EURASIAN JOURNAL OF ACADEMIC RESEARCH
Innovative Academy Research Support Center
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TOPOLOGY OF COMPUTER NETWORKS

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https://doi.org/10.5281/zenodo.4742124

ARTICLE INFO

Received: 20th April 2021
Accepted: 25th April 2021
Online: 30th April 2021

KEY WORDS

network topology, bus network topology, star network topology, ring network topology, passive star topology

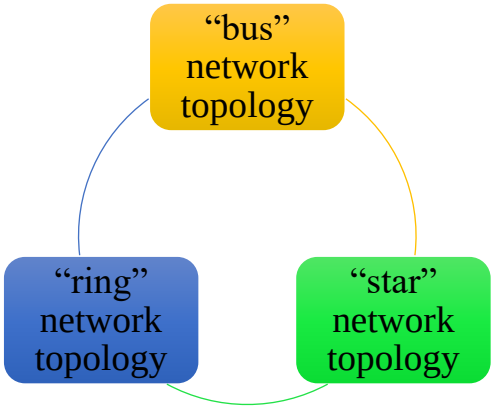
ABSTRACT

The article provides information on computer network topologies. The topology of computer networks provides information on their application, as well as the types of network topologies and their use, as well as their advantages and disadvantages.

Under topology, the structure (structure, configuration, structure) of a computer network is generally understood as the physical location of network computers relative to each other and the method of connection via communication lines. It should be noted that the concept of topology mainly applies to local networks where the structure of connections can be easily traced. In global networks, the communication structure is usually less important by users because each communication session can be conducted automatically.

The topology determines the requirements for the equipment, the type of cable used, the possible and most convenient ways of managing the exchange, reliability, opportunities for network expansion.

There are three main network topologies:



1. A network topology bus (bus) in which all computers are connected in parallel to a single communication line and the data received from each computer is transmitted simultaneously to all other computers *(Figure 1);*

2. Network topology star (asterisk), in which other central computers are connected to a single central computer, and each uses its own separate communication line *(Figure 2);*

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3. The network topology is a ring (ring) in which each computer always transmits data from one computer to another in the next chain and receives data only from the previous computer in the chain, and this chain is closed in a “loop” *(Figure 3).*

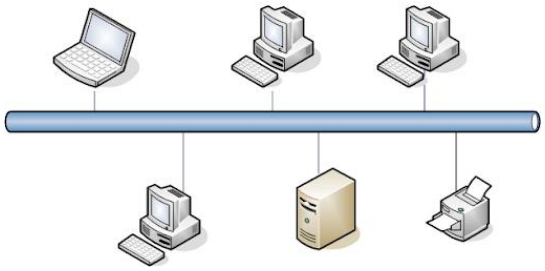

Figure 1. “bus” network topology

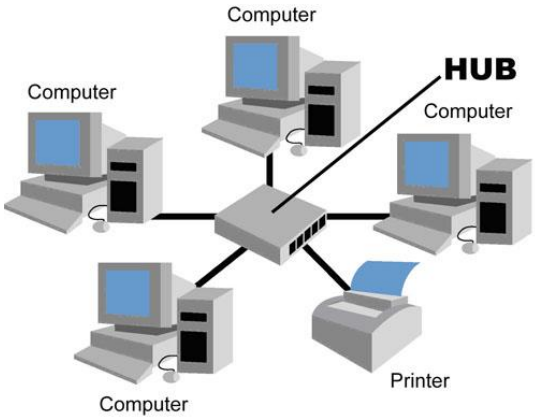

Figure 2. “star” network topology

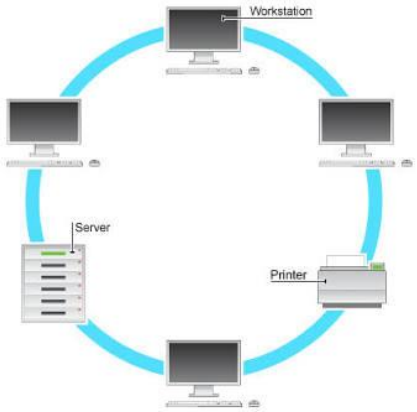

Figure 3. “ring” network topology

The bus topology, by its structure (or also referred to as the “ordinary bus”), allows computers to define network equipment, as well as the equal rights of all subscribers. With this connection, computers can only be transmitted sequentially because it is a single communication line. Otherwise, the transmitted data will be corrupted as a result of overuse (conflict, conflict). Thus, the bus performs a half-duplex (half-duplex) exchange (in both directions, but in turn, but not at the same time).

The "bus" topology does not have a central subscriber to which all data is transmitted, which increases its reliability (if any center does not work, the whole system managed by this center stops working). Adding new subscribers to the bus is very simple and is usually possible even in network operation. In most cases, when using a bus, a minimal amount of patch cable is required compared to other topologies. True, you need to consider that two cables are compatible for each computer (except for two), and this is not always convenient.

