Computer Networks

Topic 5:

Network Media & Connectors

V1.0

Computer Networks

Topic 5 – Lecture 1:

Network Media

V1.0

Scope and Coverage

This topic will cover:

- Network media
- Network connectors
- Selecting media and connectors

Learning Outcomes

By the end of this topic, students will be able to:

- Categorise network cables and connectors
- Describe the usage of network cables and connectors

Network Media

- Support the sending and receiving of signals
- For each media type, we require knowledge of:
  - Physical characteristics
  - Limitations
- Each medium has a unique design and usage with implications for:
  - Cost
  - Performance
  - Installation

Physical Media

- Factors to consider when choosing network media:
  - Bandwidth rating
  - Maximum segment length
  - Maximum number of segments per internetwork
  - Maximum number of devices per segment
  - Interference susceptibility
  - Connection hardware
  - Cable grade
  - Bend radius
  - Costs of materials and insulation

Bandwidth

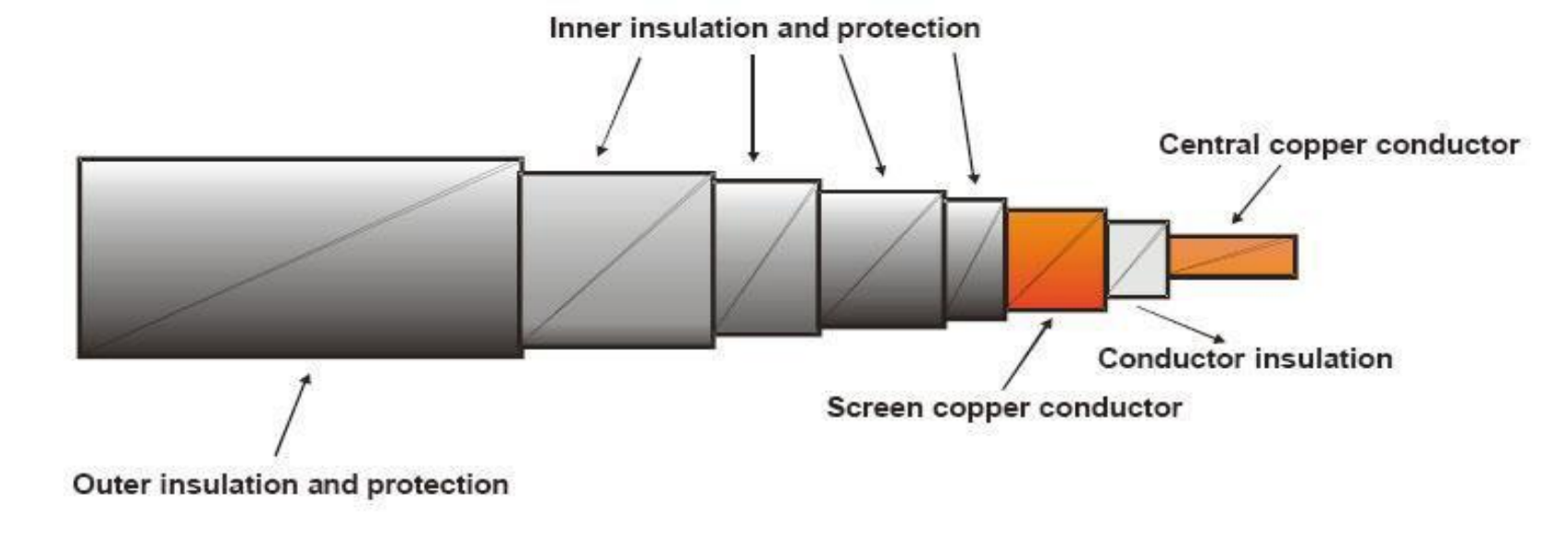
- In analogue systems, this describes the band of frequencies that can carry information.
- In digital, the number of bits per second
- Customers demand more complex and powerful services and these require a much higher bandwidth.
- Bandwidth limits of existing technologies have been expanded:
  - Older networking components can remain in use
  - Supports higher bandwidth than originally rated

