

# Computer networks

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# Computer network

- is a complex of **technical means** and **interconnected** and **cooperating computers** and their **hardware** and **software resources**, which are appropriately **connected** and ensure mutual communication and data transfer.

# Computer network

Made up of three basic parts:

- ✓ **Hardware** – technical tools – **transmission media** (optical cable, radio waves, infrared radiation, laser, etc.), **electronic devices** (with the function of transmitting, receiving, repeating and routing transmitted signals) and **stations** (service stations, i.e. servers and workstations).
- ✓ **Software** – program resources (software in specific electronic devices, e.g. switch, firewall, network OS of servers and application software on PC).
- ✓ **Orgver** (organization security) - measures to ensure network management and a set of user behavior rules when using the network + network administrator function.

# 1.1 Division of computer networks

- according to the types of connected computers,
- according by architecture,
- according to area.

# According to the types of connected computers

- **Homogeneous** – all connected computers are of the same type, e.g. center computers, personal computers, etc.
- **Heterogeneous** – can contain several types of computers, e.g. public data networks.

# According by architecture

**Client-server architecture** - the basis of this architecture is the division of the system into two parts – client and server. Consists of one server and several client computers, i.e. workstations. Its basic principle consists in sending requests from client computers to the server, which processes these requests and sends back the required information.

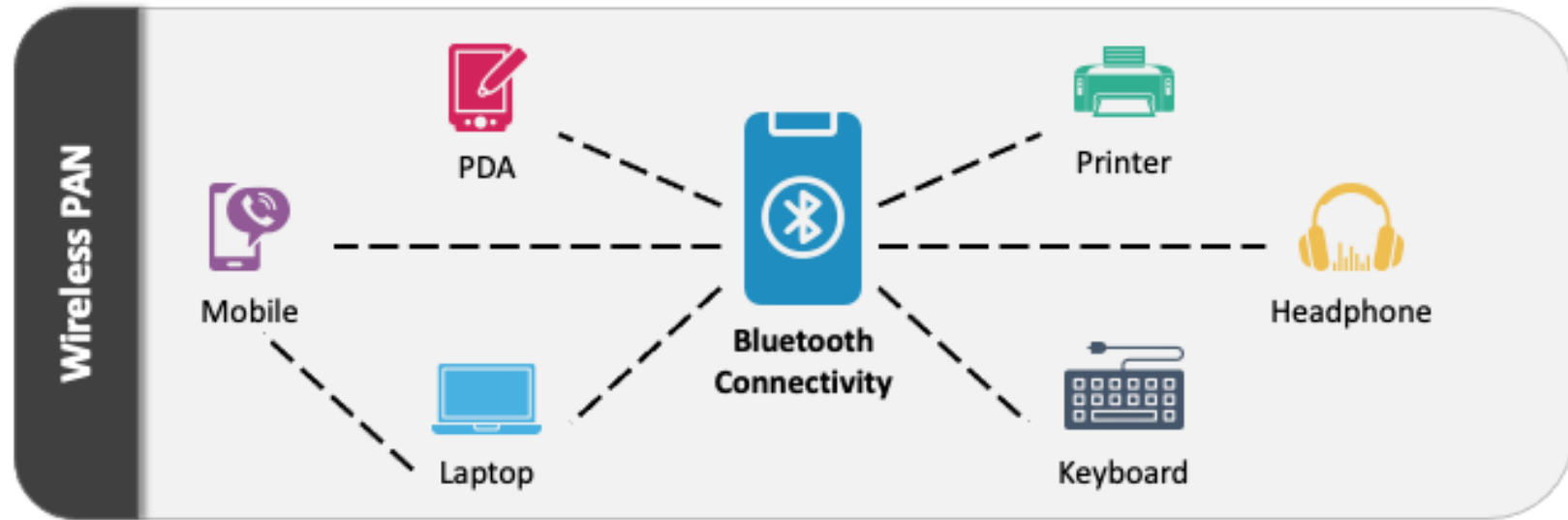
**Peer-to-peer (P2P) architecture** - networks connecting specific computers without connecting to a central server. Computers serve as a client, server and often a router at the same time.

## According to area

- **PAN (Personal Area Network)** - very small personal networks involving cooperating devices serving usually one person. The network connects devices within a range of several meters and wireless technologies are used to connect them.

# PERSONAL AREA NETWORK (PAN)

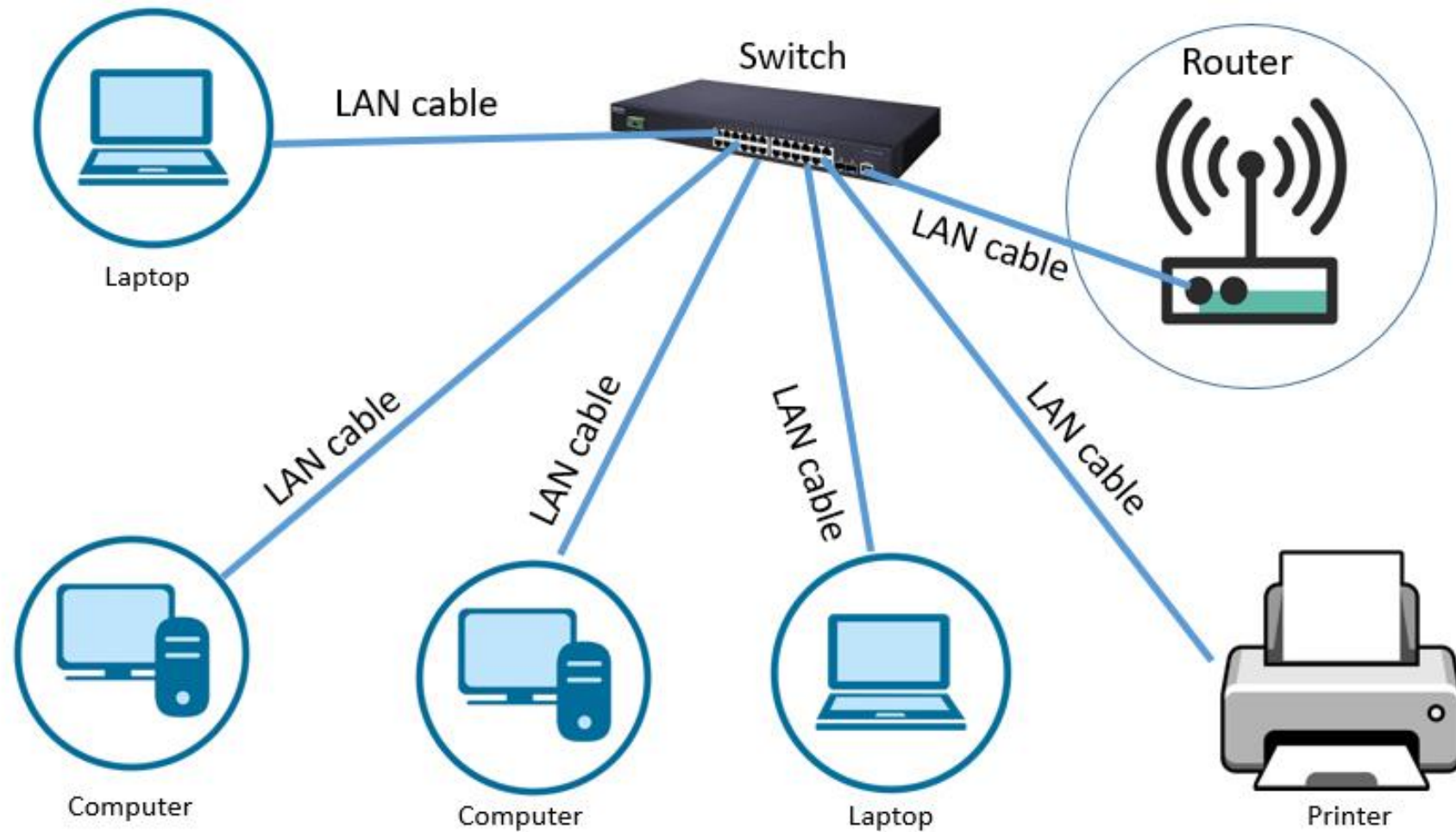
Types of PAN Network





## According to area

- **LAN (Local Area Network)** - local data networks that connect individual computers and servers in a relatively small geographic area - within a few kilometers. This is usually a computer network within one building or a couple of buildings that are close to each other.

