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**ПРОФЕССИОНАЛЬНО-ОРИЕНТИРОВАННЫЙ
АНГЛИЙСКИЙ ЯЗЫК**

Telecommunication systems and networks
Методические указания для студентов специальности 5В071900

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Данные методические указания предназначены для развития умений чтения и перевода технических текстов в области радиотехники и связи. Методические указания включают в себя аутентичный текстовый материал технического характера с упражнениями и заданиями для усвоения лексико-грамматических конструкций и терминов по данной специальности. Содержательная сторона методических указаний современна, актуальна и соответствует тематике изучаемой дисциплины.

Материал может найти применение, как на аудиторных занятиях, так и в практике самостоятельной работы с целью формирования иноязычной профессиональной компетенции студентов – бакалавров специальности 5В071900.

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Introduction

These methodical and practical guidelines intended for 2-3-year students are prepared in compliance with the Course syllabus and designed to help the learners develop professional language skills and competences. There will be no attempt to replace the content of themes and topics of the major specialties, but make it easier for future specialists to deal with foreign sources and partners, thus, use the English language in order to enhance their professional growth, to boost career development and always enjoy unlimited worldwide information resources and opportunities.

Much will depend on the students' ability to work independently. Undoubtedly, there will be numerous textbooks, special teaching aids and recommendations, but real-life up-to-date information will always remain indispensable.

Unfortunately, we have to admit the fact, that the subject material of the present guide is rather limited, narrowed to quite a few topics, related, however, to the basic concepts of telecommunication systems, networks and convergence in telecoms and IT.

Unit 1. Telecommunications. Basic Concepts

Start-up

1.1 In pairs or small groups, discuss and suggest suitable answers to the following questions:

- *What general problems can be solved with the help of computer networks?*
- *What types of computer networks do you know?*
- *What are communication protocols designed for?*

Text A. Telecommunications (1)

The term “telecommunications” refers to the transmission of information over long distances using the telephone system, radio, TV satellite or computer links. Examples are two people speaking on the phone, a sales department sending a fax to a client or someone reading the teletext pages on TV. But in the modern world, telecommunications mainly means transferring information from one PC to another via modem and phone lines (or fiber-optic cables).

The global telecommunications network is the largest and most complex technical system that man has created. It makes up a substantial part of a country's infrastructure and is vital to the development of the country. Development in the field of telecommunications has been very rapid in recent years. By telecommunications we mean here all processes that render it possible to transfer

voice, data and video with the help of some form of electromagnetic system, including optical transfer methods.

This rapid development points to new demands on knowledge and competence for everyone who takes an active part in modern telecommunications. Today the rate of change and innovation in the telecommunications industry is accelerating at a breakneck pace. New telecommunications technology enables companies to interface directly with their customers wherever on the globe they happen to be. The coming convergence of voice, data, and video technologies means that the media, entertainment, computer, and telecommunications organisations are all going to be merging and interoperating their activities. Even something so small as an individual strand of optical fiber today has the capacity to carry million television channels simultaneously. How will telecommunications technology evolve and with what impact in the coming years?

1.2 In text A find synonyms or equivalents for the following words and expressions.

Computer connections; transmission; make it possible; excessive speed; clients; coming closer (about services); occurring at the same time.

1.3 Find equivalents for the following Russian words and expressions.

Слияние (организаций); передача информации; стремительное развитие; взаимодействовать с клиентами напрямую.

1.4 Due to the new telecommunications technology companies do not need to cooperate with their clients directly (True or False?).

1.5 Find and present to the group information supporting the idea that “The global telecommunication network is vital to the development of the country”. A two-three minute presentation will be welcomed and result in additional assessment points.

1.6 Read text B and give headings to the paragraphs.

Text B. Telecommunications (2)

1. _____

Telecommunication is the transmission of signals over a distance for the purpose of communication. In modern times, this process almost always involves the sending of electromagnetic waves by electronic transmitters but in earlier years it may have involved the use of smoke signals, drums or semaphore. Today, telecommunication is widespread and devices that assist the process, such as television, radio and telephone, are common in many parts of the world. There is also a vast array¹ of networks that connect these devices, including computer networks, public telephone networks, radio networks and television networks.

Computer communication across the Internet, such as e-mail and instant messaging, is just one of many examples of telecommunication.

2. _____

Telecommunication systems are generally designed by telecommunication engineers. Major contributors to the field of telecommunications include Alexander Bell who invented the telephone, John Logie Baird who invented the mechanical television and Guglielmo Marconi who first demonstrated transatlantic radio communication. In recent times, optical fiber has radically improved the bandwidth available for intercontinental communication, helping to facilitate a faster and richer Internet experience. And, digital television has eliminated effects such as snowy pictures and ghosting. Telecommunication remains an important part of the world economy and the telecommunication industry's revenue has been placed at just under 3% of the gross world product.

3. _____

The basic elements of a telecommunication system are:

- a transmitter that takes information and converts it to a signal for transmission;
- a transmission medium over which the signal is transmitted;
- a receiver that receives and converts the signal back into usable information.

For example, consider a radio broadcast. In this case the broadcast tower is the transmitter, the radio is the receiver and the transmission medium is free space. Often telecommunication systems are two-way and devices act as both a transmitter and receiver or transceiver. For example, a mobile phone is a transceiver. Telecommunication over a phone line is called point-to-point² communication because it is between one transmitter and one receiver, telecommunication through radio broadcasts is called broadcast communication because it is between one powerful transmitter and numerous receivers.

4. _____

Signals can either be analogue or digital. In an analogue signal, the signal is varied continuously with respect to the information. In a digital signal, the information is encoded as a set of discrete values.

5. _____

The shaping of a signal to convey information is known as modulation. Modulation is a key concept in telecommunications and is frequently used to impose the information of one signal on another. Modulation is used to represent a digital message as an analogue waveform. This is known as keying and several keying techniques exist – these include phase-shift keying, amplitude-shift keying³ and minimum-shift keying⁴. Bluetooth, for example, uses phase-shift keying for exchanges between devices.

Comments:

1) ¹*a vast array (of networks, technologies, etc.)* – широкий спектр (сетей, технологий и пр.)

2) ²*point-to-point* – "точка-точка". Тип связи между устройствами в сети передачи данных (syn. monocast).

3) ³*amplitude-shift keying* – амплитудная манипуляция, АМн.

4) ⁴*minimum-shift keying* – манипуляция минимальным сдвигом, манипуляция с минимальным сдвигом.

1.7 Complete the chart with the key words from the text.

Paragraph	Key words
1	
2	
3	
4	
5	

1.8 Match the terms with their definitions.

1. modulation	a) a device which transmits and receives radio or electronic signals
2. transmission medium	b) the rate of data transfer, measured in bits per second
3. transceiver	c) the physical path between transmitter and receiver
4. analogue	d) the process of varying one or more properties of a periodic waveform, called the carrier signal...
5. optical fiber	e) it describes the proportional relationship between a signal and a voltage or current that represents the signal.
6. bandwidth	f) It is made of extruded glass (silica) or plastic, slightly thicker than a human hair. It can function as a waveguide, or "light pipe".

1.8 Underline the sentences that, in your opinion, contain the basic information and summarize the general ideas of the text.

1.9 Prepare a report and take part in the discussion on the topic "Uses of radio and communication". Use any additional information you can find in other sources.

Text C. Telecommunications: a brief historical review

The first true telecommunications system using electrical signals to carry messages started in the 1840s with machine telegraphy. Samuel Morse first developed the telegraph in 1832 but it was not until the mid-1840s that the system was put into practical use - sending coded electrical messages (Morse Code) along the wires. The telegraph became a rapid success, its speed quickly outdating the Pony Express for long-distance communications.

The next major step forward came in 1878 with the invention of the telephone by Bell. This enabled speech to be transported as electrical signals along wires and revolutionized personal communications.

In 1886, Hertz verified experimentally that electrical energy could be radiated and thus proved the existence of electromagnetic wave. This opened the way for the free-space transmission of information without wires. This provided the basis for all radio and TV broadcasting.

In 1901, Marconi established long-distance telegraph communication by transmitting between England and Canada. Although he did not realize it at the time, he achieved such long 20 distances by reflecting radio waves in the ionosphere (layers of ionized gases and electrons existing in the earth's upper atmosphere at heights of 50-500 km). This overcame the problem of transmitting round the earth from one side of the Atlantic to the other.

With the discoveries of the diode and thermionic valve in the early part of the last century, advances were made in both receiver and transmitter design with an associated impact in telegraphy, telephony, and civil and military communications. Radio broadcasting soon followed, with powerful transmitters serving to communicate over wide areas. Television (TV) was first established in 1937. Radar (radio detection and ranging) was also developed from the 1930s and played a vital role in aircraft detection and navigation in World War II.

As further advances in technology took place (e.g. the invention of the transistor in 1947 and the subsequent development of microelectronic integrated circuit technology), new applications became feasible, and new systems were developed.

Data communications - the transmission of coded data (e.g. text, graphics, financial information) between 'intelligent' terminals and computers - was first established in the early 1950s using modems, equipment which enables the telephone network to convey data as well as speech. Other improvements in materials and devices also led to the transmission of information via cables. Much of today's long-distance telephone traffic is by submarine cable.