Physical Cable Types

- Carry a physical signal that may be:
  - Electrical
  - Light pulses
- The primary cable types are:
  - ***Coaxial cable***
  - ***Twisted-pair***
  - ***Fibre-optic cable***

Coaxial Cable

- Was the main original form of network cabling
- Now obsolete
- Contains shielding - protective layer(s) wrapped around cable to protect it from external interference



Twisted Pair Cable

- Unshielded Twisted Pair (UTP)
- Most popular LAN cabling type
- 10BaseT
  - Maximum length is 100 meters
- Includes one or more pairs of insulated wires
- Specifications give the number of twists per foot (or per metre).

10BaseT

- *10* for 10 Mbps operation
- *Base* for baseband
- *T* for twisted pair
- Maximum length per segment 100 meters (330 ft)
- Maximum of 2 devices per segment
  - one is the station and the other is the hub
- Uses a star topology

UTP Cabling Categories

- UTP cabling is rated according to a number of categories devised by the ***TIA*** and ***EIA***
  - Cat1: 0.4 MHzTelephone and modem
  - Cat2: Unsuitable for modern systems
  - Cat3: 16MHz10BASE-T and 100BASE-T4 Ethernet
  - Cat4: 20MHz16 Mbit/s Token Ring
  - Cat5: 100MHz 100BASE-TX & 1000BASE-T Ethernet
  - Cat6: 250MHz 1000BASE-T Ethernet
  - Cat6a: 500MHz 10GBASE-T (under development)
- Cat5 and Cat6 are the most common

Fibre Optic Cable

- The core and cladding are made of ultra-pure glass.
- Light is guided down the centre of a fibre and reflects off the inner surface.
- Each fibre is protected by a plastic buffer coating.
- Further protection from the outer covering.

Fibre Optic Cable Types

- Two types:
  - ***Single-mode***: costs more and generally works with laser-based emitters, but spans the longest distances
  - ***Multimode***: costs less and works with light emitting diodes (LEDs), but spans shorter distances
- Installation is more difficult, time-consuming and costly than copper wire.

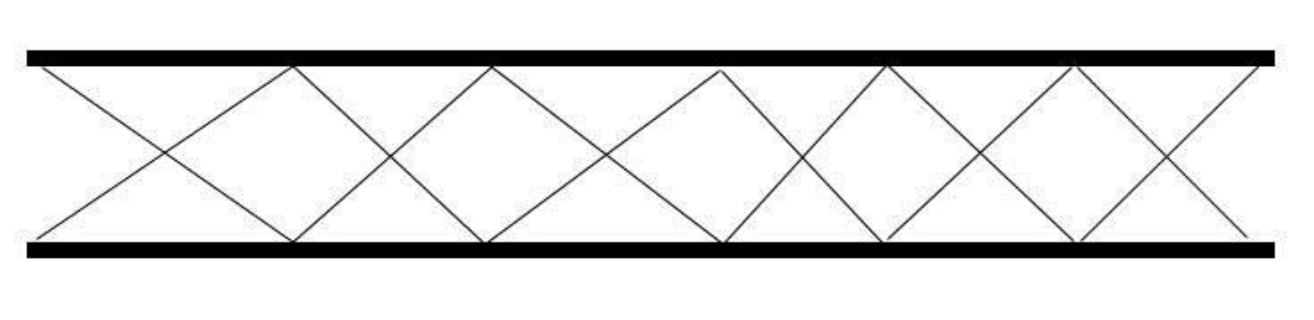
Fibre Optic Advantages

- Immune to electrical interference
- Can cover large distances
- High transmission speeds
- Not easily tapped

The big disadvantage is cost.

