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Unit 1

Text A

Telecommunications

Telecommunication is the transmission of signs, signals, messages, words, writings, images and sounds or information of any nature by wire, radio, optical or electromagnetic systems.

Telecommunication occurs when the exchange of information between communication participants includes the use of technology. It is transmitted either electrically over physical media, such as cables, or via electromagnetic radiation. Such transmission paths are often divided into communication channels which afford the advantages of multiplexing.

The Latin term communication is considered the social process of information exchange, the term telecommunications is often used in its plural form because it involves many different technologies.

Key concepts

Modern telecommunication is founded on a series of key concepts that experienced progressive development and refinement in a period of well over a century.

Basic Telecommunication technologies may primarily be divided into wired and wireless methods.

Overall though, a basic telecommunication system consists of three main parts that are always present in some form or another:

- A transmitter that takes information and converts it to a signal.
- A transmission medium, also called the physical channel that carries the signal. An example of this is the "free space channel".
- A receiver that takes the signal from the channel and converts it back into usable information for the recipient.

For example, in a radio broadcasting station the station's large power amplifier is the transmitter; and the broadcasting antenna is the interface between the power amplifier and the "free space channel". The free space channel is the transmission medium; and the receiver's antenna is the interface between the free space channel and the receiver. Next, the radio receiver is the destination of the radio signal, and this is

where it is converted from electricity to sound for people to listen to.

Sometimes, telecommunication systems are "duplex" (two-way systems) with a single box of electronics working as both a transmitter and a receiver, or a transceiver. For example, a cellular telephone is a transceiver. The transmission electronics and the receiver electronics within a transceiver are actually quite independent of each other. This can be readily explained by the fact that radio transmitters contain power amplifiers that operate with electrical powers measured in watts or kilowatts, but radio receivers deal with radio powers that are measured in the microwatts or nanowatts. Hence, transceivers have to be carefully designed and built to isolate their high-power circuitry and their low-power circuitry from each other, as to not cause interference.

Telecommunication over fixed lines is called point-to-point 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 low-power but sensitive radio receivers.

Telecommunications in which multiple transmitters and multiple receivers have been designed to cooperate and to share the same physical channel are called multiplex systems. The sharing of physical channels using multiplexing often gives very large reductions in costs, Multiplexed systems are laid out in telecommunication networks, and the multiplexed signals are switched at nodes through to the correct destination terminal receiver.

Analog versus digital communications.

Communications signals can be sent either by analog signals or digital signals. There are analog communication systems and digital communication systems. For an analog 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 (for example, a set of ones and zeros). During the propagation and reception, the information contained in analog signals will inevitably be degraded by undesirable physical noise. (The output of a transmitter is noise-free for all practical purposes.) Commonly, the noise in a communication system can be expressed as adding or subtracting from the desirable signal in a completely random way. This form of noise is called additive noise, with the understanding that the noise can be negative or positive at different instants of time. Noise that is not additive noise is a much more difficult situation to describe or analyze, and these other kinds of noise will be omitted here. On the other hand, unless the

additive noise disturbance exceeds a certain threshold, the information contained in digital signals will remain intact. Their resistance to noise represents a key advantage of digital signals over analog signals.

Telecommunication networks.

A telecommunications network is a collection of transmitters, receivers and communication channels that send messages to one another. Some digital communications networks contain one or more routers that work together to transmit information to the correct user. An analog communications network consists of one or more switches that establish a connection between two or more users. For both types of network, repeaters may be necessary to amplify or recreate the signal when it is being transmitted over long distances. This is to combat attenuation that can render the signal indistinguishable from the noise. Another advantage of digital systems over analog is that their output is easier to store in memory, i.e. two voltage states (high and low) are easier to store than a continuous range of states.

Communication channels.

The term “channel” has two different meanings. In one meaning, a channel is the physical medium that carries a signal between the transmitter and the receiver. Examples include the atmosphere for sound communications, glass optical fibers for some kinds of optical communications, coaxial cables for communications by means of the voltages and electric currents in them, and free space for communications using visible light, infrared waves, ultraviolet light, and radio waves. Coaxial cable types are classified by RG type or “radio guide”, terminology derived from World War II. The various RG designations are used to classify the specific signal transmission applications. This last channel is called the “free space channel”. Sending radio waves from one place to another has nothing to do with the presence of an atmosphere between the two. Radio waves travel through a perfect vacuum just as easily as they travel through air, fog, clouds, or any other kind of gas.

The other meaning of term “channel” in telecommunications is seen in the phrase communications channel, which is a subdivision of a transmission medium so that it can be used to send multiple streams of information simultaneously. For example, one radio station can broadcast radio waves into free space at frequencies in the neighborhood of 94.5 MHz (megahertz) while another radio station can simultaneously broadcast radio

waves at frequencies in the neighborhood of 96.1 MHz. Each radio station would transmit radio waves over a frequency bandwidth of about 180 kHz (kilohertz), centered at frequencies such as the above, which are called the "carrier frequencies". Each station in this example is separated from its adjacent stations by 200 kHz, and the difference between 200 kHz and 180 kHz (20 kHz) is an engineering allowance for the imperfections in the communication system.

In the example above, the "free space channel" has been divided into communications channels according to frequencies, and each channel is assigned a separate frequency bandwidth in which to broadcast radio waves. This system of diving the medium into channels according to frequency is called "frequency-division multiplexing". Another term for the same concept is "wavelength-division multiplexing", which is more commonly used in optical communications when multiple transmitters share the same physical medium. Another way of dividing a communications medium into channels is to allocate each sender a recurring segment of time (a "time slot", for example, 20 millisecond out of each second), and to allow each sender to send messages only within its own time slot. This method of diving the medium into communication channels is called "time-division multiplexing" (TDM), and is used in optical fiber communication. Some radio communication systems use a hybrid of TDM and FDM.

Task 1. Read and translate text A.

Task 2. Give the Russian equivalents of the following expressions:

radio broadcasting station, power amplifier, the transmission medium, broadcasting antenna, interference, broadcast communication, sensitive radio receivers, combat attenuation, frequency-division multiplexing, wavelength-division multiplexing, time-division multiplexing, to convey information

Task 3. Complete the following sentences using text A.

1. Telecommunication is the transmission of…
2. Such transmission paths are often divided into…
3. In a radio broadcasting station the station's…
4. The free space channel is…
5. Telecommunication over fixed lines is called…

6. Communications signals can be sent…
7. Commonly, the noise in a communication system can be …
8. A telecommunication network is a collection of…
9. In one meaning, a channel is the physical…

Task 4. Make up your questions to text A, ask your partners.

Task 5. Using the material of the text above, write the main points. Use the following conversation phrases:

I think it is important…, Generally speaking…, It is interesting to know…

Task 6. Write the summary of text A.

Text B
Principles of Wireless Communications

Wireless communications begin with a message that is converted into an electronic signal by a device called a transmitter. The transmitter uses an oscillator to generate radio waves. The transmitter modulates the radio wave to carry the electronic signal and then sends the modified radio signal out through space, where it is picked up by a receiver. The receiver decodes, or demodulates, the radio wave and plays the decoded message over a speaker. Wireless communications provide more flexibility than wire-based means of communication. However, there are some drawbacks. Wireless communications are limited by the range of the transmitter (how far a signal can be sent), and since radio waves travel through the atmosphere, they can be disturbed by electrical interferences (such as lightning) that cause static.

Wireless communications systems involve either one-way transmissions, in which a person merely receives notice of a message, or two-way transmissions, such as a telephone conversation between two people. An example of a device that sends one-way transmission is a pager, which is a radio receiver. When a person dials a pager number, the pager company sends a radio signal to the desired pager. The encoded signal triggers the pager circuitry and notifies the customer carrying the pager of the incoming call with a tone or a vibration, and often the telephone number of the caller. Advanced pagers can

display short messages from the caller, or provide news updates or sports scores.

Two-way transmissions require both a transmitter and a receiver for sending and receiving signals. A device that functions as both a transmitter and a receiver is called a transceiver. Cellular radio telephones and two-way radios use transceivers, so that back-and-forth communication between two people can be maintained. Early transceivers were very large, but they have decreased in size due to advances in technology. Fixed-base transceivers, such as those used at police stations, can fit on a desktop, and hand-held transceivers have shrunk in size as well. Several current models of hand-held transceivers weigh less than 0.2 kg (0.5 lb).

Modes of Wireless Communications

Wireless communications systems have grown and changed as technology has improved. Several different systems are used today, all of which operate on different radio frequencies. New technologies are being developed to provide greater service and reliability.

Air Transceivers

Radio operators still monitor distress channels, but maritime and aviation telecommunications systems now use high-frequency radios and satellites capable of transmitting speech, rather than wireless telegraphy, to send messages. Aircraft pilots use radios to communicate with air traffic controllers at airports and also to communicate with other pilots. Navigation beacons are equipped with transmitters that send automated signals to help ships and aircraft in distress determine their positions. While high-frequency radio can transmit signals over long distances, the quality of these signals can be diminished by bad weather or by electrical interference in the atmosphere, which is often caused by radiation from the sun.

Hand-Held Radio Transceivers

Police, fire, and other emergency organizations, as well as the military, have used two-way wireless radio communication since the 1930s. Early vehicle-based radios were large, heavy units. After the invention of the transistor in 1948, radios shrank in size to small hand-held radio transceivers, which civil authorities now use to communicate with each other directly. Public two-way radios with several frequency options are widely available as well. Usually limited in range to a few miles, these units are great aids for

such mobile professionals as construction workers, film crews, event planners, and security personnel. Simpler two-way radios, called walkie-talkies, have been popular children's toys for years.

Shortwave

Long-range broadcast services and frequencies, in what is known as the shortwave radio band (with frequencies of 3 to 30 megahertz), are available for amateur or ham radio operators. Shortwave radio broadcasts can travel long distances because of the concentration of ionized, or electrically charged, particles in the layer of the atmosphere known as the ionosphere. This layer reflects radio signals, sending signals that are transmitted upward back to earth. This skipping of waves against the ionosphere can greatly increase the range of the transmitter. The degree of reflectivity of the ionosphere depends on the time of day.

Cellular Radio Telephones

Cellular radio telephones, or cell phones, combine their portable radio capability with the wired, or wireline, telephone network to provide mobile users with access to the rest of the public telephone system used by non-mobile callers. Modern cellular telephones use a network of several short-range antennas that connect to the telephone system. Because the antennas have a shorter range, frequencies can be reused a short distance away without interference.

Satellite Communications

Satellite communications services connect users directly to the telephone network from almost anywhere in the world. Special telephones are available to consumers that communicate directly with communications satellites orbiting the earth. The satellites transmit these signals to ground stations that are connected to the telephone system. These satellite services, while more expensive than cellular or other wireless services, give users access to the telephone network in areas of the world where no telephone service exists.

The number of companies offering wireless communications services has grown steadily in recent years. In 1988 about 500 companies offered cellular radio telephone (cell phone) services. By 1995 that number had grown to over 1500 companies serving millions of subscribers. Wireless communication is becoming increasingly popular

because of the convenience and mobility it affords, the expanded availability of radio frequencies for transmitting, and improvements in technology.

Refraction is important at long ranges (tens to hundreds of kilometers) due to gradients in moisture content and temperature in the atmosphere. In urban, mountainous, or indoor environments, obstruction by intervening obstacles and reflection from nearby surfaces are very common, and contribute to multipath distortion: that is, reflected and delayed replicates of the transmitted signal are combined at the receiver. Signals from different paths can add constructively or destructively: such variations in amplitude are known as fading. The dependence of signal strength on position of transmitter and receiver becomes complex and often non-monotonic, making single-receiver estimates of position inaccurate and unreliable. Multilateration, using many receivers, is often combined with calibration measurements ("fingerprinting") to improve accuracy.

