Chapter 2 Student Book Answers

What you should already know

1 a) i) MAC address

- A unique number that identifies a device connected to the internet.
- It can be a physical or virtual address.
- A MAC address is usually fixed.

IP address

- When a device connects to the internet it is given an IP address.
- An IP address is usually unique for a particular session.
- It's format is xx.xx.xx.xx.

b)

- A MAC address identifies a device (usually NIC contains the address).
- An IP address is the location of the device on the internet.
- A MAC address and IP address operate on different layers of the internet protocol.
- A MAC address identifies machines on layer 2.
- An IP address are used on layer 3.
- Even if a computer has an IP address it still needs a MAC address to find other devices which may be on same network.

c)

- An ISP is a company that provides services to access and use the internet.
- The company will charge a fee for the service provided.
- An ISP has equipment and telecommunication lines to allow internet connection.
- An ISP provides user with an IP address when connecting to the internet.

d)

- An internet (web) browser is software application for accessing information on the World Wide Web
- An internet browser allows user to view pages on different websites.
- They allow location of websites by typing in the URL in the address bar.

2 Advantages

- NIC/WNIC cards
- network cabling to connect up computers and devices
- switches/hubs to connect devices to form a network

Disadvantages

- router required if internet/external networks need to be accessed
- firewall if any external links exist
- servers to manage security, store common software/files, manage printer queues
- setting up privileges to allow access to user areas
- web browser and ISP if internet connection needed

3 a)

- They will require software to enable WiFi if accessing internet via wireless router.
- Most devices will need a cell net provider (3G, 4G, 5G) and web browser.

b) **Advantages**

- very small therefore very likely to be carrying it all the time
- can also make calls or access internet on the move
- can be used anywhere since they don't need to be near a router.

Disadvantages

- small screens can make reading web pages more difficult and more difficult to navigate
- small/virtual keyboards can make typing slower and more error prone
- web browsers (etc.) can drain the battery quickly
- small memory size (most don't allow memory expansion)
- not all webpage features are compatible with smartphone OS
- data transfer rates can be relatively slow.

Activity 2A

1   Client-server network

- Works well with a small group of workers doing research.
- It is possible to control network resources with good network security (essential when doing research).
- It is also important that data needs to be backed up on a central server so that all researchers have access to the latest developments and data.

2   Peer-to-peer network

- Group of consultants is probably small but it all depends on how secure the data needs to be.
- If it is essential that it needs to be very secure, then they may need to consider client-server networks instead

(Note: as long as the chosen network can be **fully justified**, there is often more than one possible answer to the question).

Activity 2B

1   a)   LAN:

- Are networks that cover small geographical areas, for example, a building.
- A typical LAN will consist of a number of computers and devices connected by hubs/switches.

WAN:

- Is a network which covers very large geographical area (e.g. whole country or continents).
- Wans are formed from connecting number of LANs together by routers/gateways.
- Due to vast distances, they use public communication links (such as telephone lines and/or satellites).

MAN:

- Is a network that covers smaller geographical area than a WAN.
- They often connect devices in a number of buildings within a city (e.g. a university campus).

b) **Benefits:**

- sharing of resources such as printers

- software licence for all the computers on a network is usually cheaper than licences for the same number of stand-alone computers
- ability to share files leads to more consistent/reliable data since all data accessed from a central server
- use of a network manager to ensure security and access rights and also to control external links to, for example, the internet.

c) i) Thick client – a computer that doesn't rely on processing being done by a server or other computer; can operate online or offline.

