OVERVIEW OF NETWORK TYPES AND TOPOLOGIES

Before you start

Objectives: learn about different types of networks and on what basis it can be classified.

Prerequisites: no prerequisites.

Key terms: network classification, host roles, peer-to-peer, client-server, geographic proximity, local area network, wide area network, metropolitan area network, personal area network, network topologies, bus topology, ring topology, star topology, mesh topology, physical topology, logical topology.

Network Classification Based on Host Roles

Peer-to-Peer

The first type of network that we will consider is called a Peer-to-Peer. In this kind of network there is no such thing as server and network hosts don't have a specific role. They provide network services and they also consume network services. In a peer-to-peer network we can have hosts that will fulfill a variety of different roles. For example, one computer can have a printer connected to it which is shared on the network. Another computer can have a large hard drive installed and everyone is allowed to put files on that hard drive. So, in this situation we have hosts that both provide and consume network services. In essence, they function both as a client and as a server at the same time. The main benefit of peer-to-peer network is the ease of installation. All we have to do is share

our resources on the network. It's also very inexpensive since we don't have to buy server hardware and software. Of course, there's some drawbacks to a peer-to-peer network. First of all, a peer-to-peer network is not very scalable which means that the bigger it gets, the harder it is to manage it. That's because they lack centralized control. Peer-to-Peer networks are usually implemented in small organizations which use limited number of computers. In situations where there are more than 10 computers on the network, we should consider using centralized, server based network.
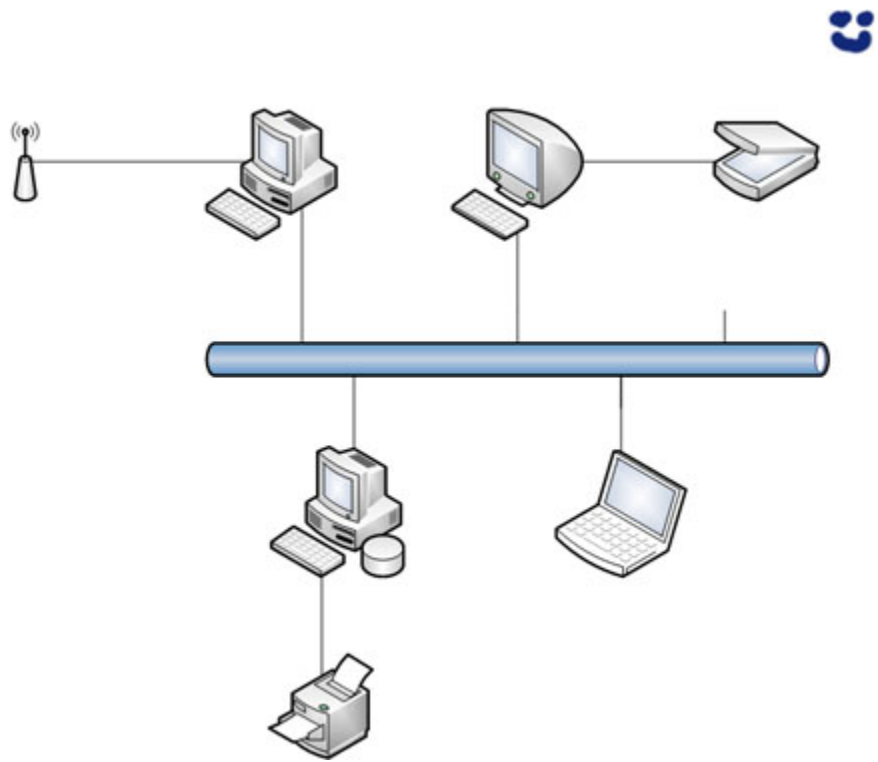