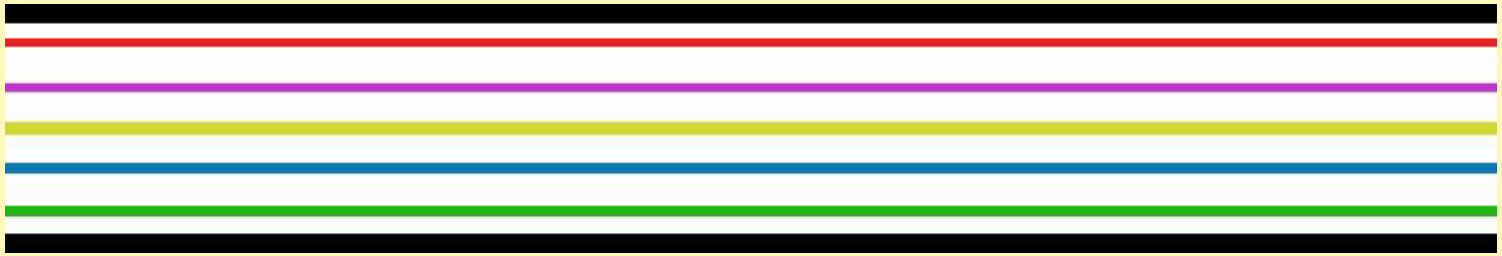
Multimode Fibre Optic

- Early fibre optic cables
- Light signals from a laser are broken up into a number of paths.
- Each is reflected off the internal wall of the fibre.
- Signal quality is determined by the amount of reflection.



Monomode Fibre Optic

- Single stream down each strand
- Further developed to allow multiple frequencies to be sent down the same core
- Allows for greater distances and transmission speeds



Wireless Media

- Media does not have to be physical.
- Wireless connections are also network media.
- Frequency is measured in ***Hertz***
  - Affects the amount and speed of data transmission
  - Lower-frequency transmissions carry less data more slowly over longer distances
  - ***Radio*** -10 KHz (kilohertz) to 1 GHz (gigahertz)
  - ***Microwave*** -1 GHz to 500 GHz
  - ***Infrared*** - 500 GHz to 1 THz (terahertz)

Computer Networks

Topic 5 – Lecture 2:

Network Connectors

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Connectors

- Network consists of:
  - ***Nodes***
  - ***Media***
- Also need to connect the media to the nodes
- Range of devices for doing this
- Choice depends upon
  - Cable type
  - Network type
  - Device

Coaxial Cable Connector

- Most common type of connector used with coaxial cables is the ***Bayonet Neill-Concelman*** (BNC) connector
- E.g. 10Base2 thin Ethernet (now obsolete)
- Different adapters available for BNC connectors
  - ***T-connector***
  - ***Barrel connector***
  - ***Terminator***

UTP Connectors

- UTP comes in 2 main forms:
  - ***Two-pair*** (four wire) for telephone
  - ***Four-pair*** (eight wire) for data networks
- Each has a different connector:
  - ***RJ-11*** for four-wire telephony
  - ***RJ-45*** for eight wire data networks

RJ-11

- RJ stands for ***registered jack***
- Strictly this is a combination of plug and wiring configuration
- Used for a single telephone line

RJ-45

- The standard connector for UTP cabling in data networks
- Like a large telephone-style connector
- Made of plastic
- Can only be inserted one way
- Standard designates which wire goes with each pin inside the connector

Wiring an RJ-45 Connector

- The wiring configuration depends upon the standard being followed.
- Private Study Exercise 2 asks you to investigate the wiring configurations.

Fibre Optic Connectors

- Terminate the end of an optical fibre
- Enable connection faster than splicing
- Align the cores of fibres so that light can pass
- Common connectors are:
  - FC
  - LC
  - MT-RJ
  - SC
  - ST

FC Connectors

Ferrule Connector

- A popular connector for monomode fibre optic cable
- A screw on connection
- Must have the key aligned in the slot properly before tightening
- It is steadily being replaced by SCs and LCs.