  ii) Thin client – a device needing access to the network for it to work e.g. a POS terminal at a supermarket; depends on a more powerful computer to do the processing.
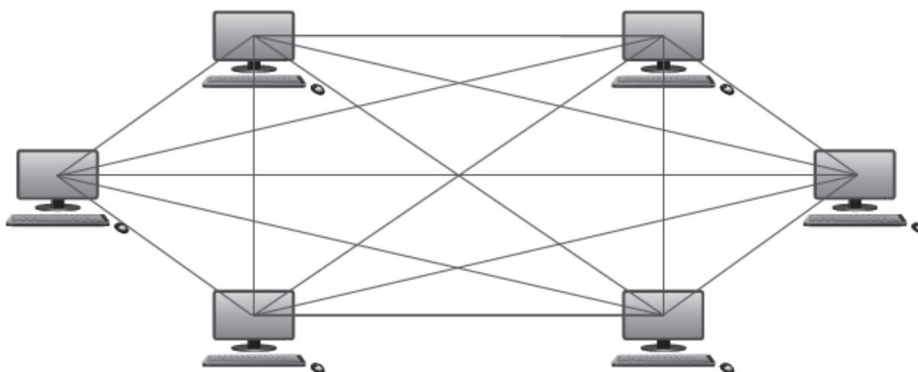
2 a) i) bus

  (ii) star
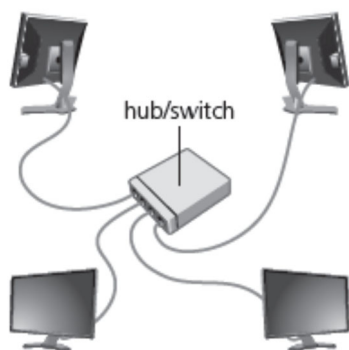
  iii) mesh

b) Bus

Advantages	**Disadvantages**
• easier to expand network • requires less cabling.	• failure of main cable results in failure of whole network • not very good under heavy load.

Star

Advantages	Disadvantages
• easier to upgrade	• if the central hub/switch fails, then the whole network will be down
• if one node or link fails, then the rest of the network can still function.	• high cost of cabling.

Mesh

Advantages	Disadvantages
• easier to detect network faults	• requires bulk cabling
• has very good privacy and security	

3 a) Public cloud – a storage environment where the customer/client and cloud storage provider are different companies.

Private cloud – a storage provided by a dedicated environment behind a company firewall, the customer/client and cloud storage provider are integrated and operate as a single entity.

b) Benefits:

- Customer/client files stored on the cloud can be accessed any time, from any device, anywhere in the world provided there is internet access.
- There is no need for the customer/client to carry external storage devices around with them or even use the same computer where the original files were stored.
- Cloud storage provides user with remote and automatic back-up of data.
- It offers almost unlimited storage capacity (at a cost).

c) Drawbacks:

- There are well-known security aspects to consider.
- If the internet is unstable/fails or the broadband connection is slow it may be difficult/impossible to access files from the cloud storage facilities.
- Costs can be high if a large amount of cloud storage is required.
- There may be limited data transfer rates.
- Potential for failure of the cloud storage company with unknown results.

4

Wireless networking	Wired networking
• It is easier to expand the networks and it isn't necessary to connect the devices using cables.	• Using cables produces a more reliable and stable network; wireless connectivity is often subjected to interference.
• This gives devices increased mobility provided they are within range of the WAPs.	• Data transfer rates tend to be faster and there won't be any 'dead spots'.
• There is an increased chance of interference from external sources.	• Setting up cabled networks tends to be cheaper overall in spite of the need to buy and install cable.
• Data is less secure than with wired systems; it is easier to intercept radio waves and microwaves than cables; it is essential to protect data transmissions using encryption (e.g. WEP, WPA2).	• However, cabled networks lose the ability for devices to be mobile; they must be close enough to allow for cable connections.
• Data transmission rate is still slower than for cabled networks although it continues to improve.	• Having lots of wires can lead to a number of hazards such as tripping hazards, overheating of connections (leading to potential fire risk) and disconnection of cables during routine office cleaning.
• Signals can be stopped by walls and there may be drop off points.	• Many devices (for example, smartphones) are only set up for WiFi/Bluetooth connectivity.
• There may be legislation regarding which signal frequencies may be used.	• There may be building restrictions preventing the laying of cables, etc.

