

OCR Computer Science A Level

1.3.3 Networks

Concise Notes



Specification

1.3.3 a)

- Characteristics of a Network
- Importance of Protocols and Standards

1.3.3 b)

- The internet Structure:
 - The TCP/IP stack
 - Protocol Layering
 - LANs and WANs
 - DNS
 - Packet and Circuit Switching

1.3.3 c)

- Network Security and Threats
- Firewalls
- Proxies
- Encryption

1.3.3 d)

- Network Hardware

1.3.3 e)

- Client-server
- Peer-to-peer



Networks and Protocols

Characteristics of a network

- Two or more computers connected together that can transmit data

Protocols

- Sets of rules defining how two devices communicate with each other
- Need to be standard so all devices can communicate, regardless of manufacturer



The Internet Structure

- A [network of networks](#)
- Allows computers on opposite sides of the globe to communicate with each other

The TCP/IP Stack

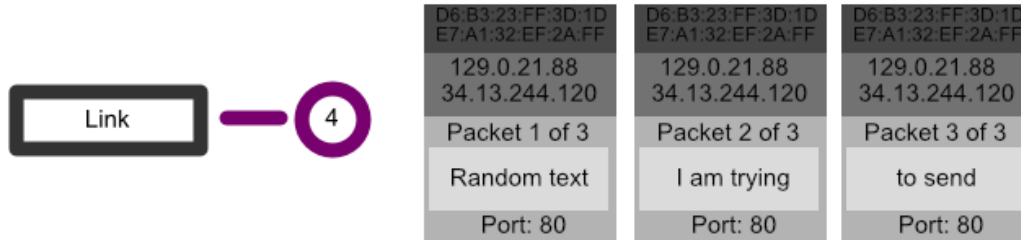
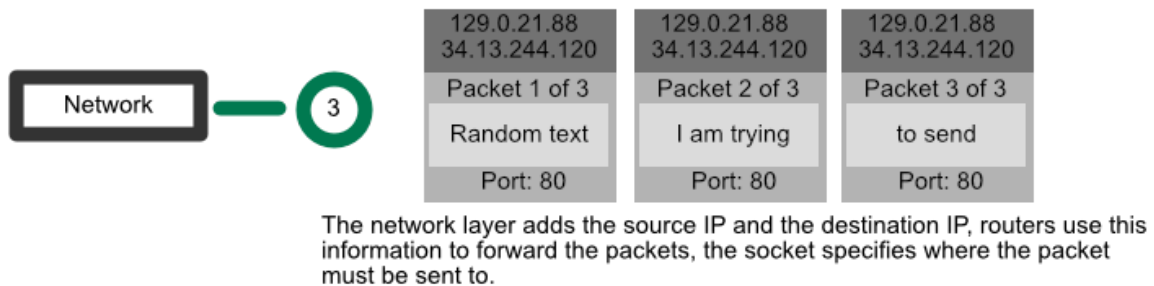
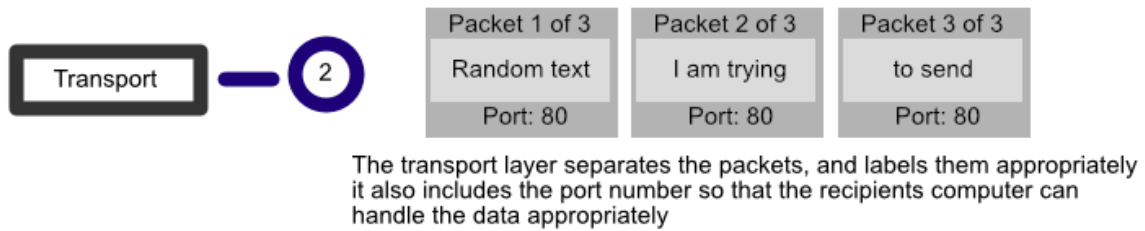
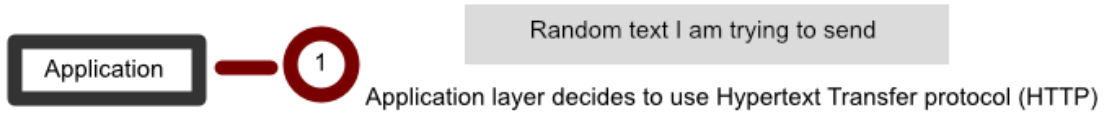
- Transmission Control Protocol / Internet Protocol
- A [stack of networking protocols](#) that work together passing packets during communication