Task 1. Read and translate text B.

Task 2. Find the sentence which expresses the main idea of each paragraph of text B. Entitle each paragraph.

Task 3. Answer the following questions.

1. Which device uses radio waves to transmit and receive signals?
2. What is the main function of the transmitter?
3. What do wireless communications systems involve?
4. Can you describe the modes of wireless communications?
5. What are the basic principles of cellular radio telephones and satellite communications?

Task 4. Make up and write the scheme of text B using titles of each paragraph.

Task 5. Write the summary of text B.

Task 6. Give the Russian equivalents of the following expressions:

wireless telecommunications system, fixed location, wireless technologies, wire-based services, short-range communication, one-way transmission, the encoded signal triggers.

Text C
Radiolocation

Radiolocating is the process of finding the location of something through the use of radio waves. It generally refers to passive uses, particularly radar - as well as detecting buried cables, water mains, and other public utilities. It is similar to radionavigation, but radiolocation usually refers to passively finding a distant object rather than actively one's own position. Both are types of radiodetermination. Radiolocation is also used in real-time locating systems (RTLS) for tracking valuable assets.

Basic principles

An object can be located by measuring the characteristics of received radio waves. The radio waves may be transmitted by the object to be located, or they may be backscattered waves (as in radar or passive RFID). A stud finder uses radiolocation when it uses radio waves rather than ultrasound.

One technique measures a distance by using the difference in the power of the received signal strength (RSSI) as compared to the originating signal strength. Another technique uses the time of arrival (TOA), when the time of transmission and speed of propagation are known. Combining TOA data from several receivers at different known locations (time difference of arrival, TDOA) can provide an estimate of position even in the absence of knowledge of the time of transmission. The angle of arrival (AOA) at a receiving station can be determined by the use of a directional antenna, or by differential time of arrival at an array of antennas with known location. AOA information may be combined with distance estimates from the techniques previously described to establish the location of a transmitter or backscatterer. Alternatively, the AOA at two receiving stations of known location establishes the position of the transmitter. The use of multiple receivers to locate a transmitter is known as multilateration.

Use of RSSI to locate a transmitter from a single receiver requires that both the transmitted (or backscattered) power from the object to be located are known, and that the propagation characteristics of the intervening region are known. In empty space, signal strength decreases as the inverse square of the distance for distances large compared to a wavelength and compared to the object to be located, but in most real environments, a number of impairments can occur: absorption, refraction, shadowing,

and reflection. Absorption is negligible for radio propagation in air at frequencies less than about 10 GHz, but becomes important at multi-GHz frequencies where rotational molecular states can be excited.

TOA and AOA measurements are also subject to multipath errors, particularly when the direct path from the transmitter to receiver is blocked by an obstacle. Time of arrival measurements are also most accurate when the signal has distinct time-dependent features on the scale of interest—for example, when it is composed of short pulses of known duration—but Fourier transform theory shows that in order to change amplitude or phase on a short time scale, a signal must use a broad bandwidth. For example, to create a pulse of about 1 ns duration, roughly sufficient to identify location to within 0.3 m (1 foot), a bandwidth of roughly 1 GHz is required. In many regions of the radio spectrum, emission over such a broad bandwidth is not allowed by the relevant regulatory authorities, in order to avoid interference with other narrowband users of the spectrum. In the United States, unlicensed transmission is allowed in several bands, such as the 902-928 MHz and 2.4-2.483 GHz Industrial, Scientific, and Medical ISM bands, but high-power transmission cannot extend outside of these bands. However, several jurisdictions now allow ultrawideband transmission over GHz or multi-GHz bandwidths, with constraints on transmitted power to minimize interference with other spectrum users. UWB pulses can be very narrow in time, and often provide accurate estimates of TOA in urban or indoor environments.

Radiolocation is employed in a wide variety of industrial and military activities. Radar systems often use a combination of TOA and AOA to determine a backscattering object's position using a single receiver. In Doppler radar, the Doppler shift is also taken into account, determining velocity rather than location (though it helps determine future location). Real Time Location Systems RTLS using calibrated RTLS, and TDOA, are commercially available. The widely used Global Positioning System (GPS) is based on TOA of signals from satellites at known positions.

Task 1. Read and translate text C.

Task 2. Give the definition of radiolocation.

Task 3. Complete the following sentences using the text.

1. The radio waves may be transmitted…

2. One technique measures a distance by using…
3. Another technique uses the time…
4. The use of multiple receivers to locate…
5. In empty space, signal strength decreases…
6. Absorption is negligible for radio propagation in air…
7. Signals from different paths can add constructively…
8. Radar systems often use a combination of TOA and AOA to…

Task 4. Write a summary of the text. Limit it to 10 sentences.

Task 5. Use a dictionary and find Russian equivalents of the following words.

the received signal, the original signal strength, the angel of arrival, multiple receivers, multilateration, the transmission characteristics, non-line-of-sight receptions, backscattered, the propagation characteristics, inverse square.

Text D
Radar Principle

The electronic principle on which radar operates is very similar to the principle of sound-wave reflection. If you shout in the direction of a sound-reflecting object (like a rocky canyon or cave), you will hear an echo. If you know the speed of sound in air, you can then estimate the distance and general direction of the object. The time required for an echo to return can be roughly converted to distance if the speed of sound is known. The radio-frequency (rf) energy is transmitted to and reflected from the reflecting object. A small portion of the reflected energy returns to the radar set. This returned energy is called an ECHO, just as it is in sound terminology. Radar sets use the echo to determine the direction and distance of the reflecting object. The term RADAR is an acronym made up of the words: RAdio (Aim) Detecting And Ranging. The term "RADAR" was officially coined as an acronym by U.S. Navy Lieutenant Commander Samuel M. Tucker and F. R. Furth in November 1940. Under some conditions a radar system can measure the direction, height, distance, course and speed of these objects. The frequency of electromagnetic energy used for radar is unaffected by darkness and also penetrates fog and clouds. This permits radar systems to determine the position of airplanes, ships

or other obstacles that are invisible to the naked eye because of distance, darkness, or weather. Modern radar can extract widely more information from a target's echo signal than its range. But the calculating of the range by measuring the delay time is one of its most important functions.

Basic design of a radar system (the operating principle of a primary radar set)

The radar antenna illuminates the target with a microwave signal, which is then reflected and picked up by a receiving device. The electrical signal picked up by the receiving antenna is called echo or return. The radar signal is generated by a powerful transmitter and received by a highly sensitive receiver.

The Primary Radar Basic Principle

All targets produce a diffuse reflection i.e. it is reflected in a wide number of directions. The reflected signal is also called scattering. Backscatter is the term given to reflections in the opposite direction to the incident rays. Radar signals can be displayed on the traditional plan position indicator (PPI) or other more advanced radar display systems. A PPI has a rotating vector with the radar at the origin, which indicates the pointing direction of the antenna and hence the bearing of targets.

Transmitter

The radar transmitter produces the short duration high-power rf pulses of energy that are into space by the antenna.

Duplexer

The duplexer alternately switches the antenna between the transmitter and antenna need be used. This switching is necessary because the high-power pulses of the transmitter would destroy the receiver if energy were allowed to enter the receiver.

Receiver

The receivers amplify and demodulate the received RF-signals. The receiver provides video signals on the output.

Radar Antenna

The Antenna transfers the transmitter energy to signals in space with the required

distribution and efficiency. This process is applied in an identical way on reception.

Indicator

The indicator should present to the observer a continuous, easily understandable, graphic picture of the relative position of radar targets. The radar screen displays the produced from the echo signals bright blibs. The longer the pulses were delayed by the runtime, the further away from the center of this radar scope they are displayed.

Task 1. Read and translate text D.

Task 2. Write the summary of text D.

Task 3. Look through the text and answer the following questions:

1. What does the term “radar” mean?
2. What is the basic design of a radar system?
3. Why do we need transmitter?
4. Explain, what is duplexer?
5. What are the main functions of receiver, antenna, indicator?

Task 4. Write and then formulate a brief description of the radar system. Your description should answer these questions:

1. What does the radar system consist of?
2. What are the components of the transmitter?
3. What does the receiver consist of?
4. Where is the signal generated?
5. What happens to it after that?
6. If a target is hit, what happens to the reflected signal?
7. How does the receiver process the signal?
8. What happens to both signals finally?

Task 5. To help you make description of the radar system, match components and their functions.

Oscillator	the signal is radiated
Power amplifier	the signal is generated
Transmitting antenna	the signal is amplified

Receiving antenna the signal is rectified
Radio frequency amplifier the signal is amplified
Detector both signals are displayed
Comparator a weak reflected signal is received
Indicator the received signal is compared with a reference signal from the transmitter

Task 6. Read this text. Try to retell.

Let's take a look at how the perception module finds out what's around the car:

1. Radar - a common sensor that is already used on cars with cruise mode. However, the radar is not very well aware that in front of him is a pedestrian, if he is not in a metal suit. A distinctive feature of the radar is the ability to learn the radial velocity.

2. Cameras are responsible for the overall picture on the road.

3. Lidar - a sensor that determines the distance to certain objects on the road, and also "sees" everything better than radars and cameras. But he has two minuses: price and quality. Even if the lidar is made according to all the guests, it can still quickly fail due to the constant movement, actually because f this it remains a niche technology. But in general, a lidar is an interesting invention, with the help of which is good. In order to better distinguish what is around a car, the method of segmentation can be applied by instances, where, unlike ordinary segmentation, objects do not merge into one color, but break into parts. The vision of the car can be realized using only cameras and radars- the cheapest technology. The peculiarity of this method lies in the local use of technology: base maps are loaded into the on-board computer, processed by neural networks, and then compared to the loaded maps.

Task 7. Make up your questions to the text "Multiplexer". Ask your partner.

Multiplexer

In electronics, a multiplexer (or mux) is a device that selects between several analog or digital input signals and forwards it to a single output line. A multiplexer of 2n inputs has n select lines, which are used to select which input line to send to the output. Multiplexers are mainly used to increase the amount of data that can be sent over the network within a certain amount of time and bandwidth. A multiplexer is also called a data selector. Multiplexers can also be used to implement Boolean functions of multiple variables.

An electronic multiplexer makes it possible for several signals to share one device or resource, for example, one A/D converter or one communication line, instead of having one device per input signal.

Conversely, a demultiplexer (or demux) is a device taking a single input signal and selecting one of many data-output-lines, which is connected to the single input. A multiplexer is often used with a complementary demultiplexer on the receiving end.

An electronic multiplexer can be considered as a multiple-input, single-output switch, and a demultiplexer as a single-input, multiple-output switch. The schematic symbol for a multiplexer is an isosceles trapezoid with the longer parallel side containing the input pins and the short parallel side containing the output pin.

Text E
Antenna array

An antenna array is a set of multiple connected antennas which work together as a single antenna, to transmit or receive radio waves. The individual antennas (called elements) are usually connected to a single receiver or transmitter by feedlines that feed the power to the elements in a specific phase relationship. The radio waves radiated by each individual antenna combine and superpose, adding together (interfering constructively) to enhance the power radiated in desired directions, and cancelling interfering destructively) to reduce the power radiated in other directions. Similarly, when used for receiving, the separate radio frequency currents from the individual antennas combine in the receiver with the correct phase relationship to enhance signals received from the desired directions and cancel signals from undesired directions. More sophisticated array antennas may have multiple transmitter or receiver modules, each connected to a separate antenna element or group of elements. An antenna array can achieve higher gain (directivity), that is a narrower beam of radio waves, than could be achieved by a single element. In general, the larger the number of individual antenna elements used, the higher the gain and the narrower the beam. Some antenna arrays (such as military phased array radars) are composed of thousands of individual antennas. Arrays can be used to achieve higher gain, to give path diversity (also called MIMO) which increases communication reliability, to cancel interference from specific directions, to steer the radio beam electronically to point in different directions, and for

radio direction finding (RDF). The term antenna array most commonly means a driven array consisting of multiple identical driven elements all connected to the receiver or transmitter. A parasitic array consists of a single driven element connected to the feedline, and other elements which are not, called parasitic elements. It is usually another name for a Yagi-Uda antenna. A phased array usually means an electronically scanned array; a driven array antenna in which each individual element is connected to the transmitter or receiver through a phase shifter controlled by a computer. The beam of radio waves can be steered electronically to point instantly in any direction over a wide angle, without moving the antennas. However the term "phased array" is sometimes used to mean an ordinary array antenna.

