selecting the best of them, based on which new models are generated according to various rules. The genetic algorithm is the classical algorithm among the evolutionary algorithms.

4) Simulation Approach is classical for cybernetics with one of its basic concepts of a black box. An object which behavior is simulated is just a «black box». We do not care what it and the model have inside and how they function, the main thing is that our model behaves exactly the same

in similar situations. In this way, another human property is modeled – the ability to copy what others do, without going into details, why it is needed. Often this ability saves him a lot of time, especially at the beginning of his life.

Within the framework of hybrid intellectual systems, they try to unite these directions. Expert rules of inference can be generated by neural networks, and generating rules are obtained through statistical training.

Analyzing the history of artificial intelligence, one can single out such a broad direction as the modeling of reasoning. For many years, the development of science has been moving along this path, and now this is one of the most developed areas of intelligent systems. Simulation of reasoning involves the creation of symbolic systems, at the input of which a certain task is posed, and the output requires its decision. As a rule, the proposed task is already formalized, that is, it is translated into a mathematical form, but either does not have a decision algorithm, or it is too complicated. This direction includes: the proof of theorems, decision making and game theory, planning, administrating, forecasting.

An important direction is *the processing of natural language*, within the framework of which the analysis of the possibilities of understanding, processing and generation of texts in the «human» language is carried out. In particular, the problem of machine translation of texts from one language to another has not been completely solved here.

An important property of intelligence is the ability to learn. Thus, *knowledge engineering*, combining the tasks of obtaining knowledge from simple information, their systematization and use, comes to the forefront. Achievements in this area affect almost all other areas of research in artificial intelligence. Two subregions are important here. The first of them – *machine training* – refers to the process of independent knowledge acquisition by an intellectual system in the process of its work. The second is related to the creation of expert systems of programs using specialized knowledge bases to obtain reliable conclusions on any problem.

The problems of *pattern recognition* are already being solved within the framework of intelligent systems. This includes character recognition, handwriting, speech, text analysis. Especially worth mentioning is *computer vision*, which is associated with machine learning and robotics. Robotics and artificial intelligence are often associated with each other. Integration of these two sciences, the creation of intelligent robots, can be considered another direction of artificial intelligence.

*Machine creation* is a separate field because the nature of human creativity is even less studied than the nature of the intellect. Nevertheless, this area exists, and it is connected with writing computer music, literary works (often – poems or fairy tales), artistic creativity. There are many applications of artificial intelligence, each of which forms an almost independent direction.

***The Implementation of Intellectual Information Systems in Kazakhstan***

Automated complexes with elements of robotics appeared in a number of Kazakhstan machine-building enterprises in the 90s of the last century, and today such systems are actively introduced in traditional industries of Kazakhstan: metallurgy, oil and chemistry. Automation and Robotics Association established in Kazakhstan (CAAR) is engaged in the implementation of the most advanced design ideas and solutions in the oil and gas and manufacturing sectors, in energy and IT technologies.



*Figure 12.6. The First Humanoid Robot Guide «Sholpan»  
Created in Kazakhstan in 2013*

*Self-learning artificial intelligence was created by young Kazakhstani inventors based on artificial neural networks. According the specialists from the Kazakh city of Karaganda, it will help protecting public order in the streets of the cities, and in identifying violators of traffic rules. This development fell into the top 40 best European projects of 345 participants.*

*An artificial neural network is able to recognize objects by images and independently determine and memorize the characteristic features of each object. In addition, this program can be used in accounting or warehouse accounting. Also, the artificial intelligence, video analysis and automatic analytics system will be useful in researching the marketing building. For example, in large boutiques this intelligent neural network is able to track which zones in the store fall under the view of customers most often, and determine their age and sex. The network is built on the principle of biological networks from the nerve cells of a living organism. As noted by one of the developers of the iSam system, their development has 250 million artificial neural connections.*

*Kazakhstan company Absolyte.Systems, engaged in developments in the field of IT-technologies created the decentralized operating system with artificial intelligence DIOS Artificial Emotion Intelligence Technology under the working title «ZION.CITY». The system with artificial intelligence will help to solve the problem of optimization and data processing in the world of IT-technologies. The innovation system is a Kazakh product. It will ensure the implementation of more than 70% of the tasks in the «100 Concrete Steps» program on implementation of the five institutional reforms of the Head of State Nursultan Nazarbayev. Knowing about DIOS with artificial intelligence, the world giants in the field of IT show a great interest in our system. To date, one of the world's IT-giants has announced about the desire to come to Kazakhstan to study it.*

In the message of the President of the Republic of Kazakhstan N.Nazarbayev to the people of Kazakhstan dated January 31, 2017, the Head of State noted: «It is important to significantly increase labor productivity. The main factor here should be the widespread introduction of elements of the Fourth Industrial Revolution. This automation, robotization, artificial intelligence, the exchange of «large data, and others».

## **12.5. Using Smart Services**

Considering that technical progress is marching peacefully through the world with leaps and bounds, the development of Smart-technology continues, improves and captures more and more areas of human activity, which will greatly simplify and accelerate the interaction of man with the world of electronics. Today, based on smart technology, users are provided with a wide range of smart services. Let's consider some of them:

- 1) **Smart TV, or Connected TV** – the technology of integrating the Internet and digital interactive services into modern TVs and digital television receivers, as well as in the technical interaction between computers and TVs. New devices that support Smart TV (actually being computers in the form of a TV set and supporting its capabilities) are predominantly aimed at Support entertainment media on the Internet. The concept of Smart TV was born in the same way as Smart Phone, which, in turn, appeared thanks to the integration of the Internet, gadgets and software applications into modern mobile Telephones. The technology that activates Smart TV is being introduced into various devices. These devices allow users to search for videos, movies, photos and other media content on the Internet, on local cable TV channels, on satellite TV channels or on devices stored on the hard disk.
- 2) **Smart Shelf Solutions** employees of trading companies can watch from mobile devices what is happening on the shelves in the store, notice violations of planograms (*outline plans, Masonry of the goods on the specific shop equipment*) and monitor sales. Equipment automatically generate orders. 80% of the needs for «smart» retail are met through basic functions: control of the lack of products, monitoring the temperature and the presence of power in the refrigerator.
- 3) The system can be an independent statistics analyzer and integrate into any existing software, such as SAP. Shelves can «order» themselves products, send notifications on pre-installed events.
- 4) **USSD-banking** allows you to quickly get information about the current balance of a bank payment card, lock and unlock a bank payment card, order a call from the bank.
- 5) The service allows customers to pay for services via SMS-messages, manage the state of their plastic cards in real time, and also receive information on the amount of available amount on the card account and on their operations.
- 6) **Entertainment** – a group that brings together all sorts of interactive services, the possibility of ordering media content, quizzes and so on. The service allows subscribers-owners of mobile devices running Android, iOS, WP with special applications to watch TV programs and videos. The service allows you to receive java-games, video from popular movies, musical full-tracks with SMS, color and animated pictures, java-books and java-applications on your mobile phone.

- 7) **Service based on GPS / GLONASS**, allowing you to control the movement of employees, cars and any other objects using a smartphone or GPS tracker. A service that gives a possibility to know the waiting time for public transport (bus, trolley, tram) by means of USSD-request. A service that allows you to pay for car parking at a paid parking lot from a mobile phone account. Recently, the system of satellite monitoring for children is in demand, it allows to take care of the child's safety remotely.
- 8) **«Smart School»** – this platform provides an opportunity to use the modern service of electronic diaries and journals. This service is used today in schools in major cities of Kazakhstan (Astana, Almaty, Ust-Kamenogorsk and Others). The use of such technology increases the motivation of students, provides access to various reference systems, electronic libraries and other information resources. Each student, working on his tablet, has an opportunity to exchange information. Becoming a smart-society is a global trend and largely depends on the level of development of education. In Kazakhstan, new technologies used in the educational process were actively discussed from the moment of approval by the President of the Republic of Kazakhstan N.Nazarbayev on December 7, 2010 of the State Program «Development of Education of the Republic of Kazakhstan for 2011-2020», which initiated the implementation of the e-learning system "E-Learning" at the national level.

## **12.6. Green Technologies and ICT**

The introduction of «green» technologies is a trend caused by tightening of the policy in the field of the environment and climate change. Factors associated with this trend, affect the usual technological approaches, the introduction of resource-saving technologies, reducing emissions. Among the consequences traced in the future are modernization of production, increasing production costs, reducing environmental load and the need for long-term investments for the implementation of projects.

To reduce harmful emissions into the environment, companies began to switch to the model of advanced production, which received the term advanced manufacturing. It is characterized by the use of new secure materials and intelligent systems, in particular, robotics and wireless sensor networks. An example is a set of interconnected wireless sensors

and information systems that control the state of objects in the enterprise: equipment, conveyors, assembly machines, reactors.

Such systems process the data received from the sensors in real time, and interact with the control elements of production. Such an automated system responds to any changes in the indicators at the enterprise, notifies the personnel about accidents and problem situations, analyzes the efficiency of the use of equipment, estimates the level of environmental pollution and the volume of waste produced.

Today, technologies can serve not only the interests of the consumer and corporations, but also help in creating effective tools for protecting the environment. Use of ICT solutions can reduce the total amount of greenhouse gas emissions by 15% by 2020 according to the Global Initiatives for the sustainable development of the electronic sphere (GeSI). This is five times the volume of emissions produced by the ICT sector.

In many countries of the world, «active» houses, working on renewable energy sources and consuming less energy than they can produce, are gaining popularity. Large Japanese Panasonic Corporation implements many projects in this direction. Its largest project is the smart city of sustainable development Fujisawa, opened in the suburbs of Tokyo in 2014. It is noteworthy that it houses 1000 houses that do not throw away CO<sub>2</sub>. Most of the electricity consumed by the city is produced by it with the help of solar panels or special equipment for generating energy from natural gas. Rational energy consumption in smart homes is provided by SMARTHEMS systems. In addition to solar panels, each house has a battery, where the accumulation of excess energy, produced during the daytime, is use at night. The construction of a smart city is planned to be completely completed by 2018 [66].

Architects and builders are increasingly choosing the certification of objects according to the standards of environmental construction, the American LEED, British BREEM or German DGNB. This means that a building is initially designed to consume less energy, and that a minimum of waste is produced during construction».

The company Global Development officially stated that the Business Center Park View Office Tower in Almaty, the premium office building, was certified by BREEAM with «very good» rating. The valuation was carried out by a certified appraiser for BREEAM standards – Drees & Sommer. To date, Park View Office Tower is the first «green» (green) office building in Kazakhstan and Central Asia (Figure 12.7).





In Park View Office Tower, automated control systems are introduced, which involves the economical use of resources in organization of water supply, heating, lighting, power supply. Recovering technology is used (return part of the resources for reuse). This is really a good solution, which allows not only to create a normal climate inside the building during the winter season, but also to reduce electricity consumption by using hot water. Heat output from the solution of warm floors is much higher than with conventional radiators. «The systems of automatic control of lighting in those rooms where light is used intermittently, reduces payments for electricity by 25%».

International Exhibition EXPO-2017 in Astana is one of the key national projects of Kazakhstan. The initiative of organizing such a great event in the capital of our country belongs to the President of the Republic of Kazakhstan Nursultan Nazarbayev. EXPO 2017 is the greatest opportunity to get new energy and green technologies, economic development.

More than 50 architects from different countries participated in the contest for the best project of the EXPO-2017 exhibition complex. The winner was selected out of top 10 projects – it was presented by the American company Adrian Smith + Gordon Gill Architecture LLP. It was taken into account that this company has a great experience not only in construction, but also in the sphere of «green economy». The main building of EXPO – the National Pavilion of Kazakhstan – will be built in the form of a sphere using the most advanced technologies. A strong high-tech glass



with a double layer will be used in its construction, which will make it possible to isolate the building from external temperature and sound. This pavilion will become an exemplary «green technologies» project.

The President of Kazakhstan instructed that the construction of new communications for EXPO-2017 and their management should be carried out according to the principles of the «smart city». For this purpose, a project «Smart Astana» is being implemented in the capital aimed at modernizing the city's infrastructure through the introduction of modern information technology.

The appearance of «smart» computer systems in the capital will not only make living comfortable, but also ensure the safety of guests and residents of the city.

At the same time, all decisions of the «smart city» will be fully implemented in the territory of the EXPO exhibition. To optimize energy consumption, new technologies in the field of energy accounting in buildings will be used. Thus, the use of various sensors to record the number of people and distribution of lighting has been planned, which will reduce the use of energy.

To smooth peak loads on the grid, as well as to integrate renewable energy sources into the exhibition infrastructure, Smart Grid technology will be applied. It will allow real-time monitoring of energy consumption of all large objects for decision-making on the distribution of loads in automatic mode.

In addition, new technologies will be used to optimize the parking of cars and the movement of people on the territory of the exhibition complex. These systems will be directly related to the systems that ensure the safety of visitors of the exhibition and official participants, which will promptly prevent and resolve emergency situations [67].

## 12.7. Teleconferences

**A teleconference** is an activity in which group communication is carried out between territorially distributed Participants using teleconferencing technology.

The teleconference is carried out on the basis of a software and technical environment that provides user interaction. The technology of teleconferences is a method of conducting discussions between remote groups of users. Discussions are either in the Real time, or in the mode of viewing documents.

A real-time teleconference is a teleconference, the participants of which simultaneously participate in the discussion and have the opportunity:

- 1) show partners texts and images;
- 2) to conduct a speech dialogue;
- 3) use the remote pointer to select certain parts of the image on the screens;
- 4) manage the transfer of files and messages.

A teleconference in the document view mode is a teleconference that uses a database that hosts publicly available:

- 1) record-description of the topic of discussion;
- 2) record-statements of participants in the conference on the topic of discussion.

Today, video conferencing is most often used (using video communication tools).

Not long ago, people who wanted to discuss a problem had to gather in one place. In our time, with the development of Teleconferencing technologies, persons at a considerable distance from each other, can participate in a computerized version of the conference as easily as if they had gathered in one room [57].



*Figure 12.9. Technology of teleconferences*

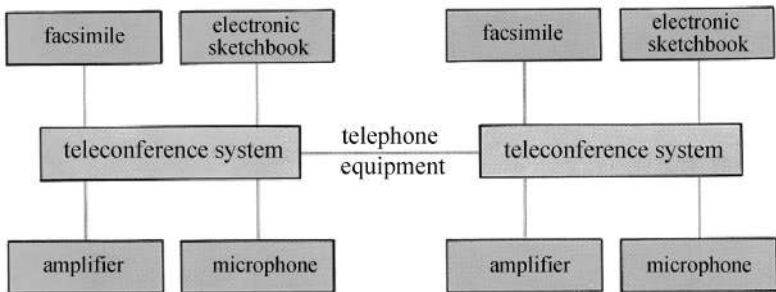
Microphones of the audio-teleconferencing system, similar to those shown in Figure 12.9, catch people's voices in two offices located in different cities. Simple devices installed at both ends of the telephone line convert the sound waves of the outgoing voices into digital pulses, and then perform an inverse transformation, sending a voice to the amplifier. Special electronic circuitry removes the effect of echoes and creaks, which occur when sound comes from the amplifier into a microphone. Facsimile machine and electronic sketch pad complete the list of equipment for teleconference,

providing an exchange of records and illustrations for the entire time of the meeting.

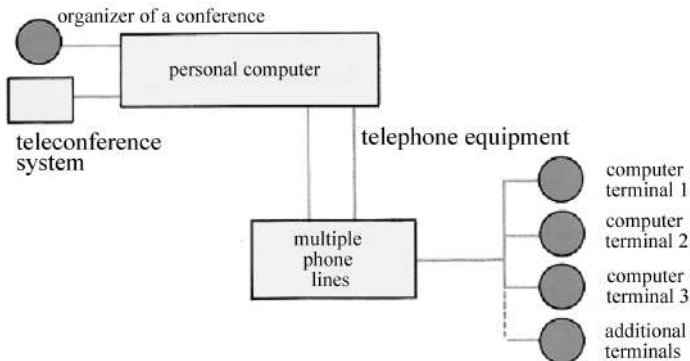
With the development of telephony, companies can discuss problems directly, without having to send their own employees in expensive and tedious business trips. This same method allows students to take a course of study, while at a considerable distance from a college or a university. When they have a question to a teacher, they just raise their hand – electronically – by clicking on the keys of their personal computer. Many educational institutions, corporations and government organizations have estimated the speed and simplicity of audio and computer teleconferences [57].

### ***Varieties of Teleconference Communication***

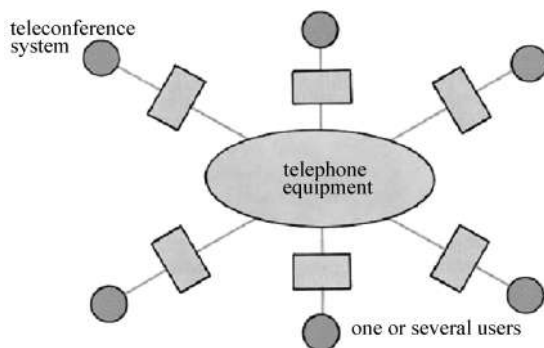
Teleconferences can be attended by individuals as well as whole groups. Figures 12.10 (a, b, c) give examples of possible combinations of conference participants, as well as communication equipment and facilities required in each specific case.



*Figure 12.10 a. The Scheme of the Bilateral Conference*



*Figure 12.10 b. The Scheme of the Conference with a Large Number of Participants*



*Figure 12.10 c. The Scheme of Group Teleconference*

## 12.8. Telemedicine

According to the definition of the World Health Organization, «Telemedicine is a comprehensive concept for health systems, services and activities that can be remotely sent via information and telecommunication technologies, for the development of world health over spreading diseases, as well as education, management and research in the field of medicine».

With the development of information and telecommunication technologies, medicine is also changing. The appearance of gadgets, the availability of cellular communications and the Internet, including mobile 3G and 4G, changes the appearance of medicine. If twenty years ago it was mainly about telephone consultations, then in time even such free software as Skype allowed the patient to talk face to face with the doctor even from Pharmacies. Moreover, the look of telemedicine is changed due to various gadgets. The first to appear in the 1970s was a pulse meter, it has now become an integral part of many «smart» hours. This is another source for collecting information that will be useful to doctors for diagnosing and developing recommendations. Telemedicine as one of the leading trends in recent years should attract a lot of attention from investors. [57].

Modern gadgets collect information about movements, count the number of steps and measure the pulse. With the development of the industry, these data will become more accurate – it is known, that pulse monitors do not have surgical precision in their measurements. The first ECG monitor (Figure 12.11) of the heart rhythm, manufactured by Polar, uses optical pulse measurement technology popular in modern devices.



*Figure 12.11. The First ECG Heart Rate Monitor*



*Figure 12.12. Modern «Smart» Cock with Functions of Control over the Body*

Human Integration with modern gadgets, such as fitness trackers and just smart phones, which have software installed sports applications and diaries, will allow doctors to obtain the maximum amount of information about the patient. Thus, the created software collects from all the given

Applications, data on the behavior of the patient, about his activity and nutrition, and then adds this information with food photos from instagram and sends him to the clinic where the patient is being treated and consulted.

### ***Telemedicine Systems as Part of a Smart Home***

As one example of a home complex for data collection, a patient can be brought to the Washlet toilet room, designed Jointly by Toto and Daiwa House (Figure 12.13). In this «smart room» is collected information about the change in body weight, the measurement of blood sugar, and also carried out a monitor of blood pressure and urine analysis.



*Figure 12.13. «Clever» Toilet Room Washlet*

The great potential of information and communication technologies is used in remote surgery. A famous robot surgeon DaVinci, to be more precise – the robotic-assisted surgical system da Vinci (Figure 12.14) is a device for performing surgical Operations, consisting of two blocks: the

surgeon's console, through which the second unit is controlled – a rack with four robotic manipulators. Each surgical maneuver is regulated directly by the surgeon: the robot does not take itself and can not be programmed. Each of the manipulators of the device performs a certain function: two of them with the highest accuracy are repeated the movements of the surgeon, who is behind the control console. The third manipulator is equipped with A camera that transmits an extremely accurate image of the site to be operated on the monitor. The fourth «hand» performs assisting function.



*Figure 12.14. Robot-Assisted Surgical System «da Vinci»*

Manipulators, in fact, perform the functions of a surgeon, but the cuts for the operation are much smaller: the diameter Manipulators is 1 cm.

*In Kazakhstan there is a medical portal [zdrav.kz](http://zdrav.kz). The developer of the medical portal is «Global Technology Network» LLP (GTNet).*

GTNet was established in 2006 in Almaty by a group of medical professionals interested in promoting biomedical and infocommunication technologies in Kazakhstan. Since then, the company has managed to take one of the leading positions in such areas, such as the development of medical portal [zdrav.kz](http://zdrav.kz), telemedicine, analytical developments for medical and demographic research.

As part of its technological direction, GTNet took part in the State Program «Development of Telemedicine and Mobile Medicine in Rural Areas». GTNet Company has developed a computer program Medline, which provided an optimal interface between telemedicine network users and consultants. Such equipment was equipped with 16 Telemedicine centers in rural areas of Kazakhstan. GTNet was responsible for installing the equipment, setting up a telecom communication (terrestrial and satellite), and also participated in the training of physicians and technical specialists

in the use of tele-medical equipment. Within the framework of the project, several telemedicine consultations sessions for Kazakhstani patients with the Harvard Clinic Massachusetts General Hospital, as well as with a children's hospital in Paterson, New Jersey, USA were conducted.

In Kazakhstan, 133,392 patients received telemedicine consultations from 2004 to 2016. The most demanded were consultations on cardiology – 5,600 sessions, pulmonology – 3,215 sessions, Neurology – 2,251 sessions and others.

To date, the National Telemedicine Network (NTMS) unites 199 health facilities across the country and is divided into district, provincial and republican levels. Employees of regional level medical organizations (141 district and city hospitals) can receive consultations of their colleagues from regional hospitals and republican medical centers.

Timely and correct diagnosis and the prescription of the treatment with telemedicine allows doctors to promptly address the emergency issues in medical care for patients, reduce the travel costs of citizens, and also reduce the costs of medical organizations for the delivery and accompaniment of severe patients in regional or republican clinics.

Work is underway to modernize the National Telemedicine Network during 2016-2018. It is the modernization of equipment, servers, updating the software «IS-Telemedicine» etc. In this regard, heads of health organizations were encouraged to make proposals for the modernization of the existing and creation of new telemedicine centers with regard to medical equipment taking into account the profile of the health care organization.

## 13. E-TECHNOLOGY

One of the main characteristics of the information society is the process of informatization – the active introduction of information and communication technologies in various spheres of production, business, education, public life.

### 13.1. E-business

In the process of its development the global Internet network has evolved into the tool of conducting electronic business (e-business) from the means of e-mail and the source of mass information, based on the principles of the network economy. ***E-business*** is an entrepreneurial activity that uses the capabilities of information technology and global information networks with the purpose of making a profit. The main product of e-business is information, so e-business is sometimes called Information business.

The main component of e-business is *e-commerce*. ***E-commerce*** is not only the sale and purchase operations, but also the support of the processes of formation of demand for products and services, online processing of orders, as well as exchange of information between partners. Today e-commerce in trade plays an important role, since the Internet has become an effective intermediary between traders all over the world. The turnover of financial resources in the sphere of direct sales, that is, sales «from the seller to the consumer» amounted to more than 1.3 trillion dollars, between companies - 15 trillion dollars. According to the analysts and experts in electronic commerce in 2018 e-commerce will account for more than 40% of the total trade indicators in countries with transitional economy while in the developed countries this figure will decrease slightly from 70 to 60%.

#### ***Basic E-Commerce Models***

E-commerce is the main factor of economic growth in both developed and developing countries. The low cost of contracting over the Internet allows companies of all sizes to expand their sales abroad and look for suppliers through Internet commerce.

In e-business, the following models are distinguished.



	Government (G)	Business (B)	Citizens ( C )
Government	G2G Coordination	G2B informing and sales of illiquidity	G2C
Business	B2G supply	B2B e-commerce	B2C e-commerce
Citizens	C2G taxes	C2B comparison	C2C Auction

### ***Model B2B***

The business for business system is the organization of complex information and trade interaction between companies through electronic communications (Internet, intranet, mobile and other means of communication). The main difference of the B2B system is the automated exchange of data between two interacting systems, which means the availability on both sides of complex automated control systems (enterprise resource management systems). In the B2B system, any contractor can view the current needs of the company, immediately respond to them, plan the delivery schedule, determine the delivery methods, invoice, and all this information into the enterprise resource management system.

First of all, the B2B systems are intended for the decision of problems of sale and material and technical supply. In addition, this system allows you to reduce transaction costs and remove inefficient links from supply chains. The B2B model consists of:

- 1) *The aggregation model (electronic trading platform)* is a universal place for procurement of material and technical support for the company. In a single place, suppliers' catalogs on groups and product categories displayed in real time are presented in a single form.
- 2) *The model of the Shopping Hub* – on the site form a trade community of sellers and buyers. The seller has a special place to advertise their goods, and the buyer has the ability to obtain information containing specifications and descriptions of products. This model can be horizontal, that is, support all sellers and buyers from different branches. The diagonal trading model supports certain categories of sellers and buyers and certain categories of goods. The peculiarity of this model is availability of auctions for the sale of large quantities of rare goods or auctions for the integrated supply of small companies.
- 3) *Bulletin Board* – is a structure where sellers and buyers can post something that can arouse the interest of sellers and buyers. The

parties, having found each other, carry out interaction outside the structure. The purpose of this type of electronic business is to encourage the industry to more standardized contacts.

- 4) *The model of auctions* – sellers and buyers put up competing applications for the conclusion of contracts. This is the ideal model for eliminating surpluses at the best price.
- 5) *Brokerage Site* – works as an intermediary between the buyer and the seller, which exists for the purpose of obtaining an order from one enterprise and placing it in another enterprise through the Internet.
- 6) *Corporate Site of the Company* – is intended for communication of this company with other partners by counter-parties, operating and potential investors. The site contains information about the company, its management, as well as product catalogs and a description of the services.
- 7) *Online Stores* – this model can be built into a common corporate site or exist separately.
- 8) *The Procurement Service* – allows an enterprise to implement material and technical supplies directly through its web site. To do this, you need to place your needs in material and technical resources in order to find a supplier and get commercial offers from him.

Advantages and disadvantages of the B2B system: the system expands the coverage of the market; Internet platforms provide price reduction; the activity of online intermediaries reduces the transaction costs of the buyers' companies; Web-based systems allow you to identify the best Ways of doing business.

### ***Model B2C***

The B2C system takes place in cases when the enterprise sells its goods or services via the Internet directly to the consumer. System B2B – the principle of concluding a contract is based on mutual profit.

B2C system is the sale of goods based on the principle first-in – first served. An example of the implementation of B2C is electronic shops, booking and ticket sales systems, Internet kiosks.

The development of B2C business is connected with the general development of the economy and the increase in the welfare of buyer

- 1) Logistics;
- 2) Transport Infrastructure;
- 3) Postal System;
- 4) Payment Systems of Online Stores.

Trading companies operating in the B2C system have the following structures:

- 1) Web-shop-window is placement of a catalog of products or goods of the company in the network that have min ordering tools.
- 2) In addition to the shop-window the online store contains all the necessary business infrastructure for managing the process of electronic commerce.
- 3) Trading Internet systems (TIS) are an online store and a web-office that is fully integrated with business companies.

B2C is organizationally and methodologically simpler than the B2B system. For the client, an online store is a showcase where the following is to be submitted:

- 1) Catalog of goods;
- 2) Interface elements for entering registration information;
- 3) Order formation;
- 4) Making payments through the Internet;
- 5) Obtaining information about the company-seller;
- 6) Presence of on-line help. Shop window is located on the Internet server and is a web site with active content.

### ***Model C2C***

System C2C (buyer for the buyer). Around the website, an online community of people is formed, united by specific interests, their number is directly proportional to the efforts of project participants and the organization of necessary services. Direction C2C allows you to enter into transactions at any convenient time, reduce overhead costs and save money for the end user.

The C2C sector includes *online auctions* where sales are made directly from one person to another in the framework of electronic business, when there is one seller and many buyers. To participate in auctions as a buyer or a seller it is enough to become a client of one of the auction servers and put up for sale your product or express a desire to buy it. The Internet allows one person who became an auction customer to participate simultaneously in several electronic tenders, and to register it is enough to have an electronic bank account. Banking structures use electronic auction technology for currency trading. Sale of goods for the highest possible price is called direct auction. In this structure is one seller, and buyers two or more. A reverse auction is a system with one buyer and several sellers, all public procurement auctions use this structure. Auctions implement natural pricing schemes, so they are used to explore market opportunities.

Trades at auctions are conducted according to the following schemes:

- 1) Standard or English Auctions use open format of the proposal, when all buyers are aware of each other's offer. The seller assigns a starting price, and buyers indicate a price of 3% more than the proposed price.
- 2) Dutch auctions begin with a deliberately inflated price, also uses an open form of offers and continues until one of the buyers agrees to accept it.
- 3) Simultaneous bid auctions – all buyers simultaneously assign prices and the winner is the one who offers the maximum.
- 4) Double auctions – when an offer comes from the seller and the buyer at the same time. As a result, an equilibrium price is established - electronic exchanges operate on the principle of electronic auction.
- 5) Auction closed – when the buyer and seller make closed (secret) offers in the previous maximum.

At on-line auctions there is a system of rating evaluations of bidders. It is that the winner of the auction and the seller present to each other estimates reflecting their attitude towards the counterparty that has been developed during the interaction. The issuance of this assessment is mandatory. PRO XY – automatic rate increase system.

Internet Exchange allows you to actively deal with financial assets in an active mode. The exchange is a trading platform, where the price of a commodity is determined by supply and demand. At the exchange, the goods must be standard, as the trade is anonymous and the buyer cannot see the goods before buying it. The income of the Internet exchanges consists entirely of commission for the conclusion of a transaction.

### ***Forms of Payment in Electronic Business***

Most of the firms that sell online, accept payment by credit cards issued by banks. The most commonly used payment systems worldwide are American Express, Visa, Mastercard and Discover – both in real and online stores. In many countries, people prefer to use country-specific cards. A lot of companies specialize in processing payments from international consumers. In order to find such a company, it is necessary to type the words «international online payments» in any browser, such as Google or Bing. One popular payment option is PayPal, an independent service that handles payments made through credit cards and consumer bank accounts, and sends money to a seller. PayPal is becoming more popular among small firms that sell online to foreign buyers. PayPal guarantees payment to the seller.

### ***Information Infrastructure of Electronic Business***

Successful e-business relies on an infrastructure that meets the following three criteria:

- 1) *Flexibility* – for rapid development of e-business models by adding new functionality to applications, and integration of systems and applications with customers, business partners and suppliers.
- 2) *Scalability* – to adapt to unpredictable fluctuations in customer requests and user workload.
- 3) *Reliability* – to ensure the safe and continuous operation and availability of e-business applications to end users.

In order for the IT environment to provide the flexibility, scalability and reliability required for e-business, companies must develop an IT infrastructure of a new type. This The infrastructure should consist of open interfaces that allow you to easily connect new applications and services. It can also support individual processing and management of elements within the infrastructure, including the management of the entire environment. And the e-business infrastructure reflects five logical functions:

- 1) *Web Application Servers* – processes in the company the logic of applications for e-business And manages interaction with users. While most companies have only one Web application server, some prefer to keep multiple servers – in order to optimize each of them for a particular function or to provide support for excessive loads and scalability.
- 2) *Directory and Security Services* – their task includes computational functions at the interface of the internal infrastructure of the company's electronic business and the external environment of the Internet: routing control, basic authentication, firewall and transcoding The ability to support new types of devices and transmit outgoing data to the Internet directly in the format of this device. Border servers also improve the characteristics of caching, load balancing, and connection security.
- 3) *Edge Servers* – the security policy management server provides a single and global registration for multiple systems, which eliminates the need for multiple passwords. It can also manage security independently of each of the individual applications, providing administration and control over user authorization from a single console. Such a system will allow the company to implement a multi-level approach to security, offering a higher degree of protection against unauthorized access, but without causing irritation of the full-right users.

- 4) *Data & Transaction Servers* – the formation of a flexible and reliable electronic business requires a seamless integration between Web application servers and internal data and transaction servers. These servers support complex and mission-critical tasks. They provide a high level of security and application integrity and can perform complex transaction on big data sets. Scalability on these servers is achieved not by adding additional server hardware, but by increasing the capacity of the existing system.
- 5) *Storage Management* – the need to provide scalability quite often forces companies to build an e-business infrastructure that is based on multiple systems and even on several types of server platforms to cope with the workload of e-business applications. Although such an implementation can significantly increase the scalability and reliability of the entire infrastructure, at the same time it introduces the problem of data integrity – you need guarantees that all applications have an access to the same data set. The management of data storage can help solve this problem. Data storage management enables each application within the enterprise to access reliable information – regardless of the type of storage used.

Although these five functions can be performed on a single server or on multiple servers, the separation of functions will allow the company to make changes in infrastructure faster: to improve one function without losing the interaction of other components within the e-business infrastructure.

As e-business develops, companies should invest in its infrastructure. More complex business models and e-business applications may impose new infrastructure requirements, resulting in additional costs for network and server hardware, software, personnel and infrastructure processes. With the successful implementation of e-business, these costs must be paid back by revenue growth, received from the electronic business or from the results of other production activities.

### ***Legal Regulation in Electronic Business***

In 2006, the United Nations Commission on International Trade Law (UNCITRAL) adopted the use of electronic messages in international contracts. The international business community welcomed the signing of this Convention as a sign of the growing legal recognition of the conclusion of contracts in electronic form, particularly in developing countries. This was a valuable development that facilitated the development of cross-border e-commerce and operations.

*What are the advantages of electronic commerce created by the UNCITRAL Convention:*

- 1) The Convention allows electronic communications to meet the requirements of other international conventions without the need to revise each of these conventions individually;
- 2) The Convention contains provisions that require signatory countries to recognize the legitimacy of electronic communications, as well as provisions that deal with issues that usually arise in electronic agreements, such as the location of the parties, the requirements for information and format, invitations to make offers, the time and place of sending and receiving incoming messages.
- 3) The Convention strengthens the legal certainty of the concept of party autonomy and confirms it. The autonomy of the parties is an integral element in the conclusion of contracts in electronic form. The Convention allows the parties to formulate their electronic agreements in the most productive manner.

*Initiatives supplemented by UNCITRAL:*

- 1) In 2004 ICC Electronic Terms (ICC eTerms) developed the «Electronic Terms» – additional provisions intended for use in international contracts by companies around the world. The electronic terms of the ICC are a number of articles designed to be included by the parties in their contractual documents in order to show that they intend to conclude a binding electronic contract.
- 2) ICC has developed an annex to the UCP 500 for the electronic submission of documents under the Letter of Credit transactions – Electronic UCP (eUCP). This annex consisted of 12 articles and was intended for use in tandem with UCP 500 in cases where documents are submitted in electronic format

### ***Significance of Electronic Signature in Electronic Commerce***

Electronic signatures are important as guaranteeing proper identification of communicating partners, authenticating and preventing denial of messages, which the parties exchanged. In order for the electronic signature mechanism to work, it is necessary to take a number of steps at the international level. In many countries, electronic signature laws that include rules concerning certification services are being developed or already adopted. In particular, in the Republic

Kazakhstan adopted the Law of the Republic of Kazakhstan of January 7, 2003 No. 379-II (as amended on November 24, 2015) «On Electronic Document and Electronic Digital Signature».

- 1) ICC has developed a set of recommendations that are designed to help states and businesses ensure the reliability of electronic authentication and electronic signature, which will facilitate the conclusion of international transactions in electronic form. Here are some of these recommendations:
  - ICC has developed guidelines that contain common definitions and reflect best practices regarding authentication and certification, which were published by several business organizations and must be constantly reviewed in order to reflect business practices.
  - ICC recommends the freedom to the agreement when establishing the rights and obligations of the parties using electronic signatures.
  - ICC recognizes the need for legal recognition of certificates and electronic signatures, both nationally and internationally. According to the ICC, they should be supported by the adoption of appropriate government measures.
- 2) The ICC recommends that measures taken by the state provided a predictable legal basis build on the fundamental concept of freedom of contract. Such measures should be non-discriminatory; neutral, in terms of technology and architecture; promote the flexibility of the content, form and functions of certificates and similar certifying mechanisms; and promote competition among providers of authentication services.
- 3) ICC encourages: rules for assessing the legal validity of electronic signatures should not contain requirements Localization, availability of local partners, local insurance schemes or guarantees, mutual recognition or otherwise act as trade barriers. Neutral criteria for adequacy should be used to establish recognition.
- 4) The ICC calls for: the standards of electronic signatures used or recognized by governments should be technologically neutral, commercially available, allow the use of technological innovations and should not give preference to any particular solution.

*The e-commerce market of Kazakhstan has been gaining momentum in recent years. Turnovers already exceeded \$ 700 million. The crisis that emerged showed that it is this segment of the market that is most promising today, and new opportunities for the growth of online trading have appeared. People save, they start looking more in the internet and go where it is cheaper – e-commerce unequivocally goes up. The most developing e-commerce market in Kazakhstan is household appliances. In our large networks were: Sulpak, Technodom, The planet of electronics – everyone*



*has online stores. Another example is the electronic markets Satu.kz – in fact, it's the same the very bazaar.*

## **13.2. E-Learning**

E-learning is understood as an educational process that is characterized by systematical and intensive application of modern information and communication technologies and means of computer facilities. This concept forms a single synonymous series with such terms as remote, multimedia, computer, virtual, online, Web-oriented, cybernetic education and others. The current state of computer facilities and the widespread use of the Internet makes it possible to realize the numerous advantages of electronic learning technology: high interactivity, remoteness, massiveness, access to electronic libraries, the creation of a unified educational environment and other.