Image 111.1 - Peer-to-Peer Network

Client - Server

Another classification within the host roles category is a client server network. In a client server network, unlike a peer-to-peer network, network hosts have specific roles assigned to them. We have certain systems, certain hosts that are assigned to be servers. A server provides network resources. On a client-server network we also have clients or workstations. Server provides the resources and the client uses resources. With a peer-to-

peer network everybody had the same or similar operating system, but in a client server network client workstations have generic user-friendly operating systems like Windows XP, Vista, 7, MacOS or Linux. Servers would have some special optimized operating system like Server 2003 or Server 2008. These operating systems are designed to provide network resources and are not designed for client type tasks. The main benefit of this type of network is that it's very highly scalable. That means it's very easy to expand the size of the network, it's very easy to add more clients and it's very easy to add more servers. Client server networks are also much easier to support. That's because services are centralized. If we know where are all the services, we know where to look when we have some problems with them. Backup is also a lot easier. We can configure that users store their data on the server. That way, instead of having to back up individual workstations we only need to backup one location - the server. There are some drawbacks. Operating systems for servers are fairly expensive (the exception, of course, is Linux). The other thing is that this type of network takes a lot of planning. We have to decide which servers are going to host which services, where they're going to be placed on the network, etcetera.
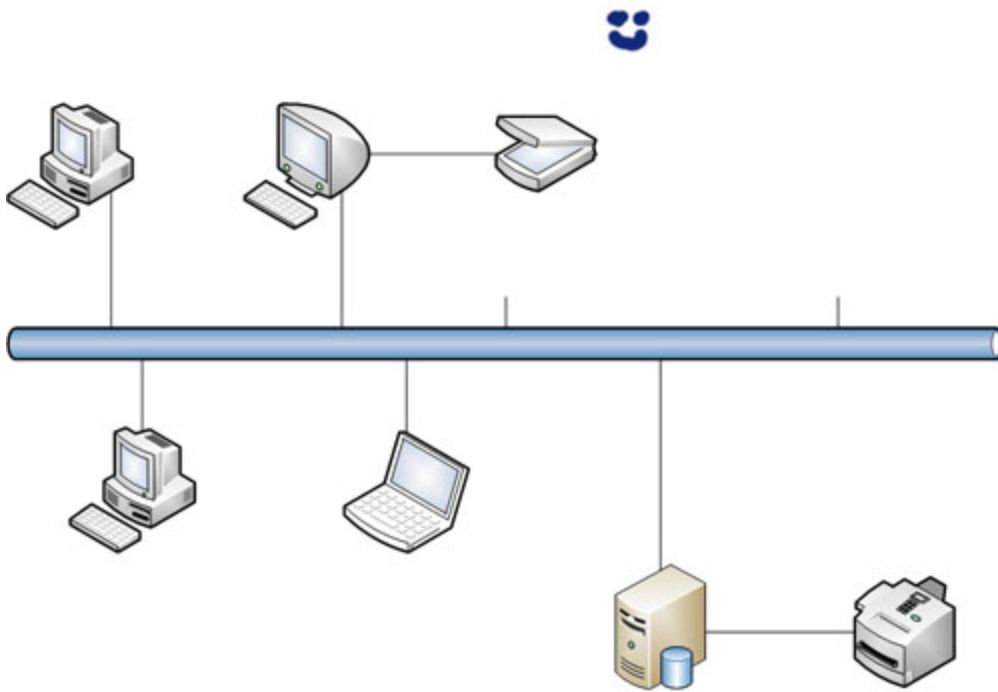
Image 111.2 - Client-Server Network

Network Classification Based on Geographic Proximity

Local Area Network (LAN)

