



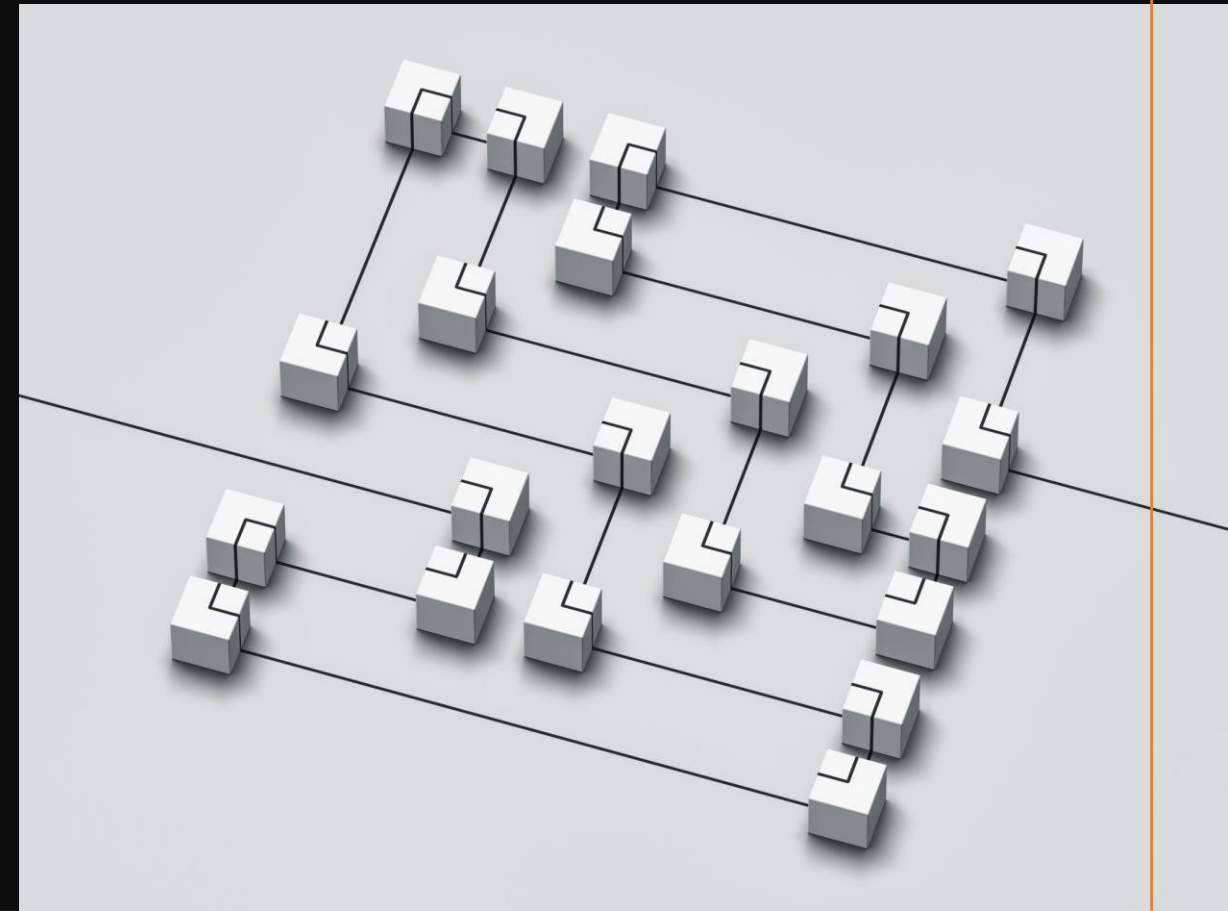
Scalable Campus Network Design & Operations Workshop -*Structured Cabling*

