Computer Networks and Topologies

A computer network is a collection of computers, hardware, software and peripheral devices that use a communication technology to share data. Networks can be classified into two broad types: Local Area Networks (LAN) and Wide Area Networks (WAN).

Local Area Networks are usually privately owned and cover a small area. LANS are used in businesses, schools, hospitals and similar organisations having a cluster of buildings or departments close to one another. LANs are formed by connecting a series of computers together using various cables and equipment. The way in which the computers and devices are connected is termed network topology.

Network Topologies

Topology is the general layout of the components and links that form a network. Essentially it is a map representing the layout of sites and how these are interconnected.

When designing a network, physical topology is one of the most important things to understand, as it will have a major impact on the scalability, maintainability, cost and reliability of the network.

Four common types of topology are used in LANS:

- bus topology
- ring topology
- star topology
- peer-to-peer.

Bus topology

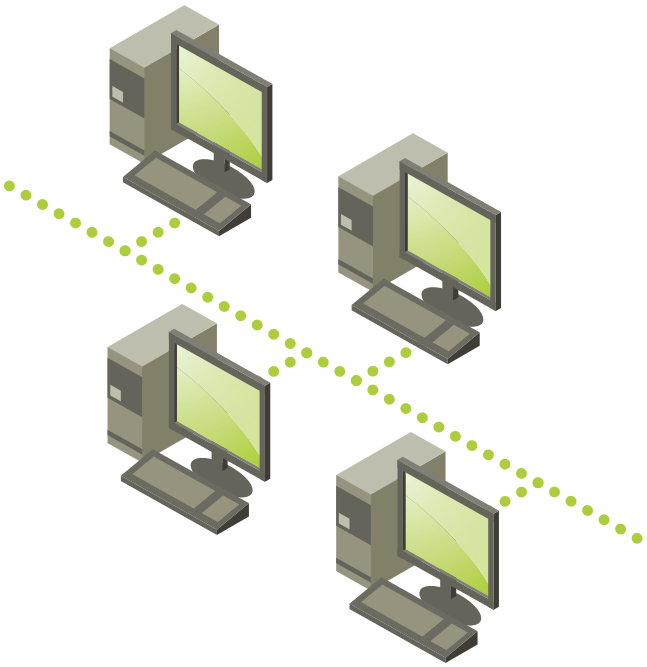
A bus network uses a central cable terminated at each end. All devices (nodes) on the network share this single communication cable, termed a bus, and thus share communication. Software protocols are used to keep the data transmissions under control and prevent errors. Data sent by a node (the transmitting node) reaches all nodes on the network at the same time. Each node checks the data to see if the information is addressed to it. When a node accepts the data, it sends a message back to the transmitting node. This allows only one device to communicate at a time.

Advantages:

- If one computer on the network is not working, the rest of the computers can still access the network and continue to work.
- Upgrading and expanding a bus network is very easy.
- Performance of a bus network is better than that of a star or ring network because all nodes receive the data at the same time.

Disadvantage:

- If the main transmission cable is damaged or the ends are not properly terminated, the network will not work and all nodes are disabled.



Ring Topology

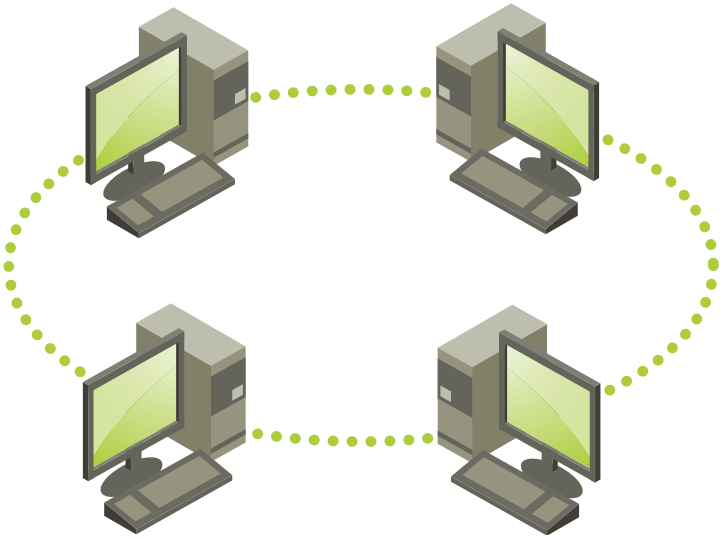
A ring topology comprises a collection of separate point-to-point links, arranged to make a ring. Each node attached to the ring has one input and one output connection, so each device is connected to two links. Data transmitted around the ring is analysed by each node in turn. One by one, the nodes analyse the data and, if it isn't addressed to a particular node, it is passed on to the next node.

Advantage:

- Ring topologies use less cable than star networks and don't require a central computer to control the data transfer.

Disadvantages:

- If the ring is broken or one of the nodes fails, all nodes on the network will be affected.
- Transmission can be slow, as nodes analyse the transmitted data in turn.



Star Topology

Star networks use a central computer (server) to connect many nodes to the network. Star networks are very common and used extensively because of their reliability and performance. The star network's central computer stores all of the data and information required by the nodes. The central computer often provides the processing power for the nodes and performs many of the larger tasks. The central computer controls all of the data requests and transfers between the nodes.