The first kind of network based on geography is the Local Area Network or LAN. Local area network resides within a small geographic area. An example of a local area network would be the network inside a particular company or the network at our home. It can have, for example, multiple floors but they would all be connected by a network medium in some way. It could also be multiple buildings and they could be interconnected in some way. We could have several buildings, like a campus for example. It's still a local area network because the network is managed by and belongs to single organization and the distance separating the hosts is relatively small. This is called an inter-network, but it is still a local area network.
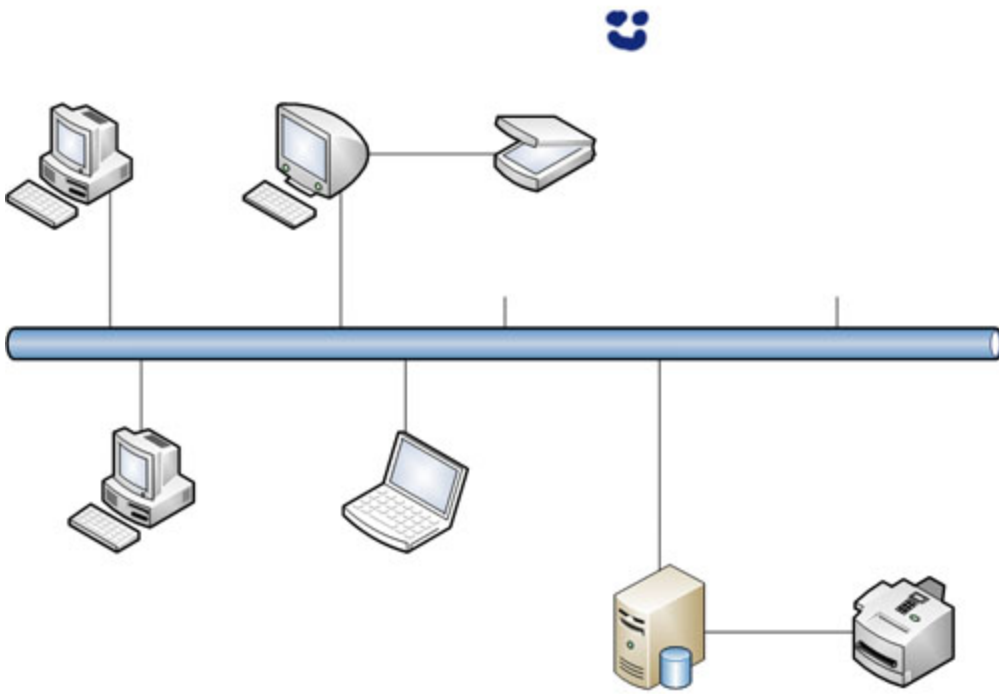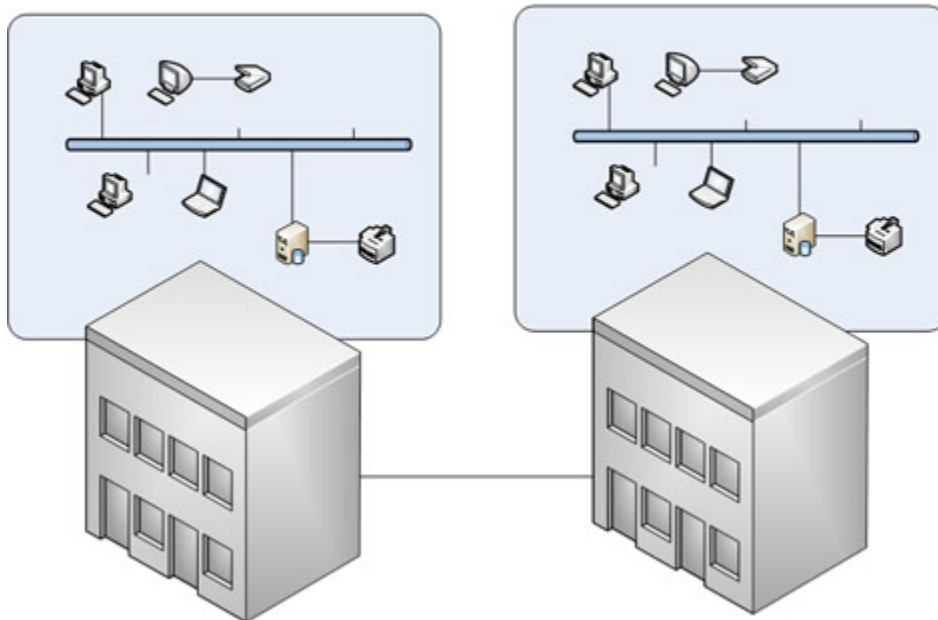
Image 111.3 - Local Area Network (LAN)

Image 111.4 - Inter-connected LAN

Wide Area Network (WAN)