Moses Ojiambo

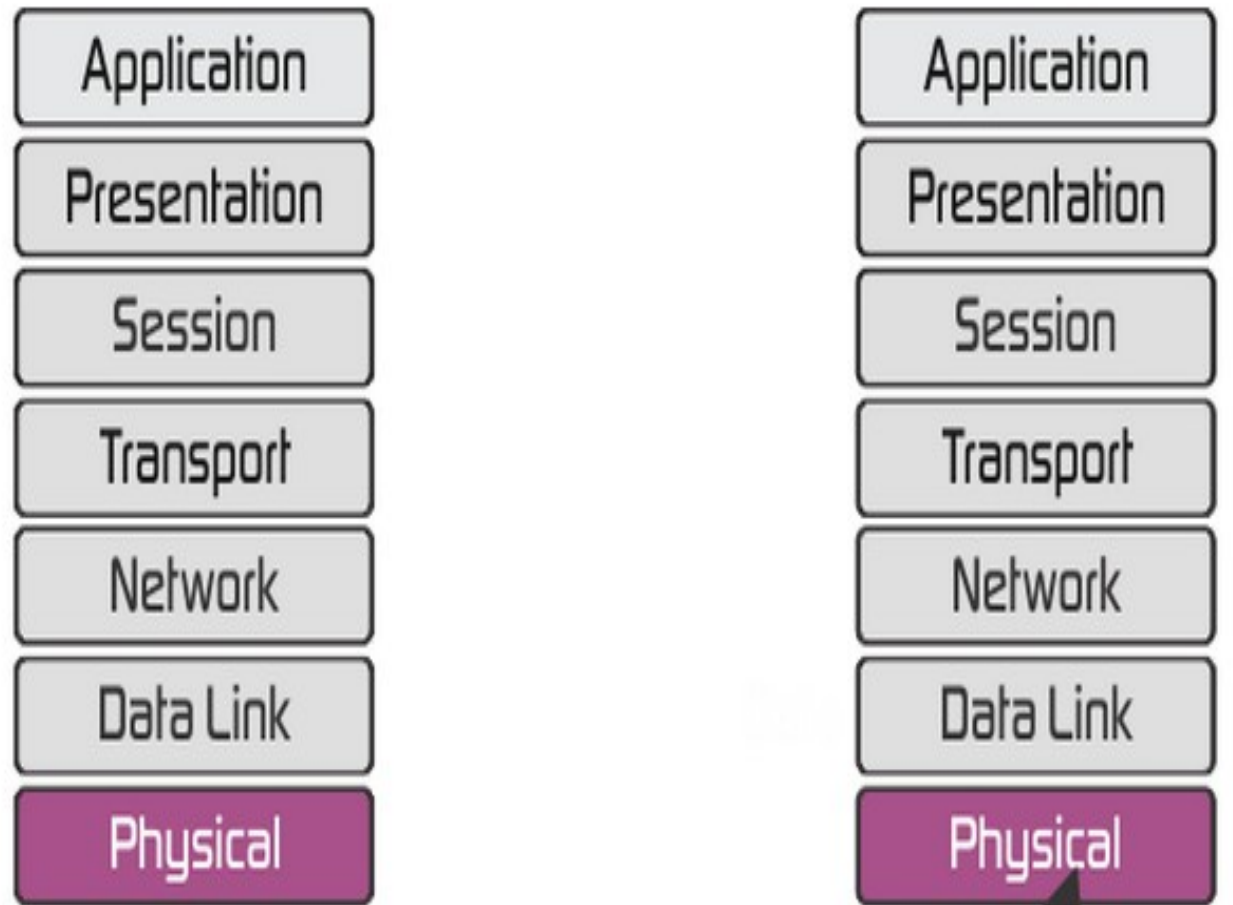
*Transforming learning research and working
environments with ICT*

Agenda

- Physical Infrastructure (Cabling & Cable Installation)
- Fiber Optics



Physical Layer



Optical Fiber/Copper wire/Electromagnetic waves



Campus Networks Challenges

- **Bad cabling/ unstructured** – No support for high bandwidth
- **Unmanaged devices** – “the enemy” – Cheap is expensive!
- **Daisy Chains (Cascades)** – violating STP device limit
- **NO Monitoring (Network Management Systems)**
- **Frequent Power outages**



Components of Structured Cabling

1. Horizontal Cabling
2. Backbone Cabling
3. Work Area
4. Telecommunication closet/ enclosure
5. Equipment Room
6. Entrance Facility

Physical Layer Functions

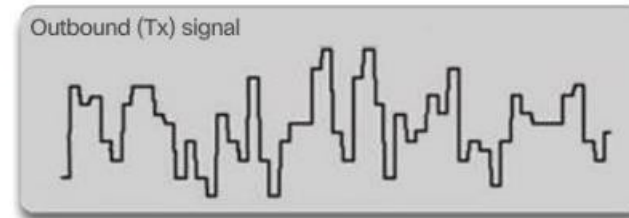
- Provides means to transport the bits
- Encodes bits as series of signals and transmits onto local media