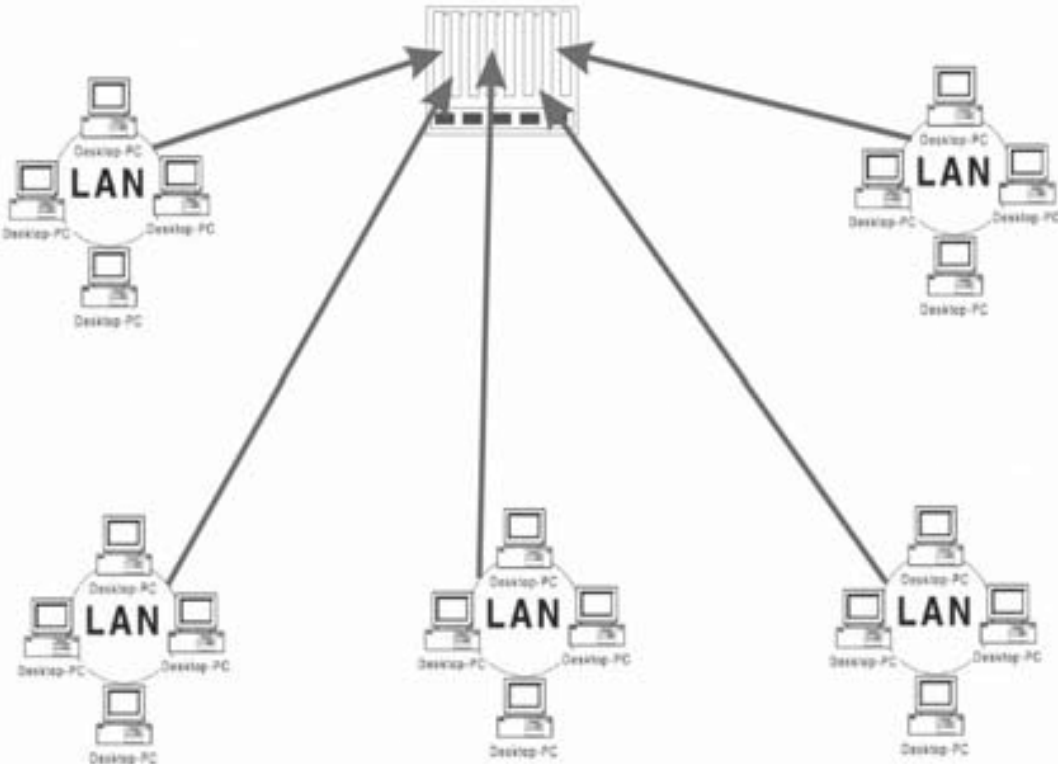


# Local Area Network

## According to area

- **MAN (Metropolitan Area Network)** - it is a network that interconnects LANs located in a smaller geographical area (usually between several buildings up to the extent of a city or metropolis) into a single network. The dominant transmission media are metallic and optical lines, the use of wireless radio technologies is also expanding.