The system of electronic education is a complex software and hardware complex distributed between servers and client computers. Data exchange in the educational subnet is carried out, as a rule, via Internet channels and local network communications. Management of this multi-level hierarchical system is performed via special software platforms, which in Englishlanguage publications are called virtual learning environment (VLE) or learning management systems (LMS). In publications in Russian, such platforms are usually called distance learning systems (DLS).

Let's list the basic capabilities of SDS, which form their basic functional:

- 1) Creation and loading of educational and auxiliary materials. The SDS should include tools for editing and uploading educational materials, plans, notes, additional instructions and the like to the educational site. In many modern DLS, this function is implemented using the Web interface.
- 2) Creating and implementing online tests. Online tests are an effective way of operational control and self-control of knowledge. The testing subsystem allows you to instantly assess the quality of mastering new material.
- 3) Issue and verification of tasks. Posting and checking jobs on-line greatly simplifies this time-consuming procedure.
- 4) Operational control of progress.
- 5) Forums, chats, videoconferences and other types of networked collective interactivity.

Currently, there are more than 100 commercial and free software environments that support remote e-learning. For this reason, choosing a system that meets the needs of the existing educational institution, or creating a new network educational resource based on the DLS, is a non-trivial task.

To assess the DLS, the set of criteria selected by WCET (WICHE Cooperative for Educational Technologies) is used. This is a public network organization that unites leading universities and prominent specialists in higher education ([wcet.wiche.edu](http://wcet.wiche.edu)). Its purpose is to discuss key issues and modern technologies of higher education (including networking and distance learning).

Numerous properties and technical parameters that serve to assess the consumer properties of DLS are divided into three groups on the basis of functional similarity: teaching tools; support tools; technical specifications.

***The «Teaching Tools»*** section integrates various functions of distance learning systems that provide for an independent work of a student, his communication with colleagues and teachers.

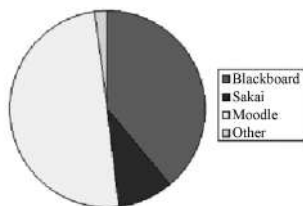
For example, issuing assignments via e-mail, discussing training material in a discussion group, creating custom notes, subscription to RSS-news, exchange of educational content, keeping an electronic journal and much more.

***The «Support Tools»*** section includes DLS resources, designed to administer and support training curricula, cost, curriculum and trajectory of learning. Thus, this section includes, the means for organizing training courses from individual modules, ordering tools for modules, design tools and templates, tools for testing compliance with training standards and techniques, technical support for a single repository of training modules and materials, and others.

***The section «Technical specifications»*** combines the list of technical requirements necessary for the full operation of the Distance learning system. This includes requirements for technical and software types of support: operating system, database, viewer and more.

Based on the analysis (according to [www.zacker.org](http://www.zacker.org)), the leaders in DLS are Moodle, Sakai and Blackboard with a slight advantage of the first system. Despite some methodological and technical vulnerability of the analysis, it correctly reflects the current rating situation in the market of distance education systems. In particular, this conclusion is confirmed by the frequency of search queries in the Google Trends system, as well as the

studies commissioned by some commercial organizations. So, according to the site seemedia.pro distribution of the mass market shares looks as shown in Figure 13.1.



*Figure 13.1. Mass Market Share of Distance Learning Systems*

Consider the **Moodle system** (Modular object-oriented dynamic learning, the leader in DLS) is one of the most powerful and common remote learning environments in our time. It is distributed based on the license for open source GPL code systems ([www.gnu.org/copyleft/gpl.html](http://www.gnu.org/copyleft/gpl.html)). On its basis, it is possible to configure a specialized distance learning system that best meets the needs of an educational institution.

Moodle supports more than 40 languages, including Russian. On its basis, a lot of educational resources have been created and successfully functioned: sites and courses. The popularity of this tool can be estimated from the statistical data on [www.moodle.org](http://www.moodle.org):

- 1) more than 80 000 registered educational sites;
- 2) the number of users is close to 70 million;
- 3) the number of courses created exceeds 7,300,000;
- 4) its is used in 233 countries.

Let's list the main advantages and features of this system:

- 1) Free distribution and open source code. This factor is very important for educational institutions (in particular, for universities), which are able to conduct their own software development. The open architecture of the system allows replenishing it with custom modules and customizing the program code for the features of the organization and the current situation.
- 2) Software development. The Moodle system is a dynamically developing software environment. Members of the international Moodle community participate in its creation: users, programmers, system administrators and organizations. This guarantees continuous

improvement of the system and its compliance with modern and prospective requirements of distance learning.

- 3) Easy installation, configuration and administration of the system. Moodle is easy to install and does not impose high demands on technical and system software. Moodle works under the control of the main modern operating systems: Unix, Linux, Windows, Mac OS X, Netware and others.
- 4) Functional completeness. Moodle allows you to implement all the basic functions of modern SDL. Experience shows that in Moodle environment it is possible to carry out any modern didactic technique and even experimental pedagogical technologies.
- 5) Scalability. The system does not have significant «dimensional» constraints. It is suitable for working in a small environment Educational organization (school, college and other educational institutions) and can serve as a technical base for the educational process in a large university, which has thousands of students and hundreds of electronic training courses.

**The Blackboard system** is a set of programs designed for distance education and the development of training courses. This is a developed software, which includes modules: Blackboard learn, Blackboard Collaborate (virtual classes), Blackboard Mobile (mobile training), Blackboard Connect (system for mass online distribution), Blackboard Transact (identity system), Blackboard Analytics (data storage and analysis system) and others.

This is a commercial product with a closed code, which is developed and supplied by Blackboard Inc. Most American universities in the first hundred use this platform for remote education.

**The Sakai system** is an open source software environment developed and used by the scientific community institutions, commercial organizations and individuals. Sakai is distributed by a free community license and is used for training, research and cooperation. The Sakai software is based on Java technologies, which, in particular, means higher stability and reliability of the code compared to other open source systems. System Engineering Bulletin 510 is well structured, it includes many

Main auxiliary modules from which it is possible to collect specialized distance learning systems for a specific Educational institution.

*In the Republic of Kazakhstan, many educational institutions have implemented DLS. For example, in KazNU. Al-Farabi department of distance education is a structural unit of the university. Since 2008, KazNU actively implements the remote education management system Moodle.*

*The functions of the department are:*

- 1) the formation and preparation of electronic textbooks and teaching aids;*
- 2) teaching of KazNU teachers to use modern technologies in the educational process and methods of work on the creation of multimedia and electronic textbooks and teaching tools;*
- 3) creation, replication and distribution among the faculties and departments of the University of multimedia and electronic training programs for the use in the educational process based on materials provided by the faculties of the university;*
- 4) support of training courses for distance education;*
- 5) delivery of educational material to students of distance education;*
- 6) consultations on distance education;*
- 7) study of trends and directions of application of distance education and multimedia teaching aids in the educational Process.*

*Nazarbayev Intellectual School. Schools are equipped with the latest computer systems, multimedia cabinets equipped with high-performance electronic computers, interactive electronic boards, high-speed Internet, innovative software that will not only help you gain knowledge, but can also guide the learning process.*

### ***Electronic Textbooks***

Electronic textbooks (EE) are beginning to take an increasing place in our lives. The rapid development of electronic industry, microelectronics, computer technologies and Internet technologies contributes to the appearance and dissemination of electronic textbooks.

To date, there is an active process to create electronic textbooks in the hypertext form and their implementation in the educational process. However, there is no single standard for the construction of electronic textbooks, there are no mechanisms for their legal protection, there are no uniform criteria for determining the quality of electronic textbooks.

Usually electronic textbooks are divided into two types: those that are distributed on disks or placed on local networks are distinguished by rich illustrative material of high quality in the form of interactive models, video fragments, three-dimensional images, demonstrating various processes and phenomena, as well as sometimes a more complex multi-level structure of presentation of material and control.

Electronic textbooks have a number of advantages. Compared to conventional textbooks, electronic books contain a huge amount of information, at small sizes. Of course, that standard teaching tools,

textbooks will never lose their relevance, a book, a textbook, will always be close to the person, and help him. And electronic textbooks, are very much a good addition to the classical methods and methods of teaching. One can give this definition to an electronic textbook:

*Multimedia (electronic) textbook is the presentation of educational material in electronic form, with the use of the following objects:*

- 1) formatted hypertext;
- 2) graphic images;
- 3) animation;
- 4) audio and video recordings.

In the development of ET it is advisable to select as sources such print and electronic publications that:

- 1) most fully correspond to the standard program;
- 2) concise and convenient for creating hypertexts;
- 3) contain a large number of examples and tasks.

When creating the ET, first of all, the material is divided into sections consisting of modules that are minimal in volume but closed in content; a list of concepts that are necessary and sufficient for mastering the discipline is compiled. Then the source texts are processed in accordance with the table of contents and the structure of the modules; texts that are not included in the lists are excluded, and those that are not included in the sources are added; the links between the modules and other hypertext links also should be checked. Thus, a hypertext project for computer implementation is being prepared.

At the next stage, the hypertext is implemented in electronic form. As a result, a primitive electronic publication is created, which can already be used for educational purposes. Computer support is being developed. Instructions for users on the use of EC are being developed.

Now the electronic textbook is ready for further improvement, that is, sound and visualization with the help of multimedia tools.

First of all, the ways of explaining individual concepts and statements are changed, and texts for replacement with multimedia materials are selected. Modules visualization scripts are being developed to achieve the greatest visibility and the maximum unloading of the screen from textual information. The visualization of the texts is performed, that is, the computer embodiment of the developed scenarios using drawings, graphs and, possibly, animation. So the information is better absorbed, it is simple in understanding and is evident.

Convenience of ET application is obvious, especially in disciplines, the content of which is constantly updated in connection with progress, for example, informatics, economic and legal disciplines. Each year, it is possible to update the ET. The ET must have the following characteristics:

- 1) a clear structure;
- 2) fast transition to any element;
- 3) the ability to search;
- 4) readability;
- 5) brevity.

#### *Structural Organization of Electronic Textbook*

The number of electronic textbooks is growing every year on the computer products market. At the same time, disputes about what an «electronic textbook» should be, and what functions it should perform, do not subside. At present, the following requirements are imposed on electronic textbooks:

- 1) the information on the chosen course should be well structured and represent the completed fragments of the course with a limited number of new concepts;
- 2) each fragment, along with the text, should present information in audio or video, that is, «live lectures»;
- 3) textual information can duplicate some of the live lectures;
- 4) illustrations representing complex models or devices, should have an instant prompts that appear or disappear synchronously with the movement of the cursor on individual elements of the illustration (map, plan, diagram, product assembly drawing, object control panel and so on);
- 5) the text part should be accompanied by numerous cross-references, which reduce the search time necessary information, as well as a powerful search center;
- 6) video information or animations should accompany sections that are difficult to understand in the usual way;
- 7) the availability of audio information, which in many cases is the main and sometimes irreplaceable content of the textbook.

It must be remembered that the ET is not an exact copy of any book publication. Such a textbook is badly perceived and uninteresting to the student. Now there are many programs for creating power management, for example with. HTML files.

*The first electronic textbooks for the first class appeared on the website of the Ministry of Education and Science of the Republic of Kazakhstan*

*in 2016. Electronic versions of the textbooks are provided for posting on the site by Kazakhstani publishing houses, which also published textbooks for all first-graders of the country this year. «Modern children have slightly different skills of perception of information, the world experience shows that one of the effective mechanisms of increasing the effectiveness of training is to provide students with broad access to electronic educational resources. Modern methods of interactive submission of educational material make it possible to make study interesting and exciting for schoolchildren of any age. Use of electronic textbooks will allow the Kazakhstani educational system not only to meet new technological trends, but also to attract the interest of the pupils to the program,» the Ministry noted.*



*Figure 13.2. Electronic Textbooks for Students of Schools*

### **13.3. E-Government**

Currently, the state, as the main public institution, seeks to respond quickly to changes in society and the economy, while making its own changes to create a government structure that is more oriented to the needs of citizens and business.

In the conditions of isolated activity of the state structures, various institutions have their own rules and procedures, as well as their own legal basis for activities, their own methods of work and business processes, which leads to disunity of actions, duplication of information and inefficient use of resources.



In order to provide comprehensive services and improve the efficiency of its work, the state is currently seeking to unite isolated structures. By reorganizing internal business processes, many government agencies are reducing many steps and operations that require the direct participation of citizens, using the technical solutions that standardize the information systems of authorities and allow them to integrate them. The process of using information technology in public administration characterizes the transition of the state to a new level of interaction with society – «e-government» [57].

The concept of e-government is to change the internal and external relations of the state organizations based on the use of the Internet, information and telecommunication technologies (ICT) in order to optimize the services provided, to increase the public's involvement in issues of state management and improvement of internal business processes.

The general scheme of the architecture of «electronic government» includes the following main blocks (directions of development):

- 1) Systems for ensuring remote access of citizens to information on the activities of state bodies on the basis of ICT.
- 2) Public service delivery systems using modern ICT.
- 3) Interdepartmental system of electronic document management.
- 4) Systems for planning and monitoring the activities of public authorities.
- 5) Regulatory framework for the creation of e-government.
- 6) Unified services and data infrastructure systems - a set of nationwide systems, registries and classifiers.
- 7) Providing ICT systems and system support for internal processes of state bodies.
- 8) Technological infrastructure and system for its support.
- 9) The system of management and methodical support of the program for the formation of «e-government».

### ***Forms of Electronic Interaction***

Many countries, including Kazakhstan, have already implemented or are still implementing a large number of initiatives in the field of Electronic government. This variety of initiatives can be divided into several categories – from simpler forms of interaction to more complex ones (Figure 13.3):

*Public dissemination of information* is the creation of applications that provide access to government information on the Internet. This category implies relations in which both the state and the user play a passive role.

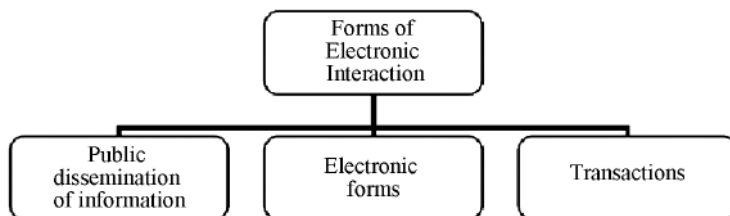


Figure 13.3. Forms of Electronic Interaction

*Electronic forms* or interactive interaction give, for example, the possibility of access in electronic form to various forms of documents that are required for citizens or enterprises to interact with the state. At the level of interactive activity, users no longer act in the same passive role, as they have the ability to access the Internet in state institutions with a specific request. However, this does not necessarily imply a response.

*Transactions* can include the filing of applications in electronic form for obtaining licenses for the conduct of professional activities, the filing of tax returns, applications for the exchange of documents and the like. Realization of real operations (transactions) implies active communication between the state and the addressee of the services. An example could be a service request followed by electronic confirmation of the application or a fully realized chain of obtaining the right to open one's business.

### ***Forms of E-Government Implementation in Developed Countries***

If we talk about the world experience in the formation of «electronic government», then for the first time the idea of creating an «electronic government» and e-democracy have been proposed by scholars from the United States of America (USA) and the United Kingdom, implying the use of new ICTs for the protection and development of basic democratic values and, above all, for citizen participation in the decision-making process of government and public administration.

It is necessary to distinguish three basic models of the formation of «electronic government» in the experience of different regions and countries of the world: *in America, Europe and Asia*. The American model shows the specifics of the formation of «electronic government» in the US; European includes the development of «e-government» in most countries of Western, Central and Eastern Europe; the Asian model is most successfully used in Singapore and South Korea.

The highest level of e-government implementation involves the creation of unified standards for government information systems: data standards, inter-agency information exchange standards, standards for metadata (and information retrieval), and security standards.

The world leaders in implementing common standards within the framework of the concept of e-government are: Great Britain (government gateway, government intranet and e-GIF standard); Denmark (infrastructure Infostructureba); Sweden (Government Elink (GeL)); Australia (FedLink is a government gateway and a protected government intranet); Hong Kong (Government System Architecture (GSA) – architecture of the state system); USA (Federal Corporate Architecture Information technologies of state organizations).

The US approach is connected with the creation of the concept of the corporate architecture of the state organization and its electronic government. Together – both e-government and the federal corporate IT architecture – provide the necessary components to achieve the desired goal of successful implementation of applied information systems for e-government, which in turn will provide the required efficiency and responsibility in performing functions which the government controls. The main purpose of the American model of «e-government» is simplification, accessibility and low costs in the interaction of citizens and legal entities with state bodies.

In turn, the European model is characterized by such supranational institutions as the European Parliament, the European Commission, the European Court, whose recommendations are mandatory in the development and regulation of the «e-government» for all countries of the European Union. Great Britain pays great attention to standards and protocols, which should guarantee the compatibility of public systems and technologies. Key standards for ensuring compatibility and unity of public systems are defined in the Government Interoperability Framework (e-GIF) and set the basic requirements for the provision of integrated online public services. Following these standards is mandatory for all public systems. The most active period of automation of the British government fell on the 2000s. In the 2000s, a new conceptual job began. Expenditures of the budget on creating the necessary infrastructure of «egovernment», adoption of supporting normative acts were increased, which accelerated the development of the ICT field in the country. In the UK, the e-government implementation program was adopted, based on the regulations «White Paper on Government Modernization» «E-citizens, e-business, e-government. Strategic concept

of serving society in the Information Age». In addition, in 2011 the UK Government approved a new ICT strategy, which was designed to reduce costs and improve the efficiency of the country's ICT systems. In 2011, the government of Britain instead of developing a site that combines many state sites into a single system decided to rework existing public services in electronic form in such a way that they meet the interests of citizens. In order to motivate the population to move to a more convenient way, a single portal GOV.UK has been created, currently there are 24 ministerial departments and over 330 government agencies, and various materials on 47 topics are also published on the portal: on culture, environmental protection and much more. The GOV.UK portal is a single point of access to public services in electronic form provided with the use of ICT.

Distinctive style of management of the Asian model, which relies on the Asian type of corporate culture and multi-layered system of public administration, organized on the principle of a hierarchical pyramid. So, the government of South Korea in the formation of «e-government» focused on the satisfaction of the needs of the population and the introduction of ICT primarily in the field of culture and education (<http://zerde.gov.kz>).

In 1995, the Framework Law on the Promotion of informatization, developed by the Government of South Korea, entered into force in Korea, this law laid the foundation for the implementation of e-government initiatives. In the period from 1987 to 2000, the authorities transferred work processes to digital technologies, and the «e-government» infrastructure was formed. At this stage, the activities of key departments (customs, tax service, patent office) have been automated. An infrastructure of «e-government», a portal for «e-procurement», a service for informing citizens through smartphones was launched. In the period from 2001 to 2007, the range of public services provided in electronic form was expanded, a full translation of all processes into digital technologies. Between 2008 and 2012, e-government was integrated with other information systems to ensure the smooth provision of public services to citizens. Also in 2013, the Republic of Korea is implementing the «smart government» strategy – e-government. The new strategy focuses on the transition to the maximum use of mobile devices, which are currently available to all residents of the Republic of Korea. Mobile phones are used to provide public services in electronic form, informing, alerting and paying for travel. In addition, the government set a task to increase the collection and processing of large data, and uses them not only for the needs of state administration, but also to provide the population of the republic.

Independent information systems of «e-government» agencies of the Republic of Korea are united in a common center of GIDC, in which professional management of all data is carried out. Center GIDC has eight levels of protection, is equipped with an analysis system to prevent hacking, a system for detecting hacking, an emergency protection system. Another interesting element of the «electronic government» of the Republic of Korea is the On-Nara workflow management system (in Korean – «the whole country»). The On-Nara system is installed on all working computers of officials and represents a unified system of document circulation, where the preparation, negotiation and sending of documents take place. On-Nara system receives electronic applications from citizens, it also prepares an answer. The system keeps records of user actions and stores all versions of documents. Specialized systems of «electronic government» is integrated with On-Nara. Also at present, the Republic of Korea is actively working with open and big data. For example, a project for the organization of urban land transport is carried out. Thus, due to the fact that «e-government» is aimed at providing citizens and businesses with fast and high-quality access to public services and improving the efficiency of state bodies by applying modern technologies, it is necessary to develop the ICT area as a factor in ensuring effective governance of the state and providing Population of highquality public services (<http://zerde.gov.kz>).

In Russia, the federal target program (FTP) «Electronic Russia» has been implemented. In the text of the program, its global goal is designated as the formation in the Russian Federation of an e-government infrastructure that is necessary: to improve the quality of relations between the state and society by enhancing the access of citizens to information on the activities of public authorities; Increase the efficiency of providing state and municipal services; unified Standards of public services; enhancement of the effectiveness of interdepartmental interaction and internal organization of the activities of public authorities on the basis of inter-agency information exchange and the use of information and telecommunication technologies by the authorities; increase the efficiency of management of the introduction of information and telecommunications technologies in the activities of public authorities; increasing the effectiveness of information management systems of public administration; ensuring the efficiency and completeness of control over the activities of public authorities. The concept of building an e-government of Russia is realized due to the large-scale introduction of ICT in the life of the state to provide a convenient mechanism for interaction of all subjects

life, namely citizens, enterprises and government bodies (<http://www.cyberleninka.ru>).

### ***E-Government of the Republic of Kazakhstan***

The idea of creating an «electronic government» in Kazakhstan was first voiced by the president of the country, N.N.Nazarbayev in the State Program «Kazakhstan-2030» in 1997. The introduction of «e-government» in Kazakhstan is aimed at improving the quality and reducing the duration of provision by state bodies services to citizens and organizations, providing access to various government bases, the ability to track activities of the state bodies, the creation of an effective and optimal in composition state machinery. To date, many tasks of the initial stage of the formation of «e-government» in Kazakhstan, which were determined by the state in accordance with Legislative acts, state programs in the field of ICT development in the country, have been successfully implemented. The State program for the formation of «e-government» in the Republic of Kazakhstan for 2005-2007 was approved and implemented, approved by the Decree of the President of the Republic of Kazakhstan of November 10 2004 № 1471, the program for the development of «e-government»

Republic of Kazakhstan for 2008-2010, approved by the Decree of the Government of the Republic of Kazakhstan dated November 30, 2007 No. 1155-1 and the State Program «Information Kazakhstan 2020» approved by the Decree of the President of the Republic of Kazakhstan No. 414 of January 8, 2013, which contributed to the phased formation and development of «e-government», the introduction of electronic and public services in electronic form.

At present, the draft state program «Digital Kazakhstan-2020» is being developed, which in its turn will be the main strategic tool for improving the ICT field in Kazakhstan. In addition, the Laws of the Republic of Kazakhstan «On Electronic Document and Electronic Digital Signature» of January 7, 2003, «On Communications» dated July 5, 2004, «On Informatization» dated November 24, 2015, define the main tasks and legal bases for the development of «e-government», as well as the development of the architecture of e-government «in general.

In the global ranking of the United Nations in 2016, the United Kingdom took the first place in terms of the level of development of «e-government», the second place – Australia, the third place – South Korea (the leader of the past). Also, the USA is on the 12th place in the global rating, Russia by 35 positions, China by 63, Uzbekistan and Kyrgyzstan by 80 and 97 positions, respectively. ***Kazakhstan is on the 33rd line***, ahead of all CIS

countries. In addition, according to the UN report, among Asian countries in the level of development of «e-government» Kazakhstan became the 7th in 2016. Higher up are South Korea, Singapore, Japan, Israel, Bahrain and the United Arab Emirates.

At present, we can say that «e-government» is actively being implemented in Kazakhstan and the country is one of the leaders of Asia in this direction. Our country demonstrates significant progress in the development of «e-government» and its implementation in the daily life of the country and society. To further ensure the effective functioning of e-government in our country, it is first of all necessary to pay attention to the following issues: improvement of the necessary business processes; development of the regulatory framework; increase of the level of training; elimination of information inequality in the country.

By solving the above-mentioned problematic issues and effectively implementing the state policy aimed at the development of the ICT sector in the country, there are great opportunities to build an effective model of «e-government» and achieve high results in the world rating on the development of «e-government» ([http: // zerde. Gov.kz](http://zerde.gov.kz)).

As the world experience shows, there are various models for the development and implementation of e-government. For today there is no single model that could meet all the conditions and decisions of the formation of «electronic government». This is due to the fact that each country has its own characteristics, priorities and a different level of necessary resources for the implementation of this task.

## 14. INFORMATION TECHNOLOGIES IN PROFESSIONAL SPHERE. INDUSTRIAL ICT

### 14.1. Software for Specialized Solution in Professional Sphere

In the previous chapters, we looked at software. There are system and applied software. In this chapter, we dwell in more detail on the applied software (Figure 14.1).

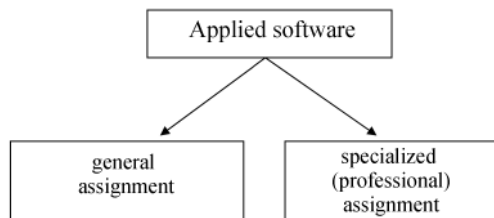


Figure 14.1. Classification of Application Software

Applied software is a set of application programs, with the help of which, in this workplace, specific tasks are performed. These are end-user programs, *general and specialized (professional)*. They are designed to solve problems in a specific subject area.

*The applied software of the specialized (professional) sphere* consists of separate application programs and software packages intended for solving various tasks of users and automated systems created on the basis of these (packages) applications.

#### **Classification of Applied Software by the Field of Application:**

- 1) Applied software of enterprises and organizations. For example, financial management, the system of relations with consumers, supply chain. This type also includes departmental software for small businesses, as well as software for individual units within a large enterprise. (Examples: Transport Cost Management, IT Support Service).
- 2) Enterprise infrastructure software. It provides common opportunities to support enterprise software. These are databases, e-mail servers, network management and security.



- 3) Information worker software. It serves the needs of individual users in creating and information management. This is usually the management of time, resources, documentation, for example, text editors, spreadsheets, client programs for e-mail and blogs, personal information systems and media editors.
- 4) Software for accessing content. It is used to access certain programs or resources without editing them (but it can also include the editing function). It is intended for groups or individual users of digital content, such as media players, web browsers, auxiliary browsers and others.
- 5) Educational content software is close to media and entertainment software, but unlike it, it has clear requirements for testing user knowledge and tracking progress in learning about a particular material. Many educational programs include functions of joint use and multilateral cooperation.
- 6) Simulation software. Used to simulate physical or abstract systems for research, training or entertainment purposes.
- 7) Software tools in the field of media. Provide the needs of users who produce print or electronic media resources for other consumers, on a commercial or educational basis. These are programs for printing, layout, multimedia processing, HTML editors, editors of digital animation, digital sound and the like.

Application programs for design and construction. Covered by computer-aided design (CAD), computer-aided engineering (computer aided engineering – CAE), editing and compiling of programming languages, integrated development environment programs (Integrated Development Environments), interfaces for application programming (Application Programmer Interfaces) ([http://abc.vvsu.ru/books/ Inform\\_tehnolog](http://abc.vvsu.ru/books/Inform_tehnolog)).

### **14.1.1. Special Purpose Software**

#### ***Expert Systems (ES)***

Constantly increasing demands on the means of information processing in the economy and social sphere stimulated the computerization of the processes of solving heuristic (unformalized) tasks such as «what will happen if» based on the logic and experience of specialists. The main idea in this case lies in the transition from strictly formalized algorithms that prescribe how to solve the problem to logical programming, indicating what

needs to be solved on the basis of knowledge accumulated by experts in subject areas.

The basis of expert systems is the *knowledge base*, in which information on this subject area is laid. There are two main forms of knowledge representation in ES: *facts and rules*. Facts capture quantitative and qualitative indicators of phenomena and processes. The rules describe the relationships between the facts usually in the form of logical conditions, linking causes and effects.

The so-called expert systems are used to solve problems of this class. Expert systems are systems for processing knowledge in a highly specialized field of preparing user solutions at the level of professional experts. Expert Systems are used for:

- 1) interpretation of the state of systems;
- 2) prediction of situations in systems;
- 3) diagnostics of the state of systems;
- 4) targeted planning;
- 5) elimination of system malfunctions;
- 6) management of the functioning process and so on.

As means for implementing expert systems on computers, the so-called shells of expert systems are used. Examples of shells are CLIPS, a popular shell for building a public domain; OpenCyc – a powerful dynamic ES with a global ontological model and support for independent contexts;

WolframAlpha is a knowledge base and a set of computational algorithms, Intellectual «computing engine of knowledge»; MYCIN is the most well-known diagnostic system that is designed to diagnose and monitor a patient with meningitis and bacterial infections; HASP / SIAP is an interpretive system that determines the location and types of vessels in the Pacific according to acoustic tracking systems; Expert Systems used in the economy: Shadl (Dialogue) Expert-Ease and others ([http://abc.vvsu.ru/books/inform\\_tehnolog/](http://abc.vvsu.ru/books/inform_tehnolog/)).

**Method-oriented applied software packages (ASP)** differ in that their algorithmic basis implements some economic and mathematical method for solving the problem. These include ASP: mathematical programming (linear, dynamic, statistical, and so on); Network planning and management; Queuing theory; Mathematical statistics.

#### **14.1.2. Professional Software**

This is the widest range of application software. Virtually there is not a single subject area for which there is not at least one ASP. Problem-oriented

ASPs are software products designed to solve a specific task in a specific functional area. Of the whole variety of problem-oriented ASP, we will identify groups intended for the integrated automation of control functions in the industrial and non-industrial spheres, the ASP of subject areas.

## CAD

**Computer-Aided Design Systems (CAD, CAD / CAM / CAE)** is an automated organizational and technical system designed to automate the design process: developing on the computer drawings, diagrams, 3D-models, design and technological documentation consisting of personnel and a complex of technical, software and other means of automating its activities. The main purpose of creation CAD – improving the efficiency of engineers, including:

- 1) Reducing the complexity of design and planning;
- 2) Shortening the design time;
- 3) Reducing the cost of design and manufacturing, reduction in operating costs;
- 4) Improving the quality and technical and economic level of design results;
- 5) Reduction of costs for full-scale modeling and testing.

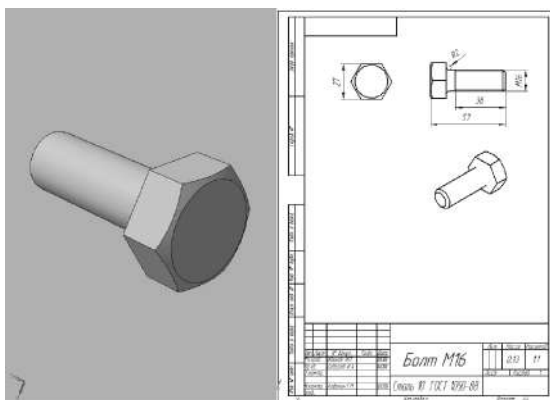


Figure 14.2. Creating Drawings in AutoCAD

Achievement of these goals is ensured by:

- 1) Automation of documentation design;
- 2) Information support and automation of the decision-making process;
- 3) The use of parallel design technologies;
- 4) Unification of project solutions and design processes;

- 5) Reuse of design decisions, data and developments;
- 6) Strategic design;
- 7) Replacement of full-scale tests and prototyping by mathematical modeling;
- 8) Improving the quality of design management;
- 9) Application of methods of variant design and optimization.

The most popular software: Compass, AutoCAD, ZWCAD, nanoCAD Electro, BtoCAD, Stroyexpertiza BASE.

### ACS

**Automated Control System (ACS)** is a set of hardware and software, as well as personnel, designed to manage various processes within the technological process, production, enterprise. ACS are used in various industries, energy, transport and the like. The term «automated», in contrast to the term «automatic», emphasizes the retention of some functions for the operator, or the most general, purposeful character, or not amenable to automation. The ACS with Decision Support System (DSS) is the main tool for increasing the validity of management decisions ([http://abc.vvsu.ru/books/inform\\_tehnolog](http://abc.vvsu.ru/books/inform_tehnolog)).

The most important task of the automated control system is to increase the efficiency of the management of the object on the basis of the growth of labor productivity and perfection-Methods of planning the management process. The following automated systems are distinguished:

- 1) Automated process control system or process control system – solves the problems of operational control and control of technical objects in industry, energy, transport.
- 2) Automated production management system (ACS) – solves the problems of production organization, including basic Production processes, incoming and outgoing logistics. Carries out short-term output planning with accounting of production capacities, analysis of product quality, modeling of the production process. For solutions MIS and MES systems as well as LIMS systems are used for these tasks. Examples: Automated street lighting control system («ACS UO») is designed to automate centralized management of street lighting; Automated control system for outdoor lighting («ASUNO») – is designed For the organization automation of centralized control of outdoor lighting; Automated traffic management system («ACS DD») – designed to control the transport and pedestrian traffic on the city's road network or motorway.

- 3) Automated Enterprise Management System («ASUP») – MRP, MRP II and ERP-systems are used to solve these problems. In the event that the enterprise is an educational institution, learning management systems are applied. Examples: «Hotel management system». Along with this name PMS (Property Management System) is used; «Automated system of operational risk management» is software that contains a set of tools necessary to solve tasks of managing operational risks of enterprises: from data collection to reporting and forecasting.

The main classification features that determine the type of ACS are:

- 1) the scope of the operation of the management object (industry, construction, transport, agriculture, non-industrial sphere and so on);
- 2) the type of the managed process (technological, organizational, economic and so on);
- 3) the level of the system of public administration, the inclusion of the management of the national economy in accordance with the current schemes of management of industries (for industry: industry (ministry), industrial association, research and production association, enterprise (organization), production, shop, site, technological unit).

The functions of the ACS generally include the following elements (actions):

- 1) planning and (or) forecasting;
- 2) accounting, control, analysis;
- 3) coordination and (or) regulation.

The necessary composition of the elements is chosen depending on the type of the particular control system. The functions of the ACS can be combined into subsystems by functional and other characteristics.

In the sphere of industrial production from the point of view of management, the following main classes of governance structure structures can be distinguished: decentralized, centralized, centralized, dispersed and hierarchical.

### **ASNI**

*ASNI is an automated system of scientific research* (a less commonly used terms are SANI – Automation of Scientific Research and SAE – Automation system of the experiment). This software and hardware system based on computing technique, designed to conduct scientific research or complex tests of samples of new technology on the basis of obtaining and using models of the objects under study, phenomena and processes.

Areas of science and technology in which the application of ASNI is most effective are:

- 1) nuclear physics (collection and processing of experimental data obtained on reactors, accelerators and installations of thermonuclear fusion);
- 2) plasma physics and solid state physics;
- 3) radiophysics and electronics;
- 4) astronomy and radio astronomy;
- 5) space research (processing of information obtained from artificial satellites);
- 6) geology and geophysics (exploration of minerals);
- 7) world ocean studies, environmental studies, weather and natural disaster forecasting;
- 8) biology and medicine (research in the field of molecular biology, microbiological synthesis, diagnosis of diseases);
- 9) chemical technology (modeling of technological processes, obtaining materials with specified properties);
- 10) research of complex technological processes in industry;
- 11) research and development in the field of energy (power plants, transmission networks, energy systems);
- 12) research and development in the field of transport communications, communication networks and networks of computers;
- 13) full-scale and bench tests of complex technical objects (aircraft, transport devices, machines, structures);
- 14) economics, social studies, law and linguistics.

The boundaries of ASNI are difficult to define, often in its framework the private tasks inherent in other types of automated systems are solved: process control systems, CAD, GIS, SAE and others. In any case, the main task of ASNI is to obtain new knowledge about the process, object or phenomenon under investigation.

## GIS

**Geoinformation system** (geographic information system, GIS) is a system for collecting, storing, analyzing and graphically visualizing spatial (geographic) data and associated information about the required objects. The concept of the geoinformation system is also used in a narrower sense – as a tool (software product) that allows users to search, analyze and edit both the digital map of the terrain and additional information about the objects (Figure 14.3).

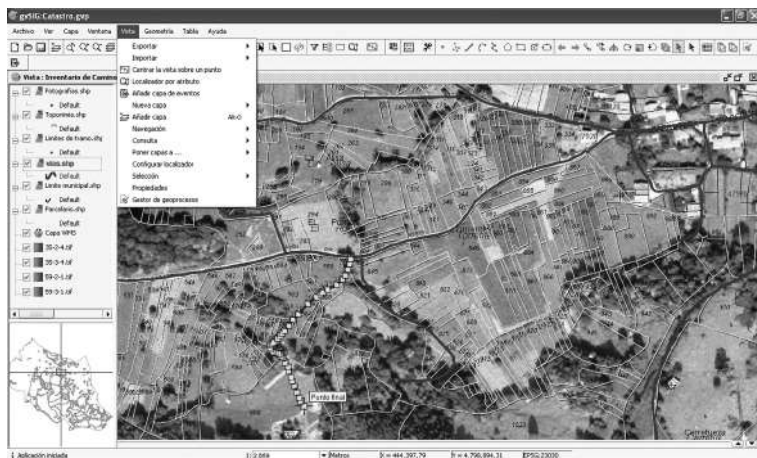


Figure 14.3. Editing a Layer in gvSIG

Geoinformation system can include in its composition spatial databases (including, under the control of universal DBMS), editors of raster and vector graphics, various means of spatial data analysis. They are applied in cartography, geology, meteorology, land management, ecology, municipal administration, transport, economy, defense and many other areas. Scientific, technical, technological and applied aspects of designing, creating and using geoinformation systems are studied by geoinformatics.