The space race led to yet another means of long-distance communication, via fixed and mobile earth stations to satellites. Today, several hundred satellites orbit

the earth, and satellite links provide all forms of communication and related services such as telephony, data, TV, navigation, meteorology, and surveillance.

One of the very latest developments is the optical fiber cable - a tiny glass fiber which can be used to convey signal information by light pulses. Optical fiber cable with extremely low loss at low cost has now been developed with very high data-carrying capacity. Several thousands of telephone messages can be carried down a single fiber.

Perhaps the greatest change which has occurred in the last decades is that from analogue to digital methods of information transmission. The very first commercially employed telecommunication system, telegraphy, was and still is a digital system. However, telephony, radio, and TV all started as analogue systems. Today, the general trend is strongly towards the digital, and now the vast majority of telecommunications systems are digital. Problems of noise and interference can be combated much more successfully in a digital system.

The advances in microelectronics and the merging of communications with computers have led naturally to the digital transmission mode with its advantages of computer control, automatic error checking of signals, excellent memory storage, facilities for data, and intelligent terminals. The market need for vast quantities of information transmission and processing at very high speed can only be reliably catered for by using digital techniques. In fact, the most rapidly growing field is almost certainly in data communications employing high-speed digital techniques.

1.10 Translate the following sentences into Russian.

a) Samuel Morse first developed the telegraph in 1832 but it was not until the mid-1840s that the system was put into practical use...

b) Perhaps the greatest change which has occurred in the last decades is that from analogue to digital methods of information transmission.

c) The market need for vast quantities of information transmission and processing at very high speed can only be reliably catered for by using digital techniques.

1.11 Find English equivalents of the following terms and phrases:

Стационарные и подвижные наземные станции; это позволило передавать речь в виде электрических сигналов по проводам; малые потери при низкой стоимости; стационарные и подвижные наземные станции; в течение следующего десятилетия телевизионные системы станут, преимущественно, цифровыми; рыночные потребности в передаче больших объемов информации.

1.12 Answer the following questions:

1) What invention, according to the text, "revolutionized personal communication"?

2) What advances were the discoveries of the diode and thermionic valve followed by?

- 3) What are the advantages of the digital transmission mode?
- 4) What, according to the text, is the greatest change which has occurred in the last twenty years in methods of information transmission?
- 5) What advantages of digital transmission mode, besides excellent memory storage, were mentioned in the text?

1.13 Take brief notes from the text on the significance of the developments in telecommunications (Nineteenth century; 1901-1945; 1946-1980; 1980s on).

1.14 Read the following text and render the information in English.

Text D. Что такое телекоммуникация (электросвязь)

Телекоммуникацией принято считать прием и передачу звука, сигнала, текста, знака, письменного изображения по кабельной, проводной, магнитной, оптической, радио- и другим электромагнитным системам.

Система технических средств, с помощью которой осуществляется телекоммуникация, называется сетью телекоммуникаций. Сами же технические средства телекоммуникаций это оборудование и машины, которые используются для обработки, передачи и приема сообщений телекоммуникаций.

Каналы связи. Выделяют три основных разновидности каналов связи:

- 1) *симплексные* — то есть допускающие передачу данных только в одном направлении, (например, в телевизионной и радиовещательной сетях);
- 2) *полудуплексные* — то есть когда два узла связи соединены одним каналом, по которому информация передается попеременно то в одном направлении, то в противоположном (в информационно-справочных и запросно-ответных системах);
- 3) *дуплексные* — позволяют передавать данные одновременно в двух направлениях за счет использования четырехпроводной линии связи (два провода для передачи, два других – для приема данных), или двух полос частот.

По реализации каналы связи делятся на:

- беспроводные (радиосвязь);
- оптоволоконные;
- проводные.

Спутниковые, естественно, относятся к беспроводным, т.е. к радиоканалам.

1.15 Answer these questions:

- 1) What are the basic parts of a telecommunication system?
- 2) What are the main types of data transmission media?
- 3) What are channels of communication and their main functions?
- 4) Why is the analog telecommunication system being replaced by the digital system?

1.16 Match the following words with their Russian equivalents:

- | | |
|---------------------------------|-----------------|
| 1) стационарная (связь) | a) fiber-optic |
| 2) цифровая (связь) | b) wireless |
| 3) подвижная (связь) | c) fixed |
| 4) беспроводная (связь) | d) discrete |
| 5) наземный (ретранслятор) | e) mobile |
| 6) преобразовывать (сигналы) | f) process |
| 7) дискретные (сообщения) | g) digital |
| 8) ретранслятор | h) convert |
| 9) волоконно-оптическая (связь) | i) ground-based |
| 10) обрабатывать (сигнал) | j) relay |

1.17 Make up a list of terms you can find in the text. Translate them into English and write definitions.

1.18 Prepare a 2-3-minute presentation reflecting the history of modern-day communication technology in Kazakhstan.

Unit 2. Transmission Media

Start-up

What does the efficiency of the transmission medium depend on (discuss with your partner)?

Do you believe that fiber optic is more efficient than copper cable?

Is the word "media" singular or plural? Write the following words in singular: data, media, criteria, syllabi, phenomena, crises, analyses, theses.

Text A. Transmission Media

Transmission media are the highways and arteries that provide a path for telecommunications devices. There is a general tendency to say that one transmission medium is better than another. In fact, each transmission medium has its place in the design of any communication system. Each has characteristics which will make it the ideal medium to use based on the particular set of circumstances. It is important to recognize the advantages of each and develop a system accordingly. Factors to consider when choosing the transmission media include: cost, ease of installation and maintenance, availability, and most important, efficiency of transmission. It is important to recognize the advantages of each and develop a system accordingly.

Transmission efficiency is generally viewed as the amount of signal degradation created by the use of a particular transmission medium. The

transmission medium presents a "barrier" to the communication signal. The "barrier" can be measured by many different factors. However, one common question is asked about all communication media. How far will the communication signal energy travel before it becomes too weak (or distorted) to be considered unstable? There is equipment available to extend the distance for transmitting a signal, but that adds to the overall cost and complexity of deployment.

2.1 Match the words in column A with their synonyms in column B:

<i>A</i>	<i>B</i>
Circumstances	difficulty
Degradation	conditions
Barrier	placement
Distorted	attenuation
Deployment	obstacle
Complexity	weakened

2.2 Translate this sentence into Russian:

Transmission efficiency is generally viewed as the amount of signal degradation created by the use of a particular transmission medium.

2.4 Answer the following questions:

- 1) What factors should be considered when choosing the transmission media?
- 2) Why is a transmission medium called a "barrier" to the communication signal?
- 3) What common question is usually asked about all communication media?
- 4) How can you explain the term "transmission efficiency"?

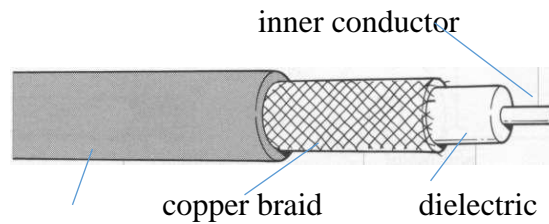
Text B. Transmission lines

The most common types of transmission media used today are: Copper Wire; Fiber Optics; Radio Frequency (Wireless); Free Space Optics.

Many engineers will argue that one transmission medium is the best, or better than some of the others. The reader should keep in mind that each medium has advantages and disadvantages. Which medium is best depends upon the purpose of the communications system and the desired end results. In fact, most systems are a hybrid. That is, two or more media are combined to effect the most efficient communication network infrastructure. There are many traffic signal systems that combine a twisted copper pair infrastructure with wireless links to serve part of the system. The decision to create this type of system may have been based on economics, but that is certainly one of the reasons to choose one medium over another, or to combine the use of several.

Coaxial cable (coax):

Flexible coax has a copper wire core surrounded by copper braid. The core and braid are insulated from each other by a dielectric material such as polyethylene and covered by a PVC sheath.



PVC sheath (outer conductor)

The braid helps to screen the signals from interference. Coax can carry a large number of signals over long distances up to 1000 Hz. It is used to connect telephone exchanges and for cable television.

Advantages of coaxial cable:

- low cost;
- easy to install, easy to expand;
- up to 10Mbps capacity;
- moderate level of EMI immunity.

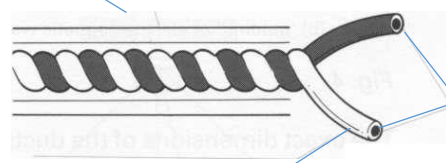
Disadvantage:

- single cable failure can take down the entire network.

Twisted pair.

Two insulated copper wires are twisted together to reduce interference effects and are enclosed in an insulating polyethylene sheath. Because the wires are twisted, unwanted stray signals picked up by one tend to be cancelled by similar signals picked up by the other. They are used for communications over longer distances, for example to connect telephones to their local exchange.

insulator (e.g. polyethylene) sheath



insulator (e.g. polyethylene)
covering wire

There are two types of twisted pairs cabling:

- 1) Unshielded twisted pair (UTP).
- 2) Shielded twisted pair (STP).

1. Unshielded twisted pair is more common. It can be either voice grade or data grade depending on the condition.

Advantages of UTP:

- easy installation;
- high speed capacity;
- low cost.