**MAN**



**LAN 1**

**HOSPITAL  
LAN**

**LAN 2**

**COLLEGE  
LAN**

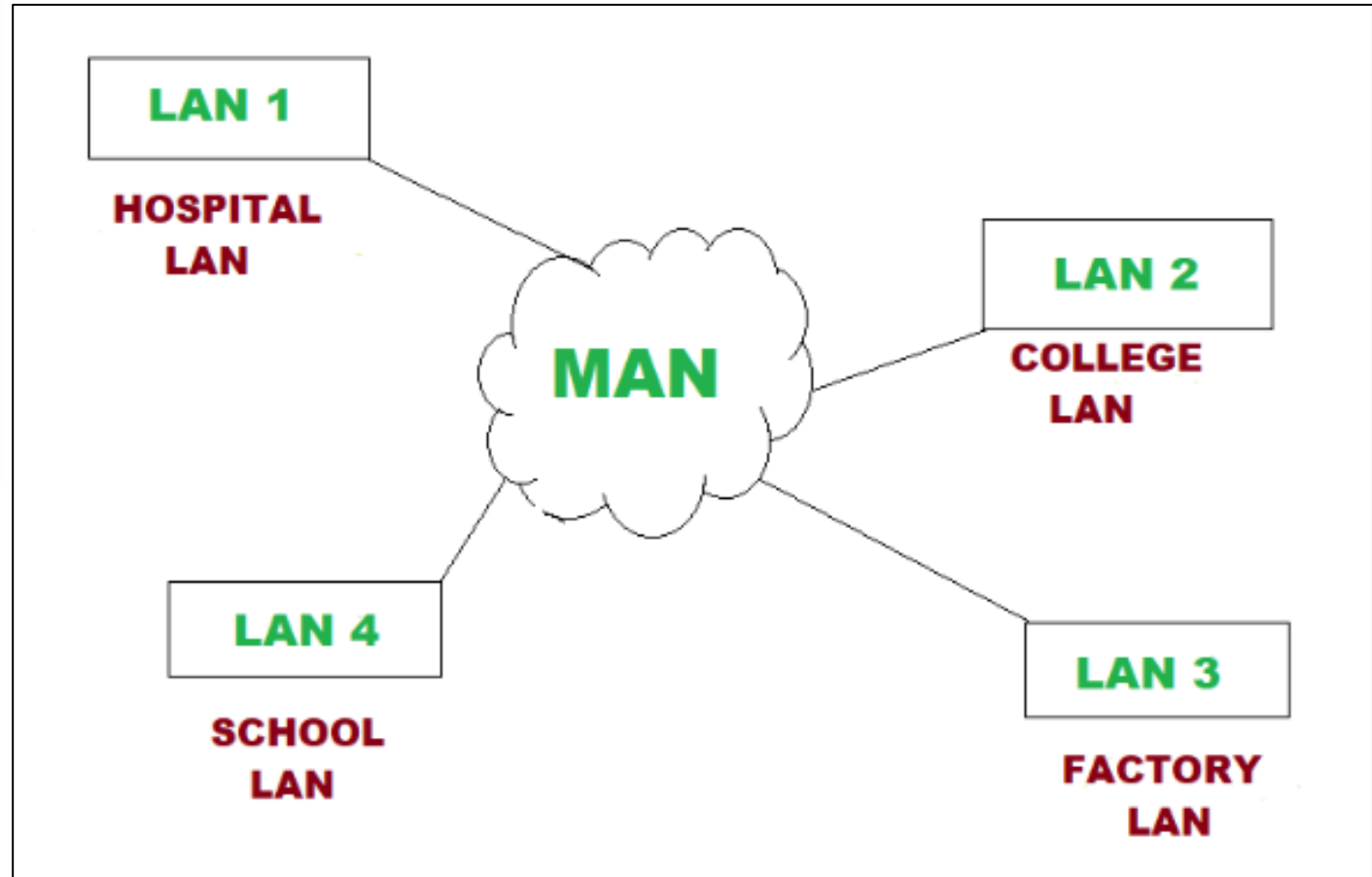
**MAN**

**LAN 4**

**SCHOOL  
LAN**

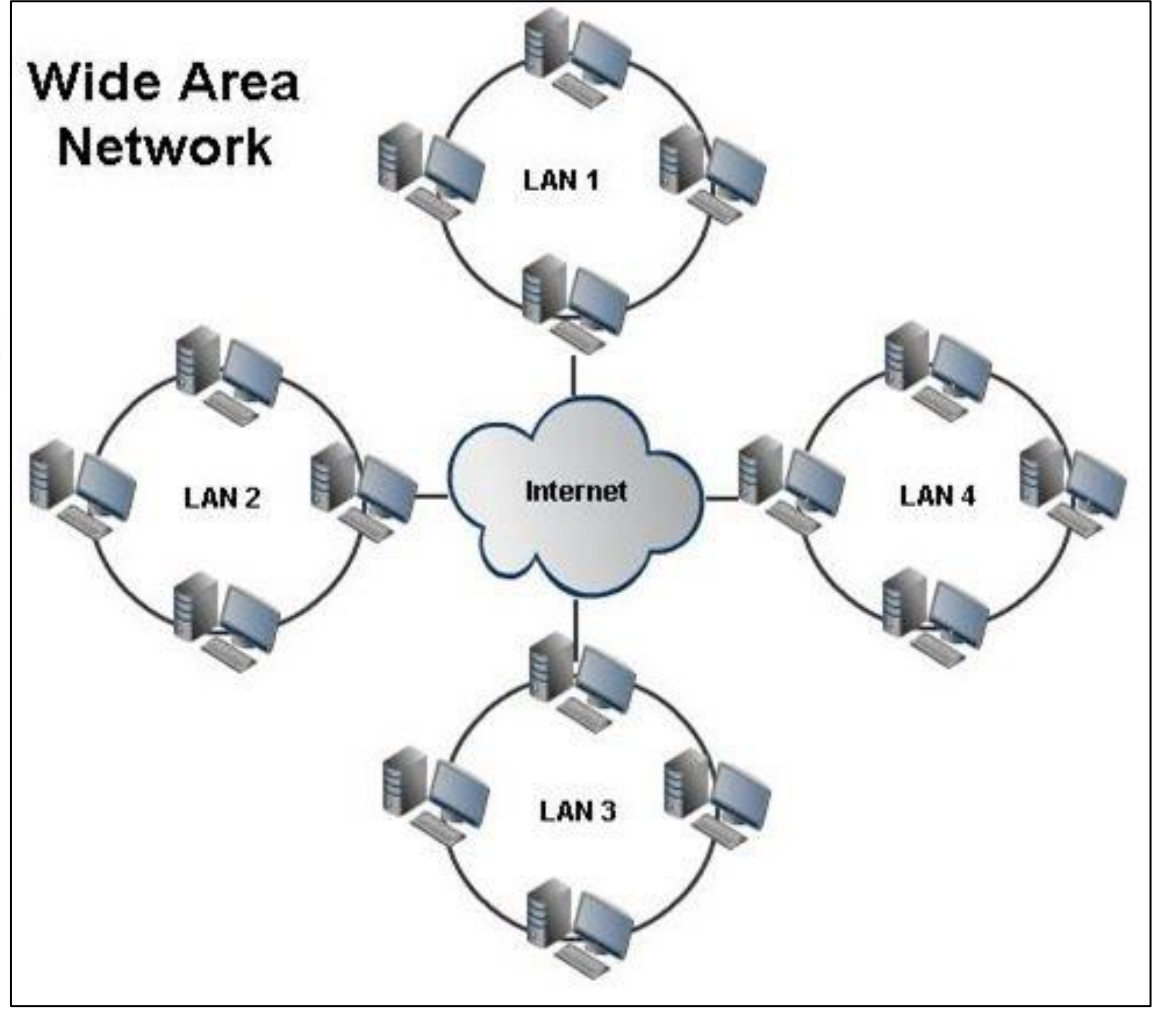
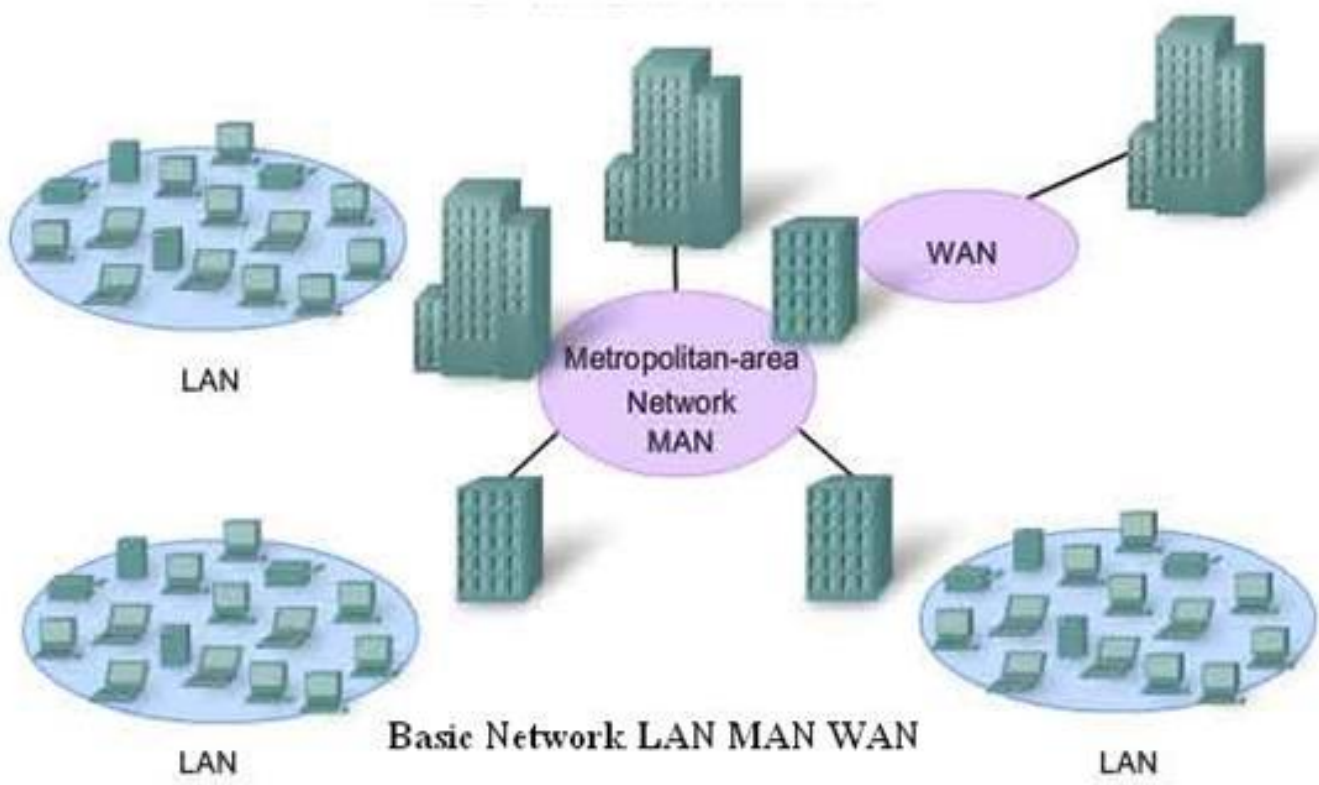
**LAN 3**

**FACTORY  
LAN**



## According to area

- **WAN (Wide Area Network)** - it is a network that connects computers or smaller computer networks such as LANs and MANs around the world. Distances in such a network are unlimited, they are networks on larger territories, e.g. state, continent, world. All kinds of transmission media are used - metallic, optical, wireless radio.



# 1.2 Topology of networks

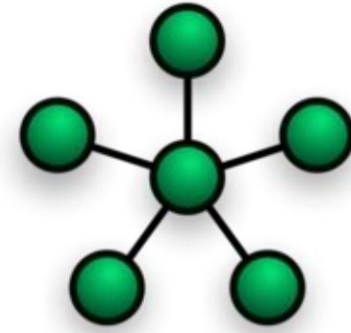
- it is a physical arrangement of connections between network nodes - a network map. It characterizes how the individual nodes of the network are connected to each other or it is the structure or architecture of a computer network.

