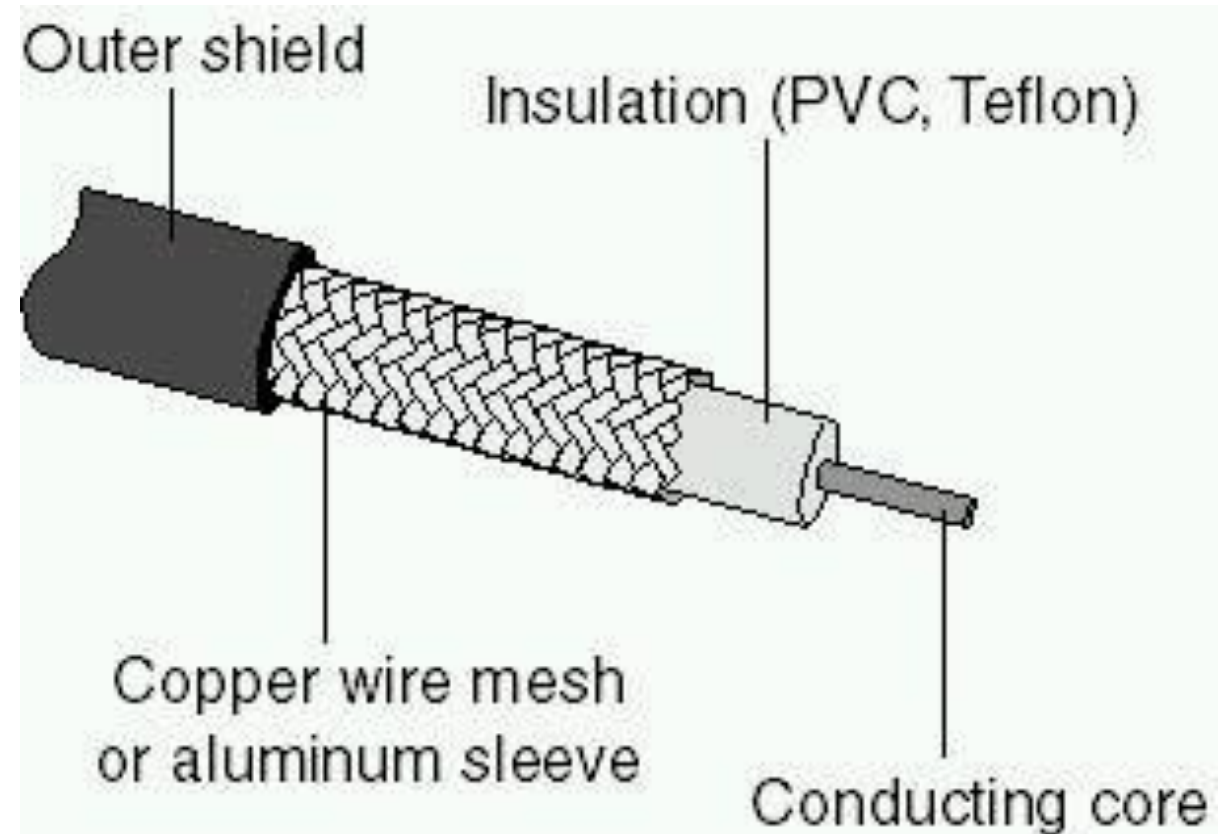# Cables, Connectors and Components

Cables and Connectors

- Mostly WiFi today
- Coaxial
- Twisted pair
- Fibre Optic

Coaxial (or coax)

- In the past, the most widely used network cable
  - relatively inexpensive
  - Light
  - Flexible
  - easy to work with
- Rated by Radio Guide (RG) number
- WARNING: Do Not burn!

Outer shield

Insulation (PVC, Teflon)

Copper wire mesh
or aluminum sleeve

Conducting core

Plenum Rating

- Most cables are covered in PVC that is
    - Flexible
    - Durable
    - Inexpensive
    - Produces poisonous gas when burnt!

- Alternative is a teflon coated cable
    - Plenum rated coating
    - No toxic gases when burnt
   - Used in cable ducts in walls or ceilings

RG Number

- Most used was RG-8 (thicknet) and RG-58A (thinnet)
- RG-8 max distance 500M – Network backbones
- RG-58A max 185M
- Both had impedance of 50 Ohms

RG #	Popular Name	Eternet Implementation	Type of Cable
RG-6	Satellite/Cable TV, Cable Modems	N/A	Solid Copper
RG-8	Thicknet	10Base5	Solid Copper
RG-58 U	N/A	None	Solid Copper
RG-58 A/U	Thinnet	10Base2	Stranded Copper
RG-59	Cable Television	N/A	Solid Copper

- 10Base – max speed 10Mbs, last number is value in 100M distance
- Only RG-6 and RG-59 in use today.
  - RG-6 max distance 304M and supports digital
  - RG-59 max distance 228M and only analogue
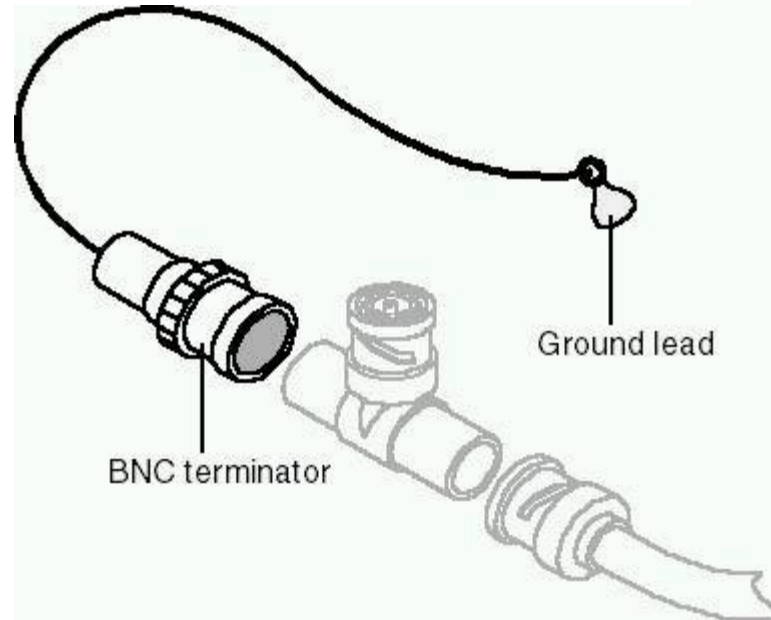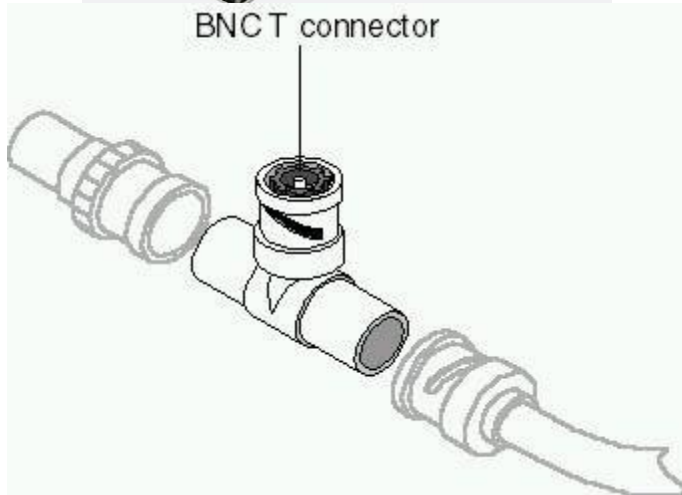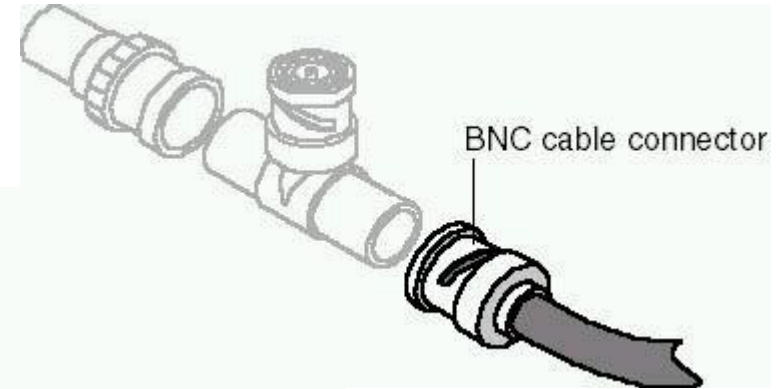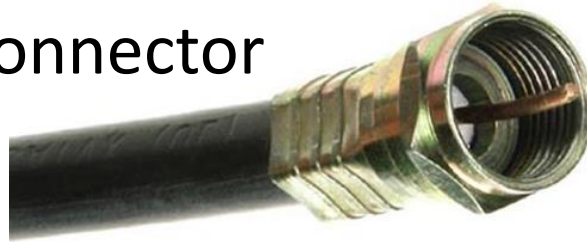 - Both have 75 Ohm impedance