Data in geo-information systems describe, as a rule, real objects, such as roads, buildings, reservoirs, forest tracts. Real objects can be divided into two abstract categories: *discrete* (houses, territorial zones) and *continuous* (relief, precipitation, average annual temperature). Vector and raster data are used to represent these two categories of objects.

Modern analysis of geospatial data allows you to combine the geoinformation system with business analytics, which leads to a qualitative, rapid decision-making by reducing the time for searching and analyzing the necessary information. Spatial analysis allows you to use the map as one of the standard measurements, like time. Typical questions that the geoinformation system can answer:

- «What's in ...?» (The place is determined).
- «Where is this located?» (Spatial analysis).
- «What has changed since ...?» (Determine the time changes in a certain area).
- «What spatial structures exist?»

- «What if ...?» (Modeling what happens if you add New road) ([http://abc.vvsu.ru/books/inform\\_tehnolog](http://abc.vvsu.ru/books/inform_tehnolog)).

## **Billing**

***Billing in telecommunications*** is a complex of processes and solutions at telecommunications enterprises responsible for collecting information on the use of telecommunications services, their tariffication, invoicing subscribers, and processing payments. Billing system is an application software supporting business processes of billing. Billing is the most important component of the activity of any commercial communication operator, regardless of the type of telecommunications: fixed-mobile operators, Internet telephony, virtual operators, Internet providers, digital transit operators, digital television providers, cannot exist without billing, through which invoices are issued to consumers of their services and economic component of their activities.

Billing functions at the enterprise are grouped into three main blocks: *settlement operations, information services, financial services*.

In a broad sense, when considering billing in the integration with revenue management (*Billing and revenue management*) such functions as revenue assurance (revenue assurance), profitability management (profitability Management), fraud management (fraud management) are additionally distinguished ([http://abc.vvsu.ru/books/inform\\_tehnolog](http://abc.vvsu.ru/books/inform_tehnolog)).

## **CRM**

***Customer Relationship Management (CRM)*** software application is software for organizations designed to automate strategies for interaction with a customer (client), in particular to increase sales, to optimize marketing and to improve customer service by storing customer information and the history of relations with them, the establishment and improvement of business processes and the subsequent analysis of the results.

CRM is a model of interaction based on the fact that the center of the entire business philosophy is the client, and the main areas of the company's activities are measures to ensure effective marketing, sales and customer service. Support for these business goals includes collection, storage and analysis of information about consumers, suppliers, partners, as well as on internal processes of the company. Functions to support these business goals include sales, marketing, consumer support.

CRM-system can include:

- 1) frontal part that provides customer service at sales points with autonomous, distributed or centralized processing of information;



- 2) operating part, which provides authorization of operations and operational reporting;
- 3) data warehouse;
- 4) analytic subsystem;
- 5) distributed sales support system: replicas of data at sales points or smart cards.

Basic principles of CRM:

- 1) The availability of a single repository of information, where information on interaction with customers – the client base – is collected.
- 2) Use of many channels of interaction: service at points of sale, phone calls, e-mail, events, meetings, registration forms on websites, sponsored links, chat rooms, social networks.
- 3) Analysis of collected information on clients and preparation of data for the adoption of appropriate organizational decisions, for example, the segmentation of customers based on their importance for the company, the potential response to certain promotions, the forecast of the need for certain products of the company.

The main goal of the implementation, as a rule, is to increase the degree of customer satisfaction by analyzing the accumulated information about client behavior, regulation of tariff policy, and setting up marketing tools. Due to application automated centralized processing of data, it is possible to effectively take into account the individual needs of customers efficiently and with minimal participation of employees, and due to the speed of processing – to carry out early detection of risks and potential opportunities.

### **SRM**

**SRM** is supplier relationship management. Corporate information system (or its module), designed to automate the SRM-strategy of the company, in particular, to improve the level of management and optimization of procurement activities, improving the customer service of the company by choosing and working with suppliers, establishing and improving business processes and subsequent analysis of results.

### **DMS**

**Document management system**, DMS is a computer system (computer programs) used to track and store electronic documents and / or images (images and other artifacts) of paper documents. Document management systems (DMS) are usually considered as a component of the enterprise content management system (ECMS), a variety of content management system (CMS). In general, document management systems (DMS) provide

storage, versioning, marking metadata and security in relation to documents, as well as indexing and advanced features Search document ([http://abc.vvsu.ru/books/inform\\_tehnolog](http://abc.vvsu.ru/books/inform_tehnolog)).

## **WMS**

***Warehouse Management System*** is an information system that provides automation of business process management for the warehousing of a profile enterprise.

Solved problems:

- 1) *Acceptance of goods and materials*: acceptance of goods in real time using radio terminals or paper carriers; printing bar codes; flexible identification with both the purchase order or the supplier's pre-notification of shipment, and without them; acceptance for safe keeping; conformity check and data correction.
- 2) *Warehousing*: Automatic warehousing or storage under the control of personnel; Custom Rules Warehousing to maximize the use of storage space and / or the performance of warehouse operations; comprehensive criteria for constructing storage cells; customizable creation of warehousing tasks; preparation of non-packaged goods of various suppliers to storage.
- 3) *Automation of a one-time acceptance and shipment of goods*: reloading of the received goods for sending to customers; transit shipment of products through the warehouse.
- 4) *Flexible management of orders and groups of orders*: a complex grouping of orders; processing and issuing of orders in groups with optimization of processes and resources; unification and division of lots of goods; customizable product identification function on packing at shipment and return.
- 5) *Replenishment of stocks*: adjustable parameters of the need for replenishment; replenishment with incomplete pallets; a joint replenishment of a group of goods on one pallet; automatic generation and sending of replenishment tasks; configurable replenishment strategies; different options of replenishment (piece, box, pallet).
- 6) *Completion of orders*: automatic generation and sending of tasks to employees for completing orders; Packing directly into the pallet, taking into account the requirements of ergonomics, as well as dimensions, weight and other parameters of the goods; complete with conveyor belt; bundling of goods and so on.
- 7) *Loading*: scheduling of shipment of goods taking into account the priorities; sorting and combining goods during loading depending

on the sequence of delivery; loading, check and close operations controlled by radio terminals; checking and closing the send operation; the definition (choice) of the carrier; marking of conformity; creation of accompanying documents.

- 8) *Inventory management*: container tracking; full functionality for working with a weighted product; flexibility in the movement and adjustment of stock; interim partial inventory; complete physical inventory with fixation of weight at the entrance and exit; monitoring of the state and obtaining information about stocks in real time; consolidation of reserves for all rcs; localization of stocks and configuration of warehouse areas and zoning; date accounting and tracking the timing of the sale of goods; tracking the owners of stored property; flexible re-dispatch system, breakdowns into lots, movement of stocks.
- 9) *Manage tasks to the personnel*: automatic generation and sending of tasks for: acceptance; placement; stock transfer; counting turnover; replenishment of stocks; completion of orders; loading;
- 10) *Submissions*: planning the work of the distribution center; drawing up a schedule for the execution of tasks with their rearrangement in accordance with the priorities; dispatching and interleaving tasks; mass movements; container management; application of licensed / patent information and so on.
- 11) *Storage and production management*: determine the exact location of the storage cell; progressive storage optimization; automatic replenishment and transfer to auxiliary warehouses; movements within the organization; management and optimization of storage by shelf life; control and treatment of hazardous materials; inspection of warehouse equipment and planning refueling.
- 12) *Warehouse workers*: human resource management; accounting of working hours; tracking tasks to staff; reporting on human resources; designing labor standards; determining the planned labor performance.

## **ERP**

**ERP (Enterprise Resource Planning)** is an organizational strategy for integrating production and operations, labor management, financial management and asset management, focused on continuous balancing and optimization of enterprise resources through a specialized integrated application software package that provides a common model of data and processes for all areas of activity.

As a characteristic feature of the ERP-strategy, there is a principled approach to the use of a single transaction system for the vast majority of operations and business processes of an organization, regardless of the functional and territorial disconnection of their origin and passage, the obligation to reduce all transactions to a single base for subsequent processing and obtaining real-time balanced plans.

Replicability, that is, the ability to apply the same software package for different organizations (perhaps with different settings and extensions), appears as one of the mandatory conditions of the ERP system. One of the reasons for the widespread use of replicated ERP-systems instead of custom-made development indicates the possibility of introducing best practices through re-engineering business processes according to the solutions applied in the ERP-system. However, there are also such ERP-systems that are developed for separate organizations.

The modular principle of organization allows you to implement ERP-systems in stages, sequentially putting into operation one or more functional modules, and also choose only those that are relevant for the organization. In addition, the modularity of ERP-systems allows you to build solutions based on several ERP-systems, choosing from each best in its class modules. The breakdown by modules and their grouping is different, but most major suppliers have groups of modules: finance, personnel, operations.

In this section, we have considered only some of the specialized software.

*The business of Kazakhstan is actively introducing specialized software into its activities. Many IT companies provide their services for the development and implementation of modern IT solutions. An example is the Kazakhstan company «Center for Information Systems WTO», which performs qualified services related to automation of the activity of enterprises. LLP "Center for Information Systems WTO" is the owner of a certificate of compliance, certifying that the quality management system meets the requirements of ST RK ISO 9001-2009 with reference to the activities: "Development, implementation and maintenance of application software, provision of consulting and information Services". Clients of the company are state institutions and business structures: KGP Urban Cadastral Center of the city of Karaganda have the right of economic management of the akimat of the city of Karaganda, the Office of the Akim of the city of Karaganda; KGKP Management of parks of culture and rest and others.*

## 14.2. Modern IT trends in the Professional Sphere

According to Morgan Stanley's research, there are all the prerequisites for the fact that since 2016 corporate expenses for cloud services, information security and software analytics will increase. Based on the comments of the speakers made within the framework of the round table, which was held in DailyMoneyExpert in December 2016, an overview of the main trends of the IT market in 2016 was prepared ([http:// Dailymoneyexpert.ru](http://Dailymoneyexpert.ru)).

Now, on a global scale, one of the most exciting processes of transforming IT business is happening. «The world's largest taxi park UBER does not have cars, the most popular media resource Facebook does not create content, one of the largest retail companies Alibaba does not have its own stores, and the huge hotel network AirBnB does not own any room» (<http://dailymoneyexpert.ru>).

Gradually, IT ceases to be a technical discipline, becoming the foundation for businesses that are initially far from information technology. In accordance with the theory of Kondratieff's cycles, the modern IT market is at the very beginning of the next technological cycle, which the experts call NBICconvergence. It should be the same breakthrough as spinning, and then steam engines at their time, as well as the main future trend in the service sector, not only in IT, but also in the convergence of the most diverse services (<http://Dailymoneyexpert.ru>). Experts see the future of the IT industry in different ways, but highlight the general trends that are typical for 2016. There are ten trends:

- 1) ***Development of Cloud Technologies.*** Many business processes are gradually moving to the cloud environment and gradually changing the business itself. Find a company that does not work in the «clouds» almost impossible. Small business uses cheap and free «cloudy» products of Microsoft Azure, Amazon Web services, the Google Cloud Platform. Medium and large are private and hybrid clouds. By optimizing the company gets the desired effect without serious investment. The complete transfer of data to the external environment slows down only security – the risks for large business from placing in the cloud data on financial planning, personnel and business resources are too great. Therefore, noncritical services or duplicating functions are outsourced outside, for example, for fault tolerance Services are rented in a private data center. This is typical for financial organizations, telecoms, public authorities and so on.

- 2) ***Mobility.*** Cloud technologies lead to an increase in business mobility: in this case, it is both about the fact that companies are no longer tied to a specific location, and that the company itself is aware of the demand for mobile technologies from customers. That IT solutions were in demand that everything that a person uses in a working life – a laptop, a computer, a phone, a tablet, interactive whiteboards, a printing technique was a single whole, worked in the same environment, and the user could continue working on any device with any application.
- 3) ***Big Data Technologies.*** Big Data is perhaps the most frequently mentioned trend, which experts say. Solutions based on BigData are excellent tools for analyzing the preferences of the target audience, changing the nature of sales (their seasonality, peaks, etc.). But the most profitable solution, especially for SMB (medium and small business), here, nevertheless, is not the introduction of complex solutions, but the purchase of ready-made results of analyzing client preferences, behavioral changes, demand, and so on. It is produced using BigData technologies. And here, accordingly, one can observe a powerful growth of the trend for the creation and development of SaaS solutions that give the results of such analytics in the finished form (BigData-as-a-Service) to SMB clients».
- 4) ***Internet of Things.*** According to CCS forecasts, by 2020 more than 50 billion various technical devices will be connected to the Internet, which means that the Internet of things is the segment where it is worth waiting for new discoveries. This trend will require some standardization of protocols and interfaces, because the more complex the technology around us, the more you need to make efforts to ensure its interaction with other systems.
- 5) ***Strengthening of Information Security.*** Cloud technologies, mobility and other market trends make it more important to pay attention to data security. The growth of the market in terms of products that provide information security (systems for protection from external intrusions, systems for protection against internal data leaks – Kaspersky Lab, InfoWatch), began before the crisis.
- 6) ***Smart Devices.*** The growth of the number of smart devices that can manage various processes is inevitable. Knowingly the market of the same «smart» bracelets is now on the rise.
- 7) ***3D printing.*** It is obvious that the invention of 3D printers will have an important impact on many industries. This is one of the breakthrough areas. The reduction in prices for 3D printers will lead

to a rapid evolution of their design and expansion of the horizons of their application in various industries. At present time experiments with 3D-printers are conducted in a variety of areas – from clothing design to aeronautics. One of the most promising markets for additive technologies is the production of medical devices and medical products, in particular implants and prostheses, which are usually made to order.

- 8) ***Business Involvement in IT projects.*** IT ceases to be the lot of technical directors. Information technology solves more and more business tasks and allows you to respond to increasingly complex challenges of the market, regardless of the scope of the company.
- 9) ***Development of Online Learning.*** This trend has been going on for several years, although experts assure that the industry is still far from achieving significant success. It should be noted that Machine Learning has developed interesting developments in this direction from both Google and Microsoft and from other companies.
- 10) ***Growth of the Influence of Electronic Settlement Systems.*** The growth of electronic payments continues, and new formats of interaction come to the market. New technical capabilities

Offer a basis for the development of proposals. And the growth of penetration of modern equipment makes real implementation of mass IT solutions, for example, the transition to mobile payments, which requires technical training of the population.

### **14.3. Use of search Engines and Electronic Resources for Professional Purposes**

Every year, the volume of the Internet increases many times, so the probability of finding the necessary information increases dramatically. The Internet unites millions of computers, many different networks, the number of users increases by 15-80% per year. And, nevertheless, more and more often when accessing the Internet, the main problem is not the lack of the information sought, but the opportunity to find it. As a rule, an ordinary person, due to various circumstances, cannot or does not want to spend more than 15-20 minutes searching for the answer he needs. Therefore, it is especially important to correctly and correctly learn where and how to look to get the desired answers.

To find the information you need, you need to find its address. To do this, there are specialized search engines (indexes robots (search engines),

thematic Internet directories, meta-search systems, people search services and so on).

Let's consider the basic resources (services) of the Internet. The main services of the Internet today include the following services:

- 1) World Wide Web (WWW);
- 2) E-mail (e-mail);
- 3) FTP file archives;
- 4) Communication on the Internet.

The most popular Internet resource is the World Wide Web or WWW, which represents a huge number (over a billion) of multimedia documents, the distinguishing feature of which is the ability to refer to each other. This means the presence of a link in the current document that implements the transition to any WWW document that can be physically located on another computer on the Internet. Information on the WWW is presented in the form of documents, each of which can contain both internal cross-references and links to other documents stored on the same or on any other server.

**Hypertext** is a set of separate documents (pages) that have links to each other. On the Internet, there are several ways to transfer data (protocols). The most popular network is the Hyper Text Transfer Protocol (http).

**Hypertext link** – the highlighted part of the document, which implements the transition to another document. It is implemented in the form of underlined text, button or picture.

**E-mail (e-mail).** The oldest resource of the Internet is E-mail (e-mail) – the system for sending e-mails. E-mail is a means of exchanging information, prepared electronically, between people who have access to a computer Network. The main areas of e-mail application are the maintenance of personal correspondence and work with some information resources of the Internet, such as mailing lists, off-line newsgroups and file transfer systems via e-mail. E-mail (e-mail) is widely used in the library process. This is just business correspondence, and the technological basis of services – EDD, «Request-response».

**FTP (File Transfer Protocol)** is a storage and system for sending all kinds of files. FTP allows Connect to FTP servers, view the contents of directories and download files from the server or to the server; In addition, it is possible Mode for transferring files between storage servers and the system for sending all kinds of files.

**ICQ** – a system that implements a paging-like connection via the Internet. It allows you to get a unique number called UIN (Universal Internet



Number) used for calling and direct communication. A great feature of the system is the search for an ICQ subscriber via indirect data, for example, by e-mail. After establishing a connection with the subscriber, you can chat with him by sending text messages.

### ***Information Retrieval Systems***

All search engines are united by the fact that they are located on specially-allocated powerful servers and are tied to effective communication channels. Search engines are also called information retrieval systems (IPS). The number of simultaneously served visitors to the most popular systems reaches many thousands. The most famous serve a day millions of customers.

Types of search engines:

- 1) ***Systems that Use Search Robots.*** They consist of three parts: the crawler («bot», «robot» or «spider»), the index and software of the search engine. The crawler is needed to bypass network and create lists of web pages. Index is a large archive of copies of web pages. The purpose of the software is to evaluate the search results. Due to the fact that the search robot in this mechanism constantly explores the network, the information is more relevant. Most modern search engines Systems are systems of this type.
- 2) ***Man-Operated Systems (Resource Catalogs).*** These search engines get lists of web pages. The catalog contains the address, title and brief description of the site. The resource directory looks for results only from the descriptions of the page submitted to it by the webmasters. The advantage of directories is that all resources are manually checked, hence the quality content will be better compared to the results obtained by the system of the first type automatically. But there is a drawback – the updating of directory data is done manually and can significantly lag behind the actual state of affairs. Ranging of pages cannot be instantly changed. Examples of such systems include the Yahoo directory, dmoz and Galaxy.
- 3) ***Hybrid Systems.*** Such search engines as Yahoo, Google, MSN, combine the functions of systems using search robots, and systems controlled by humans.
- 4) ***Meta-systems.*** Metasearch systems combine and rank the results of several search engines. These search engines were useful when each search engine had a unique index, and the search engines were less «smart». Since now the search has much improved, the need for them has decreased. Examples: MetaCrawler and MSN Search.

Each country tries to create at least one own search engine. In particular, Kazakhstan has its own search engines: *kaz.kz akumo.kz; Google.kz; Kaztube.kz and others*.

Let's get acquainted with the main search engines.

**Yandex** (<http://www.yandex.ru>) – began work in 1997. It contains more than 33 million documents, supports its own catalog of Internet resources. Also is the best search engine for Revealing illustrations. The Englishlanguage version is provided with an Internet resource guide. It has a detailed system of request formation. In particular, it is allowed to enter the search rule in natural language – in this case all the necessary extensions are produced automatically. A more detailed query can be made using the Advanced Search mode (+ sign), which uses a multistage menu system. Yandex is the only Russian search engine that indexes documents in PDF, DOC, RTF, SWF, PPT and XLS formats. The database is updated weekly.

**Rambler** (<http://www.rambler.ru>) – one of the first Russian IPS, was opened in 1996. At the end of 2002, an indigenous Modernization, after which Rambler again entered the group of leaders in network search. Currently, the volume of the index is about 150 million documents. To compose complex queries, it is recommended to use the «Detailed query» mode, which provides ample opportunities for compiling a search request using menu items.

**YAHOO!** Is an American company that owns the world's second most popular search engine (7.57%) (in the United States and Canada, according to the agreement with Microsoft in 2009 and as of 2016, Yahoo! search is carried out by a search engine Bing) and provides a number of services, combined Internet portal Yahoo! Directory; The portal includes the popular Yahoo! Mail service, one of the oldest and most popular on the Internet. According to Alexa Internet statistics, in June-July 2016, Yahoo! is the fifth most visited website on the Internet, and approximately 32% of visits consist of viewing only one page.

**The search system of Mail.ru** started working in 2007. The volume of the index file in the spring of 2009 was more than 1.5 billion pages located on Russian-language servers. In addition to searching for texts, the system searches for illustrations and video fragments placed on specialized «self-filling» Russian servers: Photo@Mail.Ru, Flamber.Ru, 35Photo.ru, PhotoForum.ru, Video@Mail.Ru, RuTube, Loadup, Rambler Vision and the like. Gogo.ru allows you to limit the search area to commercial sites, information sites, as well as forums and blogs. The «Advanced Search» form also allows you to limit the search to certain types of files (PDF, DOC,

XLS, PPT), the location of the search terms in the document or in a specific domain.

**Google** (<http://www.google.com>) is one of the most full foreign IRS. The volume of its database is more than 560 million documents. A distinctive feature of Google IPS is the technology of determining the relevance of a document by analyzing links to the other sources on this resource. The more links to a page are on other pages, the higher its rating in the IPS of Google.

**AltaVista** (<http://www.altavista.com>) – one of the oldest search engines is one of the first places in terms of documents – more than 350 million. AltaVista allows simple and advanced searches. «Help» allows even unprepared users to correctly compose simple and complex queries.

In addition to well-known search engines, there are specialized universal search engines that allow specialists to search for a particular subject area. Let's consider some of them:

**FindSounds.com** – this resource is intended for those users who are in creative search. The resource allows you to search sound files of different formats – wav, mp3, aiff, au. In the resource database there are a variety of sounds – animal screaming, grinding cars, ringing, knocking, sirens, buzzing of insects, rumbling of explosions and shooting, splash of water and so on. Sound files can be searched for by different criteria, for example, by size, the presence of two or one channels of sound (stereo / mono), the sampling frequency and the bit depth. In the search results, the resource shows not only links to found files, but also their main characteristics, and also shows a graph of the amplitude of the sound, by which you can judge about the nature of the sound of this sample.

**Gnod.net** – the service has several databases – for music performers, for films, books and people. Thus, the resource has absorbed four services: Gnod Music, Gnod Books, Gnod Movies and Flork. The last service, Flork is a social experiment to find people who are interested in communicating with each other. Alldll.net – is a searchable database of the most popular DLLs. Files are sorted alphabetically, there is a search function. The search file can be searched even if only the approximate name of the library is known. It's enough to start entering text in the query field and at the bottom of the page there will be a huge list of files that begin with those letters that were typed.

**Medpoisk.ru** – search for medical information is a universal search engine that is designed to search exclusively for medical sites. This site is an excellent tool for every medic and anyone who wants to get an answer

to any question from the field of medicine. How to treat this or that disease, what contraindications for this or that medicine, which doctor to apply to – all this and much more can be learned by «asking» the search engine. The search engine includes a labor exchange and can be used for searching works among health professionals. The resource also contains a catalog of medical institutions sorted by region. Among these institutions, the addresses of clinics, medical centers of different focus, maternity homes, diagnostic centers, cosmetology salons and others.

#### **14.4. Security Issues in Industrial Information and Communication Technologies**

Today it is difficult to imagine a modern industrial company, be it an oil refinery, a hydroelectric plant or any conveyor production that could work without the use of information technology and automation of technological processes. At the same time, unlike traditional working computers, industrial information networks and technological systems usually remain without adequate protection, since standard solutions for information security unsuitable. As a result, industrial enterprises and critical infrastructure facilities are vulnerable, and the consequences of cyberincidents are much more dangerous than data leakage.

There is a growing number of threats for the ACS TP by extortion programs. From 2015 to 2016, this category of threats has become much larger and more diverse. Especially dangerous programs are extortionists for industrial environments - infection of these systems can have a strong

Effect and cause widespread damage. This makes ACS TP an attractive target for intruders. In this case, the extortion programs attacking the ACS TP have their own specifics: malware is not aimed at encrypting files, but at interrupting the technological process or blocking access to critical assets.

In addition to general threats, the industrial sector faces targeted attacks and specialized malware. Stuxnet, Citadel, Energetic Bear / Havex, Miancha, BlackEnergy, Irongate, PLC Blaster – this list is constantly replenished. And, as shown by the attacks of Stuxnet and Black Energy, one infected USB-drive or a phishing letter is enough for the attackers to overcome the «air gap» and penetrate into the isolated net.

In industry, every minute of idling turns out to be tangible losses, therefore the priorities in the field of protection for ACS differ from the corporate IT infrastructure – the uninterrupted operation of technological nodes in the first place, the confidentiality of data on the second. This

requires a fundamentally different approach to the construction of a security system, so that the technological processes are continuous, and any failures are eliminated promptly.

Another difference between ACS TP and business systems is in the technologies used. Industrial systems are extremely complex: they often use highly specialized technologies and components such as SCADA servers, workstations, programmable logic controllers. They must be adapted to the security system. In addition, the explosive growth of the Internet of things raises new threats against which are powerless traditional protective technologies.

Over the past year, according to the US Department of Homeland Security, 41% of the incidents investigated are related to the energy industry.

Traditionally, technological networks are constructed isolated from public networks, this architecture allows reliable protection from external intrusions, but does not provide IS within the technological network. Therefore, conventional usb-drives and passwords «by default» on the equipment can pose a serious threat to the IS of technological networks. The information security system should have a multi-level well-designed architecture that allows to protect both individual devices and entire subsystems.

The expert notes that in the IT world there are already many tools and methods for ensuring information security, they need to be «transferred» to the technological networks together with the industry. (<http://digitalsubstation.com>).

Let's consider in particular the solution of Kaspersky Industrial CyberSecurity (KICS). This solution was created specifically to protect complex industrial environments, is highly flexible and customized according to the requirements of the enterprise.

One of the main functions of Kaspersky Industrial CyberSecurity is the monitoring of the integrity of the industrial network: several technologies analyze traffic, monitor all programs being launched and connected devices, monitor the industrial process and monitor the operation of programmable logic controllers (PLCs). In turn, the intrusion prevention system conducts continuous monitoring of activity in the technological network and restricts connections to its nodes, blocking unauthorized attempts to enter. And the vulnerability monitoring system scans the infrastructure for open flaws in the software, thus preventing the penetration of exploits into the industrial network (<http://media.kaspersky.com>).

The Kaspersky Industrial CyberSecurity solution allows for in-depth analysis of information circulating in automated process control systems (APCS) and transmits information about suspicious events and contingencies to information collection and analysis systems: SIEM, systems Corporate analytics. At the same time, the enterprise security system is managed centrally with a single console.

The wide customization options of Kaspersky Industrial CyberSecurity allow you to configure the solution in strict accordance with the requirements of a specific industrial site, so that the protection platform can be effectively integrated into the existing workflow of the organization. So, Kaspersky Industrial's solution CyberSecurity was successfully tested in practice in a number of pilot projects, including the TANECO refinery, which needed to ensure the information security of industrial facilities. During the first month of operation, the program recorded attempts to unauthorized access to the technological network and attempts to change the sensor values (<http://media.kaspersky.com>).

*The problem of the security of industrial ICTs is also faced by Kazakhstan. As shown by Kaspersky Lab's research, 23% of Kazakh companies do not understand what tools will help them effectively withstand DDoS attacks (DDoS attack (from eng. Distributed Denial of Service, distributed denial-of-service attack). As a result, 25% of organizations are not at all protected from this threat. In addition, more than half of the companies surveyed (63%) rely on built-in hardware protection, which is completely useless in the case of complex and large-scale DDoS attacks, which have recently become widespread.*

*According to the same research in Kazakhstan, 29% of companies indicated that the reason for the incident was a targeted (targeted) attack on them (premeditated by criminals' actions against a specific state or non-state structure / organization). As a result of successful targeted attacks, valuable information was stolen in 10% of Kazakhstan companies. At the same time, a third of Kazakh companies noted that they understand the importance of protect their systems from targeted attacks and are afraid of them. In the first place, the organizers of the targeted attacks are interested in the State power bodies, science-intensive industries, financial institutions, and military-industrial enterprises.*

*Kaspersky Lab identified the top 3 cyber threats to business in Kazakhstan (threats that the companies actually faced at least once):*

- 1) 42% are faced with viruses and malware;*
- 2) 38% – improper use of IT resources by employees;*

3) 27% lost devices containing confidential information (for example, smartphones with access to corporate mail / network or laptops).

The relevance of this problem is well understood in R & D center Kazakhstan Engineering. Therefore, on October 24, 2016 Kaspersky Lab held a conference «Cyberattacks on state bodies and industrial enterprises: trends and ways of confrontation», within the framework of which it signed a memorandum of partnership with R & D LLP Center «Kazakhstan Engineering», a subsidiary of JSC «National Company» Kazakhstan Engineering «under the management of the Ministry of Defense of the Republic of Kazakhstan.

A modern laboratory is opening on the basis of the center, which, through the established Scientific and Technical Council within the framework of the R & D Center Development Concept, will train specialists, distribute and promote the creation of interactive protection in the structural subdivisions of the ministries and departments.

On January 9, 2017, the Resolution of the Government of the Republic of Kazakhstan «On Approving Uniform Requirements in the Field of Information and Communication Technologies and Information Security» comes into force. The information security requirements contained therein are also mandatory for owners of private information systems that are integrated with the state.

As well as owners of critical information and communication infrastructure. This includes industrial enterprises and other categories of economic objects that have automated technological processes, the violation of which can affect the country's security.

Unified requirements also contain rules for ensuring technological safety, which include requirements for information infrastructure, information systems and resources, Software, technological platforms, hardware at all stages of their life cycle.

In the event of technological failures or signs of computer attacks, the Unified Requirements set out algorithms for responding to emerging incidents of information security and the order of interaction of owners or owners within the framework of normatively fixed procedures for their localization and prevention on a wider national scale ([www.zakon.kz](http://www.zakon.kz)).

## 15. PROSPECTS OF ICT DEVELOPMENT

### 15.1. Prospects of the IT Market Development: Development of Free Software

In this section, we look at the prospects of commercial software, known as *free software (FS)*, in terms of meeting the needs of government agencies and organizations in computer programs, in comparison with alternative (non-free) software.

With the growth and development of the ICT industry, the phenomenon of mass commercial software has developed significantly. Commercial software is software that is performed, as a rule, within the framework of the relevant professional activities and specialization of the business:

- 1) the order of a specific end-user;
- 2) with the expectation of a predetermined circle of end-users.

Commercial software differs from the so-called «in-house» software development (development by the strength of the organization itself); from the development of programs supplied as part of an integral whole of the suppliers' equipment (software and hardware complexes) and from development of programs outside the commercial context in general (in the course of scientific experimentation, training projects, as a hobby and the like).

This software is a work that is regulated by copyright ownership. Free software (FS) is a model in which a basic set of property rights is transferred («licensed») to the owner of each copy of the work. In this way, creation and introduction into economic and civil circulation, as additional copies of the work, as well as copies of the modified work, or a composite work, including original, are possible without obtaining additional consent of the author (or other rightholder), mandatory cash deductions or the like. A free license is an exercise of the right, the rights granted are referred to as «freedoms».

Free software is widely used in professional use. First of all, it's tools (programs used in the software process itself, including writing, debugging, modifying programs), then server programs and, especially as a special case of the latter, network (Internet) Services in which free OSES (such as GNU / Linux and FreeBSD) and application programs (such as the Apache Web server or the Postfix mail program) today are leading by a wide margin.

Internet networks, the deployment and development of which was made possible primarily through free software, are themselves a powerful tool



to reduce the costs of communication and coordination of developments (<http://www.libertarium.ru>).

**Non-Free Software.** An alternative to free software is non-free («proprietary»), in which the author (or other rightholder) retains a number of rights for himself. A typical model of non-free licensing provides mandatory deductions (in the form of the purchase of additional copies or «licenses» for their production) for the introduction of additional copies, but there are other forms of non-free software.

***Strengths of Free Software:***

- 1) *The presence of a voluminous amount of already written free programs.*  
Even if a finished program, implementing the volume of the necessary functionality and suitability for the end user in terms of functionality and other qualities in full, does not exist, the order for modification (modification, adaptation, localization, documentation) of an existing program, a package or a system is much cheaper (and less risky) than the order to develop it from scratch. In case of any mass use of the program, it will often be cheaper to purchase the appropriate number of copies (or licenses) of non-free programs.
- 2) *The right to introduce additional copies into the economic circulation.*  
The existence of this right is significant, since it avoids the cost of purchasing additional copies (or licenses for their independent production) and costs for the multicensured accounting of the programs used («Censors «), which in itself is not an easy task given the size of the state as the end user.
- 3) *The right to modify and access the source code.* The presence of this right allows to avoid «binding» the end user in terms of choosing a counterparty when ordering or reloading services. Any service for correction, adaptation, modification of the program can be ordered in a competitive market.
- 4) *Ability to transfer to another software or hardware environment.*  
A special case of modification, the right to which is provided by free licenses and technical capability of which is provided by the availability of source code, is the transfer of the program to a different software environment (for another OS) or hardware (for equipment of a different type) environment. Most free programs are available for more than one OS or hardware platform. This capability is important because it reduces the dependency of the end user on previously adopted (inherited) solutions in terms of hardware and software.

- 5) *The availability of end users in other sectors of the economy and the private services market.* It is possible that part of the development will be carried out by a contract outside the public sector. Just as the results of the execution of government contracts become available to private users, the results of performance contracts in private sectors are made available to the state as an end user. An important detail is that the use of programs in the private sector can be more diversified and dynamic than in the public sector, respectively, when changing the application profile of the program. We in the public sector are still in the likelihood that the relevant application of the program has already taken place outside the public sector and some of the costs of correcting the mistakes and shortcomings that are inevitably identified with such a change have already been eliminated.
- 6) *The possibility of using the source code as a de facto specification.* In many computer applications, standardization significantly (sometimes for years) lags behind the development of software. With non-free software, this often entails a drop in program compatibility, the overcoming of which involves significant and unjustified costs (ordering programs in an uncompetitive situation, paying for expensive «reverse engineering» of non-free programs, etc.). In the case of free software for the period up to the formation of a sectoral, industrial or state standard for any application itself the source code of free programs can act as an actual specification, which can be accessed if necessary to ensure compatibility with other programs. What is important, the presence of the source code practically excludes the situation of «locked data», in which some data stored with the extracted from the operation of the program, it is difficult to translate into a format available for other programs.

### ***Use of STR in Kazakhstan***

On December 9, 2016, within the framework of the championship among students of high schools of the Republic of Kazakhstan for free and open source software, a round table was held on the topic «Prospects for the Development of Free and Open Source Software in Kazakhstan».

It was attended by representatives of national companies, international and domestic ICT enterprises. Deputy Chairman of the Board of JSC «NIKKH Zerde», presented the project «Programs for the Development of Wide Application of Free Software in the Development of Information systems and Software Products in the Republic of Kazakhstan». The purpose of this program is to identify priority actions for the formation of

a unified state policy in the field of the development of free software in the country. In particular, it is necessary to focus on the following areas:

- 1) State support for the development of free software, the development of education and research using free software, the popularization of free software;
- 2) Creation of a technological base for effective use of free software;
- 3) Emergence of a community of open source developers in the republic, from the number of both active specialists and students of the relevant faculties, whose support will allow the country to obtain its own adapted to local technological realities and the most important safe software (<http://zakupki.zerde.gov.kz>).

## **15.2. Formation of an Innovative Ecosystem Based on ICT**

The concept of «ecosystem» is known to everyone in the course of biology. In the most general form, the ecosystem is «a relatively stable system of living and inanimate elements of nature, between which the circulation of substances is constantly occurring, and the properties of metabolic processes between them are stable.» Simultaneously, simple biological ecosystems are made up of more complexly organized ones, thus forming a biosphere. Over time, the use of the term «ecosystem» has become useful for communities characterized by similar functions and structures. Therefore, ideas Biological ecosystem can also be used in economic sciences ([www.vedomosti.ru](http://www.vedomosti.ru)).

The concept of «innovative ecosystems» (IE) is most clearly defined through its functions (exchange and criticism of ideas, the search for investors, the commercialization of innovations or the creation of structures that will implement these innovations) and the purpose is the kind of innovation community. The subjects of the «ecosystem» are the researchers and scientists, the scientific community, innovative managers, investors and others.

The global scale of changes actualizes the task of forming a modern innovative ecosystem that can ensure the competitiveness of industrial production on the basis of breakthrough in the field of high technology, national security and sustainable socio-economic development in general. Just like biological ecosystems in the aggregate make up the biosphere, and IE can be built on different levels: world (supranational), national, regional, corporate and individual ([www.vedomosti.ru](http://www.vedomosti.ru)).

***The World Innovative Ecosystem.*** The main objective of the world innovation ecosystem is to create an environment and conditions for the implementation of global innovation projects for the implementation of breakthroughs in recognized areas of knowledge (digital world, biotechnology, nanotechnology and others), as well as the balance between the openness of new technologies and the preservation of intellectual property rights.

***The National Innovation Ecosystem*** includes various institutes that organize innovative processes of fundamental research and development, venture investments that create an innovative mentality of the society, innovative entrepreneurship, creating conditions for the generation of new ideas, their subsequent commercialization. Involvement for these goals of creative, competent people. Ensuring of national strategic priorities and their use for the formation of strategic innovative goals in the world innovation race.