Characteristics

- Bandwidth
- Throughput

Purpose of the Physical Layer
Physical Layer Media

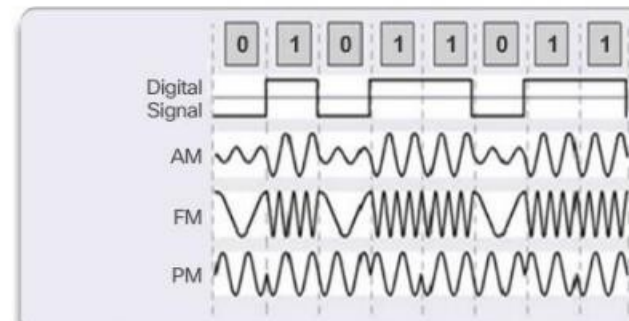
Three basic forms of network media



Electrical Signals -
Copper cable



Light Pulse -
Fiber-optic cable



Microwave Signals -
Wireless

Copper Cabling - Characteristics

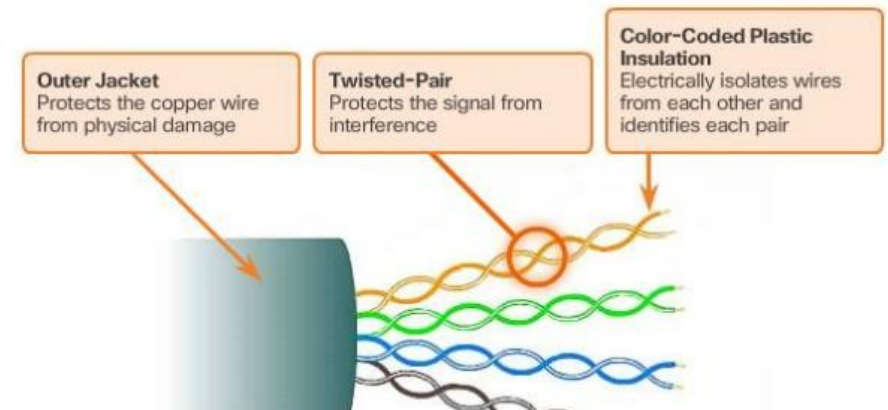
- Transmitted as electrical pulses
- Attenuation - the longer the signal travels, the more it deteriorates
- Strict distance limitations - 80m (practical)
- Electromagnetic interference (EMI) or Radio Frequency Interference (RFI) - distorts and corrupts data signals being transmitted (to counter copper cables are wrapped in shielding)
- Crosstalk - disturbance caused by electromagnetic fields of a signal on one wire to the signal in an adjacent wire (to cancel crosstalk opposing circuit wire pairs are twisted together)



Copper Cabling - UTP

Unshielded Twisted-Pair Cable

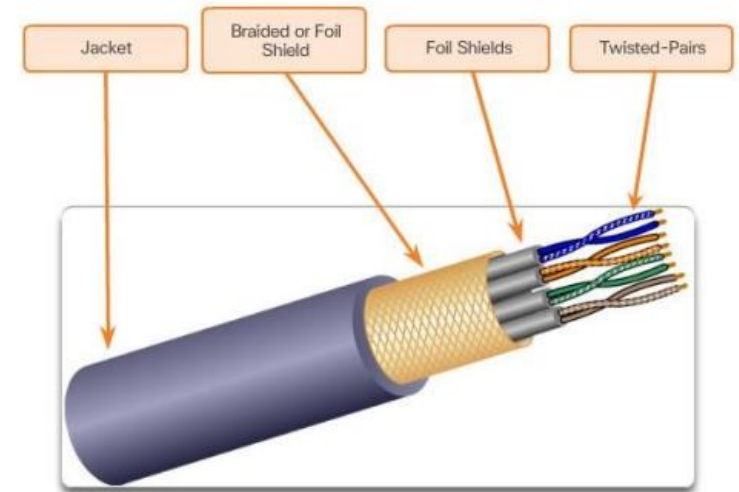
- UTP cabling is the most common networking media.
 - Terminated with RJ-45 connectors.
 - Used for interconnecting network hosts with networking devices such as switches.
 - Consists of four pairs of color-coded wires that have been twisted together to help protect against signal interference from other wires.
 - Color codes aid in cable termination.