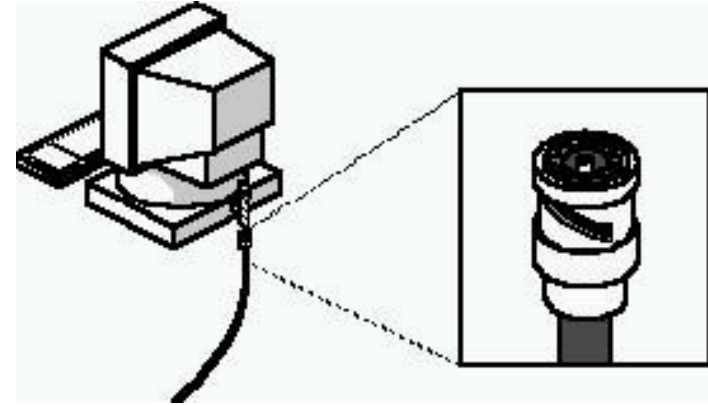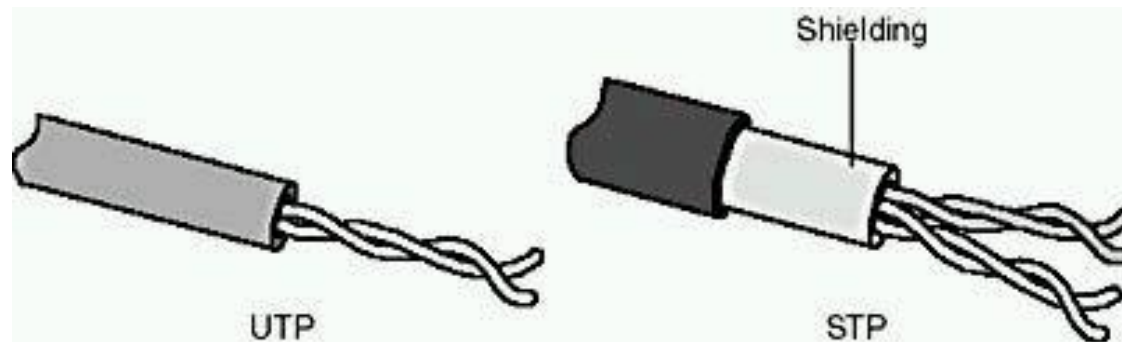# Thicknet

- Thicknet – very hard to work with
- Uses Vampire Taps
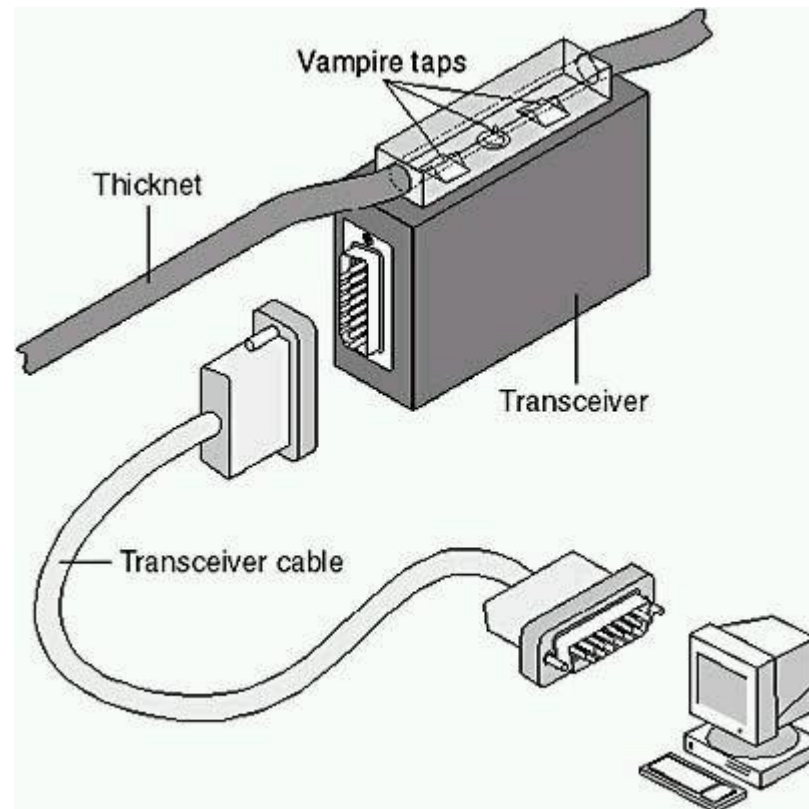
Thinnet Connection