***The Regional (Territorial) Innovation Ecosystem*** is the most developed element of the national innovation ecosystem, since the territory is both a consumer and a customer of innovative products, services, innovations, Including the creation of comfortable conditions for achieving the competitiveness of territories in the problems of ensuring innovative development. Successful examples of IE at the national level are the innovative system of Finland, Germany, USA, Canada, Japan; Regional – MIT (Massachusetts University), Silicon Valley (Stanford University), New Jersey (University of Princeton and former Bell-Laboratory); Corporate – IBM, Microsoft, GE, Google and others. The basis of the territorial innovation ecosystem are universities, technical universities and research institutes, capable of acting as generators of ideas, innovations, new developments and a source of intellectual human capital; small innovative enterprises; corporations and companies that produce innovative products; developed system of venture investment; innovative community, traditionally focused on innovation processes ([www.vedomosti.ru](http://www.vedomosti.ru)).

*Within the framework of the implementation of the program «The Nation's Plan – 100 Concrete Steps to Implement the Five Institutional Reforms», a special place was given to the creation of innovative clusters «63 step. Development of Two Innovative Clusters as the Basis for the Formation of a Knowledge-based Economy. In Astana the Business Campus of Nazarbayev University, scientific centers and laboratories will be stationed for joint research projects and development work, as well as their further commercialization.*

*To implement specific production projects, a park of innovative technologies will attract local and foreign high-tech companies».*

With in the framework of this step, work is carried out to develop two innovative clusters:

*1) The park of innovative technologies – with a focus on the formation of a critical mass of domestic high-tech companies through the transfer of technology and the development of their own competencies in conjunction with the world's technological leaders (TNCs) in the following priorities:*

- Smart industry.*
- New materials and additive technologies.*
- Smart environment.*
- New energy and clean technologies.*
- Financial technologies, e-commerce and new media.*

*2) Astana Business Campus (Nazarbayev University) - with an emphasis on research and development and commercialization of the results of scientific and technical activities on the following priorities:*

- Biomedicine;*
- New Energy;*
- High technology (HiTech).*

*Today, Nazarbayev University is a large scientific and educational ecosystem that, in addition to teaching, conducts diverse scientific and innovative research on the basis of the Technopark NU and the innovative cluster Astana Business Campus (business incubators, biotechnology laboratory, heart stitch laboratories, physics, battery institute).*



*Prime Minister of RK Bakytzhan Sagintayev February 7, 2017 acquainted with the scientific and innovative potential of Nazarbayev University*

***Corporate Innovation Ecosystem*** is developing on the platform of the theory of open innovation. Open innovation implies a constant search for new competencies for innovative projects that are best carried out outside corporations, through partners, interaction with universities, attraction of innovative companies (start-ups) for the implementation of innovative projects based on preliminary establishment of conditions for owning and using intellectual property. As a rule, the research activities of corporations are organized through parent companies, spin-off, while companies participate in the educational processes of universities, representing the processes improvement of technologies based on the knowledge gained.

***The individual level of the innovative ecosystem*** is an innovative person (homo innovaticus) – the subject of innovative development, ensuring the generation and implementation of innovative ideas, which must constantly update its knowledge and self-learning, to be mobile both geographically and mentally, to have research and project competencies capable of partnerships and trusting interaction. For the formation of an individual level of an innovative ecosystem, such a reform of the education system is necessary, which should be based on the understanding of profound changes in the current conditions of globalization, the strategy of continuing education, the creation of comfortable working conditions and the quality of life in the sphere of science and high technologies for people providing innovative processes – researchers, analysts, experts, investors, managers of venture financing and innovative entrepreneurship, the founders of startups and other. In a society based on innovation and scientific knowledge, the role of universities in interactions with the state and business should be strengthened.

Despite the sufficient world experience in building innovative ecosystems, an exhaustive list of sufficient conditions to ensure the success of the national innovation ecosystem does not exist, because each country has its own individual characteristics (climatic, geopolitical, socio-cultural, resource and others). Each country, territory, corporation, university should determine individual methods of management and development of innovative processes to achieve success in innovation ([www.vedomosti.ru](http://www.vedomosti.ru)).

In the conditions of the transition of developed countries to the postindustrial society, the knowledge economy, new mechanisms and tools for the commercialization of knowledge, the transfer of technology, the organization of innovation processes have been formed, which were called *models of strategic innovation networks*, which help to identify main stages

of the development of innovation ecosystems. Table 15.1 presents such stages of the formation of innovative ecosystems.

Table 15.1

### Stages of Formation of Innovative Ecosystems

The Name of the Stage	The Content of the Stage
1. Concentration of resources	Building research capacity and building an innovative climate
2. Transformation of the regional economy and the formation of an innovative ecosystem	Integration of technological start-ups of small innovative enterprises of large hightech business at the regional level and the formation of clusters of knowledge-intensive companies and innovative competencies, the development of a regional innovation policy of the support of innovative entrepreneurship.
3. Innovative and technological breakthrough	Growth of large high-tech companies, technological start-ups, formation of the venture investment market and the mechanism of risk sharing.
4. Maturity of the innovation ecosystem	Created innovative infrastructure becomes more technological and scalable; development of their own brand of the innovation ecosystem, creation of new technological chains based on international cooperation.

### 15.3. Startup. Acceleration and Incubation Programs

*A startup* is a newly established company (perhaps even not yet a legal entity) that is at the stage of development. And building their own business either on the basis of new innovative ideas, or on the basis of *newly emerging technologies*.

For the first time the term «start-up» appeared in the United States in 1939. Then, almost all enterprises and firms engaged in high-tech developments were concentrated near the city of San Francisco, in the valley of Santa Clara (California). In those days, students of the Stanford University David Packard and William Hewlett, creating there their own small project, called this case a startup (from the English start-up – start, run). Over time, this startup has grown into such a huge and successful company as Hewlett Packard. Other classic examples of successful start-ups

are Microsoft (founders – Bill Gates and Paul Allen), Apple Computer inc. (Founders Steve Jobs and Steve Wozniak) and Google (founders – Larry Page and Sergey Brin) (<http://constructorus.ru>).

One of the main reasons for the creation, successful development and continued existence of start-ups is the slowness of large corporations that successfully use existing products, but are not engaged into the development and creation of new ones. Therefore, start-ups, thanks to their mobility in terms of the implementation of new ideas, compete with large corporations. The main resource for creating a new startup is a good innovative idea. The very idea, which has no tangible incarnations, and existing only on paper or in words (startup plan), can cost a lot. Another factor of success of this idea is its relevance (the degree of necessity for the consumer), because the idea may be unusual and new, but the benefit of it will be a minimum.

A good team is important for a startup. It is important that one startup effectively complement the other, that is, had the necessary qualities and skills that the companion does not have.

More often than not, the characteristics of a start-up are a lack of finance and a fragile position of the firm in the market. Today, investments in startups are handled by so-called *business angels* and *venture funds*. Venture entrepreneurs dispose of the shares of mutual funds, that invest in young, but very promising undertakings. *Business angels* are private investors who independently determine the object of investment and invest their own blood into it. You can conditionally add friends and relatives to these two «wallets» of startups. This category ranks third in terms of investments in start-ups at the world level.

Venture funds, unlike business angels, invest their depositors' funds in the start-ups (money from insurance companies, pension funds, individuals) and finance projects with a high or medium risk share, but with good yield potential. Venture funds like business angels can sometimes invest in projects at an early stage (when there is only a business plan), but more often they prefer companies that recently entered the market, who do not have the means for a full-fledged start ([http:// constructorus.ru](http://constructorus.ru)).

***Incubators and accelerators*** are one of the key elements of a start-up ecosystem. These organizations are engaged in the development of projects at an early stage, turning them into a business that can be sold by market valuation, rather than by cost. Worldwide, incubators and accelerators work with a large flow of projects, sharing risks of their investors.

In the classical sense, the ***accelerator*** is *the institution of the venture market*, which is an organization that cultivates businesses from the ideas of



enterprising people who want to become entrepreneurs. Accelerator usually has an urgent program for project development, which consists of theoretical courses that introduce basic concepts of venture entrepreneurship and project management, as well as practical exercises aimed at the introduction of acquired knowledge into a real project. Usually the *accelerator* employs a team of entrepreneurs who have experience in creating their start-ups, which attracted venture capital for this, as well as out of business by sale, as well as serving staff – lawyers, accountants and designers and others.

*The incubator* differs from the accelerator in that it works to «grow» already formed businesses before attracting investments from venture funds. In this respect, the very essence of programs can differ only by a deeper immersion in the issues of investment analysis, structuring transactions and communicating with investors.

Both the incubator and the accelerator miss hundreds of startups during their existence, receiving shares in the capital of these companies in exchange for services provided. At the same time, a strict screening of projects is carried out. So, abroad, accelerators usually do not exceed 75% of startups, and out of incubators no more than 25-33%. This does not mean that the remaining startups always do not work and are closed, but it becomes more difficult for them to participate in the search for investments without changing their development strategy.

*The main task of the incubator and accelerator* is to increase the professionalism of start-ups and create the conditions for the further development of the product or service so that the start-up market increases the business valuation. In this regard, one of the options for assessing the success of such projects is the growth of capitalization of startups-residents of incubators and accelerators. So, abroad, such organizations work for the startups to grow by 3-4 times, and if the incubator and accelerator keep their shares in the project and it is sold to a large player, then the growth can be 8-10 times. Obviously, the startup needs yet to reach such limits, therefore, when there is an incubator or accelerator, there is almost always a community of active business angels who invest their money in an incubator or accelerator that distributes them to their residents, or a venture fund (<http://constructor.ru>).

### ***Kazakhstan Model of Incubation and Acceleration***

Within the framework of the «Startup Kazakhstan» program for the incubation of start-ups in 2016, two incubators were created, which later (2017-2018) will turn into Technology Development Centers with the participation of transnational companies (TNCs). Such a sequence was

chosen intentionally, because unlike industrial sectors, in information technologies startups are the main source of breakthrough innovations (<http://invest.mid.gov.kz>).

For reference:

1) ***The incubator for financial technologies will be focused:***

- Blockchain technologies for further use in the IFCAC (Private Placement Market with the issue of digital shares and the initial focus on subsoil users).
- Open government (reliability of data).
- Electronic transactions in the commercial sector (banking).

At the moment, the final phase of negotiations on cooperation with NASDAQ, Bloomberg, IBM, Deloitte is taking place. At present, private investments from the Bank of Astana have already been attracted.

2) ***Incubator for Smart Environment (Smart City)*** – focus on Internet technologies of things and a new generation network (5G). Active work with Ericsson, IBM, Huawei is part of Digital Kazakhstan program. As a result, measures under the «Startup Kazakhstan» program will allow to incubate about 50 high-tech and export-oriented start-up companies by 2020 with 30% private capital participation (more than 2 bln. tenge). In addition to attracting private investments, start-up companies will also have access to the technology platforms of the above-mentioned Competence Centers, as well as the opportunity to participate in the acceleration program (training and accelerated business development program). By the end of 2018, as a result of these measures, created up to **2000 highly skilled jobs in SMEs** (<http://invest.mid.gov.kz>).

#### **15.4. Development of Necessary Infrastructure of Electronic Payments and Logistics**

In recent years, the payment industry around the world has moved into a completely different phase of its development and is experiencing a transformation in terms of technological and institutional components. Payment services are undergoing a significant evolution. Innovation and the development of technologies in the payment market led to the emergence of alternative payment solutions, new business models and types of market participants. This is facilitated by the appearance of various FinTech Organizations (*organizations implementing technological projects in the field of finance*) and a relatively high speed of introduction, diffusion of

new technologies (the gap between development and mass introduction of technologies is being reduced).

In the global payment industry, the role of non-bank players, who thanks to innovative technologies, form new segments of the retail payments market is increasing. All these global processes are able to change the sphere of the financial market in the near future, which will create new challenges for the traditional banking. In the new emerging technological reality, it is no longer necessary for a customer to use the services of banks to make electronic payments. The famous expression of B.Geyts «We need banking, but not banks» became the main slogan of the formation a new model of digital banking based on private payment platforms.

In recent years in a number of countries the trends show that the provision of the client's payment needs is gradually shifting from banks to non-banking services (financial start-ups, Internet giants and telecom companies). The rapid spread of gadgets (smartphones) leads to further penetration in the maintenance of retail payments by developers of various user applications that make it easier and faster to process payments. At present, 3 models of rendering retail payment services have been developed in Kazakhstan on the market.

**Model 1. «Traditional banking model».** The customer has a bank account or a payment card attached to the account. The service for opening and maintaining bank accounts is the exclusive prerogative of banks all over the world. To make payments, customers directly interact and use the services of banks – in the branch or branch of the bank for physical visits, electronic devices (ATMs, «Cash in» terminals, POS terminals, multi-kiosks) and remote services – Internet / mobile banking.

**Model 2. «Non-Banking Model».** There are services of non-banking organizations that allow clients to make transactions through *payment terminals for instant payment, or points for cash and electronic money systems*. The first service is based on the use of agency schemes (legal solution) and is focused on the organization of cash payments on regular services in favor of their suppliers. Banks do not participate in the process of servicing and payment of customers' payments under this scheme (except for servicing the bank account of the payment aggregation within the standard banking service).

As part of the work of *electronic money systems*, banks participate only as issuers of electronic money (a guarantor of the fulfillment of monetary obligations). At the same time, payment functionality is fully implemented

on the side of non-bank operators. These operators ensure the functioning of systems, maintenance of electronic wallets, maintenance and processing of all customer transactions, entering into contractual relations with customers.

**Model 3. «Mixed model».** This section for the existence of payment transactions of customers involves their bank accounts (payment cards linked to these accounts), but the initiation and servicing of payments is carried out using the technological platform of third-party private non-banking organizations.

The domestic market has a number of such Internet providers and mobile payments. Customers use a mobile application or an Internet portal of such providers who, on the basis of their technological platform, ensure interaction with banks for further write-offs from customers' accounts and the execution of money transfers to the respective recipients of money (trade and services entities). This means that the client performs the operation with the help of a technological solution of a third-party organization that takes care of processing this payment and its execution through interaction with banks (through the bank). Typically, the technology for making payments to these entities is based on the use of customer payment cards and assumes a contract between the technology provider (non-bank organization) and the relevant bank (its partner).

In each of the above models (within the ecosystem), significant changes occur, due to technological innovations and the emergence of new business schemes. One of the most important trends of the recent years in the market of electronic banking services in Kazakhstan (Model 1) is the introduction and promotion by the banks of technologies aimed at servicing payment transactions of customers of third-party banks. This trend allows customers to be serviced for the implementation of payment transactions by the solutions (services) of other banks, not necessarily changing your bank, which is sometimes even difficult and problematic for the client in a number of cases and for various reasons (salary projects, individual conditions of service and the like). That is, the client, having an account or a payment card of one of the banks, gets the opportunity to use the Internet portal or a mobile application of another bank to make payments and transfer money to the client, including the third bank. It should be noted that this technology is realized on the basis of the use of payment cards and banks (the bank of the payer's customer, the servicing bank-service provider, the beneficiary bank) for servicing the client's payments interact through the International payment systems VISA, MasterCard [69].

In the world there are already the first online banks without physical offices (neobanki), approbation of the business model of the work of such banks specializing in the provision of financial services (deposit, credit, payment and other services) via the Internet and mobile applications. The potential for the development of banking services under this scenario directly depends on the existence of a mature payment industry for the electronic payment sphere. In Kazakhstan, there are no prerequisites for the development of this type of banking business model. The reason is that people have the overwhelming majority of transactions connected with cash, entering and withdrawing money to / from the system (s) to the bank (a) both in cash through the use of a network of other banks, and in a non-cash order by transfer requires Time and money costs, there is also the problem of the lack of a full-fledged online channel for rapid replenishment/transfer of accounts between banks and a relatively high cost of services for payment cards in the performance of interbank transactions. Nevertheless, the development of alternative payment services encourages banks to become more client-oriented, to give people the opportunity to access financial services at any time of the day and to implement omnichannel banking strategies [69].

Within the framework of Model 2, non-bank operators – aggregators are beginning to consolidate their infrastructure to provide services as on acceptance of cash payments, and electronic money. Many of the large existing aggregators with an extensive network of payment terminals to collect cash payments began to promote electronic money services by creating an appropriate. In parallel, non-bank operators are implementing solutions that allow customers to make payments through Aggregation of various sources – e-wallet, payment card (by linking a payment card to an electronic purse by analogy with PayPal technology), a subscriber account at the cellular. Thus, non-banking organizations go beyond the non-banking segment of the payment market (flow maintenance payments that are not traditionally associated with the use of a bank account), mastering new areas of the payment business.

Model 3 has a significant prospect of expansion and further development, but the possibility of its spread is still limited at the level of card technologies.

The existing trends in the world market (the development of payment technologies, the desire to simplify the payment process, a change in consumer behavior in people) allow us to assume with a high probability

that in the future the influence and development of Models 2 and 3 on retail financial services. [69]

Today, the market is a big competition among banks. In the coming years, banks should move to a qualitatively new level, when the main incentive is not to open an account for the client (issuing a payment card), but to have access to the maintenance of its payment flows, for example *cards that combine cards of other banks on one physical medium*.

Unconditional leader among traditional banks in the Republic of Kazakhstan, providing payment services related to e-commerce in online mode, is «Halyk Bank». Bank customers are provided with a wide variety of bank services that are available to them in remote mode.

As a result of the development of the technological process, payments and transfers have become possible at the global level in social networks (Facebook, Classmates and the like), using mobile devices through a payment platform of technology concerns, such as Apple Gog.

A crypto currency is a central issue in the electronic payment system. **Crypto currency** is a digital (virtual) in a currency, the unit of which is a coin. The coin is protected from forgery, because it is encrypted information, copy gle and Samsung (Apple Pay, Android Pay / Wallet, Samsung Pay). Which is impossible (using cryptography and defined the prefix «crypto» in the title). The future of the crypto currency is far not ideal as crypto-currencies are mainly held by the efforts of private actors trying to increase their popularity within the framework of promoting their own commercial interests. In many countries, including Kazakhstan, the use of crypto-currencies is outside the legal field and does not apply to the legally permitted way of conducting financial transactions. Today is of some interest and has a perspective not of the crypto currency, but the technology on the basis of which it was created, for example, one of the known crypto currency *Bitcoin* – Blockchain. Currently, the global issue is actively discussing the use of blocking technology for solving specific local tasks and improving business processes, including both in the public administration system and in the provision of financial and social services. Some of the world's largest banks have merged into consortiums and conduct test work on the use of technology distributed registries block to optimize banking services in the international context [69].

Leading mobile operators of our country, using the current legal design for electronic money, are at the stage of launching new services for mobile payments. It will be possible to expect strengthening of integration processes

of domestic systems with international electronic money systems for mutual servicing of cross-border flows through Internet commerce. This direction will enable users of Kazakhstan's systems to use their own electronic money to make payments on purchases in foreign Internet resources [69].

### ***Logistic Level Payment Systems***

Two models determine today the trends in the development of a payment environment for e-commerce in the global economy – American and Chinese. At the heart of both models is the priority development of payment systems of logistics levels 5PL (network logistics) and 4PL (integrated logistics). At the same time, the United States was the pioneer of new payment technologies, and China creatively reworked them, turning them into tools to ensure global expansion of their goods.

The most perspective in e-commerce is the 5PL payment system, which, in contrast to the 4PL are completely virtual and do not require the presence of payment terminals. The spread of 4PL payment systems today is explained by the insufficiency of Internet penetration. With the development of Internet technologies, their importance will inevitably decline.

Payment providers at the level of 5PL are as virtual as e-commerce itself. They exist thanks to and through traditional providers of banking services – card payment systems, outside of which their customers can not withdraw money, or replenish their accounts in the payment system.

The basic payment systems for 5PL providers are VISA and MasterCard card systems, which account for about 50% of all plastic cards in the world today. The 5PL providers themselves are international processing centers that are deeply integrated into the e-commerce infrastructure that make electronic payments from card accounts in real time.

The first in the world payment provider of the 5PL level was the American payment system «PayPal». Its institutional feature is that it was originally integrated into the world's largest eBay trading platform, being its payment-subdivision.

The unique experience gained by PayPal when making payments on the eBay trading platform was used to expand the payment system around the world. As a result, «PayPal» has become today the largest international provider of electronic payments, whose revenues are almost 51% formed outside the US. Today the payment system «PayPal» is localized in 80 countries of the world, including in Kazakhstan. PayPal payment system from year to year demonstrates phenomenal growth indicators.

Alternative «PayPal» Chinese payment system «Alipay» level 5PL was created in 2004 to service payments on Chinese trading platforms group of

companies «Alibaba Group». It is based on the use of plastic cards of the world's largest Chinese national payment system UnionPay. Today, Alipay is the largest payment provider in China. In addition to Alibaba Group, this payment system serves even more than 460,000 merchants around the world in 14 major foreign currencies. In Kazakhstan, Alipay services payments through payment systems «QIWI», «WebMoney», not counting payments from bank cards «VISA» and «MasterCard».

A common feature of payment providers «PayPal» and «Alipay» is the implementation of the functions of institutional regulation and arbitration in e-commerce. So, «PayPal» accepts and considers within 45 days from the moment of purchase of claims of buyers, and also writes off from the account of sellers in a non-acceptance order money resources in case of decision-making in their favor. «Alipay» does the same, reserving payment before the expiration of the check-in period from the time of receipt of the purchase (according to the transport provider). In case the customer is dissatisfied with the purchase, «Alipay» completely returns the payment made by the buyer.

The great success of payment providers of the 5PL level in the consumer market is explained by their deep integration into the commercial infrastructure of payment commerce. Buyers do not risk anything by purchasing goods – they can always get money back if the goods do not correspond to the description or are damaged in transit. The very possibility of instant payment for goods via the Internet at the level of 5PL forms the highest degree of consumer confidence in sellers. Payment providers of lower levels (2PL-4PL) can not oppose this policy, rapidly losing competitiveness.

### **15.5. Prospects of the Development of E-technologies in Kazakhstan**

#### ***Modernization of the Economy and Social Sphere through ICT***

- 1) Identification of priority industries that make the main contribution to the country's GDP (oil and gas, mining, rural economy, energy, trade and so on) and priority areas that maximally affect the quality of life of citizens (education, health, social security).
- 2) The inclusion in the strategic development documents of the selected industries and spheres of norms, requirements and indicators for the application ICT for maximizing the financial performance of industries. Formation of the regulatory framework for the consolidation of orders



and the formation of industry leaders, industry specialization is being prepared.

- 3) Initiation of flagship ICT projects in these sectors and spheres, which have a big impact on the development of the ICT industry (e-education for all, e-health for all, e-commerce and the like).
- 4) Flagship projects will generate a great demand for ICT technologies and products, thereby giving impetus to the development of a system transfer and the creation of domestic technologies.
- 5) Given the scale and regional distribution of flagship projects, a high demand for basic technologies (infrastructure) is forecasted.

### ***Creation of a world Technological Center in Kazakhstan***

- 1) Study of the demand of world technological players.
- 2) Determination of its own attractiveness for global TNCs. Elaboration of the regulatory framework, development of a package of preferences, creation and provision of attractive conditions (taxation, infrastructure and so on).
- 3) Developing an offset policy for the transfer of technology and knowledge. Formation of the Institute of Strategic Investors (state, TNCs, business, private sector).
- 4) Conducting a policy of localization with annual growth of Kazakhstan content.

### ***Strategy for Directions of Sectoral Application of ICT***

- 1) Education and training. In the conditions of modern life dynamism and sharp reduction of time intervals from creation to practical implementation of scientific and technical developments, e-learning becomes a key model for obtaining the knowledge required in daily activities. An important role in this Process is given to information technologies that can not only provide educational content, but also implement new teaching methods that have a number of advantages. In general, the main trends in the development of the e-learning market are similar to global trends:
  - mobile training;
  - integration with social services;
  - development of SAAS solutions.
- 2) The rapid development of the market for smartphones, communicators and tablet computers brings new developments in the e-learning industry, pushing the development of mobile learning. Today, almost any content of e-learning systems can be viewed on a mobile device and the need to develop something special is no longer there.

Obviously, mobile training in any case requires a special approach, and there are specific features of the development, so it is impossible to talk about the development of one version for all devices. In the near future, too, various applications for implementation in social networks, which is due to the huge integration of the life of most people of the younger generation with social networks.

### ***Health Care and Biomedical Sciences***

- 1) Medical expert systems for the treatment, prognosis and early detection of diseases.
- 2) Social media campaigns to promote a healthy lifestyle and a group of psychological and specialized (medical) support for the categories of diseases.
- 3) Built-in and implanted condition monitoring sensors (sugar level, pressure, temperature, ECG) with integration into medical networks and safety nets. Telemedicine and remote diagnostics including ambulances.
- 4) Devices and implants to maintain the normal functioning of a person, including cardio-stimulants, the nervous system and the brain.
- 5) Management and health management systems at all levels and integrated hospital management (ERP).
- 6) Use of computer technologies for testing new drugs.

### ***Industry, Energy, Agriculture***

Information technologies increase the flexibility of production and the speed of decision-making, provide the basis for Global markets and for the competitiveness of enterprises. However, the demand for them, with a relatively low level of informatization of domestic industry, does not demonstrate sustainable and strong growth. The economic bases of enterprises in their mass are not yet sufficiently prepared for intensive consumption of ICT. And those industries where high technology does not participate in the formation of profits, prefer to spend money on this article one-time.

In the modern information and high-tech century, domestic industrial enterprises, in order to ensure their competitiveness, should reconsider their views and attitudes on the use of ICT in production and administrative and economic activities and pay due attention to the automation and optimization of all internal processes. To ensure the competitiveness of industrial enterprises requires constant improvement of production processes through the introduction ICT and training of workers in industrial enterprises with special knowledge in the field of ICT.

It is very important for enterprises to pay attention and stimulate the development of modern approaches such as smart production (smart Manufacturing). Intelligent production is simultaneously applicable to mass production and mass production and implies full monitoring of the production cycle (Big Data technology) and the parallelization of production processes. Machines, equipment, parts and components can exchange data and information in real time.

This will become for the production and logistics of the new generation a push to increase efficiency, reliability and careful use of resources. Common trends from the industrial and industrial sectors are the managed IT environment of the new Generation, reliable communication channels, mobile management, work with large volumes of data, as well as a new transition to the concept «Industry 4.0».

In this regard, the priority development of robotic systems, intelligent systems of industrial automation is heavily influenced to solve modern urgent challenges.

Directions:

- 1) energy saving and energy as a whole;
- 2) «smart Manufacturing»;
- 3) «green technologies»;
- 4) «smart house»;
- 5) automotive and in general machine building;
- 6) metallurgy and other high-thermal chemical products water supply;
- 7) agriculture;
- 8) urban and communal technologies;
- 9) railway and, in general, transport automation;
- 10) 3D printers;
- 11) automation of production processes;
- 12) a new generation of sensors and measuring instruments;
- 13) improvement of drives, selsyns, servo drives, gyroscopes and other actuating mechanisms;
- 14) protocols and standards for data processing and transmission systems in industry;
- 15) video security systems, fire extinguishing systems, mine ventilation and many other areas where automatic technical systems are used;
- 16) «smart» trainers of the modern generation;
- 17) wireless communications and cloud technologies;
- 18) automation of production processes.

### ***Information and Communication Infrastructure in the Transport System and Logistics***

The implementation of the intellectual transport system (ITS) should be the basic tool for solving the problem of increasing the efficiency and attractiveness of Kazakhstan's transport sector – a complex of interrelated automated systems, solving the tasks of traffic management, monitoring and managing the operation of all logistics processes.

## CONCLUSION

The essence of modern information and communication technologies lies in their versatility and multifunctionality, but with great opportunities, these technologies are only tools that potentially make it possible to make more effective human activity.

The material outlined in the training manual, of course, can not disclose the entire complexity of the application of information and communication technologies in our life, and also in this manual all the possible heuristic tasks for this course. However, this training manual can serve as a starting point for mastering new knowledge in the field of ICT. In other words, in the future world only those who have a specific quality will appear to be in demand: the ability to retrain. It can be said otherwise – there will be an ability to self-change.

World practice shows that there are two types of informative orientations of the informatization of education in the state. The first type of reference *is the expansion of the accessibility of education through the use of information and communication technologies.*

The second type of benchmarks is the change in the quality of education: *the strengthening of the role of independent learning based on the active use of modern information technologies and additional educational resources.*

The textbook «Information and Communication Technologies», proposed for study, was constructed taking into account the state educational standard of the Republic of Kazakhstan.

Authors voluntarily transfer their benefits to the public domain, provided they are referred to during the copying and distribution. All materials of this manual are either authored, or taken from open sources for educational purposes.

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**With the best wishes – authors!**

# GLOSSARY

## (Terms and Definitions)

### To the Course “Information and Communication Technologies”

**Architecture of E-government** (e-Government Architecture) – means of ICT and their application to help meet the needs of subjects and objects of e-government competence.

**ATM** – terminal device of the bank electronic payment system, which allows the card account holder to withdraw money from him and to make money in cash, as well as perform such operations as payment for goods and services, obtaining documents confirming the operations performed with his help.

**Audio Conference** – voice interaction of remote users from each other, carried out in real time using telecommunications equipment.

**Authentication** is a process that allows you to determine whether a user or program is identical to a person or program, which they declare themselves when they try to access some computer system or the data maintained in it.

**Automated Databank (DBA)** – a collection of a database management system and a specific database (s) of data under its control.

**Bit** is the minimum unit of transmitted or stored information. The term is an abbreviation of the expression «binary digit». It is always represented by a combination of numbers 0 or 1.

**Bitmap** is an image consisting of dots.

**Blog** is a web diary whose main content is a regularly updated event log or diary. Entries on blog web pages can be placed by one or more authors. They are ordered in reverse chronological order and can be classified according to topics and / or other criteria.

**Broadband access** is the provision of the user's access to information and communication infrastructure resources with a transmission speed of at least 2.048 Mbps.

**Browser** is a software that provides a graphical interface for interactive search, discovery, viewing and processing of data on the network.

**Business Incubator** is a subject of innovative infrastructure created to create new enterprises, jobs and economic development of the region on the basis of a comprehensive method of organizing the innovation process.

**Business to Business Interaction** – B2B Interaction between business agents, providing for the exchange of goods, services or information,

taking place between companies and not including in this process the final consumer of this product or services.

**Byte** (byte) – the basic unit of the amount of information in any form (signs, numbers, graphics, sound, video, etc.), equal to the set eight bits of binary code (bit). Also used are larger units: kilobytes (1024 bytes), megabytes (1024 KB), gigabytes (1024 MB).

**Case** – a set of training materials on heterogeneous media (printed, electronic, audio).

**Channel** (link) is a means or a path through which signals or data are transmitted.

**Cloud Computing** (English Cloud Computing) – a service in which the user is given the opportunity to use distributed computer resources through the Internet or other networks. The sectoral innovation system is part of the NIS, focused on innovation activity in a separate direction (the industry).

**Communication Infrastructure** is a network infrastructure that provides information transfer between territorially distributed sources and recipients, consisting of communication lines using various mediums of electromagnetic signaling, and equipment to receive, transmit these signals, and process them during this transmission.

**Communication Technologies** are the processes and methods of information transfer and ways of their implementation.

**Computer Graphics** is the creation, demonstration and processing of graphic images using a computer.

**Content** is a collection of textual, graphic, audio information.

**Convergence of Technological Platforms** is a process of interpenetration of various technologies and communication services in order to expand the functionality of equipment.

**Corporate Information System** – 1. Information system that automates a significant part of business processes, which constitute the activities of the enterprise (organization). 2. Information system, users of which may be a limited number of persons defined by its owner or by agreement of users of this information system.

**Database** is a single data system organized according to certain rules, which provide for general principles of data description, storage and processing.

**Database Management System (DBMS)** – a set of software and language tools designed to manage data in a database, maintain this database, provide multi-user access to data.

**Digital image** – an electronic image, an image is presented in digital form. There are three main ways to digitally represent images: raster graphics, vector graphics, fractal graphics.

**Digitization** – digitalization – the translation of the original non-digital information into digital form, possibly with the purpose of its long-term storage.

**Distance Education** is a pedagogical system in which the methods of distance learning with confirmation are implemented educational qualification.

**Distance Learning** – distance learning with the use of textbooks, personal computers and computer networks.

**E-book** is a hypertext or hypermedia system hosted on a server or a compact.

**E-commerce** is one of the areas of e-business, based on the use of ICT in commercial activities for the sale or purchase of goods and services, involving commercial organizations, households, individuals, government bodies and other commercial and non-profit organizations.

**E-healthcare** is an economically effective and reliable form of information and communication technologies for health and related areas, including health care, medical supervision, medical literature, medical education, knowledge and research in the field of health.

**E-mail** is a method of transferring addressed messages using a computer and communication facilities. E-mail is the most common network service that allows computer users to exchange electronic messages.

**Editors of Texts** – programs for the preparation and editing of texts on a computer.

**Electronic board** – an open system for storing and presenting information (messages, software applications) on the network. Any user can receive information from the electronic board or send his information there. In distance education, an electronic board is used for teleconferences or when organizing virtual classrooms.

**Electronic digital signature** – the props of a digital document designed to protect it from forgery. Formed as a result of cryptographic transformation of the document using a private key and allows to identify the owner of the certificate of the signature key, and also to establish the absence of distortion of information in this digital document.

**Electronic Digital Signature** tool is a hardware and / or software tool that provides the implementation of at least one from the following functions – the creation of an electronic digital signature in an electronic



document using a private key of an electronic digital signature, confirmation using the public key of an electronic digital signature of the authenticity of an electronic digital signature in an electronic document, the creation of private and public keys of electronic digital signatures.

«**Electronic Health Passport**» («electronic medical record») is a collection of information about a person's health during his life, including an anamnesis of life and diseases, the results of medical diagnostic studies, vaccinations, prescriptions of medicines, methods of treatment and other data generated in electronic Access to which and protection of which are established by legislative acts and are provided with modern information and communication technologies.

**Electronic Interaction Environment** – with a set of standards, guidelines and techniques, the adherence to which ensures interoperability of information systems of authorities when interacting with each other, as well as with external systems owned by citizens or business.

**Electronic money** is money that exists and circulates exclusively in electronic form, usually without the participation of banks.

**Encryption** – encoding information in order to restrict access to its content.

**File Server** (File Server) is a computer that provides access to files stored on it for remote users (Customers).

**Free Software** is software that has free access to source code and which is used and distributed on the following terms: freely execute the program for any purpose; Freely study the work of the program and adapt it to the needs of the user; Freely distribute copies to help others; Freely improve the program and make these improvements publicly available for the benefit of society.

**Gateway** is a program designed to connect two networks using different protocols, through which data is exchanged between them.

**Global Network** is a network in which computers are combined in different countries on different continents.

**Graphical Editors** are programs for preparing and editing images on a computer. Modern graphics editors can also create moving, animated images.

**GRID** – Spatially distributed infrastructure of remote resources, combining a multitude of resources of different types (processors, long-term and operational memory, storage and databases, networks), which the user can access from anywhere, regardless of their location.

**Grid-computing** – calculations based on GRID.

**Host** is a computer (server) installed in the network nodes that decides communication and access to network resources.

**HTML** (Hyper Text Markup Language) – a language for creating documents with special formatting commands and hyperlinks.

**HTML Language** (Hypertext Markup Language) is the main language used to encode the Web.

**HTTP** (Hypertext Transfer Protocol) is a method by which hypertext documents are transmitted from a server for viewing to computers to individual users.

**Hyperlink** – a document element for communication between various components of information within the document itself, in the other documents, including those placed on different computers.

**Hypermedia** – a method of discrete representation of information on the nodes, connected via links. Data can be presented in the form of text, graphics, sound recordings, video recordings, animations, photographs or executable documentation. Hypermedia is a generalization of hypertext systems.

**Hypertext** (Hypertext) – a concept that describes the type of interactive environment with the ability to perform referrals. Links (URL format addresses) embedded in words, phrases or pictures allow the user to select (set the pointer and click the left mouse button) the text or drawing and immediately display the related information and media materials.

**Hypertext System** – the representation of information in the form of a graph, the nodes of which contain text elements (Sentences, paragraphs, pages, or even whole articles or books), and there are links between the nodes, with which you can go from one text element to another.

**ICT Opportunity Index** is a composite index compiled by the International Telecommunication Union, used to build international ratings reflecting the level of development and use of ICT in different countries.

**Informatics** is a scientific discipline that studies laws and methods for the accumulation, processing and transmission of information with the help of computers.

**Information and Communication Infrastructure** – with a set of information and communication infrastructures.

**Information and Communication Network** – a set of technical means for the transmission and processing of information.

**Information and Communication Technologies (ICT)** are technologies intended for the joint implementation of information and communication processes.

**Information Center** – the center of scientific and technical information, corporate library, data processing center or ICT-Service organization.

**Information Environment** is a set of technical and software tools for storing, processing and transmitting information, as well as existing in the country political, economic and cultural conditions for the implementation of the processes of development and use of ICT.

**Information Inequality** is a new kind of social differentiation, connected with the possession of various possibilities of using modern information and communication technologies.

**Information Industry** – the information sector of the economy Sector of the economy, including the sector of content and media and the sector of information and communication technologies.