Description

Small antennas around one wavelength in size, such as quarter-wave monopoles and half-wave dipoles, don't have much directivity (gain); they are omnidirectional antennas which radiate radio waves over a wide angle. To create a directional antenna (high gain antenna), which radiates radio waves in a narrow beam, two general techniques can be used. One technique is to use reflection by large metal surfaces such as parabolic reflectors or horns, or refraction by dielectric lenses to change the direction of the radio waves, to focus the radio waves from a single low gain antenna into a beam. This type is called an aperture antenna. A parabolic dish is an example of this type of antenna. A second technique is to use multiple antennas which are fed from the same transmitter or receiver; this is called an array antenna, or antenna array. If the currents are fed to the antennas with the proper phase, due to the phenomenon of interference the spherical waves from the individual antennas combine (superpose) in front of the array to create plane waves, a beam of radio waves traveling in a specific direction. In directions in which the waves from the individual antennas arrive in phase, the waves add together (constructive interference) to enhance the power radiated. In directions in which the individual waves arrive out of phase, with the peak of one wave coinciding with the valley of another, the waves cancel (destructive interference) reducing the power radiated in that direction. Similarly, when receiving, the oscillating currents received by the separate antennas from radio waves received from desired directions are in phase and when combined in the receiver reinforce each other, while currents from radio waves received from other directions are out of phase and when combined in the receiver cancel each other. The radiation pattern of such an antenna consists of a strong

beam in one direction, the main lobe, plus a series of weaker beams at different angles called sidelobes, usually representing residual radiation in unwanted directions. The larger the width of the antenna and the greater the number of component antenna elements, the narrower the main lobe, and the higher the gain which can be achieved, and the smaller the sidelobes will be. Arrays in which the antenna elements are fed in phase are broadside arrays; the main lobe is emitted perpendicular to the plane of the elements. The largest array antennas are radio interferometers used in the field of radio astronomy, in which multiple radio telescopes consisting of large parabolic antennas are linked together into an antenna array, to achieve higher resolution. Using the technique called aperture synthesis such an array can have the resolution of an antenna with a diameter equal to the distance between the antennas. In the technique called Very Long Baseline Interferometry (VLBI) dishes on separate continents have been linked, creating "array antennas" thousands of miles in size.

Task 1. Read and translate text E.

Task 2. Write the abstract of this text, divide text into parts, express the main idea of each part.

Unit 2

Text A

Radio Waves

Can you count how many devices you use every day thanks to radio waves? It can be a bit overwhelming to think about just how impacted our lives are by the utilization of this technology. From smartphones to laptops, GPS to baby monitors and more, we've come to harness this form of electromagnetic energy to create some amazing things. But while we use these devices each and every day, do we truly understand how they work?

Radio waves are but one type of wave in what's called the electromagnetic spectrum, which consists of a variety of waves that all serve a specific function, like infrared, x-ray, gamma rays, and radio. All of these waves manage to defy physical barriers, hurtling through the vacuum of space at the speed of light.

The organization of this spectrum is categorized by two measurements, frequency, and wavelength. Here's how they breakdown:

- Frequency. This is basically how many electromagnetic waves will pass through a given point every second. You can measure this by counting the crests of each wave (the highest point in the wave), which provides a value in Hertz.
- Wavelength. This is the actual distance that you can measure between two of the highest points in a wave, or the period. Wavelengths can be shorter than the size of an atom for some waves, and longer than the diameter of our entire planet! On this electromagnetic spectrum, radio waves have both the longest wavelengths and the lowest frequencies, which makes them slow and steady, the long-distance runners of the bunch.
- Speed of a radio signal. Another feature which can be noted about an electromagnetic wave is its speed. As it is the same as a light wave it has the same speed. Normally this is taken to be 3 x 10 8metres a second but a more exact figure is 299 792 500 metres a second in a vacuum.

The speed, frequency and wavelength of a radio wave are all related to one another. As the speed is virtually the same whether the signal is travelling in free space, or in the atmosphere, it is very easy to work out the wavelength of a signal if its frequency is known. Conversely the frequency can be calculated if the wavelength is known. The formula is very simply:

$v = \lambda \times f$

where

v =the velocity of the radio wave in metres per second (normally taken as 3 x 10 8m/s

λ =the wavelength in metres

f =the frequency in Hertz

For example a signal with a frequency of 1 MHz will have a wavelength of 300 metres.

The ultra high frequency (UHF) band has a frequency between 300 megahertz (MHz) and 3 gigahertz (GHz). You'll find the UHF band used for specific technologies like WiFi, Bluetooth, GPS, walkie-talkies, and more. On the flip side, you'll find very low frequency (VLF) in the 3 – 30 hertz range and this band is reserved exclusively for government radio stations, secure military communications, and submarines.

Now you might be wondering, how exactly do those radio waves in their particular frequencies get from place to place? Every radio, whether it's a traditional AM/FM radio or a radio found in a smartphone, uses the same basic method of transmitting information with the help of both a transmitter and a receiver.

A transmitter, as its name implies, transmits information through the air in the form of a sine wave. This wave goes flying through the air, eventually being caught by a receiver, which decodes the information within the sine wave to extract the stuff we want, like music, a human voice, or some other bit of data.

What's interesting is that a sine wave alone doesn't contain any of the data that we need, it's basically an empty signal. This is why we need to take this sine wave and modulate it, which is the process of adding another layer of useful information. There are three methods of modulation, including:

- Pulse Modulation. In this method, you are turning a sine wave on and off, which will send bits of a signal in separate chunks. Ever heard of Morse Code to send distress signals? It uses pulse modulation.
- Amplitude Modulation. This method is used in both AM radio stations and those old analog TV signals. Here, a sine wave is overlaid with another wave of information, like a person's voice. Embedding another layer of information in this wave will create a fluctuation in the amplitude of the original sine wave, which can create static.
- Frequency Modulation. This method is used by FM radio stations and

virtually every other wireless technology out there. Unlike amplitude modulation which creates some significant fluctuations in a sine wave, frequency modulation changes a sine wave very little, which has the added benefit of resulting in less static.

Once all of those modulated sine waves are sent via a transmitter and received by a receiver, the wave of information that we embedded gets extracted, allowing us to do with it as we please, like play it as audio through a speaker, or view it as video on a television screen. Waves don't always fly through the air straight from a transmitter to a receiver, and how they travel ultimately depends on what kind of wave frequency you want to send, and when. There are three ways this journey can happen, including:

Line of Sight (Space Wave)

With this method of travel, radio waves are sent as a simple beam of light from point A to point B. This method was commonly used in old-fashioned telephone networks that had to transmit calls over a long distance between two massive communication towers.

Ground Wave (Surface Wave)

You can also send radio waves along the curvature of the earth's surface in the form of a ground wave. You'll find AM radio waves traveling in this manner for short to medium distances, which is why you can still hear radio signals even when there isn't a transmitter and receiver in your line of sight.

Ionosphere (Sky Wave)

Last, you can also send radio waves straight up into the sky, which ends up bouncing off of the earth's ionosphere, which is an electrically charged part of the atmosphere. When you do this, the radio waves will hit the ionosphere, bounce back down to earth, and bounce back up again. This is the process of mirroring a wave, bouncing it back and forth to its final destination.

At this point we've gathered several things about radio waves, namely that they travel at very specific frequencies, they communicate with both a transmitter and receiver, and they can travel in a variety of ways across the earth. But with all of the different radio frequencies floating about, how does your smartphone or car radio know which particular frequency receive, and which ones to ignore? There is where antennas come into play.

It's All About Antennas

Antennas come in a bunch of different shapes and sizes, but they're all designed for the same purpose – to pick up a very specific radio wave frequency. You'll find antennas ranging from the long metal wires sticking out from an FM radio to something rounder like a satellite dish, or even a tightly tune piece of copper on a PCB. In a transmitter, antennas are used to send radio waves, and in receivers, they'll be used to pick up on a radio frequency. Antennas have three distinct features that they're measured by, including:

- Direction. For some antenna types, such as a dipole, the antenna has to be mounted in the proper direction, facing the direction of the radio wave transmission. Some antenna types, like those found in an FM radio, don't need to be oriented in a specific direction and can capture radio wave signals from any angle.
- Gain. The gain of an antenna describes how much it is going to boost a signal. For example, if you turn on an old analog TV, then you'll still likely get a picture, just a fuzzy one. This is because of the metal case and components in the TV act as an antenna. But plug an actual directional antenna in, and you'll be able to boost the signal, and gain a better picture. The bigger the gain, measured in decibels (dB), the better the reception you'll get.
- Bandwidth. Last, an antenna's bandwidth is its particular range of useful frequencies. The higher the bandwidth, the more radio waves it can pick up. This is ideal for televisions as it allows them to get more channels. But for things like your smartphone which only need a specific radio wave, a full bandwidth isn't as necessary.

Radio waves are everywhere! They have indeed shaped our modern lives like nothing else, and without them, we would never get to enjoy such useful inventions as GPS, WiFi, Bluetooth, and more.

Task 1. Read and translate text A.

Task 2. Answer the following questions.

1. What is frequency of a radio wave?
2. What is frequency measured in?
3. What is wavelength?
4. How do we calculate the speed of electromagnetic waves?
5. How does a transmitter send information through the air?

6. What are three main types of modulation? Where are they used?
7. How are radio waves propagated?
8. Name the main properties of antennas.

Task 3. Scan the text to mark the statements below true or false.

1. On the electromagnetic spectrum radio waves have both the longest wavelength and the highest frequency.
2. A transmitter transmits in formation through the air on the form of a sine wave.
3. There are two types of modulation.
4. Waves always fly through the air straight from a transmitter to a receiver.
5. Sky waves give line of sight transmission.
6. Sky waves give line of sight transmission.
7. You can send radio waves along the curvature of the earth's surface in the form of a ground wave.
8. Antennas have three distinct features: direction, gain and bandwidth.

Task 4. Find English equivalents of the following words.

Частота, длина волны, скорость, синусоидальная волна, основной метод передачи информации, значительные изменения (колебания), беспроводная технология, извлекать, поверхностная волна, прямые волны, коэффициент усиления.

Task 5. Read the text and complete the table below.

Propagation of radio waves

Radio waves from a transmitting aerial can travel in one or more of three different ways.

Surface or ground wave

This travels along the ground, following the curvature of the earth's surface. Its range is limited mainly by the extent to which energy is absorbed from it by the ground. Poor conductors, such as sand, absorb more strongly than water, and the higher the frequency the greater the absorption. The range is about 1500km at low frequencies (long waves).

Sky wave

It travels skywards and, if it is below a certain critical frequency (typically

30MHz), is returned to earth by the ionosphere. This consists of layers of air molecules stretching from about 80km above the earth to 500km. On striking the earth, the sky wave bounces back to the ionosphere where it is again gradually refracted and returned earthwards as if by ‘reflection’. This continues until it is completely attenuated.

