CA169: Week 1

What is a Network?

Networks

- Two or more computers linked together to share resources, such as:
    - Files, printers, processing power, communicate, etc
- Computers communicate with each other by
    - cables, telephone lines, radio waves, satelites, infrared beams
- Networks are LAN MAN PAN WAN

Local Area Network (LAN)

- Network confined to a relatively small geographic area.
- Typically lab in computing school, office etc.
- Typical LAN has a central server which controls the network.
- Can share resources ….printers, files.
- Most common LAN is a house !

Metropolitan Area Network (MAN)

- Covers larger geographic areas, cities, schools, local libraries, government offices
- Typically uses dedicated phone lines, coaxial cabling, fibre optic cable and wireless communication

Personal Area Network (PAN)

- Lately, we have seen the growth of PAN's
- Small Networks around you. Typically connects devices together
- Mainly use Bluetooth.
- These (simple) networks becoming ubiquitous

Wide Area Network (WAN)

- Connects larger geographic areas, such as global companies.
- Local and global networks are connected to form larger network.
- Typically uses transoceanic or satellite links
- Protocols used can be ATM networks or MPLS (carrying Ethernet) or others.
- Typically use special hardware and special fibres.
- Physical layer can be DWDM - https://en.wikipedia.org/wiki/Wavelengthdivision_multiplexing
- Main use – telephones !

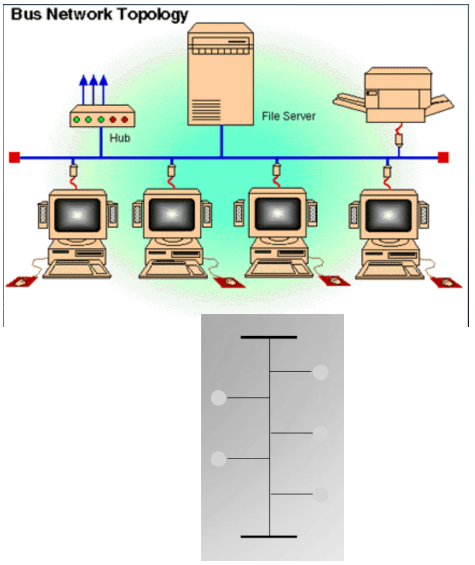
The Internet

- All of the previous network types can connect to the internet
- Infrastructure software needed – TCP\IP
- Global services available through Internet
- Internet aware applications
- Network aware devices

Network Topologies

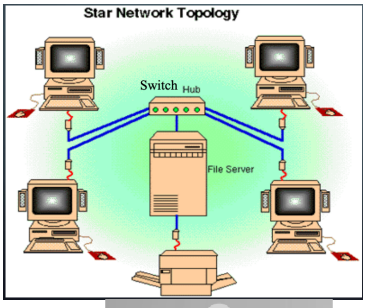
- Topology is how the cables, computers and other peripherals are connected
- Different types of topologies:
    - Star, Ring, bus, tree, Complete, irregular

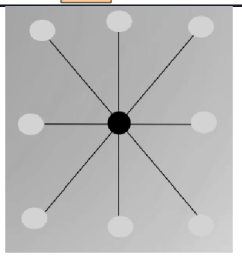
Bus Topology



- Computers share the same bus (cable) with a terminator at each end.
- Each client is connected
- to the bus.
    - Old Ethernet on coaxial cable utilises a bus
- Simple and reliable, not much hardware needed.
- Inexpensive cable and easy to expand
    - Uses the least cable
    - Management more problematic
- Heavy traffic slows overall throughput
- A break in the network brings the whole thing down.
    - Can be difficult to detect.

