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MAIN HARDWARE AND SOFTWARE COMPONENTS OF NETWORKS AND THEIR OPERATION

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Abstract; This document describes the hardware-software complex of networks as a multi-layered model. It details the functional groups of devices connected to computer networks, namely workstations, network servers, and communication nodes. The text explains different network topologies (bus, star, and ring) and access methods (Ethernet, Token Ring, Arcnet). It also addresses the challenges and schemes of computer addressing within a network, including hardware addresses, symbolic names, and numerical connection addresses (IP, IPX). Furthermore, the document defines computer networks as a set of devices enabling information exchange, highlights the advantages of networking, discusses the concept and functions of local area networks (LANs), describes their types (bus, ring, star) with their characteristics, and explains the roles of key network devices such as repeaters, bridges, routers, and gateways for interconnecting networks.

Keywords; Network components, hardware-software complex, workstation, network server, communication node, network topology, bus topology, star topology, ring topology, access method, Ethernet, Token Ring, Arcnet, computer addressing, hardware address, symbolic address, IP address, IPX address, DNS, local area network (LAN), repeater, bridge, router, gateway.

Main Hardware and Software Components of Networks and Their Operation

The hardware-software complex of a network can be described as a multi-layered model. These layers can include computers, communication facilities, network operating systems, and network applications (programs). Devices that connect to computer networks can be divided into three functional groups: workstations, network servers, and communication nodes. Therefore, any computer network can be viewed as a collection of workstations and nodes. Workstations can be diskless, local disk-based, or remote. When designing computer networks, it is first necessary to define the physical connection of computers to each other – their topology. Topology is the logical diagram of the connection of computers or nodes. Computer network topologies can vary, but there are three main types: bus, star, and ring. The remaining topologies are modifications of these three types.

The access method plays an important role in determining the sequence of network computers accessing the channel. An access method is a set of rules that at a physical level unite computers, determining the use of the data transmission channel. Widely used access methods in local computer networks include: Ethernet, Token Ring, and Arcnet facilities. In computer networks, there can be individual communication channels and shared communication channels, meaning several computers can use the communication channels in turn. Only in a fully connected network topology do computers have individual communication channels. In other topologies,

the problem of organizing shared use of communication channels arises. Here we introduce the concept of a shared transmission physical medium, or a shared data transmission medium.

A bus topology can be a typical example of networks with shared communication channels. It should be noted that networks with shared communication channels operate slower compared to networks with individual communication channels. In general, currently, classic technologies like Ethernet and Token Ring are widely used in networks with shared communication channels. Another problem that arises when connecting computers to a network is computer addressing. The requirements for network computer addresses and their addressing scheme are as follows:

- Each computer in the network must have a unique address.
- The addressing scheme should aim for minimal manual labor.
- The address should have a hierarchical structure for creating large-scale networks. Addresses without a hierarchical structure are called flat or non-structured.
- The address should be simple and convenient for users. For this, addresses should be in symbolic form.
- Computer addresses should be compact.

Currently, three addressing schemes are widely used for computers: Hardware addresses (physical addresses): These addresses are intended for small and medium-sized networks. Therefore, they do not have a hierarchical structure. An example of such an address type is the network adapter address. Addresses are written in binary or hexadecimal number systems. The disadvantages of this scheme are: when the network adapter is changed, the computer address changes. If several network adapters are installed on a computer, the computer will have several addresses. Symbolic addresses - names: Such addressing schemes are used in small, medium, and large-sized networks. They are very convenient for users. For example, ftp-arch1.tiu.uz. This computer supports an FTP archive located on the Tashkent Institute of Economics University network.

Numerical connection addresses: Such addresses are used in large-sized networks. Examples of these addressing schemes include IP and IPX addresses. Addresses are structured in a two-level hierarchical structure. The first level is called the network identifier, and the second level is called the computer identifier. The function of centrally converting addresses from one type to another is assigned to the Domain Name System (DNS) service of the Internet global computer network.

A computer network is a set of devices that enable computers to exchange information with each other. The main capabilities of a network depend on the computers and information objects connected to it. Information objects refer to collections of documents in archives, libraries, funds, databases, and other information systems. Information objects stored on computers in a network can be accessed by other computers connected to that network.

