3. Circuit switching & Packet switching

	Circuit switching	Packet Switching
Features	1. A dedicated circuit is established at the start of the communication 2. Between the sender and the receiver 3. All data are transmitted along the same route 4. This lasts for the duration of the call 5. Then the circuit is removed – 1. Set up for the duration of conversation 2. Set up before communication starts 3. Maintained throughout the communication 4. All data travel down the same route 5. Dropped at the end of the conversation 6. Complete bandwidth used	- A circuit does not has to be established at the start of the communication - Data to be sent are divided into packets - That can travel along different routes - From node to node - The packets are reassembled at the correct order at the receiver's end - Must wait until last packet is received to put data back together – - A large message is divided up into a group of smaller chunks of same size - The packet has a header and a payload - The header contains a source IP address, destination IP address, and sequence number - Each packet is dispatched independently - And may travel along different routes - The packets may arrive out of order - And are reassembled into the original message at the destination - If packets are missing, a retransmission request is sent
Pros	- Reduced latency - There are little delay in sending and receiving data once the circuit is established - … because error checking is not required - Circuit made available is dedicated to this communication stream	- Accuracy: allow accurate deliver of messages - Completeness: the missing packets can be easily detected and resend request sent so message arrive complete - Resilience: if the network changes, the the router can detect this and send data another way to ensure it arrives - Paths are also available to others; allow simultaneous use of channel;

	Circuit switching	Packet Switching
	– - Two way real-time conversation - Better synchronization - Full bandwidth available Explain why company uses circuit switching to make voice calls - A dedicated circuit is established - Can use the whole bandwidth - Two way real-time conversation - No delay as no switching - Data arrive in the order sent	doesn't use the whole bandwidth - Better security as packets hashed and sent along different routes - Packets can take the least congested route – - Packets can be rerouted if there are problems - Packets can take the least congested route - Transmission errors can be detected - Missing/corrupt packets can be resent Explain why company uses packet switching to send and receive other types of data - Asynchronous communication - Allows for error checking - Real time transmission is not required - Smaller amount of data is sent, so able to share bandwidth - Doesn't matter if data arrives out of order
Cons	- Bandwidth not available to others - Need extra time before communication to set up the circuit - Alternative route not available without restarting the conversation - Less secure, as easy to intercept data (only one route) - Failure of single route means failure of transmission - Not very flexible - Nobody else can use the circuit/channel	- Time delay to correct errors / network problems may introduce errors in packets - Require complex protocol - Unsuitable for real-time transmission application - -- - packets can be dropped/delayed - The protocols for packets switching can be more complex than those for circuit switching if a packet is lost - The sender must resend the packet, waste time - Do not work well with real time data stream - The circuit/channel has to share its bandwidth with other packets - There is a delay at the destination

	Circuit switching	Packet Switching
	even when it is idle - The circuit is always there whether or not it is used - If there's a fault, no alternative - Dedicated channel require greater bandwidth - Time to establish a link can be long	while packets are reassembled - Needs large amount of RAM to handle the large amount of data. State problems that could arise if video conferencing were to use packet switching - Picture and sound not synchronized - Interruptions/video not continuous - Can be degraded by other computing traffic
Applications	- Public telephone networks - Private telephone networks - Private data networks - Video conferencing / live stream	
Questions		The TCP/IP protocol is used to send an email message from one node on a LAN to a node on different LAN. State the steps that take place when the email message is sent and received. - Message is split into packets - Each packet is a fixed size - Each packet is given a header - … including the destination IP address, sequence number - Packets are forwarded from one LAN to another LAN - Packets may take different routes - Missing packets are requested to be resent - Packets are reassembled in order at the destination

Packet header

Purpose:

- To store data about the header
- and its routing // to ensure it reaches the correct destination

- to ensure the packet can be correctly constructed

Examples:

- IP address of the sender/ receiver
- ID of the packet
- Packet length
- Checksum
- Protocol used
- Synchronization data
- Number of packets the message consists of
- Type of service
- IP version number
- Fragmentation flags
- Fragmentation offsets

Router

Function of router in packet switching:

- The router examines the packet header
- It reads the IP address of the destination
- A router has access to a routing table
    - Containing information about: eg: available hops/netmask/gateway used
    - And the status of the routes along the route
    - The router decides the next hop/next route
    - And sends the packets to the next hop

Routing table:

- Network ID // network destination
- Routing data to decide best route
- IP address of next hop/gateway
- Interface

Explain the role of routers in sending an email from one email server to another

- A router is a node in the Internet
- A router will receive a packet that is in the process of transmission

- A router has data stored regarding the routers that are within its vicinity
- A router can access this data to make a choice of which router to send the packet to next
- The destination IP address in the packet also guides this choice
- Some of the data stored relates to the amount of traffic using a particular network link
- Different packets heading to the same destination will not necessarily be directed along the same link from the router.