The critical frequency varies with the time of day and the seasons. Sky waves of high frequencies can travel thousands of kilometres but at VHF and above they usually pass through the ionosphere into outer space.

Space wave

For VHF, UHF, and microwave signals, only the space wave, giving line of sight transmission, is effective. A range of up to 150km is possible on earth if the transmitting aerial is on high ground and there are no intervening obstacles such as hills, building, or trees. Space waves are also used for satellite communications.

	Surface wave	Sky wave	Space wave
Frequencies			
Travels			
Range			
Difficulties			

Text B
Radio

Radio means sending energy with waves. In other words, it's a method of transmitting electrical energy from one place to another without using any kind of direct, wired connection. That's why it's often called wireless. The equipment that sends out a radio wave is known as a transmitter; the radio wave sent by a transmitter whizzes through the air—maybe from one side of the world to the other — and completes its journey when it reaches a second piece of equipment called a receiver. When you extend the antenna (aerial) on a radio receiver, it snatches some of the electromagnetic energy passing by. Tune the radio into a station and an electronic circuit inside the radio selects only the program you want from all those that are broadcasting.

How radio waves travel from a transmitter to a receiver:

1) Electrons rush up and down the transmitter, shooting out radio waves.

2) The radio waves travel through the air at the speed of light.

3) When the radio waves hit a receiver, they make electrons vibrate inside it, recreating the original signal. This process can happen between one powerful transmitter and many receivers—which is why thousands or millions of people can pick up the same radio signal at the same time.

How does this happen? The electromagnetic energy, which is a mixture of electricity and magnetism, travels past you in waves like those on the surface of the ocean. These are called radio waves.

Analog radio

Radio waves carry energy as an invisible, up-and-down movement of electricity and magnetism. This carries program signals from huge transmitter antennas, which are connected to the radio station, to the smaller antenna on your radio set. A program is transmitted by adding it to a radio wave called a carrier. This process is called modulation. Sometimes a radio program is added to the carrier in such a way that the program signal causes fluctuations in the carrier's frequency. This is called frequency modulation (FM). Another way of sending a radio signal is to make the peaks of the carrier wave bigger or smaller. Since the size of a wave is called its amplitude, this process is known as amplitude modulation (AM). Frequency modulation is how FM radio is broadcast; amplitude modulation is the technique used by AM radio stations. Sending information by changing the shapes of waves is an example of an analog process. This means the information you are trying to send is represented by a direct physical change (the water moving up and down or back and forth more quickly).

The trouble with AM and FM is that the program signal becomes part of the wave that carries it. So, if something happens to the wave en-route, part of the signal is likely to get lost. And if it gets lost, there's no way to get it back again. That's why analog radios can sound crackly, especially if you're listening in a car. Digital radio can help to solve that problem by sending radio broadcasts in a coded, numeric format so that interference doesn't disrupt the signal in the same way. Let's lift the lid of an old-style analog transistor radio and see what we can find inside:

1. External, telescopic FM antenna: The one on this radio extends to about 30 cm (1 ft), which is plenty long enough to catch a good range of FM broadcasts. You can extend and swivel the telescopic antenna for better reception. Generally speaking, the longer the antenna (known as an aerial in the UK), the more signals you can pick up.

2. Battery compartment: This radio is either battery or AC powered. When you plug in an AC lead, a switch automatically cuts out the battery power.

3. Loudspeaker: There is only one loudspeaker, so this radio can reproduce only mono sounds. Generally, the bigger the loudspeaker the louder the radio (and the better the quality of sound it will make).

4. AC power input: A cable plugs into this socket so you can run the radio economically from a domestic power supply (mains electricity socket).

5. Transformer: The radio's electronic components operate on very small voltages (less than 6 volts), but the power that comes in from the AC outlet is typically 110 volts (in the USA), 240 volts (in the UK), or similar. The transformer's job is to scale down the AC voltage so it's safe and appropriate for the radio's delicate components.

6. Internal AM antenna: When you're listening to an AM (also known as MW or medium wave) broadcast, the external FM antenna is redundant. Instead, signals are picked up by this tightly coiled AM antenna concealed inside the case. If you're listening on AM, you have to turn the entire radio to reorient the built-in antenna and improve your signal reception.

7. Transformer: A series of smaller transformers help the radio hone in on just the station you want by blocking out other, nearby stations.

8. Amplifier: This small chip boosts the signal strength so it's powerful enough to drive the loudspeaker. The amplifier is based on transistors, electronic components that take in a small current and put out a much larger one—scaling it up in size. Small radios are often called "transistor radios": it was the development of the tiny transistor, from the late 1940s onward, that made it possible to pack all the components of a radio into a small portable unit. Before transistors came along, radios were typically huge wooden boxes that stood in the corner of your home, as big as an old-fashioned TV (and often even bigger).

9. Earphone socket: You can plug a small mono earphone in here to listen in privacy. If you plug stereo headphones into the mono socket, you'll hear sound in only one of the two earpieces.

10. Volume control: This is the back of the volume knob. Turning the volume knob adjusts an electronic component called a variable resistor or potentiometer, which increases or decreases the electric current flowing to the loudspeaker. A bigger current makes a louder sound with more volume; a smaller current makes a quieter sound with less volume.

11. Tuning control: This is a variable capacitor that tunes the radio in to a specific station.

Digital radio

You're driving along the freeway and your favorite song comes on the radio. You go under a bridge and—buzz, hiss, crackle, pop—the song disappears in a burst of static. Just as people have got used to such niggles, inventors have come up with a new type of radio that promises almost perfect sound. Digital radio, as it's called, sends speech and songs through the air as strings of numbers. No matter what comes between your radio and the transmitter, the signal almost always gets through. That's why digital radio sounds better. But digital technology also brings many more stations and displays information about the program you're listening to (such as the names of music tracks or programs):

– The transmitter sends program signals broken into fragments and coded in numbers (digits).

– The transmitter sends each fragment many times to increase the chances of it getting through.

– Even when things interrupt or delay some of the fragments, the receiver can still piece together fragments arriving from other places and put them together to make an uninterrupted program signal.

To help avoid interference, a digital radio signal travels on a huge, broad band of radio frequencies about 1500 times wider than those used in analog radio. This wide band allows a single digital signal to carry six stereo music programs or 20 speech programs in one go. Blending signals together in this way is called multiplexing. Part of the signal might be music, while another part could be a stream of text information that tells you what the music is, the name of the DJ, which radio station you're listening to, and so on. Switch on your digital radio and it:

– Collects fragments of radio signals flying through the air.

– Sorts through and reassembles the fragments in order to make a complete radio signal—and thus the program you want to hear.

It takes a digital radio some time to process incoming signals. Put a digital radio and an ordinary analog radio next to one another and tune them both into the same station. You'll find the sound from the digital radio lags noticeably behind the sound from the analog radio because of the time it takes to reassemble the digital signal.

Band/use	Wavelength	Frequency
LW (Long wave)	5km–1km	60kHz–300kHz
AM/MW (Amplitude modulation / medium wave)	600m–176m	500kHz–1.7MHz
SW (Short wave)	188m–10m	1.6MHz–30MHz
VHF/FM (Very high frequency / frequency modulation)	10m–6m	100MHz–500MHz
FM (frequency modulation)	3.4m–2.8m	88MHz–125Mhz
Aircraft	2.7m–2.2m	108–135MHz
Cellphones	80cm–15cm	380–2000MHz
Radar	100cm–3mm	0.3–100GHz

If you look at the table, you'll notice that the wavelength and the frequency move in opposite directions. As the wavelengths of radio waves get smaller (moving down the table), so their frequency gets bigger (higher). But if you multiply the frequency and wavelength of any of these waves, you'll find you always get the same result: 300 million meters per second, better known as the speed of light.

Task 1. Read and translate text B.

Task 2. Answer the following questions.

1. What is modulation?
2. What’s the difference between FM and AM?
3. What does analog radio consist of?
4. How does digital radio work?
5. If you put a digital radio and an analog radio next to one another and tune them both into the same station, what will you notice?
6. If you multiply the frequency and the wave length of any of radio waves, what result will you get?
7. What is multiplexing?

Task 3. Say whether the sentences are true or false. If they are false, correct them.

1. The electromagnetic energy, or magnetism, travels past you in waves like those

on the surface if the ocean.

2. A program is transmitted by adding it to a radio wave called a carrier.

3. Generally, the bigger the loudspeaker the louder the radio (and the better the quality of sound it will make).

4. The transformer's job is to scale up the AC voltage so it's appropriate for the radio's components.

5. If you multiply the frequency and wavelength of any of radio waves, you'll find you always get the same result: 300 million meters per second.

6. The conductivity of a material is the inverse of the resistance.

7. Conductance and conductivity are two valuable properties in physics.

8. Conductance and conductivity mean exactly the same thing.

Task 4. Use the text and find antonyms for the following words.

1. Wired
2. Visible
3. Tiny
4. Internal
5. To worsen
6. To increase
7. To receive

Task 5. Find the English equivalents for the following words and word combinations.

Динамик, воспроизводить, розетка, встроенный, внутренний, усилитель, качество, ток, настроить, конденсатор переменной емкости, избегать, увеличить, полоса частот, источник питания, несущая.

Task 6. Match the term with the right definition.

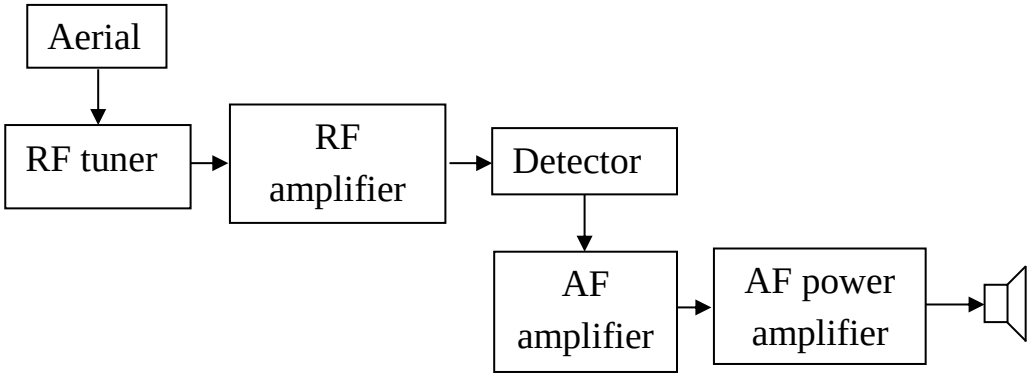
Broadcast, fluctuation, amplifier, interference, to tune, switch, carrier, capacitor, frequency, amplitude.

1. To adjust a circuit to oscillate at a particular frequency.
2. To transmit radio or TV signals.
3. Radio wave used to carry audio or video signals.
4. How often a pattern is repeated every second.
5. Small change above or below a fixed level.

6. Size of a wave at any given time.
7. Electrical component for opening and closing a circuit.
8. Electronic circuit for increasing the size of a signal.
9. Electronic component that stores charge.
10. Unwanted signals.

Task 7. Read the text and translate it into Russian.

The block diagram of a radio is shown below. The tuner selects the required RF wave from those picked up by the aerial. The selected RF wave is amplified and passed to the detector, which separates the audio modulation from the RF carrier wave. The audio frequency amplifier then amplifies the audio signal to make it strong enough to drive the loudspeaker.



A typical radio tuner circuit consists of an inductor and capacitor connected in parallel. The size of the aerial inductance coil can be kept small by winding it on a ferrite rod core.

The RF waves fed to the tuner cause the circuit to oscillate. The impedance of the circuit is smallest and the oscillation is greatest at a particular frequency known as the resonant frequency. This frequency is determined by the values of the inductance and the capacitance. By using a variable capacitor, the circuit can be tuned to the required radio frequency, and the selected RF wave passed on to the RF amplifier.