LC Connectors

Lucent Connector (or Local Connector)

- A relatively recent connector that is smaller than many others
- A standard ceramic ferrule connector
- It is easily terminated with adhesive
- Good performance
- Used widely in monomode

MT-RJ Connectors

Mechanical Transfer Registered Jack

- A duplex connector
- Both fibres in a single polymer ferrule
- Uses pins for alignment
- Has male and female versions
- Multimode only

SC Connectors

Subscriber Connector (or Square Connector or Standard Connector)

- A snap-in connector
- Widely used in monomode systems
- Has excellent performance
- Connects with a simple push-pull motion
- Also available in a duplex configuration

ST Connectors

Straight Tip

- Most popular connector for multimode networks
- Has a bayonet mount and a long cylindrical ferrule to hold the fibre
- Ferrules are usually ceramic
- Ferrules are spring-loaded; you have to make sure they are seated properly.

USB Connectors

Universal Serial Bus

- Developed as a means to connect a large number of devices to the PC
- The standard for peripherals
- Allows Plug and Play - no special user-knowledge required to install a new device
- All devices distinguishable from other devices
  - the correct driver software was always automatically used

USB 2.0

- The most common implementation
- Very easy to connect
- Half-duplex
- USB 3.0 has been developed:
  - Higher data speeds
  - Less power consumption
  - Full duplex

NIC

Network Interface Card

- Required for a computer to communicate on a network.
- Establishes and manages the computer's network connection
- Translates incoming/outgoing messages
- Modern computers have a NIC built in

Computer Networks

Topic 5 – Lecture 3:

Selecting Media and Connectors

V1.0

Selection Criteria

- Factors to be considered:
  - Bandwidth
  - Budget
  - Capacity
  - Placement
  - Existing cables
  - Environmental considerations
  - Geographic area
  - Specifics of organisation and location

Small Networks

- For small networks, such as a home network or small office, common choices are:
  - Ethernet using 10BaseT for a network using physical media
  - Wireless LANs are becoming more common due to ease of setting up and accessing the network.
- For larger organisations covering several office and/or buildings, a more structured approach is required

Cable Choice

- Most networks use some type of unshielded twisted-pair cabling.
- Some organisations use optic fibre directly to their desktop machines.
- Wireless is an option
- Ideally use Cat5e UTP as a minimum, if using cable

Installation Standards

- Two standards bodies have recognised standards for the installation of data networks:
  - ***The Telecommunications Industry Association*** (TIA)
    - TIA-568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standard, 2009
  - ***The International Organization for Standardization*** (ISO)
    - ISO 11801, 2nd Ed., Information technology - Generic Cabling for Customer Premises, 2002

Structured Cabling

- Uses an extended star physical topology
- Can be applied to any size network
- Cabling is organised into 6 components:
  - Work area
  - Horizontal wiring
  - Telecommunications closets
  - Equipment rooms
  - Vertical wiring
  - Entrance facilities