It's also possible to have a computer network where the networks and the hosts are very widely distributed geographically. In that case we are talking about a Wide Area Network or WAN. A wide area network is a group of interconnected LANs, Local Area Networks, that are separated geographically. For example, a company can have offices at different cities. Sometimes user from one city needs to access some data that is located on a server in another city. To make that possible we've connected them in some way so that these local area networks are inter-networked together, making a very large inter-network or a wide area network.
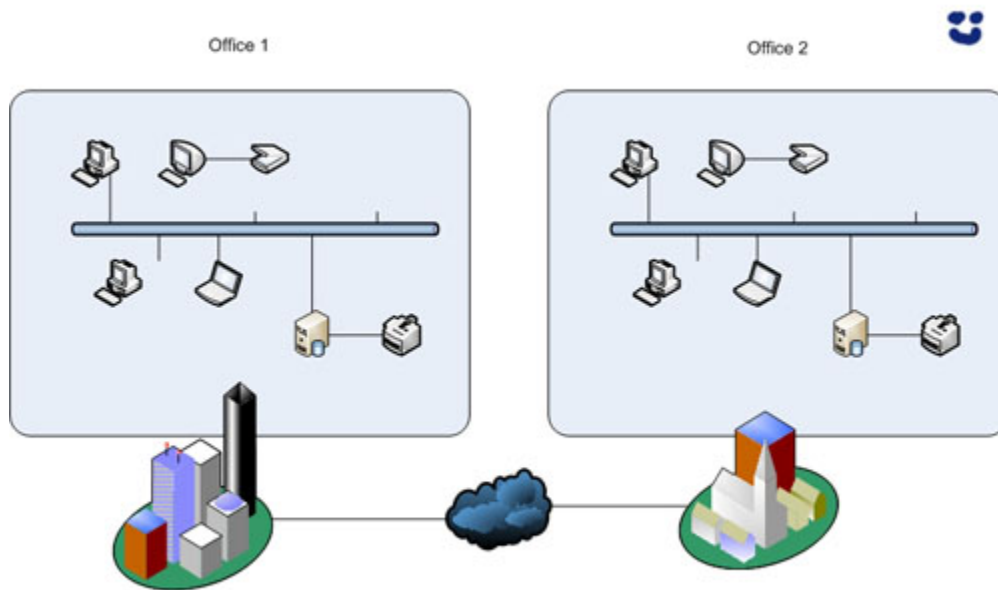

Image 111.5 - Wide Area Network (WAN)

Metropolitan Area Network (MAN)

Metropolitan Area Network is spanning a physical area larger than a LAN but smaller than a WAN, such as a city. A MAN can be owned and operated by a single entity such as a

government body or large corporation, but it usually used by many individuals and organizations. It is established by the various interconnections between WAN and LAN. MAN has many applications, it is most commonly used in banks, online reservation systems and in many military based services. MAN can provide Internet connectivity or cable television for LANs in a metropolitan region.

Personal Area Network (PAN)

PAN is a computer network organized around an individual person. It is used for communication among computer devices, including telephones and personal digital assistants, in proximity to an individual's body. Personal area networks typically involve a mobile computer, a cell phone and/or a handheld computing device such as a PDA or Pad. PANs can be used for communication among the personal devices themselves (intrapersonal communication), or for connecting to a higher level network and the Internet (an up-link). PANs can be constructed with cables or wirelessly. USB and FireWire technologies often link together a wired PAN while wireless PANs typically use Bluetooth, IrDA, Wireless USB, Z-Wave and ZigBee. Bluetooth PANs are also called piconets. Personal area networks generally cover a range of less than 10 meters (about 30 feet).

Network Classification Based on Network Topologies

Network topology is the layout of the various interconnected elements on a computer network. Topology can be physical or logical. It is good to know about network topologies because different types of networking standards may use one type of physical topology, but use an entirely different logical topology. The physical topology refers to the way the computer network is physically wired. In the first example we have many hosts that are connected to the network medium trough a wire. This is a bus topology.

