Communication

COMPUTER SCIENCE 9618 PAPER 1

Communication

Networking : Is the exchange of information and ideas among people with a common profession or special interest

Internet : A global network providing communication facilities

Network : When two or more systems are connected through wire or wireless

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Advantages Of Using Network

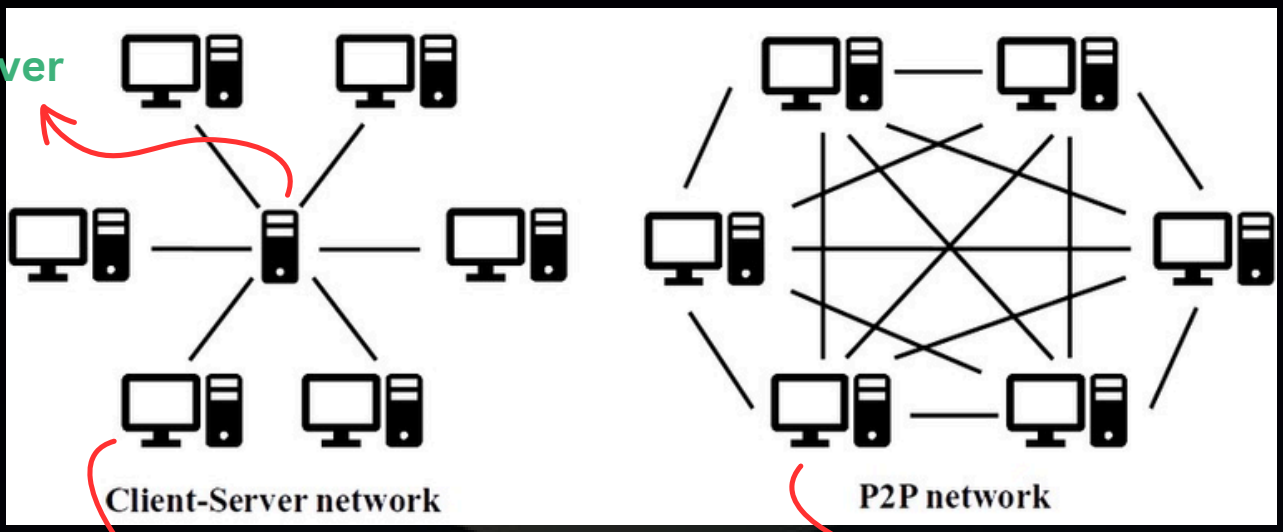
File Sharing : Users can share files with other users
Hardware Sharing : Users can share hardware such as printer
Software Sharing : Users can share software applications
Communication : Users can send mail or chat

Disadvantages Of Using Network

Cost : Additional equipment would be required
Management : Network requires management from technical stuff
Malware : Virus can easily spread through improperly secured network
Hacking : Once a device a connected to another device, it is easier to hack

Client Server Model And Peer To Peer

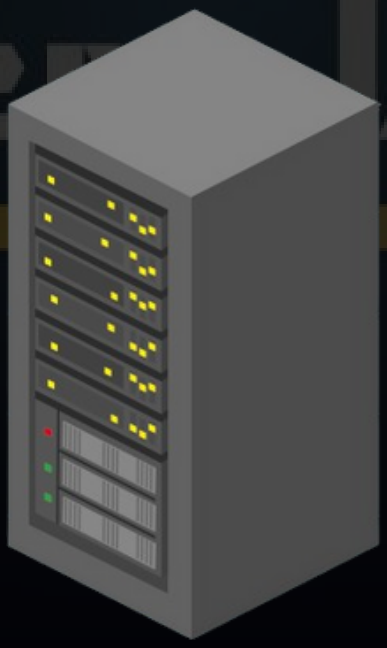
Network can be designed in two ways 1) Client Server Model and Peer to Peer



Client / User

Peer / User

A server is a computer that provides resources, data to other computers known as clients



Server

E.g

- File Server
- Print Server
- Proxy Server
- Web Server
- Application Server

What is meant by a client - server model of networked computers ?

- At least one computer used to “Serve”
- Other Computers are referred to as “clients”
- Server provides services / application

Scenario Based Questions

Downloading a file from a website is an example of a client - Server application

What is meant by the term client - server ?

- The file is made available from web server
- The user’s browser is the client software
- The client (Software Browser) requests the file from server
- The desired file is returned to the client computer

Bank has a client - server model of networked computers

Describe, using the bank as an example the key features of a client - server model ?

- The bank’s server holds the customer account data
- and performs requested task
- The computer used by the customers are the clients
- that sends request to the server
- which returns the results of the request
- E.g a customer asks for a list of recent transactions on their account

How client server model enables the employees to access same files from different computers ?

- The employees computers are the client
- The Server hosts the shared file
- An employee can request a file from the server from any of the client computers.
- Several employees can access the same file on the server at the same time.

Benefit Of Client Server

- Files and resources are centralized (Controlled by Organization)
- Creation of security / manage of security
- Centralized back up (Process that involves replicating data to server.
- Internet Monitoring
- Clients can be less powerful machines, therefore less expensive to buy
- Saving resources on server reduces the burden on the client.

Drawbacks Of Client Server

- If the server crashes, all connected clients lose access to the services, data, or resources.
- Servers require powerful hardware, specialized software, and skilled IT staff to manage them. This leads to high costs for setup
- As the number of clients increases, the server may struggle to handle the workload

Key Features Of Peer To Peer Network

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

Benefit Of Peer to Peer

- It avoids possibility of congestion when more clients are simultaneously requesting to download a file
- It allows user to download different parts of files separately
- The parts are available from more than one host

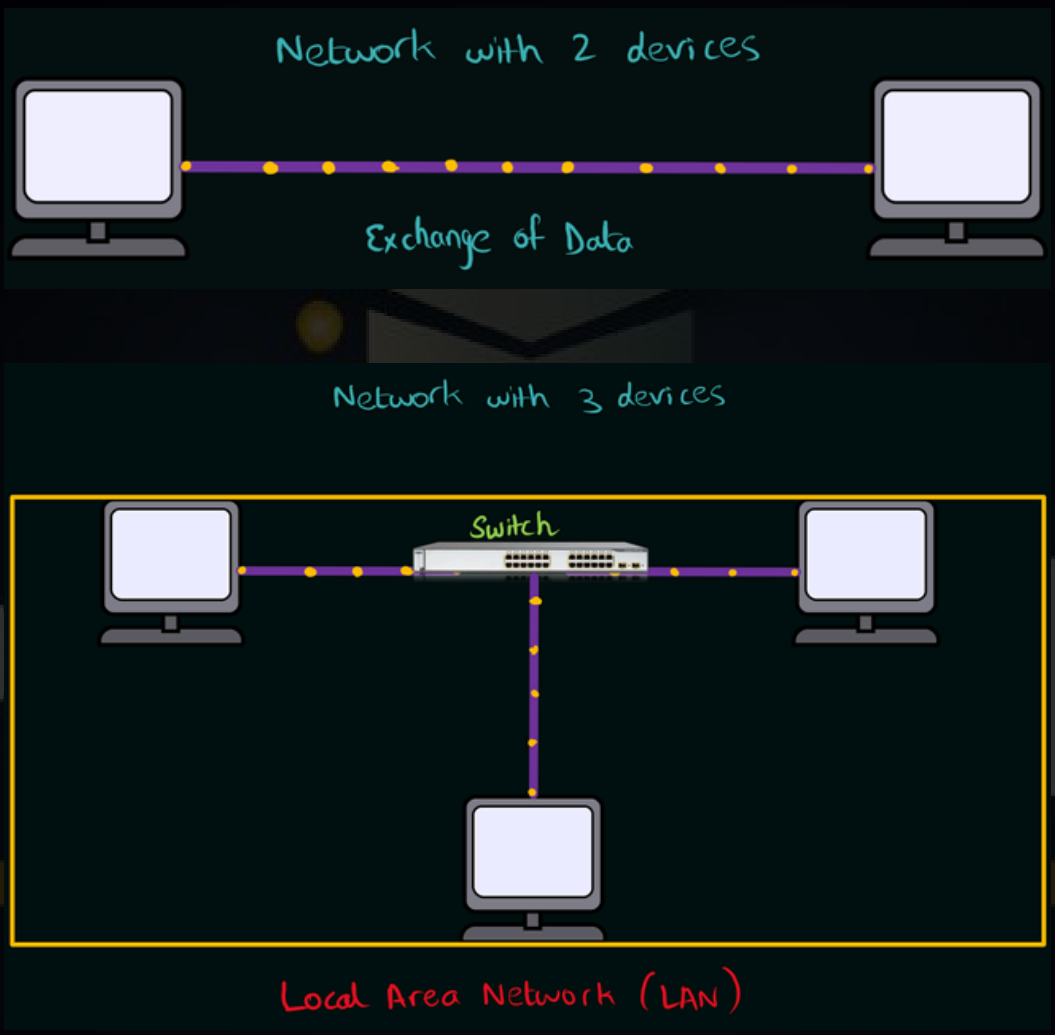
Drawbacks Of Peer to Peer

- Reduced Security, each computer is at risk from viruses from other computers
- No Central Management of backup, if the data from one computer is not backed up it is lost to all of them
- No central management of file, consistency may be difficult to maintain and each computer may have different software from others
- Individual computers may respond slower because they are being accessed by other computers

Network

LAN	WAN
Local Area Network	Wide Area Network

Network : When two or more systems are connected through wire or wireless



LAN : A network connecting computers in a single room, in a single building.

WAN : A network connecting computers on different sites, possibly thousands of kilometers apart

Exam Style Question

A school is setting up a network within one of its buildings. State whether the network will be LAN or WAN.

- LAN
- Small geographical area
- Does not use the internet to transmit within the building so the communication within the LAN happens directly over the private network and does not require the internet.

Give two characteristics of a LAN.

- Covers a small geographical area
- The infrastructure is privately owned

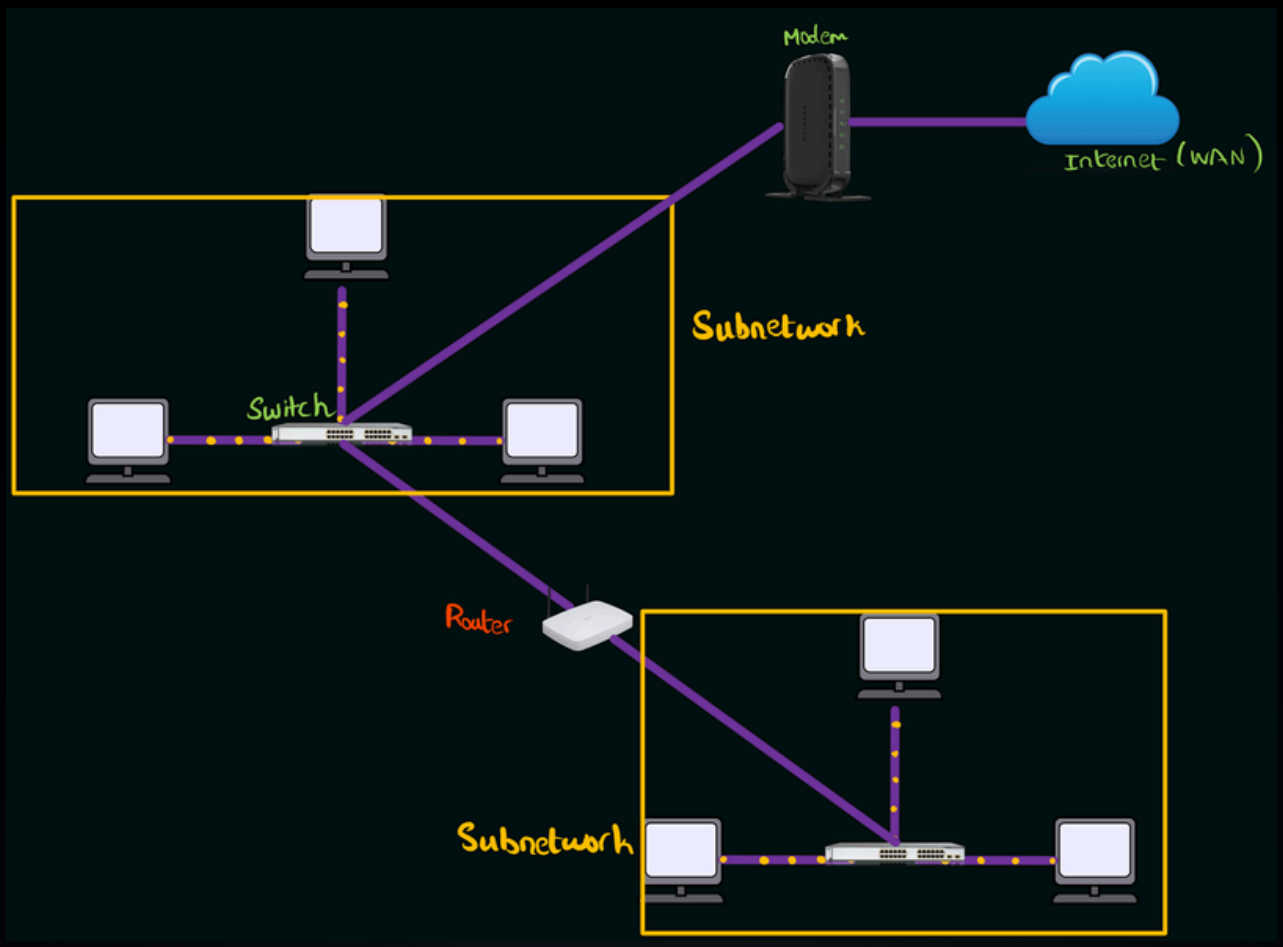
Write benefits of LAN.

- Allows the sharing of files/data
- Allows the sharing of resources e.g. hardware / software (applications)
- Allows central management such as backup and security

Differences between a WAN and LAN .

- WAN covers a large geographical area and LAN covers a small geographical area
- LAN connections between devices are usually physical, whereas the WAN connections are often virtual
- A LAN has a high data transfer rate, whereas a WAN has a low data transfer rate
- The ownership of a LAN is private; the ownership of a WAN can be private or public
- LAN is usually more secure than a WAN because protection is easier to implement

Subnetwork



A subnet, short for subnetwork, is a segmented portion of a larger network. The primary purpose of a subnet is to improve network efficiency and security by breaking down a large network into smaller, more manageable pieces.

Thin Client And Thick Client

Ahmed can go home and work remotely, he will have no issue if server goes down so more functional.

THICK CLIENT

Abdullah need connection with server, if server goes down he can not work.

THIN CLIENT

Thin Client : A device or software which is heavily dependent on having access to a server. Thin client will not work unless it is connected at all time to a server. e.g web browser

Thick Client : A thick client can either be a device or software that can also work offline. The server performs some processing for the client. The client also do most of the work independently most of the resources are installed locally.

Advantages Of Thick Client

- More robust as device can carry out processing when not connected to server
- Better uptime
- Reduce server demand
- Clients have more control

Disadvantages Of Thick Client

- Less secure (relies on client to keep their own data secure)
- Each client needs to update data and software individually
- Data integrity issues, since many clients access the same data which can lead to inconsistent data

Advantages Of Thin Client

- Less expensive to expand as low powered and cheap device can be used.
- Data updates and new software installation done on server
- More secure as server can offer protection against hacking and malware.

Disadvantages Of Thin Client

- Dependent on server, if the server goes down then the device can not work.
- More downtime

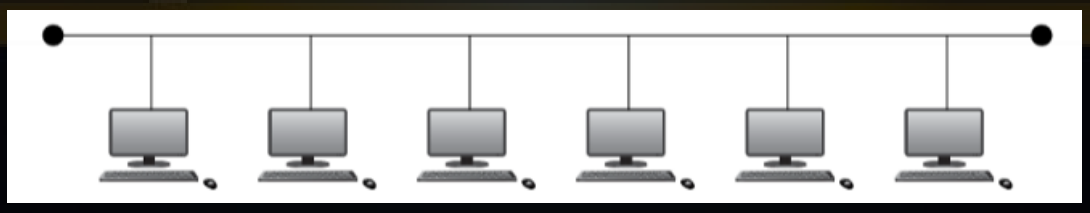
Difference between thin client and thick client.

- **Thin client relies on server, thick client can work without server.**
- **Thin client relies on faster internet , Thick client can work on slow network connection**
- **Thin client requires few local resources such as SSD, HDD, RAM, and thick client relies heavily on local resources**
- **data for thin client is stored on server, Data for thick client is stored on device itself.**

Topology

A network topology is the arrangement with which computer systems are connected to each other

Bus Topology : Uses a single central cable to which all computers and devices are connected



Advantages Of Bus Topology

- Easier to setup / extend
- Less cable required
- Less expensive

Disadvantages Of Bus Topology

- If the main cable breaks, network problem degrades badly
- Difficult to detect and troubleshoot fault at an individual station
- Efficiency reduces as the number of devices connected to it increases
- Collisions, not suitable for networks with heavy traffic
- Security is lower because several computers receives the sent signal from the source

Question : How packets are transmitted between two computers in Bus Topology

- Packets has address of recipient
- Sender transmits data through the bus
- The bus carries data along the central cable
- As the data arrives at each computer, the system compares the address to see if it matches.