(Note: a reasoned argument needs to be made based on which of the features of wired and wireless networks from the above table were chosen by the candidate)

5 **a)** **Bit streaming**

- a contiguous sequence of digital bits sent over a network/internet
- requires high speed data transfer communications link
- requires buffering
- bits arrive at destination in the same order as they were sent.

b)

- Buffers are needed since the rate that data is transmitted to the computer may be different to the data transfer rate to the media player.
- Buffers prevent movies 'freezing' if, for example, the broadband speed is slow.

c) **On demand**

- digital files stored on a server in bit streaming format
- link to encoded video is placed on the website server
- user clicks on link to start the download of the video as required
- video can be paused/fast forwarded/rewound.

Real time (live)

- live event captured on camera/microphone and sent to a computer
- video/sound signal is encoded to a bit streaming media format
- encoded data is uploaded from computer to dedicated video streaming server
- because data is live, not possible to pause/fast forward/rewind.

Activity 2C

1 a)

- standard telephone line used
- line always open until receivers replaced on handset
- line remains active even during a power cut
- uses circuit switching (which allows line to remain open)
- data (voice) transmitted in analogue (old system using copper cables) or digital (using newer optical fibre networks)
- data can transmit in both directions at the same time.

b)

- internet connection only live whilst data is being sent/received (talking)
- uses Voice over Internet Protocol (VoIP) which converts sound/video to digital packages (encoding) before sending over the internet
- VoIP uses packet switching (data is broken down into packets and then routed to the destination by the fastest route and then reassembled in the correct order at the destination)
- data undergoes file compression to reduce the amount of data being sent.

c) GEO

- Geostationary Earth Orbit
- provides long distance telephone and computer network communications
- 35 800 km above the Earth with orbital period of 24 hours.

  MEO

- Medium Earth Orbit
- used by GPS networks
- 5000 to 12 000 km above the earth with orbital period between 2 to 8 hours.

  LEO

- Low Earth Orbit
- used by mobile phone network operators
- 500 to 1500 km above the Earth with orbital period between 12 mins and 1 hour.

2 a) A: 00000000   00000000   00000000   00000000

    B: 10000000   00000000   00000000   00000000

    C: 11000000   00000000   00000000   00000000

b) A (upper): 127.255.255.255

    01111111   11111111   11111111   11111111

    B (upper): 191.255.255.255

    10111111   11111111   11111111   11111111

    C (upper): 223.255.255.255

    11011111   11111111   11111111   11111111

c) **i)** 190.15.25.240 – class B network

ii) 190.15 – net ID

25.240 – host ID

iii) This means net ID can be set at maximum 18 bits leaving 14 bits for host ID.

d)

- IPv6 uses 128 bits rather than 32 bits
- IPv6 uses hexadecimal digits
- IPv6 uses built in authentication
- IPv6 ensures no more private address collisions
- IPv6 means there is no more need for NATs

3 **a)** A private IP address is reserved for internal use behind a router or other NAT device.

A public IP address is allocated by the ISP to identify where the device is on the network – this IP address is accessible to anyone logged onto the internet.

b) protocol is https

domain is exampleofaurl.co.de

filename is computer_logic.html

c)

- browser opened and user types in url: www.exampleofaurl.co.de/computer_logic.html
- browser asks DNS for IP address
- if DNS server can't find URL in its database or cache it sends out request to another DNS server
- second DNS server finds URL and can map it to an IP address
- this IP address is sent back to first DNS server which now puts IP address and URL into its database/cache; this IP address is now sent back to the user's computer
- computer's web browser now sets up communication with the website and starts to download the pages
- web browser interprets HTML and displays pages on user's monitor.