- Thinnet Connector type BNC
- Screw type called F connector

BNC T connector

BNC cable connector

BNC terminator

Ground lead

Twisted Pair

- What you are most familiar with
- UTP – Unshielded Twisted Pair
- STP – Shielded Twisted Pair
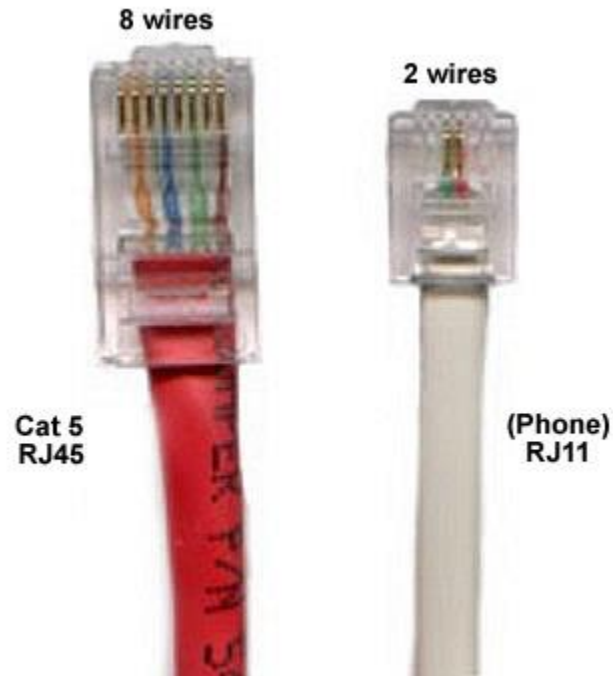
Twisted Pair Category (IEEE 802.3)

- Category 1 Two twisted pairs for voice but not data transmissions. Most telephone cable prior to 1983 was Category 1 cable.

- Category 2 Lowest grade cable for data transmissions up to 4 megabits per second (Mbps). It consists of four twisted pairs of copper wire.

- Category 3 Cable for data transmissions up to 10 Mbps. It consists of four twisted pairs of copper wire with three twists per foot.

- Category 4 Cable for data transmissions up to 16Mbps. It consists of four twisted pairs of copper wire.

- Category 5 Cable for data transmissions up to 100 Mbps. It consists of four twisted pairs of copper wire.

Twisted Pair Category continued

- Category 5e This category certifies UTP cable for data transmissions up to 1 Gbps. It consists of four twisted pairs of copper wire that are physically separated. More twists per foot. Maximum interference protection.

- Category 6 Cable for data transmissions up to 10 Gbps (but only for 55 meters) It consists of four twisted pairs of copper wire, differently configured to CAT5e. Lowest cable you should use for network backbones.

- Category 6a Cable for data transmissions up to 10 Gbps (but for 100 meters).

- Category 7 Every wire is shielded. 10Gps for 100 Meters. Also called class F.

Twisted Pair connectors

- RJ-11 and RJ-45
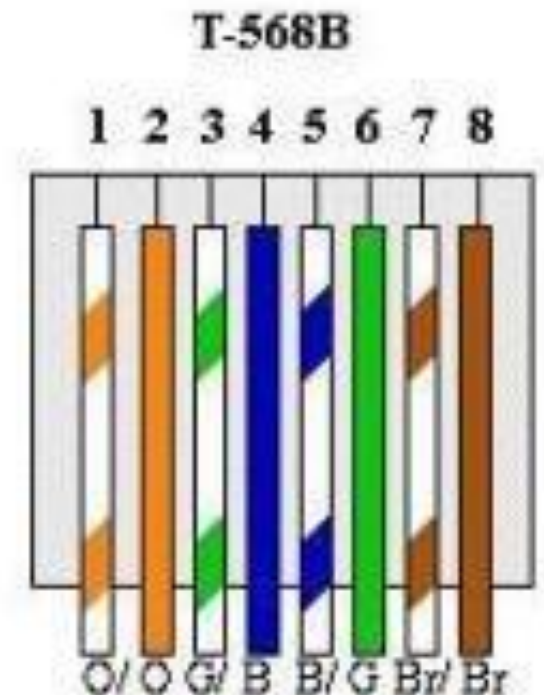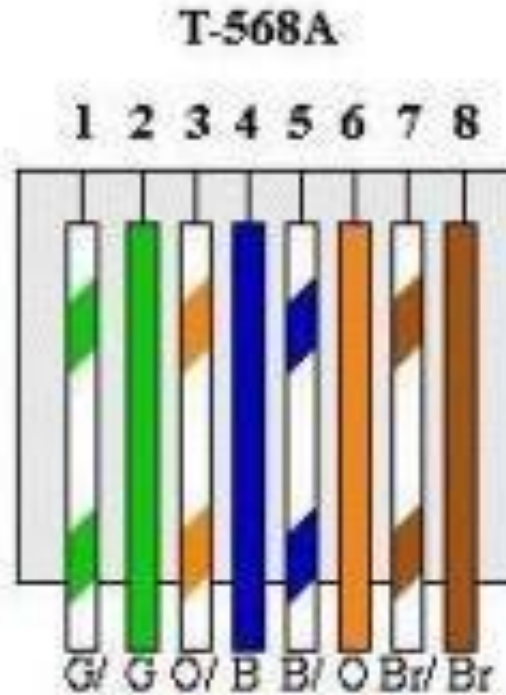- RJ – Registered Jack
- Crimped connectors

8 wires

2 wires

Cat 5
RJ45

(Phone)
RJ11

RJ-45 Wiring Standa

T-568A

1 2 3 4 5 6 7 8

G/ G O/ B B/ O Br/ Br

T-568B

1 2 3 4 5 6 7 8

O/ O G/ B B/ G Br/ Br

• 568A and 568B

EIA 568A

Pin #	Wire Color Legend		Signal
1		White/Green	TX+
2		Green	TX-
3		White/Orange	RX+
4		Blue	TRD2+
5		White/Blue	TRD2-
6		Orange	RX-
7		White/Brown	TRD3+
8		Brown	TRD3-

EIA 568B

Pin #	Wire Color Legend		Signal
1		White/Orange	TX+
2		Orange	TX-
3		White/Greege	RX+
4		Blue	TRD2+
5		White/Blue	TRD2-
6		Green	RX-
7		White/Brown	TRD3+
8		Brown	TRD3-

568A   CAT5e CABLE   CAT5e CABLE   568B
CROSS-OVER CABLE (568A - 568B)

568A   CAT5e CABLE   CAT5e CABLE   568A
STANDARD PATCH CABLE (568A - 568A)

568B   CAT5e CABLE   CAT5e CABLE   568B
**STANDARD PATCH CABLE (568B - 568B)**

Optical Fibre

- Digital data signals in the form of modulated pulses of light
- Very secure – cannot be tapped
- Sometimes plastic core
- Glass core – superior distance and quality
- Only one direction per cable, so in pairs
- not subject to electrical interference
- extremely fast
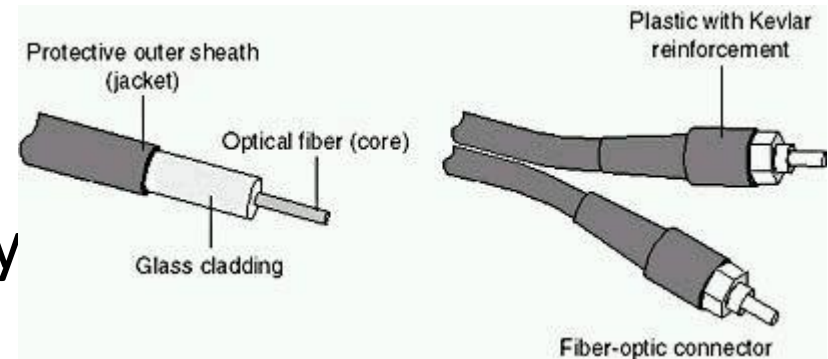
Optical Fibre