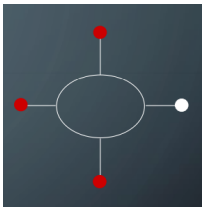
Star Topology

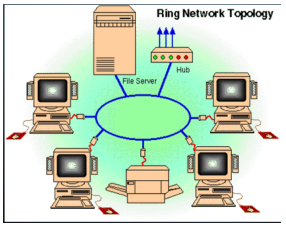




- Each node connected directly to central computer.
- All data must go through central node (hub/switch)
- Relies heavily on central computer
- Each device has a separate wire.
- Easy to install new devices.
- Disconnecting / Adding devices does not interrupt network.
- Easy to detect breaks/faults
- More cable is required (look at our cabinets)
- If central node fails, network falls over
- Commonly uses twisted pair, also uses co-axial (rare now) cable and fibre optic

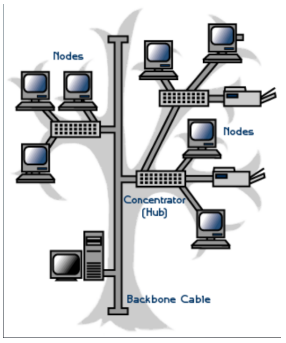
Ring Topology





- Computers tied together in a ring
- Each device is connected to the next one in line
- Circle of cable
- Signal travels in one direction
- When a device receives control (token)
    - It acts on it
    - or passes it on
- Not common these days for LAN.

Tree Topology



- Modern LANs utilise Switches tobuild a tree topology, even when the network looks like a mesh.
- Need to ensure that loops are not introduced, special protocols built into switches (STP)

Topology Considerations

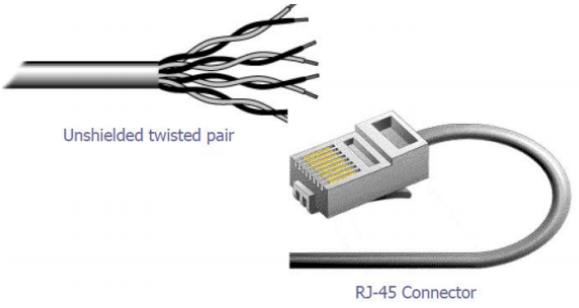
- Money
  - Bus cheapest, no need for central node
  - But what about management cost?
- Length of cable
  - Bus uses shortest cable, but how expensive is cable anyhow?
- Efficiency
  - Star topology easies to add new nodes
  - Manage existing infrastructure
- Cable type
  - Most common cable is twisted pair, most often used with star topologies

Communications Media

- Before we get into how networks work
- We need to look at how they can talk to each other
- These are the physical devices a computer uses to talk to others on a network
- Each type of media has their own strengths and weaknesses
- E.g.
  - Possibility of electronic interference
  - Length of cable/signal strength before it degrades
  - Cost to install and maintain
- No “one size fits all” solution

Unshielded Twisted Pair

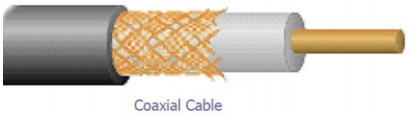
- Cable has 4 pairs of wires, twisted in pairs
- UTP can be telephone grade to high speed cable
- 5 categories
  - 1 voice only
  - 2 Data up to 4 Mbps
  - 3 Data up to 10 Mbps
  - 4 Data up to 20 Mbps
  - 5 Data up to 100 Mbps

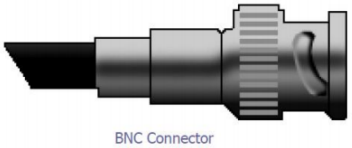


- Can be susceptible to radio and electrical interference.
- Shielded Twisted Pair exists, but extra shielding makes it bulky

Coaxial Cable

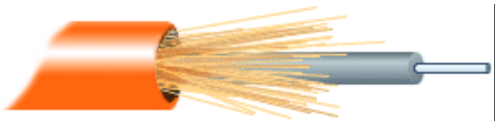
- Like your TV cable at home
- Single copper conductor at centre with plastic layer providing insulation between conductor and braided metal shield.
- Shield prevents interference
- Supports longer cable length the UTP (Twisted Pair)
- Thin coaxial (10Base2)
- Max segment length 185M
- Thick coaxial (10Base5)
- Max segment length 500M