Copper Cabling - STP

Shielded Twisted-Pair (STP) Cable

- STP provides better noise protection than UTP.
- STP cable is significantly more expensive and difficult to install.
- Uses an RJ-45 connector.
- Combines the techniques of shielding to counter EMI and RFI, and wire twisting to counter crosstalk.
- Uses four pairs of wires, each wrapped in a foil shield, which are then wrapped in an overall metallic braid or foil.



Copper Cabling Components



Inside a Network Cabinet

- A. *Rack Mount UPS atleast 1kVA*
- B. *Network Switch*
- C. *Patch Panel*
- D. *Cable Manager*
- E. *1m Patch Cords*
- F. *ODF (if fiber terminates here)*





Copper Cabling Installation Don'ts

Safety

-

EMI & Crosstalk minimization

-

Don't overload

-

Don't overlay

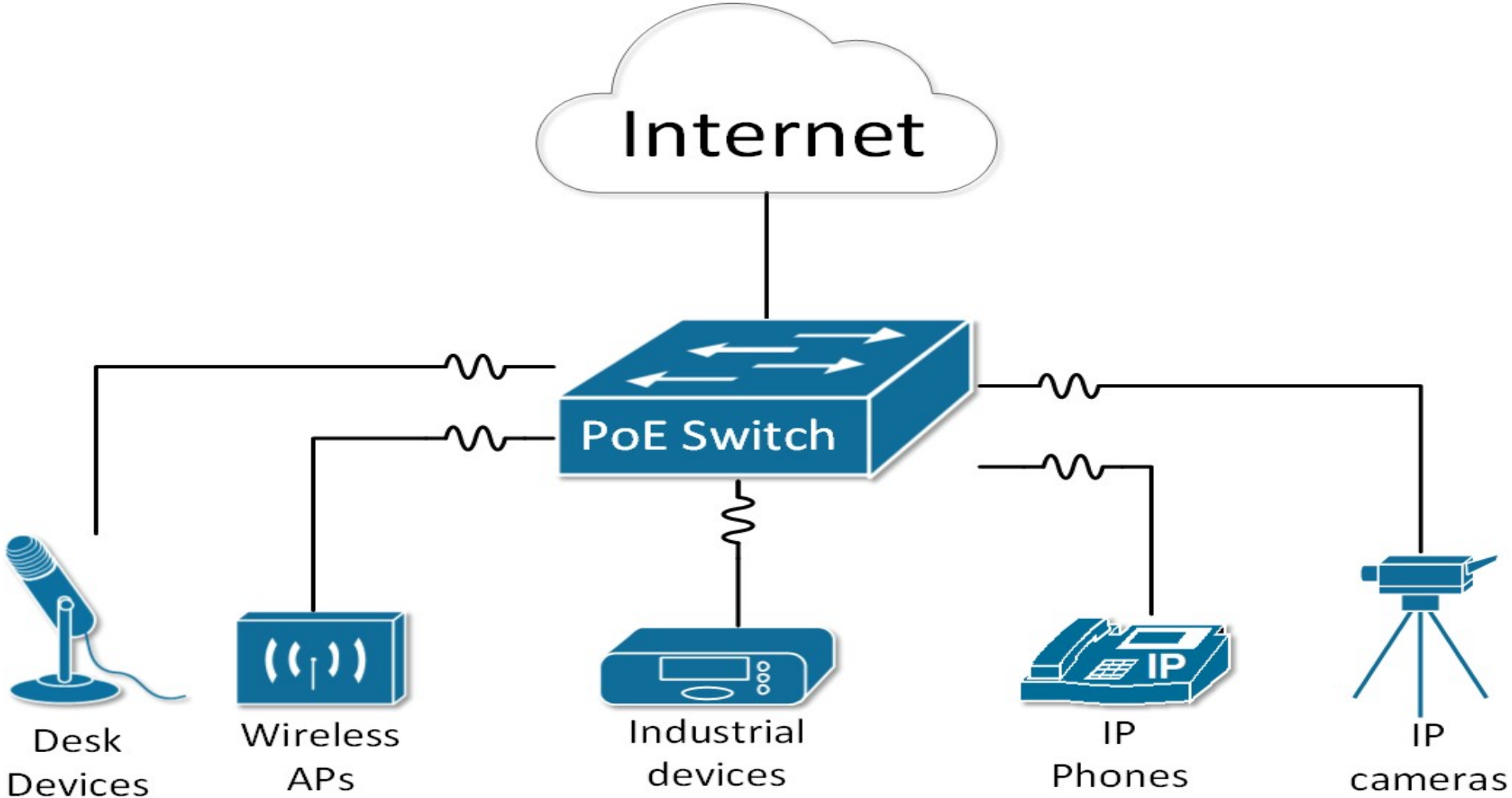
- Don't layer two types of Cables

Copper Cabling Do's

- Do cross cables at right angles
- Do use labels
- Do test cables (testing & certification)
- Do measure cable length carefully
- Do document the cable plant
- Do consult an expert (Certified Cable installer)