4 **a)** **Internet**

- a massive network of networks which are made up of computers and other devices
- stands for INTERconnected NETwork
- makes use of TCP/IP protocols.

www

- world wide web
- collection of multimedia web pages
- stored on websites
- http(s) protocols written using HTML
- URL specifies location of web pages
- documents accessed by web browsers
- information is accessed over the network.

b) Yes, it is correct.

- WANs are made up of connected LANs using the public network.
- The LANs may be private networks only accessible through passwords and user ids …

- … therefore may not be accessible from the internet since this uses common access points which are open to all users.

c) i) Web browser

- a software application for accessing information on www
- allows user to view pages on different websites
- allow location of websites by typing in the URL in the address bar.

(ii) ISP

- a company that provides services to access and use the internet
- company will charge a fee for the service provided
- has equipment and telecommunication lines to allow internet connection
- provides user with an IP address when connecting to the internet.

End of chapter questions

1 a) i) Benefits

- signal only goes to destination node therefore more secure
- easier to expand network
- centralised management means it can be monitored
- failure of one node doesn't affect whole network.

Drawbacks

- if central hub/switch fails, the whole network fails
- the overall performance is dependent on the central hub/switch.
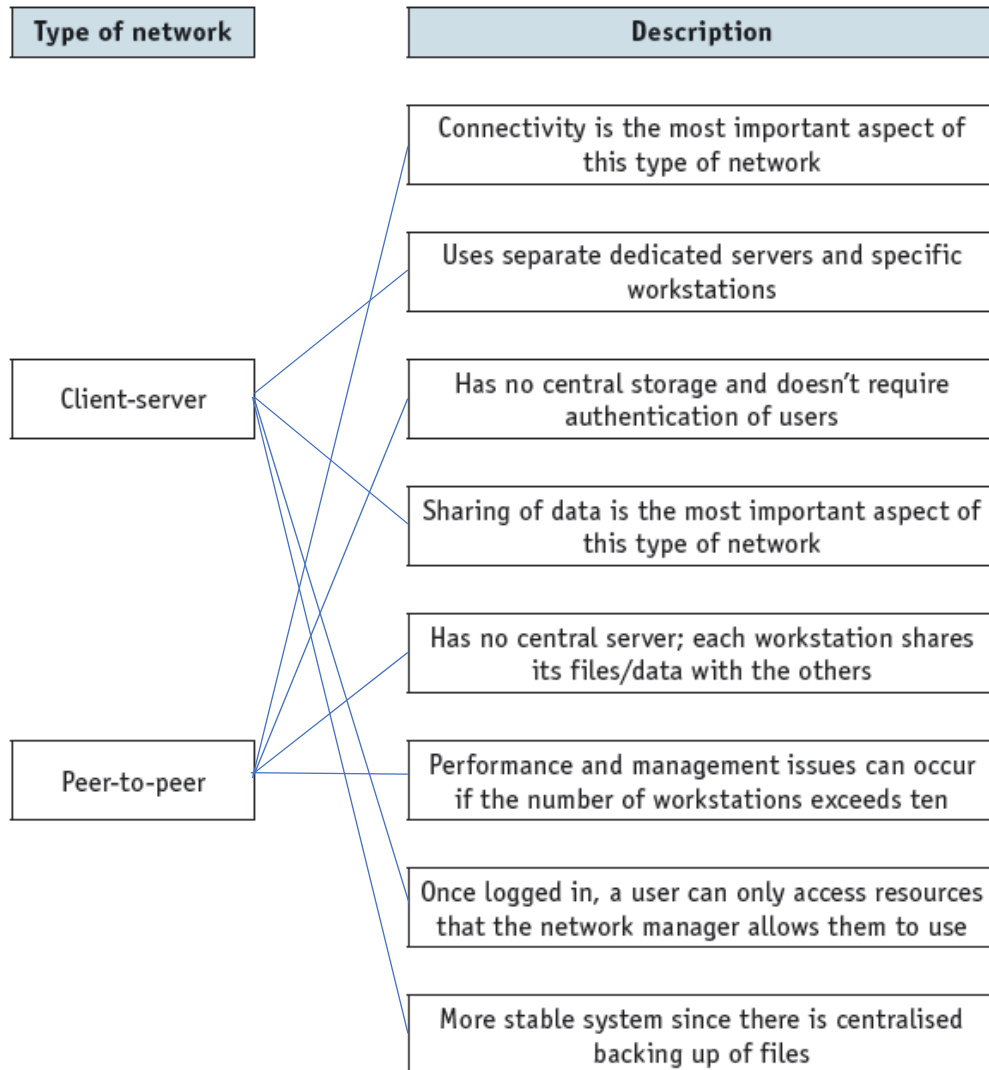
ii) Benefits