Since the resolution of possible conflicts in this case depends on the network equipment of each subscriber, equipping the network adapter with a "bus" topology is more complicated than other topologies. However, due to the widespread use of bus topology (Ethernet, Arcnet) networks, the cost of network equipment will not be so high.

The bus is not a terrible failure of personal computers, as all other computers on the network can usually continue to share. The bus didn’t seem scary and broke the cable because in this case we were overwhelmed with two fully running tires.

However, through the characteristics of the propagation of electrical signals along long communication lines, it is necessary to ensure the insertion of special devices into the terminals of the bus terminals shown in the figure. 1 in the form of a rectangle. Without the involvement of terminators, the signal is reflected from the end of the line and distorted, making communication through the network

impossible. When the cable is broken or damaged, the coordination of the communication line is broken and even the exchange between the computers connected to each other stops. A short circuit at any point on the bus cable will destroy the entire network. It is very difficult to localize any fault in the network equipment on the bus because all the adapters are connected in parallel and it is not easy to understand which one is failing.

When a network with a bus topology crosses a communication line, the information signals are weakened and in no way restored, which places strict limits on the total length of the communication lines, moreover, depending on the distance each subscriber transmits. can receive signals of other levels from the network. This places additional demands on network equipment reception nodes. To increase the length of the network with the bus topology, several segments (each of which is a bus) connected to each other using special signal carriers - repeaters are often used.

However, such an increase in network length cannot last indefinitely, as there are also limitations associated with the rapid propagation of signals along communication lines.

Disadvantages of bus networks
It is difficult to expand such networks (to increase the number of computers in the network and the number of segments - individual cable segments that connect them).
Because the bus is common, the transmission can be transmitted at any time. only one computer. If two or more computers start transmitting at the same time, the signal will be distorted (collision or.) Collision) may damage all frames. Computers are then forced to stop transmitting and then transfer data in turn. The impact of the collisions is so significant that the amount of data transmitted over the network increases and more computers are connected to the bus. Both of these factors will undoubtedly reduce the maximum and maximum network performance and slow down its performance.
"Bus" is a passive topology - computers only "listen" to the cable and cannot recover the signals that are broken during transmission over the network. To expand the network, you need to use repeaters (repeaters) that amplify the signal before moving it to the next segment.
Network reliability is low with bus topology. When the power transmission reaches the end of the cable, it is reflected (unless special precautions are taken), which disrupts the operation of the entire network segment. To prevent this reflection of the signals, special cable ends are installed at the ends of the cable. resistors (terminals) winning signals. If there is a break in any part of the cable - for example, the integrity of the cable is compromised or the connector is broken - then there are two unfinished segments at the end of which the signals begin to reflect and the whole network does not work.

Topology star- This is a topology that has a well-defined center to which all other subscribers are connected. All data exchange is done only through a central computer, this method has a very large load, so it can not do any work other than the network. It is clear that the network equipment of the central subscriber should be more complex than the equipment of the peripheral subscribers. In this case, there is no need to talk about the equal rights of subscribers. As a rule, it is the most powerful central computer and all the

functions of exchange management are loaded on it. No conflicts with the star topology are in principle possible because the management is fully centralized, which is why there is no conflict.

If we are talking about a star resistance to a computer failure, then a peripheral computer failure will not affect the operation of the rest of the network, but any failure of the central computer will cause the network to fail completely. Therefore, special measures should be taken to increase the reliability of the central computer and its network equipment. I dug up any cable or short circuit, the star topology just broke the exchange with one computer and all the other computers could continue to work normally.

When you get off the bus, there are only two subscribers in the asterisk on each communication line: central and peripheral one. Often two communication lines are used to connect them, each of which transmits data in only one direction. Thus, each communication line has one receiver and one transmitter. All this greatly simplifies the installation of the network compared to the bus and prevents the need for additional external terminals. The problem of signal drop on a communication line is easier to solve than a "bus" on a "star" because each receiver always receives the same level of signal. A serious shortcoming in the stellar topology is the sharp limit on the number of subscribers. Typically, a central subscriber can serve 8-16 peripheral subscribers. If it is very easy to connect new subscribers within these limits, it is impossible to set them up if they are exceeded. True, sometimes a star allows for multiplication, i.e. it connects to each other instead of another central subscriber (peripheral subscribers) (resulting in a topology of interconnected stars).

The star shown in the figure. 2, is called an active or real star. There is also a topology called the passive star, which only looks like a star (Figure 4). At this time, it is more common than an active star. Suffice it to say that it is used in the most popular Ethernet network today.