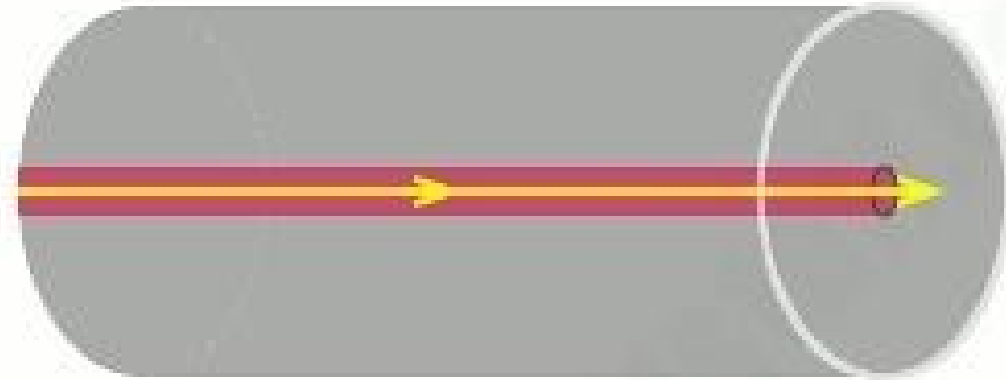


Power over Ethernet - PoE IEEE 802.3af/t

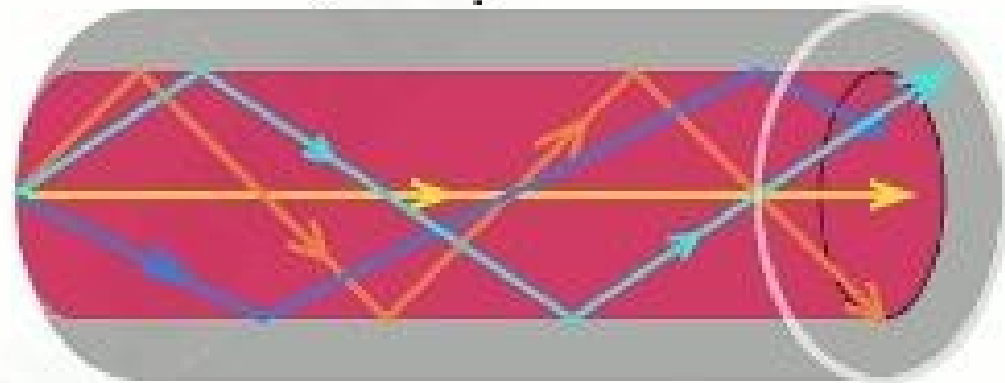


Introduction to Fiber Optics

Total internal reflection

