

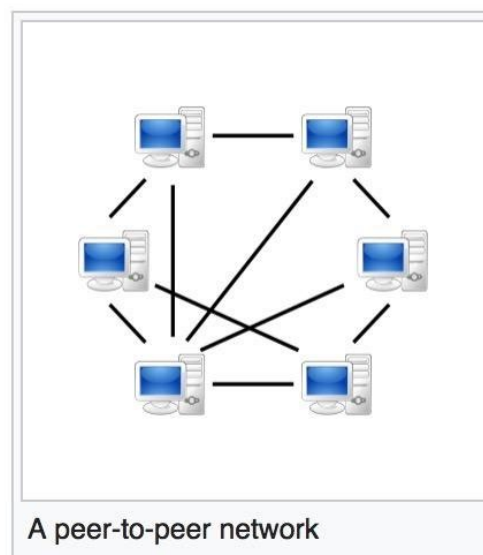
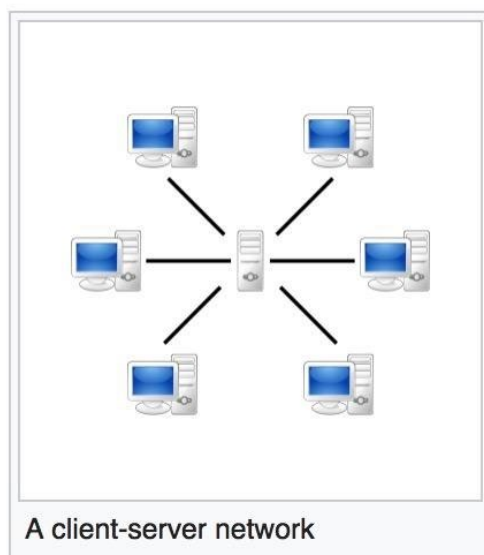


Temasek Junior College
2024 JC2 H2 Computing
Networking 2 – Types of Network

1 Network Classification by Organisation

- Computers in a network are generally classified as either clients or servers.
- A **CLIENT** is a network device that initiates a connection to a server to request for resources and services to perform operations. Employees in offices or students in schools would normally use client computers to do their work.
- A **SERVER** is a network device that shares resources and responds to requests from devices and other servers on the network. It usually has a higher capacity and is more powerful than a client as it needs to manage resources and services. These might include:
 - Providing central storage of files (**File server**)
 - Sharing hardware such as printers (**Print server**)
 - Store, process and deliver web pages (**Web server**)
 - Provides database services to clients (**Database server**)
 - Controlling logins and network access (**Remote access server**)
- Although any device can function as a server, computers that are designed specifically for use as servers are built to be reliable and less prone to failure. This means that they may be much more expensive than normal computers.
- Devices can be organised in either a client-server or peer-to-peer network.

Illustration of client-server and peer-to-peer networks.



1.1 Client-Server Network

- In a client-server network, one or more higher-capacity computers will act as servers while the remaining computers are clients. Each server contains data and other resources to be shared with clients. The server also fulfils requests from clients.

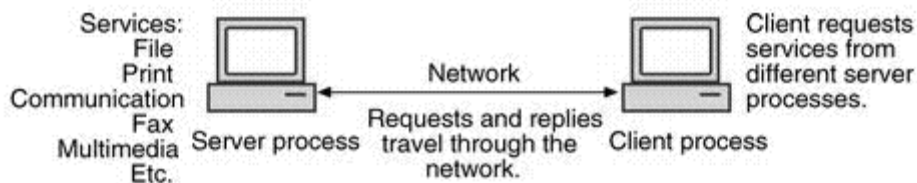


FIGURE 12.1 A BASIC CLIENT/SERVER COMPUTING MODEL

For example, when you want to view a webpage, you will use a web browser (which is a web client). The browser will request the page from a web server. The server will send the page back to the browser and the page will be displayed.