Task 8. Explain what happens at each stage in this flowchart, which shows how a radio works. Use the information from the text in Task 7.

Component	**Function**
1. Aerial	
2. RF tuner	
3. RF amplifier	
4. Detector	
5. AF amplifier	
6. Loudspeaker	

Text C
History of Radio

The history of radio begins in the mid 1800s with theoretical discussions that electricity and magnetism were related. The telegraph system was the first direct commercially viable technology to be developed from this discovery, although telegraph required fixed wire cables and could only be transmitted from point to point, and needed human operators to retransmit a signal over long distances.

The first true wireless experiments weren't carried out until after James Maxwell had developed his own theories and incorporated the experiments of Michael Faraday into the unified theory of electromagnetism in 1865. Over the next decade several amateurs and physicists such as William Henry Ward, Mahlon Loomis, and Thomas Edison patented methods of sending and receiving a wireless telegraph system but none of these people ever demonstrated a working system.

This all changed in 1884 when Temistocle Calzecchi-Onesti invented a device which was subsequently refined and then named a coherer by Edouard Branly in 1886. The coherer became the enabling technology that allowed early radio signals to be received. The coherer is a glass tube filled with metal filings and connected to an electrical current which produced an audible click in a sounder whilst the signal was being received.

By 1887 Heinrich Hertz had refined a system that allowed him to experiment with sending wireless signals to a wireless receiver and is credited with being the first person

to intentionally transmit and also receive a wireless signal. Strangely Hertz had no interest in the technology and was simply experimenting with practical electromagnetic waves to advance his theories, but his research paved the way for other, and more commercially attuned inventors. In 1933 Hertz was honored when the unit of measure of radio and electrical frequencies was named in his honor as part of the new International Metric System.

A Serbian-Croatian immigrant to the US Nikola Tesla in 1892 demonstrated the first complete radio transmitter and receiver system, and in so doing was the very first person to successfully invent radio. Sadly, Tesla suffered a fire in his laboratory in 1895 just as he was about to demonstrate radio over a distance of 50 miles in New York. That experiment never happened but by 1898 Tesla demonstrated the first radio controlled boat and filed a series of patents for radio in the early 1900s.

Guglielmo Marconi, a young man from Bologna in Italy had been fascinated by the idea of wirelessly transmitting a telegraph signal and in 1894 succeeded in inventing a spark transmitter with an antenna that he used to broadcast a signal across his parents garden and then across a distance of a mile in the countryside. The Italian Postal Service which controlled telegraph services weren't interested in Marconi's experiment so in 1896 he made his way to England and successfully demonstrated his technology to the English Post Office who immediately secured his services.

The following year Marconi established the Wireless Telegraph and Signal Company and was selling his patented invention to shipping companies. So successful was Marconi's invention that Queen Victoria herself had one installed on a ship that her son the Prince of Wales was using whilst he recovered from illness. In 1898 Marconi also established the American Marconi Co recognizing that the US was quickly becoming one of the world's most important merchant navy operators.

Whilst Marconi's inventions were outstanding his real genius lay in commercializing his technology, an act that started with demonstrating a successful broadcast across the Atlantic in 1901, an event which progressed the development of radio broadcasting far more than any other single act. Marconi was related to British nobility who were powerful investors in his companies and in the emerging markets in the US.

So powerful were his backers that Marconi managed to have a patent for the invention of radio registered even though Tesla had a pre-existing patent. A legal dispute between the two started in 1915 and wasn't finally settled until 1943 when the US

Supreme Court finally upheld Tesla's patent number 609,154 and confirming his role as the inventor of radio.

Another American Reginald Fessenden had heard of Marconi's success but was convinced the enabling technology could be redesigned and be both more efficient, but also allow audio broadcasts, and in 1900 demonstrated his new technology which would afterwards be used by the weather department for sending time and weather information to ships at see. In 1906 or 1909, nobody knows for sure since Fessenden only wrote his notes 25 years later, the very first audio transmission was carried out by Fessenden playing a violin and reading a few passages from the Bible.

Old Fashion Radio

Fessendon invented the Barretter detector which allowed him to also develop amplitude modulation (AM), a radio transmitting technique that allowed multiple transmitters to operate at different frequencies and effectively share the airwaves. So revolutionary was the development of radio by Fessenden and his peers that in 1910 a test transmission was held at the Metropolitan Opera House in New York where Enrico Caruso was performing. This broadcast was heard over 20 miles away by a merchant cargo ship sailing into New York from Europe and reported by the New York Times on January 14th 1910.

The science of radio broadcasting continued at breakneck pace during these early years although consumer uptake remained elusive. A number of audio broadcasts had been transmitted including the ultimatum demand from President Wilson to Germany in 1918 and a highly publicized broadcast from the Naval radio station at Arlington to the Eiffel Tower in France. The end of WWI saw the US government relax control of radio patents and in 1920 KDKA, a Westinghouse owned station in Pittsburgh broadcast coverage of the Harding Cox election. Between commentary they also broadcast other short programs.

Commercial broadcasting took off after this with stations opening in every major city of the US and in major capitals around Europe. The 1920s truly were the birth years of modern radio as we know it. The development of stable mass produced vacuum valves made it possible for almost every home to own a radio. These weren't small, each radio was fitted into a cabinet that would take pride of place in the family living room and around which the entire family would gather every evening.

Edwin Armstrong, a radio pioneer with the Navy during WWI continued to

develop his experiments, and being unhappy with the quality of sound from the AM system which was always known for being a bit flat and prone to white noise and static, he set about reinventing radio broadcasting which resulted in frequency modulation (FM) being made available in 1933. Stations broadcasting in FM were slow to develop given the expense of the new system until the invention of the transistor.

Scientists from Bell Labs invented the transistor in 1947, a technology that transformed modern electronics, although with the huge investments in tubes that already existed it was several years until a commercial transistor radio hit the market. Masaru Ibuka, a young radio repair technician in Japan managed to convince Bell Labs to license the use of the transistor to him for a new radio he wanted to develop. In the US Texas Instruments and Regency were also developing heir own transistor powered radios but it wasn't until 1957, and the release of Sony's TR-63 AM portable battery powered radio, which at the time was the world's smallest radio, that radio really became the dominant medium for new and entertainment.

During the 1960s television started to catch up as the preferred medium of entertainment for Americans although radio firmly held on in the car, and by the late 1990s most Americans only listened to the radio in the car or at work, a position radio is set to enjoy for years to come. Despite the advent of satellite and Internet radio, wirelessly broadcasting traffic reports, news, and music to radio receivers is still dominant.

Task 1. Read and translate text C.

Task 2. Answer the following questions.

1. When does the history of radio begin?
2. What is a coherer? Who invented it?
3. What did Marconi invent in 1894?
4. What can you say about Fessendeni's contribution to radio broadcast development?
5. What invention of 1947 transformed modern electronics?

Task 3. Find the information about other inventors who played an important role in radio development and present it to the class.

Text D
Digital television

Digital television (DTV) is the transmission of television signals, including the sound channel, using digital encoding, in contrast to the earlier television technology, analog television, in which the video and audio are carried by analog signals. It is an innovative advance that represents the first significant evolution in television technology since color television in the 1950s. Digital TV transmits in a new image format called HDTV (high definition television), with greater resolution than analog TV, in a wide screen aspect ratio similar to recent movies in contrast to the narrower screen of analog TV. It makes more economical use of scarce radio spectrum space; it can transmit multiple channels, up to 7, in the same bandwidth occupied by a single channel of analog television, and provides many new features that analog television cannot. A transition from analog to digital broadcasting began around 2006 in some countries, and many industrial countries have now completed the changeover, while other countries are in various stages of adaptation. Different digital television broadcasting standards have been adopted in different parts of the world.

Digital Video Broadcasting (DVB) uses coded orthogonal frequency-division multiplexing (OFDM) modulation and supports hierarchical transmission. This standard has been adopted in Europe, Africa, Asia, Australia, total about 60 countries.

Advanced Television System Committee (ATSC) uses eight-level vestigial sideband (8VSB) for terrestrial broadcasting. This standard has been adopted by 6 countries: United States, Canada, Mexico, South Korea, Dominican Republic and Honduras.

Integrated Services Digital Broadcasting (ISDB) is a system designed to provide good reception to fixed receivers and also portable or mobile receivers. It utilizes OFDM and two-dimensional interleaving. It supports hierarchical transmission of up to three layers and uses MPEG-2 video and Advanced Audio Coding. This standard has been adopted in Japan and the Philippines. ISDB-T International is an adaptation of this standard using H.264/MPEG-4 AVC that been adopted in most of South America and is also being embraced by Portuguese-speaking African countries.

Digital Terrestrial Multimedia Broadcasting (DTMB) adopts time-domain synchronous (TDS) OFDM technology with a pseudo-random signal frame to serve as the guard interval (GI) of the OFDM block and the training symbol. The DTMB

standard has been adopted in the People's Republic of China, including Hong Kong and Macau.

Digital Multimedia Broadcasting (DMB) is a digital radio transmission technology developed in South Korea as part of the national IT project for sending multimedia such as TV, radio and datacasting to mobile devices such as mobile phones, laptops and GPS navigation systems.

History

Digital TV's roots have been tied very closely to the availability of inexpensive, high performance computers. It wasn't until the 1990s that digital TV became a real possibility.

In the mid-1980s, as Japanese consumer electronics firms forged ahead with the development of HDTV technology, and as the MUSE analog format was proposed by Japan's public broadcaster NHK as a worldwide standard, Japanese advancements were seen as pacesetters that threatened to eclipse U.S. electronics companies. Until June 1990, the Japanese MUSE standard—based on an analog system—was the front-runner among the more than 23 different technical concepts under consideration. Then, an American company, General Instrument, demonstrated the feasibility of a digital television signal. This breakthrough was of such significance that the FCC was persuaded to delay its decision on an ATV standard until a digitally based standard could be developed.

In March 1990, when it became clear that a digital standard was feasible, the FCC made a number of critical decisions. First, the Commission declared that the new ATV standard must be more than an enhanced analog signal, but be able to provide a genuine HDTV signal with at least twice the resolution of existing television images. Then, to ensure that viewers who did not wish to buy a new digital television set could continue to receive conventional television broadcasts, it dictated that the new ATV standard must be capable of being "simulcast" on different channels. The new ATV standard also allowed the new DTV signal to be based on entirely new design principles. Although incompatible with the existing NTSC standard, the new DTV standard would be able to incorporate many improvements.

The final standard adopted by the FCC did not require a single standard for scanning formats, aspect ratios, or lines of resolution. This outcome resulted from a dispute between the consumer electronics industry (joined by some broadcasters) and

the computer industry (joined by the film industry and some public interest groups) over which of the two scanning processes—interlaced or progressive—is superior. Interlaced scanning, which is used in televisions worldwide, scans even-numbered lines first, then odd-numbered ones. Progressive scanning, which is the format used in computers, scans lines in sequences, from top to bottom. The computer industry argued that progressive scanning is superior because it does not "flicker" in the manner of interlaced scanning. It also argued that progressive scanning enables easier connections with the Internet, and is more cheaply converted to interlaced formats than vice versa. The film industry also supported progressive scanning because it offers a more efficient means of converting filmed programming into digital formats. For their part, the consumer electronics industry and broadcasters argued that interlaced scanning was the only technology that could transmit the highest quality pictures then (and currently) feasible, i.e., 1,080 lines per picture and 1,920 pixels per line. Broadcasters also favored interlaced scanning because their vast archive of interlaced programming is not readily compatible with a progressive format.