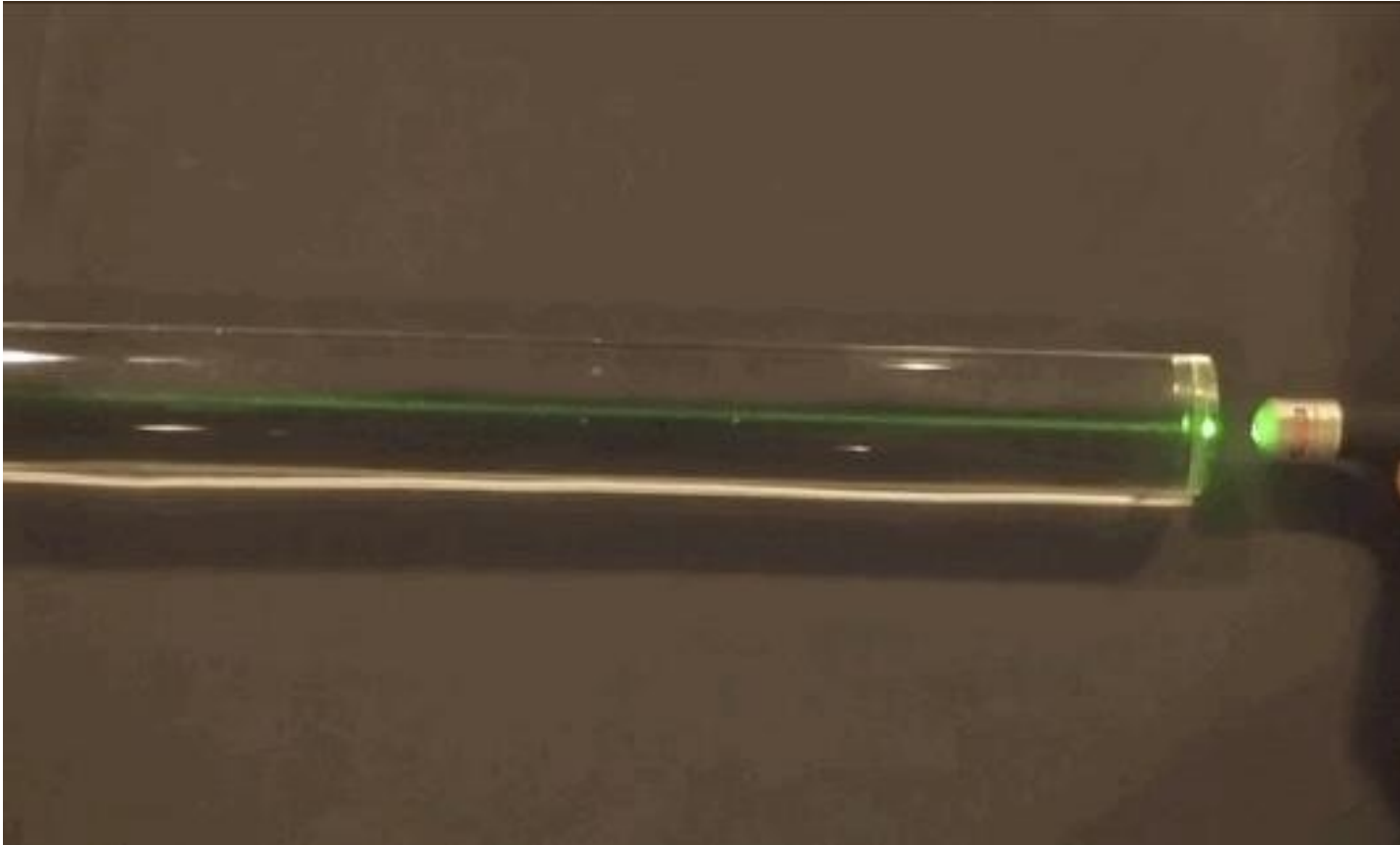


Single-mode fiber



Multi-mode fiber

How Fiber Works

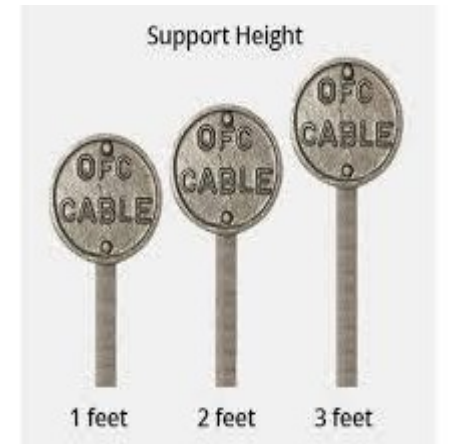
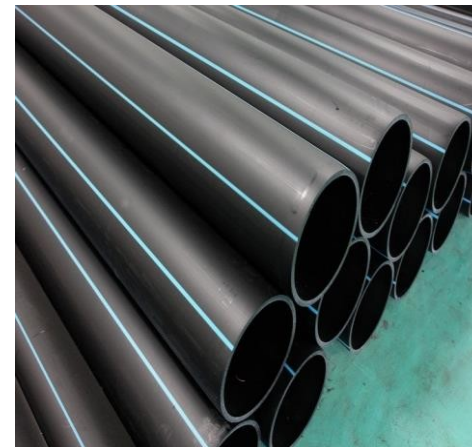