Disadvantage of UTP: short distance due to attenuation.

2. Shielded twisted pair is similar to UTP but has a mesh shielding that protects it from EMI which allows for higher transmission rate.

Characteristics of STP:

- medium cost;
- easy to install;
- higher capacity than UTP;
- higher attenuation, but same as UTP;
- medium immunity from EMI;
- 100 meter limit;

Advantages of STP: shielded; faster than UTP and coaxial.

Disadvantages of STP:

- more expensive than UTP and coaxial;
- more difficult to install;
- high attenuation rate.

Optical fibers.

An inner core made from very pure silica fiber is surrounded by a similar glass sheath, known as cladding. This is covered by a protective plastic sheath. Non-visible light from lasers or LEDs can travel along the fiber by reflection from the surface where the core and cladding meet.

Although the optical fiber has a smaller diameter than a human hair, it can be used to transmit tens of thousands of signals at high speed with very low loss and no interference from other signals. Optical fiber cable can be used in corrosive environments and is light, flexible and cheap. This type of cable is gradually replacing conventional copper wire for connecting telephones and computer networks.

Advantages of Fiber Optic Cable: fast; low attenuation; no EMI interference.

Disadvantages: very costly; hard to install.

Wireless Media.

Since the invention of the Wireless Telegraph in 1896 communication system designers have sought to use wireless because of the reduced infrastructure cost and complexity, when compared to wireline communication systems. There is no need to construct miles of telephone line poles or cable trenches. Simply put in a few strategically positioned radio towers and transmit around the world. Today, wireless systems are significantly more complex because we want to allow millions of users to make telephone calls or receive feature length movies via wireless systems. There are four general types of wireless (radio) communication systems:

- Cellular Telephone.

- Basic 2-Way Radio.
- Point-to-point.
- Wi-Fi (Wireless Fidelity), and recently, Wi-Max.

Traffic signal and freeway management systems use three of the variants to support operations, and are considering the use of Wi-Fi. The Wi-Fi/Wi-Max systems are becoming increasingly ubiquitous in their deployment, and a part of most telecommunication deployment strategies.

2.5 Read text B again and find a word or phrase that means:

- the communications channel or path over which a signal propagates;
- a type of wiring in which two conductors of a single circuit are twisted together;
- the emission of light by a substance that has absorbed light or other electromagnetic radiation, a form of luminescence;
- a type of cable that has an inner conductor surrounded by a tubular insulating layer, surrounded by a tubular conducting shield;
- a form of cable that uses a single center conductor with two shields;
- anything which alters, modifies, or disrupts a message as it travels along a channel.

2.6 Make up a list of terms you can find in the text. Find definitions to the terms. Make up 10 questions with the terms used in the text.

2.7 Translate the following phrases or sentences using information from text B: экранированная витая пара; высокая пропускная способность; это позволяет увеличить дальность передачи с уменьшением потерь из-за воздействия внешних электрических сигналов.

2.8 Read the following terms and translate them into Russian:

Media, copper wire, cable, transmission, high-speed data transmission, data communications, customer premises, high frequency, coaxial cable, bandwidth, telephone channel, local loop, long-distance network, capacity, traffic, transmission medium, wireless system.

2.9 Find all the abbreviations in the texts. Give their meanings.

2.10 Discuss the text with your neighbor in the form of a dialogue.

2.11 Find English equivalents for the following:

Одномодовый кабель (одномодовое волокно); затухание сигнала; техническая характеристика; передача данных на большие расстояния; скорость передачи данных; низкочастотные радиосигналы.

2.12 Answer these questions:

1) What are the main types of fiber cables? What is the difference between them?

2) Why is fiber considered to have the best overall characteristics for transmission efficiency?

3) What factors, besides highest transmission speed, may influence the choice of transmission media?

2.13 Compare transmission characteristics of fiber, copper, radio and infrared.

Text D. Среды передачи информации

Средой передачи информации называются те линии связи (или каналы связи), по которым производится обмен информацией между компьютерами. В подавляющем большинстве компьютерных сетей (особенно локальных) используются проводные или кабельные каналы связи, хотя существуют и беспроводные сети.

Передача на большие расстояния при любом типе кабеля требует сложной передающей и приемной аппаратуры: для этого надо формировать мощный сигнал на передающем конце и детектировать слабый сигнал на приемном конце.

Промышленностью выпускается огромное количество типов кабелей, которые можно разделить на три большие группы:

- кабели на основе витых пар проводов, которые делятся на экранированные и неэкранированные;
- коаксиальные кабели;
- оптоволоконные кабели.

Каждый тип кабеля имеет свои преимущества и недостатки.

Витые пары проводов используются в самых дешевых и на сегодняшний день, пожалуй, самых популярных кабелях. Они довольно гибкие и удобные для прокладки. Неэкранированные витые пары характеризуются слабой защищенностью от внешних электромагнитных помех, а также слабой защищенностью от подслушивания с целью, например, промышленного шпионажа. Для уменьшения излучений кабеля, защиты от внешних электромагнитных помех и снижения взаимного влияния пар проводов друг на друга (cross-talk - перекрестные наводки) применяется экранирование.

Основные достоинства неэкранированных витых пар — простота монтажа разъемов, на концах кабеля, а также простота ремонта любых повреждений по сравнению с другими типами кабеля. Все остальные характеристики у них хуже.

Коаксиальный кабель - это кабель с центральным медным проводом, который окружен слоем изолирующего материала для того, чтобы отделить центральный проводник от внешнего проводящего экрана. Внешний проводящий экран кабеля покрывается изоляцией. Стоимость коаксиального кабеля выше стоимости витой пары и выполнение монтажа сети сложнее.

Коаксиальный кабель применяется, например, в локальных сетях с архитектурой Ethernet, построенных по топологии типа “общая шина”. Коаксиальный кабель более помехозащищенный, чем витая пара и снижает собственное излучение. Пропускная способность – 50-100 Мбит/с. Допустимая длина линии связи – несколько километров.

Несанкционированное подключение к коаксиальному кабелю сложнее, чем к витой паре.

Кабельные оптоволоконные каналы связи

Оптоволоконный кабель – это оптическое волокно на кремниевой или пластмассовой основе, закрытое внешней оболочкой.

Оптическое волокно передает сигналы только в одном направлении, поэтому кабель состоит из двух волокон. На передающем конце оптоволоконного кабеля требуется преобразование электрического сигнала в световой, а на приемном конце обратное преобразование.

Основное преимущество этого типа кабеля – чрезвычайно высокий уровень помехозащищенности и отсутствие излучения. Несанкционированное подключение очень сложно. Скорость передачи данных 3 Гбит/с. Основные недостатки оптоволоконного кабеля – это сложность его монтажа и небольшая механическая прочность.

2.15 Match the words on the left with the words on the right to make pairs of words that often go together.

- | | |
|----------------|--|
| 1 coaxial | a) twisted pair cable, cord |
| 2 unauthorized | b) medium, speed, line |
| 3 unshielded | c) cable |
| 4 copper | d) communication, processing, security |
| 5 data | e) access, distribution, use of property |
| 6 transmission | f) wire, cable, ore |

2.16 In your vocabulary notebook, write out all the terms and expressions related to the topics of the specialty, with definitions (in English) showing the exact meaning in the above text. Read the text again, take notes and render it in English.

Unit 3. Communication Systems and Networks

Start-up

Think of the following. What are the main parts of a communication system?

What is a modem used for?

What are the main types of a telecommunication channel?

Text A. Basic communication systems

Data communications are the transfer of data from one device to another via some form of transmission medium. A data communications system must transmit

data to the correct destination in an accurate and timely manner. The five components that make up a communications system are the message, transmitter, receiver, medium, and protocol. Text, numbers, images, audio, and video are different forms of information. The transmitter injects a signal into the channel that delivers it to the receiver. The receiver must recover the information contained in the receiver signal despite the limitations introduced by the channel.

The channel can be a physical one, like a copper cable and an optical fiber, or simply air or even vacuum that transmits electromagnetic waves. Any channel is subject to some kind of electromagnetic “noise” and interference.

In order to transmit a digital signal at a reasonable distance it has to be processed by *a modulator*. The modulator can:

- 1) Select the frequency at which the signal will be transmitted over the channel.
- 2) Allow for different signals to share the same modulation channel, in a process known as multiplexing.
- 3) Adapt the signals parameters to suit the requirements of a given channel (bandwidth, spectral properties, noise robustness, etc.).
- 4) Provide the flexibility to exchange spectral efficiency for robustness, as needed.

Of course, at the receiving end, the inverse operation, called demodulation, needs to be performed. So in bidirectional systems a single device will perform both operations and therefore be called a modem.

The word *modem* is a combination of the words modulation and demodulation which is precisely what a modem does. A modem can also be viewed as a device that takes information, transfers it on to a medium to allow transportation of the information, and at the other end, removes the information from the medium and restores it to its original form. This brings up two distinguishing characteristics of a modem, the type of information it accepts and the media that it operates upon.

The type of medium employed by the modem dictates the type of modulation it will employ. The medium can be a copper cable, an optical fiber or an electromagnetic wave in free space.

Although the modem is a separate building block, it is often embedded in a laptop or in a wireless router.