- SMF – Single mode fibre
  - Typical backbone cable
  - 10GBs for 40Km
- MMF – Multi mode fibre
  - 10Gbps 550Meters
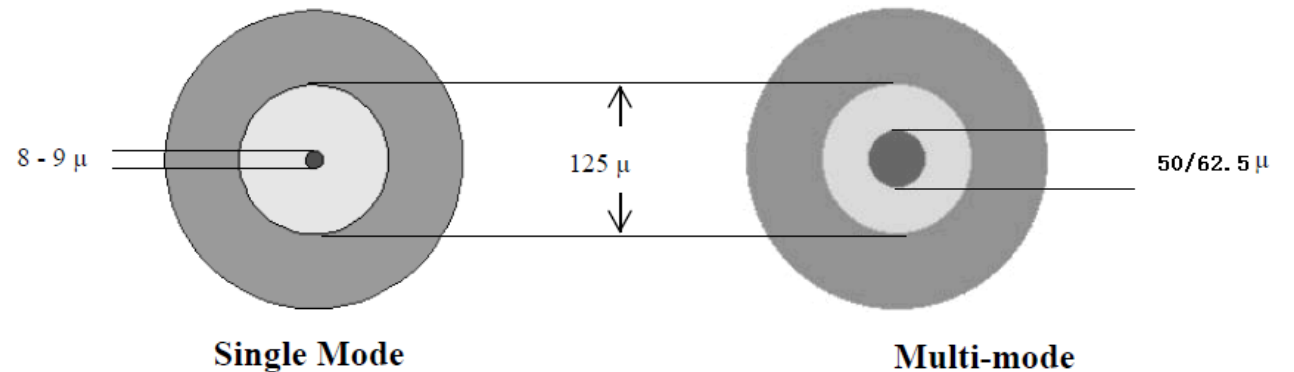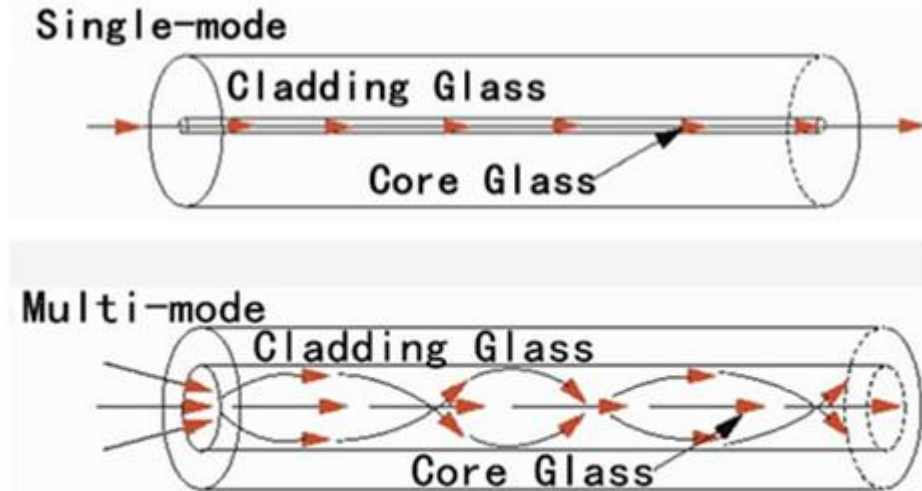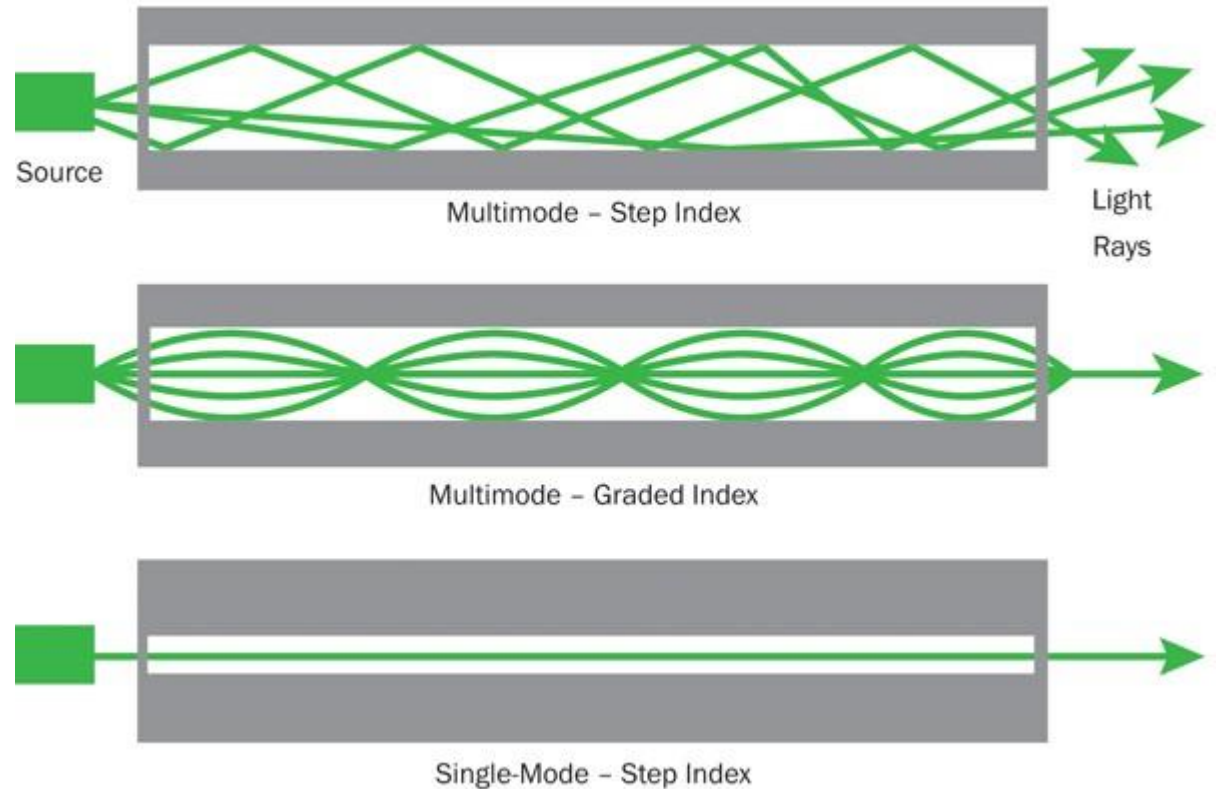
Optical Speeds and Distances