Advantages of using Fiber Optics

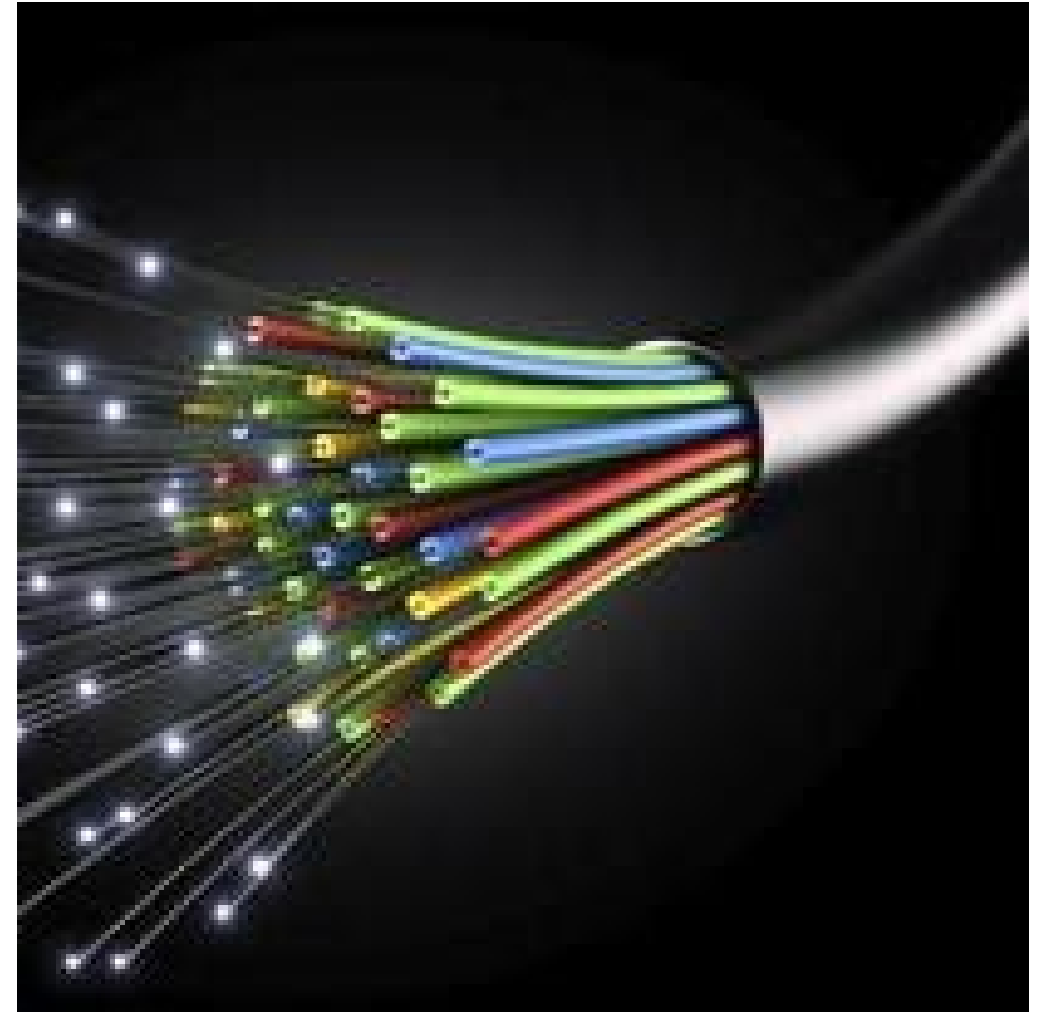
- A. *Long distance transmission with low latency*
- B. *Higher bandwidth*
- C. *Protection against crosstalk , EMI & RFI interference*