Bus Topology

Many of the networking standards that we're going to work with will use the bus topology, whether physically or logically. On a bus topology all data flows on a central wire.
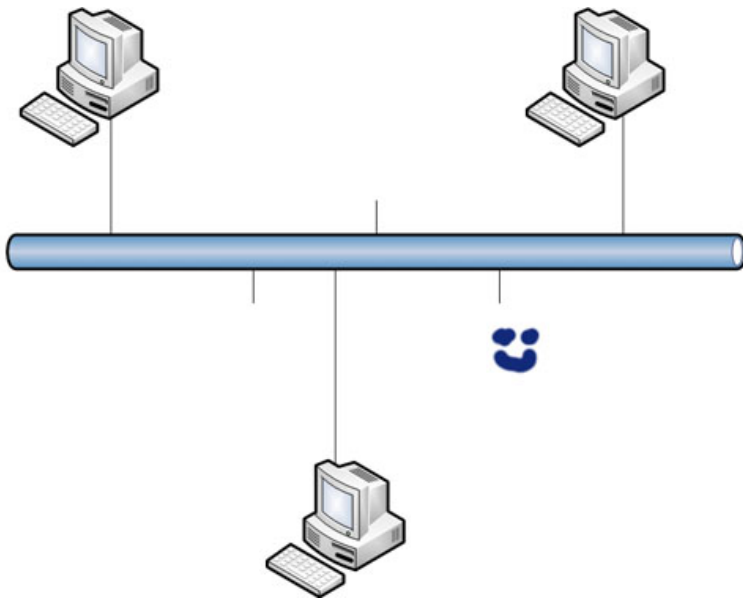

Image 111.6 - Bus Network Topology

Each and every host connected to that wire can communicate directly with any other host connected to the wire. Today we won't see a lot of networks that still use the physical bus topology anymore. However, we will find many networks that still operate logically as a bus.

Ring Topology

In the ring network topology there is no central connecting medium. Instead we have point to point connections between network hosts. Every host is connected to its two neighbours. Unlike the bus topology, with a ring topology a given workstation or a host can only communicate directly with only two other hosts on the network. Data that is addressed to hosts other than neighbors will be passed on to the next connected host until it reaches the recipient host.
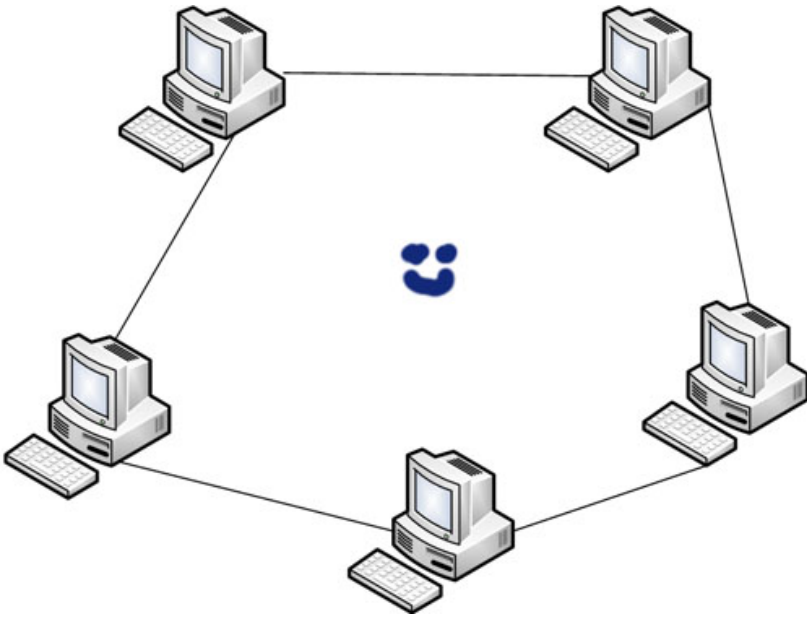
Image 111.7 - Ring Network Topology

In this way, information can be passed to any host on the network. It may not be a direct connection because it may have to go from host to host to host before it eventually arrives at its destination. Today we won't see many ring topologies anymore.