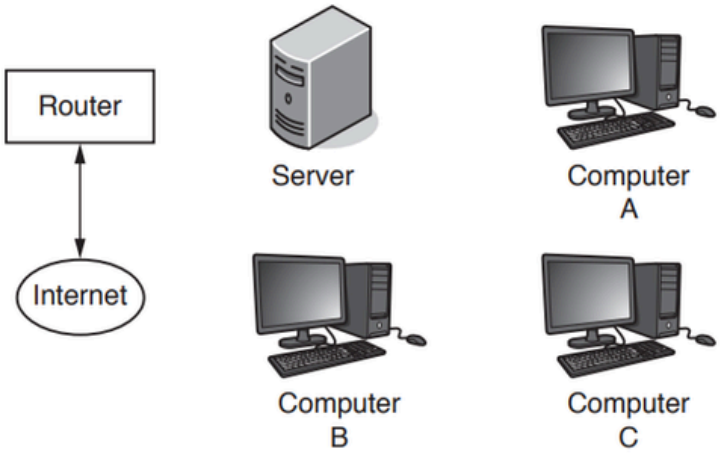
Question : Where will we use bus topology

- Used when small and temporary network is needed
- Network which does not rely on high data transfer speed
- Used in office, or schools

Exam Style Question

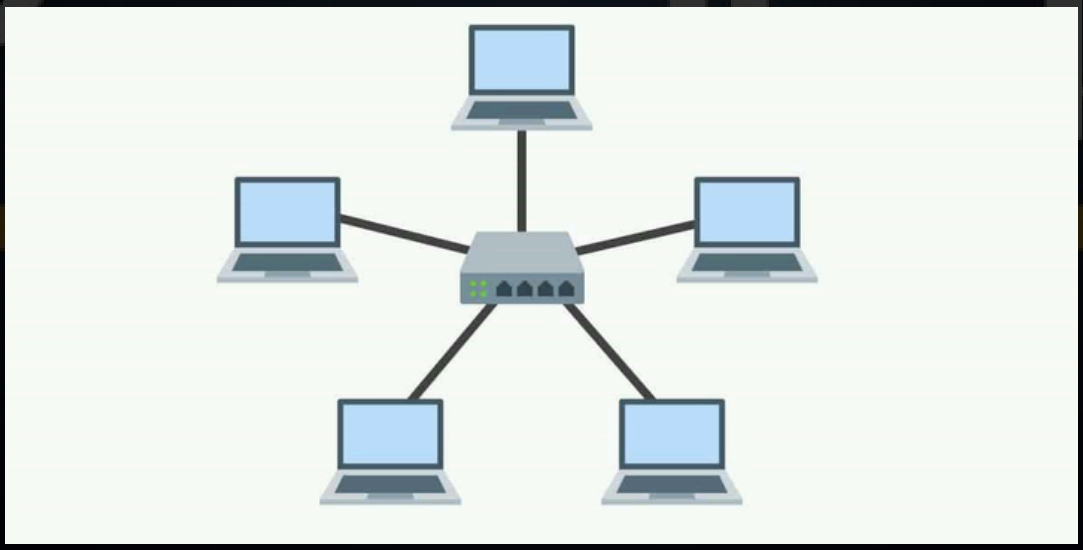
1 A Local Area Network (LAN) consists of three computers, one server and a router connected to the Internet. The LAN uses a bus topology.

(a) Complete the following diagram to show how the computers, the server and the router could be connected.



[2]

Star Topology : Every Computer is linked with central device



Advantages Of Star Topology

- Signals only go to destination so more secure
- Easy to connect / remove node
- Centralized Management helps in monitoring the network
- Failure of one node or link doesn't affect the rest of the network
- Fewer Collision

Disadvantages Of Star Topology

- If the central device fails then whole network goes down
- Performance is dependent on capacity of central device

Question : How packets are transmitted between two computers in Star Topology

- Packets has address of recipients
- Sender sends data to central device
- Server reads address and find where recipient is
- Server directly sends data to recipient
- Server transmit packets only to recipient

Question : Where will we use Star Topology ?

- Large organization
- Educational establishment
- Where high performance is must
- Found in home as well, where router act as server

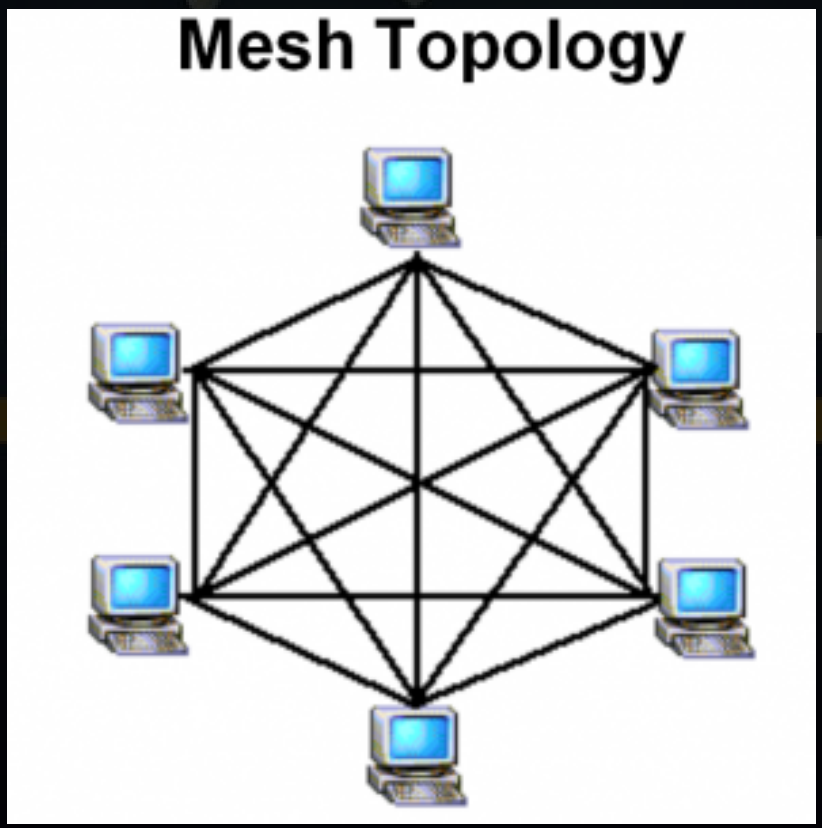
Exam Style Question

2 Cables connect the computers in a university admissions department in a star topology. The server room contains the server and printer for the employees to use. The department has three employees. Each employee has a computer connected to the star network.

(a) (i) Draw a diagram to show this topology.

[3]

Mesh Topology : All the device are interconnected to each other



Advantages Of Mesh Topology

- Any broken links in the network do not affect the other nodes there are more routes available
- Good privacy and security, since packets travel along dedicated routes and not using one main line
- New nodes can be added without interruption

Disadvantages Of Mesh Topology

- A large amount of cabling is needed, which is expensive and time consuming
- Setup and maintenance is difficult and complex

Question : How packets are transmitted between two computers in Mesh Topology

- Packets has address of recipients
- Sender transmits packets directly to node
- As each node is connected to at least one another node

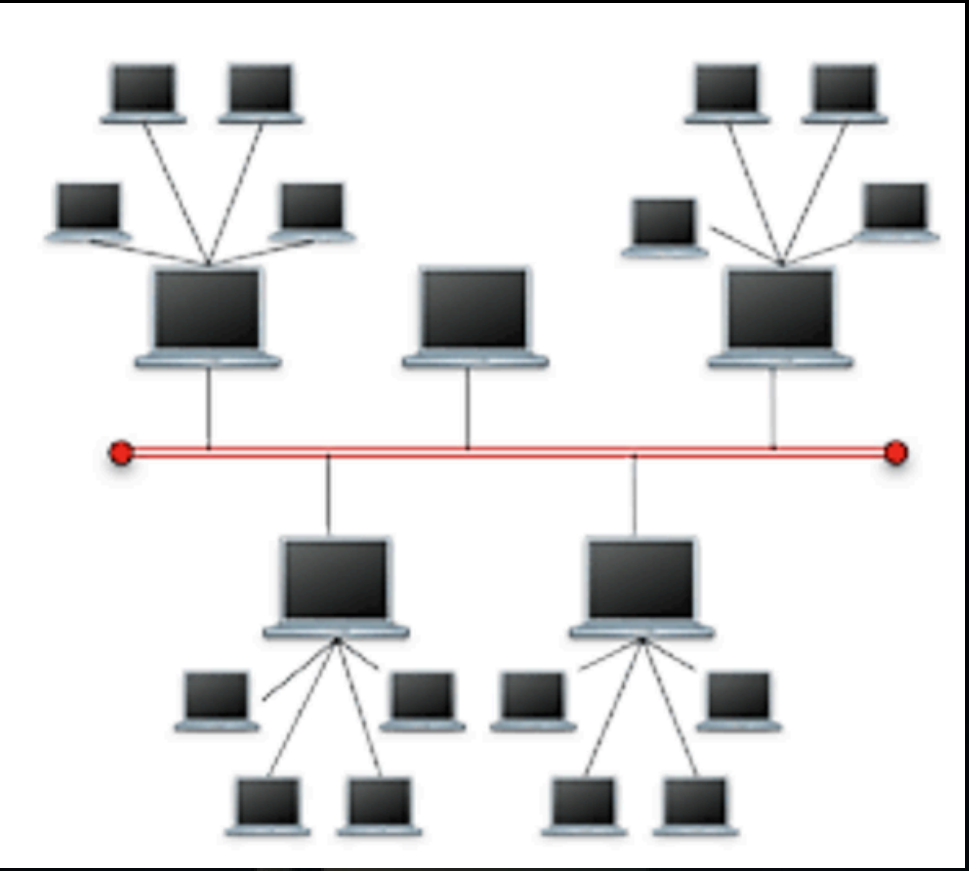
Question : Where will we use mesh topology ?

- Where establishment of communication is very important
- Military organization
- Emergency Service

Question : What is meant by a mesh topology ?

- All computers are connected to at least one other device
- There are multiple routes between devices
- The computers can act as relays, passing packets on towards the final destination

Hybrid Topology : Combination of two or more topologies



Advantages Of Hybrid Topology

- Highly reliable as in case of failure there are many sub networks
- Easy to trouble shoot and fix errors

Disadvantages Of Hybrid Topology

- Cost, expensive to setup
- Difficult to manage
- Complex network

Question : Where will we use Hybrid topology ?

- Large organization with different topologies in each building.

Cloud Computing

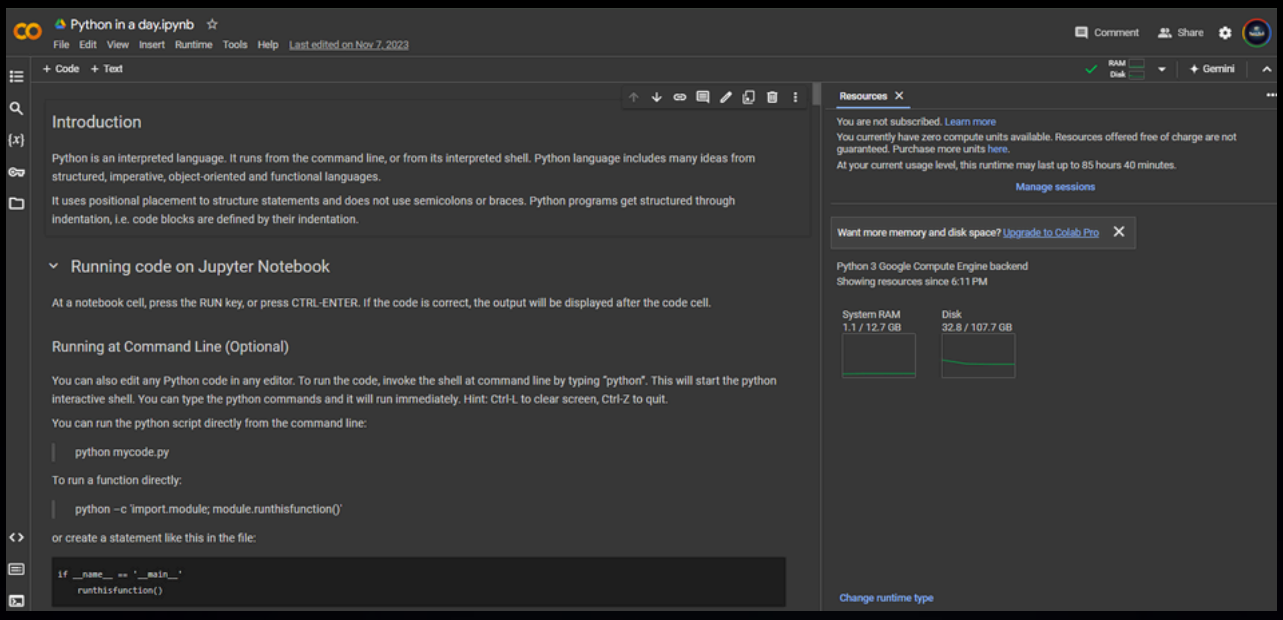
Cloud Computing refers to data and application being stored and run on cloud so less storage is occupied and less processing is done on local device.

What Is Cloud ??

Is a big building which contains servers

Question : Define Cloud Computing?

- Accessing a service/files/software on a remote server



Advantages Of Cloud Computing

- Files Stored on the cloud can be accessed at any time from any device anywhere in the world with internet
- No need to carry external storage device and saves storage on existing devices
- Cloud storage can be free
- Most cloud service provider have inbuilt backup
- Security could be better
- can easily increase capacity
- Data can be easily shared

Disadvantages Of Cloud Computing

- Can only access the cloud with internet access
- No control over security and it may not be strong
- No control over backups
- It can take a long time to upload/download the data
- It can be more expensive in the longer term
- There could be a limit to amount of storage unless paid for
- There could be issues with the company offering cloud services

Private Cloud

- Computing services offered either over the Internet or a private internal network
- Only available to select users not the general public
- Private is a dedicated/bespoke system only accessible for/from the organisation

Application : Highly regulated industries and govt agencies would use private cloud.

Public Cloud

- Computing services offered by 3rd party provider over the public Internet
- Public is open/available to anyone with the appropriate equipment/software/credentials

Application : For general use.

Exam Style Question

Question : Explain why the company uses a public cloud to store courses

- Courses must be available to anyone who wishes to follow them
- Courses must be available on the internet
- Company is willing to share infrastructure with other companies (public)
- which is more economic for the company

Question : Describe disadvantages of storing data on a public cloud compared to storing data on a server in a LAN ?

- There could be a possible loss of control unlike the LAN
- because the data is stored on someone else's infrastructure
- reliance on external agency to complete tasks, e.g. backups, security
- Requires reliable internet connection
- to ensure access to the remote data, more likely with LAN
- Increased recurring costs as cloud provider charges must be paid, costs for LAN once only.

Question : Describe the benefit of the company of using private cloud storage instead of Public Cloud Storage ?

- Not reliant on a third party
- gives greater control over security/privacy
- gives greater control over backup
- Storage can be tailored/scalable to company requirements
- an example e.g. the amount of storage accessible / facilitating the sharing of files.

Transmission Media

Wireless Vs Wired

Benefits of wireless network Compared to wired network

- Devices can be more mobile as they do not have to be connected to cable
- Easier to set up as no cables needs to be connected
- Additional devices can be easily added
- Many different types of device can be connected at the same time

Drawbacks of wireless network Compared to wired network

- Easier to hack
- Interference
- Signal degrades quickly

Benefits of using wired connection to watch films and play games

- Faster connection or higher bandwidth is needed to download/stream large files and there will be less time waiting / less latency / fewer delays
- More reliable / stable connection and there will be no issues with distance/walls/interference
- More secure

Benefits of using wireless connection to watch films and play games

- Freedom of movement can move between different rooms with a mobile device and still receive/transmit data and there is no need of a physical connection
- Easily expanded if friends want to access the same network
- Less cabling / expertise is needed which makes the initial setup less expensive

Exam Style Question

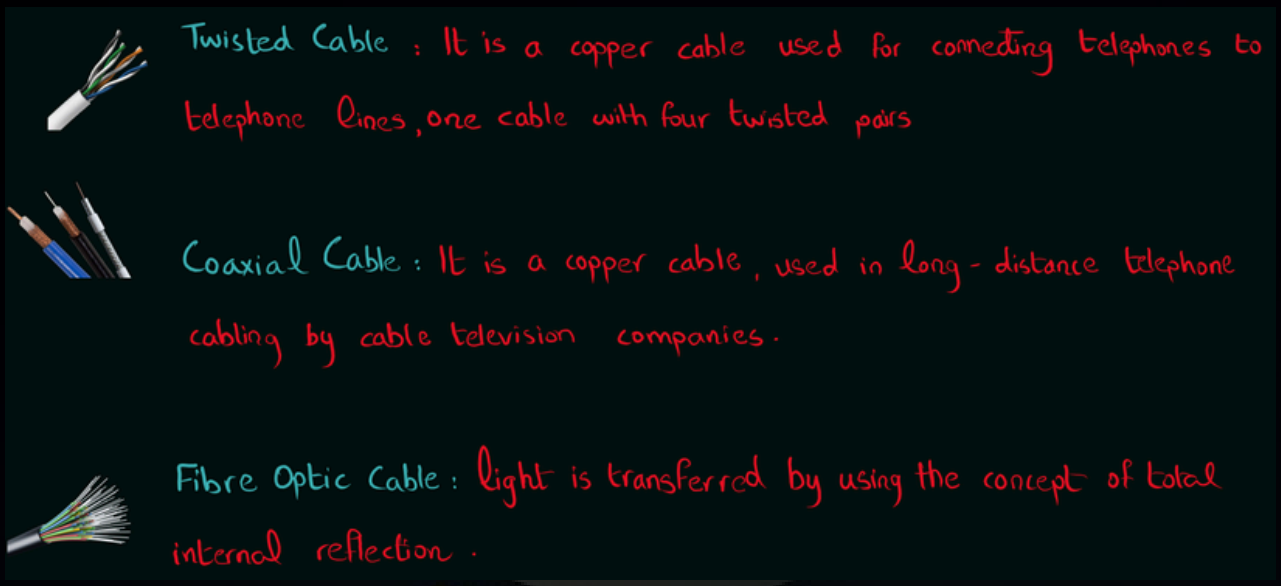
Question : Students can connect their devices to the university network using cables or a wireless connection.

Explain the benefits to the students of allowing them to use both wired and wireless connections ?