Comparison of analog vs digital

DTV has several advantages over analog TV, the most significant being that digital channels take up less bandwidth, and the bandwidth needs are continuously variable, at a corresponding reduction in image quality depending on the level of compression as well as the resolution of the transmitted image. This means that digital broadcasters can provide more digital channels in the same space, provide high-definition television service, or provide other non-television services such as multimedia or interactivity. DTV also permits special services such as multiplexing (more than one program on the same channel), electronic program guides and additional languages (spoken or subtitled). The sale of non-television services may provide an additional revenue source.

Digital and analog signals react to interference differently. For example, common problems with analog television include ghosting of images, noise from weak signals, and many other potential problems which degrade the quality of the image and sound, although the program material may still be watchable. With digital television, the audio and video must be synchronized digitally, so reception of the digital signal must be very nearly complete; otherwise, neither audio nor video will be usable. Short of this complete failure, "blocky" video is seen when the digital signal experiences interference.

Analog TV began with monophonic sound, and later developed multichannel television sound with two independent audio signal channels. DTV allows up to 5 audio signal channels plus a sub-woofer bass channel, with broadcasts similar in quality to movie theaters and DVDs.

Task 1. Read and translate text D.

Task 2. Answer the following questions.

1. When did a transition from analog to digital broadcasting began?
2. What are the most widely used DTV broadcasting standards?
3. What can you say about the history of DTV?
4. What advantages does DTV have over analog TV?

Task 3. Study the text. Note ways in which high definition television will be different from existing sets. Compare your answers with your partner.

The aim of high definition television (HDTV) is to provide the viewer with more realistic images than are offered by today's television sets.

Existing European television pictures are made up of 625 lines, with a total of about 120 000 dots.

In comparison an HD picture consists of 1250 lines and is composed of four times as many dots. This gives greatly increased detail and enhanced colour reproduction.

For HDTV the width/height ratio of the screen has been changed from 4:3 (as in conventional TV) to 16:9, like the screens in cinema. From corner to corner it measures 100-125 cm.

The optional viewing distance for HDTV is three times the height of the screen compared with seven times the present televisions.

This means your viewing range will be expanded from 10º to 30º. As a result you will have a much greater sense of reality, and may feel that you are there as the action unfolds. HDTV offers you three-dimensional sound, as it uses more speakers than today's sets.

Feature	Existing	High definition
no. of lines	625	1,250

Unit 3

Text A

History of mobile phones

Although most of us feel like we couldn't live without our mobile phones, they've not really been in existence for very long. In fact, mobile phones as we know them today have only been around in the last 20 years.

While the transmission of speech by radio has a long history, the first devices that were wireless, mobile, and also capable of connecting to the standard telephone network are much more recent. The first such devices were barely portable compared to today's compact hand-held devices, and their use was clumsy.

Along with the process of developing a more portable technology, and a better interconnections system, drastic changes have taken place in both the networking of wireless communication and the prevalence of its use, with smartphones becoming common globally and a growing proportion of Internet access now done via mobile broadband.

When were mobile phones invented?

Mobile phones, particularly the smartphones that have become our inseparable companions today, are relatively new. However, the history of mobile phones goes back to 1908 when a US Patent was issued in Kentucky for a wireless telephone. Mobile phones were invented as early as the 1940s when engineers working at AT&T developed cells for mobile phone base stations.

The very first mobile phones were not really mobile phones at all. They were two-way radios that allowed people like taxi drivers and the emergency services to communicate. Instead of relying on base stations with separate cells (and the signal being passed from one cell to another), the first mobile phone networks involved one very powerful base station covering a much wider area.

Motorola, on 3 April 1973 were first company to mass produce the first handheld mobile phone. These early mobile phones are often referred to as 0G mobile phones, or Zero Generation mobile phones. Most phones today rely on 3G or 4G mobile technology.

Task 1. Read and translate text A.

Task 2. Discuss the meaning of the words and phrases. Give definitions to these words.

Handheld mobile phone, to communicate, mobile phone networks, the transmission of speech by radio, a colourful screen, handheld devices.

Task 3. Complete the sentences according to the text.

1. The very first mobile phones were two-way radios that allowed people….
2. Instead of relying on base stations with separate cells, the first mobile phone networks involved …
3. The early mobile phones are often referred to…
4. Although most of us feel like we couldn't live without our mobile phones, they've not really been in existence for….
5. The first such devices were barely portable compared to today's compact…

Task 4. Scan the text to mark the statements below true or false.

1. Motorola, on 6 April 1975 were first company to mass produce the first handheld mobile phone.
2. The very first mobile phones were two-way radios that allowed people like taxi drivers and the emergency services to communicate.
3. Instead of relying on base stations with separate cells, the first mobile phone networks involved two very powerful base stations covering a much wider area.
4. The first mobile phones are often referred to as 0G mobile phones, or Zero Generation mobile phones.

Text B
Mobile phone generations

0G refers to mobile radio telephone systems. They were telephone systems of wireless type that preceded the modern cellular mobile form of telephony technology. Since they were the predecessors of the first generation of cellular telephones, these systems are sometimes retroactively referred to as pre-cellular or sometimes zero

generation, systems. Technologies used in pre-cellular systems included the Push to Talk (PTT), Mobile Telephone Service (MTS), Improved Mobile Telephone Service (IMTS), and Advanced Mobile Telephone System (AMTS). These early mobile telephone systems can be distinguished from earlier closed radiotelephone systems in that they were available as a commercial service that was part of the public switched telephone network, with their own telephone numbers, rather than part of a closed network such as a police radio or taxi dispatch system.

The first generation (1G) is the analog telecommunications standard that was introduced in 1979 and the early to mid-1980s and continued until being replaced by 2G digital telecommunications. 1G refers to the first generation of wireless telephone technology, mobile telecommunications. The main difference between the two mobile telephone systems (1G and 2G), is that the radio signals used by 1G network are analog, while 2G networks are digital.

2G technologies enable the various mobile phone networks to provide the services such as text messages, picture messages and MMS (Multimedia Message Service). 2G provides three primary benefits over their predecessors: phone conversations are digitally encrypted; 2G systems are significantly more efficient on the spectrum allowing for far greater mobile phone penetration levels; and 2G introduced data services for mobile, starting with SMS (Short Message Service) plain text-based messages. Second generation cellular telecom networks were commercially launched on the GSM standard in Finland by Radiolinja (now part of Elisa Oyj) in 1991.

3G technology provides an information transfer rate of at least 200 kbit/s. Later 3G releases, often denoted 3.5G, also provide mobile broadband access of several Mbit/s to smartphones and mobile modems in laptop computers. This ensures it can be applied to wireless voice telephony, mobile Internet access, fixed wireless Internet access, video calls and mobile TV technologies. A new generation of cellular standards has appeared approximately every tenth year since 1G systems were introduced in 1981/1982. Each generation is characterized by new frequency bands, higher data rates and non–backward-compatible transmission technology. The first 3G networks were introduced in 1998 and fourth generation 4G networks in 2008.

4G provides, in addition to the usual voice and other services of 3G, mobile broadband Internet access, for example to laptops with wireless modems, to smartphones, and to other mobile devices. Potential and current applications include amended mobile web access, IP telephony, gaming services, high-definition mobile TV,

video conferencing, 3D television, and cloud computing. LTE (Long Term Evolution) is commonly marketed as 4G LTE. It was first commercially deployed in Norway and Stockholm in 2009.

5G is a generation currently under development. 5G is generally seen as the fifth generation cellular network technology that provides broadband access. It denotes the next major phase of mobile telecommunications standards. It should be rolled out by 2020 to meet business and consumer demands. Analog signals representing sounds and images are digitized in the phone, converted by an analog to digital converter and transmitted as a stream of bits. All the 5G wireless devices in a cell communicate by radio waves with a local antenna array and low power automated transceiver (transmitter and receiver) in the cell, over frequency channels assigned by the transceiver from a common pool of frequencies, which are reused in geographically separated cells. The local antennas are connected with the telephone network and the Internet by a high bandwidth optical fiber or wireless backhaul connection. Like existing cellphones, when a user crosses from one cell to another, their mobile device is automatically "handed off" seamlessly to the antenna in the new cell.

Task 1. Read and translate text B.

Task 2. Discuss the meaning of the words and phrases. Give definitions to these words.

Cellular mobile, radiotelephone systems, digital telecommunications, wireless telephone technology, mobile telecommunications, SMS, mobile broadband access, smartphones, mobile web access, high-definition mobile TV, cloud computing, cellular network technology.

Task 3. Complete the sentences according to the text.

1. 0G refers to telephone systems of wireless type that…
2. These early mobile telephone systems can be distinguished from earlier closed radiotelephone systems in that they were…
3. The first generation (1G) is the analog telecommunications standard that was introduced in…
4. 2G technologies enable the various mobile phone networks to provide the services such as…

5. 3G technology provides an information transfer rate…

Task 4. Choose the correct word from the text to complete the sentences.

1. 4G provides, in addition to the usual voice and other services of 3G, mobile _____Internet access.
2. 3G technology provides an information transfer _____of at least 200 kbit/s.
3. 4G potential and current applications include amended mobile web access, IP_____, gaming services, high-definition mobile TV, video conferencing.
4. 5G is generally seen as the fifth generation cellular network _____that provides _____access.
5. 5G should be rolled out by 2020 to meet business and _____demands.

Text C
Smartphone

A smartphone is a mobile phone that has an advanced level operating system and delivers high-level computing and connectivity features. Smartphone's operating system comes with incredible data storage and file transfer facilities. Operating system's sophisticated applications let users perform dozens of computing functions just at the click of a button. The basic features that distinguish a Smartphone from a normal mobile are its high-resolution touchscreen, WiFi connectivity, browsing features, more storage space and RAM.

How Does a Smartphone Work?

A smartphone uses cell phone network technology, which is classified into generations. A Smartphone operates based on 4G technology. This technology instigates high-speed data transfers. Smartphone's advanced operating system manages the hardware and software resources. The operating system helps users download and install multiple applications on the mobile device. The incredible combination of the phone network technology and operating system let users multitask effectively. The Bluetooth technology of the Smartphone lets the phone link up with other nearby devices like a printer, computer, scanner and headsets. With the help of a wireless signal, a Smartphone can connect to a public email account, or even with a business' server to

receive emails anywhere.

Incredible Smartphone Uses

The advanced computing features help users save time. You don't have to access a desktop to view and edit the important business documents, edit photos and videos and check updates. Smartphone has important social media and affiliated sites, like Facebook, Amazon, Twitter, YouTube as Mobile Apps. So accessing all these sites gets easier. Social networking and being close to friends and family become effortless. Smartphone's high resolution 3.5" or 5" screens provide a wonderful reading experience. Many of the Smartphone Apps like WhatsApp and Viber can be used for free messaging and calls. Additionally, the quality of camera and the video recordings of a Smartphone are far superior to the regular mobile phones.

How Does Smartphone Help a Business?

A smartphone also has great contributions in business growth. Many businesses, especially the small business owners use the diversified features of a Smartphone for the growth of their businesses.

The first and most important benefit of having a Smartphone is that it assures faster connectivity and response. For a small business owner, staying in touch with its prospective customers is very important. So the dynamic Smartphone features let the businesses connect with the customers fast and resolve their queries. This improves customer service and helps businesses attract new customers gradually.

Second, Smartphone Apps like Facebook, Twitter & LinkedIn help the small business owners keep track of the progress of social media campaigns. Also, Smartphone allows the convenience and flexibility to respond quickly to consumer disappointments and concerns on these social media platforms. So, it can be said that a Smartphone also helps in online reputation management.

Mobile video Apps like Skype, Google talk and Tango let team members hold an emergency virtual meeting easily. Sharing important business files is extremely easier through Apps like Dropbox.

Salespeople can quickly access important presentations on this smart device in their cars. They can browse Google for some last minute research. So Smartphone and its incredible features actually assure ease of use and provide incredible business growth opportunities.