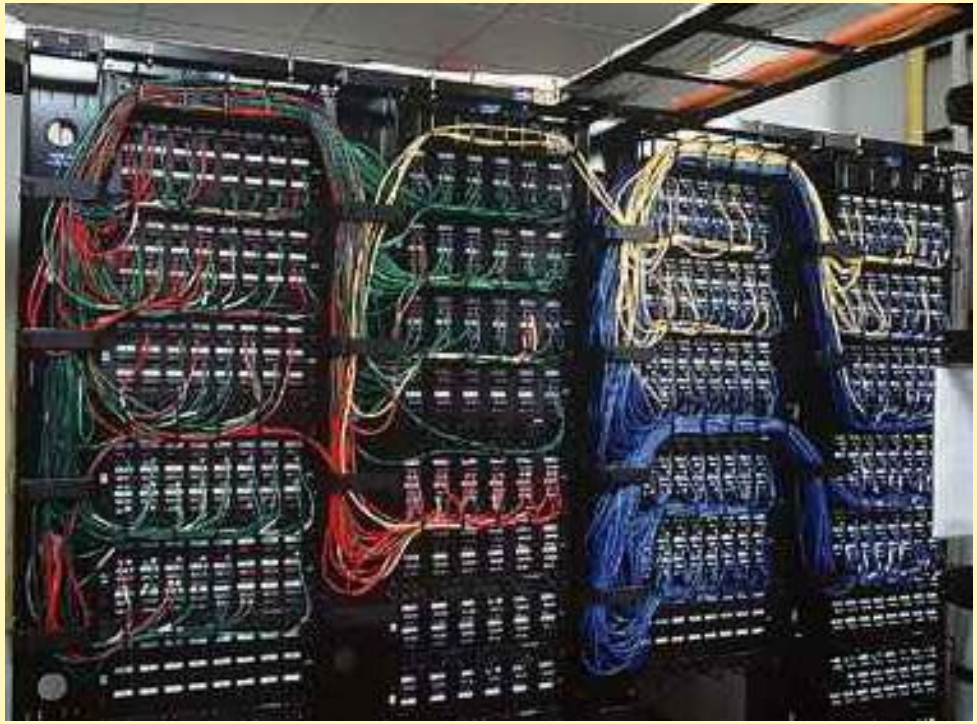
Work Area

- Room containing workstations and peripherals
  - ***Faceplates*** and wall jacks are installed.
  - ***Patch cables*** connect computers and printers to wall jacks.
  - ***Wall jacks*** connect to a telecommunications closet.
  - Patch cables should be less than 6 meters long.
  - Standard requires at least one voice and one data outlet on each faceplate in each work area.
  - Connection between wall jack and ***telecomms closet*** (TC) is made via horizontal wiring.