## **Direct connection** (*Point-to-Point* or *Line*)

- it is the simplest topology - it connects two endpoints.



# Star topology



Individual computers are connected via a hub. The message is also propagated along the line and can be received by the destination station. In its simplest form, it consists of one central node, which can be made up of a switch, a hub – concentrator, a router or a computer that acts as any of these devices.

If the central node of the network is passive, the originating node must be able to tolerate echo reception of its own broadcast data with delay (path to the central node and back), as well as any delay generated at the central node.

*Advantages* - cable failure, or pc causes the failure of only one workstation, simple fault detection (e.g. lit LED), easy modification and addition of new computers, central monitoring and management.

*Disadvantages* - failure of a node will cause an entire segment of the network to fail, higher costs.



# Tree topology

Linking computers into a tree-like structure. It is based on a star topology by connecting active network elements that are in the center of individual stars. Such a connection is primarily used in large-scale computer networks in large companies.

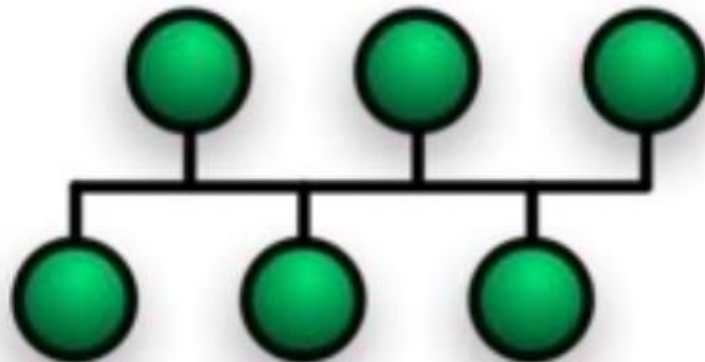


# Bus topology

Individual computers are connected to a bus. A bus means a direct line to which other computers connect.

*Advantages* - simple connection, workstation outage will not cause network crash, cheap solution, easy to expand.

*Disadvantages* - complex fault detection (longer finding out where the network interruption occurred), by improperly disconnecting one computer, the entire network branch will be interrupted.

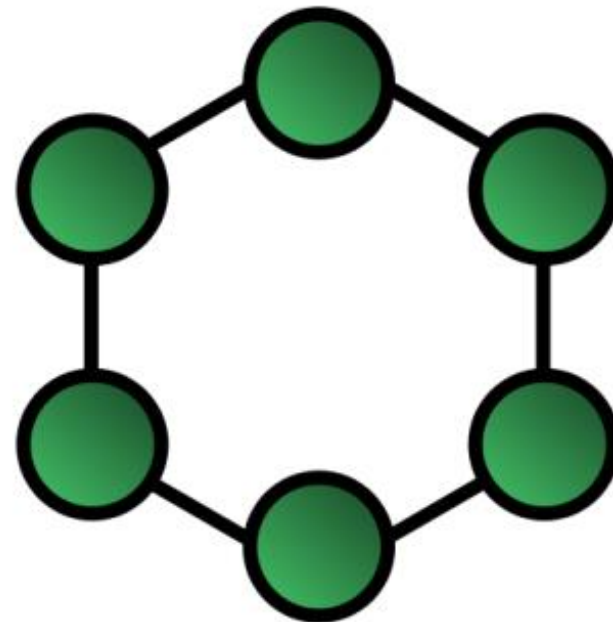


# Ring topology

Computers are connected in a closed circle. A message travels in one direction from computer to computer to the destination computer.

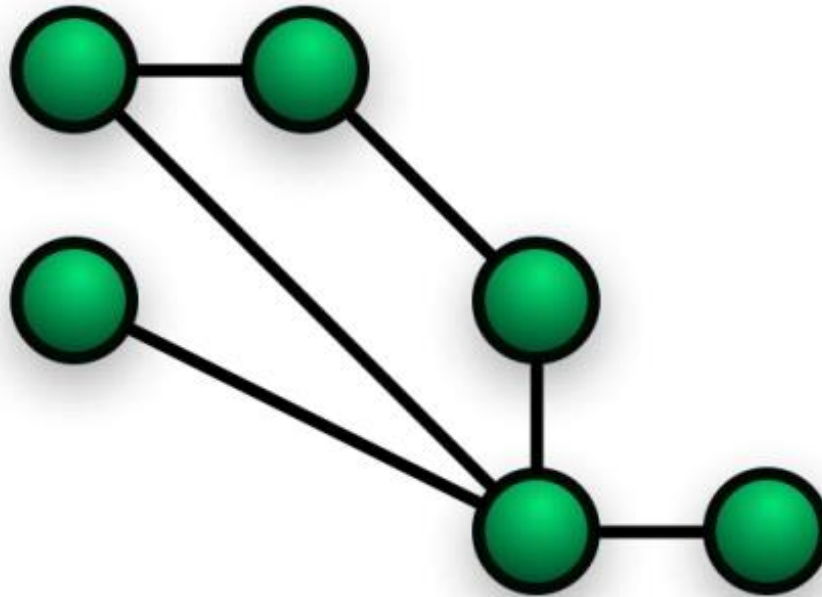
*Advantages* – simple connection, cheap solution, easy to expand

*Disadvantages* - difficult fault detection, the failure of one PC affects the entire network.



# Unlimited topology

Individual computers are connected to each other, which makes it possible to keep the network in operation even if one of the layers of the network goes down.



## 1.3 Transmission technology

The communication system is made up of a set of compatible telecommunications devices that connect geographically separated devices, where communication between components is ensured by the so-called protocol.

A **protocol** is a set of agreed upon rules that must be followed in order for communication to be successful. All protocols are specified by official documents, similar to, for example, SI units.

However, unlike them, protocols are not immutable. Most of them are designed to provide the greatest possible backward compatibility (possibility to cooperate with systems using an older version), the easiest extensibility and, above all, the highest possible optimization of activity.

## 1.3 Transmission technology

**Arcnet** – suitable for networks where there are not high demands on the amount of data transmitted in the network. The advantage is the low price and ease of execution. It is possible to use different network topologies or combinations thereof. This technology was created in 1977 and is not very used today.

## 1.3 Transmission technology

**Ethernet** - a very widespread type of hardware. It is suitable for networks where there is a greater network load. Ethernet is based on the idea that computers on a network will send messages in a manner similar to radio, but over a common cable or channel, sometimes referred to as ether. Each computer has a globally unique 48-bit MAC address that is assigned to each card at the factory to ensure that all systems on a shared Ethernet have different addresses. Thanks to the ubiquity of Ethernet today, many manufacturers have built Ethernet cards directly into computer motherboards. The concept of this technology was created in 1980.

**IBM Token Ring** - this kind uses a ring network topology and is very powerful due to the access method and high transmission speed. Token ring belongs to the deterministic methods of access to the medium. It means that each network node must wait for a specific packet to arrive. In Token Ring, it is the so-called Token. The operation can be described very simply as follows: a specific packet (token) is transmitted over the network and each node must wait for the token to arrive. If the token reaches it, it can start sending data. If it does not send any other data, it sends an empty token to the network. This technology was created in the early eighties.



## 1.3 Transmission technology

**FDDI (Fiber Distributed Data Interface)** - belongs to standard LAN technologies. It was created based on the need to ensure a reliable and fast connection of powerful servers, which are distant from a few meters to tens of kilometers. This technology is mainly used as a fast backbone network with high data throughput.

