

A Level CS C02 Network (1)

WAN(Wide area network): a network connecting computers **on different sites**, possibly thousands of kilometers apart

WAN benefits:

1. a 'job' could be run on a remote computer that had the required application software
2. a data archive that was stored on a remote computer could be accessed
3. a message could be transmitted electronically to a user on a remote computer.

WAN feature:

1. It will be used by an organisation or a company to connect sites or branches.
2. It will not be owned by the organisation or company.
3. It will be leased from a public switched telephone network company (PSTN).
4. A dedicated communication link will be provided by the PSTN.
5. The transmission medium will be fibre-optic cable.
6. Transmission within the WAN will be from switch to switch.
7. A switch will connect the WAN to each site.
8. There will not be any end-systems connected directly to the WAN.

LAN(Local area network): a network connecting computers **in a single room**, in a single building or on a single site

LAN benefits:

1. The expense of installing application software on each individual PC could be saved by installing the software on an application server attached to the LAN instead.
2. A file server could be attached to the LAN that allowed users to store larger files and also allowed files to be shared between users.
3. Instead of supplying individual printers to be connected to a user's PC, one or more printers could be attached to a print server that was connected to the LAN; these could be higher quality printers.
4. Managers in organisations could use electronic mail to communicate with staff rather than sending round memos on paper.
5. The 'paper-less office' became a possibility, where files were to be stored in digital form on a file server rather than as paper copies in a filing cabinet.

LAN features:

1. It will be used by an organisation or a company within a site or branch.
2. It will be owned by the organisation or company.
3. It will be one of many individual LANS at one site.
4. The transmission medium will be twisted pair cable or WiFi.
5. The LAN will contain a device that allows connection to other networks.
6. There will be end-systems connected which will be user systems or servers.

Data sent through the medium models:

1. **simplex mode** where data flow is one-way only
2. **half duplex** where data can flow either way but not simultaneously
3. **full duplex** where simultaneous both-ways data flow is possible.

Message sent type:

1. a **broadcast**, which is a one-to-all communication (as used traditionally for radio and television)
2. a **multicast**, which is from one source to many destinations
3. a **unicast**, which is a one-to-one communication.

Network topology:

the configuration of a network that defines how the various devices on the network are connected

point-to-point topology: a **dedicated** link (simplex or duplex, unicast)

bus topology: only one link but it is shared by a number of end-systems and is therefore described as a **multi-point connection**. A message must therefore be **broadcast** even though it might only be intended for one end-system.

The topology is **resilient** because a fault in an end-system or in the link to it does not affect the use of the network by the other end-systems.

mesh topology: has a point-to-point connection to each of the other end-systems. (duplex, unicast or multicast or broadcast)

star-topology: each end-system is linked to a center device. (duplex, message from center is unicast, multicast or broadcast)

The most important is that the central device can be used to connect the network to other networks and, in particular, to the Internet.

hybrid network: a collection of connected LANs where some of them have different topologies or supporting technologies

Client Server: an architecture where a client runs an application provided by a server on a network

Thin-client: a client that only provides input and receives output from the application

role of thin-client:

1. chooses an application provided by the server
2. possibly carries out some processing before running the application on the server and also after receiving output from the application
3. alternatively, possibly downloads the application from the server and runs the application itself.

Thick-client: a client that carries out at least some of the processing itself

role of thick-client:

1. The server stores a database which is accessed from the client system.
2. The server stores a web application which allows the client system to find or, sometimes, supply information.
3. The server stores a web application which allows the client system to carry out an e-commerce or financial transaction.

factors	thin clients	thick clients
Installation	browser base installation	installed locally
type of devices	used by handheld devices	Customization system use thick clients
processing type	complete processing on server side	use computer resources more than server
Deployability	easily deployable	more expensive
data validation	data verification is required from server	data verification is done by client

File sharing:

File sharing method:

1. client-server model: a user uploads files to the server, another user downloaded these from the server
2. peer-to-peer network: Each peer can therefore act as a client and request a file from another peer or it can act as a server when another peer requests the download of a file.

Peer-to-peer feature:

1. All computers are of equal status
2. Each computer provides access to resources and data
3. Computers can communicate and share resources
4. Each computer is responsible for its own security

Peer-to-peer advantages:

1. it avoids the possibility of congestion on the network when many clients are simultaneously attempting to download files
2. parts of a file can be downloaded separately
3. the parts are available from more than one host.

Peer-to-peer drawback:

1. Reduced security, no center management of security
2. No central management of backup
3. No central management of files
4. Individual computer may respond slower
5. In order to share files. all the computers involved need to be switched on

Client-server model advantages:

1. It allows an organisation to control the downloading and use of files.
2. The files can be better protected from malware attacks because the files are stored on one server which will be regularly scanned using appropriate anti-virus soft ware.