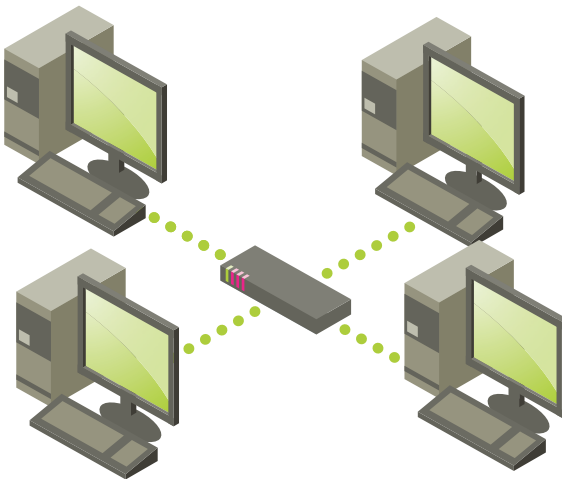
Advantages:

- If one node is not working, the rest of the network can continue to operate.
- The control and transfer of data can be monitored by the central computer.

Disadvantage:

- If the central computer (server) crashes, the network is no longer operating and each node loses its ability to send and receive data.

Peer-to-Peer



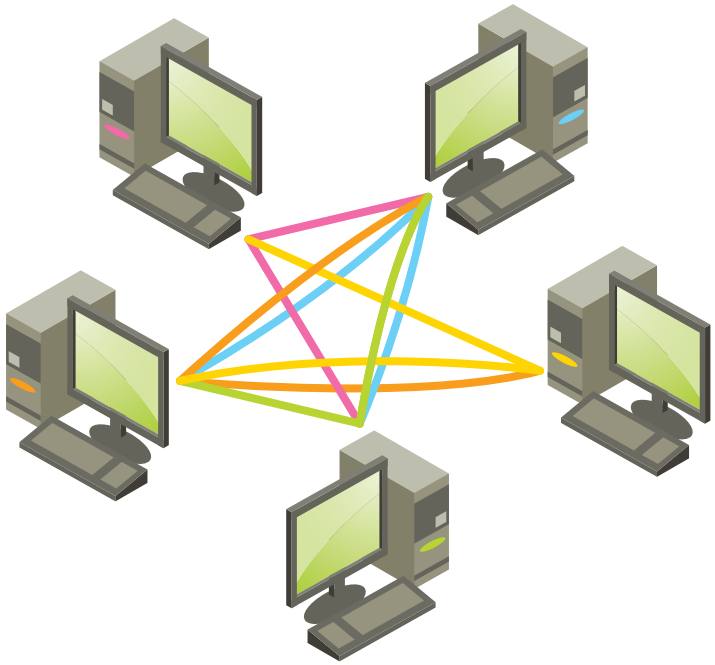
Peer-to-peer networks are cheap and easy to maintain. Each node on the network is directly connected by separate cable to others (all or some) and does not require a central computer. A peer-to-peer computing system treats all computers on the network the same. Individual computers may share hard drives, CD-ROM drives and other storage devices with the other computers on the network. This is different from a client - server set-up in which most of the computers (clients) tend to share resources from one main computer (the server). Peer-to-peer offers file-sharing and transmission in small, simple networks. It is often used to connect a peripheral device, like a printer, to several computers.

Advantages:

- In peer-to-peer networks, the bandwidth of all users can be shared, so the total bandwidth and usually the available download bandwidth for each user grows as the number of users grows.
- Less initial expense – no need for a dedicated server.

Disadvantages:

- No central computer available for storage of files and applications.
- Does not provide the security available on a client-server network.



Advantages of networking computers

Speed – Sharing and transferring files within networks is very rapid and can save time while maintaining the integrity of the files.

Cost – Individually-licensed copies of many popular software programs can be costly. Site-licensed (shared) versions are available at considerable savings. Programs stored on a network's server allow for easy upgrading because only the server copy needs upgrading instead of upgrading individual workstations. This is particularly true for 'thin' client networks.

Security–Sensitive files and programs on a network are easily password-protected and a series of drives can be established for specific directories to restrict access to authorised users. This can also assist with controlling illegal software copying.

Peripheral equipment sharing–Resources such as printers, fax machines and modems can be shared.

Electronic mail–Email helps personal and professional communication. Electronic mail on a LAN enables staff in an organisation to communicate within the building without leaving their desks.

Centralised software management – Software can be loaded on one computer (the file server), eliminating the need to spend time and energy installing updates and tracking files on independent computers throughout the building.

Workgroup computing – Workgroup software (such as Microsoft® BackOffice®) allows many users to work on a document or project concurrently.

Disadvantages of networking computers

- The cabling, network cards, file servers, required to set up a network are expensive.
- If one computer, cable or network card fails, the entire network might stop operating.
- Viruses stored on a networked computer can spread to other computers over the network.
- Files stored on computer networks can be accessed, stolen and edited more easily than files stored on a non-networked computer. Appropriate security measures must be implemented to prevent this.
- If the server develops a fault, users might not be able to run the application programs. A fault in the network can cause users to lose data.
- Decisions on resource planning tend to become centralised.
- Networks which grow with little thought or appropriate planning can become inefficient over time.
- As traffic increases on a network, performance declines unless it is properly designed.