## 1.4 Network architecture

It is defined by:

- **network topology,**
- **access methods,**
- **communication protocols.**

# 1.4 Network architecture - access methods

The network uses several devices at the same time, so it is necessary to determine who can broadcast when (access the transmission media). The method that determines these rules is called the access method. An access method is a set of rules for workstation access to a transmission medium. It is a way of deciding the order of stations when broadcasting news. It is a feature given by the relevant network technical equipment standard.

Access Methods:

- *Carrier Sense Multiple Access with Collision Detection (CSMA/CD)*
- *Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) - WiFi*
- *Token Passing (Token Bus, Token Ring)*

# 1.4 Network architecture - communication protocols

A communication protocol is a set of rules, methods of network access and communication over a network. It is primarily about the type of transmission, its speed, control, etc. In order for successful communication to occur, both parties must follow the given communication protocol.

Protocols are defined by the following world organizations (we call them standard-setting organizations):

**CCITT:** *Comité Consultatif International Téléphonique et Télégraphique* (International Telephony and Telegraphy Advisory Board), today renamed to ITU-T.

**ISO:** *International Standards Organization* (international organization for the design of standards).

**IEEE:** *Institute of Electrical and Electronics Engineers*, a non-profit organization based in the USA

# 1.4 Network architecture - communication protocols

## **TCP/IP Protocol (Transmission Control Protocol/Internet Protocol)**

The TCP/IP communication protocol is currently one of the most popular protocols. It is not a single protocol but a group of protocols. The reason for the need for multiple protocols is the complexity of the problems to be solved. The solution takes place on several levels and each of them uses a different kind of protocol.

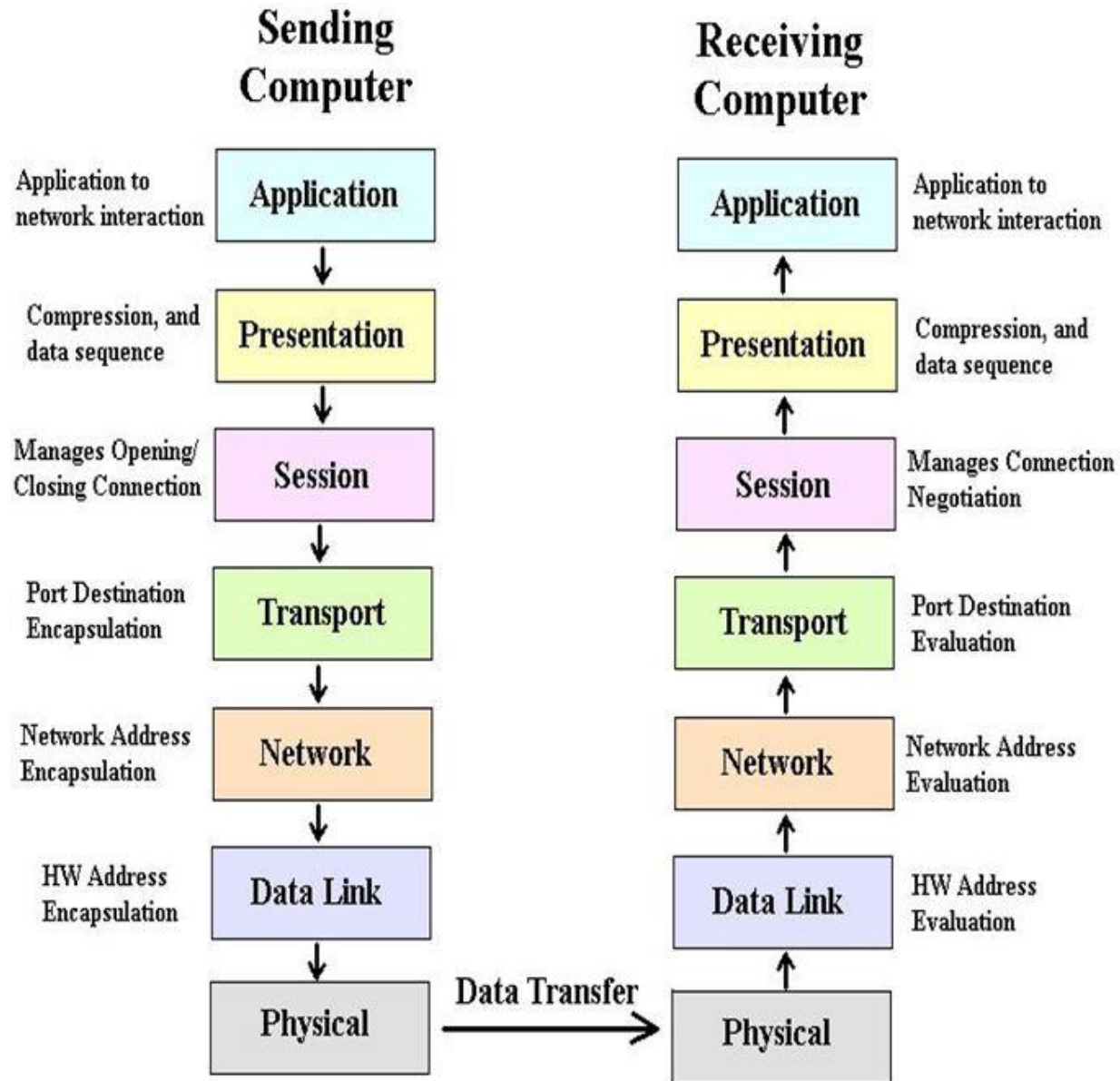
The TCP/IP protocol is universal in the sense that it can be used for communication between computers with different OSs. It is routable and thanks to that it has become the standard for communication on the Internet. The TCP/IP model has 4 layers. From top to bottom, these are the layers: application, transport, network and network interface. Each layer has its own purpose.

# 1.4 Network architecture - communication protocols

## **ISO/OSI network architecture model**

In the field of computer networks, the reference model of network architecture - the ISO/OSI standard - was adopted by the ISO organization as an international standard. The model is seven-layered, it specifies the activities of individual layers.

# Network Layer Interaction



While the first four layers are quite precisely defined, the other three layers may not be strictly used as defined by this model. Theoretically, each layer adds its own header to the data packet from the front with the data of this layer and at the end a checksum or information about the end of the layer's data.

Data transfer between two applications, e.g. between the sending process A and the receiving process B takes place in such a way that on the sending side, a header containing control information is gradually added to the data from the higher layer in each layer, and on the receiving side, the headers are gradually removed.



**Physical layer** - the role of the physical layer of the network is the transmission of electrical, optical or radio signals over the transmission medium. The physical layer describes the transmission medium itself (metallic, optical cable, wireless radio connection) and the nature of the transmitted signal (electrical, optical, coding methods). The physical layer does not understand the transmitted data itself, it only understands it as a stream of bits.

**Link layer** (data link layer) - provides a mechanism for communication between two neighboring stations in the network, it can ensure the detection and possibly also the correction of errors that may occur during transmission through the physical layer.

**Network layer** – includes overall communication in the data subnet, provides means for the transfer of blocks of data between open systems, this layer ensures the routing and interconnection of data as it moves through the network.

**Transport layer** - includes the communication of end devices connected to the data network and balances the different characteristics of different data networks, provides reliable services for transmission between two end points.

**Session layer** – the session layer, which mainly includes activities related to creating, maintaining and canceling a session, provides two end users with the means to organize and synchronize connection and data exchange.

**Presentation layer** – mainly includes transformation and conversion activities. A layer that ensures the selection of an appropriate syntax for presenting information and for transforming application data into or out of this common syntax.

**Application layer** – the highest, seventh layer in the OSI reference model, including communicating application processes. It provides means for exchanging information and contains application-oriented protocols, with which these processes communicate. The application layer represents the interface for the end user.

## 1.5 Addressing

Each computer has a globally unique 48-bit, so-called **MAC address** (the hardware address of the network card assigned by the manufacturer) to ensure that all systems on a shared Ethernet have different addresses.