Faceplate & Patch Cable

Telecommunications Closet

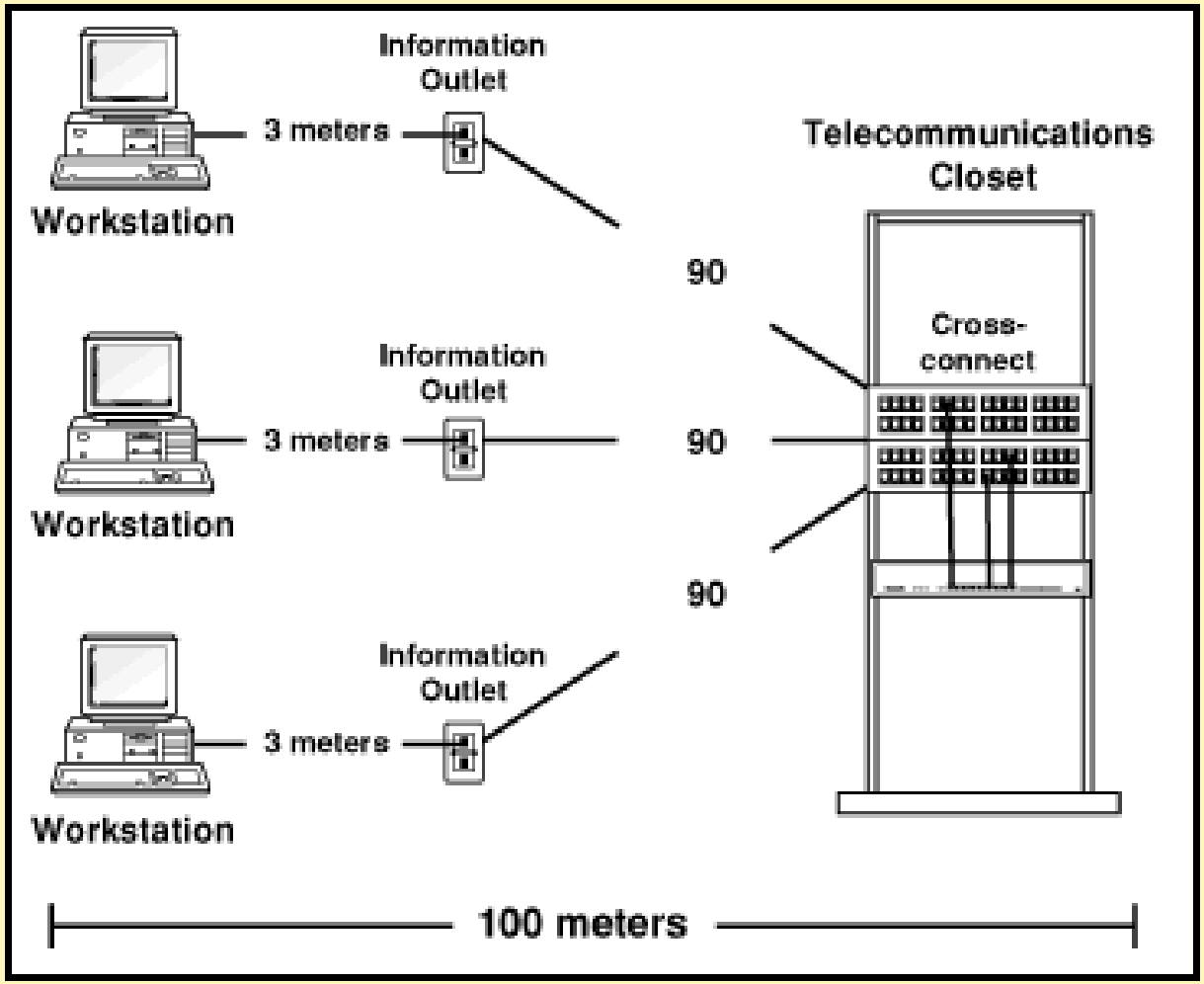
- Also known as cable closet



Horizontal Wiring

- Runs from the work area wall jack to the telecommunications closet
- Types include four-pair UTP (Category 5e or 6) or two fibre-optic cables
- Horizontal wiring from the wall jack to the patch panel should be no longer than 90 metres
  - Patch cables in the work area and in the telecommunications closet can total up to 100 meters

Structured Cabling Max Distances



Equipment Rooms

- Contains servers, routers, switches, and other major network equipment
- Serves as a connection point for vertical cabling running between TCs
- In installations covering several buildings, each building may have its own equipment room.

Vertical Cabling

- Interconnects telecommunications closets and equipment rooms
- Runs between floors and between buildings
- Often fibre optic (but can be UTP)
  - Multimode fibre optic, up to 2000 meters
  - Single-mode fibre optic, up to 3000 meters
  - Between equipment rooms and TCs, distance is limited to 500 metres for both fibre optic cable types
  - From the main cross-connect to equipment rooms, fibre optic cable can run up to 1500 meters

Entrance Facilities

- The location of the cabling and equipment connecting corporate network to telecoms provider
- Can also serve as an equipment room and the main cross-connect for all vertical cabling
  - Where a connection to a WAN is made
  - Where corporate LAN equipment ends and a third-

    party provider's equipment and cabling begins

Wireless Networks

- Remember that wireless networking is gaining in popularity
- Acts like a wired network
- Uses ***electromagnetic frequencies***:
  - Radio
  - Microwave
  - Infrared
  - Laser

References

- Elliot, B. (2002). *Designing a Structured Cabling System to ISO 11801,* 2nd edition. Woodhead Publishing Ltd.
- British Telecom (2004). *BT Structured Cabling*, British Telecom
- Tomsho, G. (2006). *Guide to Networking Essentials,* 5th edition. Course Technology.

Topic 5 – Network Media & Connectors

Any Questions?