Task 1. Read and translate text C.

Task 2. Discuss the meaning of the words and phrases. Give definitions to these words.

High-resolution touchscreen, to edit photos, to perform dozens of computing functions, WiFi connectivity, to install multiple applications.

Task 3. Complete the sentences according to the text.

1. A smartphone is a mobile phone that has an advanced level…
2. Operating system's sophisticated applications let users perform…
3. A Smartphone operates based on…

Task 4. Choose the correct word from the text to complete the sentences.

1. Smartphone's advanced operating system manages the _____and software resources.
2. The incredible combination of the phone network technology and _____system let users multitask effectively.
3. The Bluetooth technology of the Smartphone lets the phone link up with other ____devices like a printer, computer, scanner and headsets.

Text D
Smartwatch

Smartwatch is a term for which there appears to be no commonly accepted definition. At best, one might refer to it as a multi-purpose device that's generally worn on the wrist.

What Does It Do?

It goes beyond simple time-keeping function of traditional watches. It runs computer applications and can access email, sports, weather, stocks, horoscopes and more. Some models run simply as a mobile operating system and would function pretty much like a media player for playback of video and audio files and FM radio with the use of a Bluetooth headset. Other models that have full mobile phone capability and

other similar features can make and receive phone calls. Still other types have built-in features as a camera, accelerometer, thermometer, chronograph, calculator, compass, map display, GPS navigation, speakers, a rechargeable battery and a watch that keeps time.

What Is Its Technology Concept?

The wide-spread understanding of the Smartwatch concept is that it makes use of the wireless technology to communicate with your smart phone. It has the capability as well to communicate with a wireless headset, heads-up display, microphone, modem and other devices.

Variations of Smartwatches

Some smartwatches would tend to lean towards a “Sports watch” functionality which comes with a “fitness tracker” similar to those GPS watches custom-made specifically for training, diving and outdoor sports. It’s got features that reflect the lap times and speed. It has a GPS tracking set-up, a dive computer, route tracking, a heart rate monitoring device.

For smartwatches to work effectively with phones, they’ll have to work on different types of operating systems. Some are designed only for Android. Others work with Androids and iPhones. Most of these offer permutations of functions, where some serve only as a trigger to alert you when a text message or an email comes in. Others have the set up to allow you to read them. Still some smartwatches, depending on the manufacturer have social media functionality, and some offer calendar functions.

Task 1. Read and translate text D.

Task 2. Read the text again and be ready to retell the text.

Unit 4

Text A

Packet switching

Packet switching is a method of grouping data that is transmitted over a digital network into packets. Packets are made of a header and a payload. Data in the header is used by networking hardware to direct the packet to its destination where the payload is extracted and used by application software. Packet switching is the primary basis for data communications in computer networks worldwide.

In the early 1960s, American computer scientist Paul Baran developed the concept Distributed Adaptive Message Block Switching with the goal to provide a fault-tolerant, efficient routing method for telecommunication messages as part of a research program at the RAND Corporation, funded by the US Department of Defense. This concept contrasted and contradicted then-established principles of pre-allocation of network bandwidth, largely fortified by the development of telecommunications in the Bell System. The new concept found little resonance among network implementers until the independent work of British computer scientist Donald Davies at the National Physical Laboratory (United Kingdom) in 1965. Davies is credited with coining the modern term packet switching and inspiring numerous packet switching networks in the following decade.

A simple definition of packet switching is: the routing and transferring of data by means of addressed packets so that a channel is occupied during the transmission of the packet only, and upon completion of the transmission the channel is made available for the transfer of other traffic.

Packet switching allows delivery of variable bit rate data streams, realized as sequences of packets, over a computer network which allocates transmission resources as needed using statistical multiplexing or dynamic bandwidth allocation techniques. As they traverse networking hardware, such as switches and routers, packets are received, buffered, queued, and retransmitted (stored and forwarded), resulting in variable latency and throughput depending on the link capacity and the traffic load on the network. Packets are normally forwarded by intermediate network nodes asynchronously using first-in, first-out buffering, but may be forwarded according to some scheduling discipline for fair queuing, traffic shaping, or for differentiated or guaranteed quality of service, such as weighted fair queuing or leaky bucket. Packet-based communication

may be implemented with or without intermediate forwarding nodes (switches and routers). In case of a shared physical medium, the packets may be delivered according to a multiple access scheme.

Packet switching contrasts with another principal networking paradigm, circuit switching, a method which pre-allocates dedicated network bandwidth specifically for each communication session, each having a constant bit rate and latency between nodes. In cases of billable services, such as cellular communication services, circuit switching is characterized by a fee per unit of connection time, even when no data is transferred, while packet switching may be characterized by a fee per unit of information transmitted, such as characters, packets or messages.

Task 1. Read and translate text A.

Task 2. Discuss the meaning of the words and phrases. Give definitions to these words.

Packet switching, application software, the routing and transferring of data, variable bit rate data streams, computer network, statistical multiplexing, networking hardware, quality of service, leaky bucket, multiple access scheme, circuit switching, cellular communication services.

Task 3. Complete the sentences according to the text.

1. Packet switching is a method of…
2. Packets are made of…
3. Packet switching is the primary basis for…
4. American computer scientist Paul Baran developed the concept Distributed Adaptive Message Block Switching with the goal to….
5. Davies is credited with coining the modern term…
6. Packet switching allows delivery of variable…

Task 4. Choose the correct word from the text to complete the sentences.

1. Packet switching is the primary basis for data communications in computer ____worldwide.
2. Paul Baran developed the concept Distributed Adaptive Message Block Switching with the goal to provide a¬¬¬_____, _____routing method for

telecommunication messages.

3. Davies is credited with coining the modern term_____.

4. Packets are received, buffered, queued and _____.

5. Circuit switching is characterized by a fee per unit of_____.

Task 5. Scan the text to mark the statements below true or false.

1. In the early 1970s, American computer scientist Paul Baran developed the concept Distributed Adaptive Message Block Switching.

2. Packet switching allows delivery of variable bit rate data streams, realized as sequences of packets.

3. Packets are normally forwarded by intermediate network nodes asynchronously using first-in, first-out buffering.

4. Packets can not be forwarded according to some scheduling discipline for fair queuing, traffic shaping, or for differentiated or guaranteed quality of service.

5. Packet-based communication may be implemented with or without intermediate forwarding nodes (switches and routers).

Text B
Connectionless and connection-oriented packet switching

Packet switching may be classified into connectionless packet switching, also known as datagram switching, and connection-oriented packet switching, also known as virtual circuit switching. Examples of connectionless systems are Ethernet, Internet Protocol (IP), and the User Datagram Protocol (UDP). Connection-oriented systems include X.25, Frame Relay, Multiprotocol Label Switching (MPLS), and the Transmission Control Protocol (TCP).

In connectionless mode each packet is labeled with a destination address, source address, and port numbers. It may also be labeled with the sequence number of the packet. This information eliminates the need for a pre-established path to help the packet find its way to its destination, but means that more information is needed in the packet header, which is therefore larger. The packets are routed individually, sometimes taking different paths resulting in out-of-order delivery. At the destination, the original message may be reassembled in the correct order, based on the packet sequence numbers. Thus a

virtual circuit carrying a byte stream is provided to the application by a transport layer protocol, although the network only provides a connectionless network layer service.

Connection-oriented transmission requires a setup phase in each involved node before any packet is transferred to establish the parameters of communication. The packets include a connection identifier rather than address information and are negotiated between endpoints so that they are delivered in order and with error checking. Address information is only transferred to each node during the connection set-up phase, when the route to the destination is discovered and an entry is added to the switching table in each network node through which the connection passes. The signaling protocols allow the application to specify its requirements and discover link parameters. Acceptable values for service parameters may be negotiated. Routing a packet requires the node to look up the connection ID in a table. The packet header can be small, as it only needs to contain this code and any information, such as length, timestamp, or sequence number, which is different for different packets.

Packet switching in networks

Packet switching is used to optimize the use of the channel capacity available in digital telecommunication networks, such as computer networks, and minimize the transmission latency (the time it takes for data to pass across the network), and to increase robustness of communication.

The best-known use of packet switching is the Internet and most local area networks. The Internet is implemented by the Internet Protocol Suite using a variety of Link Layer technologies. For example, Ethernet and Frame Relay are common. Newer mobile phone technologies (e.g., GPRS) also use packet switching.

Task 1. Read and translate text B.

Task 2. Discuss the meaning of the words and phrases. Give definitions to these words.

Connectionless packet switching, datagram switching, connection-oriented packet switching, virtual circuit switching, Ethernet, Internet Protocol, User Datagram Protocol, Transmission Control Protocol, out-of-order delivery, virtual circuit, byte stream, transport layer protocol, connectionless network layer service, to increase robustness, channel capacity.

Task 3. Scan the text to mark the statements below true or false.

1. Packet switching may be classified into connectionless packet switching, also known as datagram switching.

2. Connection-oriented packet switching is known as datagram switching.

3. Examples of connectionless systems are Ethernet, Internet Protocol (IP), and the User Datagram Protocol (UDP).

4. Connection-oriented systems include only Ethernet and Internet Protocol.

5. In connectionless mode each packet is labeled with a destination address, source address, and port numbers.

Task 4. Complete the sentences according to the text.

1. A destination address, source address and port numbers eliminate the need for a pre-established path to help the packet…
2. In connectionless mode each packet is labeled with….
3. The packets are routed individually, sometimes taking different paths…
4. Thus a virtual circuit carrying a byte stream is provided to the application by…
5. Packet switching is used to increase robustness of ….

Task 5. Choose the correct word from the text to complete the sentences.

1. The packets are routed individually, sometimes taking different paths_____ in out-of-order delivery.

2. In connectionless mode each packet is labeled with a _____ _____, source address, and port numbers.

3. At the destination, the original message may be reassembled in the ____order, based on the _____ sequence numbers.

4. Connection-oriented transmission requires a setup phase in each involved node before any packet is _____to establish the parameters of communication.

5. The signaling protocols _____the application to specify its requirements and discover link parameters.

6. Packet switching is used to optimize the use of the _____capacity available in digital telecommunication networks.

Text C
Circuit switching

Circuit switching is a method of implementing a telecommunications network in which two network nodes establish a dedicated communications channel (circuit) through the network before the nodes may communicate. The circuit guarantees the full bandwidth of the channel and remains connected for the duration of the communication session. The circuit functions as if the nodes were physically connected as with an electrical circuit.

The defining example of a circuit-switched network is the early analog telephone network. When a call is made from one telephone to another, switches within the telephone exchanges create a continuous wire circuit between the two telephones, for as long as the call lasts.

Circuit switching contrasts with packet switching, which divides the data to be transmitted into packets transmitted through the network independently. In packet switching, instead of being dedicated to one communication session at a time, network links are shared by packets from multiple competing communication sessions, resulting in the loss of the quality of service guarantees that are provided by circuit switching.

In circuit switching, the bit delay is constant during a connection, as opposed to packet switching, where packet queues may cause varying and potentially indefinitely long packet transfer delays. No circuit can be degraded by competing users because it is protected from use by other callers until the circuit is released and a new connection is set up. Even if no actual communication is taking place, the channel remains reserved and protected from competing users.

Virtual circuit switching is a packet switching technology that emulates circuit switching, in the sense that the connection is established before any packets are transferred, and packets are delivered in order.

While circuit switching is commonly used for connecting voice circuits, the concept of a dedicated path persisting between two communicating parties or nodes can be extended to signal content other than voice. The advantage of using circuit switching is that it provides for continuous transfer without the overhead associated with packets, making maximal use of available bandwidth for that communication. One disadvantage is that it can be relatively inefficient, because unused capacity guaranteed to a connection cannot be used by other connections on the same network.