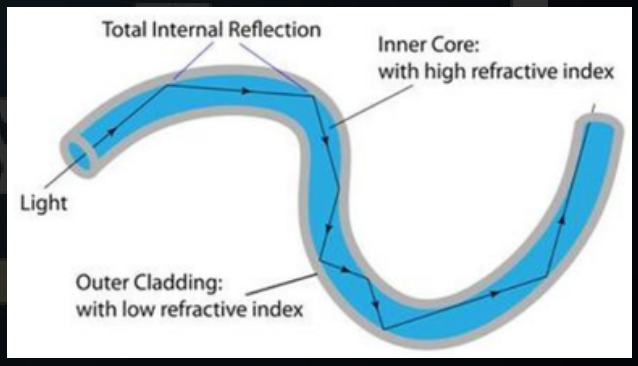
- Some students might only have one sort of connection on their device
- Wired provides better performance for the student's device
- for example, enabling faster access to university databases
- There will be less interference if students connect via a cable
- Students can transmit private/confidential data/work securely
- for example, their final dissertation
- Wireless connection means that the students can use their devices in different rooms more freely
- Wireless connection enables the students to bring multiple devices

Wired Media

We have two types of wired cables Copper and Fibre Optic cable and for copper cables there two more subdivisions Twisted and Coaxial Cable



How does light travel data ?



Pulses of lights are sent and those pulses have values 0 and 1

Benefits of Fibre Optic Cable

- Less interference in the signal
- Greater bandwidth // Faster transmission
- Difficult to hack so more secure
- Requires less signal boosting
- Consumes less power
- Lighter in weight so easier to install

Drawbacks of Fibre Optic Cable

- Installation cost is high
- Trained people are required to maintain and install
- Breaks when bent
- only transfers data in one direction
- Does not carry power only data
- Difficult to terminate

Benefits of Copper Cable

- Installation cost is low
- More flexible
- Easier to terminate
- Vast knowledge as it has been around for years

Drawbacks of Copper Cable

- Less bandwidth rate
- need repeaters
- higher interference

Question : Describe the difference between fibre-optic cables and copper cables ?

- Fibre optic data is transmitted using light, copper cable through electrical signals
- Fibre optic has higher bandwidth than copper cable // Fibre optic has higher transmission rates than copper cable
- Fibre optic has smaller risk of (noise) interference than copper cable
- Fibre optic can be used over longer distances than copper cable before repeaters are needed
- Fibre optic is much more difficult to hack into than copper cable
- Fibre optic is more prone to damage than copper cable

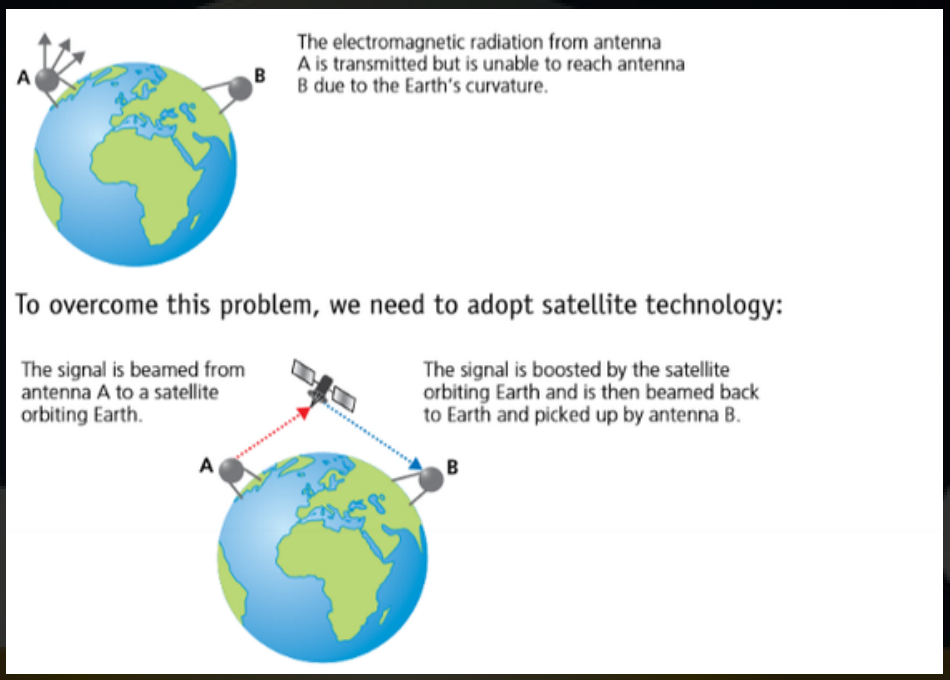
Wireless Media

Radio Waves : Are electromagnetic waves, used in wifi, frequency 3 KHz - 3 GHz. Radio waves carry data back and forth from the wireless adapter and the router

Microwaves : Are electromagnetic waves, frequency range 3 GHz - 300 GHz used in TV and MRI

Infrared : Are electromagnetic waves, frequency range 300 GHz - 400 THz used in tv remote

Satellite:



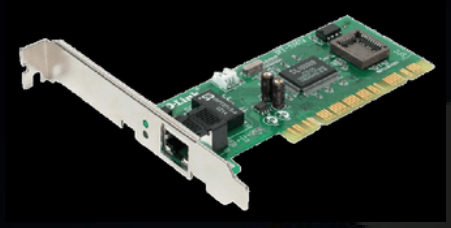
Data is converted into waves by changing the properties of electromagnetic waves such as amplitude, frequency to represent digital information (0s and 1s). A transmitter performs this changing and sends the waves through the air. At the receiving end, a receiver captures the waves and converts the changes in the wave back into the original digital data for processing by the device.

Hardwares Used In LAN

Switch

- To allow two or more devices to communicate with one another
- To connect individual devices to each other
- To receive transmissions and forward them to their destination

NIC (Network Interface Card)



- Provides device with a mac address
- to uniquely identify it on a network
- allows each individual device to connect to the network

WNIC (Wireless Network Interface Card)

- Provide interface to wireless network as an antenna
- Provides device with a mac address
- Receives analogue radio waves
- convert them to binary
- Checks incoming transmissions for correct MAC / IP address
- ignore transmissions not intended for it
- Encrypts the data
- Decrypts the data
- Takes binary input and converts to analogue waves
- sends the radio waves via the antenna

Cables : Fibre Optic or Copper (discussed above)

Bridge

Data will go to each and every computer which will increase traffic

Bridge has the mac address of each device

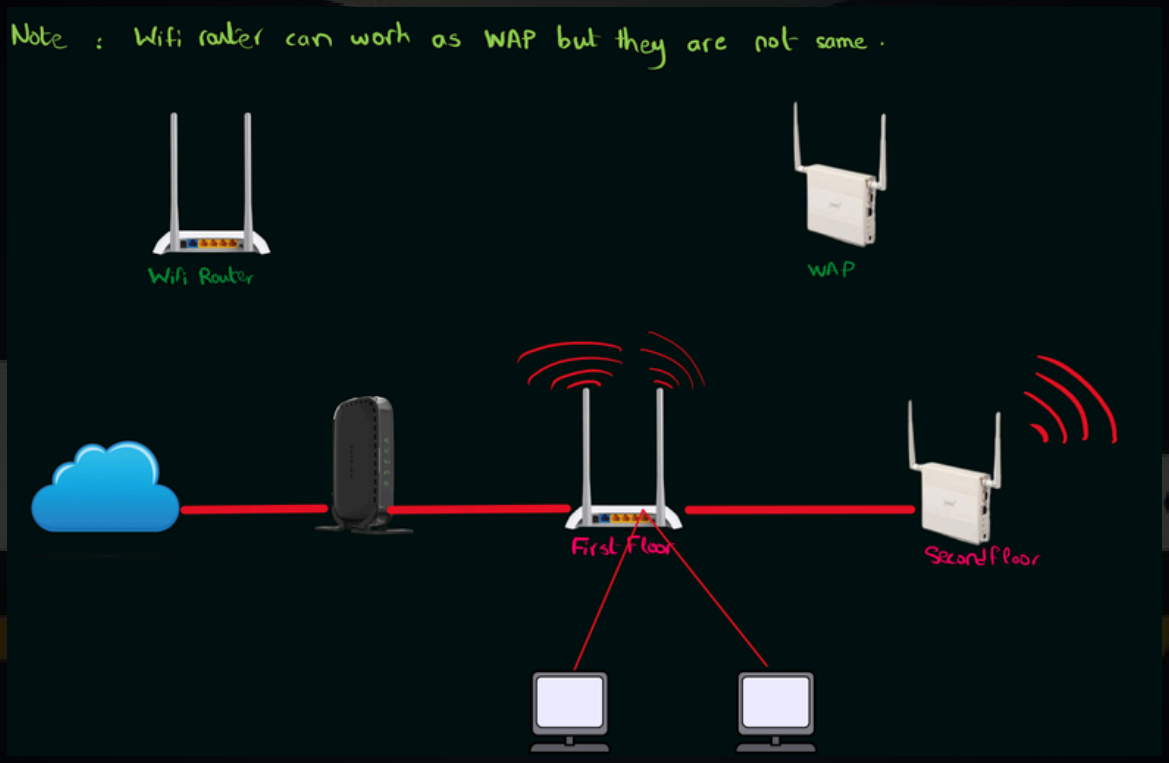
If PC1 wants to send data to PC2 then data will first go to bridge then bridge identifies if the data should stay on the left or right side

Bridge :

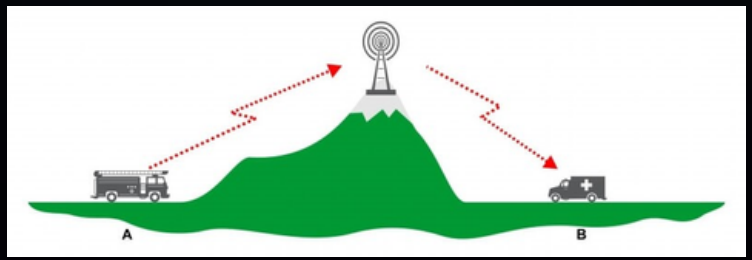
- To connect two LANs / segments with the same protocol
- To transmit data between two networks with the same protocol

WAP (Wireless Access Point) :

- To allow connection of devices (to the central device) using radio signals / Wi-Fi
- To allow the central device to send / receive radio signals / Wi-Fi signals
- To allow wireless-enabled devices to connect to a wired network



Repeater :



device used to boost signal

Router And Gateway

Router :

- Connects two or more networks
- can connect network to WAN
- Receives packets and forwards towards destination
- using IP address of destination
- Assigns private IP address
- Connects similar networks

Gateway :

- Connects two or more networks
- can connect network to WAN
- Receives packets and forwards towards destination
- using IP address of destination
- Assigns private IP address
- Connects dissimilar networks

Task	Performed by router	Not performed by router
Receives packets from devices	✓	
Finds the IP address of a Uniform Resource Locator (URL)		✓
Directs each packet to all devices attached to it		✓
Stores the IP and/or MAC address of all devices attached to it	✓	

[2]

Question : Describe the role and function of the router ?

- To receive packets from devices or the Internet
- To forward / route packets to the destination
- To find the destination of the packet
- To assign / allocate private IP addresses to devices on LAN
- provides the LAN with a public IP address
- To store / update / maintain a routing table
- To find the most efficient path to the destination
- To maintain a table of MAC and IP addresses
- act as a gateway
- performs protocol conversion
- acts as a firewall

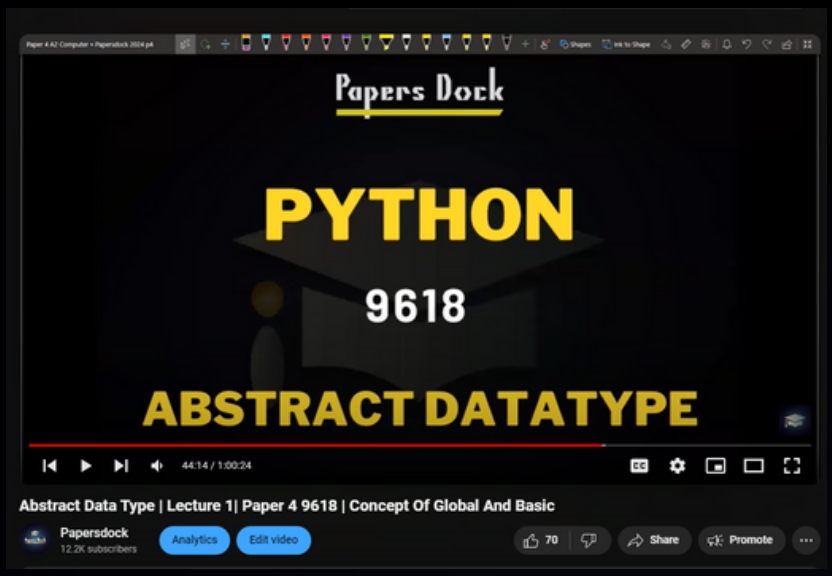
Benefits of Transmitting Data Using Satellite Instead Of Copper Cables

- not fixed to a single location
- allows access in remote / rural areas

Drawback of Transmitting Data Using Satellite Instead Of Copper Cables

- high latency / lag / slow to connect
- more expensive than wired methods, as need extra equipment
- signal is affected by bad weather
- the transmission speed is slower than fixed line broadband
- direct line of sight needed

Bit Streaming



How the video is sent using bit - streaming ? :

- The data is compressed before transmitting
- The video is transmitted continuously as a series of bits
- The video is hosted on media server
- On download, the server sends data to buffer on clients computer
- The buffer stores the data from the server
- The user's stream software receives bit stream from the buffer

On-Demand Bit Streaming

- Digital video tape are converted to bit streaming format for broadcasting on the net this is known as encoding
- These encoded streaming video are then placed on a website
- A user clicks on the link to download the encoded streaming video
- the stream video is then broadcasted to user when they require it.
- Can be paused / can go back and re watch, fast forward

Realtime Bit Streaming

- An event is captured live with a video camera
- The video camera is connected to a computer
- The video signal is converted to streaming media files, encoded on the computer
- The encoded feed is then uploaded from the computer to a dedicated streaming server via cable or high speed internet connection.
- Server sends the live images to all the users requesting it as realtime video streaming
- Can not be paused

Importance of Bit-Rate / broadband speed on bit - streaming ?

- bitrate determines how quickly the data is sent over the internet to the viewers
- higher the bitrate or broadband speed the better the quality of bit streaming and there will be no buffering

Benefits Of Bit Streaming

- no need to wait for a whole file to be downloaded
- no need to store large files on user's computer
- allows on demand playback
- no specialist software is required for playback in browser

Drawbacks Of Bit Streaming

- Video hangs if very slow internet
- video hangs if inadequate buffering capacity
- loss of internet means can't access films
- may require specific software to run the file
- viruses can be downloaded from the website

Difference b/w World Wide Web (WWW) and The Internet

Internet :

- Massive network of network
- Internet stands for interconnected networks
- uses TCP/IP protocol

World Wide Web (www) :

- Is a collection of (multimedia) webpages / documents
- stored on website
- HTTP protocol used to transmit data
- Web pages are written in HTML
- URLs specify the location of webpages
- Web documents are accessed using browsers

Exam Style Question

Melinda sends emails from her webmail account (email account accessed through a website).
Explain whether Melinda is using the internet, or the World Wide Web (WWW), or both.

- She is using both
- using internet because sending data on the infrastructure
- using WWW because accessing a website (that is stored on a web server operated by the webmail) that is part of the WWW

CSMA/CD

Carrier Sense Multiple Access - Collision Detection

Collision of data prevents it from reaching its destination

Explain what is meant by CSMA/CD ?

- Carrier Sense Multiple Access With Collision Detection
- Before transmitting the data, a device checks if the channel is busy
- If the channel is free the data is sent
- When transmission begin workstation listens to other devices and the communication channel
- If there is a collision, workstation sends a jamming signal and the transmission is stopped
- both devices wait a different random time, then try again

Functions Of CSMA/CD

- Monitor Traffic
- Only allow data to be sent when the line is idle
- detects collision on the network
- calculates random wait time
- allow re-transmission after a random amount of time

How the collision is detected ?

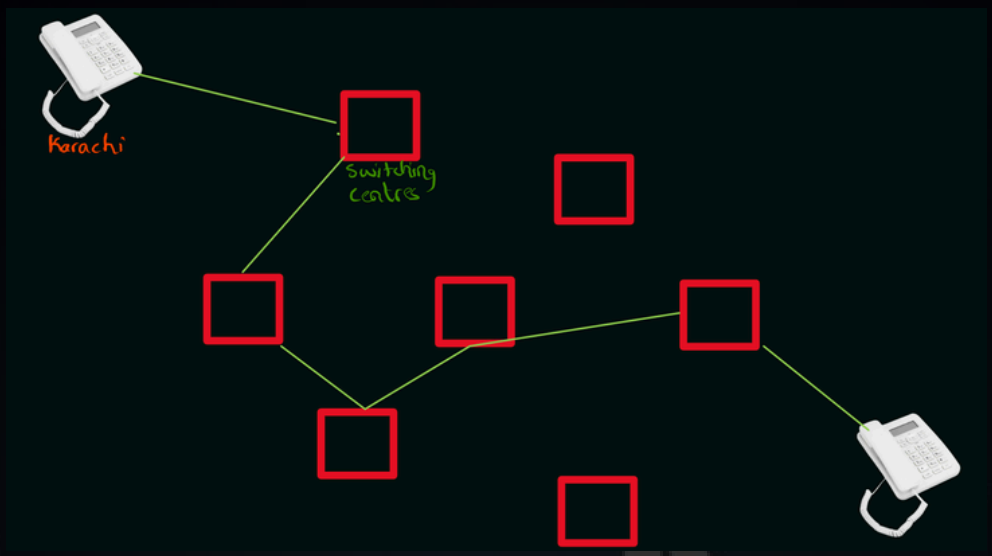
- Due to voltage change the collision is detected

Hardware Device To Support The Internet

Modem : Connects a device to internet over a telephone line

PSTN

Public Switched Telephone Network



Describe the transmission of Data using PSTN ?