• Speed and Distance depends upon cable quality and specification

Cable Type	Ethernet Specification	Maximum Speed	Maximum Distance
MMF	1000BaseLX or 1000BaseSX	1Gbps	550Meters
MMF	10GBaseSR or 10GBaseSW	10Gbps	300 Meters
SMF	10GBaseER or 10GBaseEW	10Gbps	40 Kilometers

Optical Connectors

- Most common ST, SC and LC
- ST – Straight Tip (Most widely used)
    - BNC like connector
- SC – Subscriber Connector (also square connector)
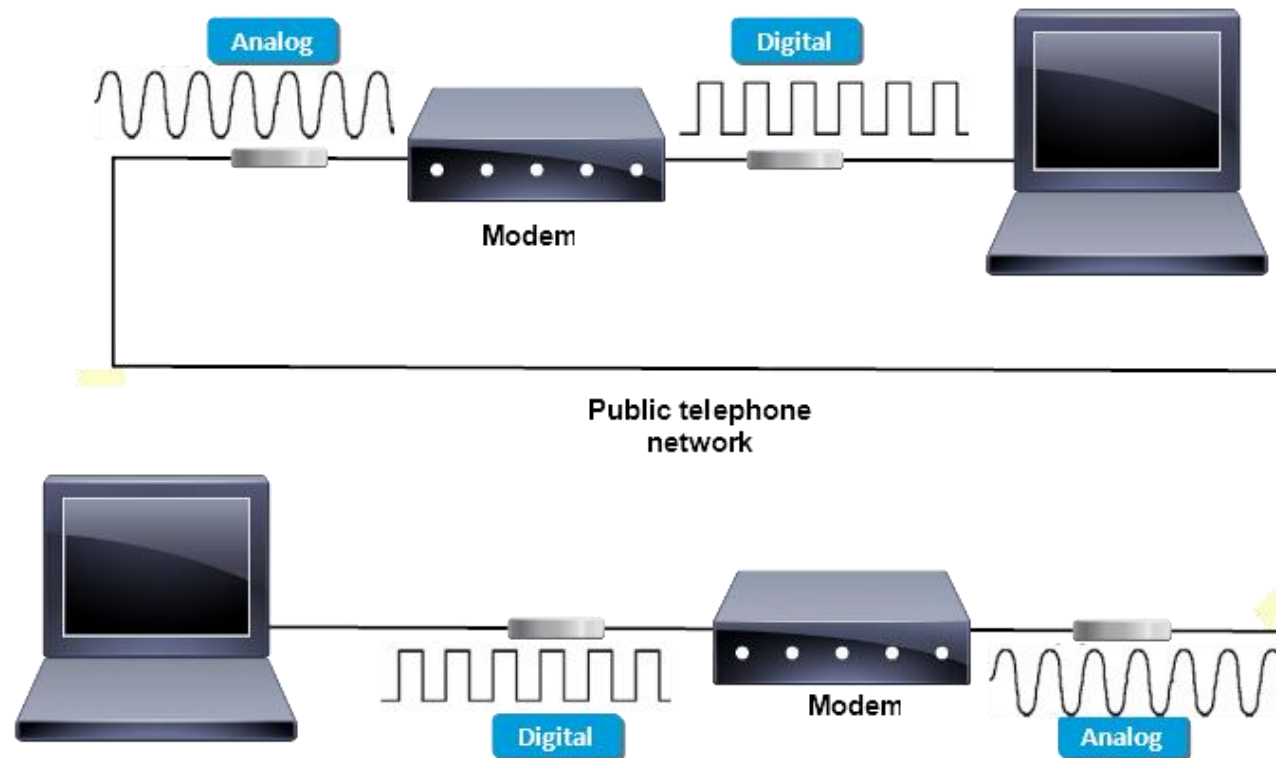   - Latched connection
- LC – Local Connector
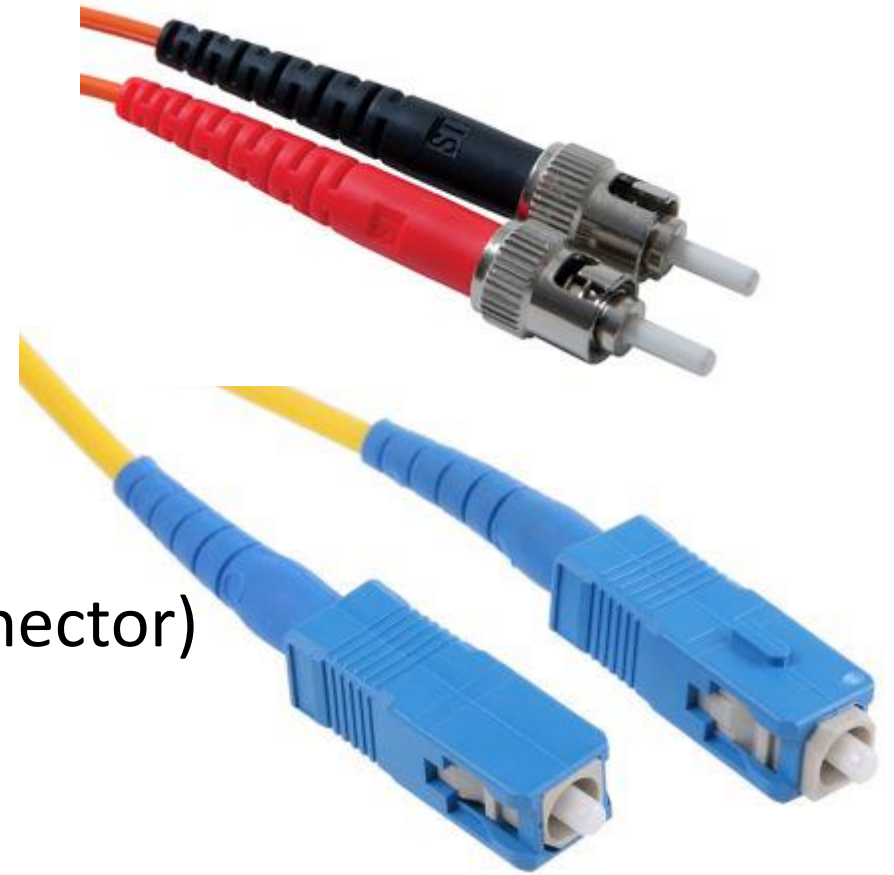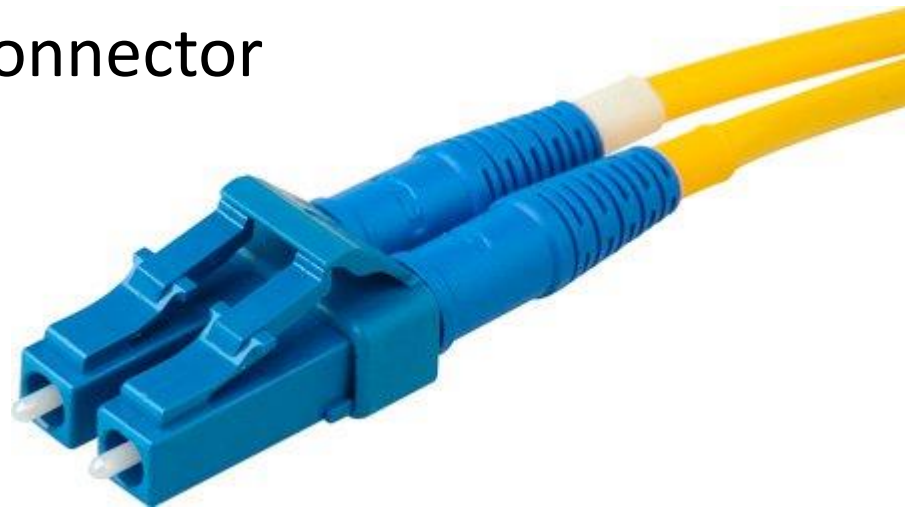
Connectivity Devices