Advantages	Disadvantages
<ul style="list-style-type: none"> Centralised control of data and resources Easy to schedule backups of all shared files at regular intervals Security may be enhanced with the use of specialised software or operating system features that are designed for servers 	<ul style="list-style-type: none"> Higher initial cost due to the need for a server Administrative costs needed for the maintenance of server and clients

1.2 Peer-to-Peer Network

- Peer-to-peer (P2P) is a type of network where all computers are considered as equals and the load is distributed among all computers. Each computer in the network is able to act as both a client and a server, communicating directly with other computers. Users are able to share files and resources located on their computers as well as access shared resources found on other computers in the network. These networks are low in cost.

Advantages	Disadvantages
<ul style="list-style-type: none"> Cheaper to set up as there is no cost related to dedicated servers Easy to set up as no specialised software or operating system features are needed 	<ul style="list-style-type: none"> More effort is required to access and back up resources as they are stored locally within each computer instead of centrally in a server Security is an issue as access rights are not administered by a central server

1.3 Client-Server Vs P2P Network

Client-Server	P2P
Centralized & less robust. Efficiency and reliability depend on server. If a server fails, many users will be affected. For example, if a file server fails, no-one will be able to access their files until the service is restored.	P2P Decentralized & more robust. No single point of failure. If one device fails, it will have less impact. Most users will be able to carry on with their work.
Popular data = more congestion = slower.	Popular data = more distribution = faster.
Centralized data repository: easier to maintain, more accountability, better security.	Decentralized data: more redundancy, harder to maintain, less accountability, less security.
Server can control and record transactions by clients.	Transactions are not recorded, harder to trace.
One server can work with a wider variety of client capabilities.	Peers need to be compatible.
Server must be easy to find: Hence well-known port numbers.	Peers need to find each other.
Most important files are stored on servers, easier to make sure that all of these files are backed up. In a large organisation, there is likely to be a network manager who will be responsible for the security and back up of the servers.	Individual users are likely to be responsible for backing up their own data.

2 Network Classification by Transmission Medium

- A **WIRED NETWORK** is a network of devices connected by a physical medium, such as cables. Data transfer is typically faster and more secure in a wired network. However, as the number of devices and the distance between devices increase, the cost of setting up the network increases as well.
- Computers in a network communicate using a set of network protocols, just like how people communicate using languages. The Ethernet is the most widely used wired network protocol in LANs.
- A **WIRELESS NETWORK** is a network of devices in which signals are transmitted without the use of a physical medium. The transmission is in the form of electromagnetic waves, such as radio waves and microwaves. Users can be connected to a wireless network as long as they are within range of the network coverage. The most common wireless network protocol is Wi-Fi, which uses radio waves to transmit data.
- A wireless access point (WAP) is a network device that provides a connection between wireless devices up to 100 metres away and can connect to wired networks. Obstacles such as walls or metal frames can reduce the strength of Wi-Fi signals. Radio signals such as those from microwave ovens can also interfere with Wi-Fi signals. Wireless networks are becoming increasingly popular in homes and businesses as they are low in cost, easy to configure and manage, and users can move around with their devices.
- Most local area networks have a mix of wired and wireless connections. Wired connections will generally be used for larger desktop computers and devices that are not often moved, such as printers.
- At home, you will probably have a network access device (commonly referred to as "the router") that is provided by your internet service provider (ISP). This device includes a wireless access point (WAP) for devices to connect to the network wirelessly and will also incorporate a small switch with a few Ethernet ports for wired connections.