Thanks to the ubiquity of Ethernet today, many manufacturers have built Ethernet adapters directly into computer motherboards. When working in a computer network, one more address is important, and that is the so-called IP address.

Administrator: C:\Windows\system32\cmd.exe

Microsoft Windows [Version 6.1.7601]  
Copyright (c) 2009 Microsoft Corporation. Všetky práva vyhradené.

C:\Users\XX > ipconfig/all

Windows IP Configuration

Host Name . . . . . : XX  
Primary Dns Suffix . . . . . :  
Node Type . . . . . : Hybrid  
IP Routing Enabled. . . . . : No  
WINS Proxy Enabled. . . . . : No  
DNS Suffix Search List. . . . . : ynet.sk

Ethernet adapter Lokálne pripojenie:

Connection-specific DNS Suffix . : ynet.sk  
Description . . . . . : Atheros AR8131 PCI-E Gigabit Ethernet Con  
troller (NDIS 6.20)

Physical Address. . . . . : BC-AE-C5-0A-24-5C  
DHCP Enabled. . . . . : Yes  
Autoconfiguration Enabled . . . . . : Yes  
Link-local IPv6 Address . . . . . : fe80::812f:d634:974e:d270%10(Preferred)  
IPv4 Address. . . . . : 147.175.186.7(Preferred)  
Subnet Mask . . . . . : 255.255.255.0  
Lease Obtained. . . . . : 9. februára 2012 1:45:48  
Lease Expires . . . . . : 16. februára 2012 1:45:48  
Default Gateway . . . . . : 147.175.186.1  
DHCP Server . . . . . : 147.175.189.195  
DHCPv6 IAID . . . . . : 247246533  
DHCPv6 Client DUID. . . . . : 00-01-00-01-14-9B-55-3A-BC-AE-C5-0A-24-5C

DNS Servers . . . . . : 147.175.167.251  
                          147.175.189.200  
Primary WINS Server . . . . . : 147.175.189.200  
NetBIOS over Tcpi. . . . . : Enabled

# 1.5 Addressing

An **IP address** is a logical numerical identifier of a physical network interface (network card) of a given node (most often a computer) in a network that communicates with other nodes via the IP protocol (for example, for the Internet). The IP address must be unique, otherwise conflicts arise and the connection to the network is not functional.

An **IP address** is (in the IP version 4 protocol) a 32-bit number that is divided into four 8-bit numbers (a number in the range 0-255) written in decimal notation separated by a dot, for example 193.86.98.1. An IP address is either directly assigned to a network interface or is assigned dynamically using a DHCP (Dynamic Host Control Protocol) server.

## 1.5 Addressing

For better work with Internet addresses, an **IP address** is usually associated with a name (hostname), e.g. fem.uniag.sk The transfer of names and IP addresses is ensured by the DNS (Domain Name System) mechanism, i.e. a globally organized set of servers that keep records of registered domains and their assigned IP addresses.

Microsoft Windows [Version 10.0.19042.844]  
(c) 2020 Microsoft Corporation. All rights reserved.

C:\Users\egrif>ipconfig

Windows IP Configuration

Unknown adapter VPNWireguard:

Media State . . . . . : Media disconnected  
Connection-specific DNS Suffix . :

Ethernet adapter Ethernet 4:

Media State . . . . . : Media disconnected  
Connection-specific DNS Suffix . :

Wireless LAN adapter Local Area Connection\* 1:

Media State . . . . . : Media disconnected  
Connection-specific DNS Suffix . :

Wireless LAN adapter Local Area Connection\* 3:

Media State . . . . . : Media disconnected  
Connection-specific DNS Suffix . :

Ethernet adapter Ethernet:

Media State . . . . . : Media disconnected  
Connection-specific DNS Suffix . :

Wireless LAN adapter Wi-Fi:

Connection-specific DNS Suffix . :  
IPv6 Address. . . . . :  
Link-local IPv6 Address . . . . . :  
IPv4 Address. . . . . : 192.168.68.123  
Subnet Mask . . . . . : 255.255.255.0  
Default Gateway . . . . . :  
192.168.68.1

Ethernet adapter Bluetooth Network Connection:

Media State . . . . . : Media disconnected  
Connection-specific DNS Suffix . :



# 1.6 Communication services and the Internet

- Internet
- Intranet
- Extranet

Communication services are currently provided via public telephone, teletype, radiotelephone network and public data network. In the case of a public data network, it is an open communication environment for national and international data transmission. The most important role in today's communication is represented by the Internet.

The Internet (**Inter**connected **Networks**) is currently the largest computer network in the world. No person, company, organization or government owns it. However, each individual network that forms it has its own owner.

Definition of the Internet (according to the Federal Networking Council):

- global information system - computer network of networks, based on TCP/IP protocols,
- a set of information that is accessible through this network,
- the community of people using this computer network.

Slovak linguists combined the meaning of the words internet and Internet into one word internet with a small "i". However, in the literature we often encounter both occurrences.

# 1.6 Communication services and the Internet

**Intranet** – it is about the internal Internet, about the appropriate use of the principles and methods of the Internet inside the company, on the internal network.

It represents a kind of company-wide computer network in which Internet technologies are implemented. Under this term, one should imagine the transfer of data based on the TCP/IP protocol, the browser of information resources based on the Internet browser of the hypertext pages of the World Wide Web (www), electronic mail systems, access to corporate databases, management of the circulation of documents, access to information resources of the Internet.

## 1.6 Communication services and the Internet

An **Extranet** is several intranets that are connected to each other by secure communication channels using "Virtual Private Networks (VPN)" technology. Extranet is a concept of extended corporate communication that goes beyond the boundaries of the company. For mutual communication between cooperating companies, their partners, customers, suppliers, etc.

# 1.6 Communication services and the Internet - methods and possibilities of connecting to the Internet

**Dial-up** – connection to the Internet using a fixed analog telephone line. A modem is required to connect the computer. This technology was used in the early days of the Internet. It was not possible to make phone calls while using the Internet (and vice versa). The connection speed was 56 kbit/s. It is rarely used today - in areas where no other (even mobile) connection option is available.

The newer **ISDN** technology already used a digital modem, when it was possible to use a speed of 128 kbit/s. However, the advantage was mainly the fact that it was also possible to make phone calls when connected to the Internet. We also call both of these connection methods "dial-up", connecting to the Internet was actually a form of phone call, so you paid for the connection time.

# 1.6 Communication services and the Internet - methods and possibilities of connecting to the Internet

**DSL (Digital Subscriber Line)** – it also uses a fixed telephone line for high-speed Internet connection, a modem is required for connection. However, you do not pay for the connection time (this is permanent), but some operators reduce the speed after downloading a certain amount of data (e.g. 120 GB), or charge extra for data exceeding the limit.

The most common form is the so-called **ADSL (Asymmetric Digital Subscriber Line)**, i.e. asymmetric connection, where download - the speed of downloading data (browsing pages) is significantly faster than upload - the speed of sending data (e.g. sending emails). ADSL is still a very widespread way of connecting to the Internet, given that it is available (thanks to a fixed telephone line) even in smaller towns and cities. Optical networks are currently being built only in larger cities.

## 1.6 Communication services and the Internet - methods and possibilities of connecting to the Internet - wireless

**Wireless local Wi-Fi networks** - connected devices communicate via radio signal. The quality of the connection depends on direct visibility, weather, etc. The range varies from several meters to several kilometers. Clients with a device capable of receiving a Wi-Fi signal connect to the Internet through an access point. An area covered by one or more access points is called a hotspot. Wi-fi is often used in homes to create a home computer network. There is one Internet connection (e.g. fiber optic cable, DSL ...) leading to the home, and all devices (laptops, smartphones, tablets, ...) capable of receiving a Wi-Fi signal can be wirelessly connected to this connection via a Wi-Fi router.