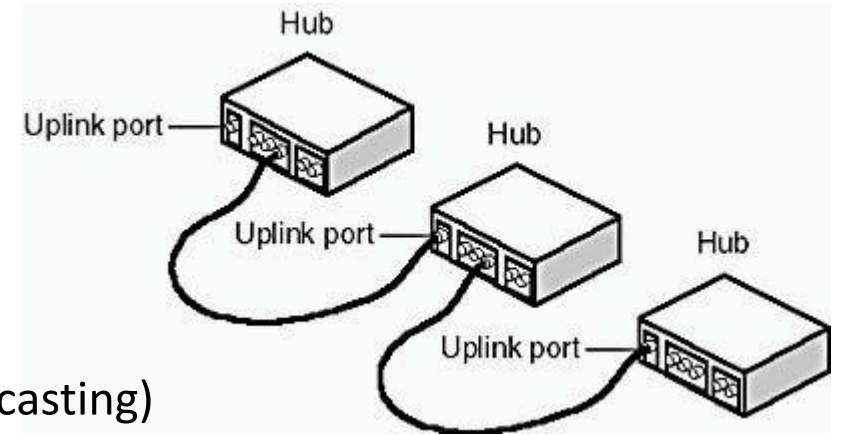- Networks made from far more complexity than just NICs

Modems

- ***Mo**dulates and **dem**odulates digital data to analogue signal*
- Only way for homes to connect in 1990's
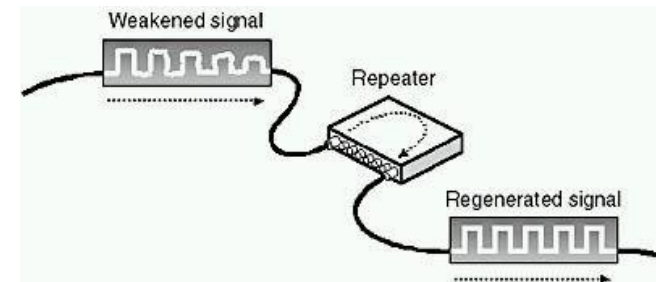- Max 56 Kbps

Components

- HUB
  - Expands a LAN
  - Most use standard and not crossover cables to connect
  - Any signal arriving on one port is copied to other ports (broadcasting)
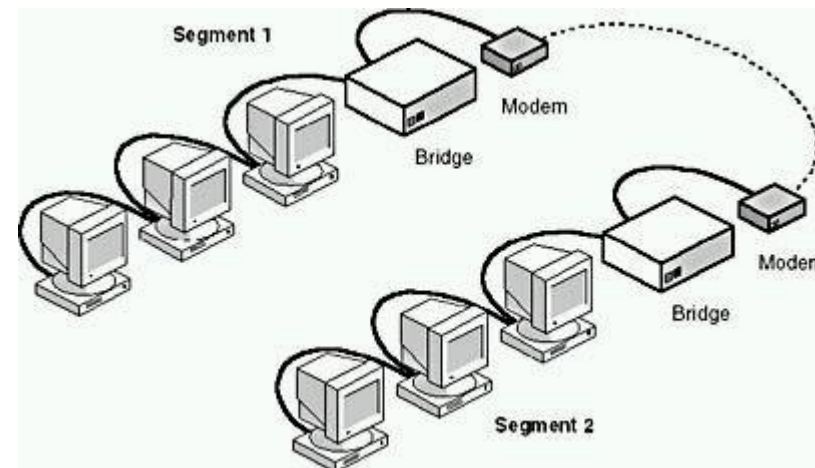 - Passive and Active (Boosts signals)

- Repeaters
  - Signals Attenuate over distance
  - Boosts (Amplifies) signals
  - Can convert Coax to Fibre but not typology
  - Just passes signals but amplifies them

- Bridges
  - Has (and maintains) routing tables
  - Divide isolate networks
  - Operate at Data Link Layer
 - Remote bridges hide modem

Bridges and Repeaters

- Bridges work at a higher OSI level (Data Link Layer - Level 2) than repeaters
- Bridges do regenerate signals (the repeater functionality)
- Bridges provide better network performance
- Isolates different networks, but will forward broadcast messages
- Bridges cannot understand protocols
- Bridges do understand MAC addresses

Patch Panels and ONT Modem

Patch cables

Patch panels

- Patch Panel
  - One or more rows of RJ45 connectors

- Optical Network Terminal (ONT) Modem
  - Fibre to home becoming the norm
  - Requires a specialist modem to connect
  - Terminates fibre and allows user to connect

Termination Point (TP)

TP

Optical Modem (ONT)