Multiplexing is the sharing of a single communication channel among different users. The communication channel can be a copper wire, an optical fiber or the space between a transmitting and a receiving antenna. Different users can be distinguished by means of different frequencies, time slots, codes or regions of space.

3.1 In the text above, find English equivalents for the following:

Обеспечить надежность (прочность); информация, содержащаяся в сигнале; отличительная особенность (свойство); встроенный в компьютер блок; временной интервал.

3.2 Answer the questions:

- 1) What are the five components of a data communications system?
- 2) What functions do transmitters and receivers have?
- 3) What does the process known as multiplexing consist in?
- 4) What is a modem and what is it designed for?

3.3 Translate into Russian:

- 1) The type of medium employed by the modem dictates the type of modulation it will employ.
- 2) Any channel is subject to some kind of electromagnetic “noise” and interference.
- 3) A modem can also be viewed as a device that takes information and transfers it on to a medium.
- 4) Of course, at the receiving end, the inverse operation, called demodulation, needs to be performed.

Text B. Transmission modes

Communication between two devices can occur in one of three ways: simplex, half-duplex, or full-duplex.

Simplex.

In simplex mode, the communication is unidirectional, as on a one-way street. Only one of the two devices on a link can transmit; the other can only receive. Keyboards and traditional monitors are examples of simplex devices. The keyboard can only introduce input; the monitor can only accept output. The simplex mode can use the entire capacity of the channel to send data in one direction.

Half-Duplex.

In half-duplex mode, each station can both transmit and receive, but not at the same time. When one device is sending, the other can only receive, and vice versa. The half-duplex mode is like a one-lane road with traffic allowed in both directions. When cars are traveling in one direction, cars going the other way must wait. In a half-duplex transmission, the entire capacity of a channel is taken over by whichever of the two devices is transmitting at the time. Walkie-talkies and CB (citizens band) radios are both half-duplex systems.

The half-duplex mode is used in cases where there is no need for communication in both directions at the same time; the entire capacity of the channel can be utilized for each direction.

Full-Duplex.

In full-duplex mode (also called *duplex*), both stations can transmit and receive simultaneously. The full-duplex mode is like a two-way street with traffic flowing in both directions at the same time. In full-duplex mode, signals going in one direction share the capacity of the link with signals going in the other direction. This sharing can occur in two ways: Either the link must contain two physically

separate transmission paths, one for sending and the other for receiving; or the capacity of the channel is divided between signals traveling in both directions. One common example of full-duplex communication is the telephone network. When two people are communicating by a telephone line, both can talk and listen at the same time.

The full-duplex mode is used when communication in both directions is required all the time. The capacity of the channel, however, must be divided between the two directions.

3.4 Answer the following questions:

- 1) What is the difference between half-duplex and full-duplex transmission modes?
- 2) Can you explain the word “walkie-talkie”?

3.5 Give some examples of simplex, half-duplex or full-duplex communication.

3.6 Write out key terms and expressions, use them to retell the text.

Text C. Networks

Defining a network. A network is the interconnection of a set of devices capable of communication. In this definition, a device can be *a host* (or an *end system* as it is sometimes called) such as a large computer, desktop, laptop, workstation, cellular phone, or security system. A device in this definition can also be a connecting device such as *a router*, which connects the network to other networks, *a switch*, which connects devices together, *a modem* (modulator-demodulator), which changes the form of data, and so on. These devices in a network are connected using wired or wireless transmission media such as cable or air.

Networks may be classified by various characteristics, such as the media used to transmit signals, the communications protocols used to organize network traffic, network scale, network topology and organizational scope. The best-known computer network is the Internet.

Communication protocols define the rules and data formats for exchanging information in a computer network. Well-known communications protocols include Ethernet, a hardware and link layer standard that is widely used for local area networks, and the Internet protocol suite (TCP/IP), which defines a set of protocols for communication between multiple networks, for host-to-host data transfer, and for application-specific data transmission formats. Protocols provide the basis for network programming.

Network Criteria. A network must be able to meet a certain number of criteria. The most important of these are performance, reliability, and security.

Performance. Performance can be measured in many ways, including transit time and response time. Transit time is the amount of time required for a message to travel from one device to another. Response time is the elapsed time between an

inquiry and a response. The performance of a network depends on a number of factors, including the number of users, the type of transmission medium, the capabilities of the connected hardware, and the efficiency of the software.

Performance is often evaluated by two networking metrics: throughput and delay. We often need more throughput and less delay. However, these two criteria are often contradictory. If we try to send more data to the network, we may increase throughput but we increase the delay because of traffic congestion in the network.

Reliability. In addition to accuracy of delivery, network reliability is measured by the frequency of failure, the time it takes a link to recover from a failure, and the network's robustness in a catastrophe.

Security. Network security issues include protecting data from unauthorized access, protecting data from damage and development, and implementing policies and procedures for recovery from breaches and data losses.

3.7 Answer the questions.

1. What devices are connected in the network?
2. By what characteristics can networks be classified?
3. Why are protocols needed?
4. What are the most important network criteria?
5. Why are throughput and delay called contradictory criteria?
6. What do you understand by the terms “security” and “reliability”?

3.8 Match the terms in column A and their definitions (descriptions) in column B:

A	B
1. Router	a) Software used to find and look at information on the web. Each web page has its own unique address known as a Universal Resource Locator (URL).
2. Browser	b) allows two different types of network to communicate with each other.
3. Bridge	c) hardware used to change analogue signals from the phone line into digital signals needed by the computer, also used to change the signals from digital to analogue.
4. Modem	d) define the rules and data formats specifying the individual address.
5. Hub	e) sends the signal to all the devices on the network and only one individual PC will accept the signal.
6. Switch	f) Hardware allowing computer to access the Internet using a phone line.

Text D. Types of networks

There are different types and sizes of networks.

A *Local Area Network (LAN)* is used to connect computers spread over a relatively small area. *LANs* are usually placed in the same building. They can be built with two main types of architecture: *peer-to-peer*, where the two computers have the same capabilities, or *client-server*, where one computer acts as the *server* containing the main hard disk and controlling the other *workstations* or *nodes*, all the devices linked in the network (e.g. printers, computers, etc.).

Computers in a LAN need to use the same *protocol*, or standard of communication. Ethernet is one of the most common protocols for LANs.

A *router*, a device that forwards data packets, is needed to link a LAN to another network, e.g. to the Net.

If your personal computer is connected to a network, it is called a *network workstation*. If your PC is not connected to a network, it is referred to as a *standalone computer*.

In order to connect to a network, your computer will need a *network adapter*. This circuitry and port could be built into the motherboard or it could be on a network interface card (NIC) in one of the computer's *expansion slots*.

Typically in a LAN, hardware is connected by a cable but new *Wi-Fi*, *wireless fidelity* technologies allow the creation of *WLANs*, where cables or wires are replaced by radio waves.

A LAN which uses radio waves rather than cables to transmit the data from machine to machine is called a *wireless local area network (WLAN)*.

To build a WLAN you need *access points*, radio-based receiver-transmitters that are connected to the wired LAN, and *wireless adapters* installed in your computer to link it to the network.

Hotspots are WLANs available for public use in places like airports and hotels, but sometimes the service is also available outdoors (e.g. university campuses, squares, etc.).

A *wide area network (WAN)* is a network which is spread over a large geographical area. WANs have no geographical limit and may connect computers or LANs on opposite sides of the world. They are usually linked through telephone lines, fiber-optic cables or satellites. The main transmission paths within a WAN are high-speed links called *backbones*.

Wireless WANs use mobile telephone networks. The largest WAN in existence is the Internet.

The ideas associated with LANs and WLANs of sharing data and making communications easier are still true with WANs. The difference is that because of the greater distances involved it is not possible to link the computers with cables or by radio.

A WAN normally uses communication media provided by a third party. An example would be a telephone company providing links via telephone cables or via broadband facilities.

Often, several LANs are linked up by a WAN. For example, a firm that has offices in London, Lahore and Colombo would probably use LANs in each of the offices. The company would then use telecommunication media to link the individual LANs together as a WAN.

- 1) Define the terms LAN, WLAN and WAN.
- 2) What is the difference between a LAN and a WAN?
- 3) Is the Internet a LAN or a WAN?

3.9 Now read and memorize these definitions:

A bridge is a hardware and software combination used to connect the same type of networks. Bridges can also partition a large network into two smaller ones and connect two LANs that are nearby each other.

A router is a special computer that directs communicating messages when several networks are connected together. High-speed routers can serve as part of the Internet backbone.

A gateway is an interface that enables dissimilar networks to communicate, such as two LANs based on different topologies or network operating systems.

A backbone is the main transmission path, handling the major data traffic, connecting different LANs together.

A LAN is a network contained within a small area, for example a company department.

A modem is a device for converting digital signals to analogue signals and vice versa to enable a computer to transmit and receive data using an ordinary telephone line.

3.10 Complete these definitions with the correct participle of the verb given in brackets.

1. A gateway is an interface (enable) dissimilar networks to communicate.
2. A bridge is a hardware and software combination (use) to connect the same type of networks.
3. A backbone is a network transmission path (handle) major data traffic.
4. A router is a special computer (direct) messages when several networks are linked.
5. A network is a number of computers and peripherals (link) together.
6. A LAN is a network (connect) computers over a small distance such as within a company.
7. A server is a powerful computer (store) many programs (share) by all the clients in the network.
8. A client is a network computer (use) for accessing a service on a server.
9. A thin client is a simple computer (comprise) a processor and memory, display, keyboard, mouse and hard drives only.
10. A hub is an electronic device (connect) all the data cabling in a network.