- The PSTN consists of many different types of communication line
- therefore the digital data may need to be converted into analogue signal
- Data is transmitted in both direction at the same time
- The communication passes through different switching centers

Description	Conventional telephone using PSTN	Internet-based system
connection only in use whilst sound is being transmitted		
dedicated channel used between two points for the duration of the call		
connection maintained throughout the telephone call		
encoding schemes and compression technology used		
lines remain active even during a power outage		

Benefits Of Dedicated Lines

- Faster transmission of data
- more consistent transmission speed
- improved security

Drawbacks Of Dedicated Lines

- Expensive to setup / maintain
- Disruption to the dedicated line would leave no alternative

Describe what is meant by Ethernet ?

- A protocol (suite)
- For data transmission over cabled network connections
- Uses Carrier Sense Multiple Access / Collision Detection (CSMA/CD)
- Data is transmitted in frames
- each frame has a source and destination (IP/MAC) address
- and error checking data (so damaged frames can be resent)

IP Addressing

What IP Stands for ?

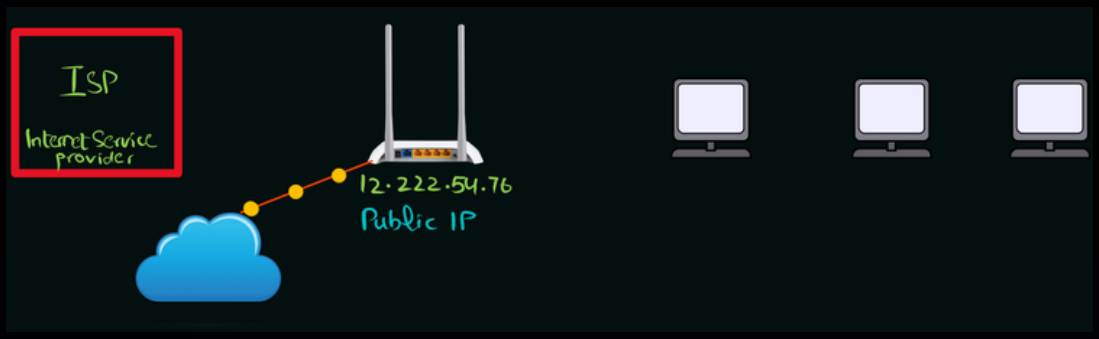
- Internet Protocol

What is the purpose of an IP address ?

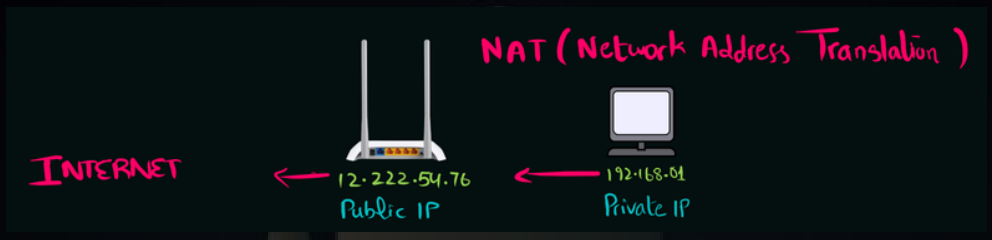
- IP address is used to locate a device on a network, it gives identifier to each device
- Each address is unique within network
- It allows a device to send data to the correct destination

Public And Private IP Addresses

- Public IP addresses are registered on the internet
- It gives access to Internet
- Public IP address are unique
- assigned by ISP (Internet Service Provider)
- It is visible to any devices on the internet



- Private IP addresses are not publicly registered on the internet
- You can not access internet by just Private IP
- assigned by router
- Only visible to devices within the Local Area Network



Network Address Translation (NAT) allows multiple devices on a local network to share a single public IP address when accessing the internet. It helps hide private IP addresses and makes the network more secure.

Explain the difference between Public and Private IP ?

- Public address can be reached across the internet and Private IP address can only be reached internally
- NAT is necessary for a private IP to access internet but Public IP does not need NAT
- A private address is more secure than a public address
- Public IP addresses are provided by ISP whereas Private IP address are assigned by router
- Public addresses are unique whereas private addresses are unique within their network but can be duplicated within other network

Static And Dynamic IP Addresses

Static

- When a computer disconnects and rejoins a network
- The address does not change
- Address is assigned by ISP

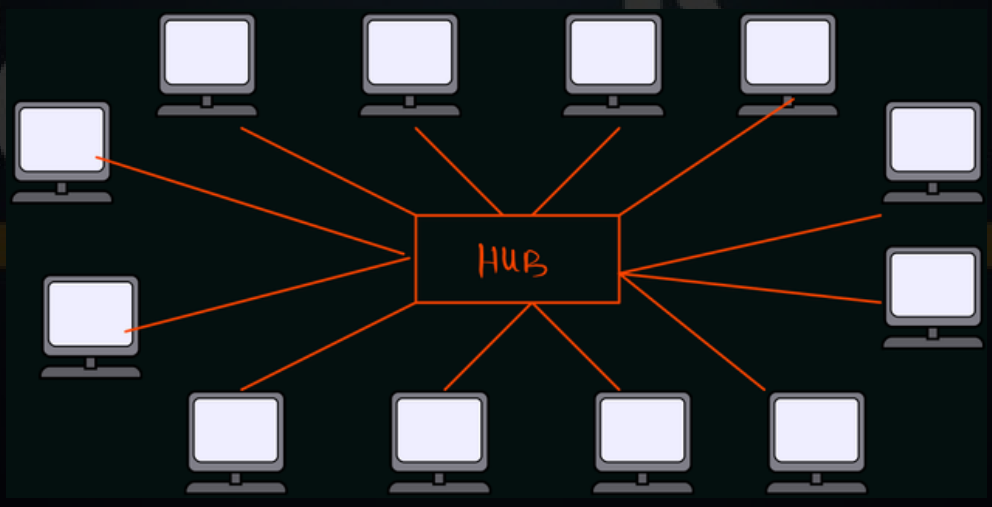
Dynamic

- Each time the computer rejoins a network
- The address changes
- address is assigned by the network operating system

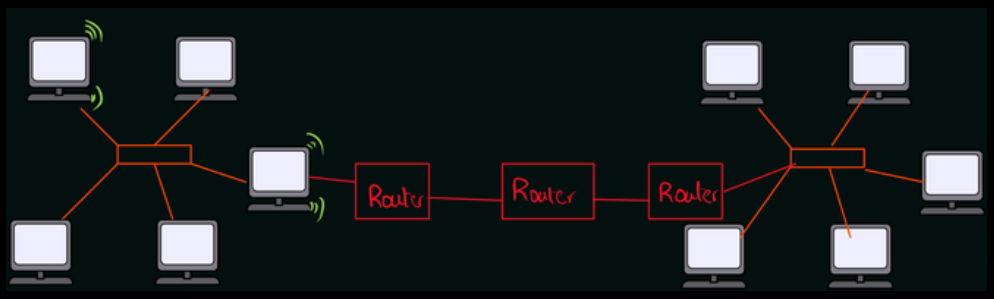
State what is meant by a static private IP address ?

- Static means the IP for that device does not change and Private means it can only be used within the LAN

Subnetting



If one computer wants to communicate with another computer it will send broadcast signals to each and every computer to identify itself. Traffic would increase and network will slow down if all the devices start to broadcast



Broadcast signals will not pass router

Use And Benefits Of Subnetting

- Split a larger networks into a grouping of smaller network
- to help minimize traffic and reduces congestion
- improving speed and network performance
- A subnet mask ensures that traffic remains within it designated subnetwork
- Improves Security

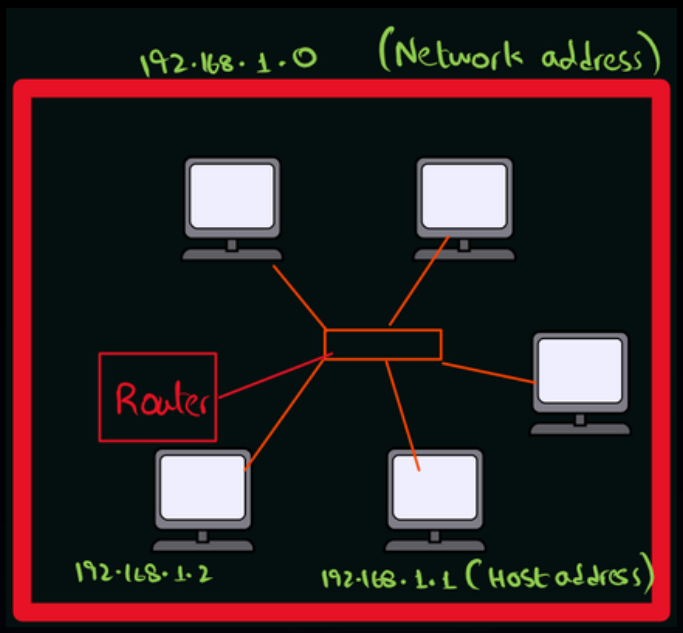
Subnet Mask

192 . 168 . 1 . 0

Octet Octet Octet Octet

- Octet Range: An octet in an IP address contains a value between 0 and 255. An IP address is made up of four octets.
- IP Address Structure: An IP address consists of two parts:

1. Network Address: Identifies the network to which the device belongs.
2. Host Address: Identifies the specific device (host) within that network.



IP Class	First Octet Range	Example IP Address
Class A	0 - 127	1.0.0.1
Class B	128 - 191	128.1.0.1
Class C	192 - 223	192.168.1.0
Class D	224 - 239	224.0.0.0

Subnet Mask is used to identify how many octet are used as network or host

Subnet Mask	Class
255.0.0.0	Class A
255.255.0.0	Class B
255.255.255.0	Class C

Exam Style Question

(ii) A subnet mask is used when subnetting a LAN.

Two devices on the LAN are located in different subnetworks.

The IP addresses and corresponding subnet masks are shown:

Device IP address	Subnet mask
10.10.12.1	255.0.0.0
192.168.12.4	255.255.255.0

Identify the following network ID and host ID.

The network ID for the device with the IP address 10.10.12.1

10

The host ID for the device with the IP address 192.168.12.4

4

[2]

An IP address in a subnetwork is divided into two parts. Identify and describe the two parts of an IP address in a subnetwork ?

- **IP address is made up of a network ID and a host ID**
- **Each device in a subnetwork has the same network ID and Each subnetwork has a different network ID**
- **Every device in each subnetwork has a different host ID but the same network ID and the host ID uniquely identifies the device within the subnetwork**

```
Connection-specific DNS Suffix  . :
Link-local IPv6 Address . . . . . : fe80::a469:b9bb:507b:3d9e%7
IPv4 Address. . . . . . . . . . . : 192.168.100.10
Subnet Mask . . . . . . . . . . . : 255.255.255.0
Default Gateway . . . . . . . . . : fe80::1%7
                                    192.168.100.1
```

Format Of An IPV4

- Each IP address should contain 4 numbers.
- The numbers should be in the range 0-255.
- The numbers are separated by full stops (periods).
- The address should not be more than 32 bits.
- Full stops (periods) are used as separators, not colons.
- The IP address consists of 4 groups.

192 . 168 . 1 . 0

Format Of An IPV6

- Valid hexadecimal numbers.
- Only one double colon is allowed.
- Consists of 8 groups.
- Groups are separated by colons.
- Each number is 4 hexadecimal digits.

2001:0B00:0000:0000:0000:0000:0000:0000

Using the Double Colon (::):

The double colon (::) in IPv6 addresses is a shorthand notation to replace consecutive sections of zeroes. However, it can only be used once in an IPv6 address. For the given address, we can replace the series of zeros with :: to shorten it:

2001:0B00::

Explain why there is a need for IPv6 ?

- **The number of IP addresses needed will exceed the number available using IPv4**

Domain Name Service (DNS)

- **Resolves domain names to numbers.**
- **Domain name is an identifier of a website (youtube.com).**

Domain	IP Address
Papersdock.com	243.64.243.1
Yahoo.com	222.15.240.1
Youtube.com	221.16.247.2

DNS looks for the IP address of a particular domain name.

Uniform Resource Locator (URL)

A URL (Uniform Resource Locator) is a human-readable address that directs to a specific resource on the internet, and it maps to an IP address that the network uses to locate the server hosting the resource.

(b) Consider the URL:

http://cie.org.uk/computerscience.html

(i) Give the meaning of the following parts of the URL.

http ..... Enables browser to know what protocol is being used to access information in the domain.

cie.org.uk ..... Is the domain name

computerscience.html ..... file name which is being viewed

[3]

- %20 : is the coding for space as <space> is not allowed in URLs.
- ? : acts as a separator, separates URL from all parameters.

How a URL is converted to matching IP? ?

- URL is parsed to obtain the domain name.
- Domain name is sent to nearest DNS server.
- DNS holds a list of domain names and matching IPs.
- Domain name resolver searches its database for the domain name.
- If DNS does not find the domain name, the request is forwarded to a higher-level DNS.
- If the domain name is found, the IP address is returned.
- If not found, then an error message is displayed.

Communication

Question 1

4 Melinda and her friends set up a peer-to-peer network between their computers to share data.

(a) Describe the key features of a peer-to-peer network.

.....

.....

.....

..... [2]

(b) Describe **two** drawbacks to Melinda and her friends of using a peer-to-peer network.

1 .....

.....

.....

.....

2 .....

.....

.....

.....

[4]

(c) Melinda connects her laptop to the internet through her router.

(i) Tick (✓) **one** box in each row to identify whether the task is performed by the router or not.

Task	Performed by router	Not performed by router
Receives packets from devices		
Finds the IP address of a Uniform Resource Locator (URL)		
Directs each packet to all devices attached to it		
Stores the IP and/or MAC address of all devices attached to it		

[2]

(ii) Melinda mainly uses the internet to watch films and play computer games.

Tick (✓) **one** box to identify whether Melinda should connect to the router using a wired or wireless network **and** justify your choice.

Wired	
Wireless	

Justification .....

.....

.....

.....

.....

..... [3]

(d) Melinda sends emails from her webmail account (email account accessed through a website).

Explain whether Melinda is using the internet, or the World Wide Web (WWW), or both.

.....

.....

.....

.....

.....

..... [3]

Question 2

(c) Seth accesses both software and data using cloud computing.

(i) Give **two** benefits of storing data using cloud computing.

1 .....

.....

2 .....

.....

[2]

(ii) Give **two** drawbacks of Seth using cloud computing.

1 .....

.....

2 .....

.....

[2]

(d) Draw **one** line from each term to its **most appropriate** description.

Term	Description
	It is only visible to devices within the Local Area Network (LAN)
Public IP address	It increments by 1 each time the device connects to the internet
Private IP address	A new one is reallocated each time a device connects to the internet
Dynamic IP address	It can only be allocated to a router
Static IP address	It is visible to any device on the internet
	It does not change each time a device connects to the internet

[4]

Question 3

8 A school is setting up a network within one of its buildings.

(a) State whether the network will be a LAN (local area network) or a WAN (wide area network). Justify your choice.

.....

.....

.....

.....

.....

..... [3]

(b) One classroom in the building has 30 computers. The computers need to be connected to the network. Each computer has a network interface card (NIC).

Identify **two** possible devices that can be used to physically connect the 30 computers to the rest of the network.

1 .....

2 .....

[2]

(c) The school has several laptops. Each laptop has a Wireless Network Interface Card (WNIC).

Describe the functions of a Wireless Network Interface Card.

.....

.....

.....

.....

.....

.....

.....

..... [4]

Question 4

(b) Andy plays some of the computer games over the internet. He has several devices that connect wirelessly to the router in his house.

(i) Identify the topology of Andy's home network. Justify your choice.

Topology .....

Justification .....

.....

[2]

(ii) The router has a wireless access point (WAP) to allow the devices to connect wirelessly.

Identify **three** functions of the router in Andy's network.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

Question 5

9 **(a)** The following incomplete table contains four network devices and their descriptions.

Complete the table by writing the missing devices and missing descriptions.

Device	Description
.....	Receives and sends data between two networks operating on the same protocol
Wireless Network Interface Card (WNIC)	....
.....	Restores the digital signal so it can be transmitted over greater distances
Wireless Access Point (WAP)	....

[4]

(b) Describe **three** differences between fibre-optic cables and copper cables.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

(c) Ethernet uses Carrier Sense Multiple Access/Collision Detection (CSMA/CD).

Describe CSMA/CD.

.....

.....

.....

.....

.....

.....

.....

..... [4]

Question 6

8 A company uses cloud computing.

(a) Define cloud computing.

.....

..... [1]

(b) State what is meant by a public cloud and a private cloud.

Public cloud .....

.....

Private cloud .....

.....

[2]

(c) Give **two** benefits and **one** drawback of using cloud computing.

Benefit 1 .....

.....

Benefit 2 .....

.....

Drawback .....

.....

[3]

Question 7

8 A Local Area Network (LAN) uses a bus topology.

Describe how Carrier Sense Multiple Access/Collision Detection (CSMA/CD) is used in a bus network.

.....

.....

.....

.....

.....

.....

.....

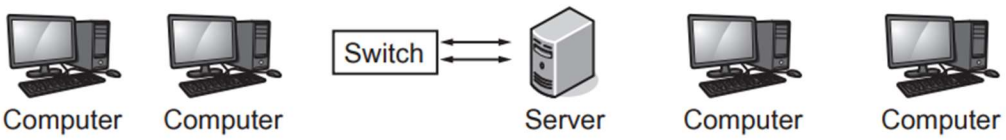
..... [4]

Question 8

10 A Local Area Network (LAN) consists of four computers, one server and a switch.

The LAN uses a star topology.

(a) Complete the following diagram to show how the hardware is connected.



[1]

(b) A router is attached to one of the devices on the LAN shown in **part (a)** to connect the LAN to the internet.

(i) Identify the device. Give a reason for your choice.

Device .....

Reason .....

.....

.....

[2]

(ii) Describe the role **and** function of the router in the network.

.....

.....

.....