2.1 Wired vs Wireless Network

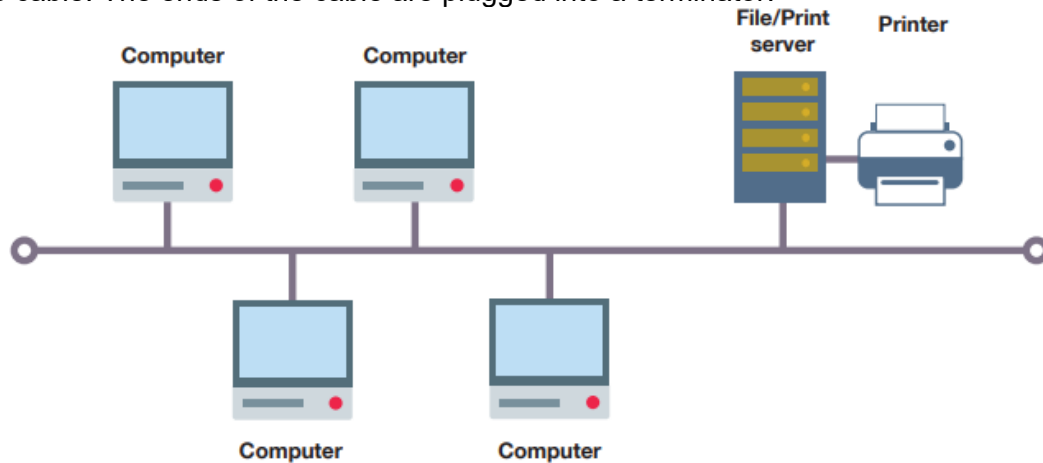
Factor	Wired	Wireless
Speed	Wired connections are usually faster than wireless connections. Signals carried over cables are less susceptible to interference so there are fewer errors.	As well as interference, most wireless transmissions are encrypted. This introduces a processing delay.
Security	Wired networks are more secure than wireless networks. Data is transmitted over physical cables, which are harder to tamper with in order to intercept messages.	Wireless networks are less secure than wired networks. Data can be intercepted by someone without them needing to be physically connected to the network.
Range	The range of a wired network is greater than wireless. Copper cable will reliably carry signals for up to 100m. Fibre optic cables are capable of carrying network signals over distances of 100km or more.	The range of a wireless network may be restricted because signals can be obstructed by thick walls and other obstacles. A mesh of access points may be needed to improve coverage.
Setup	Fixed cabling is inflexible. If a room layout is changed, the network connection points may no longer be in the correct place.	Devices do not need to be used in a fixed location. They can be located anywhere within range of a wireless access point.
Cost	Wired networks can be expensive to set up. Hubs or switches are required. In a work environment, these will probably have to be located in secure rooms or lockable cabinets so they are not tampered with. Cables will often need to be run in trunking or in channels made into walls so that they are not unsightly or cause a health and safety issue.	More than one wireless access point may be needed if the building is large or uses materials that block mobile signals.

3 Network Topologies

The different arrangements of computer connections and devices are called topologies.

3.1 Physical Bus Topology

A LAN can use different layouts or topologies. In a bus topology, all computers are connected to a single cable. The ends of the cable are plugged into a terminator.



Advantage:

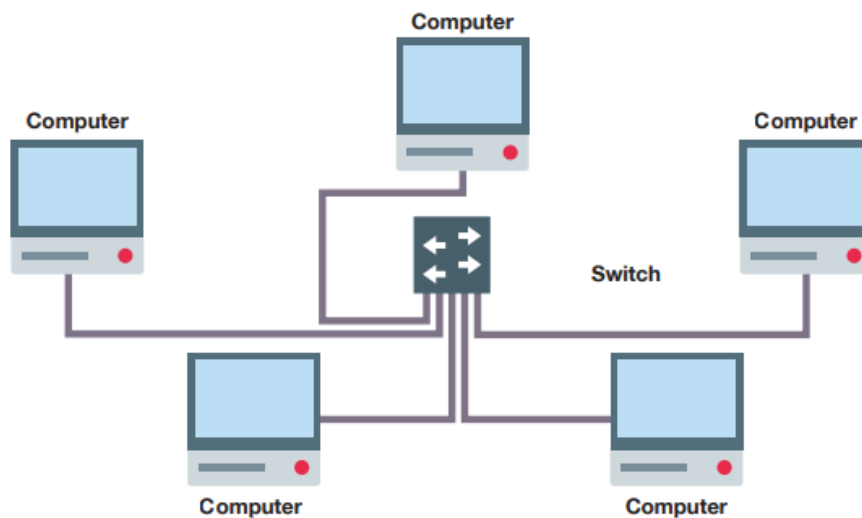
- Inexpensive to install as it requires less cable than a star topology and does not require any additional hardware