- easier to detect faults
- uses routing logic so data reaches destination node only by the shortest route or rerouted if one of the nodes fails
- has very good privacy and security

Drawbacks

- complex network topology
- requires considerable amount of cabling which means initial set up is relatively expensive

b)

Type of network	Description

Boxes under Description:

- Connectivity is the most important aspect of this type of network
- Uses separate dedicated servers and specific workstations
- Has no central storage and doesn't require authentication of users
- Sharing of data is the most important aspect of this type of network
- Has no central server; each workstation shares its files/data with the others
- Performance and management issues can occur if the number of workstations exceeds ten
- Once logged in, a user can only access resources that the network manager allows them to use
- More stable system since there is centralised backing up of files

Boxes under Type of network: Client-server, Peer-to-peer

2 a) i)

- Copper cable uses pulses of electricity to transmit data …
- … whereas fibre optic cables uses pulses of light to transmit data.

ii)

- Copper cabling is much cheaper …
- … and is a well-known technology if anything goes wrong.
- Fibre optic cables are the cable of choice when sending data over long distances …
- … this is because they offer the best data transfer rate and have a very high resistance to external interference.
- The main drawback is the high cost …
- … but they do offer the smallest signal attenuation.
- They have ~26 000 times the transmission capacity of twisted pair cables.
- single mode fibre optic cables use a single mode light source and have a smaller central core which results in less light reflection along the cable …
- … the benefit of this is that the data can travel faster and further than with multi core cables.
- Multi core cables allow for a multi-mode light source; the construction causes higher light reflections in the core.

b) GEO – Geostationary Earth Orbit:

These provide long distance telephone and computer network communications; orbital period is 24 hours and they orbit at 35 800 km.

MEO – Medium Earth Orbit

These are used for GPS systems (about 10 MEO satellites are currently orbiting the Earth); orbital period is 2 to 8 hours; they orbit at 5000 to 12 000 km.

LEO – Low Earth Orbit

These are used by the mobile phone networks (there are currently more than 100 LEO satellites orbiting the Earth); orbital period is 12 mins to 1 hour; they orbit at 500 to 1500 km.

c) i) Attenuation is the reduction in amplitude of a signal. For example, we see that infrared is worst in this respect since it can be affected by rain and can also be stopped by internal walls.

ii) When a device wants to communicate, it picks one of 79 channels at random. If the chosen channel is already in use, it randomly chooses another channel

3 a) Bit streaming

- is a contiguous sequence of digital bits sent over a network/internet
- requires a high speed data transfer communications link
- requires buffering
- bits arrive at destination in the same order as they were sent.

b) i) Benefits

- no need to store large files on a local computer
- no need to wait for whole files to be loaded before watching video
- allows on demand playback
- no specialist software needed.

ii) Potential problems

- video stops/hangs if internet connection is slow or is lost
- video stops/hangs if there is inadequate buffering
- may require special software to run certain files
- usual risk of viruses and other malware being transmitted.

c) On demand

- digital files stored on a server in bit streaming format
- link to encoded video is placed on the website server
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Real time (live)

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4 a)

- Buffers are needed since the rate that data is transmitted to the computer may be different to the data transfer rate to the media player.
- Buffers prevent movies 'freezing', for example, if the broadband speed is slow.