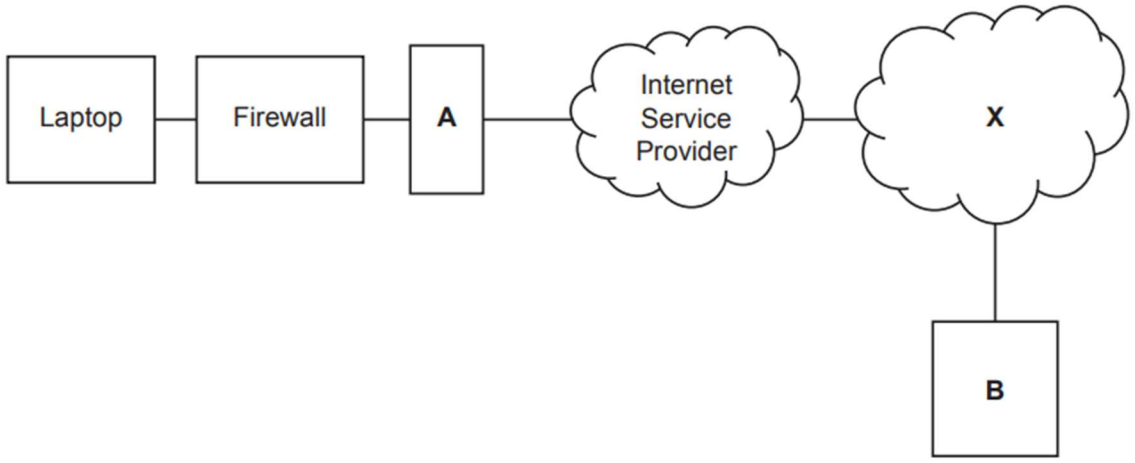
.....

.....

..... [3]

Question 9

7 **(a)** The diagram shows the hardware and software used to retrieve files stored on the cloud.



Complete the following table by writing the answer for each row.

	Answer
The name of device **A** that allows the laptop to connect to the internet	
A type of cloud, **X**	
An example of an application, **B**, that can run on the cloud	

[3]

(b) Give **one** advantage and **two** disadvantages of transmitting data using satellites instead of copper cables.

Advantage 1 .....

.....

Disadvantage 1 .....

.....

Disadvantage 2 .....

.....

[3]

(c) Local Area Networks (LANs) can be made up of several subnetworks.

(i) Give **two** benefits of dividing a network into subnetworks by subnetting the LAN.

1 .....

.....

2 .....

.....

[2]

(ii) A subnet mask is used when subnetting a LAN.

Two devices on the LAN are located in different subnetworks.

The IP addresses and corresponding subnet masks are shown:

Device IP address	Subnet mask
`10.10.12.1`	`255.0.0.0`
`192.168.12.4`	`255.255.255.0`

Identify the following network ID and host ID.

The network ID for the device with the IP address `10.10.12.1`

.....

The host ID for the device with the IP address `192.168.12.4`

.....

[2]

Question 10

(d) The CCTV cameras are connected to a network and transfer their data wirelessly to the central computer.

(i) Each device on the network has an IP address.

Complete the description of IP addresses.

An IPv4 address contains ..... groups of digits. Each group is represented in ..... bits and the groups are separated by full stops.

An IPv6 address contains ..... groups of digits. Each group is represented in ..... bits. Multiple groups that only contain zeros can be replaced with a ..... .

[5]

(ii) The network makes use of subnetting.

Describe **two** benefits of subnetting a network.

1 .....

.....

.....

.....

2 .....

.....

.....

.....

[4]

Question 11

1 A company has a LAN (local area network).

(a) Give **two** benefits of connecting computers to a LAN.

1 .....

.....

2 .....

.....

[2]

(b) Give **two** characteristics of a LAN.

1 .....

.....

2 .....

.....

[2]

(c) One of the company's offices has one server and four computers connected in a star topology.

Draw a diagram to show the layout of the office's star topology.

[2]

(d) Computers can be connected using Ethernet.

Describe what is meant by **Ethernet**.

.....

.....

.....

.....

.....

..... [3]

(e) The network runs as a thick-client model.

Describe what is meant by a **thick-client** model.

.....

.....

.....

..... [2]

Question 12

2 A university has two sites. Each site has several computer rooms. The computers are all connected as a WAN (wide area network).

(a) Identify **two** differences between a WAN and a LAN (local area network).

1 .....

.....

2 .....

.....
[2]

(b) The network uses different topologies in different areas of the sites. In one building there are five computers connected in a mesh topology.

(i) Describe what is meant by a mesh topology.

.....

.....

.....

..... [2]

(ii) Give **two** advantages of using a mesh topology instead of a bus topology.

1 .....

.....

2 .....

.....

[2]

(c) The computers in one room are set up as thin-clients in a client-server model.

Describe the role of the different computers in this model.

.....

.....

.....

..... [2]

(d) Students can connect their devices to the university network using cables or a wireless connection.

Explain the benefits to the students of allowing them to use **both** wired and wireless connections.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(e) One site has split the network into several subnetworks.

An IP address in a subnetwork is divided into two parts.

Identify **and** describe the **two** parts of an IP address in a subnetwork.

.....

.....

.....

.....

.....

..... [3]

Question 13

2 A school has a Local Area Network (LAN).

(a) The LAN connects to the internet using a router.

Describe the function of a router in a network.

.....

.....

.....

.....

.....

..... [3]

(b) Complete the following table by writing the purpose of each of these other hardware devices used to support the LAN.

Hardware device	Purpose
switch	....
Wireless Access Point (WAP)	....
bridge	....

[3]

(c) The students can save their school files on a public cloud.

Identify **two** drawbacks of the students storing their files on the public cloud.

1 .....

.....

2 .....

.....

[2]

(d) A new classroom is being set up with 20 computers and a switch.

Explain **one** advantage of implementing a star topology instead of a bus topology in the new classroom.

.....

.....

.....

..... [2]

Question 14

7 A Local Area Network (LAN) contains four devices:

- a router
- two laptop computers
- a server.

(a) The server has the IP address 192.168.3.2

Explain why this is **not** an IPv6 address.

.....

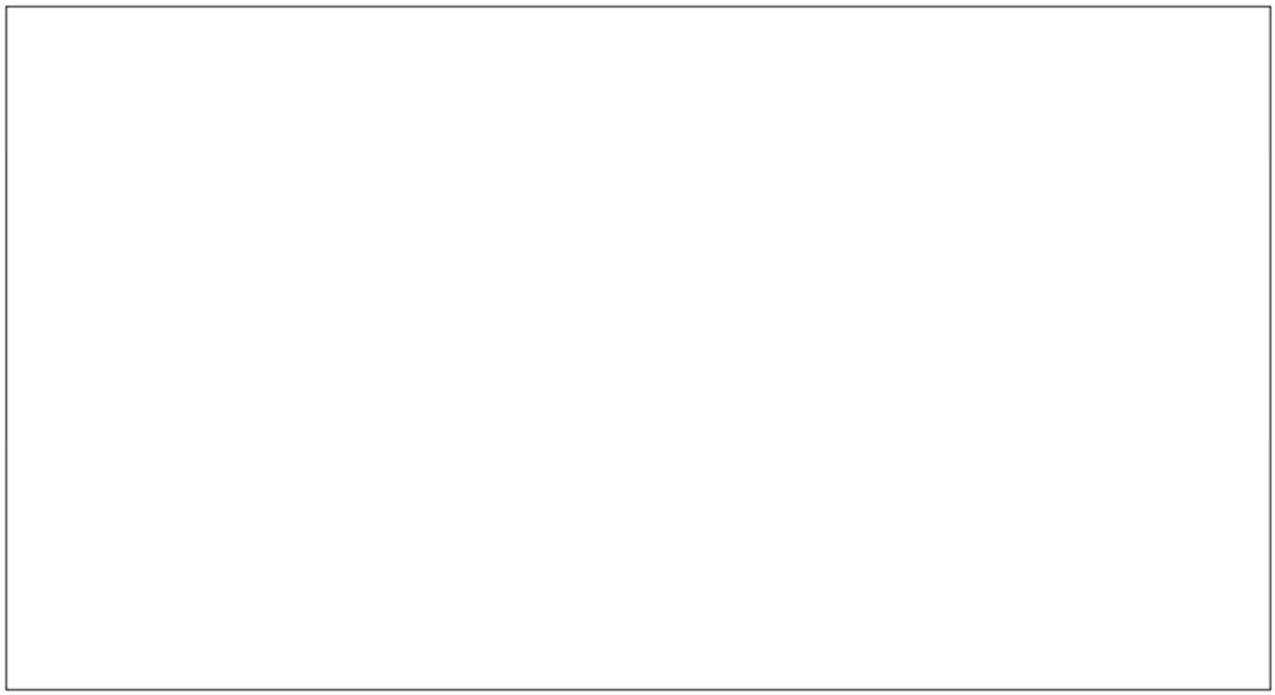
.....

.....

..... [2]

(b) (i) The LAN is set up as a star topology.

Draw a diagram of the topology of the LAN.



[2]

(ii) Explain how data is transmitted between the two laptops in the LAN.

.....

.....

.....

..... [2]

(iii) Subnetting can be used to separate a network into logical segments.

Describe **two other** reasons why subnetting is used in a network.

1 .....

.....

.....

.....

2 .....

.....

.....

.....

[4]

(c) State **three** tasks performed by devices to deal with collisions when using the Carrier Sense Multiple Access / Collision Detection (CSMA/CD) protocol in a network.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

(d) The following incomplete table contains types of IP addresses and their descriptions.

Complete the table by writing the missing types of IP addresses and the missing descriptions.

Type of IP address	Description
....	an IP address that is assigned to a device to allow direct access on the internet
static IP address	....
....	an IP address used for internal LAN communication only
dynamic IP address	....

[4]

Question 15

3 A company sells online Computer Science courses to students in different countries.

The courses are stored on a public cloud.

(a) (i) Explain why the company uses a public cloud to store these courses.

.....

.....

.....

..... [2]

(ii) Describe **two** disadvantages of storing data on a public cloud compared to storing data on a server in a Local Area Network (LAN).

1 .....

.....

.....

.....

2 .....

.....

.....

.....

[4]

(iii) State how the following security measures can be used to protect computer systems.

Firewall .....

.....

Encryption .....

.....

Passwords .....

.....

[3]

Question 16

(e) The video doorbell allows both real-time and on-demand bit streaming.

(i) State what is meant by bit streaming.

.....

..... [1]

(ii) Give **two** differences between real-time and on-demand bit streaming.

1 .....

.....

.....

2 .....

.....

.....

[2]

Question 17

5 A bank allows customers to access their accounts using an application that they can download onto a device such as a smartphone.

(a) The system that allows customers to access their accounts using the application is a client-server model.

Describe the roles of the different devices in this model.

.....

.....

.....

.....

.....

.....

.....

..... [4]

Question 18

8 A business is creating a local area network (LAN) in its office.

(a) The business is deciding which topology to use.

Tick (✓) **one or more** boxes in each row to identify the topology, or topologies, each statement describes.

Statement	Bus	Star	Mesh
all devices connect to one central device			
all devices connect to a central cable			
multiple paths for the packets to travel along			
robust against damage because if any line fails, the rest of the network retains full functionality			
most likely to lose data through collisions			

[5]

(b) The LAN will connect to the internet through a router. The router has a public IPv6 address.

(i) State why the router has a public IP address.

.....

..... [1]

(ii) One difference between an IPv4 and IPv6 address is that the numbers in an IPv4 address are separated by full stops and in an IPv6 address they are separated by colons.

Identify **two other** differences between an IPv4 and IPv6 address.

1 .....

.....

.....

2 .....

.....

.....

[2]

Question 19

(b) The exam markers use software that operates as a thin-client to mark the exam papers.

Complete the table by identifying **two** characteristics of a thin-client.

Describe how each characteristic will be used in this software.

	Thin-client characteristic	Description of use in this software
1	.....	.....
2	.....	.....

[4]

(c) Data transmitted on the internet passes through multiple different systems.

(i) Describe the role of routers in the transmission of data through the internet.

.....

.....

.....

..... [2]

(ii) Describe the role of the PSTN (Public Switched Telephone Network) in the transmission of data through the internet.

.....

.....

.....

..... [2]

Question 20

5 A multimedia design company has an office with a LAN (local area network). The LAN can have up to 20 devices connected with cables and other devices connected using wireless access.

(a) The company has private cloud storage for its employees to store their work.

(i) Define the term **private cloud**.

.....

..... [1]

(ii) Describe the benefits to the company of using private cloud storage instead of public cloud storage.

.....

.....

.....

.....

.....

..... [3]

(b) Part of the internal structure of the wired LAN is a star topology.

Explain how packets are transmitted between two devices in a star topology.

.....

.....

.....

..... [2]

(c) A different part of the network uses the Ethernet protocol.

(i) A collision is detected.

Describe how the collision is managed using Carrier Sense Multiple Access/Collision Detection (CSMA/CD).

.....

.....

.....

..... [2]

(ii) Identify **two** drawbacks of using CSMA/CD.

1 .....

.....

2 .....

.....

[2]

(d) The devices in the office have static private IP addresses.

State what is meant by a **static private IP address**.

.....

.....

..... [1]

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Question 21

7) A company allows customers to stream music from its servers over the Internet. The company's internet connection is currently provided through copper cables. (a) Identify two pieces of hardware, other than the cables, that enable the servers to connect to the Internet. Describe the purpose of each device.

Device 1 .....

Purpose .....

.....

.....

Device 2 .....

Purpose .....

.....

..... [4]

(b) The company wants to upgrade their internet connection to fibre-optic cables. Give one benefit and one drawback to the company of upgrading to fibre-optic cables.

Benefit.....

.....

.....

Drawback .....

.....

..... [2]

Question 22

1 Ana owns a small company with four employees. The office has a network containing several computers that run on a client-server model. There is one server that connects to the Internet using a router.

(a) Networks transmit data using various types of connection shown in the following table.

Complete the table.

Type of connection	Description
Fibre-optic	....
....	A communication device in Earth's orbit that receives and transmits data
Radio waves	....
....	Carries data as electrical signals and can consist of a twisted pair

[4]

(b) Explain how the client-server model enables the employees to access the same files from different computers.

.....

.....

.....

.....

[2]

(c) Each computer in the network has a private IP address. Give two reasons why the computers do not have public IP addresses.

1 .....

.....

2 .....

..... [2]

Question 23

1) Devices connected to the Internet have IP (Internet Protocol) addresses. (a) Three IPv4 addresses are given. Circle either Valid or Invalid to indicate whether each address is valid or invalid. Explain your decision.

Address 1: 3A.21.2H.1 Valid / Invalid

Explanation .....

.....

Address 2: 299.53.2.2 Valid / Invalid

Explanation .....

.....

Address 3: 192.2.1.0 Valid / Invalid

Explanation .....

..... [3]

(b) A website can be accessed using either the Uniform Resource Locator (URL) or the IP address. Describe how a URL is converted into its matching IP address.

.....

.....

.....

.....

.....

..... [3]

(c) People use the Internet to stream media. Complete the following statements by filling in the names of the missing methods of bit streaming. ..... Bit streaming is used when watching a live stream of events that are currently taking place. The event is captured live with a video camera connected to a computer, and it cannot be paused or rewound. ..... Bit streaming is used when watching an event that has taken place in the past. Existing media are encoded to bit streaming format and uploaded to a server. It can be paused and rewound.

Question 24

Computers on the Internet have IP addresses. (a) IP addresses can be in either IPv4 or IPv6 format.

(i) Give an example of a valid IPv4 address.

.....

.....[1]

(ii) State why there is a need for IPv6 addressing.

.....

.....[1]

(iii) A computer's IPv6 address is: C100:2235::1000:25AA:AA50 Explain why this IPv6 address would be an invalid IPv4 address.

.....

.....

.....

..... [2]

(b) A company has computers in two separate buildings that communicate using the Internet over a Public Switched Telephone Network (PSTN).

(i) Describe the transmission of data using a PSTN.

.....

.....

.....

..... [2]

(ii) The company wants to install a dedicated line between the two buildings. Identify one benefit and one drawback of installing a dedicated line between the two buildings.

Benefit.....

.....

Drawback.....

..... [2]

(c) A network can use routers and gateways. Explain the role of routers and gateways in a network.

.....

.....

.....

.....

.....

.....

..... [4]

(d) The company has an email server. Identify three other types of server.

1 .....

2 .....

3..... [3]

Question 25

Customers of a bank can access their account information by logging in on the bank's website.

(a) The bank has a client-server model of networked computers.

(i) Describe, using the bank as an example, the key features of a client-server model.

.....

.....

.....

.....

.....

..... [3]

(ii) Give two other examples of applications that can use the client-server model.

1 .....

.....

2.....

..... [2]

(c) The bank is upgrading its local area network (LAN) copper cables to fibre-optic cables.

(i) State two benefits to the bank of upgrading to fibre-optic cable from copper cable.

1 .....

.....

2 .....

..... [2]

(ii) State two drawbacks of upgrading to fibre-optic cables.

1 .....

.....

2 .....

..... [2]

Question 26

(e) Dominic sends his videos to his colleagues over the Internet using bit streaming.

(i) Describe how the video is sent using bit streaming.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(ii) Circle either Real-time or on-demand to identify whether the video will be sent using real-time or on-demand bit streaming. Justify your choice.

Real-time / on-demand Justification

.....

.....

.....

..... [2]

Question 27

(c) The self-checkout machines connect to a server that stores all the data for the supermarket. This is a client-server network.

(i) Describe, using an example for the supermarket, the client-server network model.

.....

.....

.....

.....

.....

.....

.....

..... [4]

Question 28

1 Four communication media and five features are shown.

Draw one or more lines from each communication media to the appropriate feature(s).

Communication media	Feature
Fibre-optic cable	Can be twisted pair or co-axial
Radio waves	Transmits light pulses
Copper cable	Large range of wavelengths
Satellite	Least likely to have interference
	Wireless transmission

[6]

Question 29

A college has a client-server network.

(a) The college has a file server and other servers. State the purpose of two other servers in the college network.

Server 1 .....