**Information Need** is one of the types of non-needs – the information needed to solve a specific problem or achieve a certain goal.

**Information Processes** – the processes of collecting, processing, storing, storing, searching and disseminating information.

**Information Resources** – individual documents and arrays of documents in information systems (libraries, archives, funds, data banks, other types of information systems) accumulated by mankind to meet their needs in this or that information.

**Information Security** – the state of information, information resources and information systems, in which the required probability is to protect information from leakage, theft, loss, and so on.

**Information Security** is a state of security ensuring the confidentiality of access to information, authorized access to it, its integrity, reliability, completeness and consistency.

**Information System (IS)** – a system designed to create, store, process, search, disseminate, information. Information - information about the surrounding world and the processes occurring in it, regardless of the form of their presentation.

**Information Technology** is a system of scientific and engineering knowledge, as well as methods and means used to create, collect, transmit, store and process information in the subject area.

**Innovation(s)** – new or improved technologies, types of products or services, as well as organizational and technical solutions of production, administrative, commercial or other nature.

**Innovation Fund** is a fund of financial resources, created with the purpose of financing innovative activity.

**Innovative Activity (process)** – scientific, technological, organizational, financial and commercial activities, to implement innovations or conceived for this purpose.

**Innovative Model** – Business innovation model – The system of innovative diagnostics, preceding the introduction of innovations, is a set of predictive schemes. It includes a pricing structure, a rationale for increasing profits, a network of suppliers and marketing, and a competitive strategy.

**Innovative Potential** – the ability to develop Innovative ideas developed by some person, team or community, scientific and technical potential in the form of scientific research, design and engineering organizations, experimental production facilities, experimental testing grounds, educational institutions, personnel and technical means of these organizations.

**Intellectual Property** is the possession of the representation of an idea (due to copyright) or an idea embedded in an industrial process (thanks to a patent). The ideas themselves can not be the subject of ownership.

**Interaction «Business for the Consumer»** – B2C Interaction of the business agent with the end user (natural person), usually with the purpose of selling goods, services or information.

**Interaction «State for Citizens»** – G2C Interaction of authorities with citizens (as consumers) in the process of performance of functions assigned by the legislation to these authorities.

**Interaction «State for the State»** – G 2G In the interaction between various authorities in the process of implementation functions entrusted to them by law.

**Interaction «The State for Business»** – G 2B In co-operation of authorities with business agents in the process of performance by authorities of the functions assigned to them by law.

**Interactive Information System** is a private version of an extra-active system, in which not only transmission occurs, but also exchange of information in the dialogue mode, for example: e-mail and chat rooms, telephony, interactive television and more.

**Interactive Whiteboard** is a touch screen connected to the computer, the image from which the projector is transferred to the board.

**Internet** – an open world information system, consisting of interconnected computer networks, providing access to remote information and information exchange between computers.

**Internet** is a global information network, parts of which are logically interconnected through A single address space.

**Intranet** – a closed corporate network, built on the basis of Internet technologies. It may include a corporate web.

**IP address** is the 32-bit Internet protocol address assigned to the node. The IP address contains two components: the node number and the network number.

**Knowledge** (about the subject area) is the whole set of useful information and procedures that can be applied to it in order to generate new information about the subject area.

**Knowledge base** is a formalized system of information about a certain subject area, containing data on the properties of objects, the laws of processes and the rules for using these data in the given situations to make new decisions.

**Link** is a document element used to create links within this document and links to other documents. In the latter case, it is more correct to talk about a hyperlink.

**Outsourcing** is the transfer to a third-party contractor of some functions or parts of the organization's activities in order to increase labor productivity and / or reduce the cost of production, mainly due to the cheaper labor of the contractor.

**Media Library** is the center of the information infrastructure of the educational institution, in which conditions are specially organized that actively contribute to the formation of information culture of students (in a broad sense), their independent activity, as well as professional development of teachers through the means of new information technologies.

**Metadata** – structured or unstructured data that explicitly describes the properties of information in some source – for example, its genesis, composition, structure, presentation format, content, storage location, owner, access methods, as well as the functions of the services provided, access authority and other user properties.

**Mobile Telephony** – wireless telephone technology. Mobile telephony has a significant impact on the changes in the way of life and thinking of modern people, providing them with the means that are characteristic of the information society.

**Modem** is an external or internal device that is connected to a computer for transmitting and receiving signals over different communication lines. Abbreviation from «modulator».

**Multimedia Electronic Textbook** – hypertext and multimedia translation of a printed textbook on a computer. Compared with printed materials, such a textbook can be promptly amended; It has a great graphic

visibility and convenient user interface (menus, hyperlinks of help and the like).

**Multimedia Systems** are programs that allow using various forms of information processing: text, graphics, animation, music, speech, video recording.

**National Innovation System (NIS)** is a set of legislative, structural and functional components that ensure the development of innovative activities in the country.

**Network** is a system of interacting elements linked together by dedicated or switched lines for providing local or remote communication (voice, visual, data exchange, etc.) and for information exchange between users with common interests.

**Network Readiness Index** is the composite index prepared by the World Economic Forum (WEF) and the international business school INSEAD, used to build international ratings reflecting the level of development of information societies in different countries.

**Network Technology** is a kind of distance learning technology based on the use of telecommunications networks.

**Next Generation Network (NGN)** – Information and communication network, which is based on the principles that allow to provide services regardless of the technologies used in the network, service providers and the location of user equipment.

**Node** is a computer, terminal, or any other device connected to the network. Each network node is assigned a unique address, which allows other computers on the network to communicate with it.

**On-Line Technologies (on line)** – means of communication of messages in the network information space, providing synchronous information exchange in real time: «talking channels» (chats), audio and video conferences and more.

**Operating System** is the main program program (complex of programs) on a computer. Organizational (administrative) measures of protection are measures regulating the functioning of IP, the use of its resources, personnel activities, the interaction of users of the system in such a way as to make it as difficult or impossible to implement the threats to information security.

**Page address** is data that accurately determines the logical address of the site or the Web.

**Port** – a place to connect to the computer of different devices.

**Portal** – a site organized as a system-level, multi-level aggregation of various resources and services. Gives the user clear information, provides

instant access to services such as search engines, e-shopping, free e-mail, commercial advertising, instant messaging and more.

**Program for Creating Presentations** is an electronic program for preparing and demonstrating slides on a computer screen (preparing slides on transparencies, paper), when it is necessary to present a group of people with graphics, text and diagrams.

**Protocol** – in information and communication technologies, a procedure that accurately describes the process of interaction between the two agents.

**Quality of Service (QoS)** – the principle of building a network to implement the required quality of service delivery.

**Regional Computer Network** – a network that connects computers within a certain region.

**Remote Access** is the technology of interaction of subscriber systems with local networks through territorial communication networks.

**Routing** is the process of determining in a communication network the path by which a call or data block can reach a destination.

**Search Engine, a search engine** (on the Internet) is software that automatically collects and classifies information about sites in Internets that delivers it at the request of users. Examples: AltaVista, Google, Excite, Northern Light and others.

**Search for Data** – select data for a specific combination of characteristics.

**Security Administrator** – a person or group of persons responsible for ensuring the security of the system, for the implementation and continuity of compliance with established administrative measures of protection and providing ongoing organizational support for the operation of the physical and technical protection measures used.

**Server** – a network node that contains data and provides services to other computers; Computer connected to the network and used to store information.

**Self-Organizing Networks** are communication networks in which the mechanism of interaction among themselves is implemented without the need for centralized management and manual administration.

**Site** – the address for hosting the server on the Internet. Often called the entirety of the Web.

**Smartphone** is a kind of personal electronic assistant – a mobile phone with enhanced functionality comparable to a pocket personal computer.

**Spreadsheets** are programs for executing and storing numerical calculations in tables on a computer.

**Structure (system)** – a set of stable links, ways of interaction of the elements of the system, determining its integrity and unity.

**Subject Area** is the totality of objects of the real or perceived world considered within the given context.

**Supercomputer** is an ultra-high-performance software and hardware complex.

**System** (in the domain) is a set of interrelated elements, each of which is connected directly or indirectly with each other element, and two any subsets of this set can not be independent, without violating the integrity, unity of the system.

**Technological Platform** is a set of technologies and / or communication services.

**Telecommunication(s)** – communication with the help of electromagnetic oscillations regardless of the medium of propagation.

**Telecommunication Network** – a network of information exchange and processing, formed by a set of interconnected computers and means of communication and intended for the collective use of technical and information resources.

**Telecommunication System** is a system providing telecommunications and consisting of a transmitter that receives information and converts it into transmitted signals, a transmission medium carrying signals, and a receiver that receives signals and performs their reverse transformation into user-friendly information.

**Teleconference** is a multi-faceted messaging on the network and a method for conducting discussions between remote user groups. Each participant of the teleconference sends their messages on the established network address, where they are available for viewing to all participants. Response messages can be sent either to the same public address or to the sender of the original message.

**Telemedicine** is a complex of organizational, financial and technological measures ensuring the implementation of a distance medical consulting service in which a patient or a doctor directly conducting an examination or treatment. The patient receives a remote consultation of another doctor using information and communication technologies that do not contradict national standards.

**Traffic** – the cumulative volume of transmitted information per unit of time, expressed in units of information stream (bit/s).

**UN Readiness Index For E-Government** – a composite index used by the United Nations Department of Economic and Social Affairs for building



international ratings reflecting the level of readiness for e-government in different countries.

**URL** (Uniform Resource Locator) – the address format of the network node, which specifies the name of the server on which the file is stored, the path to the file directory and the actual file name.

**Vector Image** is an image that is constructed using a mathematical description of simple objects.

**Venture Fund** is a financial and credit organization focused on the practical use of technical / technological development and results of scientific achievements associated with a high degree of risk in anticipation of high profits.

**Videoconference** – electronic interactive interaction of remote users, carried out in real time with the help of telecommunications equipment. Transmitted images displayed on the computer display may include video streams, still images of objects, information or data from graphs, files or applications.

**Virtual Reality** is a new technology of contactless information interaction that implements with the help of complex multimedia.

**Virtual Whiteboard** (white board) – an electronic board with the ability to directly edit text or make appropriate notes over the original text with the transfer of this information over a distance.

**VRML** (Virtual Reality Modeling Language) is a virtual reality modeling language intended for formatting the Web.

**Web Page** – a single document containing hyperlinks, located on the WWW and defined by the URL. You can open and view the content using the browser browser. As a rule, these are multimedia documents, including text, graphics, sound, video, animation, hyperlinks to other documents.

**Web Server** – a program running on the computer, designed to provide documents to other www computers that send relevant requests.

**Wi-Fi** (Wireless Fidelity) is a term used to refer to 802.11 wireless networks and devices operating in these networks.

**WWW** (World Wide Web) – World Wide Web, designed for hypertext linking multimedia.

**3G, 4G** – the designation of cellular communication of the third and fourth generation, based on the latest UMTS technologies. The first generation phones are analog phones, the second generation.

# SELF-EXAMINATION QUESTIONS

## Topic 1

1. Definition of information and communication technology.
2. Identify at least five factors that, in your opinion, have the greatest impact on the existence of a «digital» inequality in the country. Ways to reduce the «digital» backlog.
3. Projects for the development of society, implemented in the country and aimed at the following areas: small and medium-sized businesses; poorly protected strata of the population. Define the role of ICT in similar projects.
4. Key positions of the Millennium Declaration of the MDGs achieved in our country.
5. What MDGs is our country ready to achieve in the near future?

## Topic 2

1. What are the main components of which a desktop or portable computer systems consist of?
2. A system bus and its role in a computer system.
3. Purpose of a controller.
4. The main types of ports in a computer system.
5. Make up the most preferable, from your point of view, configuration of an office desktop computer for your daily business. Specify the amount of memory, speed, types of ports and external devices.

## Topic 3

1. Classification of software by the degree of its interactions with the hardware of a computer.
2. Applied software of general purpose.
3. Classification of software by the way it interacts with a computer network.
4. Cross-platform software.
5. Classification of operating systems.

## Topic 4

1. Explain the term «interface».
2. Types of user interfaces.
3. A difference between an interface-menu and an interface with free navigation.
4. Usability of interfaces.
5. Development stage of a user interface

### **Topic 5**

1. The data bank. Components of a data bank.
2. Purpose of the DBMS. Basic data models.
3. Definition of an application, when is it developed?
4. Operators of the SQL language.
5. SQL Standards.

### **Topic 6**

1. The system of collection and primary processing of information.
2. Input and output data of the subsystem «Document Processing». Depict the algorithm of one or several processes that are part of the subsystem «Document Processing».
3. Fundamentals of Data Analysis.
4. Processing Large Amounts of Data.
5. Methods of Data Analysis.

### **Topic 7**

1. Classification of computer networks.
2. Basic topologies of computer networks.
3. Methods of commutation in computer networks. Network hardware.
4. Stacks of TCP / IP protocols. Multilevel OSI model. Protocol DHCP.
5. Technologies of connection to a network.

### **Topic 8**

1. Information security model.
2. Methods and means of protection of information processing systems.
3. Information security of distributed systems.
4. Distinctive features of encryption standards.
5. Electronic digital signature - legal and technical aspects.

### **Topic 9**

1. Addressing in the Internet: a person's mail address, a computer address, URLs addresses. Web pages addresses.
2. The main Internet services.
3. Internet technologies: HTTP, DHTML, CSS, JavaScript.
4. Message formats.

### **Topic 10**

1. A model for providing ubiquitous and convenient network access on demand to a common pool of configurable computing resources.

2. Types of clouds.
3. Internet service of cloud technologies.
4. Service Models. IaaS Services
5. Conditions for access to a cloud service.

### **Topic 11**

1. Multimedia computer.
2. Combining sound, music and video in one document in order to simulate the impact of the real world on the senses.
3. Multimedia information. Types of multimedia information.
4. Basic data compression technologies.
5. Process of reproduction of sound information.

### **Topic 12**

1. The technology of the Internet of things. Application area. Smart - services.
2. Technology Big Data. Data centers.
3. Blocking technology. Features of security technology.
4. Green technologies and artificial intelligence.
5. The technology of telemedicine.

### **Topic 13**

1. Electronic payments. National payment system.
2. A systematic approach to the automation of content management in a virtual company.
3. E-learning. Electronic textbooks and electronic publications.
4. Electronic government of the Republic of Kazakhstan.
5. Implementation of e-government technology in the developed countries.

### **Topic 14**

1. Industrial information and communication technologies.
2. Special software. Application area.
3. Modern IT-trends in Kazakhstan in the professional sphere.
4. Search engines and electronic resources in the professional sphere.
5. Security in corporate information systems.

### **Topic 15**

1. Free software.
2. Ecosystems. Innovative ecosystems.

3. Startups. Accelerators. Incubators.
4. E-technology.
5. IT entrepreneurship and support of start-ups.

# Laboratory Work № 1

## Architecture of Computer Systems

**Objective of the Work:** Study of a personal computer.

**Equipment:** PC, keyboard, mouse, a set of screwdrivers.

### Brief Theoretical Information

The motherboard is the main part, all other PC parts are installed on it. Let us consider the main devices located on the motherboard.

**Power Elements** are devices located on the motherboard consume quite a lot of power (a processor is up to 110 W, video cards are up to 125 W and so on). In addition, devices are equipped with electric motors (CD-ROM, hard drive, and so on), at the time of turning on they consume a fairly large amount of power. Therefore, for normal PC operation, it is necessary to stabilize the power supplied to the motherboard. When the voltage drops below a certain level, the motherboard generates a power failure signal and restarts the PC. The second function of the power system is to supply and support the necessary supply voltage to the processor and some other devices that can depend on a manufacturer and a model of the specific device.

**SMB (System Management Bus)** – devices. This is a special PC management system. It is responsible for the performance of the motherboard (control of voltages and temperatures, fan speed, etc.) and the operation of various energy-saving systems (transition to modes with reduced power consumption and return to operational status).

**BIOS (Basic Input / Output System)** is a basic input / output system. It is responsible for the interfacing of software and hardware, configuration and diagnostics of the PC devices, performs low-level input-output operations.

**Chipset.** Chipset is a set of micro schemes that provides the functioning of the motherboard and the devices installed and connected to it. In addition, the chipset can include additional devices that expand the functions of the motherboard (built-in video, audio, network, and so on, controllers).

**Integrated controllers** (not included in the chipset). Usually these are devices that do not build into the chipset, or devices that exceed the built-in ones by their properties. For example, it can be a powerful built-in video card, multi-channel sound card, external device controller (RAID, iLink etc.). Embedded devices have their advantages and disadvantages.

Advantages:

1. No need for additional equipment, if there is a built-in one.
2. Expanding the functionality (by flashing the BIOS devices, you can get new functions that were not previously used).

Disadvantages:

1. The built-in device cannot be replaced.
2. Some devices cannot be disabled (manufacturer's defect).
3. Usually built-in devices are inferior in their characteristics and functions to discrete (stand-alone) devices.

**Setup devices** are designed to configure the motherboard and individual devices.

A jumper is a bridge that plays the role of a switch, it can be in two states: on, off. Sometimes they are collected in blocks to be selected from several options, for example, the processor's supply voltage.

Switches are similar to jumpers, they are also assembled into blocks.

Recently, all the adjustment functions are transferred to BIOS, and the jumpers from the board are removed to set up the settings without opening the case.

Slots and connectors are designed to install various devices on the motherboard. Their varieties are:

- Socket – for installing the processor;
- Slot – for installing boards, processor, memory;
- Pad – to install the BIOS and some other chips;
- Pin connectors – for connecting CD-ROM, HDD, USB-port;
- Other – can be either standard or depend on the manufacturer, designed to facilitate a connection of any device.

### **Work Procedures**

1. List the connectors for connecting external devices on the back of the case.
2. Remove the cover from the PC. Disconnect the power and data cables. Remove the expansion cards.
3. Draw expansion cards and motherboard. Find out the purpose of the components located on them, a manufacturer, and a model of this device. Record the result in Table 1.1.
4. Assemble the PC.
5. Answer the questions to the laboratory work.
6. Write a conclusion on the work. Compare the methods of composition of PC devices and their characteristics, indicate the advantages and disadvantages of both methods.

Table 1.1

## PC Components

Device	Producer	Model	Main Parameters



## Laboratory Work № 2

### Operating System Windows 7

**Objective of the Work:** To study the main system objects and control methods of Windows 7 OS and the procedure for working with them.

**Equipment:** PC.

#### Brief Theoretical Information

Windows 7 operating system is the latest high-performance and reliable system with new computer and file management capabilities, which helps to perform the usual tasks on a personal computer much quicker and easier.

#### Work Procedures:



1. Master the order of loading and shutting down the Windows OS.
2. Study the purpose of the *Desktop* and its elements.
3. Learn the techniques of working with the mouse.
4. Study the purpose of the *Main Menu*, its structure and access to it.
5. Learn the purpose, start-up and work process of the *context menu*.
6. Explore the purpose, capabilities, and workflow of the *Windows 7 Help System*.
7. Master the purpose, ways of loading and shutting down of the standard Windows 7 Programs.

#### Methodical Instructions for Performing the Laboratory Work

**1. Booting Windows 7** occurs automatically every time you turn on the PC, if it is installed on the computer. If you have multiple versions of Windows installed on your computer, that is, you have a multi-boot configuration, you can choose which version to run by default. You can also create a list of automatically launched programs when the Windows system boots.

#### Shutdown Windows 7.

The correct algorithm for shutting down *Windows 7* is the following:

1. Close all applications (all open windows). In the vast majority of cases, this is done by clicking the mouse on the close-Window button  (in the upper-right corner of the window).
2. Click the  **Start** button.

3. In the *Main Menu* that appears, click the button ***Shut Down***.

As a result, after some waiting, the system will turn off the power to your computer. After that, do not forget to turn off the power of the monitor and the additional devices that are connected to your computer, if they have their own power cables (some devices connected to USB ports are powered from the computer).

**2. The Desktop** is the main area of the screen that appears when the computer is turned on and *Windows 7 OS* starts up. Icons of various objects can be placed on the Desktop, for example, files and folders, and they can be arranged in a convenient order (Figure 1). To start an object, double-click its icon. Windows of the open programs and folders are displayed on the desktop.

To provide quick access to files, folders, programs and other objects from the *Desktop*, you can create shortcuts for them.


A **shortcut** is a tool for quickly accessing an object. It contains a reference (path) to the object, not the object itself. Double-clicking on the shortcut opens the object for which it was created. When you delete a shortcut, only the shortcut is deleted, but not the object itself. A shortcut from the icon  of the object itself can be recognized by the arrow on it.



Figure 1. Windows 7 Desktop Interface

The area of the desktop is sometimes expanded, including the Taskbar, which is located along the lower border of the screen (Figure 1). Unlike the desktop, which can be closed by open windows, the taskbar is almost always visible. It consists of three main parts:

- The **Start** button that opens the *Main Menu*;
- *The middle part*, in which the buttons show the open programs, files and folders, allowing you to quickly switch between them;
- *Notification area*, in which there are clocks and icons (thumbnail images) showing the status of some programs and computer settings.

### Exercise 1

#### Desktop Elements and Actions

1. *Review* the purpose of the *Desktop* items in the tooltips. To do this, hover your mouse over the object and hold it on this object for 1-2 seconds.
2. *Move* the icons of objects (files, folders, shortcuts) to any other place on the *Desktop*. To do this, select the desired object with the left mouse button, press it and while holding it, move the mouse to another place on the *Desktop*.
3. *Move the Taskbar* along the left, right, or top border of the *Desktop*. To do this, place the mouse pointer over the empty space of the Taskbar and, holding the left mouse button, move it to the left, right, or upper border of the *Desktop* respectively. Return the Taskbar to its original position. You can perform this operation if the option *Lock the taskbar* is disabled in the context menu for the *Taskbar*.
4. *Look* at how the open windows of folders, files, and programs are displayed in the *Taskbar*. To do this, open the windows in sequence, for example, the *Computer* folder, the *WordPad* program, and any *file* located on the *Desktop*. Track how, when you open each window on the *Taskbar*, the corresponding button with the name of the open object appears.
5. To move between the windows of open objects, click on their buttons sequentially and see how changes the contents of the *current (active) window* on the screen monitor accordingly, while hiding other open windows.

### 3. Basic ways of working with the mouse

A standard mouse has two buttons: the main button (usually the left one) and the auxiliary button (usually the right one). The main button is used much more often. Most mouse models are equipped with a scroll wheel located between the buttons, which makes it easier to view documents and

web pages. In some cases the scroll wheel can be pressed and used as the third button. More advanced mouse models can have additional buttons for other functions.

**Pointing to an object** on the screen means to place the mouse so that its pointer as if touching an object. When the mouse points at the object, often a tooltip with a description of this object appears. For example, if you point to the *Recycle Bin*, the following information appears on the *Desktop*: *Used to temporarily save the files and folders that have been deleted.*

**Click** – means to press and release the left mouse button. In most cases, clicking is used to select an object or open a menu. Sometimes this action is called a single click or click with the left mouse button.

**A double click** is a click that is quickly executed twice. Typically it is used to open objects on the desktop or in a folder window. For example, you can run the program or open folder by double-clicking on the corresponding icon.

**Right-clicking** opens the context menu (a list of available actions for the selected item or Object).

**Drag-and-drop** (sometimes called drag and drop) is used to move objects to another location, and to move windows and icons on the screen.

If you have a *scroll wheel* on your mouse, you can quickly view documents and web pages. To scroll down, turn the wheel back (toward you). To scroll up, turn the wheel forward (away from you).

The mouse settings can be changed according to the personal preferences of the user. For example, you can toggle the functions of the buttons and the mouse pointer, make the mouse pointer more visible, change the speed of scrolling by the mouse wheel, change the purpose of the mouse keys in relation to the physiological characteristics of the user (left-hander).

#### **4. The Main Menu of Windows 7**

When you click the Start button on the Taskbar, the main menu of *Windows 7* appears (Figure 2). This menu displays the installed applications and assembles commands for the system settings and information retrieval.

The left part (on the left panel) of the appeared rectangle displays a short list of applications that were used last time or which, according to the developers of the operating system, you will often use. On the left of the application names there are the icons. They give the application an individuality and allow you to quickly find it with your eyes among the rest. To start any of these applications, simply click on its name or the icon.



Figure 2. The Main Menu of Windows 7

However, as mentioned, this is a short list of applications. To see all installed (that is, ready-to-run) applications, you must click on the item All Programs. As a result, a short list of applications in the left panel of the Main Menu will be replaced with a full list of installed applications (Figure 3). Here you can see applications with their own icons (menu commands), and folders containing applications or other folders with icons. Run the application for execution by clicking on its name with the mouse.

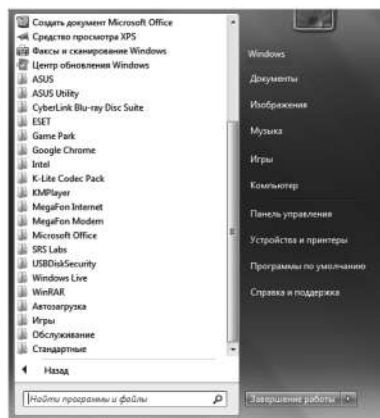



Figure 3. A complete List of Installed Applications

If you do not remember or do not know what you need an application for, you can move the mouse pointer over its name and do not move the mouse for a while. In this case, you can see a hint that describes the purpose of the application.

In addition to applications with their own icons in this list, there are folders with icons . These folders can contain applications or other folders. When you click on a folder name, it opens, and a list of its contents is displayed. For example, Figure 4 shows the *Standard* folder that appears when clicked on it.

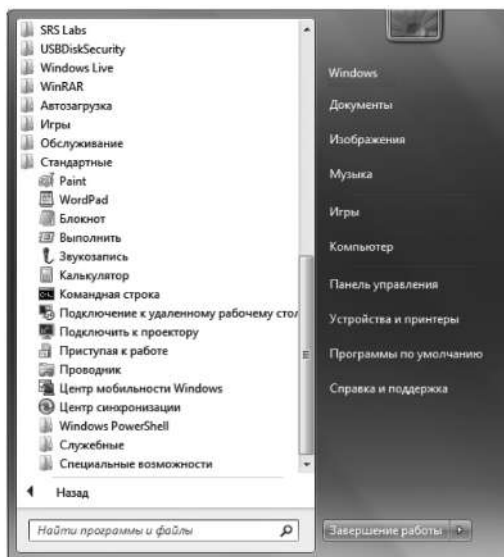


Figure 4. Contents of the *Standard* folder

To start an application, click on its name or the icon. When the selected application is launched, the Main Menu automatically disappears from the screen.

In addition to the list of applications, there are other panels in the Main Menu (Rectangular areas). There is a list of commands to the right of the list of applications, that allow you to call some useful functions. Let's consider each point separately.

**Documents** – opens a window where the contents of the Documents folder automatically created by *Windows 7* for you are displayed. In it you can store electronic documents (files with text, tables).

**Images** – opens a window where the contents of the Images folder automatically created by *Windows 7* for you are displayed. You can store various images in it, such as photos.

**Music** – opens a window where the contents of the Music folder automatically created by *Windows 7* for you are displayed. You can store files with music in it.

**Games** – opens a window where standard games included in *Windows 7* are stored. Any of them can be launched by double-clicking on the icon or title.

**Computer** – opens a window that lists all the logical drives available on your computer, and all devices with removable media (floppy drive, CD drive, DVD drive).

**Control Panel** – brings up the *Windows 7* operating system settings window. We shall take a look at some of these settings later.

**Devices and printers** – brings up a window with a list of installed printers.

**Default programs** – allows you to configure the start of programs that are launched by default for processing files of various types or when performing some standard actions.

**Help and Support** – allows you to call help system *Windows 7*.

At the bottom of the right panel of the Main menu is the **Shut Down button**, which is used to shutdown the *OS Windows 7*.



Figure 5. Search Results

In the lower left part of the *Main Menu* there is a field for searching for various files and programs located on your computer. The keyboard cursor already flashes in this field, so you can immediately enter the desired file name or fragment. During the input process, the preliminary search results will be displayed in the field above, where there is a list of applications (Figure 5).

If a desired file or a program appeared in this list, you can click on it with the mouse. The file will open for viewing or editing, and the program will start.

## Exercise 2


### Working with the Main Menu


1. By clicking the **Start button**, open the *Main Menu* and review its contents.

2. Sequentially, by hovering the mouse over the items on the right side of the Main Menu window, use the tool tip to learn the purpose of each of these points.

3. Watch how the items of the left part of the Main Menu window are opened, for example, according to the following scheme:

*Start* → *All Programs* → *Accessories* → *System Tools*.


4. Run the Calculator application from the list of the most used programs (on the left side of the Main Menu window) and explore the features of this program. After you finish using the application, close it by clicking on the (close) button  in the title bar.

5. Move the mouse cursor (select) to any program on the left side of the *Main Menu* window, the name of which ends with an icon . Look at how the submenu (submenu) of this program is displayed).

6. Learn how to close *Windows OS* from the *Main Menu*. To do this, follow the steps for the proposed scheme:

*Start* → *Shutdown*.

## 5. Context menu

To start programs, execute commands on OS objects (files, folders, other graphic elements), you can use the context menu, which is called by the right mouse button or by the key  on the keyboard.

A **context menu** is a collection of commands or other actions that apply to a selected object (pointed to by a mouse). A list of actions that can be performed on the application or document appears next to the icon. To select the desired command or action in this list, click on the corresponding item



in the context menu with the left mouse button, after which the selected action or command will be executed. Figure 6 shows the context menu for the **Desktop**. In Exercise 3, consider the contents of the context menu, depending on the selected object.



Figure 6. Calling the Context Menu


### Exercise 3

#### Working with the Context Menu

1. Right-click in the free space of the **Desktop**. Consider the list of the possible commands for this object.
2. Right-click the **Recycle Bin**. Consider the list of possible commands for this object.
3. Right-click on any **file** located on the desktop. Note the difference between the command lists applicable to the objects folder and file.
4. Call the shortcut menu for the Taskbar by right-clicking on the empty space on it. Examine the purpose of the list commands.
5. Take a look at the context menu for the folder and **application windows**.

## 6. Windows 7 Help System

You can access the help service in one of the following ways:

1. From the Main Menu, select **Help and Support**.
2. In the window of any folder, click the button  (calling help for the folder).
3. Press the key **F1** (all windows should be minimized).

Help and Support Center is the button that opens the Windows 7 Help page for novice users.

Print – when this button is pressed, the help page displayed on the screen is printed.

Help – displays all Help topics by topic.

Search – allows you to find specific words or phrases found in the help materials.

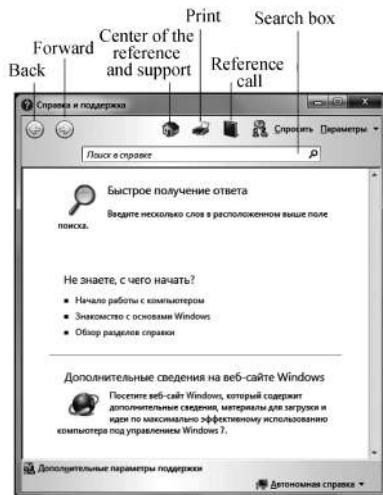




Figure 7. Windows Explorer Window

### Exercise 4




#### Getting Reference Information

##### Help and Support Center


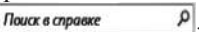



1. Call one of the methods offered above Help and Support.
2. Click the button . The help window will open a list of sections of this tab.
3. Click the section **Learn** the basics of the Windows.

4. The list that appears contains sections that help you get an idea of the tasks and tools necessary to successfully work with your computer. From the listed partitions, select Programs, files and folders.
5. Select the Files and Folders.
6. In the window that opens, read the information on the selected question.
7. After viewing the help information, close the Help window with the button .

### *Reference*

1. In the Computer folder window, click the button .
2. Click the button . The opened window will display all Help topics by topic.
3. Select the theme Files, Folders and Libraries by clicking the mouse.
4. Review the items in the window that opens and select the Files and Folders section.
5. After viewing help information, close the Help window with the button .

### *Search Field*

1. Press the key to display the help screen .
2. Click the Search in Help field  . Put in a keyword or phrase into the field, for example, Files and Folders, press the Enter key or the key .
3. The Help window displays the Top 30 results list for **files and folders**.
4. Select the most suitable result, for example, Files and Folders by clicking on it with the mouse.
5. After viewing the help information, close the Help window with the button .

If the exercise is performed correctly, the result of using all the methods of obtaining help will be the same.

**Independent work:** Get background information on the issue that interests you.

## **7. Standard Windows 7 Programs**

When you install the operating system, by default, the whole package of standard programs Windows 7, which can be found in the menu **Start** → **All Programs** → **Standard** (Figure 8), is downloaded.

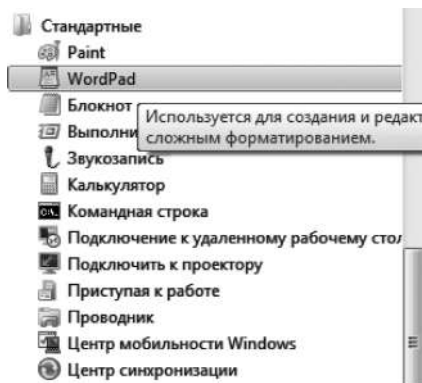


Figure 8. Standard Windows Programs

Using standard programs, you can draw, type text documents, communicate by e-mail, watch movies and listen to music. Let us describe some of them in more detail.

**Notepad** is a simple text editor, which is most often used to view and edit text files.

**WordPad** is a text editor for creating and editing documents. Unlike Notepad, *WordPad* documents can contain various formatting and graphics, you can insert objects (pictures or other documents) into a *WordPad* document or associate them with it.

**Calculator** – used to perform simple operations: addition, subtraction, multiplication and division. The calculator also provides for the implementation of programmable, engineering and statistical calculations.

**Paint** is a component of Windows 7 that allows you to create drawings on an empty sheet or on top of other images. Most of the tools used in Paint are on the ribbon next to the top of the Paint window.

## Exercise 5

### Download Standard Programs from the Start Menu

1. Download the Paint application from the list of Standard Programs in the following way: **Start** → **All Programs** → **Accessories** → **Paint**.
2. Study the appearance of the program window.
3. Create the simplest object in the program window using the appropriate buttons.
4. Close the application window without saving the document.

## Laboratory Work № 3

### Microsoft Office 2010. Work with Microsoft Word

**Work Objective:** To get acquainted and get skills of work with Microsoft Word 2010 program.

**Equipment:** PC, keyboard, mouse, a set of screwdrivers.

#### Brief Theoretical Information

Microsoft Word (or simply Word) is a word processor designed to create, view and edit text documents.

When you start working on a document in Word editor, you should install or check the settings of the main parameters. Entering symbols, inserting tables, drawings and other objects into the document is done at the position of the text cursor. Entering a text can be done in the **Insert** or **Substitution** mode. The **INS** key is used to switch modes. Figure 1 shows the Word editor window.

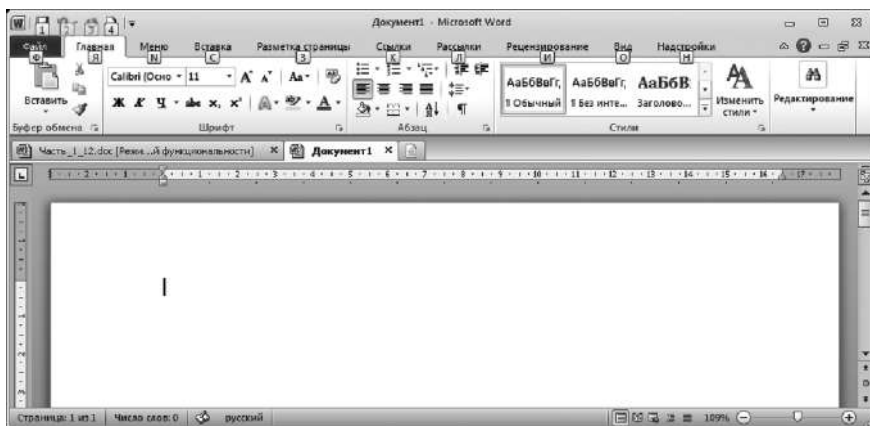


Figure 1. The Word Editor Window

When you enter text into a document, a new line is formed when the right edge of the page is reached (without pressing the **Enter** key – carriage return). The **Enter** key should be clicked only to end the paragraph and go to the next one. Delete objects and symbols to the right of the cursor by using the **Del** key. To delete characters to the left of the cursor, use the **Backspace** key.

When entering and formatting text, you must follow the following rules:

1. There should be only one space between words.
2. Before the punctuation marks, you do not need to put spaces, after the punctuation mark, you must do it.
3. Words enclosed in quotes or parentheses must not be separated from them by spaces.
4. Before and after the dash, you need to put spaces.
5. Hyphen should be used without spaces.
6. You should not use an empty paragraph as a means for indenting the next paragraph, this leads to a «forced» formatting. For such purposes, you should use the **Main Page Layout – Paragraph menu** command and set the necessary indents and intervals in the **Paragraph** dialog box.
7. Do not use a tab character or multiple spaces to indicate a red line. The first lines are set using the menu command **Layout Page – Paragraph**.