Fiber Plant Components

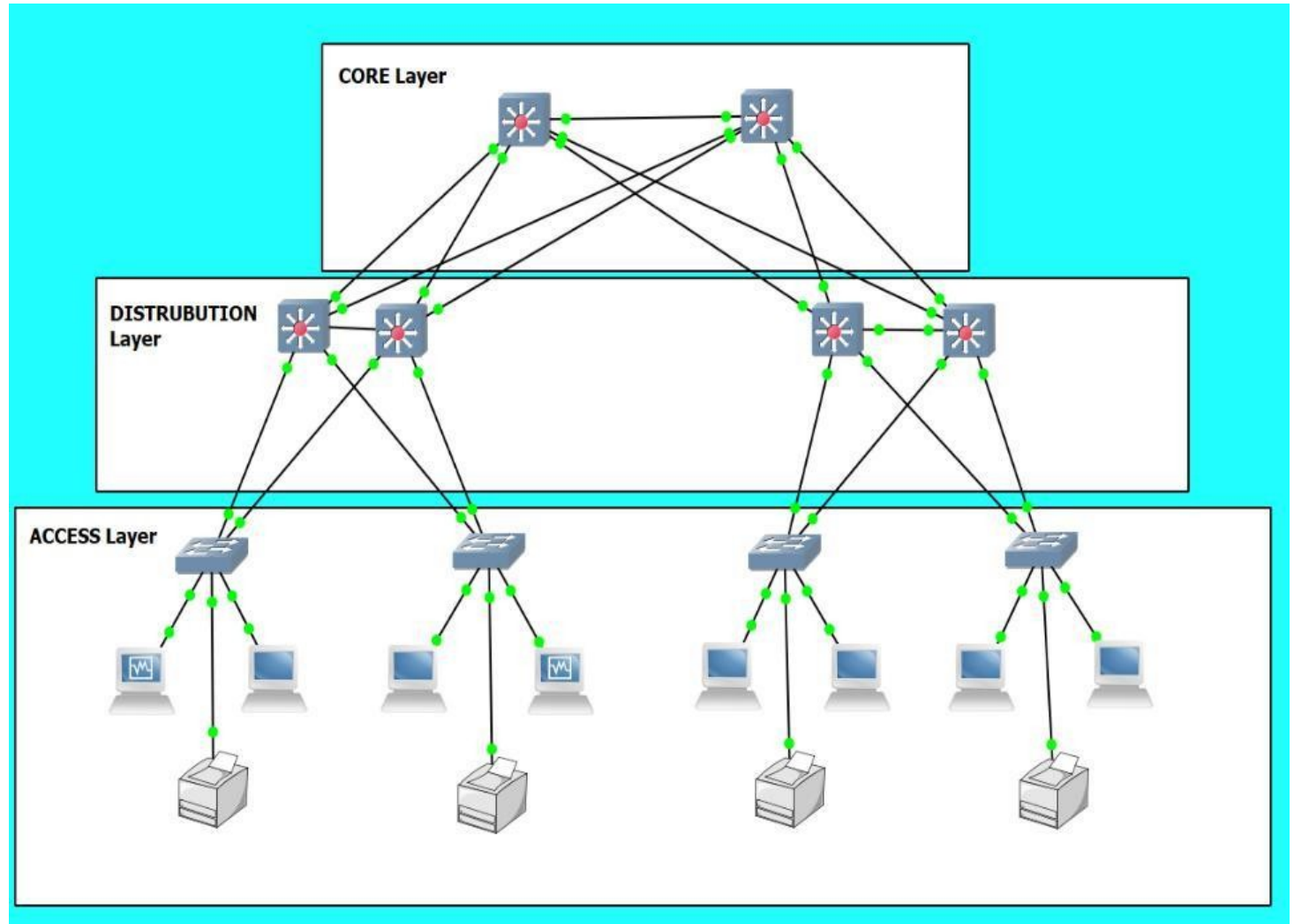


Optical Fiber Cable Design Considerations

- A. *Plan the Cable route - work with internal estates department*
- B. *Trenches 1.2m depth (warning tapes to be buried 0.5m above duct)*
- C. *Install fiber cable inside HDPE ducts*
- D. *Warning tapes to be buried 0.5m above ducts*
- E. *Manholes - Rectangular 1200m x 600m x 1200m*
- F. *Fiber Termination (Splicing) - Optical Distribution Frames (ODF) - **No Media Converters***
- G. ***Use Appropriate SFPs***
- H. *Test cable plant using OTDR, label and document*



Campus Network Architecture



Core Network Design (Server room/Data Centre)

Reliability is the GOAT! - Remember the whole network relies on the core

MUST Haves...

1. **Stable Electrical Power Supply** - AVR for voltage stabilization
2. **UPS backup** (*redundant UPSes as your network evolves*)
3. **Generator / Solar backup**
4. **Proper grounding /earthing**
5. Lightning arrestor for lightning prone areas
6. **Reliable air conditioning** - repair faulty ACs
7. **Network/ Server Cabinets**
8. **Fire Suppression** - minimum hand-held fire extinguisher

Q&A

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