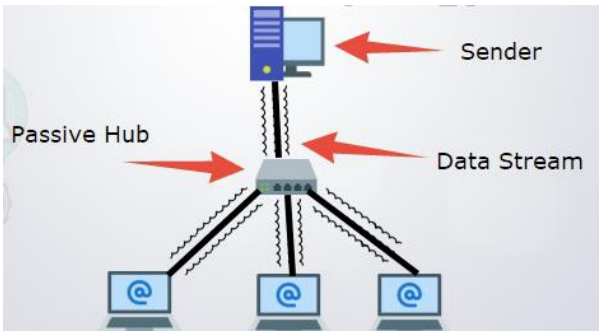

Figure 4. "Passive star" topology

A network hub with this topology does not have a computer, but a cell or hub that performs the same function as a repeater. It restores incoming signals and sends them to other communication lines. While the wiring diagram is similar to a real or active star, in reality we are dealing with a bus topology because the data received from each computer is transmitted to all other computers at the same time and there is no central subscriber. Naturally, the passive star turns out to be more expensive than regular plastic, as in this case you will also need slots. However, it offers a number of additional features related to the star's preferences. Therefore, in recent years, the passive star is replacing the real star, which is increasingly considered an uncompromising topology.

An intermediate type topology between active and passive stars can also be distinguished. In this case, the slots not only transmit signals, but also control the exchange, but it does not participate in the exchange itself.

The big star advantage (both active and passive) is that all the connection points are concentrated in one place. This allows you to easily manage the network, detect network

faults by disconnecting one or another subscriber from the hub (for example, on a bus), as well as restricting unauthorized access points that are critical to the network. In star mode, each peripheral subscriber can be contacted with one wire (transmitted in both directions) or two wires (each transmitted in one direction), while the second situation is more common. The general disadvantage of an all-star type topology is that the cable consumption of another topology is much larger. For example, if the computers are located on a single line (as in Figure 1), then choosing a star topology will require several times more cabling than the bus topology. This can significantly affect the cost of the entire network.

Advantages of star topology networks:
Reliability - connecting to a central socket and disconnecting computers from it does not affect the operation of the rest of the network; cable interruptions affect only one computer;
Ease of maintenance and troubleshooting - All computers and network devices are connected to a central connection device, which significantly simplifies maintenance and repair of the network.
Security - The concentration of access points in one place makes it easier to restrict access to important objects of life.

Topology ring- This is a topology in which each computer is connected to only two through communication lines: it receives only one data and transmits it to another. On each communication line, just like a star, only one transmitter and one receiver work. This eliminates the use of external terminators. An important feature of the ring is that each computer transmits (restarts) the signal, i.e. it performs a repeater function, because the signal drop across the entire ring is insignificant, only the decrease between the neighboring computers of the ring is significant. In this case, there is no clearly defined center, all computers can be the same. However, often a special subscriber who manages the exchange or manages the exchange is allocated in the sprat. It is clear that the presence of such a control subscriber reduces the reliability of the network, as its failure paralyzes the entire exchange.

Strictly speaking, sprat computers are not exactly equal (unlike bus topologies, for example). Some of them receive information from the computer, which is currently being transmitted, earlier, and others - later. Based on this feature of the topology, exchange control methods developed specifically for the “ring” for the network have been created. In these methods, the next transfer right (or, as they say, network capture) passes to the next computer in the circle.

Connecting new subscribers to a “call” is usually absolutely painless, but it requires forcibly shutting down the entire network during the duration of the connection. As in the “bus” topology, the maximum number of subscribers on a sprat can be very large (a thousand or more). The ring topology is usually the most resistant to overloads, which ensures reliable operation with the largest flow of data transmitted over the network, because, as a rule, there are no collisions (unlike the bus). and no central subscriber (unlike the star). .

Since the signal in Sprata passes through all the computers on the network, the failure of at least one of them (or the

restoration of its network) will completely destroy the robot of the entire network. Similarly, any open or short circuit in each ring wire makes the whole network impossible. The ring is the most vulnerable to cable damage, as this topology typically provides for the laying of two (or more) parallel communication lines, one of which is in reserve.

However, the big advantage of the ring is that the location of the signals by each subscriber can significantly increase the size of the entire network (sometimes up to several tens of kilometers). The rings in this regard are far superior to other topologies.

Advantages of ring topology networks:	Disadvantages:
since the cables in this network do not have loose ends, no terminals are needed here;	the signal inside the "ring" must pass through all computers in series (and only in one direction), each of which checks that the data is directed to it, so the transmission time can be very large;
each computer acts as a signal amplifier that allows you to build long-distance networks;	connecting a new computer to the network often requires it to shut down, which disables all other computers;
in the absence of collisions, the topology is highly resistant to overloads, ensuring the efficient operation of large volumes of data transmitted over the network.	failure of at least one computer or device disrupts the operation of the entire network;
	an open or short circuit in any of the loop wires makes the whole network impossible;
	usually put two loops to prevent the network from shutting down in the event of a computer failure or cable breakage, which significantly increases the cost of the network.

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