Server 2 ..... [2]

(b) The students use the network to access the Internet. One student stated, 'The Internet and the World Wide Web are the same thing'.

Tick (✓) one box to indicate whether this statement is true or false.

True // False

Justify your choice.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[5]

Question 30

Computer **A** needs to access a web page.

(a) State how Computer **A** could access the web page without using a Domain Name Service (DNS).

.....

.....[1]

(b) **(i)** The following table shows four IPv6 addresses.

State if each address is valid or invalid.

IP address	Valid or invalid
21E5:69AA:FFFF:1:E100:B691:1285:F56E	
::255.255.255.255	
59FB::1005:CC57:6571	
56FE::2159:5BBC::6594	

[4]

(ii) The following table shows four statements about either public or private IP addresses.

Tick (✓) **one** box in each row to indicate whether each statement refers to a public or a private IP address.

Statement	Public	Private
192.168.2.1 is an example of this type of address		
Assigned by the Internet Service Provider (ISP)		
IP address cannot be duplicated in different networks		
Network Address Translation (NAT) is necessary to access the Internet directly		

[4]

(c) One type of transmission media is copper cable. Give two additional types of transmission media.

1 .....

2 ..... [2]

Question 31

2 Gopal types the Uniform Resource Locator (URL) of a website into a web browser.

(a) The following sequence (1 to 5) describes the steps that take place. There are three missing statements.

1 Gopal types into the web browser.

2 .....

3 DNS looks up the URL in table

4 .....

5 .....

Three statements **A**, **B** and **C** are used to complete the sequence.

A	DNS finds corresponding IP address
B	Web browser sends URL to Domain Name Service (DNS)
C	DNS returns IP address to web browser

Write one of the letters **A** to **C** in the appropriate rows (2, 4 and 5) to complete the sequence. [2]

(b) Describe the purpose of an IP address.

.....

.....

.....

..... [2]

(c) A telecommunications operator has installed fibre-optic cables in Gopal's neighbourhood.

(i) Give three benefits of fibre-optic cable over copper cable.

1.....

.....

2 .....

.....

3 .....

..... [3]

(ii) Give two drawbacks of fibre-optic cable over copper cable.

1 .....

.....

2 .....

..... [2]

Question 32

Ava needs to view a website and she knows the Uniform Resource Locator (URL).

16

(a) Complete the series of steps that take place.

Write the **letter** of the appropriate statement in each space.

A	DNS finds corresponding IP
B	DNS looks up URL in table
C	Ava types the URL into a web browser

1 .....

2 Web browser sends URL to Domain Name Service (DNS)

3 .....

4 .....

5 DNS returns IP address to web browser

[2]

(b) **(i)** An IPv4 address has been entered as 12.258.3

Give **two** reasons why this IP address is invalid.

1 .....

.....

2 .....

..... [2]

(ii) An IPv6 address has been entered as 15EF:5L63::2014:BB::60AA

Give **two** reasons why this IP address is invalid.

1 .....

.....

2 .....

..... [2]

(c) The table shows four descriptions of IP addresses.

Tick (✓) **one** box in each row to identify whether each description applies to a public or private IP address.

Description	Public	Private
The address can be reached over the Internet.		
The address is more secure.		
The address can only be accessed through the same LAN.		
The address can be duplicated in different networks.		

[4]

Question 33

The network manager of a Local Area Network (LAN) has replaced the Ethernet cables with a wireless network.

(a) Give three benefits of a wireless network compared to a wired network.

1 .....

.....

2 .....

.....

3 .....

..... [3]

(b) Give one drawback of a wireless network compared to a wired network.

.....

.....[1]

Question 34

6 Downloading a file from a website is an example of a client-server application.

(a) Describe what is meant by the term **client-server** for this application.

.....

.....

.....

.....[2]

(b) The following sequence of steps (1 to 5) describes what happens when someone uses their personal computer (PC) to request a web page. The web page consists of HTML tags and text content only. Four of the statements from **A**, **B**, **C**, **D**, **E** and **F** are used to complete the sequence.

A	Browser software interprets the script, renders the page and displays.
B	Browser software renders the page and displays.
C	Browser software compiles the script, renders the page and displays.
D	The web server retrieves the page.
E	The Domain Name Service (DNS) uses the domain name from the browser to look up the IP address of the web server.
F	The web server sends the web page content to the browser.

Write one of the letters A to F in the appropriate row to complete the sequence.

1. The user keys in the Uniform Resource Locator (URL) into the browser software.
2. .....
3. .....
4. .....
5. .....

[4]

Question 35

7 Access to World Wide Web content uses IP addressing.

(a) State what IP stands for.

.....[1]

(b) The following table shows four possible IP addresses.

Indicate for each IP address whether it is valid or invalid and give a reason.

Address	Denary / Hexadecimal	Valid or Invalid	Reason
3.2A.6AA.BBBB	Hexadecimal		
2.0.255.1	Denary		
6.0.257.6	Denary		
A.78.F4.J8	Hexadecimal		

[4]

(c) Describe **two** differences between public and private IP addresses.

1 .....

.....

2 .....

.....[2]

Question 36

(a) Explain the difference between the World Wide Web (WWW) and the Internet.

.....

.....

.....

.....[2]

(b) Three methods of connecting devices include fibre-optic cables, copper cables and radio waves. The table below gives descriptions relating to these connection methods.

Tick (✓) one box on each row to show the method that best fits each description.

Description	Fibre-optic cable	Copper cable	Radio waves
Wireless medium			
Twisted-pair is an example			
Uses light waves			
WiFi			
Fastest transmission medium			

[5]

(c) Bit streaming is used for both real-time and on-demand services.

Describe one difference between real-time and on-demand bit streaming.

.....

.....

.....

.....[2]

(d) A device needs an IP address to connect to the Internet. IPv4 is the more common type of IP address.

Describe, using an example, the format of an IPv4 address.

.....

.....

.....

.....[3]

(e) A computer user keys in the Uniform Resource Locator (URL) of a web page into a web browser.

Describe how the browser uses the Domain Name Service (DNS) to display the web page.

.....

.....

.....

.....

.....

.....

.....

..... [4]

Question 37

6) A user watches a video available on a website. The website uses on-demand bit streaming.

Describe how it is possible to watch the video without it continually pausing.

.....

.....

.....

.....

.....

.....

.....

.....[4]

Question 38

(a) Telephone calls can be made by using:

- conventional telephones (using the Public Service Telephone Network (PSTN) over a wired network
- a computer, equipped with speakers and microphone, connected to the Internet

Put a tick (✓) in the correct column to match each description to the appropriate communication method.

Description	Conventional telephone using PSTN	Internet-based system
connection only in use whilst sound is being transmitted		
dedicated channel used between two points for the duration of the call		
connection maintained throughout the telephone call		
encoding schemes and compression technology used		
lines remain active even during a power outage		

[5]

(b) Distinguish between the Internet and the World Wide Web (WWW).

.....

.....

.....

.....

.....

.....[3]

(c) Name the hardware device that is being described:

(i) A device that transfers data from one network to another in an intelligent way. It has the task of forwarding data packets to their destination by the most efficient route.

.....[1]

(ii) A device used between two dissimilar LANs. The device is required to convert data packets from one protocol to another.

.....[1]

(iii) A device or software that provides a specific function for computers using a networ The most common examples handle printing, file storage and the delivery of web pages

.....[1]

Question 39

(a) Explain the term bit streaming.

.....

.....

.....

.....[2]

(b) A person watches a film streamed from a website on a tablet computer.

(i) Give two benefits of using bit streaming for this purpose.

1 .....

.....

2 .....

..... [2]

(ii) State two potential problems of using bit streaming for this purpose.

1 .....

.....

2 .....

..... [2]

(c) Explain the terms on-demand bit streaming and real-time bit streaming.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

Question 40

(a) The table shows four statements about IP addresses.

Tick (✓) to show which of the statements are true.

Statement	True (✓)
The IP address consists of any number of digits separated by single dots (.)	
Each number in an IP address can range from 0 to 255	
IP addresses are used to ensure that messages and data reach their correct destinations	
Public IP addresses are considered to be more secure than private IP addresses	

[2]

(b) Consider the URL:

http://cie.org.uk/computerscience.html

(i) Give the meaning of the following parts of the URL.

http .....

.....

.....

cie.org.uk .....

.....

.....

computerscience.html .....

.....

.....

[3]

(ii) Sometimes the URL contains the characters %20 and ?.

Describe the function of these characters.

%20 .....

.....

? .....

..... [2]

Question 41

A company operates a chemical plant, which has a number of processes. Local computers monitor these processes and collect data.

The computers transfer these data to a central computer 50 km away. A telecommunications company (telco) provides cables.

Engineers at the telco had to decide which type of cable to use. They considered the use of either copper cable or fibre optic cable.

State two benefits of each type of cable. Each benefit must be clearly different.

Benefits of copper cable

1 .....

.....

2 .....

.....

.

Benefits of fibre optic cable

1 .....

.....

2 .....

..... [4]

Question 42

(a) (i) Describe what is meant by a client-server model of networked computers.

.....

.....

.....

.....[2]

(ii) Give two benefits of using the client-server model.

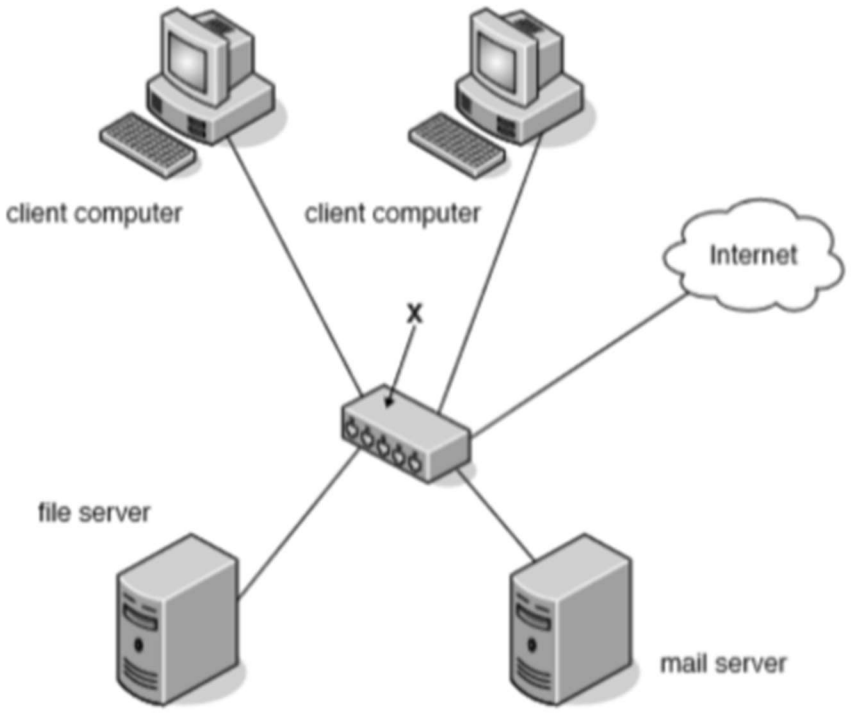
1 .....

.....

2 .....

..... [2]

(b) The diagram shows a computer network with connection to the Internet.



Name the hardware device labelled **X**.

.....[1]

Answer

Answer 1

4(a)	**1 mark** per bullet point to **max 2** • All computers are of equal status • Each computer provides access to resources and data // data is distributed • Computers can communicate and share resources • Each computer is responsible for its own security	**2**
4(b)	**1 mark** per bullet point to **max 2** per drawback • Reduced security // no central management of security • … only as secure as the weakest computer on the network • … each computer is at risk from viruses from other computers • No central management of backup • ... if the data from one computer is not backed up it is lost to all of them • No central management of files/software • … consistency may be difficult to maintain • … each computer may have different software from the others • Individual computers may respond slower • … because they are being accessed by other computers • In order to share files etc. all the computers involved need to be switched on • ... so the files etc. may not be always available	**4**

4(c)(i)	**1 mark** for first 2 ticks, **1 mark** for last 2 (shaded)	**2**

Task	Performed by router	Not performed by router
Receives packets from devices	✓	
Finds the IP address of a Uniform Resource Locator (URL)		✓
Directs each packet to all devices attached to it		✓
Stores the IP and/or MAC address of all devices attached to it	✓	

4(c)(ii)	**1 mark** per bullet point for justification up to **max 3** No mark for identification of wired/wireless Wired • Faster connection // higher bandwidth • …. needed as she is downloading/streaming large files • … less time waiting / less latency / fewer delays • **More** reliable / stable connection • … is less susceptible to issues with distance/walls/interference • **More** secure Wireless • Freedom of movement • … can move between different rooms with a mobile device and still receive/transmit data • … no need of a physical connection • Easily expanded if friends want to access the same network • Less cabling / expertise is needed • ... making the initial setup less expensive	**3**
4(d)	**1 mark** for identifying that she is using both. **1 mark** per bullet point for justification • using internet because sending data on **the infrastructure** • using WWW because accessing a **website** (that is stored on a web server operated by the webmail) that is part of the WWW	**3**

Answer 2

5(c)(i)	**1 mark** per bullet point to **max 2** • Cloud storage can be free (for small quantities) • No need for separate (high capacity) storage devices // saves storage on existing devices • Can access data from any computer **with internet access** • Most cloud data services will have in-built backup/disaster recovery • Security could be better • Can easily increase capacity • Data can be easily shared	**2**

5(c)(ii)	**1 mark** per bullet point to **max 2**: • Can only access (the cloud) with internet access • Security may not be strong // no control over security • There may not be any backups // no control over backups • It can take a long time to **upload/download** the data • It can be more expensive in the long term • There could be a limit to the amount of storage unless paid for • There could be compatibility/access issues • There could be issues with the company offering cloud services	**2**

5(d)	**1 mark** for each correct line **Term** / **Description** Public IP Address Private IP address Dynamic IP address Static IP address It is only visible to devices within the Local Area Network (LAN) It increments by 1 each time the device connects to the internet A new one is reallocated each time a device connects to the internet It can only be allocated to a router It is visible to any device on the internet It does not change each time a device is connected to the internet	**4**

Answer 3

8(a)	**1 mark** per bullet point • LAN • Small geographical area • No leasing external infrastructure / transmission media // does not use internet to transmit within the building	**3**
8(b)	**1 mark** per item • router • switch • hub	**2**
8(c)	**1 mark** per bullet point to **max 4** • Provide interface to wireless network • … as an antenna • Receives analogue radio waves • … convert them to digital / binary • Checks incoming transmissions for correct MAC / IP address • … ignore transmissions not intended for it • Encrypts / encodes the data • Decrypts / decodes the data • Takes digital/binary input and converts to analogue waves • … sends the radio waves via the antenna	**4**

Answer 4

3(b)(i)	**1 mark** for identification of star topology **1 mark** for justification Devices are connected directly to the router independently // all devices are **only** connected to the router	**2**
3(b)(ii)	**1 mark** for each correct function to **max 3** • To receive packets from devices or the Internet • To forward / route packets to the destination • To find the destination of the packet • To assign / allocate private IP addresses to devices on LAN • To store / update / maintain a routing table • To find the most efficient path to the destination • To maintain a table of MAC and IP addresses	**3**

Answer 5

<table>
<tr>
<td>9(a)</td>
<td>1 mark for each completed name or description
<table>
<tr><th>Device</th><th>Description</th></tr>
<tr><td>Router</td><td>Receives and sends data between two networks operating on the same protocol</td></tr>
<tr><td>Wireless Network Interface Card (WNIC)</td><td>Hardware component that allows a device to connect to a wireless network // Provides a MAC address to the device to identify it on the wireless network</td></tr>
<tr><td>Repeater</td><td>Restores the digital signal so it can be transmitted over greater distances</td></tr>
<tr><td>Wireless Access Point (WAP)</td><td>Hardware component that provides radio communication from the central device to nodes on the network (and vice versa)</td></tr>
</table></td>
<td>4</td>
</tr>
<tr>
<td>9(b)</td>
<td>1 mark for each difference
e.g.
• Fibre optic data is transmitted using light, copper cable through electrical signals
• Fibre optic has higher bandwidth than copper cable // Fibre optic has higher transmission rates than copper cable
• Fibre optic has smaller risk of (noise) interference than copper cable
• Fibre optic can be used over longer distances than copper cable before repeaters are needed
• Fibre optic is much more difficult to hack into than copper cable
• Fibre optic is more prone to damage than copper cable</td>
<td>3</td>
</tr>
<tr>
<td>9(c)</td>
<td>1 mark per point to max 4

• A workstation / node (wishing to transmit) listens to the communication channel
• …data is only sent when the channel is free // ... if channel is free data is sent
• Because there is more than one computer connected to the same transmission medium
• ... two workstations can start to transmit at the same time, causing a collision
• If a collision happens, the workstations send a (jamming) signal / abort transmission
• …and each waits a random amount of time before attempting to resend</td>
<td>4</td>
</tr>
</table>

Answer 6

8(a)	Accessing a service/files/software on a remote **server**	**1**
8(b)	**1 mark** each from: Public e.g. • Computing services offered by 3rd party provider over the public Internet • Public is open/available to anyone with the appropriate equipment/software/credentials Private e.g. • Computing services offered either over the Internet or a private internal network • Only available to select users not the general public • Private is a dedicated/bespoke system only accessible for/from the organisation	**2**
8(c)	**1 mark** for each benefit to **max 2** e.g. • Can be accessed anywhere **with Internet access** • Do not need to install security // security might be better • Do not need to perform backups • Do not need to buy specific software/hardware • Can easily share documents • Can have multiple people working on the same document **1 mark** for drawback e.g. • You cannot access it if no internet access • Reliant on someone else to backup • Reliant on someone else for security // **can have** poorer security • Cannot access if server goes down	**3**