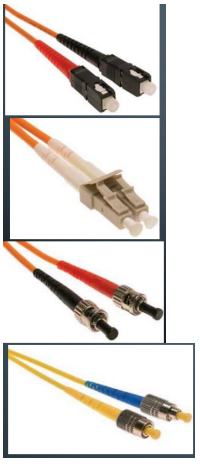


Fibre Optics

- Centre glass core surrounded by layers of protection
- Transmits light rather than electrical signals
- Not susceptible to electrical interference
- Capable of transmitting data over longer distances and at higher speeds than coaxial and TP
- 10BaseF
- Outer coating is made from Teflon or PVC
- Plastic helps cushion glass core
- Kevlar around plastic strengthens cable and prevents breakage
- From a security perspective, one of the great advantages of fibre networks is that they do not radiate any electromagnetic signals
- There is a prevalent myth that fibre networks cannot be tapped: with physical access to the cable, they can
- However, it is considered impossible to tap an optical cable without introducing a detectable increase in attenuation.
- A secure system should continuously monitor received optical signal strength and should alert on any abrupt change



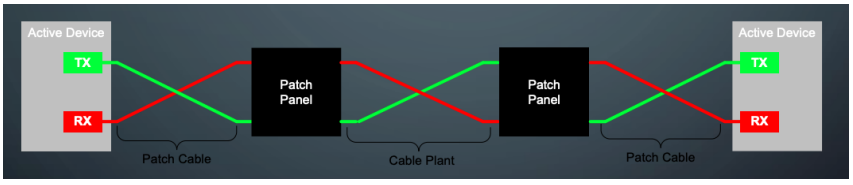
Fibre Connectors



- SC – In widespread use. Used on the original Gigabit Ethernet GBICs
- LC – Used in newer cabling installations. Used on new small form factor (SFP) GBICs
- ST – "Bayonet" mount, often used on older fibre installations
- FC – Screw mount. Only ever found on carrier-grade equipment (and usually with higher-powered lasers…don't look into these)

Patch Panels

- Fibre within or between buildings are typically terminated on patch panels like these
- Fibre patch cables are used to link active equipment to the patch panels
- In order to ensure that Transmit is always connected to Receive in each direction, patch leads and internal cable plant are always (supposed to be) crossed over this means that you can use a patch cable on its own to link two physically adjacent devices



Laser Safety

- Lasers are categorised into various classes according to the amount of optical power they emit.
- It is important to know what these mean:
- Class 1
    - The output power is below the level at which it is believed eye damage will occur.
    - Exposure to the beam of a Class 1 laser will not result in eye injury and may therefore be considered safe
- Class 2
    - A person receiving an eye exposure from a Class 2 laser beam, either accidentally or as a result of someone else's deliberate action (misuse) will be protected from injury by their own natural aversion response
- Class 3R
    - The laser beams from these products exceed the maximum permissible exposure for accidental viewing and can potentially cause eye injuries, but the actual risk of injury following a short, accidental exposure, is still small.
- Class 3B
    - Class 3B lasers may have sufficient power to cause an eye injury, both from the direct beam and from reflections.
- Class 4
    - Have an output power greater than 500 mW (half a watt).
    - There is no upper restriction on output power.
    - Capable of causing injury to both the eye and skin and will also present a fire hazard if sufficiently high output powers are used.
- In “enterprise” communications equipment, lasers more powerful than Class1 are rarely encountered (but always check !).
- Class 3 lasers are sometimes encountered in long-haul, DWDM carrier networks.

Radio

- Wireless LAN
- No cables
- High frequency radio signals
- Each workstation has a transceiver / antenna
- Also includes mobile phone technology, microwave transmission, satellite for longer distances
- Expensive, history of poor security (now down to ignorance, strong encryption available now),
- Susceptible to interference
- More on this later