### Exercise 1

1. Create an **ICT** folder on disk D for laboratory work. This folder will save all the results of your work.
2. Start the **Microsoft Word** program. The editor window will appear on the screen (Figure 1). Examine the main menu items, toolbars and window items.
3. Set the margins: left – 3.0 cm, right – 1.0 cm, top – 2 cm and bottom – 2.5 cm through the menu command **Page Layout – Margins – Custom Margins**. The «Page Setup» dialog box appears.
4. Learn how to install and remove the ruler and grid using the commands **View – Ruler** and **View – Grid**.
5. Type the text containing brief information about you and your computer knowledge (Summary).
6. Save the document in the **ICT folder**.
7. Create a new document. Now, two documents are open in the **Word** window. Type the text of the title page of the laboratory work (the name of the educational institution, the department, the number of the laboratory work, the topic of the laboratory work; Performed by: the name of the student, Checked by: the Name of the Teacher, city, year)
8. Save the document in the ICT folder.
9. Learn to switch between document windows and arrange the windows of all documents using the **View – Switch Windows**.
10. Close all document windows.
11. Open the **ICT** folder on drive D and check the saved files.

## Exercise 2

Formatting information in the Word editor. Create a new document and type the text shown in Figure 2.

### Methodical Guidelines

1. To insert a special character, use the **Insert – Symbol – Other Symbols** command.
2. For page numbering, select **Insert – Page Number** from the main menu.
3. Set the margins: left – 2.5 cm, right – 1.5 cm, top – 2 cm and lower – 2 cm through the menu command **Page Layout – Margins command – Custom Margins**.
4. To insert a picture, move the cursor to the desired position. Insert the picture with the **Insert – Image** command. Set the appropriate dimensions of figure 2.

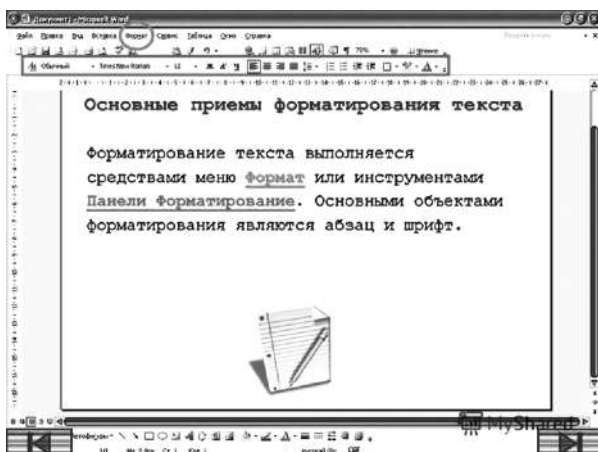


Figure 2. Task 2 Text

5. To insert symbols at the beginning of the subtitles, use the **Insert – Symbols – Other Symbols** command, select the desired character from the Wingdings group, insert and set the desired character size.
6. Parameters of the paragraph in the text are set using the menu command **Main – Paragraph**.

### Exercise 3

Creating Tables. Create a «Class Schedule» table for your group.

#### Methodical Guidelines

Create a new document. Enter the heading «Class Schedule», group name, semester and year.

Execute the menu command **Insert – Table – Insert Table**, in the Insert Table dialog box, specify the number of columns – 8 and the number of lines – 6.

Enter the data in the appropriate cells in the table. To automatically enter values in the first column, use the command **Menu – Home – Numbering**. Use the **Menu – Constructor** command to give the table the required appearance.

Figure 3 shows an example of the appearance of a table.

№	Time	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
12	8 <sup>00</sup> – 8 <sup>50</sup>						
3	8 <sup>55</sup> – 9 <sup>45</sup>						
4	9 <sup>55</sup> – 10 <sup>45</sup>						
5	10 <sup>50</sup> – 11 <sup>40</sup>						
6	11 <sup>50</sup> – 12 <sup>40</sup>						

Figure 3. Samples of Table from Exercise 3

### Exercise 4

Inserting Formulas. Inserting formulas in the Word editor is done by using the Microsoft Equation editor. Place the cursor where you want the formula to be inserted. In the **Menu – Insert – select Equation**. As a result of calling the **Formula Editor**, the toolbar appears (Figure 4):



Figure 4. Formula Editor Toolbar



Working with the formula editor panel requires some skills. To facilitate the work with formulas in the formula editor, there are a number of standard formula templates. Using the formula editor, write down the formula according to the options indicated by the teacher.

Option 1

$$A = \sum_{t=1}^{50} \frac{s}{t} bff$$

Option 2

$$\sqrt{2}E = \int gtrw^n - \frac{s}{t}$$

Option 3

$$v = \frac{s}{t} bff + \int_1^{\infty} b$$

Option 4

$$\lim_{x \rightarrow 0} \frac{\operatorname{tg}(z+15)}{x(\sqrt{1+x}-1)}$$

Option 5

$$v = \frac{s}{t} \int gtrw^n - T$$

Option 6

$$\chi^2 = \sum_{i=1}^n \left( \frac{X_i - \mu}{\sigma} \right)^2$$

Option 7

$$\frac{5 + \sqrt{25 - 4p}}{2p} < 0,$$

Option 8

$$\lim_{x \rightarrow 0} \frac{x^2 - 2x + 1}{x^2 - 1}$$

Option 9

$$\lim_{x \rightarrow 0} \frac{\ln \cos x}{\ln \cos 3x}$$

Option 10

$$x_{1,2} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Option 11

$$\lim_{x \rightarrow 0} \frac{\sin x}{\cos x - 1}$$

Option 12

$$\lim_{x \rightarrow 0} \frac{1 - \cos x}{x(\sqrt{1+x}-1)}$$

### Exercise 5

Draw a block diagram of the computer. An example of the flowchart is shown in Figure 5.



Figure 5. A Computer Block Diagram

### Exercise 7 (creative).

A fractal pattern is given (Figure 6).

1. Create a fractal pattern from equilateral triangles.
2. Suggest several variants of pattern construction.
3. Choose the optimal solution to the problem.
4. Describe the stages of creating a fractal pattern from triangles

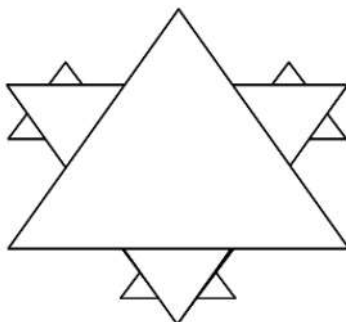


Figure 6. Fractal Pattern

## Laboratory Work № 4

### Creating, Filling, Editing and Formatting Tables in Excel

**Work Objective:** Obtaining skills to enter and format text, numbers, dates. Address cells. Relative, absolute and mixed addressing.

**Equipment:** PC, Excel spreadsheet.

#### Brief Theoretical Information

A program from Microsoft, included in Office, called Excel or spreadsheets was created to make the user's work more convenient with data tables, as well as the work is performed with numerical values.

Thanks to the use of the spreadsheets, it is much easier to work with data, you can get accurate results without performing any manual calculations with the help of this program. Also, spreadsheets allow you to solve much more complex tasks much faster with the help of special «programming».

The main feature of MS Excel is its ability to use formulas in order to describe different connections between the values of different cells. It should be noted that according to the given formulas the calculation will be performed automatically. If a person changes the value of a cell, then there will be a recalculation of the values of all the other cells that are connected with it by formula relations automatically, due to which the whole table and the data that are in it will be updated.

The main features of spreadsheets include:

- 1) automation of all final calculations;
- 2) one can make the same calculations over the large data sets;
- 3) you can solve problems by selecting values with different parameters;
- 4) you can process the results of experiments;
- 5) tabulate functions and formulas;
- 6) prepare tabular documents;
- 7) search for the most optimal values for the selected parameters,
- 8) create graphs and diagrams on the already entered data.

The download of the program in question can be done in the following ways:

1) Execute the sequence of commands: *start => programs => standard => Microsoft Excel;*

2) Click the Microsoft Excel shortcut with the left mouse button if the shortcut of the program is located on the desktop;

3) Execute the sequence of the following commands (in order): **start => find => files and folders**. You will see a dialog box on the screen where you need to enter **Microsoft Excel** (the full name of the MS Excel file) in the «Name» field, and then click the «Find» button. After the search was performed, double-click the Microsoft Excel shortcut with the left mouse button. After this program is fully loaded – close the search window.

You can determine that the downloading of the MS Excel program was completed when you see a program with an open worksheet called «Sheet 1» in the standard workbook named «Book 1» on the screen.

In order to create a workbook, the following actions should be performed:

1) Expand by clicking the left mouse button on the «**Tools**» menu, in which to select the «**Settings**» submenu. In the opened dialog, go to the «**General**» tab. You will see a window with the name «**Sheets in a new book**». Set the desired number of sheets and click on the «**OK**» button.

2) Click on the «**New**» button on the toolbar.

3) Left-click on the «**File**» menu, where you select the item «**Save as ...**». You will see a window in which you must select the «**My Documents**» window. Select the address of the desired document in the opened directory, and then in the «**File name**» field write down the required title of the workbook and click «**Save**». You will not have to do such actions in the future work with this file, but periodically save your document by pressing the «**Ctrl + S**» key combination or by selecting «**Save**» in the «**File**» menu.

## 1. Entering Text Data

**Exercise 1.** In the range of cells A1: E3, create a copy of the table below.

	A	B	C	D	E
1	<i>Wrapping</i>	Text	<i>t</i>	<i>TEXT</i>	<i>TEXT</i>
2	text		e x <i>t</i>		
3	in Excel				

## Methodical Guidelines

Enter the desired text in several cells, previously combining cells B1: B3, C1: C3, D1: D3, E1: E3, and arrange it in various ways in different formats.

To combine cells, use the display mode **merge cells** of the aligning tabs of the **Format / Cells** command.

To direct text in cells, you need to select the desired orientation of the alignment tab of the **Format / Cells** command.

To format the text, use the **Format / Cell / Font** command, to specify the borders – **Format / Cells / Border**.

**Exercise 2.** Enter the sentence in one cell A1 of sheet 2 and format as follows:

<p><b>ELECTRONIC PROCESSOR</b>  <b>EXCEL</b>  <i>INTENDED FOR PROCESSING</i>  <u>DATA</u> presented in the <i>TABLIC</i>  <b>FORM.</b></p>
--

### Methodical Guidelines

To add a new row to the cell, use the **ALT + ENTER** key combination. To position the text in a cell in several rows you can also apply the **alignment** of the **Format / Cells** command and select the **Wrap by words** check box.

**Exercise 3.** On Sheet 3, build a table of the following type:

(текущая дата)		(текущее время)	
<b><i>СПИСОК СТУДЕНТОВ ГРУППЫ</i></b>			
№ п/п	Фамилия и.о.	Дата рождения	Средний балл
1.	Сапарбаев С.С.	12.05.1995	85
2.	Ремизов В.Т.	23.07.1995	86
3.	Макатаев К.Т.	01.12.1994	89
Средний балл группы 86,6			

### Methodical Guidelines

To merge cells in 1, 2 and the last line, select the appropriate cells and use the merge button on the toolbar.

To enter the current date, you must press **Ctrl +;**

To enter the current time, press **Ctrl + Shift +;**

To set borders, use the **Borders** button on the toolbar.

To fill the cell, use the functions of the View tab **Format / Cells** command or the *fill color* button on the toolbar.

**Exercise 4.** On sheet 4:

- 1) Write the names of all months of the year, starting from January in cells A1-A12.
- 2) Write the names of all months of the second half of the year in the cells B1-G1.
- 3) Write the names of the days of the week in cells A13-G13.

### **Methodical Guidelines**

Enter the first value and use the autocomplete marker (a small box located in the lower right corner of the active cell or the selected area).

#### ***1. Enter and Fill-In Numerical Data***

**Exercise 5.** On sheet 5:

- 1) Enter the integer 1256 in cell C1. Copy this cell into cells C2, C3, C4, C5 and display cell C1 in numerical format, cell C2 in exponential, cell C3 in text, cell C4 in date format, cell C5 in fractional format.
- 2) Set the format of cell C6 so that positive numbers are displayed in green, negative – red, zero – in blue, and text information in yellow.
- 3) Fill the range A1: A10 with arbitrary fractional numbers and make the percentage format. Copy the range A1: A10 to the range D1: D10, increasing the values twice. Set the new range to a fractional format.
- 4) Using the built-in calculator, calculate the average value, the number of numbers, the number of values and the minimum value of the built-in range A1: A10 and write these values in the 15th line.

### **Methodical Guidelines**

To set the display format for a number, use the desired format of the **Number** of the **Format / Cells** tab or define your (custom) format.

With the selected range of numbers in the status line, the calculator values of the current function appear. You can change the calculator function by calling the context menu (right mouse button) for the status bar.

**Exercise 6.** On sheet 6, you need:

- 1) Fill cells A1: A10 with consecutive natural numbers from 1 to 10.

- 2) Fill the range B1: D10 with consecutive natural numbers from 1 to 50.
- 3) Fill the range of E1: E10 with consecutive odd numbers from 1 to 19.
- 4) Fill in 27 lines with numbers 2, 4, 8, 16, ... (20 numbers).
- 5) Copy the range A1: D10 to cells A16: D25.
- 6) Interchange the contents of cells of the range A1: A10 with cells D1: D10 and the contents of the cells of the range A16: D16 with cells A25: D25.

### Methodical Guidelines

To fill in the numbers, use the **Edit / Fill / Progress** command or use the autocomplete marker.

**Exercise 7.** On Sheet 7, build a table of Pythagoras (multiplication table). Copy the resulting table to the free space of the sheet, having reduced values three times.

## 2. Formulas, names, arrays. Formulas over arrays.

**Exercise 1.** Perform calculations using the following formulas:

$$A = 4 + 3 * x + 2 * x^2 + x^3, \quad B = \frac{x + y + z}{x * y * z}, \quad C = \sqrt{\frac{1 + x}{x * y}},$$

assuming x, y, z are given in cells A3, B3 and C3.

### Execution

Enter the concrete values of the variables in cells A3, B3 and C3, for example 1.2, 3, 1.5 and assign the names X, Y, Z respectively to these cells. To assign names to cells, use the **Insert / Name / Assign** command.

In cells A5, A6 and A7, we introduce an explanatory text, and in cells B5, B6 and B7 – the corresponding formulas. For example, to calculate the first value, you can enter the formula  $= 4 + 3 * X + 2 * X^2 + X^3$ . However, it is better to perform the calculations according to the Horner scheme, which allows to reduce the number of operations performed. In this case, the formula takes the form  $= ((X + 2) * X + 3) * X + 4$ . The proposed formulas are used as their operands - the created names, which makes them similar to the corresponding mathematical formulas. If necessary, you can also use the links to the cells in the worksheet. In this case, the desired formula would have the form  $= (A3 + 2) * A3 + 3) * A3 + 4$ .

The form of the spreadsheet is shown in the following figure.

	A	B	C	D
1	Вычисления по формулам			
2	X	Y	Z	
3	1,2	3	1,5	
4	Результаты:			
5	A=	12,208		
6	B=	1,056		
7	C=	0,782		

**Exercise 2.** On the sheet, create a table that contains information about the prices for products. Fill in empty table cells with arbitrary prices, except for the «Average» column and the «Total» line.

	Oct	Nov	Dec	Average
Milk				
Butter				
Cream				
Cottage cheese				
Total				

Create names by rows and columns and calculate the average monthly prices of each product and all dairy products by months, using the built-in names.

### Methodical Guidelines

To calculate the average value, use the AVERAGE function.

**Exercise 3.** On the sheet, write down the formula for calculating the product of the sums of two one-dimensional arrays  $A$  and  $B$ , i.e.

$R = \sum_{i=1}^n a_i \cdot \sum_{i=1}^n b_i$ ; where  $a_i$  and  $b_i$  are the corresponding elements of the arrays, and  $n$  is their dimension.

### Execution

Enter the specific data, for example,  $A = \{1.5, 1.23, 1.65, 2.44, 1.44\}$  and  $B = \{2.11, 3.12, 2.14, 2.33, 3.12\}$ , respectively, into the cells A2: E2 of the second and A3: E3 of the third line of sheet 3 of the worksheet. Then, in the cell A5, we introduce the formula: = SUMM (A2: E2) \* SUM (A3: E3). If



the name A is assign to the range A2: E2, and the name B to the range A3: E3, then you can apply the formula: = SUM (A) \* SUM (B).

**Exercise 4.** On the sheet, write down the formulas for calculating the sums  $S_i$  of each row of a two-dimensional array (matrix) D, i.e.  $S_i = \sum_{j=1}^n d_{i,j}, i = 1, 2, \dots, m;$  where m is the number of rows of the matrix, n is the number of columns

### Execution

Let us introduce specific data  $\{d_{i,j}\}, i = 1, 2, \dots, 5, j = 1, 2, \dots, 4$  (matrix – five rows four columns) into cells A1: D5. Calculate the sums of each row and put them in cells F1: F5. To do this, put the following formula in cell F1: = SUM (A1: D1), and use the autocomplete marker to copy it to cells F2: F5. Since the formula uses a relative reference, each copy will be adjusted to its location and the sum of the corresponding row of the matrix will be calculated.

**Exercise 5.** Write formulas on the sheet to calculate the values of the elements of the array  $Y_i = a_i / m \text{ ax } (b_i), i = 1, 2, \dots, n$ , where  $a_i$  and  $b_i$  are the elements of the corresponding arrays, and n is their dimension.

### Execution

Let us introduce specific data  $\{a_i\}, i = 1, 2, \dots, 5; \{b_i\}, i = 1, 2, \dots, 5$ , respectively into the cells A2: E2 of the second, and A3: E3 of the third row of the worksheet sheet 5. Then, in the cell A5, enter the formula: = A2 / MAX (\$ A \$ 3: \$ E \$ 3) and use the autocomplete marker to copy it to cells B5: F5. The second operand uses the absolute reference, so only the first operand will be set to the new location.

**Exercise 6.** On the sheet, set an arbitrary array of numbers. Calculate the sum of the positive numbers and the number of negative numbers in this array.

### Execution

We enter arbitrary data, for example, in cells A2: D6 of the worksheet, respectively. To calculate the sum of positive numbers, in the cell F4 we introduce the formula: = SUMMIF (A2: D6; <>0»;A2:D6), and to calculate the number of triggers in cell F5 by formula: = COUNTIF (A2: D6; <<0»).

**Exercise 7.** On the sheet fill the arbitrary range with any numbers. Find the sum of the numbers given in the cell A1.

### **Execution**

Let us introduce specific data, for example, in the cells A2: E2 of the worksheet sheet. We write an arbitrary number in cell A1, and in cell A4 we enter the formula: = SUMMER (A2: E2; «>» & A1; A2: E2).

**Exercise 8.** Set the array of numbers on the sheet, and use the corresponding functions to calculate the arithmetic mean of the positive numbers and the arithmetic mean of the absolute values of the negative numbers in this array.

### **Methodical Guidelines**

The average arithmetic value of positive numbers is equal to the quotient of dividing the sum of the positive numbers by the number of positive numbers. To solve the task, use the functions of SUMIF, ACCOUNT and ABS.

**Exercise 9.** On the sheet, create an arbitrary list of names, and give it the name of the NAME. Determine how many times in the NAME your name is listed, specified in the cell.

### **Methodical Guidelines**

Use the COUNCIF function.

## ***3. Construction of graphs, surfaces and diagrams in Excel***

**Exercise 1.** To compile a table of the company's revenues in absolute and percentage terms and a diagram of revenue growth based on the company's income data.

### **Growth of the Firm's Revenues in Absolute and Percentage Terms**

Months	Revenue in 2015, thousand KZT	Revenue in 2016, thousand KZT	Revenue in 2016, %
January	150	187	
February	190	194	
March	215	220	

April	214	236	
May	235	247	
June	254	275	
July	260	275	
August	265	270	
September	285	286	
October	290	315	
November	300	325	
December	325	340	

### Execution

1) Create a table of calculating the company's revenues: determine the type, size and style of the fonts for row and column headings: Times New Roman Cyr, size 12, style bold; For the rest of the text - Times New Roman Cyr, size 10, normal style;

2) Calculate the growth of the firm's income level in percentage terms in each month of 2015 in relation to January 2016 (3rd Column of the table);

3) =  $(C_i - C \$ 3) / C \$ 3$  where  $C_i$  is the address of the cell of the  $i$ -th month of the column. The income level of the firm in 1999,  $C \$ 3$  is the absolute address of the cell. The income level of the firm for January 2016;

4) Calculate the total revenue level of the firm for 2016 and 2015, put the results in the last row of the second and third columns, respectively;

5) Calculate the average value of income growth in percent, put the result in the last row of the fourth column;

6) Construct a diagram of the dependence of the firm's income level for 2016 and 2015 by months in the form of a histogram;

7) Construct a diagram of the dependence of the firm's income level in percentage terms in the form of a linear graph;

8) Build a combined chart (type **nonstandard / graph / histogram** according to the received table data (second, third and fourth columns);

9) Consider other types of diagrams, master the editing of chart elements.

**Exercise 2.** Draw a pie chart showing the average score for the subjects on the basis of the table «Results of the Examination Session» of Section 3.

Results of the Examination Session

№	Name	ICT	Math	Philosophy
1.	Karimbayev K.M.	86	79	87
2.	...	...	...	...
3.	...	...	...	...
...				
Average Grade				

**Exercise 3.** Built a graph of the function  $y=\sin x$ . The value of the argument  $x$  should be in the range of -6 till 6 with the step 0.5.

### Execution

Let us build a table:

X	-6,0	-5,5	-5,0	...					
Y	0,28	0,71	0,96	...					

For this, we fill the values of X by pulling. In the line Y we insert the formula = Sin (B2) and extend to the end of the table.

Then select the built-in range and on the standard panel click on the Chart Wizard button. Choose the type of chart-graph.

**Exercise 4.** Create a spreadsheet for plotting the graph of the quadratic function  $y = a x^2 + bx + c$ , assuming  $a$ ,  $b$  and with parameters in the interval  $[-5; 5]$  with the steps of 0.2.

**Exercise 5.** Create a spreadsheet for plotting the graph  $y = a \cdot \sin (b \cdot x + c)$ , counting  $a$ ,  $b$  and  $c$  parameters on the interval  $[n_1; n_2]$  with a step  $h = (n_2 - n_1) / 30$ .

**Exercise 6.** Create a spreadsheet for displaying the function graph

$$z = \frac{\cos(x^2 + y^2 + 1)}{\sqrt{x^2 + y^2 + 1}}, \quad -2 \leq x \leq 2, \quad -2 \leq y \leq 2.$$

## Laboratory Work № 5

### Creating a Database Using DBMS ACCESS 2010

**Work Objective:** to master the practical skills of creating a database in MS DBMS environment.

**Equipment:** computer class.

**Software:** DBMS MS Access 2010.

#### Brief Theoretical Information

**Microsoft Access database** is a collection of data and objects (ie forms, reports, etc.) that relate to a specific task and represent a complete system. The Access database consists of tables, queries, forms, reports, access pages, macros and modules. In addition, the Access application contains some other objects, including links, database properties, and specifications import and export.

**A table** is a database object in which data is stored as records (rows) and fields (columns). It is the main structural element of the relational database management system.

**Query** is a database object that allows you to search and display data stored in tables that satisfy specified conditions (including from several tables). Using a query, you can modify and delete the records of the tables, as well as perform various calculations.

**Form** is a database object that is a user interface element intended for viewing, entering and modifying data in one or more tables.

**Report** is a database object intended for analysis and printing of data organized and formatted in accordance with user requirements.

**Macros** are macros or a set of macros used to automate tasks.

**Module** is a database object that allows you to create libraries of routines and functions used throughout the application. Using the module codes, you can solve tasks such as handling input errors, declaring and applying variables, organizing loops, and so on.

Table 1 lists the types of data that are provided in Microsoft Office Access 2010, how to use them, and how much space is required to store each type of data. It should be remembered that the maximum file size for the Office Access 2010 database is 2 gigabytes.

Table 1

## MS Access Data Types

<b>Data Type</b>	<b>Application</b>	<b>Size</b>
Text	Used for alphanumeric characters, including text, as well as text and numbers that are not used in calculations.	Up to 255 characters
MEMO field	Used for text that exceeds 255 characters or text that uses RTF formatting. The MEMO field property specifies whether the field supports formatted text.	Up to 1024 x 1024 x 1024 characters, for storage which requires 2 gigabytes (2 bytes per character). Of these, you can display up to 65,535 characters in one control element.
Numeric	Used to store numerical values (integer or fractional) that are used in calculations (except for monetary sums).	1, 2, 4, 8 or 12 bytes (16 bytes when the field is used for the replication code).
Date / Time	Used to store date and time values.	8 bytes
Monetary	Used to store monetary values. Used to prevent rounding during computation.	8 bytes
Counter	Used to generate unique values that can be used as the primary key. These values are automatically inserted into the field when you add an entry. Fields with data type «Counter» can be formed by adding a unit, adding a specified value or using random numbers.	4 bytes (16 bytes when the field is used, is used as the replication code).
Logical	Used for logical Value: Yes / No, True / False or On / Off.	1 bit (0.125 bytes)
Object field OLE	Used to store OLE objects from other Microsoft Windows programs.	Up to 1 gigabyte

Attachment	Used to store binary files (files, which can not be read with a text editor), such as digital images (photos and other images) or files created with other Microsoft Office applications. Using the field with the data type «Attachment», you can put more than one file.	2 gigabytes for compressed attachments. For uncompressed attachments of approximately 700 KB, depending on the degree of compression of the attachments.
Hyperlink	Used for storage of hyperlinks (including links to Access application objects that are stored in the database).	Up to 1024 x 1024 x 1024 characters, for the storage of which requires 2 gigabytes (2 bytes per character). Of these, you can display up to 65,535 characters in one control.
Wizard of substitutions	It is used to run the substitution wizard, which allows you to create a field in which values are displayed in the form of a drop-down list from another table, query or list of values (in fact, the substitution wizard is not a data type). Create a field in which a drop-down list displays values from another table, query, or list of values (in fact, the substitution wizard is not a type of data)	If a substitution field is attached to a table or a query, then this is the size of the attached If the substitution field does not have another column attached ). (that is, a list of values is stored), then this is the size of the text field used to store the list.

In most database management systems, including Microsoft Access versions prior to Microsoft Access 2007, only one value can be stored in the field. When working with Microsoft Office Access 2010, you can create a field that stores multiple values, such as the list of categories to which the problem applies. Technically, the model of a field that simultaneously allows multiple values in Access implements the many-to-many relationship.

Consider the need to create a field that simultaneously allows multiple values, in cases where you want to perform the following tasks:

- 1) store a selection from the list of options, containing several values at the same time (and this list is relatively small);
- 2) export the Access table to the SharePoint site, where variants or substitutions with multiple values are available in Windows SharePoint Services;
- 3) create a link to the SharePoint list that contains fields of options or substitutions with multiple values.

In addition to the situations described above, fields that simultaneously allow multiple values can be used when there is confidence that you will not have to later migrate the database to Microsoft SQL Server. Fields that simultaneously allow multiple values from the Office Access 2010 format are converted to SQL Server fields as fields of MEMO (ntext) type that contain delimited values. Because SQL Server does not support data types that simultaneously allow multiple values and represent a multi-to-many model, additional design and transformation work may be required.

Table 2 lists the properties of the fields and describes the effect of these properties on the fields, depending on their data type.

Table 2

MS Access Field Properties

Property Field	Property Use
Field size	Sets the maximum size for the data.
Field format	Set the display of the default field on the screen and when printing.
Number of decimals	Specifies the number of decimal places to use when displaying numbers.
New Values	Specifies which values (sequential or random) are assigned to the «Counter» field when adding a new entry.
Input mask	Edit symbols that define the methods of data entry.
Signature	The text displayed by default as a signature in forms, reports, and queries.
Default Value	A value that is automatically assigned to the field when a new record is added.
Condition on the value	An expression, the value of which must be true when adding or changing the field value.



Text to check	The text that appears when you enter a value that violates the condition specified in the Condition on Value field.
Required field	Specifies whether this field contains a value in each record.
Blank lines	Allows (by setting the value Yes) to enter a zero-length string ("" ) in the text field and in the MEMO field.
Indexation	By creating and using an index, it speeds up access to this field for reading.
Unicode compression	Compresses the data contained in this field if it contains less than 4096 characters (this condition is always true for text fields). If the field contains more than 4096 characters, no action is taken.
IME mode	Manage the conversion of impersonations in East Asian versions of Windows.
IME offer mode	Manage the conversion of sentences in East Asian versions of Windows.
Smart Tags	Allows you to select the smart tags applied to the field.
Add-on Only	When the property is set to Yes, a log of the field value is maintained.
Text format	To store data in the form of HTML-code and use RTF-formatting, choose the Format RTF. To store only text without formatting, select Normal text.
Align text	Align the default text in the control.
Display date selection item	Specifies whether the date selection item (Calendar control) is displayed in the Access application when the user changes the field value.

In the theory of relational databases, the table is an initially unordered set of records. The only way to identify a specific entry in this table is to specify a set of attributes that would be unique for this record.

A *key* is a set of attributes that uniquely identifies an entry. There are the following types of keys:

**Primary key** represents one or more fields (columns), the values of which uniquely determine each entry in the table. The primary key does not allow Null values and must always have a unique index. The primary key is used to bind the table to foreign keys in other tables. The primary key can be *natural* or *artificial*. The key, consisting of information fields of the table (that is, fields containing useful information about the described objects) is called a *natural key*. Theoretically, a natural key can always be formed, in this case it is called «*intellectual key*». An artificial key is an additional service field, the only purpose of which is to serve as a primary key. The values of this field are not formed on the basis of any other data from the database, but are generated artificially. As a rule, a surrogate key is simply a numeric field into which values from an increasing numeric sequence are entered;

**Foreign key** – represents one or more fields (columns) containing a reference to the field or fields of the primary key in another table. The foreign key determines how the tables are linked.

The keys are also divided into two classes: simple and composite.

A simple key consists of one attribute, a composite key consists of several attributes. The use of composite keys complicates the joining of the tables.

After you create a table for each topic in the database, you need to provide Microsoft Access 2010 with the tools that you can use to re-merge information as needed. This is done by placing common fields in the linked tables and defining the relationships between the tables. After that you can create queries, forms, and reports that simultaneously display the information from the multiple tables.

Inter-table relationships can combine two or more entities. As a rule, they correspond to some interaction between entities and describe the relationship that arises between them. During logical design, relationships between the tables can have their own attributes. This relationship is identified as a separate entity of the type of connection.

Relationships fall into three main types, depending on the number of entity records associated with writing another entity:

- *One to one*, each record of the first entity corresponds to only one entry of the second entity, and each record of the second entity has only one record of the first entity. Example: the author, who currently has only one unfinished book.
- *One to many*, each entry of the first entity can correspond to several records of the second entity, however, only one record of the first

entity corresponds to each record of the second entity. An example is a publishing house that has published several books.

- *Many to many*, each record of the first entity can correspond to several records of the second entity, and each record of the second entity corresponds to several records of the first entity.

In Microsoft Access, you can create inter-table links directly using the Data Schema window or by dragging a field from the **Field List** area. In the Access application, inter-table links are used to demonstrate how to associate the tables to use them in the database object. There are several reasons for creating inter-table relationships before creating other database objects (forms, queries and reports):

- 1) Inter-table links provide information for the structure of queries.
- 2) Inter-table links provide information for the structure of forms and reports.
- 3) Inter-table relationships are the basis by which data integrity can be ensured.

Data Integrity refers to the system of rules used in Microsoft Access to maintain links between records in related tables, as well as providing protection against accidental deletion or alteration of related data. To set Data Integrity is possible if the following conditions are satisfied:

- 1) The associated field of the main table is a primary key or an alternative key (has a unique index).
- 2) The linked fields (the primary key of the main table and the foreign key of the subordinate table) have one data type. There is an exception here: the counter field can be associated with a numeric field which **Field Size** property has the value **Long integer**.
- 3) Both tables belong to the same Microsoft Access database. To establish the integrity of the data, the database in which the tables are located must be open.
- 4) When setting the integrity of the data, remember the following rules:
- 5) It is not possible to enter a value in the foreign key field of the linked table that is not contained in the key field of the main table.
- 6) It is not possible to delete an entry from the main table if there are associated records in the subordinate table.
- 7) It is not possible to change the value of the primary key in the main table if there are entries associated with this entry.

To set data integrity rules for a particular connection, when you create it in Microsoft Office Access, select the check box **ensuring data integrity**.

If this check box is selected, any attempt to perform an action that violates one of the rules listed above will result in a warning on the screen, and the action itself will be canceled.

To overcome the restrictions on deleting or changing related records, while maintaining data integrity, you must check the **Cascading Update for Linked Fields** and **Cascading Delete Linked Fields** check boxes. If the **Cascading update of the linked fields** check box is selected, then when the key field of the main table is changed, the corresponding values of the related entries are also automatically changed. If the **Cascading delete associated fields** check box is selected, then when you delete a record in the master table, all associated records in the subordinate table are also deleted.

After creating the necessary tables, fields and links, you need to review the structure of the database again and identify possible shortcomings. It is advisable to do this at this stage, while the tables are not filled with data.

In Microsoft Access, there are two tools that help in improving the structure of databases:

- *The table analysis wizard* can analyze the structure of the table, suggest suitable new structures and links, and also divide the table into new linked tables, if that makes sense.
- *The speed analyzer* examines the entire database, gives recommendations for its improvement, and also implements them.

## ***1. Creating a Database***

1. Start Microsoft Access from the **Start** menu or using the shortcut. The menu for creating an Access database is displayed.

2. In the «New» section of the «**Available Templates**» section, select the «**New Database**» command (Figure 1).

3. In the **New Blank Database** area, in the **File Name** field, enter a file name, for example «My\_Garden» and specify the path to the folder to which it should be saved.

4. Click the **Create** button.

A new database will be created and a new table will be opened in the table mode. If necessary, a new database can be created using templates, and in addition, it is possible to download additional templates from the MicrosoftOfficeOnline Web site.



Figure 1. Creating a new database

## 2. Creating Tables

When creating a database, the data is stored in tables – lists of rows (records) and columns (fields) related to a particular field. When creating a new database, a new table is automatically created. You can also create a table by adding a new table into an existing database, import or create a table reference from another data source, such as a book MicrosoftOfficeExcel, a text file, or another database.

### *Creating a Table in the Design View*

**Exercise:** in the designer mode, create the tables «**Orders**», «**Delivery**», «**Vendors**», «**Actual\_Address\_Delivery**» (see Annex 1).

1. In the **Database** window, select the **Create** tab, on it in the **Tables** group – **Table Design**.
2. In the **Field Name** box, type the name of the field to be generated.
3. In the **Data Type** column, select the required data type from the list.
4. In the **Description** box, type the text that explains the purpose and use of this field in the table.

In the **Field Properties** section, set the required field properties:

- Field size (FieldSize);
- Validation Rule;
- Format;
- Input Mask;
- Required.

Formation of an Input Mask (see Appendix 2). The input mask defines how to enter data into the database. Choose a Type of the Input Mask row in the Field Properties section and click the Input Mask Wizard button (three-point button). Confirm the table to be saved.

In the window that opens, the **Input Mask Wizard**, select the necessary mask from the list provided (if it is in the list). If there is no needed mask in the list, click the List button in the open window of the Masks Creation Wizard. The Configure Input Masks window opens (Figure 2).

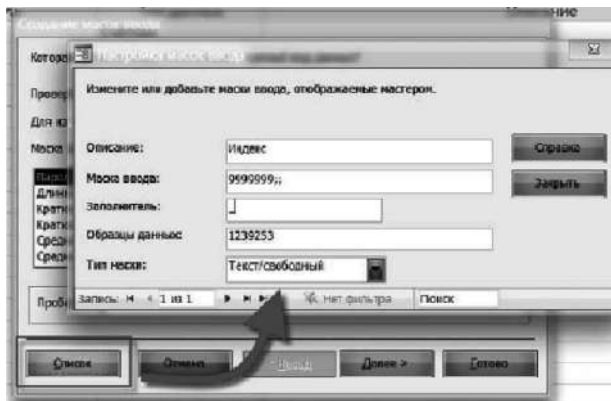


Figure 2. Window with an input mask

5. In the *Description* field, enter the name of the input mask to be created; in the *Input mask* box, enter the actual mask (Appendix 2); in the *Placeholder* field select a placeholder mask from the mask's symbols (by default – the underscore sign); enter the sample data in the appropriate field (as an example for the user) and select Mask type. Click Close.

6. The newly created mask appears in the *Mask Wizard window* – **Next**. In the *Try It* field, enter the data for verification of the Mask actions – **Next (Next)** – **Next (Next)** – **Finish**.

7. If necessary, the mask can be built without the help of a master.

### Primary Key Definition

In *Design mode*, use the mouse pointer to highlight a line describing the field that should be used as the key. Click the *Primary Key* button on the toolbar and click the right mouse button and select the appropriate menu item (Figure 3).



Figure 3. Service Group

When defining a composite key, it is necessary to select all the fields included in the key (for example, holding down the Ctrl key) at once, and assign them as the key ones.

Forming the «Default Value».

1. In the «**Orders**» table for the «**Order Date**» field in the **Field Properties** section, select the **Default Value** line.
2. Using the **Expression Builder (...)** (**Functions – Built-In Functions – Date / Time**)), build the expression Date (). After this, when creating a new order in the field, the current date will be displayed by default.

### ***Saving the Table Structure***

There are several options for saving the table structure:

1. **Click the Save button on the Quick Access Toolbar.**
2. Right-click the document tab and select **Save As** from the shortcut menu.
3. Select the File tab (Backstage view), and then select the Save As command. Enter the name of the created Table, click OK, close the window.