Star Topology

A star topology uses a central connecting device. All hosts on the network connect to the central connecting device with a network cable and that's the physical topology. However, because of different protocols it may actually operate like a Ring or a Bus topology. If one host needs to send data to some other host, it will send the information to the central connecting device. The central connecting device then replicates the information and forwards it on to the appropriate host.
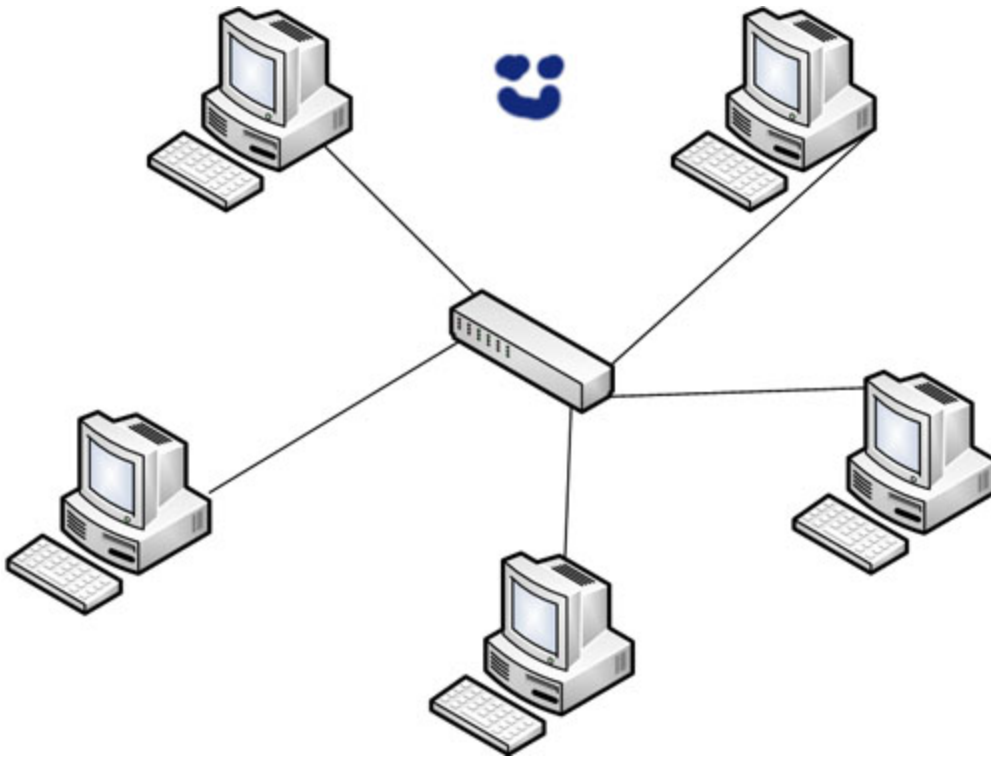
Image 111.8 - Star Network Topology

The way in which a central connecting device works depends on the networking standard that we are using. Some devices will copy that data and send it out to all hosts (Hub). Each host will then look at that information and check if it is addressed to it. If the packet is not addressed to that particular host, it will drop the packet. This way only the right recipient will read the information in the packet.

Other networking tehnology will operate in a very different manner. The central device will remeber which host is connected to which port on a central device (Switch). Because the central device knows which host is connected to which port, it will send data directly to the right recipient of the packet.