b) i) low buffer value = 200 kiB = 200 × 1024 = 204 800 bits

high buffer value = 1.8 MiB = 1.8 × 1 048 576 = 1 887 437 bits

during first 2 seconds, incoming data = (1.5 × 1 048 576)/8 = 196 608 bits

and outgoing data is = (600 × 1024)/8 = 76 800 bits

therefore, data build up is (196 608 – 76 800) = 119 808 bits

therefore, low buffer mark is now (204 800 + 119 808) = 324 608 bits

ii) The buffer builds up as follows:

after 4 seconds: 444 416 bits

after 6 seconds: 564 224 bits

after 8 seconds: 684 032 bits

after 10 seconds: 803 840 bits

and produces a graph which shows high buffer value reached after about 30 seconds of bit streaming:
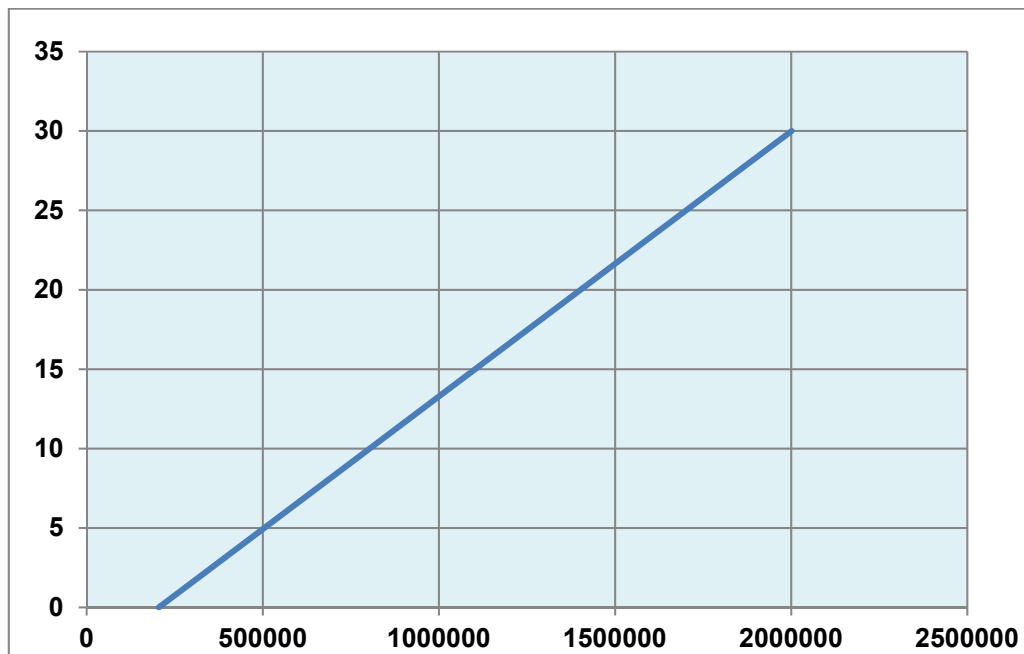
c)

- A larger buffer is needed (e.g. 20 MiB).

- The rate at which data is sent to the media player must increase.

5 a) i) Data collision is when two messages along same data channel sent at same time could collide.

ii) CSMA/CD relies on fact that frames being sent cause voltage level changes.

iii)

- When a collision is detected, the station stops transmitting the frame and transmits a jam signal.

- It then waits for a random time period before resending data frame.

b)

Network device		Description
gateway		device that analyses packets of data transmitted from one network to another or analyses data within a single network
switch		network point (node) that connects two networks that use different protocols
hub		device that connects LANs that use the same protocol to allow them to work as a single network
router		device on a network that redirects data received to only those destinations on the LAN network that match the address in the data packet
bridge		device that sends all the received data packets to every device in the network irrespective of any data packet addresses