Answer 7

8	**1 mark** for bullet point (**max 4**): • CSMA/CD is a protocol used to detect and prevent collisions in a bus topology • before transmitting, a **device** checks if the channel is busy • If the channel is busy the device waits // if the channel is free the data is sent • because there is more than one computer connected to the same transmission medium • ... two workstations can start to transmit at the same time, causing a collision • If a collision is detected by the device, transmission is aborted / a jamming signal is transmitted • both devices wait a (different) **random** time and then try again	**4**

Answer 8

10(a)	all four computers directly connected to the **switch** and no other connections.	**1**
10(b)(i)	**1 mark** for the device. **1 mark** for corresponding reason. • Device: Server • Reason: Server processes the requests and authorises traffic // firewall software on the server authorises traffic // server acts as the proxy • Device: Switch • Reason: Switch is connected to all the computers // to share access to the router on the network	**2**
10(b)(ii)	**1 mark** for each bullet point **(max 3)**: • receive packets from devices / internet • find destination of packets using the IP address • forward packets to **the destination** • assign **private** IP addresses to devices on LAN • store/update/maintain a routing table • find most efficient **path** to destination • maintain table of MAC and IP addresses • provides the LAN with a public IP address • acts as a gateway • performs protocol conversion • acts as a firewall	**3**

Answer 9

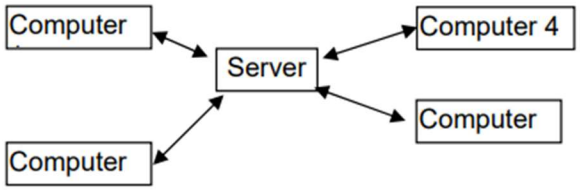
7(a)	**1 mark** for each correct answer: **Answer** The name of device A that allows the laptop to connect to the internet — Router A type of cloud, X — Public (cloud) An example of an application, B, that can run on the cloud, — Email / Graphics / Word processor / Spreadsheet / Game / Database, etc.	**3**

7(b)	**1 mark** for a correct advantage: • not fixed to a single location • allows access in remote / rural areas **1 mark** for each correct disadvantage (**max 2**): • high latency / lag / slow to connect • more expensive than wired methods, as need extra equipment • signal is affected by **bad weather** • the transmission speed is slower than fixed line broadband • direct line of sight needed	**3**
7(c)(i)	**1 mark** for each bullet point (**max 2**) Examples: • improves security • reduces congestion • allows extension of the network / devices attached • aids day-to-day management • improves performance	**2**
7(c)(ii)	**1 mark** for each correct answer: • network ID = 10 • host ID = 4	**2**

Answer 10

4(d)(i)	**1 mark** for each term An IPv4 address contains **4** groups of digits. Each group is represented in **8** bits and the groups are separated by full stops. An IPv6 address contains **8** groups of digits. Each group is represented in **16** bits. Multiple groups that only contain zeros can be replaced with a **:: // double colon**.	**5**
4(d)(ii)	**1 mark** for identification, **1mark** for expansion e.g. • Reduce amount of traffic in a network // improve network speed • Data stays in its subnet so it does not travel as far • Improves network security • .. so that not all devices can access all areas of the network • Allows for easier maintenance • … because only one subnetwork may need taking down/changing while the rest of the network can continue	**4**

Answer 11

1(a)	**1 mark** each to **max 2** • Allows the sharing of files/data // Allows communication between the devices • Allows the sharing of resources e.g. hardware / software (applications) • Allows central management // by example, backup, security, etc.	**2**
1(b)	**1 mark** each to **max 2** • Covers a small geographical area • The infrastructure is privately owned // not controlled by external organisations	**2**
1(c)	**1 mark** each to **max 2** • Each computer directly connected only to the server ... • ... all components correctly labelled 	**2**
1(d)	**1 mark** each to **max 3** • A protocol (suite) • For **data transmission** over standard / universal **wired** / **cabled** network connections • Uses Carrier Sense Multiple Access / Collision Detection (CSMA/CD) • Data is transmitted in frames • … each frame has a source and destination (IP/MAC) address • ... and error checking data (so damaged frames can be resent)	**3**
1(e)	**1 mark** each • The server performs **minimal** / **some processing** for the client • The clients also do **most** of their own processing/work independently // most of the resources are installed locally	**2**

Answer 12

2(a)	**1 mark** each to **max 2** • WAN covers a large **geographical** area and LAN covers a small **geographical** area • LAN connections between devices are usually physical, whereas the WAN connections are often virtual • A LAN has a high data transfer rate, whereas a WAN has a low data transfer rate • The **ownership** of a LAN is private; the **ownership** of a WAN can be private or public • LAN is **usually** more secure than a WAN because protection is easier to implement	**2**
2(b)(i)	**1 mark** each to **max 2** • All computers are connected to at least one other device • There are multiple routes between devices • The computers can act as relays, passing packets on towards the final destination	**2**
2(b)(ii)	**1 mark** each to **max 2** • If one line goes down there are more routes available • Improved security as not using one main line • No/fewer collisions • New nodes can be added without interruption or interfering with other nodes • More secure because data is sent over a dedicated connection	**2**
2(c)	**1 mark** each to **max 2** • Server performs **all** processes required by the task and/or data storage • Clients **only** sends requests to the server and displays the returned results	**2**
2(d)	**1 mark** each to **max 4** Examples: • Some students might only have one sort of connection on their device • Wired provides better performance for the student's device • ... for example, enabling faster access to university databases • There will be less interference if students connect via a cable • Students can transmit private/confidential data/work securely • ... for example, their final dissertation • Wireless connection means that the students can use their devices in different rooms/sites/outside/anywhere more freely // student devices can be portable • Wireless connection enables the students to bring multiple devices // bring their own devices // change devices	**4**

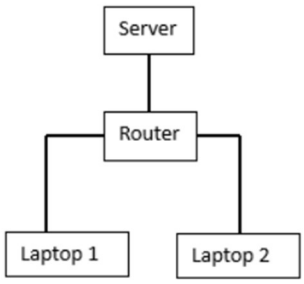
2(e)	**1 mark** for identification • IP address is made up of a network ID and a host ID **1 mark** each to **max 2** for description • Each device in a subnetwork has the same network ID // Each subnetwork has a different network ID • Every device **in each subnetwork** has a different host ID but the same network ID // the host ID uniquely identifies the device **within the subnetwork**	**3**

Answer 13

2(a)	**1 mark** for each bullet point (**max 3**) • Receives packets from internet / external network • Implements a firewall • Analyses the destination IP address of each packet • Forwards the packet towards its destination // send packets onto local network or external network • ...using the routing table • Maintains / updates the routing • Allocates private IP addresses • Finds the most efficient route to the destination • Changes the packet format for transmission over the next network // • Network Address Translation (NAT):NAT is a technique used by routers to allow multiple devices in a private local area network (LAN) to share a single public IP address.	**3**
2(b)	Switch: **1 mark** for each bullet point (**max 1**) • To allow two or more devices to communicate with one another • To connect individual devices to each other • To receive transmissions and **forward** them to their destination Wireless Access Point (WAP): **1 mark** for each bullet point (**max 1**) • To allow connection of devices (to the central device) **using radio signals** / Wi-Fi • To allow the central device to send / receive **radio signals** / Wi-Fi signals • To allow wireless enabled devices to connect to a wired network Bridge:**1 mark** for each bullet point (**max 1**) • To connect two LANs / segments with the **same protocol** • To transmit data between two networks with the **same protocol**	**3**

2(c)	**1 mark** for each bullet point (**max 2**) • The students cannot access their files without a reliable internet connection • The amount of space for no payment may be limited so students will have to purchase more space if needed • The students do not have control over the backup (or security) of their work // the students are dependent on a third party for the (security and) backing up of their work	**2**
2(d)	**1 mark** for each advantage and **1 mark** for valid corresponding expansion • Star topology is more resilient to faults • …because there is no single cable and leads to less disruption to teaching • Higher performance as fewer collisions • ...because each device in the classroom is only connected to the switch • Easier to add new nodes • …because each device in the classroom connects directly to the switch • Easier to fault find compared to bus topology	**2**

Answer 14

7(a)	**1 mark** for each bullet point **(max 2)** • Only has four groups of digits // IPv6 has eight groups • Uses dotted notation instead of colons • Because it is a 32 bit / 4 byte address // IPv6 is 128 bits / 16 bytes	**2**
7(b)(i)	**1 mark** for server only connected to router **1 mark** for two laptop computers connected only to router 	**2**

7(b)(ii)	**1 mark** for each bullet point (**max 2**) • The data from the sending laptop is transmitted to the router • The data has address of recipient • The router determines recipient's destination address • ... by using a routing table • The router transmits data directly / only to recipient	**2**
7(b)(iii)	**1 mark** for each use (**max 2**) and **1 mark** for corresponding expansion (**max 2**) • To improve the security of the LAN • … so that devices do not receive unintended data • … so that a compromised device does not expose the whole network • ... so not all devices can access all segments • To make the network management easier • … because faults can be isolated more efficiently • ... by appropriate example • To make the network easier to expand // For better control of network growth • … by allowing for greater range of IP addresses to be available • To improve network performance • To reduce network congestion • … by localising network communications // by dividing data between segments • … so that devices are not flooded with data • … because data sent between devices on the same subnet stays within the subnet	**4**
7(c)	**1 mark** for each bullet point (**max 3**) • To monitor the communications channel • To send data only when there is no data being transmitted / the line is quiet / idle • **To detect a collision** and then stop transmissions of further data // transmit a **jamming** signal • To calculate a **random** wait time / back-off time • ... then retransmit the data after that random wait time • Increase **random** time if multiple collisions	**3**

7(d)	**1 mark** for each highlighted area **Type of IP address** / **Description** public IP address — an IP address that is assigned to a device to allow direct access on the internet static IP address — an IP address that is fixed / doesn't change each time a device re-joins a LAN / network private IP address — an IP address used for internal LAN communication only dynamic IP address — an IP address that may be refreshed / changed each time a **device re-joins** a LAN / network	**4**

Answer 15

3(a)(i)	**1 mark** for each bullet point (**max 2**). • Courses must be available to anyone who wishes to follow them • Courses must be available on the internet • Company is willing to share infrastructure with other companies (public) • …which is more economic for the company	**2**
3(a)(ii)	**1 mark** for each bullet point (**max 2** for each disadvantage). • There could be a possible loss of control unlike the LAN • …because the data is stored on a remote infrastructure / someone else's infrastructure • …reliance on external agency to complete tasks, e.g. backups, security • Requires reliable internet connection • …to ensure access to the remote data, more likely with LAN • Increased recurring costs • ...as cloud provider charges must be paid, costs for LAN once only.	**4**

3(a)(iii)	**1 mark** each for firewall, encryption and passwords. Firewall: • Monitors incoming and outgoing traffic and rejects any traffic that does not meet the set rules Encryption: • Ensures that if data is intercepted / obtained it cannot be understood without the decryption key Passwords: • Ensures only users with the correct password can access the resources // prevents unauthorised access	**3**

Answer 16

2(e)(i)	**1 mark** for: Continuous ordered flow of bits over a communication path	**1**
2(e)(ii)	**1 mark** each to **max 2**: • Real-time is direct from source whereas on-demand is pre-recorded/downloaded to view later • Real-time cannot be re-watched, on-demand can be paused, re-watched etc. • Real-time plays continually, on-demand downloads sections/blocks and cannot play until next section is downloaded	**2**

Answer 17

5(a)	**1 mark** each: • Identification of server in the bank scenario • Description e.g. Receives requests, processes the requests • Identification of client in bank scenario • Description e.g. Sends request to the server, waits and outputs the response	**4**

Answer 18

<table>
<tr>
<td>8(a)</td>
<td>1 mark for each correct row:

<table>
<tr><th>Statement</th><th>Bus</th><th>Star</th><th>Mesh</th></tr>
<tr><td>all devices connect to one central device</td><td></td><td>✓</td><td></td></tr>
<tr><td>all devices connect to a central cable</td><td>✓</td><td></td><td></td></tr>
<tr><td>multiple paths for the packets to travel</td><td></td><td></td><td>✓</td></tr>
<tr><td>robust against damage because if any line fails, the rest of the network retains full functionality</td><td></td><td>✓</td><td>✓</td></tr>
<tr><td>most likely to lose data through collisions</td><td>✓</td><td></td><td></td></tr>
</table>
</td>
<td>5</td>
</tr>
<tr>
<td>8(b)(i)</td>
<td>1 mark for:

to be visible to and accessible by other devices on the internet</td>
<td>1</td>
</tr>
<tr>
<td>8(b)(ii)</td>
<td>1 mark each:

• IPv4 has 4 groups of digits whilst IPv6 has 8 groups
• IPv4 is usually represented in denary whilst IPv6 is usually represented in hexadecimal
• IPv4 groups are between 0 and 255 whilst IPv6 is between 0 and FFFF
• IPv4 is 32 bits whilst IPv6 is 128 bits
</td>
<td>2</td>
</tr>
</table>

Answer 19

<table>
<tr>
<td>3(b)</td>
<td>1 mark for characteristic
1 mark for description of application to examination software:

<table>
<tr><th>Thin-client characteristic</th><th>Description of use in this software</th></tr>
<tr><td>Data is not stored on the client computer</td><td>Exam papers are stored on the server and not on the examiner's computer // exam papers are not permanently stored on the examiners' computers</td></tr>
<tr><td>Client computer is reliant on access to server</td><td>Examiners cannot mark if their device cannot access the server / the server 'goes down'</td></tr>
<tr><td>Client computer heavily reliant on network/internet connection</td><td>The marking software will not operate without network/internet access</td></tr>
<tr><td>Client computer requires few local resources/memory</td><td>Examiners can use devices with low resources and the marking software will still function</td></tr>
<tr><td>Client computer performs minimal functions/processes</td><td>The marking software transmits requests, the server responds and sends the response to the user</td></tr>
</table>
</td>
<td>4</td>
</tr>
</table>

3(c)(i)	**1 mark** each to **max 2**: • Receives **packets** from internet • Analyses the destination IP address of each packet • Forwards the **packet** towards its destination • ... using the routing table • Maintains/updates the routing table • Finds the most efficient route to the destination	**2**
3(c)(ii)	**1 mark** each to **max 2**: • The PSTN consists of many different types of communication lines • … therefore the digital data may need to be converted into a different form/analogue signal • Data is transmitted in both directions at the same time // duplex data transmission • Using a PSTN the communication passes through different switching centres/ISPs	**2**

Answer 20

5(a)(i)	**1 mark** for: Dedicated/bespoke services/storage on a remote server only available to company	**1**
5(a)(ii)	**1 mark** each to **max 3**: e.g. • Not reliant on a third party • … gives greater **control** over security/privacy • … gives greater **control** over backup • Storage can be tailored/scalable to company requirements// an example e.g. the amount of storage accessible/ facilitating the sharing of files	**3**
5(b)	**1 mark** each: • Sending computer transmits packets directly to switch/router/central device • Switch/router/central device **checks destination address** of packet and forwards directly to that device	**2**
5(c)(i)	**1 mark** each to **max 2**: • Jamming signal is transmitted by the **sending device** • Transmission is aborted • The **sending device** waits a **random** time before trying to send data again ... • ... if further collisions occur the wait time is increased	**2**
5(c)(ii)	**1 mark** each to **max 2**: • Random time increased each time so can be infinite waiting • May be constant jamming signal so nothing ever sends • Certain nodes cannot be prioritised • High power consumption • Only suitable for short distance network // limited distance • Not scalable // more nodes means exponentially longer waiting times	**2**
5(d)	**1 mark** for: Static means the IP for that device does not change **and** Private means it can only be accessed/seen/used within the LAN	**1**

Answer 21

7(a)	**1 mark** for device, **1 mark** for matching purpose. **Max 2** devices. • Router • To connect (devices) / the servers to the Internet // to transmit data between the servers and the Internet // to forward data towards its destination • Gateway • To connect a server that uses a different protocol to the Internet // to join two different types of network • Modem • To connect (the servers) to the Internet over a telephone line • Network interface card // NIC • To enable the servers to connect to the (company) network	**4**
7(b)	**1 mark** per bullet point, **max 1** for benefit, **max 1** for drawback Benefit: • (Consistently) faster data transmission • More stable connection Drawback: • High initial cost as new hardware will be needed • Expertise required to complete connections	**2**

Answer 22

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)</td><td>1 mark for each correctly completed media or description

<table>
<tr><th>Type of connection</th><th>Description</th></tr>
<tr><td>Fibre-optic</td><td>Transmits data as light //
Uses (a bundle of) glass/plastic threads to transmit data</td></tr>
<tr><td>Satellite</td><td>A communication device in Earth's orbit that receives and transmits data</td></tr>
<tr><td>Radio Waves</td><td>Carries data wirelessly, often known as Wi-Fi //
Carries data in the form of electromagnetic waves</td></tr>
<tr><td>Copper cable</td><td>Carries data as electrical signals and can consist of a twisted pair</td></tr>
</table>
</td><td>4</td></tr>
<tr><td>1(b)</td><td>1 mark per bullet point to max 2

• The employees' computers are the clients
• The server hosts the (shared) files
• An employee can request a file (from the server) from any of the client computers
• Several employees can access the same file (on the server) at the same time</td><td>2</td></tr>
<tr><td>1(c)</td><td>1 mark per bullet point

• Improved security because the IP address is not visible outside the network
• An internet presence is not required for each employee computer
• Only the router needs a public IP address, as only the router needs to be externally visible
• Reduces number of (public) IP addresses needed</td><td>2</td></tr>
</table>

Answer 23

1(a)	**1 mark** for each correct indication and explanation **3A.21.2H.1** Invalid H is not a valid hexadecimal digit **299.53.2.2** Invalid 299 is not in the correct range **192.2.1.0** Valid Consists of four numbers in the range 0–255 separated by full stops	**3**
1(b)	**1 mark** per bullet point to **max 3** - URL is parsed to obtain the Domain name - Domain name is sent to the nearest Domain Name Server (DNS) - DNS holds a list of Domain names and matching IP addresses - DNS name resolver searches its database for the Domain name - If DNS does not find the Domain name, the request is forwarded to a higher level DNS - If the Domain name is found, the IP address is returned - If the Domain name is not found, the request is passed to a higher level server - If the Domain name is finally not found, an error message is generated	**3**
1(c)	**1 mark** for each correct term Real-time On-demand	**2**