The danger, however, is that many users will leave the Wi-Fi router unpassworded, thereby allowing neighbors to use this connection (who then have free Internet and access to all computers on the network). The squares of some cities, shopping centers, or trains and buses are covered by Wi-fi signal (free, free of charge). However, Wi-Fi is also used commercially, i.e. it is a substitute for a fixed Internet connection (the provider, especially in cities, provides a Wi-Fi connection within a radius of several kilometers through a powerful transmitter on the roof of one building). The speed is at the level of 5-10 Mbit/s and is time and data limited.

## 1.6 Communication services and the Internet - methods and possibilities of connecting to the Internet - wireless

**Mobile internet connection** - uses the infrastructure of mobile operators (mobile hotspots). The Internet is available either directly on the mobile phone, but the mobile phone (or USB modem with an inserted SIM card) is the receiver to which the laptop or desktop computer is connected via the USB interface. The advantage is wide availability, a speed of several Mbit/s, but it is relatively expensive financially, the connection is data limited, i.e. after transferring a certain amount of data (1 - 5 GB) the Internet slows down (e.g. to 16 kbit/s) or data exceeding the limit is required pay separately.

**Satellite connection** - it is used over long distances, the signal is available everywhere, but its establishment is extremely expensive. A long response time is characteristic.



## 1.6 Communication services and the Internet - methods and possibilities of connecting to the Internet

**Internet through cable television distribution** - connection to the Internet is made using cable television distribution.

**Optical Internet** - the signal is conducted through an optical cable, i.e. using light. When laying optical cables, it is necessary to observe the maximum permissible bending radius. It has become the standard in big cities, its speeds are in the tens of Mbit/s, it provides unlimited data connections, and it is a very affordable connection.

## 1.6 Communication services and the Internet – Internet services

The Internet offers several standard services through which individual user applications function. To use individual services, the user must have a program (client) installed on his computer, which can communicate with servers providing a specific type of service (www browser, ftp client, e-mail client, etc.) via an Internet connection.

# 1.6 Communication services and the Internet – Internet services – World Wide Web

The foundations of the Internet were laid in the 1960s, when the US military tried to ensure the connection of military mainframe computers on the territory of the US for problem-free communication.

In August 1969, there was already a first network that included 4 nodes. Other institutions, especially universities, gradually joined it.

In 1989, a worker at the European Laboratory for Particle Physics in Switzerland realized that file transfer over a network could be used to create hypertext documents in which tagged words point to other documents located in different locations around the world. For the internal needs of the workplace, he created a program unit that he called web - web (hypertext links).

# 1.6 Communication services and the Internet – Internet services – World Wide Web

The Web spread very quickly throughout the network and became the most popular Internet service under the name World Wide Web (WWW). The WWW gives an integrated view of documents from various sources (e.g. globally accessible library catalogues, tourism information, weather forecasts, newspapers and magazines, conferences, virtual exhibitions, trade, etc.).

It is based on the use of hypertext and hypertext information. The basic unit of information for the WWW service is a document (called a page or WWW page), which contains links to other documents using highlighted keywords (text with links - hypertext). In addition to textual information, a document can also contain images, sound sequences or video sequences.

Due to the possibility of integrating non-textual (multimedia) data, we speak of the WWW as a multimedia system.

# 1.6 Communication services and the Internet – Internet services – FTP (File Transfer Protocol)

**FTP** is a protocol from the group of TCP/IP protocols designed to transfer files between computers, whether on the Internet or a local network. On the FTP server, it is possible to create several user accounts (accounts), set rights for users, their access to uniform files. Some FTPs are anonymous, so it is not necessary to know the **login** name and **password**, only the server address is sufficient.

# 1.6 Communication services and the Internet – Internet services – Electronic mail

The mechanism is the same as for classic mail. Sending a letter means handing it over to the transport system, which is made up of programs called **Mail Transfer Agents** (MTA). These "agents" ensure the entire path of the letter from the sender to the addressee. If the next agent towards the recipient is not available, the previous agent will hold the letter in the queue until the next agent becomes available. Agents use **Simple Mail Transfer Protocol** (SMTP) to communicate with each other. When the letter arrives at the destination agent, the agent drops it into the addressee's mailbox.

Mailbox is a file that contains the user's inbox. Addressing and routing of mail is simplified by the Internet domain name system - **Internet Domain Name Service** - DNS. Allows you to address computers on the Internet using the so-called domain addresses.

# 1.6 Communication services and the Internet – Internet services – Electronic mail

An address consists of a computer name and several domains, all separated by dots. Domains specify the computer, the domain located furthest to the right is the **top-level domain** - outside the US it denotes the state, within the US there are the following designations:

**.edu** - *academic institutions,*

**.gov** - *government institutions,*

**.com** - *commercial organizations,*

**.org** - *non-profit organizations,*

**.mil** – *military organizations.*

# 1.6 Communication services and the Internet – Internet services – Electronic mail

e-mail address: `Firstname.Surname@uniag.sk`

First name.Surname - username or "alias". The username matches the name of the mailbox, "alias" is usually FirstName.Surname (especially on company servers, it is assigned to the username in a special file on the server).

Advantages of electronic mail systems: speed of delivery, low costs, flexibility of using a postal account with access via the web from different locations. Important is the importance of maintaining etiquette on the network (netiquette), such as using a concise message description in the "message subject" field, brevity in responses, checking the grammar of outgoing electronic messages.



# 1.6 Communication services and the Internet – Internet services – Interactive communication

Interactive communication or in other words chat is conducting a conversation in real time (often gradually with a large number of people) using the Internet and a computer. Originally, the chat was text-only, meaning that only characters could be exchanged. It gradually underwent development and today it is possible to communicate with the chat using images, animations, audio/video conference, etc. We distinguish:

- webchat - chatting in a web environment (pokec.sk, facebook.com, ....),
- audiochat - voice chat that resembles a telephone conversation over the Internet (Skype, TeamSpeak, MS Teams, ...),
- video chat - chat where participants can see each other via video (Skype, MS Teams, ...).

# 1.6 Communication services and the Internet – Internet services – Interactive communication

**Social networks** - private or work. The development of social networks occurred thanks to the significant acceleration of the Internet, the expansion of the number of its users, and the introduction of some innovative technologies that brought easier creation of interactive websites, which today we refer to as WEB 2.0.

**Facebook, LinkedIn, ....**

# 1.6 Communication services and the Internet – Internet services – web browser

A web browser is an application software that allows the user to view and interact with HTML documents hosted on web servers or on a local server (intranet).

Browsers available for personal computers include, for example: Internet Explorer (Microsoft Edge), Google Chrome, Mozilla Firefox, Opera, Safari and others.



# 1.7 Cloud Computing

- can be translated as “computing cloud” or “virtual cloud”,
- an example is Gmail, Yahoo, iCloud (+) or OneDrive.

In general, cloud computing can be understood as the storage, processing and use of data via the Internet.

This means that users have unlimited on-demand computing power without a large capital investment and can access their data anywhere there is an Internet connection.

## 1.7 Cloud Computing

The official definition of cloud computing dates back to 2009, when the American National Institute of Standards and Technology (NIST) defined it as:

**"A model that allows on-demand, compliant access to shared configurable computing capacities (*for example, data stores, applications, servers,...*), which can be increased or decreased as needed in a short period of time without major administrative actions or interventions by the provider".**



## 1.7 Cloud Computing – deployment options

Cloud computing can be deployed to solve different types of problems. In general, there is a basic division of cloud computing services according to the way they are provided, that is, which organization provides these services.

When it comes to an internal IT organization that provides these services to several organizational components, departments, subsidiary and partner companies, etc., we are talking about **private clouds**.

If the service is provided by an external managed service provider (MSP), we are talking about **public clouds**.