### ***Creating a Table in Table Mode***

**Exercise:** in the table mode, create the tables «**Employees**», «**Transportation\_Company**» and «**Details\_Order**» (Appendix 1).

1. On the ribbon, click the **Create** tab, the **Table** tool group (Tables), the Table button. As a result, a new blank table will be created.
2. Click on the new field – a list of the main field types will open. Select the type of the field to be created and give it a name. To view all possible field types on the Fields tab, in the **Add / Remove** group, select the **Other fields** button.
3. Go to the Design mode, assigning a name to the table and saving it.
4. In Design view, set the required properties of the table fields.
5. Save the table structure.

### 3. Work with Calculated Fields

In Access 2010, you can use the calculated data type to create a calculated field in a table. This greatly simplifies the display and use of the calculation results in the database. Access updates the calculated fields when editing an entry, ensuring that the value in the field is correct.

**Exercise:** create a calculated field «Products Sum» in the «Products» table, which stores information about the amount of each item of goods at the moment in the warehouse.

1. Open the «**Products**» table in Design mode. Add a field named «Products Sum» and the data type «Calculated». The Expression Builder window opens.

2. In the Expression Builder, double-click the fields that are involved in the calculation of the value of the field «Products Sum»: the field «Price Per Pack» and the field «Quantity in Warehouse». Put manually the multiplication sign or select in the group Elements of Expressions of the Arithmetic category (Figure 4).

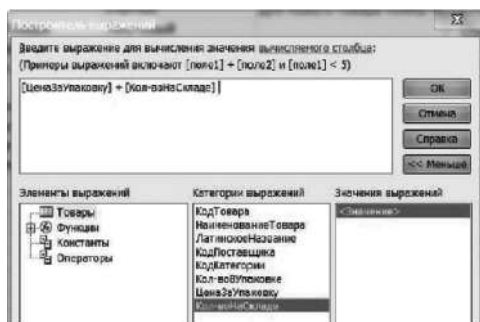


Figure 4. Expression Builder Window

Save the changes, go to the table mode and make sure the results are correct.

#### **Attaching files to a Database Record (the «Attachment» field)**

The Attachment field is intended for storing several files in one field and is intended to replace its predecessor – the type of the OLE field. Attachments can be of different types.

**Exercise:** add an «Attachment» field for the «Employees» table and place additional materials in this field – a resume of each employee (they are



in the «Resume» folder) and available photos of employees (folder «Pictures of Employees»).

1. Open the Employees table in Design mode.  
Add a field named «Annexes» and the data type «Attachment».
2. Switch to the table mode – the field you just created appears.



3. To add information to the entry, right-click on the corresponding field, select the menu item **Manage Attachments** – the **Attachment** dialog box will open.

4. Using the **Add** button, you can select the necessary files (CVs and employee photos) for each employee. Simultaneously several files (summary and, if there is, a photo of the employee) can be added to one field.

5. Save the changes in the table.

Task: in the same way, you can create a field named «Image» of the «Attachment» type in the «Products» table and add images from the «Flowers Pic» catalog for the first five products.

#### **4. Establishing Links between Tables**

After you create a table for each topic in the database, you need to provide Office Access 2010 with tools that can be used to re-merge information as needed.

This is done by placing common fields in the linked tables and defining the relationships between the tables. After that you can create Queries, forms, and reports that simultaneously display information from the multiple tables.

Task: develop a data schema for the created tables by establishing links between them (Appendix 3).

1. To view inter-table links, select the **Relationships** item on the **Database Tools** tab in the **Relationships** group. In the «Relationships» window all existing links will be displayed. If the links have not yet been defined or this window is opened for the first time, you will be prompted to add a table or query to the window. Also, you can open the **Relationships** from the tab **Table** in the **Relationships** group (Figure 5).

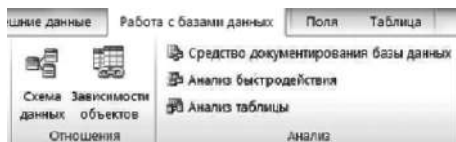


Figure 5. Selection Options for the Data Schema

2. You can create an inter-table link using the **Data Schema** window or by dragging a field into the table from the **Field List** area. When you create a link between the tables, you do not want the shared fields to have the same names. Instead, these fields must have the same data type.

3. If no relationships are defined in the database, the **Show Table** dialog box opens automatically. If it is not displayed, on the **Design** tab in the **Relationships** group, click the **Show Table** button.

4. Select one or more tables or queries, and then click **Add**. When you have finished adding tables and queries in the **Data Schema** window, click the **Close** button.

5. Drag the field (usually the primary key) from one table into a common field (foreign key) in another table. To drag multiple fields at once, by pressing and holding the Ctrl key, select each field, and then drag them. The **Edit Relationships** dialog box opens (Figure 6).

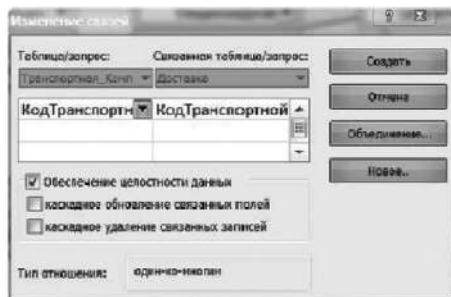


Figure 6. The Edit Links Window

6. Make sure that the names of the common communication fields are displayed correctly. If the field name is not displayed correctly, select the desired name from the list. To ensure data integrity for this connection, select the **Enforce Referential Integrity** check box. To overcome the restrictions on deleting or editing related records while maintaining data

integrity, check the ***Cascade Update Related Fields*** and ***Cascade Delete Related Records*** checkboxes. If the Cascade Updating of the associated fields (***Enforce Referential Integrity***) is in place, then when the key field of the main table changes, the corresponding values of the linked records are also automatically changed. If the ***Cascade Delete Related Records*** check box is selected, then when you delete a record in the main table, all associated records in the subordinate table are also deleted.

7. Click the **Create** button.

8. To delete or change the link, position the cursor on the link, and then click the line to select. The dedicated link will become bold. When the link is selected, right-click and select the desired menu item. Save the data schema structure and close it.

### ***5. Using the Substitution Wizard and Creating Fields With Multiple Values***

**Exercise:** working with the «***Orders***» table (the «Employee ID» field), use the wizard to create a field with several values.

1. To be able to make changes to the field types, you first need to open the ***Relationships*** and delete all links of the table that you want to modify.

2. Open the «***Orders***» table in the Design mode. Next to the name of the «***Employee ID***» field, select the ***Lookup Wizard*** data type from the drop-down menu.

3. Use the value from the table. In the Lookup Wizard, click the Switching Substitution Object button to use the values from the table or query (***I want the lookup column to look up the values in a table or query***), and then click ***Next***.

4. Select the «***Employees***» table in the list and click ***Next***.

5. In the ***Available Fields*** list, select the «Surname», «Position» fields.

6. Click the «***more***» icon (>) to move the selected fields to the ***Selected Fields*** list – ***Next***.

7. You can select one of the fields to sort the elements for the substitution, and click ***Next***. Click the Ascending button to switch to the sorting mode in the descending order. The inscription on the button will change to ***Descending***. Press the button again to switch back. Click ***Next*** button.

8. If necessary, adjust the width of the columns in the setting field and click ***Next***.

9. In the *Save group several values for this substitution?* Select the *Allow Multiple Values* check box (this checkbox must be set to allow multiple values simultaneously) – *Finish*.

10. Save the changes.

11. Switch to the *Datesheet* mode and change any entry in the *Employee ID* field of the *Orders* table by clicking on the corresponding data field. Please note that when working with the field, a drop-down list of employees (name and position) appears in which you can select one or more employees to process the order by setting a marker opposite to their names in the list.

12. Go to the *Design* mode and make sure that the data type of the «*Employee ID*» field is numeric (this is important when linking tables).

13. Save the changes in the table.

14. Open the *Relationships* and restore the links to the *Orders* table. Please note that when the «*Orders*» table was displayed on the chart, there were changes.

15. Save the data schema.

16. Similarly, use the Lookup Wizard to edit the «*Code Category*» field in the «*Products*» field with one exception: the field must have only one value (that is, there cannot be several values in the field). For substitution, you need to take the «*Category Name*» field from the «*Categories of Products*» table. After the work is done, make sure that when you edit the data in the field of the table, a drop-down list appears that does not allow selection of several values. Also make sure (in *Design* mode) that the field type is numeric.

17. Save the changes in the table, close the table, restore the communication agent in the *Relationships*, save the *Data Scheme* in the display of the «*Products*» table, there should not be any data on the data schema, since there is no possibility of selecting several values in the field)

## ***6. Viewing Information about Objects in the Database with the Help of an Archivist (Database Documentation Tool)***

One of the ways to study a particular database is to use the archivist. The archivist is used to build a report that contains detailed information about objects in the database. The archivist is also a tool for documenting the database. First, choose which objects will be discussed in detail in the report. When the archivist is started, its report contains all the data about the selected database objects.

1. On the ***Database Tools*** tab, under ***Analysis***, click the ***Database Documenter***.
2. In the ***Database Documenter*** dialog box, click the tab that represents the type of database object you want to examine. To create a report for all objects in the database, click the ***All Object Types*** tab.
3. Select one or more objects from the listed on the tab. To select all the objects on the tab, click ***Select All***.
4. Click **OK**.
5. Review the reports, close the report window.

#### ***Save And Close The Database***

1. Save all changes.
2. Quit Microsoft Access.

## Annex 1

### Tables Description

Table «Orders»

Field	Type	Size	Other Properties
OrderCode	Counter	Длинное	
Integer	Key		
ClientCode	Text	255	Required field. Indexed – Yes (same values are permitted)
EmployeeCode	Number	Long	Required field; Indexed – Yes (same values are permitted)
OrderCode	Date/time		Input mask – short date format
Required Date of Execution	Date/time		Show Date Picker – for dates
Expected Date of Execution	Date/time		Show Date Picker – for dates
ClientAccountNumber	Text	15	Indexed – Yes (same values are permitted)

Table «Delivery»

Field	Type	Size	Other Properties
OrderCode	Counter	Long Integer	Key
Transportation CompanyCode	Number	Long Integer	Required field
DeliveryDate	Date/time		Required field; Show Date Picker – for dates
Tariff	Money		Number of decimals – 2

Table «Actual Delivery Address»

Field	Type	Size	Other Properties
ActualAddressCode	Counter	Long Integer	Key
ClientCode	Text	255	Required field
Region	Text	50	Required field
City	Text	20	Required field
Street	Text	50	Required field
House	Text	4	Required field
Building	Text	5	Optional field
Index	Text	7	Input Mask 999999
Telephone	Text	14	Input Mask (999) 000-000

Table «Supplier»

Field	Type	Size	Other Properties
SupplierCode	Counter	Long Integer	Key
Company	Text	255	Required field, Indexed – Yes (same values are permitted)
Last Name	Text	20	Required field
First Name	Text	20	Required field
Position	Text	50	Required field
Office Telephone	Text	14	Input Mask (999) 000-000
Mobile Telephone	Text	14	Input Mask (999) 000-000
Fax	Text	14	Input Mask
Address	Text	100	Required field
City	Text	20	Required field
State	Text	20	Required field
Index	Text	7	Input Mask 999999

Table «Employee»

Field	Type	Size	Other Properties
EmployeeCode	Counter	Long Integer	Key
First Name	Text	20	Required field
Last Name	Text	20	Required field
Position	Text	50	Required field
Address	Text	100	Required field
City	Text	20	Required field
State	Text	20	Required field
Index	Text	7	Input Mask 999999
Telephone	Text	14	Required field. Input Mask (999) 000-000
Date_of_Birth	Date/time		Required field. Input Mask – short date format
Date of Hiring	Date/time		Required filed; Condition on the value <=Now(); Error note – «Date should not be later than the current date». Show Date Picker – for dates
Notes	Field	MEMO	Optional

Table «Transportation Company»

Field	Type	Size	Other Properties
Transportation CompanyCode	Counter	Long Integer	
Integer	Key		
CompanyName	Text	255	Required field. Indexed – Yes (same values are not permitted)
Last Name	Text	20	Required field
First Name	Text	20	Required field
Street	Text	50	Required field
City	Text	20	Required field
State	Text	20	Required field
Index	Text	7	Input Mask 999999
Telephone	Text	14	Required field. Input Mask (999) 000-000



Table «Clients»

Field	Type	Size	Other Properties
ClientCode	Text	5	Key
First Name	Text	30	Required field
Last Name	Text	50	Required field
Address	Text	255	Required field
City	Text	50	Required field
State	Text	20	Required field
Index	Text	7	Input Mask 999999
Country	Text	50	Required field
Telephone	Text	15	Required field. Input Mask (999) 000-000
CreditCard	Number	Byte	Default value 0
Number	Text	255	Indexed – YES (same values are not permitted)
Notes	Field	MEMO	Optional

Table «Order\_Details»

Field	Type	Size	Other Properties
OrderCode	Counter	Long	Composed key; Required: Indexed – Yes (same values permitted)
ProductCode	Number	Integer	
Quantity	Number	Integer	Required field. Default Value 0
Discount	Number	Double with floating point	Optional; Field format – percentage, number of decimals – 0; default value 0
ActualAddressCode	Number	Integer	Optional field
DeliveryCode	Number	Integer	Optional field

## Annex 2

### Input Mask

The input mask is a set of text constants and mask signs that determines what data and how you can be entered. For example, using the input mask, you can require users to enter dates or phone numbers as they would in a specific country, for example:

- DD.MM.YYYY
- () - ext.

The input mask can consist of three parts, separated by a semicolon. The first part is mandatory, and the other two are optional. Example of an input mask for telephone numbers in the US format: (999) 000-0000; 0; \_

The first part defines the mask string and consists of placeholders and text constants. The second part specifies whether to store mask characters along with the data in the database. Enter 0, if you want to save the mask and data in the database. Enter 1 if you want to save only the data. The third part defines the placeholder that serves to indicate the position of the data. By default, Access uses an underscore (\_). If you want to use a different character, enter it in the third part of the mask.

By default, the position accepts only one character or a space.

#### *Examples of input masks*

The following table shows some ways to apply input masks.

Input mask	Provides a value entry in the form	Notes
(000) 000-0000	(206) 555-0199	In this case, users must enter a long distance code, because in this area of the mask (000 in brackets) a placeholder 0 is used.
(999) 000-0000!	(206) 555-0199 ( ) 555-0199	In this case, in the area of a long-distance code a placeholder 9 is used, thus, the long distance codes are optional. In addition, the exclamation mark (!) causes the mask to be filled from left to right.

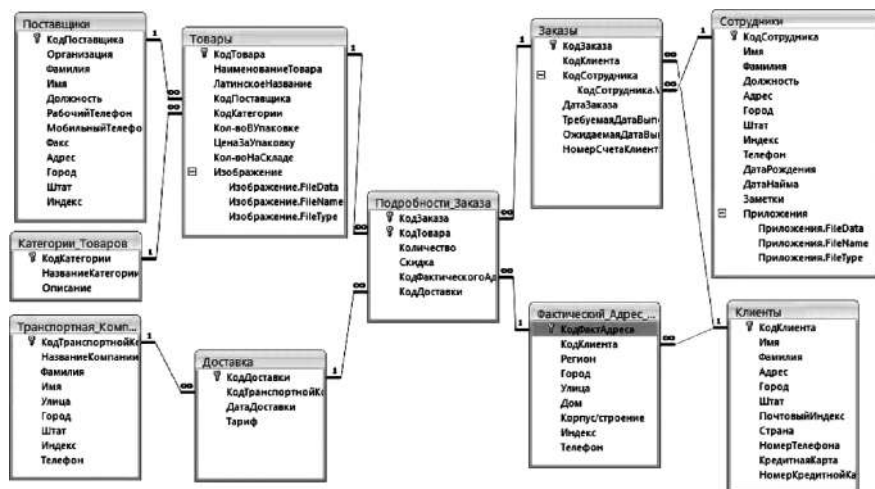
(OOO)AAA-AAAA	(206) 555-TELE	It is possible to replace the last four digits of the phone number with letters in the US format. Note the placeholder 0 in the area code area, which makes a long distance code mandatory.
#999	-20 2000	Any positive or negative number that includes no more than four characters and has no separators of thousands and fractional parts.
>L???L?000L0	GREEN 3M 9M3 MAY P 452B7	Combination of mandatory (L) and optional (?) Letters and mandatory digits (0). The sign «more» requires you to enter all the letters in uppercase. To use an input mask of this type, you must set the data type of the table field to Text or MEMO.
00000-9999	98115-98115-3007	Required a zip code and optional four-digit extension field.
>L<????????????	Maria Vadim	First or last name, the first letter of which is automatically entered in the uppercase.
ISBN 0-&&&&&&&&-0	ISBN 1-55615-507-7	The account number of the book with a text constant, mandatory first and last digits and an arbitrary combination of letters and characters between them.
>LL00000-0000	БД51392-0493	A combination of mandatory letters and numbers, all in the upper register. This type of input mask helps, for example, to correctly enter inventory numbers or to fill out other forms of inventory accounting.

## Symbols Used to Create Mask

Symbol	Description
0	The number (from 0 to 9, the input is required). Symbols plus (+) and minus (-) are not allowed.
9	A number or a space. Input is optional, plus (+) and minus (-) symbols are not allowed.
#	Enter a number, a space or a plus or minus sign in this position. If the user skips this position, a space is inserted.
L	Letter. In this position, you must enter one letter.
?	Letter. In this position, you can enter one letter, but not necessarily.
A	Letter or number. In this position, you must enter one letter or number.
a	Letter or number. In this position, you can enter one letter or number, but not necessarily.
&	Any sign or space. In this position it is necessary to enter a sign or a space.
C	Any sign or space. You can enter a character or a space in this position, but not necessarily.
	Separator of integer and fractional part, groups of digits, date and time values. The selectable character depends on the regional settings of Windows.
>	All subsequent characters are displayed in uppercase.
<	All subsequent characters are displayed in lowercase.
!	The input mask is filled from left to right, and not from right to left.
\	Specifies the input of any next character as a text constant. Used to display all the characters listed in this table as text constants (for example, \ A is output as an "A" character).
Password	In the table or form designer mode, you can set the <b>InputMask</b> property to <b>Password</b> ; This creates a password entry field. When the user enters the password in this field, the entered characters are saved, but the asterisks (*) are displayed instead.

## Annex 3

### Data schema



## Laboratory Work № 6

### IP Address

**Work Objective:** Learn about IP components.

**Equipment:** PC.

#### *IP Address*

The IP address determines a location of the node on the network, just as a home address indicates its location in the city. Like a regular address, an IP address must be unique.

Each IP address consists of two parts – *a network ID* (network ID) and *a host ID* (host ID). The first determines a physical network. It is the same for all nodes in the same network and is unique for each of the networks included in the joint network.

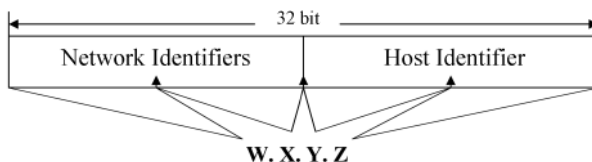
The host identifier corresponds to a particular workstation, server, router, or other TCP / IP node in the network. It must have a unique value in this network. Each TCP / IP host is uniquely identified by its logical IP address. This unique address is necessary for all network components that communicate over TCP / IP.

#### *Identifiers of Networks and Hosts*

An IP address can be written in two formats - binary (binary) and decimal (dotted decimal). Each IP address has a length of 32 bits and consists of four 8-bit fields, called octets, which are separated from each other by dots. Each octet represents a decimal number in the range from 0 to 255. These 32 bits of the IP address contain the network and host identifier.

The format of the address record in the form of four decimal numbers, separated by dots, is most convenient for perception. The following are various forms of IP address recording.

Binary Format	Dotted Decimal Format
10000011 01101011 00000011 00011000	131.107.3.24

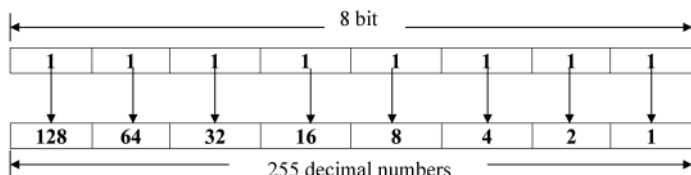


Example: **131.107.3.24**

### ***Converting an IP Address from Binary to Decimal***

In binary format, each bit in the octet is associated with a specific decimal number. The maximum decimal value of an octet is 255 (every bit participates). Each octet is converted to a number separate from the others.

A bit set to 0 always corresponds to a zero value. The bit set to 1 can be converted to a decimal number. The lowest octet bit represents the decimal number 1 and the highest bit is 128. The maximum value of the octet (255) is reached when each bit is equal to 1.



The following table shows how the bits of one octet are converted to a decimal number.

Binary Record	Bit Value	Decimal Number
00000000	0	0
00000001	1	1
00000011	1+2	3
00000111	1+2+4	7
00001111	1+2+4+8	15
00011111	1+2+4+8+16	31
00111111	1+2+4+8+16+32	63
01111111	1+2+4+8+16+32+64	127
11111111	1+2+4+8+16+32+64+128	255

### ***Classes of IP-addresses***

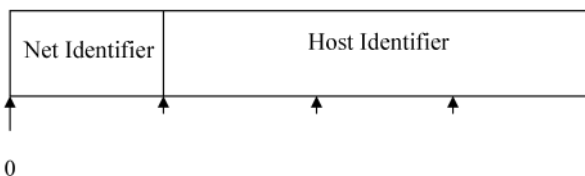
Each class of IP addresses determines which part of the address is assigned to the network identifier, and which is the host ID.

The TCP/ IP protocol supports class A, B, and C addresses. The address class determines which bits are related to the network identifier, and which to the host ID. Also, it determines the maximum possible number of nodes in the network.

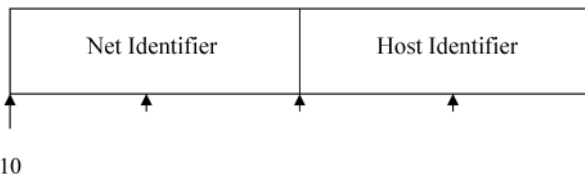
The class of IP addresses is identified by the value of its first octet, 32-bit IP addresses can be assigned to a common set 3720314628 nodes. Below you can see how fields in IP addresses of different classes are defined.

Class	IP Address	Net Identifier	Host Identifier
A	w.x.y.z	w	x.y.z
B	w.x.y.z	w.x	y.z
C	w.x.y.z	w.x.y	z

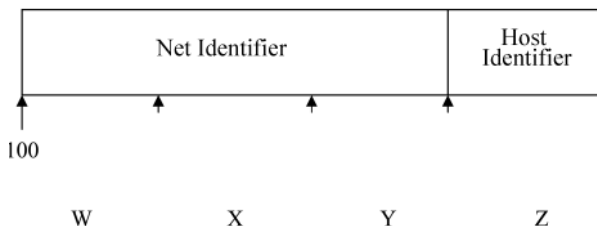
#### Class A



#### Class B



#### Class C



#### Class A

Addresses are assigned to very large network nodes. The highest bit in the addresses of this class is always zero. The next seven bits of the first octet is represented by the network identifier. The remaining 24 bits (three



octets) contain the host ID. This makes it possible to have 126 networks with a number of hosts up to 17 million in each.

### **Class B**

Class B addresses are assigned to hosts in large and medium-sized networks. The binary value of 10 is recorded in the two high-order bits of the class B IP address. The next 14 bits contain the network identifier (the first two octets). The remaining 16 bits (two octets) represent the host identifier. Thus, there are 16,384 of the Class B networks, of which about 65,000 are hosts.

### **Class C**

Addresses of class C are used in small networks. The three most significant bits of the IP addresses of this class contain a binary value of 110. The next 21 bits constitute the network identifier (the first three octets). The remaining 8 bits (last octet) is assigned to the node identifier. A total of about 2,000,000 class C networks are available, containing up to 254 hosts.

	<b>Number of Networks</b>	<b>Number of Hosts in the Network</b>	<b>Range of network identifiers</b>
Class A	126	16777214	1-126
Class B	16384	65534	128-191
Class C	2097152	254	192-223

### ***IP Addresses and Subnet Mask***

A subnet mask is a 32-bit value used to allocate its parts from the IP address: the network IDs and the host IDs. Such a procedure is necessary when determining whether an IP address refers to a local or remote network.

Each TCP / IP host must have a subnet mask – either set by default (in case the network is not divided into subnets), or a special one (if the network is broken up into subnets).

### **Default Subnet Mask**

The default subnet mask is used if the TCP / IP network is not divided into subnets. Even in a network consisting of one segment, all TCP / IP nodes need a subnet mask. The default subnet mask depends on the IP address class used in the network.

In the subnet mask, the bits corresponding to the network ID are set to 1. Thus, the value of each octet will be equal to 255. All bits corresponding to the node identifier are set to 0.

Address Class	Bits Used For The Subnet Mask	Decimal Point Entry
Class A	11111111 00000000 00000000 00000000	255.0.0.0
Class B	11111111 11111111 00000000 00000000	255.255.0.0
Class C	11111111 11111111 11111111 00000000	255.255.255.0

Example of Class B			
IP Address	131.107.	16.200	
Subnet Mask	255.255.	0.0	
Network Identifier	131.107.	y.z	
Host Identifier	w.x.	16.200	

### Determination of the Destination Address of a Package

The IP protocol uses the logical «AND» operation to determine which host the packet is destined for - located on a local or remote network. The IP address of the host is added to its subnet mask using the logical AND. Before sending each IP packet, the destination IP address also adds up with the same subnet mask. If the results of the two above operations coincide, this means that the receiver of the packet is on the local network. Otherwise, the packet is sent to the IP address of the router.

In order to perform a logical AND operation, TCP / IP compares the corresponding address and mask bits in pairs. If both bits are 1, the result is 1. In other cases, the resulting bit is 0.

Bit Determination	Result
1 “AND” 1	1
1 “AND” 0	0
0 “AND” 0	0
0 “AND” 1	0

IP Address Subnet Mast	10011111 11100000 00000111 10000001 11111111 11111111 00000000 00000000
Result	10011111 11100000 00000000 00000000

### Exercise 1

1. Specify the class of the following IP addresses

Address	Class
131.107.2.89	?
3.3.57.0	?
200.200.5.2	?
191.107.2.10	?

2. In which classes of IP addresses are more than 1000 hosts?

-----

3. In the networks of which classes of IP-addresses only 254 hosts?

-----

### Exercise 2

Perform a logical operation “AND” with the IP addresses listed below and the subnet mask and determine whether the IP address belongs to a recipient to a local or remote network.

Source IP address	10011001 10101010 00100101 10100011
Subnet mask	11111111 11111111 00000000 00000000

The result	?
IP-address of the recipient	11011001 10101010 10101100 11101001
Subnet mask	11111111 11111111 00000000 00000000
The result	?

1. Is the result the same?
2. Does the IP address of the recipient belong to a local or remote network?

## Laboratory Work № 7

### 1. Create a Simple HTML Document. Formatting Fonts and Paragraphs

**Work Objective:** To learn how to create a simple hypertext document using the Notepad text editor. Learn how to use font and paragraph formatting tags.

**Equipment:** PC, text editor Notepad, browser.

#### Exercise for Execution

1. Create a file with a hypertext document:
  - Launch **Notepad** Editor, enter text:
  - **Welcome to my first web-page!**
  - **Save the file** in the created folder. When saving, in the window dialog **Save As ...** in the line **File Type**: select the option **All files (\*.\*)**, and in the **File name** line specify a name with the extension. **Htm**, for example **1\_name.htm** (where **name** is your name).
    - Close the document, find its icon in the **My Computer** window or in the **Explorer** window.
    - Open file. Analyze with *which application* the file is displayed and how the entered phrase looks.
2. Enter the tags that define the structure of the html document:
  - Use the shortcut menu to open the file using the Notepad editor. Enter the following tags in the header section Document (between tags **<TITLE>** **</TITLE>**) specify your surname.
    - **<HTML>**
      - o **<HEAD> <TITLE> Фамилия </TITLE>**
      - o **</HEAD>**
      - o **<BODY>**
    - **Welcome to my first web-page!**
      - o **</BODY>**
    - **</HTML>**
  - **Save** the document with the same name, update its display in the browser (execute **View / Refresh** or press the button **Refresh** in the toolbar). Analyze the changes that occurred in the display of the document.
3. Edit the document:
  - Start the browser menu **View / View HTML code** and add a Signature text after the text «**Welcome to my first web-page!**».

## Student of the group NNN Last name First name

Save the document (but not close) and update it in the browser.

– Using a single **<BR>** tag, edit the document in such a way, that the caption starts with a new line, and the last name is in the next line. View the new version in the browser.

***Attention! After each change, the document needs to be saved, and browser browsing starts with updating the document download using the «Refresh» button on the toolbar.***

4. Fill out the text with the help of the Headings styles:

– The first line of the document is to style the **Heading** of the 1st level with the pair tag **<H1> ... </ H1>**. The second line is drawn as a **Heading of the 6th level**, and the third as the **Heading of the 4th level**.

– View the document in the browser by changing the font display setting (**View menu / Font size / Largest, Medium, Small and Smallest**).

– Change the style of the first line to **Level 2 Heading**, the second line to **Level 5 Header**, the last line to **Level 3 Heading**.

5. Perform font formatting:

– After the line **Surname Name** add one more line of text

– Make a phrase according to the sample below.

– **Нас утро встречает прохладой**

In the word MORNING, all letters must have different colors. In the word COOL, draw the letters CO – in red, OL – blue.

– Make a line with the signature (**Student of the group NNN Surname Name**) in italics, the font size should be set with a relative change. Use the **<FONT SIZE = «+ 2»>** and **<I>**

- View the received document in the browser.

6. Perform paragraph formatting:

– Create a new document 2\_name.htm, save it in the same working folder.

– Enter the text (use the copying of text from the document 1\_name.htm):

**<HTML>**

**<HEAD> <TITLE> Surname </TITLE>**

</HEAD>

<BODY>

Welcome to my second web-page! <BR> The Monologue of Hamlet

</BODY>

</HTML>

- Align the text to **the center**.

- Enter text:

*To be or not to be is the question: that is the question: Whether 'tis nobler in the mind to suffer The slings and arrows of outrageous fortune, Or to take arms against a sea of troubles, And by opposing end them?*

- Make the paragraph justified by its **width**.

- Restrict a paragraph to horizontal dividing lines above and below using the <HR> tag.

- Copy the monologue and break it into paragraphs. Align to Center.

*To be or not to be is the question: that is the question:  
Whether 'tis nobler in the mind to suffer  
The slings and arrows of outrageous fortune,  
Or to take arms against a sea of troubles,  
And by opposing end them?*

- Save the document.

- View the document in the browser window by resizing the window.

#### 7. Complete the list:

- Create a new document 3\_name.htm, save it in the same working folder of the hard disk.

- Enter text:

<HTML>

<HEAD> <TITLE> Фамилия </TITLE>

</HEAD>

<BODY>

Welcome to my third web-page!

</BODY>

</HTML>

- Supplement the text of the document (between the tags <BODY> ... </ BODY>)

**With the following text: I know how to draw up:**

**Headings**

## Fonts

### Paragraphs

– Draw the last three lines as a numbered list. To do this, use the following tag design:

`<OL>`

`<LI> Fonts, </LI>`

`<LI> Headers, </LI>`

`<LI> Paragraphs </LI>`

`</OL>`

– Change the design of the list to the bulleted list. Use the tags `<UL>`, `</UL>`

– Create a «mixed» list:

### I know how to make out:

#### 1. Fonts

- The size
- Colour
- Headset
- Indices

#### 2. Headshot

- From 1st to 6th level

#### 3.Paragraphs

- Alignment
- Break lines within a paragraph
- Using reformatting.

8. Present the results of the work to the teacher.

Table of the Main Tags of the HTML Document.  
Font and Paragraph Formatting Tags

Purpose	Tag Form	Comments
<b>General Structure of the HTML Document</b>		
Document type	<code>&lt;HTML&gt;&lt;/HTML&gt;</code>	The beginning and the end of the document
Document name	<code>&lt;HEAD&gt;&lt;/HEAD&gt;</code>	Not displayed by the browser
Title	<code>&lt;TITLE&gt;&lt;/TITLE&gt;</code>	The contents of the title bar of the browser window
Body of the document	<code>&lt;BODY&gt;&lt;/BODY&gt;</code>	Contents of the WEB-page



Structure of the Document Body		
Internal headings of different levels	<H№> text </H№>	Where No. is the title level number (1 to 6). For example, <H1> ... </H1> is a heading of the 1st level.
Heading with alignment	<H№ ALIGN="LEFT CENTER RIGHT"> текст </H№>	LEFT – left, CENTER – center, RIGHT – on the right
Paragraph Formatting		
Creating a paragraph (paragraph)	<P> text </P>	Paragraphs are separated by a double-line spacing
Translation of a line inside a paragraph	 	Single tag
Paragraph alignment	<P ALIGN="LEFT"> text </P> <P ALIGN="CENTER"> text </P> <P ALIGN="RIGHT"> text </P> <P ALIGN="JUSTIFY"> text </P>	LEFT – left, CENTER – center, RIGHT – on the right, JUSTIFY – width
Separating horizontal line between paragraphs	<HR SIZE="?">	A single tag. «?» Is the line thickness in pixels. The thickness of the line can be omitted
Font Formatting		
Bold	<B> text </B>	<B> <b>Bold</b> </B>
Italic	<I> text </I>	<I> <i>Italic</i> </I>
Underlined	<U> text </U>	<U> <u>Underlined</u> </U>
Strikethrough	<S> text </S>	<S> <del>Strikethrough</del> </S>
Increased size	<BIG> text </BIG>	
Reduced size	<SMALL> text </SMALL>	
Superscript	<SUP> text </SUP>	<SUP> Upper Index </SUP>
Lower index	<SUB> text </SUB>	<SUB> Lower index </SUB>

Font size	<FONT SIZE=«?»> text </FONT>	? – values from 1 to 7 or relative change (for example, +2)
Basic font size	<BASEFONT SIZE=«?»>	Single tag ?– size from 1 to 7; The default is 3 and is set for the entire document as a whole
Font Headset	<FONT FASE=«title1, title2, ...»> text </FONT>	The text is made out first, installed on the computer by a font from the list of names
Font color	<FONT COLOR=»\$\$\$\$\$»> текст</FONT>	The color is specified either by a keyword or by a hexadecimal code with a # RED – red, # FF0000 – Hex code – of the red color
<b>Making a List</b>		
Numbered	<OL> list items </OL>	<OL> <LI> List item 1 </LI> <LI> List item 2</LI> <LI> List item 3</LI> </OL>
Marked	<UL> list items </UL>	
List items	<LI> list items </LI>	

Table of Main Colors

Color	Color Name	Color Hex Code		
		Red	Green	Blue
Black	black	00	00	00
Navy	navy	00	00	80
Blue	blue	00	00	FF
Green	green	00	80	00
Dark green	teal	00	80	80
Salad	lime	00	FF	00
Pale blue	aqua	00	FF	FF
Cherry	maroon	80	00	00
Purple	purple	80	00	80
Olive	olive	80	80	00
Gray	gray	80	80	80

Light gray	silver	C0	C0	C0
Red	red	FF	00	00
Fuchsia	fuchsia	FF	00	FF
Yellow	yellow	FF	FF	00
White	white	FF	FF	FF

## 2. Pasting in the HTML Document Drawings. Creating Bookmarks and Hyperlinks

**Objective of the Work:** Learn how to fill in the T-bets in the HTML-document. Learn how to create bookmarks and hyperlinks.

1. Copy from the Internet or any folder in your personal folder files three graphic files (for example, **Arrows1.wmf**, **Arrows2.wmf**, **Arrows3.wmf**).

Make sure that documents created earlier are **1\_name.htm**, **2\_name.htm** and **3\_name.htm** are also in your folder on the hard drive.

### 2. Inserting pictures into a document

- Open the Notepad document **2\_name.htm**.

- Insert the **Arrows1.wmf** drawing at the beginning of the document **2\_name.htm**.

To insert, use the **IMG** tag with the **WIDTH** and **HEIGHT** parameters to set the drawing size to 50 pixels horizontally and vertically.

- Save the document as **4\_name.htm**.

- View the result in the browser.

- Enter the **ALIGN** parameter in the pattern tag to align the picture to the right. View the result in the browser.

- Insert the **Arrows2.wmf** drawing at the end of the document **4\_name.htm** before, choose the alignment type of the drawing at your discretion. Mouth-draw the size of the image to 100 pixels horizontally and vertically. Use the **ALT** parameter to create a tooltip «**Figure 2**» that appears when you hover the mouse over the picture.

- View the result in the browser.

### 3. Creating hyperlinks and bookmarks

- In the document **3\_name.htm**, assign hyperlinks to the following list items:

- For the word **Font**, a hyperlink to the document **1\_name.htm**.