Text E. Network topology

Topology refers to the shape of a network. There are three basic physical topologies:

Bus: In a *bus network*, the computers are all connected to a main cable which is known as the bus. All the data is sent along this one cable. It needs special devices at the ends of the bus called *terminators* which absorb signals so that they don't get reflected back into the network and cause data corruption. Bus networks are usually easy and cheap to install. There is little to go wrong, but if a fault occurs the whole network is likely to be affected. They have generally been superseded by star networks.

Star: In a *star network*, each computer and peripheral is connected to a central *hub* or *switch* by its own cable. Star networks are more difficult to install than bus networks because there is more cabling. However, if one of the cables fails, the rest of the network will continue to operate. But if a hub or switch fails, none of the devices connected to it will be able to communicate.

Ring: the workstations are connected to one another in a closed loop configuration.

There are also mixed topologies like the **tree**, a group of stars connected to a central bus. Two common patterns are a bus network and a star network.

3.11 Read the descriptions of different physical topologies of communication networks and match them with the terms in the text "Network topology":

- 1) All the devices are connected to a central station.
- 2) In this type of network there is a cable to which all the computers and peripherals are connected.
- 3) Two or more star networks connected together; the central computers are connected to a main bus.
- 4) All devices (computers, printers, etc.) are connected to one another forming a continuous loop.

3.12 Use the words in the box to complete the sentences:

LAN	nodes	hub	backbones
WLAN	peer-to peer	server	

- 1) All the PCs on a _____ are connected to one _____, which is a powerful PC with a large hard disk that can be shared by everyone.
- 2) The style of _____ networking permits each user to share resources such as printers.
- 3) The star is a topology for a computer network in which one computer

occupies the central part and the remaining _____ are linked solely to it.

4) At present Wi-Fi systems transmit data at much more than 100 times the rate of a dial-up modem, making it an ideal technology for linking computers to one another and to the Net in a _____.

5) All of the fiber-optic _____ of the United States, Canada and Latin America cross Panama.

6) A _____ joins multiple computers (or other network devices) together to form a single network segment, where all computers can communicate directly with each other.

Text F. Wireless networks

3.13 Before you read the text try to answer these questions:

- 1) What is a WAN?
- 2) How can computers be linked up over a long distance?
- 3) What are the advantages of optical-fiber cables over telephone lines?
- 4) What is the function of communications satellites?

3.14 Now read the passage and find out if your answers were correct:

For long-distance or worldwide communications, computers and LANs are usually connected into a wide area network (WAN) to form a single, integrated network. The largest WAN in existence is the Internet.

Networks can be linked together by either *telephone lines* or *fiber-optic cables*. An optical-fiber network transmits data at great speed - 100 megabits per second. A variation called FDDT transmits data at 200 Mbps. FDDI networks are typically used as backbones for wide area networks.

Modern telecommunications use fiber-optic cables because data can be transmitted at a very high speed through the extremely wide bandwidths of glass fibers. The fiber system operates by transmitting light pulses at high frequencies along the glass fiber. This offers considerable advantages:

- the cables require little physical space;
- they are safe because they don't carry electricity;
- they avoid electromagnetic interference.

Networks on different continents can also be connected via satellite. Computers are connected by a modem either to ordinary telephone wires or fiber-optic cables, which are linked to a dish aerial. This aerial has a large concave reflector for the reception and sending of signals. Then, when signals are received by the satellite, they are amplified and sent on to workstations in another part of the world.

Wireless (WiFi) networks are just like fixed LANs but instead of using cables, devices are linked by radio waves.

Each computer in a wireless network requires a wireless network interface card (NIC). These can be built in or you can use plug-in adapters. These allow each component in the network to communicate with a wireless access point (AP) to

create a wireless local area network (WLAN). The AP operates like a router in a fixed LAN. It also provides a bridge which plugs into the hub of a fixed LAN allowing both fixed and wireless users to talk to each other. If your LAN is connected to the Internet, the WLAN can also use it. If not, you can connect the WLAN to the Internet via an ADSL or cable modem.

What are the advantages of a wireless network? You don't need cabling. In older buildings it can be expensive to install cables and access points. With WiFi, one access point can cover an entire floor or even a building. You can work anywhere within range of the access point. On a sunny day you could work outside. You can make any room in the house your study. There are now hotspots in hotels, libraries and airports, so you can link to a network away from home or your office.

There are disadvantages. Fixed LANs can run at 1000 Mbps. Wireless networks are much slower and the further you are from an access point, the slower the rate. Although there are savings on the cost of cabling, wireless NICs are more expensive than the wired versions. Then there is the problem of interference, if a neighbour uses the same channel, and security. Other users may be able to intercept your data. Encryption programs like Wired Equivalent Privacy (WEP) can help.

3.14 Write a list of the advantages and disadvantages of using wireless networks.

3.15 Look through the texts above and correct the following statements.

1. In a client-server architecture, all the workstations have the same capabilities.
2. LANs link computers and other devices that are placed far apart.
3. The word protocol refers to the shape of the network.
4. Routers are used to link two computers.
5. Access points don't need to be connected to a wired LAN.
6. Wireless adapters are optional when you using a WLAN.
7. Hotspots can only be found inside a building.
8. The Internet is an example of a LAN.
9. Wireless WANs use fiber and cable as linking devices.

Grammar notes. Relative clauses with a participle.

Relative clauses with a participle are often used in technical descriptions. They allow you to provide a lot of information about a noun using as few words as possible.

Study these examples:

- 1) Computers *equipped with* wireless NICs.
- 2) A network printer *connected to* a wireless print server.
- 3) A modem *providing* access to the Internet.
- 4) A fixed LAN *linking* computers with cables.

We can use the passive participle as in examples 1 and 2.

1) Computers *equipped with* wireless NICs. = computers *which are equipped...*

2) A network printer *connected to* a wireless print server.
= a network printer *which is* connected...

We can use an active participle as in examples 3 and 4.

3) A modem *providing* access to the Internet. = modem *which provides* access to the Internet.

4) A fixed LAN linking computers with cables. = A fixed LAN which links computers with cables.

3.16 Define which type of network topology the following statements refer to (star or bus)

1. Every networked device has its own physical link with the hub or switch.

2. Any break in the ... causes serious problems.

3. If one network device crashes, or there is a fault in the network cable, all the other stations are still able to function correctly.

4. This type of network is fast, reliable and inexpensive and is the most common.

5. The performance of the entire network is directly dependent on the performance of the hub. If the server is slow, it will cause the entire network to slow down.

6. Cable length required for this topology is the least compared to other networks.

7. Security is very low because all the computers receive the sent signal from the source.

8. ... is mostly used in small networks. Good for LAN.

9. ...the data packets don't have to make their way through various nodes which makes sure that the data transfer is fast.

10. ...is the simplest of network topologies. In this type of topology, all the nodes (computers as well as servers) are connected to the single cable...

3.17 Describe the main features of a LAN in a paragraph or two:

3.18 Think of possible dangers from the Internet and what measures can be taken to prevent the negative impacts. Write a short (1-page) essay:

3.19 Read the following texts (G-A,B) and write definitions (in English) of the basic terms (italicized).

Text G. (A) Основные характеристики каналов связи

Основная характеристика канала связи – *скорость передачи данных*, т.е. суммарное количество информации, которое может быть передано через коммуникационный канал. Скорость передачи измеряется в битах в секунду

(bits per second, BPS). Производительность канала связи зависит от диапазона частот, которые могут использоваться для передачи данных – *полосы пропускания (bandwidth)*, которая представляет собой разность между самой высокой и самой низкой частотами, на которых канал связи может передавать данные. Еще одна важная характеристика каналов связи – *режимы передачи сигналов*. Существует два режима передачи – *синхронный* и *асинхронный*. Асинхронная связь медленнее синхронной, так как требует передачи стартовых и стоповых битов. Наконец, на производительность канала связи влияет *направление передачи данных*. В системах *симплексной связи* данные всегда могут передаваться только в одном направлении. *Полудуплексная связь* позволяет передавать данные в двух направлениях; но в каждый момент времени устройства могут только передавать или только принимать данные. Системы *полнодуплексной связи* могут одновременно передавать и принимать данные. К основным типам коммуникационных каналов относятся: телефонные линии (коммутируемые и выделенные), коаксиальный кабель, кабель витая пара, волоконно-оптический кабель, а также различные беспроводные линии связи (радиорелейные, спутниковые, инфракрасные).

(B) Назначение модема. Виды модемов и области их применения

Модемы применяются для передачи данных по телефонным линиям. При передаче данных модем выполняет преобразование цифровых сигналов, посылаемых компьютером, в аналоговые сигналы, которые можно передавать по телефонной линии. При приеме данных модем выполняет обратное преобразование сигналов – из аналоговой формы в цифровую. Модемы, работающие на асинхронных линиях связи, к которым относятся обычные коммутируемые телефонные линии, называются *синхронными*. Модемы, осуществляющие прием и передачу данных через выделенные линии, называются *асинхронными*.