Cloud service providers should have formal approaches for managing their own employees' access to any hardware or software used to store, transfer, or run customer data and applications.

# 1.7 Cloud Computing – deployment options

## **Public cloud**

- cloud infrastructure is available to the general public or large industrial enterprises and is owned by the organization selling the service. Public cloud users are considered untrusted, meaning they are not employees of the organization and have no contractual agreements with the provider.

Some literary sources refer to this model as the classic Cloud computing model. A public cloud is, for example, Skype or Gmail, because they are intended for the entire population or for a large number of clients. It mostly provides the same or very similar functionality for everyone.



# 1.7 Cloud Computing – deployment options

## **Private cloud**

- private clouds run in the operation of one organization, where resources are not shared by other entities.
- Private cloud users are trusted by the organization. They are either employees or have contractual agreements with the organization. In other words, it is a cloud computing environment that private organizations create for their own internal use.

# 1.7 Cloud Computing – deployment options

## **Community cloud**

- cloud infrastructure is shared by several organizations and supports a specific community that has common goals (e.g. security requirements). It can be managed by the organization or by a third party.

Users in the community are also trusted by the organizations that are part of the community. We can also say that these organizations or communities are united by a security policy or the same area of interest.

# 1.7 Cloud Computing – deployment options

## Hybrid cloud

- hybrid clouds are a combination of **public**, **private** and **community clouds**. Hybrid clouds extend the capabilities of each cloud deployment model.

Each part of the hybrid cloud is connected to the next by a gateway, controlling the applications and data that flow from one part to the other.

Users of hybrid clouds can be considered both trusted and untrusted. Untrusted users are not allowed to access the private and community parts of the hybrid cloud. Outwardly, they appear as one cloud, but they are connected using standardized technologies.

# 1.7 Cloud Computing – cloud computing services

Cloud computing offers options depending on how the infrastructure is implemented. It saves costs and delegates obligations to the provider.

Cloud models are introduced and described according to their main activities and provided services and resources. There are many distributions and they all have the common feature of ending their name with the abbreviation aaS, which stands for **as a Service**.

There are three service models:

**SaaS** (*software as a service*),

**PaaS** (*platform as a service*),

**IaaS** (*infrastructure as a service*).

## 1.7 Cloud Computing – Software as a Service – SaaS

- the **SaaS** model is a software distribution model in which applications are hosted by the vendor or service provider itself.
- most services are made available to customers over the network through a standard web browser on several types of end devices and do not require special operating system requirements.
- this feature eliminates the need to install client-side software and can be helpful for mobile temp workers.
- the services of this model are mainly provided to corporate customers through applications running on the shared infrastructure of the given provider.

# 1.7 Cloud Computing – Platform as a Service – PaaS

- the **PaaS** model was created on the basis of the **SaaS** model, in which the client has his software and service available outside his infrastructure and is accessible directly from the Internet or using a VPN network.
- the service model provides customers with the opportunity to rent virtualized servers and related services for the use of their own applications, which are created using programming languages, libraries, services and tools supported by the provider itself.
- **PaaS** providers can assist developers from the concept of their original idea to application creation, testing and deployment. All this is contained in the managed mechanism.

# 1.7 Cloud Computing – **Infrastructure as a Service – IaaS**

- the **IaaS** model is a service for renting virtual computers, network resources and storage space on which the end user can implement and run any operating system and applications.
- **IaaS** offers the highest level of control of all three models.
- although the user does not have direct control over infrastructure devices, he does have full control over operating systems and applications, and partly also over some network components (such as firewalls, load balancing devices, etc.)

**SaaS - Software as a Service**

Providing software application services to end users

**PaaS - Platform as a Service**

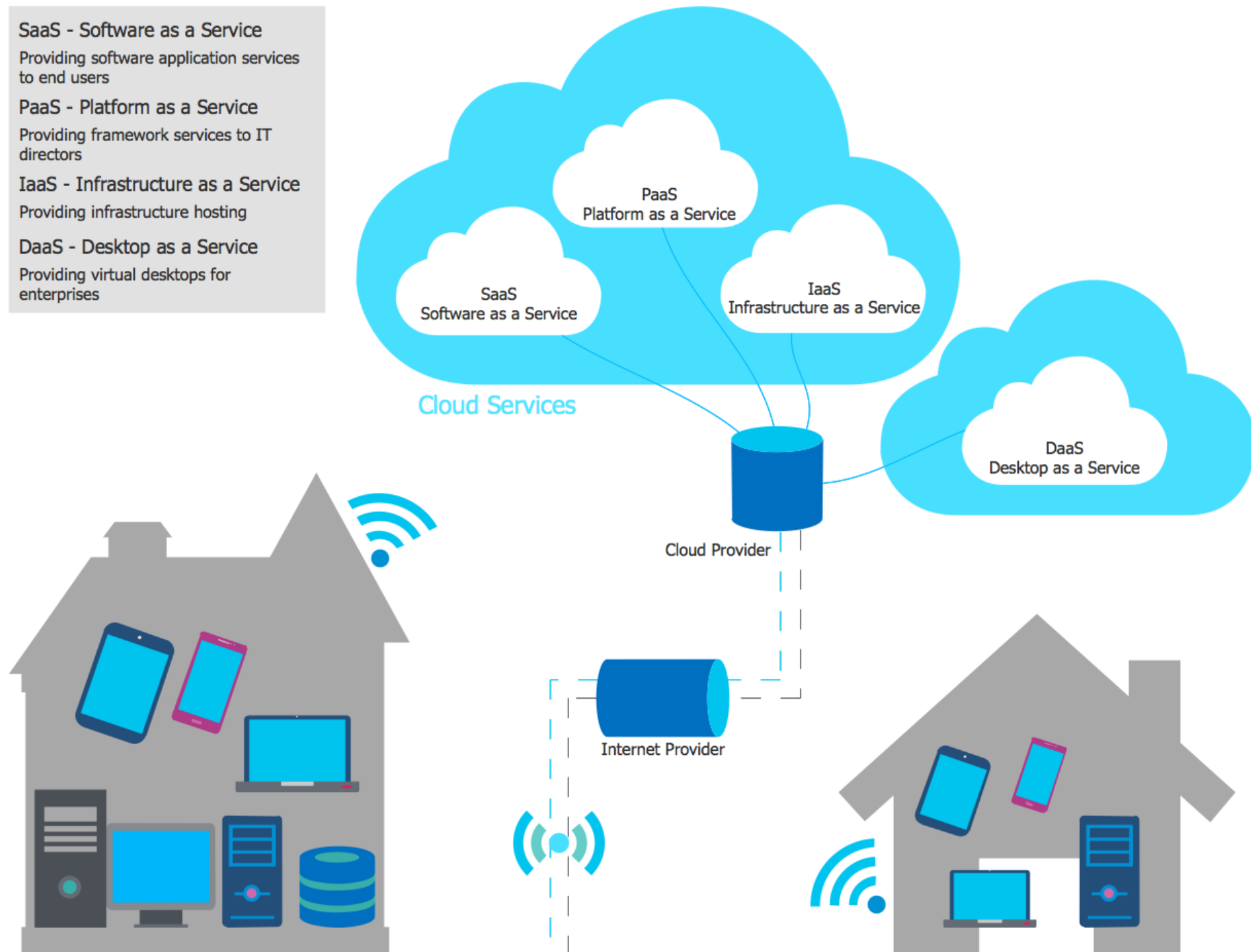
Providing framework services to IT directors

**IaaS - Infrastructure as a Service**

Providing infrastructure hosting

**DaaS - Desktop as a Service**

Providing virtual desktops for enterprises







## 1.7 Cloud Computing – cloud gaming

- Google Stadia – no longer available
- NVIDIA GeForce NOW
- Xbox Cloud Gaming