ONT

Network Cable

Optical Fibre Cable

Router
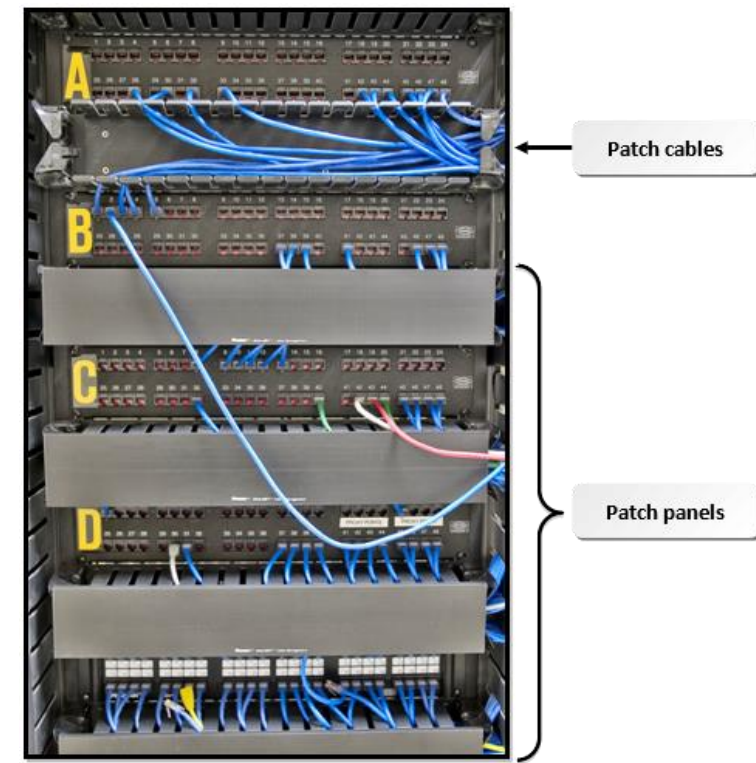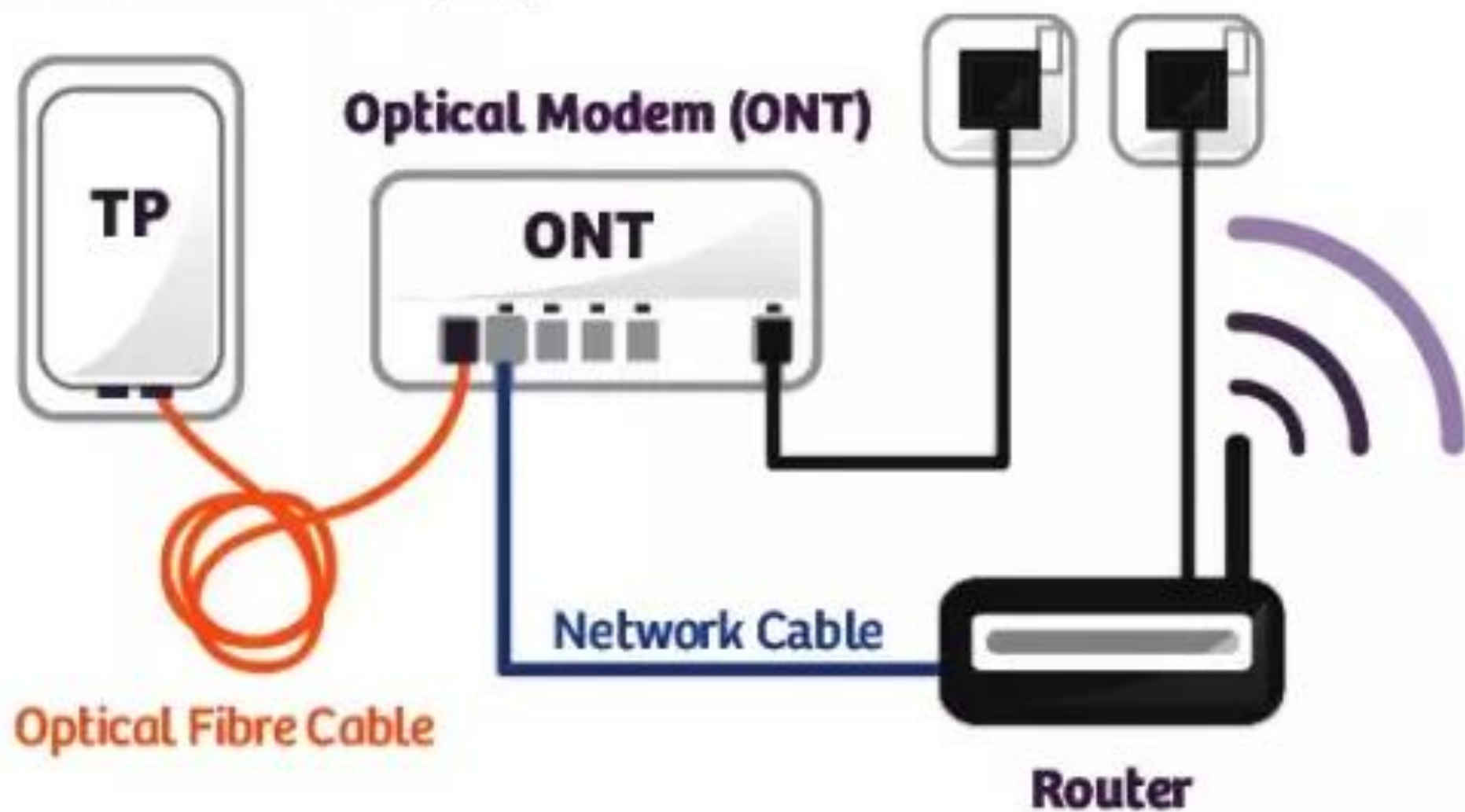
Switches

- Device to join multiple computers together on the same LAN

- Data only sent to intended destination (examines at layer 2)

- Switch to switch connection increases LAN size

- Managed Switches – ability to configure ports and monitor traffic
  - QoS – Quality of Service. Allows prioritisation of certain network traffic
  - Redundancy – multiple paths to get to destination
  - Port Mirroring – ports can be set to mirror another.
  - VLAN's – virtual LAN. Computers can be separated into logical networks.

Routers

- determines the best path for sending data

- filters broadcast traffic

- Network layer of the OSI reference model - therefore they switch and route packets across multiple networks

- Implement some bridge functionality
  - Filtering and isolating traffic
  - Connecting network segments