Mesh Topology

The mesh networking topology means that every host is connected to every other host on the network. Let's take a look at example with five hosts.
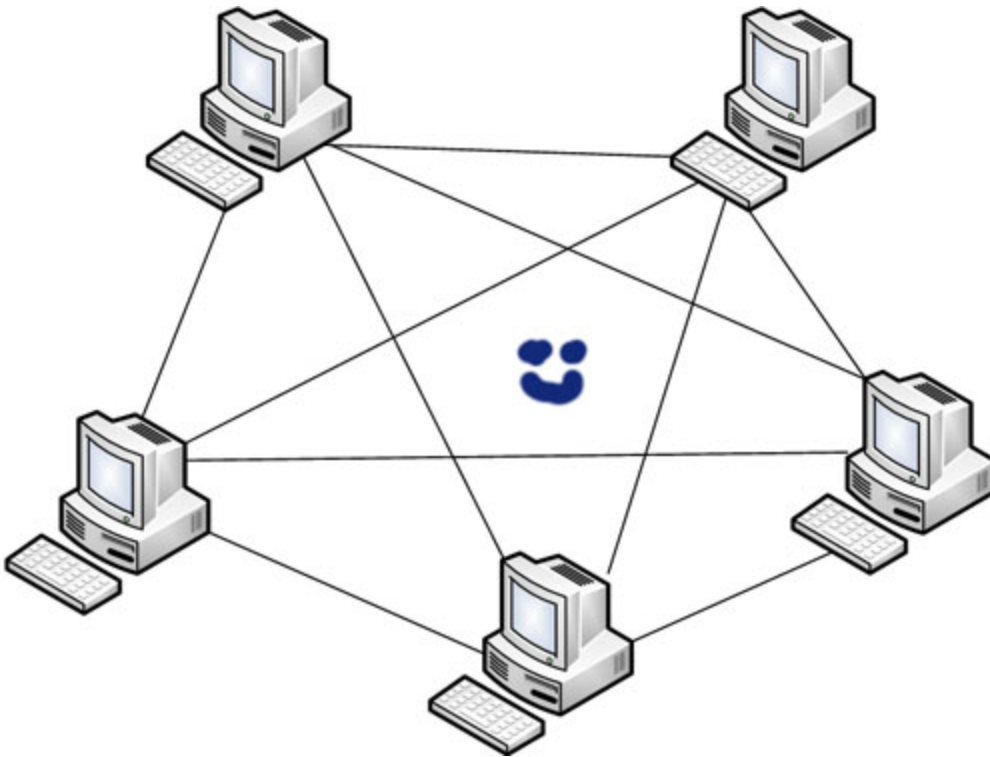
Image 111.9 - Full Mesh Network Topology

This is also known as full mesh topology. Now, imagine that we have 10, or 50 hosts. Things would get pretty complicated really fast. Because of that, this topology is more theoretical, but it can be implemented more easily in wireless networking.

Mesh Topology in Wireless Networks

Because we don't have to have a separate network interface card for every host that we have to connect to one host and because there are no cables, mesh topology can be utilized in wireless networks. Each wireless transmitter can directly communicate with the wireless receiver on any other host in the network. So called ad-hoc wireless network is implemented in this way. In ad-hoc network there is no central connecting point. Instead, every wireless host communicates directly with any other wireless host. Ad-hoc networks are not usually implemented because the amount of work to set it up, configure and maintain it is not worth it if we have more than 4 or 5 hosts. Most wireless networks are

actually configured in a star topology where there's a central connecting point called the Wireless Access Point, to which all the transmitters connect to.

Physical versus Logical Topology

The physical way the computer network is wired may not actually be the way the computer network works logically. The logical topology tells us how the traffic flows on our network. We may have a network that's wired in one way, but operate in a completely different manner. For example, in a Star topology all hosts connect to a central connecting point, and that's the physical topology. However, because of different protocols, it may actually operate like a ring or a bus topology. Most of the computer networks today use the physical star topology, but remember, all networks can operate on two levels. How it works logically could be very different.

Remember

In a peer-to-peer network network hosts don't have a specific role. In a client server network, unlike a peer-to-peer network, network hosts have specific roles assigned to them. Local area network resides within a small geographic area like the network inside a particular company or the network at our home. Wide area network is a group of interconnected LANs that are separated geographically, for example the same company can have offices at different cities which are connected using WAN. Metropolitan Area Network is spanning a physical area larger than a LAN but smaller than a WAN. PAN is a computer network used for communication among various computer devices, including telephones and personal digital assistants, in proximity to an individual's body. Network topology is the layout of the various interconnected elements on a computer network. On a bus topology all data flows on a central wire. In the ring network topology there is no central connecting medium. A star topology uses a central connecting device. The mesh networking topology in theory means that every host is connected to every other host on the

network. Ad-hoc wireless network is implemented using Mesh topology. The physical way the computer network is wired may not actually be the way the computer network works logically.

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