# Network Security and Protocols

Why do we need network security?

- To prevent unauthorised access to our electronic devices
- To protect our data eg to prevent sensitive data being stolen
- Prevent cyberattacks

## Methods of Network Security

**Authentication** allows us to confirm the identity an individual with usernames and passwords. Digital certificates also provide the identity of a person or device and allow secure information exchange.

**Encryption** The message is garbled so if it gets intercepted during transmission it will be almost impossible for anyone without the key to read the original message.

**Firewall** prevents packets containing malware getting on to the computer

**MAC address filtering** A MAC (Media Access Control) address is a unique identifier for any device that is connected to a network. Each network interface card has a unique MAC address that is a 12 digit hexadecimal code (e.g. 12-F3-EE-56-44-A1).

– *White list filtering* only allows devices on a list to connect to the network.

– *Black list filtering* devices in a black list blocked from accessing the network.

## Network Protocols

A **network protocol** is a set of rules that allow computers to communicate and exchange information over a network. There are many types of protocols depending on the application.

**HTTP (Hypertext transfer protocol)** is the protocol used for the World Wide Web. An exchange begins with a request for a web page from a client web browser to a web server. The server then sends the web page to the client.

**HTTPS (Secure Hypertext transfer protocol)** is a secure way of transferring data between a web browser and a server because the data are encrypted during transfer. Used for e-commerce and online banking.

**FTP (File Transfer Protocol)** is usually used to download or upload large files from a server to a client.

**Ethernet** is not a single protocol but a collection of related protocols. LANs most commonly use ethernet. The following is a simplified procedure:

1) Check whether there is any traffic on the ethernet
2) If so wait for traffic to clear
3) Send the packet
4) If collision detected, go to step 1 to resend.

**Wi-Fi** is a collection of protocol that use radio waves to transmit data between devices. Wi-Fi is a trademark and WLAN (Wireless LAN) is the generic term. Data are transmitted when the medium is clear, and an acknowledgement is received if the transmission was successful. If no acknowledgement is received, then the data are resent as it is assumed that a collision occurred, and the packets did not reach their destination.

### Email protocols

**SMTP (simple mail transfer protocol)** Sends the mail from the user onto the mail server.

**IMAP (Internet Message Access Protocol)** Retrieves the mail from the mail server to the client (user) and allows access from anywhere on any device because the email remains on the server.

**TCP (Transport Control Protocol)** When files are sent over the internet they are broken up into small chunks called packets. When they arrive at the destination computer they are reassembled back into the original format. TCP handles and controls all this. TCP waits for acknowledgements to verify whether the packets have reached their destination. TCP will also retransmit packets of they have not arrived at the destination or become corrupted.

**IP (Internet Protocol)** The internet protocol is a set of rules that govern the transmission of data across the internet.

**UDP (User Datagram Protocol)** is used as an alternative to TCP. It is used in video conferencing and online gaming when speed is necessary as huge volumes of data are transferred in real time. It improves speed by not checking for lost packets so they do not get re-sent.

## TCP/IP

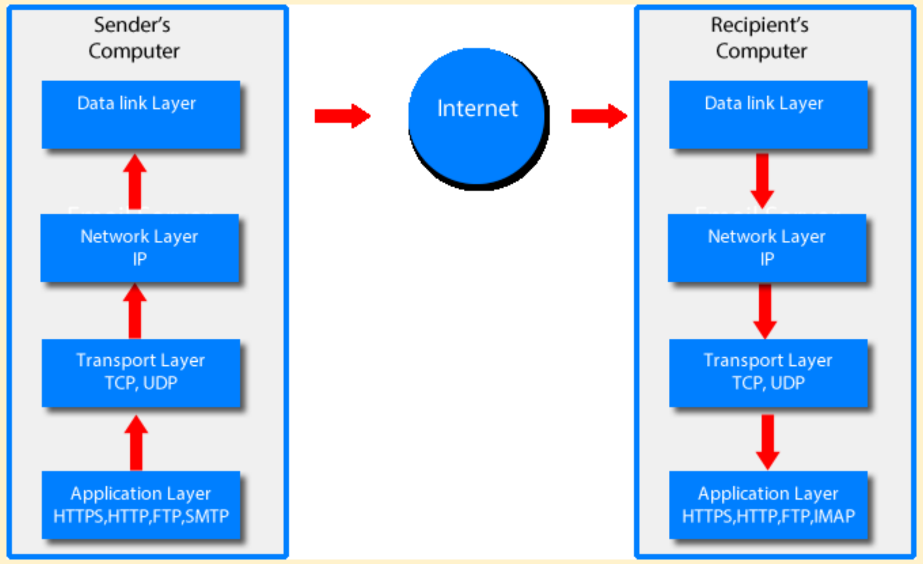
The TCP and IP protocol work closely together and are referred to as TCP/IP. The TCP/IP model consists of four layers that pass data between each layer.

**Application layer** contains protocols related to the application such as HTTP, HTTPS for web browsers, FTP for file transfer and SMTP and IMAP for email. The application layer interacts with the user via appropriate application software (eg web browser / ftp client).

The **transport layer** establishes the end to end connection. When files are sent over the internet, they are broken up into small chunks called packets. When they arrive at the destination computer they are reassembled back into the original format. It is the role of the transport layer to split the data into packets and pass the data onto the network layer. On the recipient's computer the transport layer reassembles the packets into the original form. The packets are numbered by this layer to allow them to the reassembled. The transport layer chooses the port number for sender and receiver. TCP and UDP are the main protocols used in this layer.

The **network layer** adds the source and destination IP address and route the packets over the network. At the destination the network layer strips out the IP addresses. The IP operates on this layer.

The **data link layer** has a network card and deals with the physical connection and adds the physical addresses (MAC address) of the hardware to the packets that it receives from the network layer. For each step the sender and receiver MAC address is removed then a new sender and receiver MAC address is added. The receiver MAC address becomes the sender MAC address.


Sender's Computer
Data link Layer
Network Layer IP
Transport Layer TCP, UDP
Application Layer HTTPS,HTTP,FTP,SMTP
Internet
Recipient's Computer
Data link Layer
Network Layer IP
Transport Layer TCP, UDP
Application Layer HTTPS,HTTP,FTP,IMAP