- For the word **Headers** – to document **1\_name.htm**.
- The word «**Paragraphs**» is for the document **2\_name.htm**.
- Create a bookmark in the document **1\_name.htm** before the phrase «**We are met with a cool morning**». Give it the name «**Morning**».
- Edit the first hyperlink (word **Font**) so that it points to the «**Morning**» tab in the document **1\_name.htm**.
- Create a bookmark at the beginning of the current document **3\_name.htm**.
- Give it the name «**Hello**».
- Change the second hyperlink (on the word **Headers**), defining for it the transition to the beginning of the current document on the bookmark «**Hello**».
- Create a bookmark in the document **2\_name.htm** before the monologue fragment. Give her the name «**Mono**».
- Set the hypertext link to the «**Mono**» tab to the word reformatting.
- Check that all hyperlinks are correct.
- 4. To fix hyperlinks for graphic files:
  - Edit the insertion tag for the **Arrows1.wmf** image, type in Tag attribute **ALT** to display the text prompt «**Return**». See in the browser how the pattern reacts to the hovering of the mouse.
  - Attach a hyperlink in the document **3\_name.htm** to the **Arrows1.wmf** drawing of the document **4\_name.htm**. Navigate between documents.
- 5. Present the result to the teacher.

### Main Tags for Inserting Pictures, Bookmarks and Hyperlinks

Insert Images		
Inserting a graphic file	<IMG SRC = "file" WIDTH = "width" HEIGHT = "height">	Example: <IMG SRC = "grafica.gif" WIDTH = "550" HEIGHT = "240" ALIGN = "right" ALT = "Graphic File">
Aligning a picture with text	<IMG SRC = "file" ALIGN = "Left   right   top   bottom">	
Displays the text of the tooltip when you move the mouse cursor over the drawing	<IMG SRC = "file" ALT = "text">	

Inserting Hyperlinks		
Links to another page	<A HREF="page"> Text </A>	<A HREF="str2.htm"> Link1 </A>
Link to a bookmark in another document	<A HREF = "page # Bookmark name"> text </A>	<A HREF="index.htm # metl"> Home page </A>»
Link to a bookmark in the same document	<A HREF="# name Bookmark"> text </A>	<A HREF="metkal"> Link2 </A>
Define Bookmark	<A NAME="name Bookmark"> text </A>	<A NAME="metkal">< /A>
Font, Text, Hyperlink Color		
Background picture	<BODY BACKGROUND="picture file">	<BODY BACKGROUND ="grafica.gif" TEXT="black" (black) LINK="#FF0000" (red) VLINK="#FFFF00" (yellow) ALINK="#FFFFFF" (белый) </BODY>
Background color	<BODY BGCOLOR="#\$\$\$\$\$">	
Text color	<BODY TEXT="#\$\$\$\$\$">	
Link Color	<BODY LINK="#\$\$\$\$\$">	
Color of the used link	<BODY VLINK="#\$\$\$\$\$">	
Color of the active link	<BODY ALINK="#\$\$\$\$\$">	

### 3. Creating and Formatting Tables

**Work Objective:** To learn how to use tables to design WEB-pages.

1. Create a table according to the sample, save the document as **tabl\_name.htm**. Over the top of the table, place the heading **Table # 1**.

When displaying the table in a browser, the following conditions must be met:

- the table should be aligned in the center and be a regular (symmetrical) form;

– in the central cell put the symbol \* (asterisk), the remaining cells must be empty.

	*	

**Note.** To display empty cells, put a whitespace primitive character & *nbsp* in them.

2. In the same document, create a copy of Table 1, enter the title of Table No. 2 and modify it:

- In the central cell, place a drawing **Arrows3.wmf**
- «Color» all the other cells in different colors.

3. Create another copy of the table - Table # 3 and edit the table tags so that it matches the sample below.

**Note.** To combine cells in `<TD>` tags, you must use the *colspan* = and *rowspan* =

4. Create a new HTML document – **rasp\_name.htm** with a class schedule.

- The document must begin with a title

### **Training Schedule Gr. NNN for the Spring Semester of 2017**

- The first line of the table should be formatted as field headers (using `<TH>` tags).
- The width table should occupy the full size of the window.

The width of individual columns should be set in relative units (in%), so that when the width of the window changes, the proportions of the table are preserved.

Week Day	Time	Subject	Teacher	Hall Number
Monday	08:00-08:50	Mathematics (Lec)	Prof. Sadvakasov E.T.	301
	08:55-09:45	Mathematics (practice)	Rector Sadykova C.K.	302
	09:55-10:45	Physics (Lec)	Prof. Sidorov O.I.	307
Tuesday	08:00-08:50	TV and MS (Lec)	Prof. Ashirov O.A.	310
	08:55-09:45	TV and MC (Sem)	Lecturer Popov M.A.	302
	09:55-10:45	Physics (Lab)	Senior Lecturer Mamonova E.P.	307
...	...	...	...	...

– View the created document in the browser with different window sizes and different font size settings.

5. Save the file with the schedule as **rasp\_menu\_name.htm** and modify it.

6. After the header, create a table consisting of one line manure with the names of the days of the week.

### Schedule

Monday	Tuesday	Wed	Thu	Friday	Saturday
--------	---------	-----	-----	--------	----------

7. In the table with the schedule, set bookmarks for the days of the week.

8. In the menu table, create hyperlinks for the corresponding days of the week.

9. Perform the color design of each menu cell.

10. Check the correctness of the hyperlink navigation.

11. Create a group of web pages, united menus:

– On the operating disk, create a folder My\_TimeTable to place the schedule files.

– Set the schedule for each day of the week and the table from the menu to separate files. File names: **menu.htm** – for the main page, the names of the days of the week are for the rest. Place all documents in the My\_TimeTable folder.

– Edit hyperlinks of the menu so that you can move to the corresponding document using them.

– At the end of each file with a schedule for the day, arrange a hyperlink to return to the main document from the menu.

– Draw the background of each day of the week with its own color, which coincides with the color of the cell in the menu table.

12. Present the result to the teacher.

### Tags for Tables

Define the table	<TABLE></TABLE>	Example: <TABLE border="1" align="center" width="50%" > <TR> <TH >Product</TH> <TH>Price</TH> </TR> <TR> <TD>Radiotelephone</TD> <TD>2000 </TD> </TR> </TABLE> <table><tr><td>Product</td><td>Price</td></tr><tr><td>Radio telephone</td><td>2000</td></tr></table>	Product	Price	Radio telephone	2000
Product	Price					
Radio telephone	2000					
Edge of the table	<TABLE BORDER="?"></TABLE>					
The row of the table	<TR> </TR>					
Alignment	<TR ALIGN=left   right   center   middle   bottom >					
Table cell	<TD></TD>					
Horizontal Alignment	<TD ALIGN=LEFT   RIGHT   CENTER>					



Vertical alignment	<TD VALIGN = TOP MIDDLE  BOTTOM>	
Set cell width (in pixels or %)	<TD WIDTH=«?»>	
Color Fill Cell	<TD BGCOLOR = «# цвет»> </TD>	<TD BGCOLOR = «#FF0000»> </TD> red color
Column or row header	<TH>текст </TH>	The text is centered in the cell, the bold type is set

## Laboratory Work № 8

### Email

**Work Objective:** To learn how to create an e-mail box, work with messages, create an address book.

**Equipment:** personal computer, Internet browser.

#### Theoretical Information

**E-mail** is one of the most common and popular functions of computer networks, providing messaging between network users.

The procedure for using e-mail is similar to ordinary mail in many respects. The role of post offices is played by Internet nodes, where special postal boxes are located. By e-mail, you can send not only text messages, but also finished files created in any other programs.

When sending messages by e-mail, you must specify the recipient's address on the Internet.

You can work with e-mail using a mail program (mail client) installed on a user's computer or using a browser using the web interface.

**Mail program** (e-mail client, e-mail client) is software installed on a user's computer for receiving, writing, sending, storing and processing user e-mail messages (for example, Microsoft Outlook Express, The Bat!, Netscape Messenger, Mozilla).

The e-mail forwarding system still needs a mail server (e-mail server). **A mail server** is a computer program that transmits messages from one computer to another. Mail servers work on Internet hub computers, and each e-mail user must have email clients.

There are a large number of WWW servers that offer a free mailbox and allow you to work with mail using only the browser. To get a free mailbox on such a server, you need to register. To do this, you need to fill in several required fields – enter your login, password, age, gender, etc. In case of successful registration, a free e-mail address will be assigned to you.

**Spam** is distribution of commercial, political and other advertisements or other types of messages to persons who did not express a desire to receive them. Try not to send one letter at once to a large number of people, as many may perceive this letter as spam (unwanted correspondence).

**Spammer** is a user who sends spam on the Internet, local networks, cellular communication systems, and another.



## Exercise 1

### Registration on the free mail server.

Register on one of the free servers:

Www.yandex.ru, www.mail.ru, www.nm.ru, www.rambler.ru, www.ok.ru, www.pochta.ru.

#### *The order of implementation*

1. Start the Internet browser **Internet Explorer** or **Opera** using the icon on the **desktop**.
2. In the address bar of the browser, enter the address of the site (for example, www.yandex.ru).
3. Click the **Mail – Register** or **Start Mailbox link**.
4. Complete the registration form.

**Note.** *Remember, that with the introduction of **your name and surname** you will be automatically offered free logins, you can choose or come up with your own, which will be tested by the mail server, whether it is occupied by another user.*

– ***Login, Password and Confirmation of the password fields must be filled in Latin letters, and the password must contain at least 4 symbols;***

– *Required fields are marked with asterisks.*

5. Confirm the data by clicking the **Register** button.
6. After successful registration, your personal address appears.
7. Confirm by clicking the **Save** button.

## Exercise 2

**Learning the basic capabilities and elements of the Web-mail interface.**

#### *Execution order*

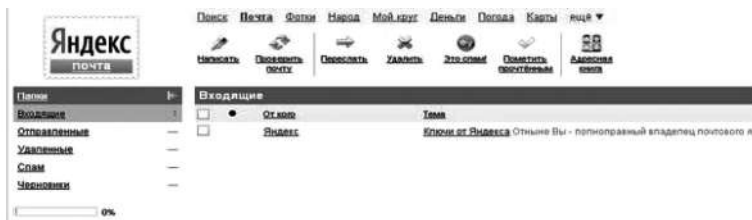
Open your new mailbox on the free mail server and learn the basic elements of the interface.



Логин:

Пароль:  Забыли пароль?

The interface of your mailbox looks like this:



### Note:

- **Inbox folder** contains all the correspondence that has arrived to you (to your mailbox).
- **Sent folder** contains all correspondence sent to other addresses on the Internet.
- **Mailing list** contains letters that were sent simultaneously to a large number of users.
- **Deleted Items folder** stores deleted messages from any other folder.
- **Drafts folder** stores not sent messages.

### Exercise 3

#### Work with e-mail messages.

##### Execution Order

1. Create a message with the subject «**Name**»:
  - Click on the write button;
  - Fill in the headers of the message: To, Cc, Theme as follows: In the **To** header, specify the address of the teacher, **Copy** is the neighbor's address on the right. For the **Topic**, specify «**Name**»;
  - Write your name, first name, patronymic, group number in the message text.
2. Send the message using the **Send** button.
3. Navigate to the Inbox. You should receive a message from the neighbor on the left. In order to read the received message, it is necessary to click on the link in the **From** field.
4. In the window that appears, click the **Reply** button. Write a reply to this email and click the **Send** button.
5. Create a new message and **attach a text file** to it:
  - Create a **Microsoft Word** document on the desktop with the right-click of the mouse, name it «Invitation», type the text of the invitation to the birthday, close the file, save;
  - Go back to your email account;

- Click the **Create** button.
- Fill the headers of the message: **To, Cc, Subject** as follows: in the header **To**, show the neighbor's address on the right. In the Subject, specify «Invitation»;
- Click on the **Browse** button, locate the file (**Desktop**);
- Write the text of the message.
- 6. Send the message by clicking on the appropriate button.
- 7. Create a new message and **attach a graphic file**:
  - Prepare the file for sending. To make a light file, let's compress it:
    - o Open **My Computer \ D: \ Laboratory \ Drawings**
    - o Right-click on the selected image.
    - o In the drop-down menu, select «Open with» – «Microsoft Office Picture Manager».
    - o In the program, click on «Edit pictures ...»
    - o The «Modify Pictures» panel appears on the right
    - o Select «Compress Drawings»
    - o In the «Compression parameters» we select one of the items:
    - o Then click the «OK» button.
    - o Save the compressed image to the desktop («File» -> «Save as ...»)
  - Go back to your email account;
  - Fill the headers of the message: **To, Cc, Subject** as follows: in the header **To**, show the neighbor's address on the right. For the **Subject**, select «Drawing»;
  - Click on the **Browse** button, locate the file (**Desktop**);
  - Write the text of the message.
- 8. Send a message by clicking on the appropriate button.
- 9. Switch to the **Inbox**. In the message list, find an email with the subject «**Invitation**» sent by the neighbor on the left. An icon in the form of a paper clip indicates the presence of an enclosed attachment in the received letter. Save the attached file to drive D: \
  - Open the received message;
  - Click on the icon of the attached file with the left mouse button;
  - In the appeared window click the Save button;
  - Specify the save path D: \
- 10. Send the message with the subject «**Invitation**» to the teacher:
  - Open the desired message and click the **Forward** button;
  - Fill in the To field, enter the teacher's e-mail address and send a message.

## Exercise 4

### Filling of the Address Book.

Enter new subscribers in the Address Book.

#### *Execution order*

1. Fill the **Address Book** using the menu item **Service – Address Book** or the corresponding button on the toolbar.
2. In the **Address Book**, enter the teacher, the neighbor on the right and left. To do this, execute the command **File – New Contact** (or left-click on the **New** button and select the menu item **Create Contact**). Carefully study the tabs presented in this dialog box. Pay attention to the fact that it has the means to enter both personal and business information (for practical purposes, as a rule, it is enough to fill only a few fields on the Name tab).
3. Begin filling in the fields in the **Name** tab from the **Name field in the book**. Enter a record that you would like to see in the contact list, for example Omarov S.T.;
4. Fill in the **Last Name** (Omarov), **First Name** (Serik) **Patronymic** (Timurovich);
5. In the **E-mail Addresses** field, enter its e-mail address.
6. Enter the entered data in the **Address Book** by clicking on the **Add** button.

**Note.** *If you need to change the entries, right-click on the entry, select **Properties** from the shortcut menu, and go to the **Name** tab.*

## Laboratory work № 9

### PowerPoint Application

**Work Objective:** to develop skills in the PowerPoint program to create spectacular, professionally designed presentations.

**Hardware:** PC, Microsoft PowerPoint 2010 software.

#### Brief Theoretical Information

The PowerPoint application is included in all editions of Microsoft Office 2010: for home and school, for home and business, in the professional version. The PowerPoint capabilities are quite extensive - it is the creation of presentations of any purpose and any professional orientation (business, scientific, educational, advertising, personal, etc.), developing demonstrations for screening or recording on an optical disk, creation of prospectuses and printed materials.

The created presentation can be saved in various formats. The main types of MS PowerPoint files used to save a presentation are:

- 1) PowerPoint presentation. The created file is saved by default with the extension \*.pptx.
- 2) Presentation of PowerPoint 97-2003. \*.ppt extension.
- 3) Presentation which can be opened in previous versions of the program. PowerPoint presentation with support for macros. Expanded \*.pptm. and others.

#### 1. Creating a Presentation

Launch Microsoft PowerPoint 2010.

1. In the program window execute – the menu «File» => the item «Create».
2. From the Patterns section, select the **Training** template and click **New** (right)
3. View the slides that were added to the presentation after selecting the template.
4. Note that the template can contain not only the design of the slides, but also the animation effects. To learn it, turn on **Animation – Animation area** on the tape and, going over the slides, find those of them the objects of which have the animation effects applied.
5. The template can also contain transitions between slides. Activate the

**Transitions** ribbon and select the Sort slide view. Near the slides containing the transitions, you will see the icon .

6. If you have an Internet connection, you can use the Office.com site template

7. Save the generated presentation as Learning.pptx

8. Create three more presentations based on the templates:

- Select the «Calendars» category and create one calendar from the suggested templates.

- Select the «Classes Schedule» category and create one class schedule from the suggested templates.

- Select the category «Certificates» and create one certificate from the proposed templates.

9. Save the results – the «File» menu => the «Save» item.



Figure 1. Microsoft PowerPoint 2010

10. Complete the three generated presentations using the following methods:

- the menu «Design» => «Themes». Assigns a theme to the entire presentation.

- the menu «Design» => «Colors». Assigns a color scheme to the entire presentation.

- the menu «Design» => «Fonts». Assigns a font layout to the entire presentation.

- contextual menu on the background of the slide (but not on objects, namely, against the background of the slide) => item «Background Format» => «Format» dialog box

Background «=>» Fill «tab. Choose one of the options – solid fill, gradient fill, pattern or texture, patterned fill.



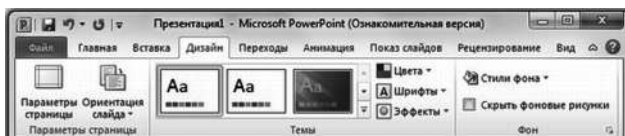


Figure 2. Background Format

## 2. Transformation of the structure into a presentation

Preparation for work

1. Open the **Import structure.docx** file in the MSWord text editor.
2. Format the text using styles by selecting the Heading 1 style for the lines typed in large print, Heading 2 for the rest of the lines
3. Save and close the file.

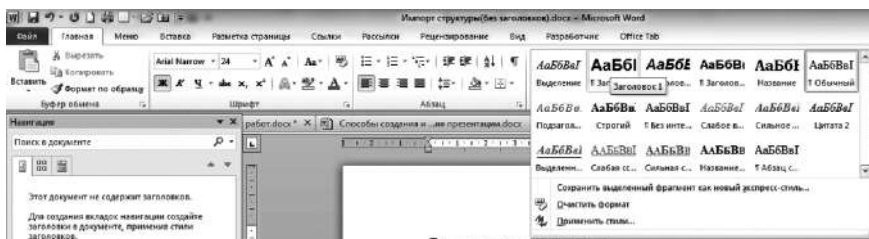


Figure 3. Text Formatting

4. Create a presentation based on the **Austin** theme.
5. From the drop-down list of the button **Create Presentation**, select the option Slides from the structure.

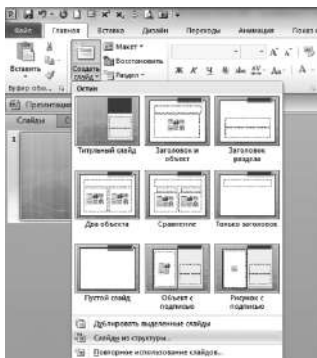


Figure 4. Theme Based Presentation

6. Select the **Import structure** file and click **Paste**.
7. In the resulting presentation delete the empty the title slide, and change the layout of the first slide with the information to Title Slide.
8. Save the presentation in .pptx format as the **Structure**.

### 3. Working with the Presentation Structure

1. Switch to the structure mode.
2. Add a new slide after the Description heading. To do this, place the cursor after the title and press Enter.
3. On the resulting slide, add the heading **Course Program**.
4. Move **Seasonal offers** to a separate slide. To do this, call the context menu on this line and select the **Increase level** command. Add the text to the slide:
  - Discounts
  - Customer search
  - Free certification
5. Attach the slide with the course program to the slide **Description**. To do this, click on the **Course Program** line on the shortcut menu and select the **Lower level** command.

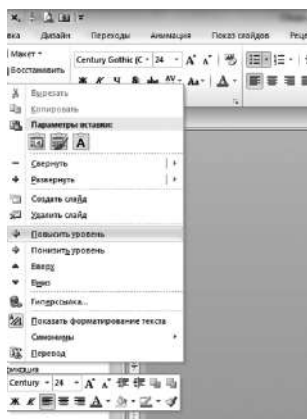


Figure 5. Attaching a Slide

6. Use the **Up** and **Down** commands of the context menu to change the order of the text in the **Seasonal Offers** slide.
7. Type the structure of the presentation. To do this, under **File – Print** in the **Settings** item, select the Structure option. Review, how the presentation printed in the chosen mode will look.

8. Send the structure to Word. To do this, select **File – Save and Send – Create Issue – Create Issue – Mark Only** structure. The MS Word file containing the presentation structure opens. Formatting will be partially preserved

9. If you want to save not only text, but also formatting, save the presentation in the structure mode. To do this, select **File – Save as – RTF structure**.

10. Open the saved structure in Word. Note that not only the source code, but also the formatting has been preserved.

## 4. Creating a Photo Album

1. Create a photo album. In the «Insert» menu, press the «Photo Album» button (bottom of the button), «Create photo album».



Figure 6. Creating a «Photo Album»

2. A new «Photo Album» dialog box appears.

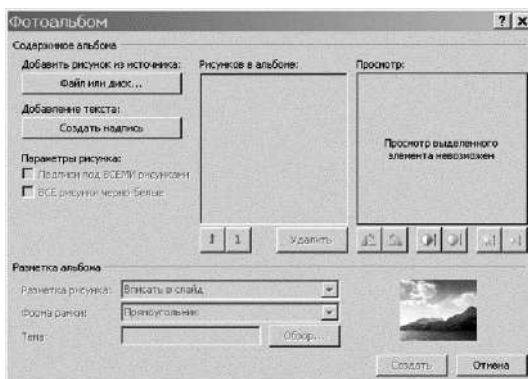


Figure 7. Dialogue Box «Photo Album»

3. Click the **«File or Disk»** button. A new window opens, in which you want to specify the drawing files.

4. After that, the user will be returned to the previous window «Photo Album».

5. Use the buttons to rotate the pictures, change their brightness and contrast.
6. Click the «Create» button to confirm the creation of the photo album.
7. In the photo album creation window, select the location of the photos one by one on the slide and change the order of their photos.
8. The shape of the frame is a rounded rectangle.
9. To create automatic signatures, check the box labeled «Signatures under all drawings».
10. Choose one of the themes.
11. View the resulting photo album. Give it a name.
12. Change the placement of the photos on the slides so that the vertical photos are placed two on the slide.
13. Further editing of the presentation can be done both in the presentation itself and with the function Insert - Photo Album - Edit Photo Album.
14. Save the presentation.

## **5. Saving the Presentation**

1. Open the photo album created earlier.
2. If you want to save the presentation as a slide show, choose **File – Save As – PowerPoint Demo (.ppsx)**. The presentation can only be viewed.
3. Selecting an option **Uneditable** the presentation will be saved as a set of pictures. Slides can be deleted, added, swapped, add transitions, etc., but you can not edit information on them.
4. Saving in **PDF** or **XPS** formats converts the presentation into an uneditable file with the appropriate extension for viewing with the help of special programs.
5. Saving in **JPG** format will turn the presentation into a set of images placed in a folder the name of which coincides with the name of the presentation.
6. You can create a video file based on the presentation using the command **File – Save and Send – Create video**. The result will be a video format WMV (should be aware that the creation of a video file – a long process).

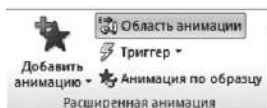
## **6. Work With Sections Of The Presentation.**

1. Open the previously created presentation Training.
2. Switch to the Sort Slide View to see the sections which the presentation is divided into.



## 8. Setting the Animation

1. Open the photo album.
2. Select the slide with the first photo. Select the photo.
3. Go to the «Animation» menu. In the «Advanced Animation» button group, click the «Add Animation» button.
4. Select an effect from the «Input Effects» category by opening the full list of «Advanced Input Effects» effects. After applying the effect - in the upper left corner of the object a ordinal number of the effect appears.
5. Turn the caption into a separate object. Select an effect from the «Selection effects» category to sign.
6. Perform additional effect settings using the **Effect Settings** button.
7. To further customize the animation effects, open the Animation area by clicking the corresponding button on the tab **Animation**.



At the moment the presentation has the following feature - you need to press either the mouse button or the key on the keyboard to trigger the next animation effect. In order for animation effects to work automatically, without user intervention, the following settings must be made:

- for the first object – the menu «Animation» => the field «Beginning» => the item «With the previous one».
- for subsequent objects (but only on this slide) – the menu «Animation» => the field «Beginning» => the item «After the previous one».

The same can be done in the animation area.

As a result, the ordinal number 0 will be indicated in the upper left corner of all objects on the slide.

1. Repeat the sequence of steps shown in points a) and b) on the remaining slides.
2. View and save the photo album.

## 9. Processing Photos

1. Create a presentation of 2 slides.

Markup: The first slide is the title one, the second one is empty.

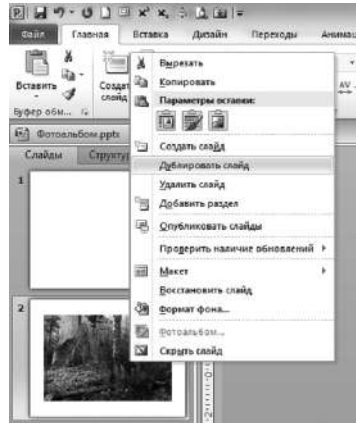


Figure 9. Processing Photos

2. Insert one photo from the **Nature** folder on the second slide.
3. Duplicate the slide 7 times.
4. Apply to the photo on the slides various effects available on the **Format** ribbon in the **Modify** group.
  - 1 slide – Color – blue light contrast
  - 2 slide – Artistic effects – bubble mosaic
  - 3 slide – Artistic effects – pencil sketch
  - 4 slide – Artistic effects – photocopy
  - 5 slide – Artistic effects – color saturation 300%
  - 6 slide – Color – Recolor – Shades of gray
  - 7 slide – Effects for drawing – Smoothing 50 points + glowing
  - 8 slide – Styles for drawings – Oval with blurred edges
5. Review the presentation.
6. Save the presentation as **Effects**.

## 10. Working with SmartArt Objects

### *Inserting a SmartArt object*

Insert a SmartArt object on the slide that reflects the following diagram:

**Scientific idea – Experimental design – Creation of prototype – Small-scale, mass production – Distribution of a new product.**

Choose the most suitable object in your opinion.

### *Creating a SmartArt object based on the list*

1. Open the presentation Working with SmartArt objects

2. Duplicate the list slide twice.
3. Convert the lists on the slide into SmartArt objects and make changes to them:

1 slide – **Target list**

SmartArt Styles – Comics

2 slide – **Vertical corner list**

Effects for Shapes – Relief

3 slide – **Continuous list with pictures**

Insert pictures

Change the form of the elements SmartArt styles:

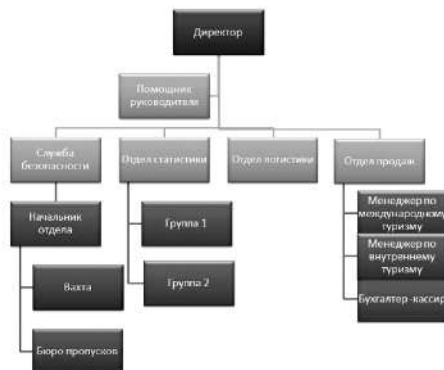
Format – Change shape – Figured arrows – Pentagon

Designer – Change Colors

SmartArt Styles – Deepening

*Insert an organizational chart.*

1. Add an empty slide to the presentation.
2. Paste the SmartArt object on the slide Hierarchy – Organizational chart.
3. Draw the diagram according to the pattern.



*Figure 10. Sample Chart*

## 11. Inserting Wordart Objects, Headers and Footage

1. **Insert WordArt Objects.** Open the presentation that you created in the previous lesson. It is necessary to replace the headers created earlier in the form of plain text into WordArt objects.



2. Your actions:

- Select title => Insert menu => WordArt => select one of the suggested options. The old version of the header can be removed. When you select a WordArt object, the «Format» menu appears.

- Use the buttons from this menu in the group of buttons «WordArt Styles» to change the appearance of the WordArt object:

- A) «Advanced Options» – changes the style of WordArt

- B) «Fill the text» – changes the color of the text

- C) «Text outline» – changes the color of the outline of the text

- D) «Text effects» – adds shadow, reflection, glow and other effects to WordArt objects



Figure 11. Text Effects

3. **Insert Headers and Footers.** Insert menu => Headers and footers => Headers and footers dialog => Slide tab. Check the Checkboxes «Date and time», «Slide number», «Footer» (enter the text of the footer).

### Inserting Screenshots

Insert menu => «Snapshot». You can then choose either to paste the entire screen of another program, or to insert an open dialog window of another program, or a «Screen Cut». If you select the option «Screen Cut» - the PowerPoint window collapses, the mouse cursor changes its form and the user is given the opportunity to select the part of the screen that is necessary to him. After the user releases the left mouse button, the previously selected part of the screen appears as a picture on the slide.

## 12. Working with a Slide Sample

1. Switch to the slideshow mode: View – Slideshow

2. Add a slide with individual design to the slideshow set:

- Insert placeholder – Title

- Insert placeholder – Picture

- Insert placeholder – Text

- Background – Background Styles

3. Create a new slide sample set: Modify Sample – Insert Slide Sample

4. In the set, place the following slides:

- Title slides. (Put a logo on it.)

- Slide «Title and Object»
  - Slide «Title and text» (text – numbered list).
  - Slide «Header and three text objects», leaving on them as text objects plain text (not a list)
  - Slide «Title and chart».
5. Select the font Arial, size 24; fFor the text of the first level Calibri, size 18.
  6. In the footer on the right, on all slides, except for the title, display the date and slide number:
    - **Insert – Date and time – tick the appropriate boxes.**
    - 7. Rename the slides you created in accordance with the filling.
    - 8. For the background of the sample slide, select the picture:
      - **Insert – Pictures – Choose from the collection.**
    - 9. On the other slides, make a gradient fill
      - **Background Styles – Background Format – Select a gradient.**

## Laboratory work № 10

### Processing of multimedia information In Windows Movie Maker

**Work Objective:** Learn the functions of the Windows Movie Maker video editor.

**Equipment:** PC.

#### Brief Theoretical Information

Windows Movie Maker is a free program for creating and editing amateur movies that comes with Microsoft Windows operating systems starting from Windows ME to Windows Vista.

You can create and display your movies directly on your home PC with the help of this program, while performing simple drag and drop operations. The program allows you to add special effects, narration and music. After creating the movie, you can write it to a CD, send it to friends and acquaintances by e-mail or put it on the Internet.

This program is fairly easy to use and primarily it is designed for amateur film making. Key features of the program:

- 1) Simple and intuitive interface.
- 2) Ability to create films of professional quality.
- 3) Ability to create a slideshow from images.
- 4) Ability to receive video from a digital or analog video camera.
- 5) Support for a large number of video cameras, including analog and digital cameras.
- 6) Ability to record movies from your computer directly to your camcorder.
- 7) Ability to crop and glue video.
- 8) Ability to add transition effects, titles and titles, audio track.
- 9) Save the highest quality picture and sound with the latest technology compression Windows Media.
- 10) Ability to adjust the quality of the created movie.
- 11) Ability to save the movie directly to the video camera.

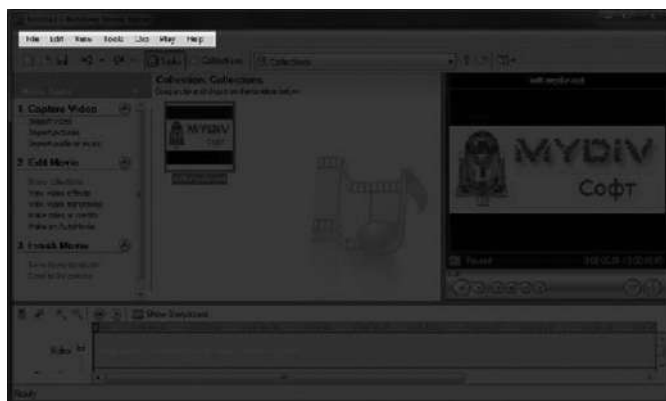
#### *The Program Interface*

The program has a classic intuitive interface (Figure 1), which is similar to most video editors. There are also some distinctive features that make this program unique.



*Figure 1. Windows Movie Maker Working Window*

The main menu (Figure 2) contains all the commands and settings for controlling the operation of the program. Using it, you can enable / disable some program panels or call the desired functions.



*Figure 2. The Main Menu Of Windows Movie Maker*

Below is the toolbar (Figure 3), which has buttons for creating / opening / saving a project, canceling / repetitions, hiding / displaying the taskbar (Tasks), hiding / displaying the Collections panel, and a drop-down list in which you can select the required group of items. There are only three groups there: Video Effects, Video Transitions, Collections.



*Figure 3. The Windows Movie Maker Toolbar*

One of the most convenient solutions that facilitate access to the functionality of the program, without which in Windows Movie Maker it would be much more difficult to work, is the taskbar (Figure 4).



*Figure 4. Windows Movie Maker Taskbar*

This panel is designed to simplify access to the most frequently used commands. In fact, the taskbar is divided into three sections:

1) **Capture Video.** There are three items for importing videos (Import video), Pictures (Import pictures) and Audio (Import audio or music) in the «work field» of the program.

2) **Edit Movie.** There are five elements here that can display Show Collections, View video effects, View video transitions, and windows for creating titles or credits and creating an auto-make films (Make an AutoMovie).

3) **Finish Movie.** In this category there are functions for creating a movie and saving it on a computer (Save to my computer) or on a video camera (Send to DV camera).

The project window (Figure 5) displays Collections, Video Effects and Transitions. To switch between these groups of items, select the corresponding item from the drop-down list of tools or from the list on the taskbar. Also in this area of the program, windows for making titles (Make titles or credits) and auto-films (Make AutoMovie) are displayed.



*Figure 5. Windows Movie Maker Project Window*

To view the contents of the collections, video effects and transitions, it is convenient to use the built-in player (Figure 6). It is also designed to display the created project, which can be viewed in full-screen mode by clicking on the main menu in the Tab «View» to the «Full Screen» item (full screen) or simply by pressing the Alt + Enter key combination.



*Figure 6. Windows Movie Maker Player*

At the bottom of the program there is a panel in which two modes of project viewing are available (Figure 7).



Figure 7. The bottom panel of Windows Movie Maker

The first mode looks like a typical time scale (Figure 8). Basically, this mode is used to select and organize slides, change the duration of their playback, add Headers, sound and video effects.



Figure 8. Timeline

The second mode has the form of a storyboard (Figure 9). This mode is useful when adding transitions and video effects.

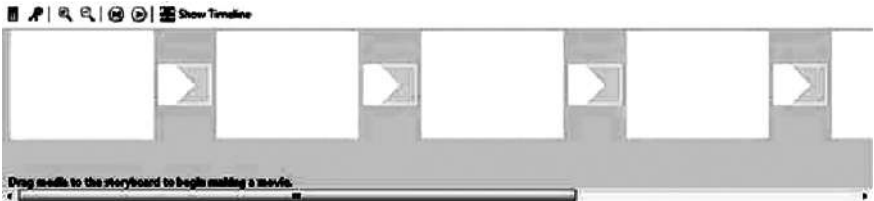


Figure 9. Storyboard Mode

Switch between modes by pressing the buttons with the words «**Show Timeline**» and «**Show Storyboard**» or by using the combination of the hot keys Ctrl + T.

## **Working with the Program**

### ***Starting the Program***

By default, you can start the program by clicking the «Start» button, then you need to go to the «Programs» menu and select «Windows Movie Maker» there.

### ***Importing Content***

On the toolbar, click, for example, «**Import pictures**» (Import images) and select several images. After you select the required images, they will be displayed in the **Collections** window. In the same way, you can add video, or audio information simply by clicking «Import video», «Import audio or music», respectively.

### ***Adding Objects to the Timeline***

Now, from the Collections project window, drag the objects onto the timeline, which, by the way, can be added by clicking on the menu item that unfolds when you right-click «**Add TimeLine**» or simply by pressing the keyboard shortcut «Ctrl + D». Also in the taskbar there is an item called «**Make an AutoMovie**» which will automatically add all the objects that are in the Collections project window.

### ***Adding Titles and Subtitles***

This is the ability of Windows Movie Maker, which allows you to create short films. To add a title, select the item «**Make titles or credits**» in the «**Edi Movie**» category or select «**Titles and Credits ...**» in the main window in the «**Tools**» tab («Tools»). In the window that appears, you can select a place in the clip to which a new title will be assigned: at the beginning, at the end, before the selected object, after the selected object or on the selected object. Then select the desired item and fill in the text field. You can also set the font and an animated display of the title.

### ***Adding Video Effects and Transitions***

In order to add video effects and transitions, you must first select the item **View video effects** or **View video transitions**, after which a window with clearly presented small effects (or transitions) thumbnails will open. You can see them in work by simply selecting any thumbnail and the effect will automatically be played in the built-in player. To add your favorites you



can simply drag them to the desired frame. Effects and especially transitions are very convenient to add in the storyboard mode.

### ***Editing a Movie in the Timeline Window***

After adding the elements, you must set the length of their playback. This can be done by selecting the desired object on the timeline and pulling it by the edges. It should be remembered that if you want to display some text at the same time when displaying, for example, you need to pay attention to the time you set for playing. For example, when adding a text, which will occupy the maximum space on the screen, you should set the playback time for 15 seconds plus 2 seconds for transitions. When determining the duration of the playback, it is best to mark the stopwatch. For more convenient adjustment, use the zoom function, with which you can more accurately and easily set a time frame for displaying certain objects.

To do this, you can use the buttons with a magnifying glass image or the **Page Down** and **Page Up** hot keys. Also, when editing, a special attention should be paid to the musical Support. Set a smooth increase in the audio playback at the beginning and attenuation, at the end click the right button Mouse in the timeline above the «**Audio**» track and selecting **Fade In** and **Fade Out**. Plus, in the same drop-down menu, you can adjust the volume by selecting **Volume**.

### ***Saving and Creating a Movie***

The last step in working with Windows Movie Maker is creating and saving a video clip. To do this, simply select the Save to my computer or **Send DV camera** option in the taskbar.

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