Task 1. Read and translate text C.

Task 2. Discuss the meaning of the words and phrases. Give definitions to these words.

Telecommunications network, network nodes, a dedicated communications channel, communication session, telephone network, packet transfer delays, virtual circuit switching.

Task 3. Complete the sentences according to the text.

1. Circuit switching is a method of…
2. The circuit guarantees the full bandwidth of the channel and remains connected for…
3. The circuit functions as if the nodes were physically connected…
4. The defining example of a circuit-switched network is the early analog…
5. In circuit switching, the bit delay is constant during…

Task 4. Choose the correct word from the text to complete the sentences.

1. In circuit switching, the channel remains reserved and protected from _____users.
2. The advantage of using circuit switching is that it provides for continuous transfer without the _____associated with packets.
3. Circuit switching is making maximal use of _____bandwidth for the communication.
4. Virtual circuit switching is a packet switching technology that _____circuit switching.

Text D
Bandwidth

Bandwidth is a term related to digital communications. It refers to the bit-rate of the available or exhausted information capacity in digital networking. In simpler words, bandwidth is synonymous to the exact rate of data transfer. It refers to the exact amount of data that can be carried between two data points at a specified time period. Generally,

network bandwidth is expressed metrically in the form of bits per seconds (BPS). However, the modern networks now measure their speeds in millions of bits every second, which is also referred as megabits per second (MBPS). Similarly, billions of bits every second, referred as gigabits per second (Gbps) is also a part of digital networking.

While understanding bandwidth, we should note that it is not the only vital factor that affects the performance of a digital network. However, other relevant factors like data loss, latency issues, lags and speed breaks may also affect the network and make it seem like a low-bandwidth issue. The bandwidth required for all digital networks may not be the same. While an IM conversation may take less than 1000 bps, a VoIP conversation is likely to exhaust 56 kbps for coming up glitch free and ostensible sounds. Again, while a standard video will exhaust 1-2 Mbps, an HD video will exhaust around 4-5 Mbps.

What is an effective bandwidth?

The term ‘effective bandwidth’ refers to the maximum and best reliable transmission rate that a network path can come up with, which is measured by a bandwidth test. This rate can be authentically determined by constantly checking the time needed for a specific file/document to leave its source point and finally download the destination source. However, in some networking platforms like the home broadband, the effective bandwidth is limited to a certain extent.

Original meaning of bandwidth

While studying about bandwidth, we should note that it is also a range of several frequencies. More specifically, it can be termed as the differences between the highest and the lowest frequency of the signal component. Just like a conventional signal frequency, the unit for measuring bandwidth is also the hertz. This is the original and the most authentic meaning of bandwidth. However, in modern times, bandwidth is strongly associated with digital networking.

What is the importance of bandwidth?

Bandwidth is highly significant for determining how fast a web page loads on a browser. In fact, it is also one of the essential things to consider while you’re choosing a platform for web hosting. The bandwidth can be significantly affected by the website and the internet connection used for accessing it. Generally, a website loaded with heavy

graphics will need higher bandwidth of 10 gigs or more. Similarly, a simple website will require comparatively smaller bandwidth. Just as fast internet connection allows you to download web pages and videos flawlessly, higher bandwidth will improve effectively the work of the user.

Task 1. Read and translate text D.

Task 2. Discuss the meaning of the words and phrases. Give definitions to these words

Bandwidth, digital communications, bit-rate¸ information capacity, digital networking, the exact rate of data transfer, to affect the network.

Task 3. Complete the sentences according to the text 1. What does metrology study?

1. Bandwidth is a term related to…
2. It refers to the bit-rate of the available or exhausted information capacity in…
3. While understanding bandwidth, we should note that it is not the only vital factor that…
4. Other relevant factors like data loss, latency issues, lags and speed breaks may also…
5. The term ‘effective bandwidth’ refers to the maximum and best reliable transmission rate that…

Task 4. Scan the text to mark the statements below true or false

1. In simpler words, bandwidth is synonymous to the exact rate of data transfer.
2. Bandwidth is the only vital factor that affects the performance of a digital network.
3. Data loss, latency issues, lags and speed breaks may also affect the network.
4. Transmission rate can be authentically determined by constantly checking the time needed for a specific file/document to leave its source point and finally download the destination source.
5. Bandwidth is strongly associated with digital networking.

Text E
Internet Bandwidth

Internet bandwidth is generally used to describe the data transfer rate of a network or Internet connection.

How does it work

- As an analogy, bandwidth can be compared to plumbing as the used data is similar to the water running through a pipe.
- The difference in bandwidth has an impact of the speed with which data is transferred as the flow is faster, thus more data can be sent at the same time. It is a matter of efficiency, and it gives the impression of being perceptually faster, when it isn't technically faster.

How much bandwidth does one need

- The answer actually depends on what the Internet connection is used for. A bandwidth increase is directly proportional to the flow of data, thus it increases the amount of data in a given amount of time.
- As the bandwidth is fixed depending on the agreement one has with their Internet provider, the adding of several requests to the network will each take part of the full capacity, thus the process may be slowed or even interrupted.

What affects Internet speed

- The Internet connection type: a bandwidth can be fixed, or capped, therefore they cannot be increased, such as Dialup or even DSL.
- Traffic congestion: the more data is requested or shared at one given time, the more bandwidth is being used in the same time, and the slower the process gets. It can happen at peak hours of the day, or if several members share a home network and are logged in at the same time.
- Outdated Equipment or malfunctions: "plumbing" is necessary, since equipment becomes outdated, or may not be configured optimally, thus reducing the efficiency of the Internet connection.
- Distance: the further the network computer is from the ISP hub, the longer it takes for the data to transfer from the Internet to the computer, slowing down the

process.

Limitations to Internet bandwidth

- Bandwidth control is a system used to limit the amount of bandwidth that a running program is allowed to use, with the purpose of organizing activities which do not necessarily need a constant running speed. These limitations are often set by download managers, online backup services, some cloud storage services and even routers as they all use massive amounts of bandwidth.
- Bandwidth throttling is another way of controlling how much bandwidth one uses by setting a limit to a certain type of traffic (like movie streaming or life sharing) or limiting traffic during a particular time of the day in order to reduce long queues.

Task 1. Read and translate text E.

Task 2. Choose the correct word from the text to complete the sentences.

1. As an analogy, bandwidth can be compared to_____as the used data is similar to the _____running through a pipe.
2. Internet bandwidth is generally used to describe the ___ _____ ____of a network or Internet connection.
3. A bandwidth increase is____ _____ ____, thus it increases the amount of data in a given amount of time.
4. The more data is requested or shared at one given time, the more bandwidth is being used in the same time, and the slower the____ ____.
5. The further the network computer is from the ISP hub, the longer it takes for the data to_____ from the Internet to the computer.

Task 3. Scan the text to mark the statements below true or false.1. What does metrology study?

1. The more data is requested or shared at one given time, the less bandwidth is being used in the same time.
2. Bandwidth can’t be compared to plumbing as the used data isn’t similar to the water running through a pipe.
3. The further the network computer is from the ISP hub, the longer it takes for

the data to transfer from the Internet to the computer, slowing down the process.

Task 4. Complete the sentences according to the text.

1. A bandwidth increase is directly proportional to the flow of data, thus it increases….
2. As the bandwidth is fixed depending on the agreement one has with their Internet provider, the adding of several requests to the network will….
3. As an analogy, bandwidth can be compared to…
4. The difference in bandwidth has an impact of the speed with which…
5. Internet bandwidth is generally used to describe…
6. The more data is requested or shared at one given time, the more bandwidth is being used in the same time, and the slower….
7. The further the network computer is from the ISP hub, the longer it takes for the data to …

Text F
Digital Subscriber Line

DSL is short for the Digital Subscriber Line. It is a medium to provide internet access by transmitting digital data through a phone line. In a DSL connection, you can use both the internet and the telephone line simultaneously. This is primarily used in residences and small businesses that require ease of access to both the internet and the phone lines.

Generally, you can connect to the internet via a few selected options. One is the regular modem that uses LAN (local area network), and another option is the cable modem. But the most versatile is undoubtedly the Digital Subscriber Line (DSL) technology. The bit rate range of a consumer DSL can be from 256 Kbit/s to over 100 M/bit. But there can be various factors which can influence this rate, as such as line condition, DSL technology and service level implementation. The gauge of the copper wire is another factor. The heavier 24 gauge wire carries the same data rate farther than the 26 gauge wire. If someone lives beyond a 5.5 KM range, then the network connectivity depends on whether the service provider will provide the connection through fiber optic cables or not.

Researchers in BELL Labs have reached a broadband speed of 10 Gbit/s using the traditional copper wires. DSL connects through USB ports. To access the internet via DSL, you must connect to a DSL specializing Internet Service Provider (ISP). The provider in question will provide you with a DSL modem which can be connected to a computer. Implementations of DSL can be either Asymmetric DSL (ADSL) or Symmetric DSL (SDSL).

Symmetric DSL (SDSL) splits the upward and downward streams evenly, providing equal speeds to both send and receive data. However, in most cases, the users like to download more data than to upload. So in those cases, the service providers offer Asymmetric DSL (ADSL) service. ADSL service offers a wider frequency range for downstream transfers, which tends to offer downstream speeds which are several times faster. Theoretically, an SDSL connection may provide 2 Mbps upstream and downstream while an ADSL connection may offer 20 Mbps downstream and 1.5 Mbps upstream.

Advantages:

- The speed is far better than that of normal modems.
- You can use the internet and the phone line at the same time.
- DSL technology doesn't require new wiring, as it uses the existing phone line that you already own.
- Service providers provide the DSL modems.
- You can choose between different connection speeds and pricings from various providers.
- It is cheaper than cable connections.

Disadvantages:

- DSL connection works better when the PC is near to the provider's office.
- DSL connection receives data faster, but it lacks speed during transmission.
- Availability is an issue in remote areas.

Transmission methods can vary depending on the region, the carrier, the market, and the equipment. These are 2B1Q, CAP (Carrier less Amplitude Phase Modulation) and TC-PAM (Trellis Coded Pulse Amplitude Modulation). The most common kind of all these transmission methods is called DMT (Discrete MultiTone modulation).

Task 1. Read and translate text F.

Task 2. Discuss the meaning of the words and phrases. Give definitions to the words.

DSL connection, service level implementation, the gauge of the copper wire, bit rate range, consumer DSL, the cable modem, versatile technology, digital data, Internet Service Provider, Symmetric DSL, DSL modems, Asymmetric DSL.

Task 3. Make 10 sentences with these words.

Task 4. Scan the text to mark the statements below true or false

1. In a DSL connection, you can not use both the internet and the telephone line simultaneously.
2. The bit rate range of a consumer DSL can be from 256 Kbit/s to over 100 M/bit.
3. DSL is a medium to provide internet access by transmitting analogue data through a phone line.
4. You can connect to the internet only with the help of the cable modem.
5. Only line condition can influence the bit rate.
6. DSL connects through USB ports.
7. Implementations of DSL can be either Asymmetric DSL (ADSL) or Symmetric DSL (SDSL).
8. DSL connection receives data faster, but it lacks speed during transmission.

Task 5. Summarize the advantages of DSL connection. Think about its downsides.

Digital Subscriber Line (DSL) connection	
Advantages	Disadvantages
a) b) c)	a) b) c)

Task 6. Complete the sentences according to the text.

1. The bit rate range of a consumer DSL can be…..

2. In a DSL connection, you can use both the internet and the telephone line…

3. The gauge of the copper wire is…

4. There can be various factors which can influence the bit rate, as such as line condition…

5. DSL connects through…

6. Implementations of DSL can be either…

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