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Cable: a transmission using copper wire or fibre-optic

Bandwidth: a measure of the amount of data that can be transmitted per second

	Twisted pair	Coaxial	Fibre-optic
Cost	Lowest	Higher	Highest
Bandwidth or data rate	Lowest	Higher	Much higher
Attenuation at high frequency	Affected	Most affected	Least affected
Interference	Worst affected	Less affected	Least affected
Need for repeaters	More often	More often	Less often

Wireless: a transmission using radio, microwave or infrared

Benefits of using wireless:

1. less hard-wiring, reduce cost
2. User and computers can be mobile, can be accessed from anywhere within range of access point
3. more straightforward to connect other devices, no need physically connect

Drawback of using wireless:

1. Transmission may be less secure
2. Bandwidth may be limited
3. It is subject to interference from other signals or obstacles
4. Limited range
5. Higher latency

Satellite network:

A satellite can act as a component in a network and can directly connect with ground-based components. These ground-based components can be much further apart than in a network with no satellites.

The disadvantage of satellites is that the greater transmission distance causes transmission delays, which can cause technical problems for the network.

The use of satellites in networks tends to be for specialised applications such as the Global Positioning System (GPS) or for Internet use in remote locations.

ISP(Internet service provider): give Internet access to an individual or company.

Router: a device that acts as a node on the internet

function: Each router is connected to several other routers and its function is to choose the best route for a transmission.

PSTN(public switched telephone network):

digital data could be transmitted provided that a modem was used to convert the digital data to analogue signals. Another modem was used to reverse the process at the receiving end. Such so-called 'dial-up' connections provided modest-speed, shared access when required.

PSTN Service:

the PSTNs have upgraded their main communication lines to fibre-optic cable employing digital technology. two service:

1. a broadband network connection for traditional network access.
2. WiFi hotspot technology, where an access point has a connection to a wired network providing Internet access.

Cell phone network: For users of devices with mobile (cell) phone capability

Bit streaming: before data is transmitted it is stored in bytes which can be transmitted one after the other as a 'byte stream'. Because of the file sizes involved, streamed media is always compressed to a sequence of bits - a 'bit stream'.

on demand: In this case the delivery of the media and the playing of the media are two separate processes. The incoming media data are received into a buffer created on the user's computer. The user's machine has media player software that takes the media data from the buffer and plays it.

real-time(live transmission):the content is being generated as it is being delivered such as when viewing a sporting event.

bit rate: The process of delivering the content is determined by the bit rate. example 300kbps or 128kbps

Wired Lans:

Server: a system **providing a service** to end-systems

Repeater: a device that connects two cables and provides a full-strength signal to the second cable

Bridge: a device that **connects two segments of a LAN**

Network Interface Card (NIC): a component used to identify the end-system

Switch: a connecting device that can send a unicast message

Wireless Lans:

Wireless Access Point (WAP): the connecting device in a WiFi LAN

Wireless Network Interface Card (WNIC): provides the NIC function in a WiFi LAN

Ethernet:

collision: If two end-systems were to transmit messages at the same time there would be what is described as a 'collision'.

CSMA/CD(Carrier sense multiple access with collision detection): if a message was being transmitted there was a voltage level on the Ethernet cable which could be detected by an end-system

CSMA/CD step:

1. Check the voltage on the transmission medium.
2. If this indicates activity, wait a random time before checking again.
3. If no activity is detected, start transmission.
4. Continuously check for a collision.
5. If no collision is detected, continue transmission.
6. If a collision is detected, stop transmission of the message and transmit a jamming signal to warn all end-stations; after a random time, try again.

Although there might be some legacy Ethernet LANs still operating, modern Ethernet is switched. Since collisions are now impossible, CSMA/CD is no longer needed.

WWW(World wide web): a distributed application which is available on the internet.

the web the web consists of an **enormous collection of websites** each having one or more web pages.

The special feature of a web page is that it can contain **hyperlinks** which, when clicked, give direct and essentially immediate access to other web pages.

Cloud computing: provision of computing services usually via the internet.

Private cloud: owned by and only accessed by an organisation

1. The organisation takes full responsibility for creating and managing the cloud installed on-site and connected to a private network
2. The organisation outsources to a third-party the creation and management of an on-site installation connected to a private network
3. The organisation outsources the creation and management of an Internet accessible system by a third-party.