Disadvantages:

- If the main cable fails, network data can no longer be transmitted to any of the nodes
- Performance degrades with heavy traffic
- Low security – all computers on the network can see all data transmissions

3.2 Physical Star Topology

A star network has a central node, which may be a switch or computer which acts as a router to transmit messages. A switch keeps a record of the unique MAC address (we will discuss in later part of this chapter) of each device on the network and can identify which particular computer on the network it should send the data to.



Advantages:

- If one cable fails, only one station is affected, so it is simple to isolate faults
- Consistent performance even when the network is being heavily used
- Higher transmission speeds can give better performance than a bus network
- No problems with 'collisions' of data since each station has its own cable to the server
- The system is more secure as messages are sent directly to the central computer and cannot be intercepted by other stations
- Easy to add new stations without disrupting the network

Disadvantages:

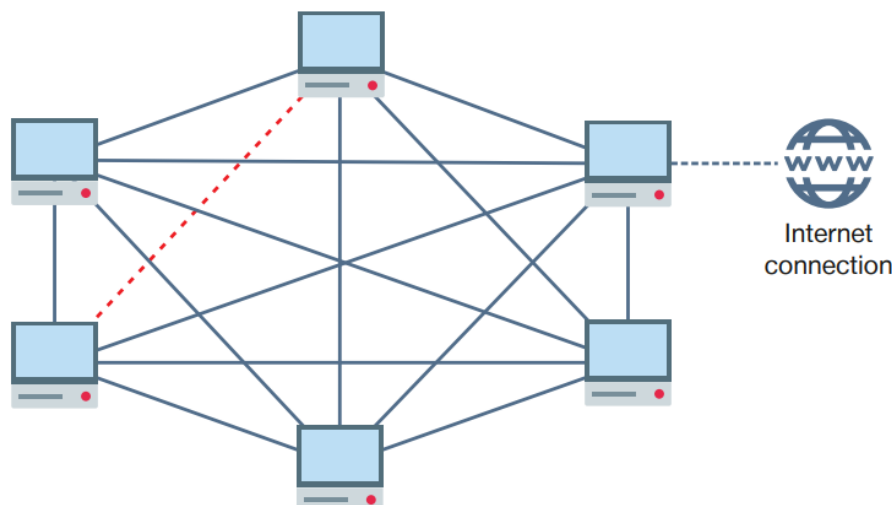
- May be costly to install because of the length of cable required
- If the central device goes down, network data can no longer be transmitted to any of the nodes

3.3 Physical vs Logical Topology

- The **physical topology** of a network is its actual design layout, which is important when you select a wiring scheme and design the wiring for a new network.
- The **logical topology** is the shape of the path the data travels in, and describes how components communicate across the physical topology. The physical and logical topologies are independent of each other, so that a network physically wired in star topology can behave logically as a bus network by using a bus protocol and appropriate physical switching.
- For example, any variety of Ethernet uses a logical bus topology when components communicate, regardless of the physical layout of the cable.

3.4 Mesh Network Topology

Mesh networks are becoming more common with the widespread use of wireless technology. Each node in a mesh network has a connection to every other node, by transmitting data across any intermediate nodes. Only one node requires a connection to the Internet and all others can share this connection. Mesh networks can quickly become big enough to cover entire cities.



Advantages:

- No cabling costs
- The more nodes that are installed, the faster and more reliable the network becomes, since one blocked or broken connection (as shown above) can easily be circumvented by another route. In this respect, the mesh topology can be described as 'self healing'.
- New nodes are automatically incorporated into the network
- Faster communication since data packets do not need to travel via a central switch

Most messages that are sent across the internet are broken into multiple packets and each packet can take a different path from source to destination. At the end point, the packets are put back into order using a sequence number that is part of the packet's header information. We will learn more about packet-switching when we discuss about the Internet.

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