Using computers attached to a network has many advantages. For example, all users can jointly use a single printer connected to a computer network, or to quickly prepare a report within an organization, it can be divided into sections, and each section can be prepared on a separate network computer. Files, catalogs, printers, and disks can be shared. This, in turn, leads to cost savings. Therefore, computers are combined into a network. The physical connection of networks (with wires or other means) does not mean that the network operates on its own.

Computers in the network operate on a network operating system. Currently, widely used Windows 95 includes programs that enable operation in a local network.

The concept of a local computer network (LAN) is relative. The reason for this is that computer networks can be established within a single room (classroom), building, organization, or an organization consisting of several branches. Therefore, computers connected within a distance of up to 500 meters can also be combined into a local network. A local network is the connection of computers, communication, and peripheral (externally connected) devices linked with special wires for the purpose of shared use.

Functions of a Local Computer Network

The purpose of creating a local network is the efficient and economical use of the existing computer park and its resources (printers, scanners, catalogs, files) in organizations and higher educational institutions.

LANs connect subscribers within one enterprise, institution, or several nearby buildings. For example, computer rooms in a college are connected via a local network. Local networks are very common because 80-90% of information circulates around that network. Local networks can have any structure. However, computers in a local network are connected by a single, high-speed data transmission channel. The distance between computers in a local network is not very large – up to 10 km, and if radio channel communication is used – 20 km. In most cases, a local computer network serving its own local data system is connected to other computing networks, both internal and external, and even regional and global networks. The main task of any computing network is to provide information and computing resources to its connected users.

Types of Local Networks and Their Specific Features We can connect a local computing network through three schemes: Bus connection uses a linear data channel to which all nodes are connected via an interface board with relatively short connecting lines. Data from the network's transmitting node is distributed along the bus in two directions. Intermediate nodes do not retransmit incoming information. Data arrives at all nodes, but only the intended recipient accepts the information. Bus connection is one of the simplest networks. Such a network is easily expandable and configurable, adaptable to various systems, and robust against possible failures of individual nodes. The well-known Ethernet network and networks built on its basis, used in offices, such as NetWare Novell networks, are also used.

In a ring network (circular connection), all nodes are connected by communication channels into a common closed loop. The output of one network node is connected to the input of the next. Data is transmitted from node to node along the ring, and each node retransmits the sent information. For this, each node has its own interface and transceiver equipment that enables control of data flow in the network. To simplify the transceiver equipment, data transmission along the ring is often performed in only one direction. The receiving node only accepts and understands the information sent to it.

It is widely used in practice due to its flexibility and reliability. In a star network, the server forms the core of the network, and each workstation connects to it via its own communication line. All data is transmitted through the central node, which retransmits, reconnects, and routes

data flows in the network. Such a network, by its structure, essentially resembles a teleprocessing system, in which all subscriber points are intelligent (including an EHM in their composition).

Disadvantages:

- High load on the central equipment.
- Complete loss of network operability if the central equipment fails.
- Very long communication lines.
- Lack of flexibility in choosing the data transmission path.

Star networks are used in clearly defined centrally managed offices. Due to the short distance between computers in a local network, it is possible to increase data transmission speed without using telephone channels. For users in local computer networks, two structural-functional units are very important: workstations and servers. Workstations are computers connected to the network, through which the user can access network resources. A network workstation can operate in both network and local modes.

A server is a multi-user computer allocated to process all workstation requests in the network, allowing these stations to access shared system resources and distributing these resources.

Network Technical Means The necessity may arise to integrate various LANs that have appeared in different departments and branches of a company at different times. Such integration is sometimes necessary at least to organize data exchange with other systems. The desire to access necessary information resources may require connecting LANs to higher-level networks. To interconnect networks, devices such as repeaters, bridges, routers, and gateways are used as inter-network interfaces. Repeaters are devices that amplify electrical signals and ensure the preservation of their shape and amplitude when transmitting signals over long distances. Bridges are described by OSI network layer protocols; they adjust traffic between networks using the same data transmission protocols at the network and higher levels, performing packet filtering according to receiver addresses. Routers are described at the transport layer of OSI protocols and perform their functions, providing connection for logically unconnected networks; they analyze information, determine its next best path, perform certain protocol modifications for adaptation and transmission on another network, create the necessary logical channel, and transmit information according to its purpose. Gateways are devices that enable the integration of computing networks using different OSI protocols at all its layers; they perform protocol modifications for all seven control results of the OSI model. Bridges, routers, and gateways in a local computing network are typically specialized dedicated EHMs with software and additional hardware.

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