Unit 4. Satellite Systems

Start-up

Word study

4.1 Translate the following definitions and memorize the terms:

altitude - 1) height above sea-level *Syn: height*; 2) the angular distance of a celestial body from the horizon measured along the vertical circle passing through the body; *Syn: azimuth*.

augment - to make greater; *Syn: increase, enhance*.

constellation - named group of fixed stars: *Many of the 88 groups of stars were named by the ancient Greeks after animals, objects, or mythological persons*.

latitude - distance north or south of the equator: *It is situated in the latitude of 40 degrees*.

longitude - distance east or west from the Greenwich meridian: *The prime meridian is at 0°*

sidereal - determined with reference to stars. *Syn: star, stellar.*

precise - strictly correct in amount or value. *Syn: exact, punctual; Ant: approximate.*

vehicle - a means for transporting people or objects. *Syn: conveyance.*

maintain - to keep in proper or good condition *Syn: support.*

utility - 1) the thing of practical use; 2) a piece of computer software designed for a routine task.

adjust - to alter slightly, esp. to achieve accuracy; *Syn: regulate.*

sequence - the successive order of two or more things *Syn: progression , series , succession.*

Word building

4.2 *Form the adjectives from the following nouns. Consult a dictionary if necessary:*

Noun	Adjective
accuracy	
integrity	
reliability	
availability	
precision	
efficiency	
application	
sequencing	
productivity	

4.3 *Match up the words which are opposite in meaning:*

Proper, precise, worldwide, occasional, allied, significant, transmit, incorporate, exclude, receive, constant, approximate, unimportant, rival, incorrect, local.

4.4 *Match up the words which have similar meanings:*

Assistance, azimuth, perform, inseparable, regulate, support, enhance, stellar, yearly, maintain, annual, inherent, adjust, augment, altitude, sidereal, aid, implement.

4.5 *Match the following words with their Russian equivalents:*

СТОЛКНОВЕНИЕ	sequence
СОВМЕСТИМЫЙ	collision
ПОСЛЕДОВАТЕЛЬНОСТЬ	alert
ПОДДЕРЖИВАТЬ	compatible
ПРЕДСКАЗЫВАТЬ	maintain

подчеркивать	estimate
настраивать	accelerate
ускорять	adjust
оценивать	underscore
предупреждать	forecast

4.6 Guess the words by their definition:

- 1) Something useful.
- 2) Height above the sea-level.
- 3) One of several parts or sections into which an object is divided.
- 4) The curved path, usually elliptical, followed by a planet, satellite, comet, etc., in its motion around another celestial body under the influence of gravitation.
- 5) A single piece of information.
- 6) Any conveyance in or by which people or objects are transported.
- 7) The wide end of a cathode-ray tube, on which a visible image is formed.
- 8) The limits within which a thing can function effectively.
- 9) The unlimited three-dimensional expanse in which all material objects are located.

4.7 Read text A and match the headings (a-d) with the paragraphs(1-4).

- a) GPS augmentations.*
- b) Roads & Highways.*
- c) What is GPS?*
- d) Timing.*

Text A. The Global Positioning System (GPS)

1. _____

The Global Positioning System (GPS) is a U.S.-owned utility that provides users with positioning, navigation, and timing (PNT) services. This system consists of three segments:

1) The space segment constellation consists of 24 satellites, that transmit one-way signals that give the current GPS satellite position and time. 24 Space Vehicles (SVs) are distributed equally among six circular orbital planes. The orbital planes are centered on the Earth, not rotating with respect to the distant stars. Orbiting at an altitude of approximately 20,200 kilometers; orbital radius of 26,600 km, each SV makes two complete orbits each sidereal day.

2) The control segment consists of worldwide monitor and control stations that maintain the satellites in their proper orbits through occasional command maneuvers, and adjust the satellite clocks. It tracks the GPS satellites, uploads updated navigational data, and maintains health and status of the satellite constellation.

3) The user segment consists of the GPS receiver equipment, which receives the signals from the GPS satellites and calculates the user's three-dimensional

position and time. In general, GPS receivers are composed of an antenna, tuned to the frequencies transmitted by the satellites, receiver-processors, and a highly-stable clock. Receivers typically have between twelve and twenty channels.

2. _____

GPS has become a widely used aid to navigation worldwide, and a useful tool for map-making, land surveying, commerce, and scientific uses. To meet the specific user requirements for PNT, a number of augmentations to the GPS are available. An augmentation is any system that aids GPS by providing accuracy, integrity, reliability, availability, or any other improvement that is not inherently part of GPS itself.

Nationwide Differential GPS System provides increased accuracy and integrity of the GPS to users on land and water. Modernization efforts include enhancing the performance and providing 10 to 15 centimeter accuracy throughout the coverage area. Over 50 countries around the world have implemented similar systems.

Wide Area Augmentation System provides aircraft navigation for all phases of flight.

Continuously Operating Reference Station archives and distributes GPS data for precision positioning and atmospheric modeling applications mainly through *post-processing*¹.

Global Differential GPS supports the real-time positioning, timing, and orbit determination requirements of the U.S. National Aeronautics and Space Administration (NASA) science missions. The U.S. Policy underscores the importance that all global navigation satellite systems and their augmentations be compatible with the GPS.

3. _____

In addition to longitude, latitude, and altitude, the Global Positioning System (GPS) provides a critical fourth dimension - time. Each GPS satellite contains multiple atomic clocks that contribute very precise time data to the GPS signals. GPS receivers decode these signals, effectively synchronizing each receiver to the atomic clocks. This enables users to determine the time to within 100 billionths of a second. Precise time is crucial to a variety of economic activities around the world. Communication systems, electrical power grids, scientific study of earthquakes and financial networks all rely on precision timing for synchronization and operational efficiency. Wireless telephone and data networks use GPS time to keep all of their base stations in perfect synchronization. Similarly, digital broadcast radio services use GPS time to ensure that the bits from all radio stations arrive at receivers *in lockstep*². Companies worldwide use GPS to *time-stamp*³ business transactions. Major investment banks use GPS to synchronize their network computers located around the world. Hollywood studios are incorporating GPS in their movie *slates*⁴, allowing for unparalleled control of audio and video data, as well as multi-camera sequencing.

4. _____

It is estimated that delays from *congestion*⁵ on highways and streets throughout the world result in productivity losses in the hundreds of billions of dollars annually. GPS enables automatic vehicle location and in-vehicle navigation systems that are widely used throughout the world today. By combining GPS position technology with systems that can display geographic information a new dimension in surface transportation is realized. A geographic information system (GIS) stores, analyzes, and displays geographically referenced information. Today GIS enables effective strategies that can keep transit vehicles on schedule and inform passengers of precise arrival times. GPS is an essential element in the future of Intelligent Transportation Systems (ITS). Research is being conducted in the area of advanced driver assistance systems, which include road departure and lane change collision avoidance systems. These systems need to estimate the position of a vehicle relative to lane and road edge with an accuracy of 10 centimeters. With the continuous modernization of GPS, one can expect even more effective systems for crash prevention, distress alerts and position notification, electronic mapping, and in- vehicle navigation with audible instructions.

GPS receivers come in a variety of formats, from devices integrated into cars, phones, and watches, and many other devices.

Notes:

1) ¹*post-processing* - обработка данных (to perform mathematical and logical operations on data according to programmed instructions in order to obtain the required information).

2) ²*in lockstep* - зд. строго одновременно, букв. «шаг в ногу» (progressing at exactly the same speed and in the same direction as other people or things).

3) ³*time-stamp* - временная отметка (to assign an accurate time to a message, transaction, etc.) The database entry consists of the MAC address, the port that address was seen on, and a time- stamp to indicate when it was see.

4) ⁴*slates* - доска, которой хлопают перед очередным дублем (a pair of boards clapped together during film shooting in order to aid sound synchronization).

5) ⁵*congestion* - скопление (the state of being overcrowded, esp. with traffic or people).

4.8 Write out of text A phrases describing general uses of GPS

Comprehension check

4.9 Answer the questions:

- 1) What are the main segments of GPS?
- 2) What augmentation are supposed in GPS?
- 3) Is the GPS system popular?
- 4) How many satellites does navigation system comprise?
- 5) What augmentation serves the US NASA science mission?

- 6) Why is timing so important?
- 7) What is the precision of atomic clock?
- 8) How are navigation systems used on the roads?
- 9) What is GIS?
- 10) What is ITS?

4.10 Read the text again and decide whether these statements are true (+) or false (—), correct the false ones:

- 1) The GPS provides only positioning services.
- 2) The system consists of four segments.
- 3) A number of augmentations are available in over 60 countries.
- 4) Precise time is crucial for military purposes only.
- 5) GPS is used in making modern films.
- 6) The delays on the roads directly affect the economy.
- 7) In-vehicle navigation systems are not common yet.
- 8) GIS is used to keep transit vehicles on schedule.
- 9) GPS is an essential element of ITS.
- 10) ITS is able to estimate the position of a vehicle with an accuracy of 1 cm.