Answer 24

Question	Answer	Marks
1(a)(i)	**1 mark** for any valid example e.g. 192.168.0.1	**1**
1(a)(ii)	**1 mark** for correct answer The number of IP addresses needed will exceed the number available using IPv4.	**1**
1(a)(iii)	**1 mark** per bullet point to **max 2** • Too many digits per group • Too many groups of digits • The address is more than 32 bits / 4 bytes • Colons are used as separators	**2**
1(b)(i)	**1 mark** per bullet point to **max 2** • The PSTN consists of many different types of communication lines • Data is transmitted in both directions at the same time // (full) duplex data transmission • The communication passes through different switching centres	**2**
1(b)(ii)	**1 mark** for benefit, **1 mark** for drawback Benefit • (Probably) faster connection / communication / transmission of data • (Usually) more consistent transmission speed • Improved security Drawback • Expensive to set-up / maintain • Disruption to the dedicated line would leave no alternative	**2**

Answer 25

4(a)(i)	**1 mark** per bullet point to **max 3.** If no application to the bank **max 2** • The bank's server holds the customer account data / website • ... and performs the requested tasks / processes. The computers used by the **customers** are the clients ... • ... that send requests to the server • ... which returns the results of the request • ... E.g. a customer asks for a list of recent transactions on their account.	3
4(a)(ii)	**1 mark** per example to **max 2** e.g. • Sending and receiving email • A company or school centrally storing files • Using a print server • Using a file server	2

4(c)(i)	**1 mark** per bullet point to **max 2** • Less interference in the signal • The signal does not degrade as quickly // Needs less signal boosting • More secure // more difficult to hack • Greater bandwidth // Faster transmission speeds possible	2
4(c)(ii)	**1 mark** per bullet point to **max 2** • Initial installation cost is higher // Cable / hardware is more expensive to buy per metre • Specialists / trained personnel are needed to install / maintain • Difficult to terminate // The electronics at both ends are more complex • Fibres can break when bent • Only transmits data in one direction // Cannot transmit power, only data	2

1(c)	**1 mark** per bullet point to **max 4, max 3 for router, max 3 for gateway** Only award the repeated bullet points (1 to 5 in each section) once Router: • Connects two (or more) networks • Can connect a network to a WAN // acts as the single access point for… • Receives packets and forwards towards the destination • …using the IP address of the destination • Assigns private IP addresses • Operates between similar networks // networks using the same protocol • Can be used to segment a network Gateway: • Connect two (or more) networks • Can connect a network to a WAN // acts as the single access point for… • Receives packets and send packets towards the destination • …using the IP address of the destination • Assigns private IP addresses • Connects two dissimilar networks // networks that use different protocols	**4**
1(d)	**1 mark** per bullet point to **max 3** for any valid answer For example: • File server • Print server • Proxy server • Web server • Application server	**3**

Answer 26

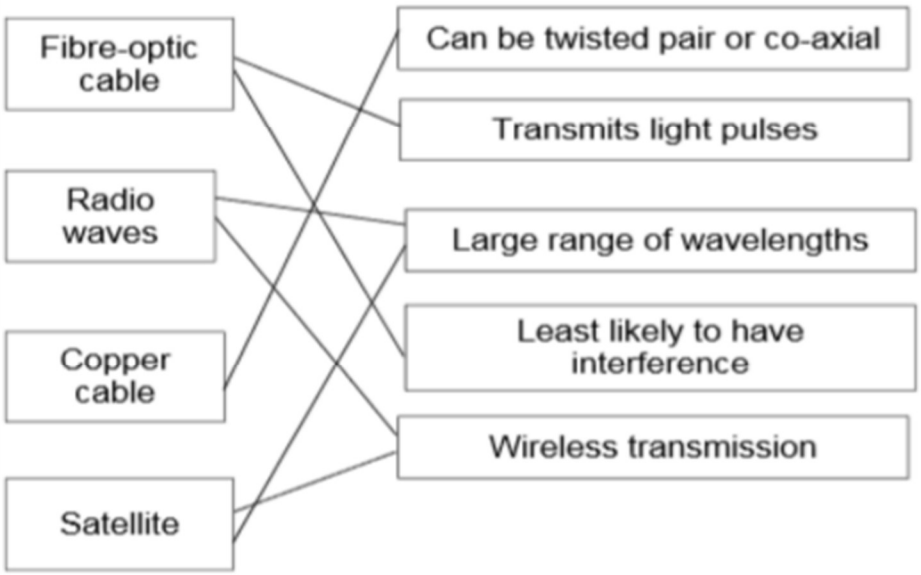
Question	Answer	Marks
6(e)(i)	**1 mark** per bullet to **max 3** □ The data is compressed before transmitting □ The video is transmitted continuously as a series of bits □ The video is hosted on a media server □ On download, the server sends the data to a buffer on the client computers // The buffer stores the data from the server □ The recipient / user's software receives bit stream from the buffer	**4**
6(e)(ii)	**1 mark** for: On-demand **1 mark** for justification from: □ The video does not need to be broadcast live // the video is already recorded □ Dominic's colleagues will watch the video at a later date // at their convenience	**2**

Answer 27

Question	Answer	Marks
1(c)(i)	**1 mark** per bullet point to **max 3** plus **1 mark** for suitable example ▯ When a barcode on an item is scanned ▯ … the server performs any requested tasks // the server looks up the details of the product ▯ The self-checkout machine is a client ▯ … that send requests to the server // the self-checkout machine asks for, e.g. the price of the item ▯ The server returns the results of the request // the server returns e.g. the item price ▯ Self-checkout machine displays e.g. price to the user	4

Answer 28

Question	Answer	Marks
1	**1 mark** for a correct line from each communication media, **max 6**	6



Answer 29

5(a)	**1 mark** per server e.g. - E-mail - Print - Web	**2**
5(b)	**1 mark** for the indicating the statement is false: True: False: ✓ **1 mark** per bullet for justification to **max 4**. - Internet is the infrastructure / global collection of networks - World Wide Web is the (multimedia web) pages / content - The World Wide Web is accessed over the Internet - Webpages are written in HTML - HTTP protocol used to transfer web pages - Internet uses IP protocol	**5**

Answer 30

Question	Answer	Marks
2(a)	Use the IP address instead of the URL	**1**
2(b)(i)	**1 mark** per correct answer **IP Address** / **Valid or invalid** 21E5:69AA:FFFF:1:E100:B691:1285:F56E / Valid ::255.255.255.255 / Valid 59FB::1005:CC57:6571 / Valid 56FE::2159:5BBC::6594 / Invalid	**4**

<table>
<tr><td>2(b)(ii)</td><td>1 mark per correct row

<table><tr><th>Statement</th><th>Public</th><th>Private</th></tr><tr><td>192.168.2.1 is an example of this type of address</td><td></td><td>✓</td></tr><tr><td>Assigned by the Internet Service Provider (ISP)</td><td>✓</td><td></td></tr><tr><td>IP address cannot be duplicated in different networks</td><td>✓</td><td></td></tr><tr><td>Network Address Translation (NAT) is necessary to access the Internet directly</td><td></td><td>✓</td></tr></table></td><td>4</td></tr>
<tr><td>2(c)</td><td>1 mark per example to max 2

▯ Fibre-optic
▯ Wi-Fi / Radio waves
▯ Microwave
▯ Infrared</td><td>2</td></tr>
</table>

Answer 31

2(a)	**1 mark** for **1 correct** answer, **2 marks** for all **3 correct** answers 1 Gopal types into the web browser **2** **B** (Web browser sends URL to Domain name Service (DNS)) 3 DNS looks up URL in a table **4** **A** (DNS finds corresponding IP address) **5** **C** (DNS returns IP address to web browser)	**2**

2(b)	**1 mark** per bullet point to **max 2** • Gives each device on a network an identifier // IP address used to locate a device on a network • Each address is <u>unique</u> within the network • Allows a device/gateway/node to send data to the correct destination / a specific device/gateway/node	**2**
2(c)(i)	**1 mark** per bullet point to **max 3** • Less interference in signal • Signal does not degrade as fast // Needs less signal boosting • More difficult to hack // more secure • Greater bandwidth // <u>Faster</u> transmission speeds possible	**3**

2(c)(ii)	**1 mark** per bullet point to **max 2** • (Initial) installation cost is higher // Cable / hardware is more expensive to buy (per metre) • Specialists / trained personnel needed to install / maintain • Difficult to terminate // Electronics at both ends are more complex • Fibre-optic cables can break when bent • Only transmits data in one direction • If a fibre-optic cable connection fails, many more services can be affected	**2**

Answer 32

Question	Answer	Marks
4(a)	**1 mark** for **1 letter** in correct space **2 marks** for all **3 letters** in correct places 1 **C** 2 URL goes to Domain Name Service (DNS) 3 **B** 4 **A** 5 DNS returns IP address to client	**2**
4(b)(i)	**1 mark** per bullet point • 258 is too large/largest individual numbers is 255 • 4 numbers needed/1 number missing/only 3 groups of numbers given	**2**
4(b)(ii)	**1 mark** per bullet point • **L** not a valid hexadecimal number • Only one double colon is allowed	**2**
4(c)	**1 mark** per row	**4**

Description	Public	Private
The address can be reached over the Internet.	✓	
The address is more secure.		✓
The address can only be accessed through the same LAN.		✓
The address can be duplicated in different networks.		✓

Answer 33

Question	Answer	Marks
7(a)	**1 mark** per benefit to **max 3** • Devices can be more mobile as they do not have to be connected to cable • Easier to set up // no cables need to be installed • Add additional devices is easier • Many different types of device can be connected at the same time	3
7(b)	**1 mark** for a drawback from the following: • Easier to hack • Interference • Signal degrades quickly	1

Answer 34

6(a)	**Two** from: ▯ The file is made available from a web/email/FTP server 1 ▯ The user's browser is the client software 1 ▯ The client (software browser) requests the file from the server 1 ▯ The desired file is returned to the client computer 1	**Max 2**
6(b)	1. The user keys in the Uniform Resource Locator (URL) into the browser Software. 2. **E** // The Domain Name Service (DNS) uses the domain name from the browser to look up the IP address of the web server. 1 3. **D** // The web server retrieves the page 1 4. **F** // Sends the web page content to the browser 1 5. **B** // Browser software renders the page and displays 1	**4**

Answer 35

6 (a) **Internet Protocol** [1]

10

(b) [4]

Address	Denary / Hexadecimal	Valid or Invalid	Reason
3.2A.6AA.BBBB	Hexadecimal	Invalid	**One** point from: • This is more than 32 bits • 6AA /BBBB in Hex is bigger than FF / 255 in denary • 6AA / BBBB uses more than 8 bits / a byte • The third / fourth group is bigger than FF / 255 in denary • The third / fourth group uses more than 8 bits / a byte
2.0.255.1	Denary	Valid	There are 4 bytes, each 255 or below // All the values are in the range 0 - 255
6.0.257.6	Denary	Invalid	257 is above 255 // The third group is above 255
0A.78.F4.J8	Hexadecimal	Invalid	J is not a valid hexadecimal digit // J8 is not a valid Hex number

One mark for each combination of valid or invalid **and** the reason.

(c) **Two** points from: [2]

- Public address can be reached across the Internet.
- Private address can only be reached internally/through the LAN/Intranet // private address cannot be reached across the Internet.
- NAT (Network Address Translation) is necessary for a private IP address to access the Internet directly.
- A private address is more secure than a public address // A public address is less secure than a private address.
- Public addresses are provided by ISP / assigned by InterNIC // Private addresses are assigned by the router (of the network concerned).
- Public addresses are unique (to the Internet) // Private addresses (are unique within their network, but) can be duplicated within other (discrete) networks.
- 10.0.0.1 to 10.255.255.254 and 172.16.0.1 to 172.31.255.254 and 192.168.0.1.to 192.168.255.254 form the private address space // IP addresses from the private address space are never assigned as public.

Answer 36

6 (a) Two from: **[2]**

- WWW is a collection of interlinked, hypertext documents/webpages/multimedia resources (accessed via the Internet) //WWW is content from web servers organised as web pages
- Internet is the global connection of interconnected computer networks
- The Internet uses TCP/IP protocol / WWW uses http protocols to transmit data

(b) **[5]**

Description	Fibre-Optic cables	Copper cables	Radio waves
'Wireless' media			✓
Twisted-pair is an example		✓	
Uses light waves	✓		
WiFi			✓
Fastest transmission media	✓		

(c) One pair from: **[2]**

- Real-time - a live stream of an event that is currently taking place
- On-demand - streaming of an event/programme that has taken place in the past

- Real time – the event is captured live with a video camera connected to a computer
- On-demand – Existing media are encoded to bit streaming format and uploaded to a server

- Real-time – cannot be paused / rewound etc
- On-demand – can be paused / re-wound / fast forwarded etc

(d) Two marks for description, **one mark** for correct example. **[3]**

- Four numbers separated with '.'
- Each number is between 0 and 255 / 00 and FF in Hex / stored in one byte.
- 32 bits long
- Correct example

(e) Four from:

- URL is a reference address to a resource on the Internet.
- The URL is passed to the nearest Domain Name Server (by browser software).
- DNS server stores a database / list of URLs and matching IP addresses.
- DNS (Name Resolver) looks for the URL in its database.
- Finds the matching IP address and returns it to the originator.
- Or if it cannot find it, it forwards to another Domain Name Server at a higher level.
- (Original) DNS server adds the returned IP address to its cache.
- (Original) DNS server returns the IP address to the browser.

Answer 37

6 Any **four** from:

- User needs high-speed broadband (connection)
- Data is streamed to a buffer (in the computer)
- Buffering stops video pausing as bits streamed
- As buffer is emptied, it fills up again so that viewing is continuous
- Actual playback is (a few seconds) behind the time the data is received by computer [4]

Answer 38

(a)

Description	Conventional telephone using PSTN	Internet-based system
connection only in use whilst sound is being transmitted		✓
dedicated channel used between two points for the duration of the call	✓	
connection maintained throughout the telephone call	✓	
encoding schemes and compression technology used		✓
lines remain active even during a power outage	✓	

[5]

(b) **maximum** of **two marks** for Internet references and **maximum** of **two marks** for world wide web references

Internet

- massive network of networks/interconnected network of computer devices
- Internet stands for Interconnected Networks
- uses TCP/IP protocol

World Wide Web (www)

- is a collection of (multimedia) web pages/documents
- ...stored on websites
- http/protocols used to transmit data
- web pages are written in HTML
- URLs specify the location of the web pages
- web documents are accessed using browsers [3]

(i) router [1]

(ii) gateway [1]

(iii) server [1]

Answer 39

1 (a) any **two** from:

- sequence of digital signals / bits
- over a communication path / Internet
- transfer of data at high speed
- requires fast broadband connection
- requires some form of buffering
- bits arrive in the same order as sent [2]

(b) (i) any **two** from:

- no need to wait for a whole file to be downloaded
- no need to store large files on user's computer
- allows on demand playback
- no specialist software is required for playback in browser [2]

(ii) any **two** from:

- video stops / hangs if very slow Internet / broadband speed low
- video stops / hangs if inadequate buffering capacity
- loss of Internet means can't access films / files
- may require specific software to run the files / films
- viruses can be downloaded from the websites [2]

(c) 2 marks for on-demand and 2 marks for real-time

on-demand

- digital video tape, analogue video tape, or digital files are converted to bit streaming – format for broadcasting on the net; this is known as encoding, these encoded streaming video files are then uploaded to a dedicated server
- a link for the encoded video is placed on a web site
- a user clicks on the link to download the encoded streaming video; the streamed video is
- then broadcast to the user as and when they require it
- can be paused / can go back and re-watch / fast-forward, etc.

real-time

- an event is captured live with a video camera
- the video camera is connected to a computer
- the video signal is converted to streaming media files (encoded) on the computer
- the encoded feed is then uploaded from the computer to a dedicated streaming server via cable, DSL, or a high-speed internet connection
- the server then sends the live images it to all users requesting it as real-time video streaming
- cannot be paused etc. [4]

Answer 40

(a)

Statement	True (✓)
The IP address consists of any number of digits separated by single dots (.)	
Each number in an IP address can range from 0 to 255	✓
IP addresses are used to ensure that messages and data reach their correct destinations	✓
Public IP addresses are considered to be more secure than private IP addresses	

accept words TRUE or FALSE in right hand column
1 mark per tick, –1 mark for each wrong tick if more than 2 [2]

(b) **(i)** http – enables browser to know what protocol is being used to access information in the domain

cie.org.uk – cie.org.uk is the domain name

computerscience.html – actual web page / file being viewed [3]

(ii) **%20** – because <space> not allowed in a URL, %20 is the coding for a space (32 in denary)

? – separates the URL from all parameters or variables [2]

Answer 41

6 any **four** points from (maximum 3 marks per type of cable):

- fibre optic cables have greater bandwidth
- fibre optic cables need less signal boosting // can transmit over longer distances
- fibre optic cables have greater security (more difficult to "tap" into)
- fibre optic cables are immune to electromagnetic and other effects
- fibre optic cabling is lighter in weight (easier to install)
- fibre optic cables consume less power
- copper cabling is less expensive to install
- copper cable is easier to install <u>because</u> it is more flexible
- it is easier to make terminations using copper cabling
- the expertise in use of copper cabling is more extensive
- has been around for years … so very little is "unknown" about installations using this type of cabling

Answer 42

(a) (i)
- at least one computer used to "serve" …
- … other computers are referred to as "clients"
- server provides services / applications etc. …
- … which may be requested by clients [2]

(ii) any **two** from:

- files and resources are centralised
- creation of security / manage security
- user needs user name and password to access network
- centralised back-up
- intranet capability
- Internet monitoring
- clients can be less powerful machines, therefore less expensive to buy
- saving resources on server reduces the burden on the client [2]

(b) router [1]