Protocol Layering

- Application Layer
 - Based at the top of the stack
 - Specifies [what protocol](#) needs to be used in order to [relate the application that's being sent](#)
- Transport Layer
 - Uses the TCP to establish an [end-to-end connection](#) between the source and recipient computer
 - [Splits up data into packets](#)
 - Labels packets with their packet number
 - Requests [retransmission](#) of any lost packets
- Network Layer
 - Adds source and destination [IP addresses](#)
 - [Routers](#) operate on the network layer and the router is what uses the IP addresses to forward the packets
- Link Layer
 - The [connection between the network devices](#)
 - Adds the [MAC address](#) identifying the [Network Interface Cards](#) of the source and destination computers
- On the recipient's computer the layers occur again in reverse:
 - Link Layer
 - Removes the MAC addresses
 - Network Layer
 - Removes the IP addresses
 - Transport Layer
 - Removes the port number and reassembles the packets
 - Application layer
 - Presents the data to the recipient in the form it was sent



This is a diagram of the TCP/IP Stack



LANs and WANs

- Local Area Network (LAN) is a network spread over a **small geographical area**
- Wide Area Network (WAN) is a network spread over a **large geographical area**, that typically requires **extra hardware**

DNS

- Domain Name System
- The system given to the **method of naming internet resources**
- A hierarchy where each smaller domain is separated from the larger domain by a full stop
- DNS server translates domain names into IP addresses when we access a website.

Packet and Circuit Switching

- Circuit Switching
 - A method of communication where a **direct link** is created between two devices
 - Link maintained for the **entire conversation**
 - The two devices must transfer and receive data at the **same rate**
- Packet Switching
 - A method of communicating **packets** of data across a network
 - A packet is just a **section of the data**
 - Packets aren't limited to a single route

Circuit Switching		Packet Switching	
Advantages	Disadvantages	Advantages	Disadvantages
The data arrives in a logical order which results in a quicker reconstruction of the data.	Bandwidth is wasted during periods of time where no data is sent.	There are multiple methods to ensure data arrives (check Checksum and Cyclic Redundancy Check)	Time is spent deconstructing and reconstructing the data packets.
This enables two users to hold a call without delay in speech.	The devices must transfer and receive data at the same rate .	There is more than one method of getting to the other devices, so if one path breaks you can use another.	
	Since switches are used, electrical interference is produced which can corrupt or lose data .	You can transfer packets over very large networks to allow communication globally.	



Data Packets

- Segments of data
- Contain various pieces of information
 - Header
 - Sender and the recipient's **IP addresses**
 - **Protocol** being used
 - **Order** of the packets
 - **Time To Live / Hop Limit**
 - Payload
 - The raw data
 - Trailer
 - **Checksum**, or **cyclic redundancy check**

Network Security and Threats

Firewalls

- Devices designed to **prevent unauthorised access** to a network
- Consist of two network interface cards (NICs), in-between the user and their internet connection.
- Pass packets between these two NICs and compares them against a set of rules (**packet filters**) set by the firewall software
- Perform packet filtering / static filtering
 - **Limit network access** in accordance with **administrator rules** and policies

Proxy Servers

- Act as an intermediary, collecting and sending the data on behalf of the user
- Protect the privacy of the user who **remains anonymous**
- Cache frequently used website data making it **faster to load**
- Reduce the web traffic
- Can be used by administrators to **prevent access** to **sensitive or irrelevant information** at work or at school

Encryption

- A way of **keeping data secure** when transmitting over the Internet

Network Hardware

Network Interface Cards (NICs)

- Required to **connect to a network**
- Assign a unique Media Access Control (MAC) address to each device

Switches

- Used to **direct the flow of data** across the network
- Most commonly used in a **star topology**



Wireless Access Points (WAPs)

- Allow devices to **connect to a network wirelessly**
- More commonly used to connect devices to a router which can allow internet access
- Used in **mesh networks**

Routers

- Used to **connect** two or more **networks together**
- One network will often belong to the ISP's network (internet service providers' network) allowing the network to connect to the internet

Gateways

- Used when **protocols aren't the same** between networks
- **Translate** protocols so that both networks have the same protocols
- Remove the header from packets before the remaining data is added with the new protocol of the new network in mind

Client-Server and Peer-to-Peer

Client-Server

- Client-Server networks have **terminals** known as clients connected to a **server**
- The server is just a **powerful central computer**
- The server holds all of the **important information** and has **extra processing power** and the clients can request to use it

Advantages of Client-Server	Disadvantages of Client-Server
<ul style="list-style-type: none"> • More secure • Central backups eliminate the need for client backups • Sharing data and resources between clients 	<ul style="list-style-type: none"> • Expensive to set up • Staff with training are required to maintain the server

Peer-to-Peer networks

- Computers are **connected to each other** so that they can share files
- **Inexpensive** to set up
- Allow users to **share resources**
- **Easy to maintain**