Language in use

4.11 Replace the italicized words with the equivalents from the box.

sidereal	annually	vehicle	altitude	aid	augmentation
precise			maintain		

1. The planes are orbiting at a *height* of approximately 20000 km.
2. Each orbital plane carries four space *conveniences*.
3. Each space vehicle makes two complete orbits each *stellar* day.
4. A number of *enhancements* to the GPS are available.
5. Each GPS satellite contains multiple atomic clocks that contribute very *exact* time data to the GPS signals.
6. The control segment *supports* health and status of the satellite constellation.
7. GPS has become a widely used *help* to navigation worldwide.
8. Delays from congestion on highways result in productivity losses in the hundreds of billions of dollars *yearly*.

4.12 Complete the sentences as in the text.
constellation, 3-dimensional, augmentation, synchronize, maintains, efficiency, vehicle, utility, displays

1. GIS is used to monitor _____ location.

2. GIS stores, analyses and _____ geographically referenced information.
3. An _____ is any system that aids GPS.
4. The GPS is a _____ that provides users with PNT services.
5. The space segment _____ consists of 24 satellites.
6. The control segment _____ the satellites in their proper orbits.
7. The user's segment calculates the user's _____ position and time.
8. Major banks use GPS to _____ their computers around the world.
9. Many economic activities rely on precision timing for operational _____.

Grammar Revision: *Noun attributes and Passive Voice:*

4.13 *Read and translate the following word combinations paying attention to nouns as attributes.*

Remote control station, light pulses, light wave communications system, transmission system, telecommunications network, glass fiber, voice signal, data signal, television signal, telecommunications transmission, construction cost, underground duct, copper cable, signal regenerator, carrier system, device reliability, laser beam wave, radio wave speed, disaster- relief team, , one-way signal, three-dimensional position, on-time performance, advanced- driver assistant system, disaster-relief team, lane-change collision avoidance system, crash prevention, position notification.

4.14 *Read the following sentences and say which of them are in the Active and which are in the Passive Voice. Translate them into Russian.*

1. While the experiment was being carried out nobody left the station.
2. A new type of satellite equipment is being produced at our plant.
3. At present scientific work is being done mostly by large groups of researchers.
4. The apparatus will be working when you come.
5. The scientists who are carrying out research into radio astronomy deal with the most difficult problems.
6. For twenty minutes the air in the laboratory was being purified by two ventilators.
7. The solar battery is converting the energy of sun rays directly into electric energy.
8. This experiment was being carried out in vacuum.
9. For a long time the electronic devices were being used for control.
10. An interesting research in the field of electronics is being done at our Institute.
11. Prospects of the usage of solar energy are already understood by everybody.

12. Now solar energy is being studied by a lot of research groups.
13. Siberian scientists are developing new types of geostationary devices.
14. We were looking for a more simple method of solution but could not find it.
15. The engineers will discuss the advantages of this new system.
16. Our laboratory is housed in an old building.
17. A new navigation equipment is being examined by our scientists now.

4.15 Read text B and say if it covers the following ideas:

1. What is the name of the Chinese navigation system?
2. What countries develop the Galileo system?
3. What is driving the technological battle between Russia and US?
4. How many satellites does navigation system need?
5. What is the advantage of the GLONASS-capable GPS receiver?

Text B. GLONASS

The days of the cold war may have passed, but Russia and the United States are in the midst of another battle - this one a technological fight over the United States monopoly on satellite navigation. Nor is Russia the only country trying to break the American monopoly on navigation technology. China has already sent up satellites to create its own system, called Baidu after the Chinese word for *the Big Dipper*¹. And the European Union has also begun developing a rival system, Galileo, although work has been halted because of doubts among the private contractors over its potential for profits.

GLONASS is a radio-based satellite navigation system, developed by the former Soviet Union and now operated for the Russian government by the Russian Space Forces. Development on the GLONASS began in 1976. The constellation was completed in 1995, but the system rapidly fell into disrepair with the collapse of the Russian economy. Beginning in 2001, Russia committed to restoring the system by 2011, and in recent years has diversified, introducing the Indian government as a partner, and accelerated the program with a goal of global coverage by 2009. A fully functional GLONASS constellation consists of 24 satellites, with 21 operating and three on-orbit *spares*¹, deployed in three orbital planes. A characteristic of the GLONASS constellation is that any given satellite only passes over the exact same spot on the Earth every eighth sidereal day. However, as each orbit plane contains eight satellites, a satellite will pass the same place every sidereal day. For comparison, each GPS satellite passes over the same spot once every sidereal day.

There were three generations of the satellites. The true first generation of Uragan satellites were all 3-axis² stabilized vehicles, generally weighing 1,250-kg.

These spacecraft demonstrated a 16-month average operational lifetime. The second generation of satellites, known as Uragan-M (also called GLONASS-M), possess a substantially increased lifetime of seven years and weigh slightly more - 1,480 kg. The latest designed generation of Uragan-K (GLONASS-K) spacecraft are the third generation of satellites. These satellites are designed with a lifetime of 10 to 12 years, a reduced weight of only 750 kg, and offer an additional *L-Band*⁴ navigational signal. As with the previous satellites, these are 3-axis stabilized, *nadir*⁵ pointing with dual solar arrays.

By May 2007 the system remains partially operational. There were 11 satellites. In recent years, Russia has kept the satellite orbits optimized for navigating in Chechnya, increasing signal coverage there at the cost of degrading coverage in the rest of the world. GLONASS availability in Russia was 45.3% and average availability for the whole Earth was down to 30.5%, with significant areas of less than 25% availability. Meaning that, at any given time of the day in Russia, there is a 45.3% likelihood that a position fix can be calculated.

The Russian system is also calculated to send ripples through the fast-expanding industry for consumer navigation devices by promising a slight technical advantage over G.P.S. alone. Devices receiving signals from both systems would presumably be more reliable. "The network must be impeccable, better than G.P.S., and cheaper if we want clients to choose Glonass," Mr. Putin said at a Russian government meeting on the system.

Notes (B):

- 1) ¹*the Big Dipper* - Большая Медведица (the US and Canadian name for the Plough (constellation)).
- 2) ²*spare* - запасной (in reserve for use when needed).
- 3) ³*axis* - ось (a real or imaginary line about which a body, such as an aircraft, can rotate or about which an object, form, composition, or geometrical construction is symmetrical).
- 4) ⁴*L-Band* - RF range 390 - 1550 MHz
- 5) ⁵*nadir* - надир (the point on the celestial sphere directly below an observer and diametrically opposite the zenith).

4.16 Make up 10 questions to the text using the following constructions:

What is the (nature, difference, process, role, importance, etc.) of...?

What is referred to as....?

What is used as...?

Where do we use. ...?

What function do the ... play?

Discussion

1. Does Russia really need its own navigation system?
2. Does Kazakhstan need to have its own navigation system?

Unit 5. Convergence in Telecoms and IT. New Trends

Start-up

5.1 Work with a partner. Make a list of all the things some of the latest mobile devices can replace. What can your personal mobile phone do, besides sending SMS?

Text A. Responding to Convergence

By: Mike Rock

Convergence is creating new businesses and forcing existing businesses to adapt quickly or die. We are seeing the convergence of telecommunications, IT & Media; the convergence of fixed & mobile services and convergence at device level. All of these trends are creating new markets and making other equipment, products, services and even whole companies rapidly obsolete. For technology manufacturers or service providers, deciding which markets to base your future on becomes a challenge with serious consequences. Should BT or AT&T provide home TV services to replace their declining telephony revenues? Should Kodak integrate a mobile phone into its cameras or just give up?

Does Microsoft still need to sell boxed software when you can download applications onto a smart phone? Does everyone have to have a mobile offering or have no future? When the communication of voice is just another software application what do equipment manufacturers like Nortel or Alcatel-Lucent do? Google just does search, right? Collisions within the telecoms, IT and media sectors are occurring now on a daily basis. Like any busy crossroads, there are going to be near misses and head on crashes. As ever, the survivors will be the companies that understand their customers, and are agile enough to quickly respond to all this change.

Vocabulary notes:

BT - BT Group (ранее *British Telecommunications plc* или *British Telecom*) — британская телекоммуникационная компания.

AT&T Inc. (stylized as *at&t*) is an American multinational telecommunications corporation, the second largest provider of mobile telephony and the largest provider of fixed telephony in the United States

Convergence - Telecommunications convergence, network convergence or simply convergence are broad terms used to describe emerging telecommunications technologies, and network architecture used to migrate multiple communications services into a single network.^[1] Specifically this involves the converging of previously distinct media such as telephony and data communications into common interfaces on single devices.

Obsolete - No longer produced or used; out of date: *the disposal of old and obsolete machinery.*

Nortel Networks Corporation, formerly known as Northern Telecom Limited and sometimes known simply as *Nortel*, was a multinational telecommunications and data networking equipment manufacturer headquartered in Mississauga, Ontario, Canada, bankrupt now.

Alcatel-Lucent is a French global telecommunications equipment company. The company focuses on fixed, mobile, and converged networking hardware, IP technologies, software, and services. Has been operating in Kazakhstan since 1991.

5.2 Based on the text, suggest English equivalents for the following words and expressions:

оборудование, службы и даже компании быстро становятся устаревшими; предоставлять услуги домашнего телевидения; уменьшение доходов; упакованный программный продукт; оживленный перекресток.