Public cloud: owned by a cloud service provider for general access

Cloud advantages:

1. For the infrastructure provision, the advantages include the better performance when running software and the increased storage capacity.
2. For the platform provision, the cloud can offer facilities for software development and testing.
3. For the software provision, the cloud will be able to run applications that require high performance systems. Alternatively, it could be that the costs to a company of buying and installing a software package themselves would be far too high.
4. Regard to outsourcing. The cloud user no longer needs technical expertise.
5. Can access data from any computer with internet access
6. Data can be easily shared
7. Can easily increase capacity

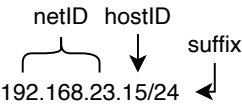
Cloud disadvantages:

1. The cloud service provider has complete access to all of the data stored on the cloud. The cloud user cannot be sure that their data is not being shared with third-parties.
2. The cloud service provider is being relied on to ensure data cannot be lost.
3. Can only access with internet access
4. It can take long time to upload/download the data
5. It can be more expensive in the long term

A Level CS C02 Network (3)

IPv4 addressing: a **32-bit** long, hierarchical address of a device on the Internet

The original addressing scheme was designed on the basis of a hierarchical address with a group of bits defining a network (a **netID**) and another group of bits defining a host on that network (a **hostID**).
 CIDR(Classless inter-domain routing): CIDR retains the concept of a netID and a hostID but removes the rigid structure and allows the split between the netID and the hostID to be varied to suit individual need.



Sub-netting:

On the Internet, all of the allocated IP addresses have a netID pointing to the router. The router then has to interpret the hostID to direct the transmission to the appropriate workstations on one of the LANS via a gateway.

NAT(Network address translation):

Sub-routing deviates from the principle that every IP address should be unique.

The solution for dealing with the addressing is to use network address translation (NAT)

The NAT box has one IP address which is visible over the Internet and so can be used as a sending address or as a receiving address.

Difference between public IP address and private Ip address:

1. Private Ip is only known within the LAN, public IP is known outside of the LAN
2. public is allocated by ISP, private is allocated by the router
3. public address are unique throughout the internet, private addresses are unique only within the LAN
4. private IP addresses are more secure than public IP address

Dynamic IP address: The ISP will have available a large number of hostIDs. However, the number of users that the ISP is supporting could very likely be larger than the total number of addresses available. Fortunately for the ISP and for an individual user many of these potential users will not be engaged in Internet interaction. The normal practice is for the ISP to create a 'dynamic address' for a user.

Static IP address: The alternative is a 'static address' which never changes and can be provided if a user is prepared to pay an extra charge.

IPv6 addressing: IP version 6 (IPv6) uses a 128bit addressing scheme allowing 2¹²⁸ different addresses

Difference between static IP address and Dynamic IP address:

1. static Ip address is provided by ISP, dynamic IP address is provided by DHCP
2. static IP does not change any time. dynamic IP change any time
3. static IP is less secure
4. the cost to maintain the static ip is high than dynamic ip
5. static ip is more stable than dynamic ip

IPv6 addressing:

1. use a 128-bit addressing scheme.
2. Documenting these addresses is going to be difficult.
2. The address is **written in a colon hexadecimal notation**.
4. The code is broken into 16-bit parts, with each part represented by four hexadecimal characters.

Difference between IPv4 and IPv6:

1. IPv4 has 4 group of digits, IPv6 has 8 groups of digits
2. In IPv4 each group is from 0-255, in IPv6 each group is from 0-65536
3. IPv4 use a full-stop between each group, IPv6 use a colon between each group
4. IPv4 is **32-bits**, IPv6 is **128-bits**

IPv6 address	comment
63E3:43D3:FFFE:FFFF:3221:1A2D:3434:FF01	A full address
72E6::CFEE:3D21:1190:231A:FF01	:0000:0000 has been replaced by ::
6C48:23:FFFE:FFFF:3D23:1190:95A:FF01	leading zeros omitted
::192.31.23.12	An IPv4 address used in IPv6

Domain name service (DNS): a hierarchical distributed database installed on domain name servers that is responsible for mapping a domain name to an IP address. Also known as domain name system. The domain name service (DNS) service allocates readable domain names for Internet hosts and provides a system for finding the IP address for an individual domain name.

There are more than 250 top-level domains which are either generic (e.g. .com, .edu, and .gov) or represent countries (e.g. .uk and .nl). The domain name is included in a universal resource locator (URL), which identifies a web page, or an email address.

name resolution:

1. If the domain is under the control of the server to which the query is sent then an authoritative and correct IP address is returned.
2. If the domain is not under the control of the server, an IP address can still be returned if it is stored in a cache of recently requested addresses but it might be out of date.
3. If the domain in the query is remote then the query is sent to a root server which can provide an address for the name server of the appropriate top-level domain. This in turn can provide the address for the name server in the next lower domain. This continues until the query reaches a name server that can provide an authoritative IP address.

DNS translate IP address step:

1. URL is parsed to obtain the Domain name
2. Domain name is sent to the nearest Domain Name Server (DNS)
3. DNS holds a list of Domain names and matching IP addresses
4. DNS name resolver searches its database for the Domain name
5. If DNS does not find the Domain name, the request is forwarded to a higher level DNS
6. If the Domain name is found, the IP address is returned
7. If the Domain name is not found, the request is passed to a higher level server
8. If the Domain name is finally not found, an error message is generated