- maintain their own routing tables
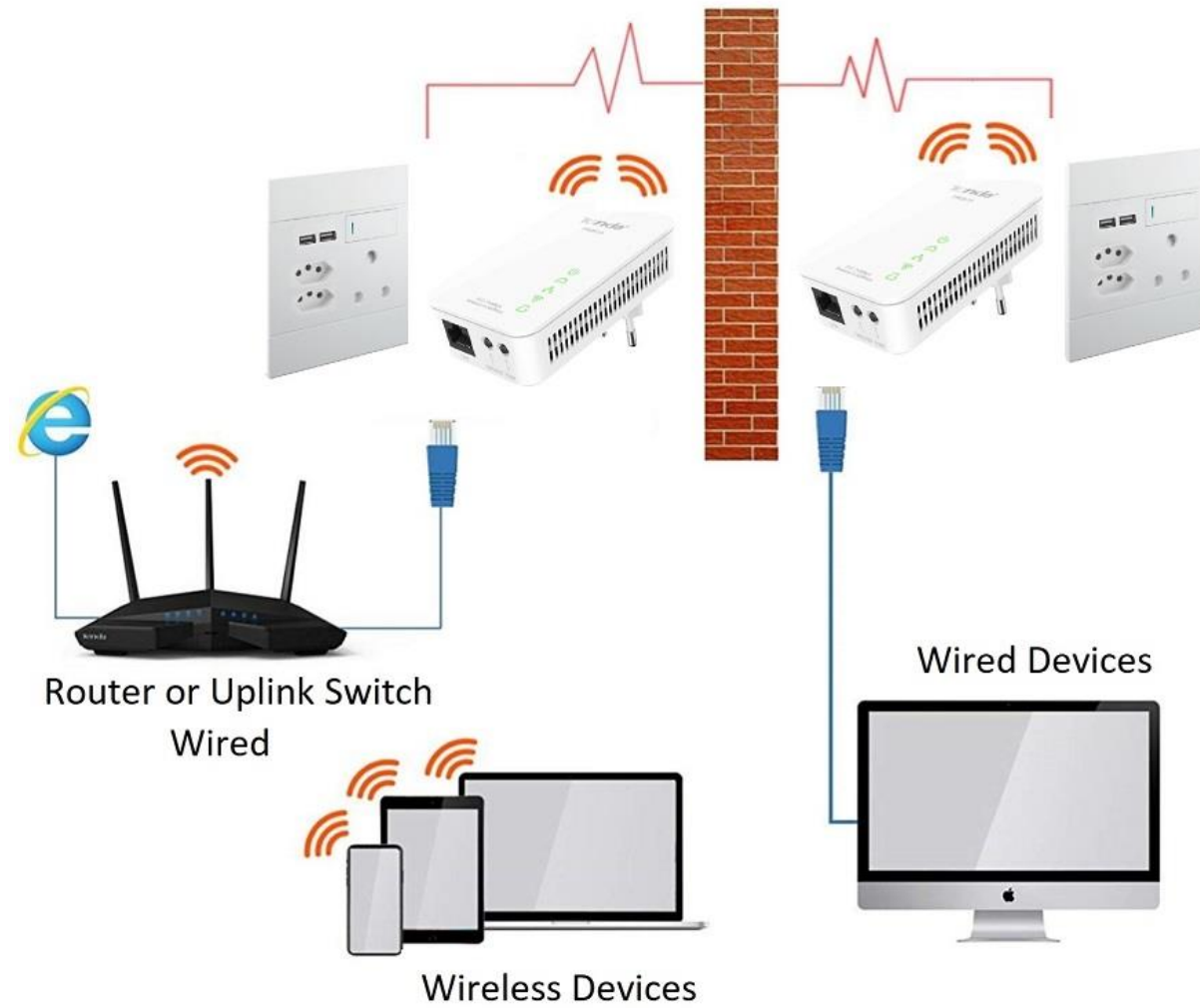
- Routers can talk to routers
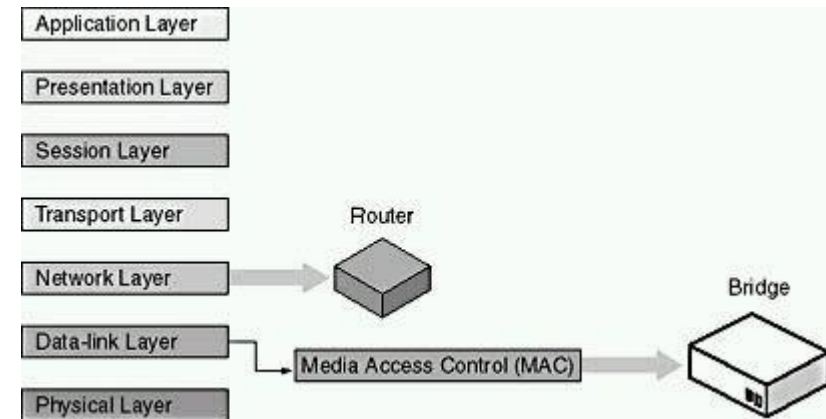
Firewalls

- Software or hardware solution.

- Blocks unsolicited network traffic.

- Configured by administrator to control incoming and outgoing transmissions according to organizational policies

Ethernet over Power

Router or Uplink Switch
Wired

Wireless Devices
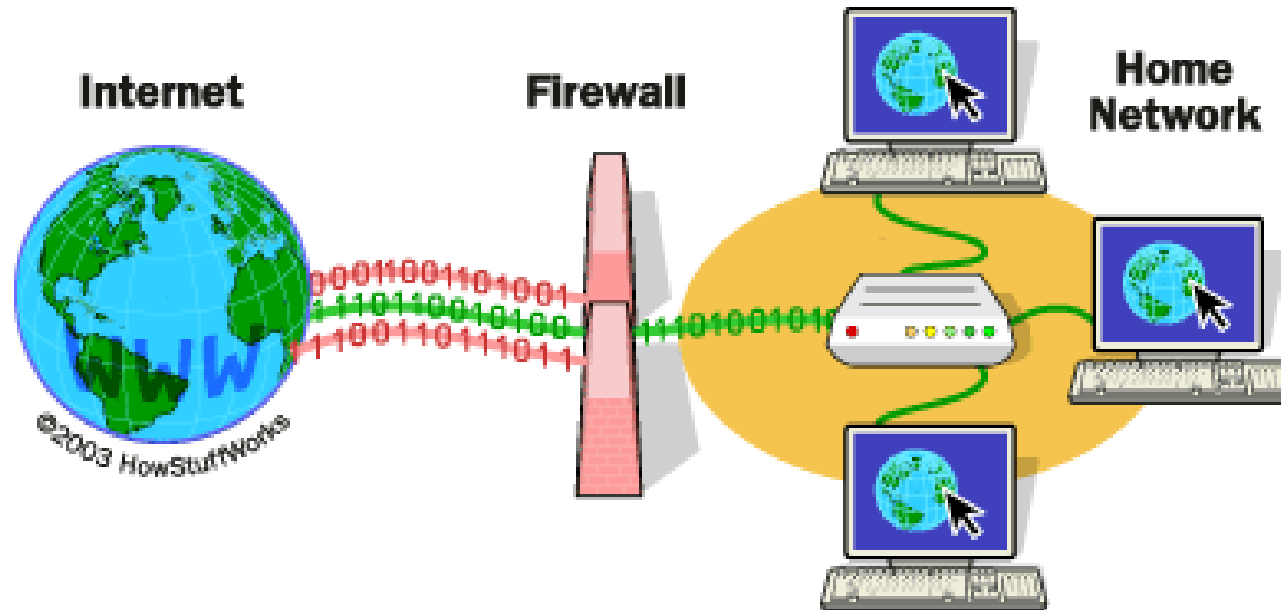
Wired Devices

Power Over Ethernet

- Uses cable to supply data and power
- Useful for low powered devices where no electrical power
  - VoIP Phones
  - Surveillance Cameras
  - Door controllers
  - Card Readers
  - Alarm devices
  - Clocks
  - Digital Signs
- PSE – Power Sourcing Equipment

Power Over Ethernet

- Original twisted pair not designed to carry power over great distances
- PoE capable switch, Midspan device or PoE power injector
- PoE switch provides power at each port
- Midspan – inserted between non PoE switch and the Powered Device (PD)
  - Usually Midspan is close to non PoE switch
  - Injection of power on to cable but passes data

Software Defined Networking (SDN)

- https://www.youtube.com/watch?v=Z5Gi2Bpd82M

- https://www.youtube.com/watch?v=EdVOeGDYHCU