5.3 Write a comment in response to this blog post.

Tech tutorial:

3G G.4G = New generations of mobile phone standards, allowing mobile network operators to offer advanced services.

Ethernet = A very high bandwidth data networking technology used by companies in LANs and increasingly WANs.

GSM = Global System for mobile communications. A worldwide standard for mobile phones making phones from one operator compatible with a different operator in another country.

MPLS = Multi-Protocol Label Switching. A data networking protocol and service that can carry different kinds of traffic-voice, data, video etc.

Open source = Software that is made available to developers and users, licensed to encourage re-use without charge.

SaaS = Software as a Service.

Wi-Fi = A technology providing wireless transmission of data over a short range (for example, in a house or office)

Wi- Max = A technology providing wireless transmission of high speed data over a large area (for example, a city).

5.4 Read the magazine article about trends in Telecoms and IT. Match the industry Leader to their area of expertise.

- | | |
|-----------------|-------------|
| 1) Peter Wilson | a) software |
| 2) Jenny Lane | b) telecoms |
| 3) Sanjay Ravi | c) hardware |

Text A. State of play

To celebrate our 10th anniversary, we invited industry leaders to share their thoughts about the changing world of Telecoms and IT. To find out what they think, read on ...

Peter Wilson

The world is now plugged in, and countries are connected up using a mixture of terrestrial networks, undersea cables, satellite and microwave communications, Wi-Max and Wi-Fi, GSM and 3G. The move from packet-based services to the internet protocol means everyone expects to communicate voice, data and video from anywhere to anywhere, globally. The availability of wide area data services such as MPLS and Ethernet have spread all over the world, allowing companies to manage and communicate with their operations wherever they may be.

A reason for this has been the fall in bandwidth costs, and broadband is getting cheaper and cheaper. Services can now deliver tens or even hundreds of megabits of bandwidth into individual homes for much less money than a 64Kb line that a whole factory might have used to run its operation only a few years ago.

Jenny Lane

In 1965 Gordon Moore stated that the number of transistors on a chip would double about every two years. And that has more or less remained true since then. As we write, a single chip can hold about 1 billion transistors each making 3 billion binary calculations per second.

There has' been a huge increase in the volume of data and data storage capacity required for this; secondly, there has been a significant decrease in the size and power consumption of hardware and finally manufacturing costs are falling significantly. The result is that there are more and more powerful computers in our lives, and even handheld devices can store gigabytes of data holding thousands of MP3 music, files or hundreds of films.

Sanjay Ravi

The internet is changing the way we access, buy and use applications. We go online and download the software we want onto our computer, like any other digital product. Increasingly we don't even have the software on our hardware, but visit an internet site and use that application as a service. The use of this Software as a Service (SaaS) model means that we may not need such powerful computers in the future.

We have seen the impact of off- shoring and the rise of India as the world centre of software development and application management. We are also seeing some of the smartest applications and services coming out of people's bedrooms; more and more experts are producing Open source software, which is becoming more and more popular, creating a real threat to the big corporations.

5.5 Read the text again. Say if the following statements are TRUE (T) or FALSE (F) according to the text.

According to Peter Wilson:

- 1) most countries are connected up with undersea cables. T F
- 2) many countries have unreliable mobile phone networks. T F
- 3) recently bandwidth costs have risen dramatically. T F

According to Jenny Lane:

- 4) Moore's predictions have been fairly accurate. T F
- 5) a typical chip can now hold 3 billion transistors. T F
- 6) both data storage capacity and power consumption have gone up. T F

According to Sanjay Ravi:

- 7) fewer people are going to computer stores to buy software. T F
- 8) SaaS will require ordinary users to have more powerful computers. T F
- 9) software development needs the support of a big corporation to succeed. T F

6.6 Match the words on the left with the words on the right to make pairs of words that often go together. The word on the left must go with all three words in the set. See the example.

- | | |
|------------|---|
| 1 access | a chip, wafer, valley |
| 2 download | b an application, a network, an account |
| 3 go | c online, offline, on holiday |
| 4 mobile | d phone, telephony, broadband |
| 5 silicon | e a file, an image, a demo version |

5.7 Complete the sentences using pairs of words from exercise. Make any changes that are necessary.

- 1 Everyone has _____, so payphones are becoming redundant.
- 2 Many internet entrepreneurs from _____ in California are now turning their attention to alternative forms of energy.
- 3 Before you buy the program, you can _____ just to see how you like it.
- 4 With a mobile broadband connection, you can _____ any time and anywhere.
- 5 Internet banking allows users to _____ and check their balances.
- 6 How many transistors can you fit onto a _____?

Talking about change

We can use the present continuous to talk about change.

Manufacturing costs *are falling* significantly

More and more experts *are producing* Open source software.

We often use one or more comparative adjectives to talk about change.

Broadband is getting cheaper and cheaper.

Open source software is becoming *more and more popular*.

5.8 Complete sentences with the words in brackets, making any changes that are necessary.

- 1 Digital radio sets *are becoming* (become) less and less popular.
- 2 More and more people _____ (listen) to radio over the Internet.
- 3 _____ Laptops are getting _____ (cheap).
- 4 Handheld devices are becoming _____ (sophisticated).
- 5 Battery life _____ (get) _____ (long).
- 6 In some areas, VoIP _____ (take over) from PSTN.
- 7 Mobile broadband speeds _____ (increase) dramatically.

Convergence in business

5.9 New words are continually being created in Telecoms and IT. Often these words are made up of two parts. Match the openings in Column A with the correct endings in Column B. See the example.

A	B
UP	-space, -crime
DOWN	-load, -grade, date (upload, upgrade, update)
E	-time, -load
TELE	-book, -mail, -commerce
CYBER	-working, -conferencing, -coms

5.10 Now match the openings in Column A with the endings in Column B

A	B
hard-, ad-, spy-	BAND
wave-, broad-, narrow-	BYTE
broad-, pod-, news-	CAST
smart-, cell-, i-, head-	WARE
kilo-, mega-, giga-	PHONE

Can you think of any other words with these openings and endings?

5.11 Complete the sentences using a suitable word from exercises 11, 12

1. _____ is increasing, so more and more people have an office at home and aren't commuting to an office.
2. The police are recruiting IT experts to deal with the alarming increase in _____.
3. Each memory module contains a _____ of RAM, or 1024 megabytes, to be precise.
4. Our servers are very reliable, so we have hardly any _____.
5. This anti-virus program scans your PC for _____ that threatens your security.
6. Did you buy a full version of the OS or just an _____?

5.12 Read the article about networking developing countries and answer the questions below.

Text H. Developing Countries Seek to Upgrade Their Telecoms Networks

As developing countries seek to upgrade their telecoms networks, they are faced with difficult choices.

On the one hand, they have the advantage of being able to forget about rolling out national fixed line networks. In some countries, teledensity is as low as 4%, so expanding a wired network to cover an entire population is far too expensive. The result is that they can bypass an old technology and move straight to a national wireless network to provide broadband and voice [VoIP] services.

On the other hand, there is a difficult choice to make - Wi-Max or 3G?

In many developing countries, Wi-Max [Worldwide interoperability for Microwave Access] has already made a huge impact. It delivers high-speed access wirelessly, enabling fixed and mobile broadband services over large coverage areas. It is an IP-based system and comes in two versions, fixed and mobile. Fixed Wi-Max is suited for delivering wireless last mile access for fixed broadband services, similar to DSL. Mobile Wi-Max supports both fixed and mobile applications with improved performance and capacity while adding full mobility. In India, Tata has launched what it says will be the world's biggest Wi-Max network, with a projected cost of \$600 million.

In the other corner is 3G (and coming soon, 4G and LTE), a well-established wireless network in developed countries. 3G has evolved from the voice-centric telecoms world but is able to deliver not just voice but high-speed broadband access as well. The last ten years have seen the growth of huge networks in the developed world, and emerging nations are catching up rapidly. China is investing billions of dollars in rolling out a nationwide 3G network that will reach 70% of the population, and the Asia Pacific region expects to have over 500 million 3G subscribers in the next few years.

In the longer term, we are already starting to see the convergence of Wi-Max and 3G. While Wi-Max has broadened to become more mobile and capable of being used for media services, 3G cellular has become increasingly broadband, resulting in practical convergence between these fields of development. What's more, both are driven to use the same core sets of technologies.

At the moment, developing countries still have to make a choice between the two systems, and are faced with the familiar Betamax vs VHS or BluRay vs HD decision. But if the two technologies can co-operate rather than compete, then the future of broadband and voice services in developing countries will look a lot brighter.

5.12 Answer the following questions:

- 1) Why are some developing countries not developing their wired networks?
- 2) What suggests that Wi-Max and 3G are equally suitable for developing countries?
- 3) According to the text, what will happen to Wi-Max and 3G in the future?

5.13 Over to you:

- 1) What wireless technologies are being used in your country?
- 2) What are the limits to wireless technology when compared to fixed line?
- 3) Can you see the world becoming entirely wireless in the future?

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Людмила Яковлевна Коробейникова

ПРОФЕССИОНАЛЬНО-ОРИЕНТИРОВАННЫЙ
АНГЛИЙСКИЙ ЯЗЫК

Telecommunication systems and networks

Методические указания для студентов специальности 5В071900

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