Networking

Copper Cabling & Connections

Copper Cabling & Connections

- Guiding Question: How do different types of network media impact data transmission, connectivity, and overall network performance?

- Students will:
  - Define the characteristics of network media.
  - Construct networks using different types of media and network devices.

What do we need to network?

- **Hosts:** Computers that WANT to share - client workstations, laptops, servers.
- **Media:** A way to connect the different parts - cables or air.
- **Network Devices:** A place for them all to connect - switch or Router.
- **Peripherals:** Things to share - printer, scanner, copier, modem.
- **Services:** Data to share - files, website, email.

Network Media

- **CABLING TYPE:** What will carry the data signal?
- **SPEED:** How much data can be transmitted per second?
- **CONNECTOR:** What is the correct connector type for this media?
- **STANDARDS:** What is the naming scheme for this media?
- **DISTANCE:** How far can a signal travel through a particular type of media before degradation of the signal becomes a concern?

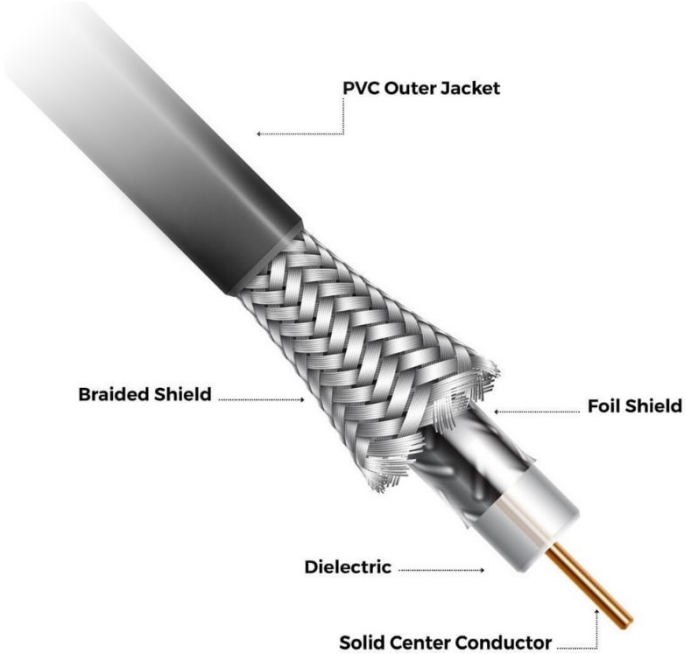
IEEE Standards

Just like roads needs rules to keep cars from crashing into each other, networks need rules to make sure data gets delivered safely.

- **Institute of Electrical & Electronics Engineers** (IEEE)
  - Create standards for digital equipment to achieve compatibility and quality control.
- The primary networking rules 802.3 Ethernet set the standards for how fast data will move and what kind of connections can be made.
- Example:
  - 802.3u Fast Ethernet - 100BaseT (100 Mbps)

Coaxial Cable

- **Type:** A copper core wire that is surrounded by insulators and other shields. RG-6 is the most commonly used coaxial cable.
- **Speed:** 10 Mbps
- **Connector:** F-type or BNC
- **IEEE:** 802.3 Ethernet – 10Base2
- **Distance:** 185 meters
- **Uses:** In households to deliver cable internet and television.



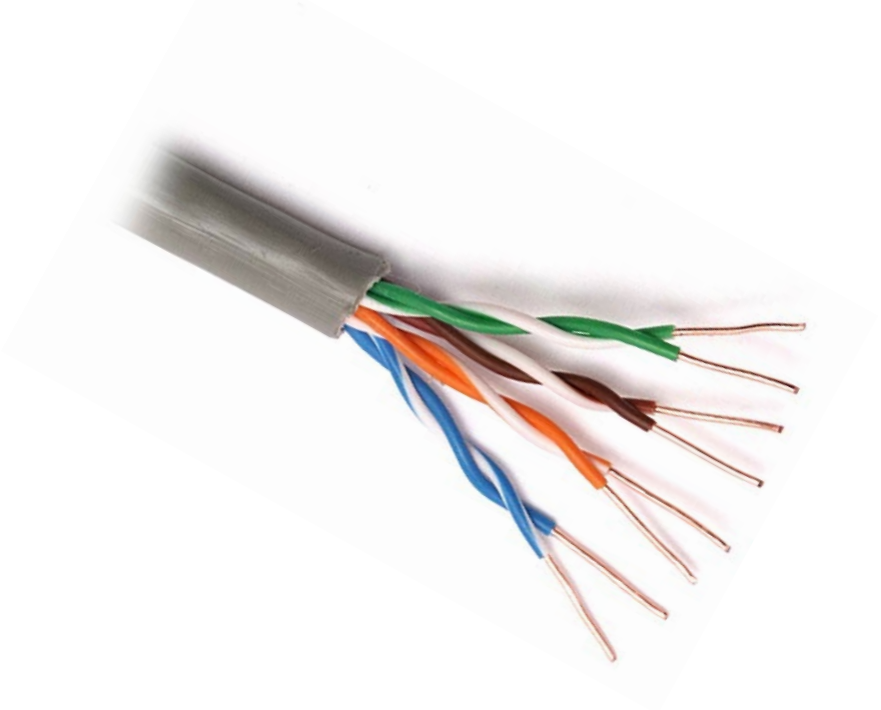
Direct Attach Copper (DAC) Cable

A special type of cable used in data centers for fast connectivity between network backbone devices.

- **Type:** Uses twinaxial cable.
- **Speed:** 10Gbps to 400 Gbps
- **Connector:** SF:+ or QSFP+
- **Distance:** 5 – 15 meters
- **Note:** Significantly cheaper than fiber optic.

Twisted Pair Cable

- **Type:** 4 pairs of twisted copper wires in a plastic casing.
  - Twisting the matching pairs helps reduces signal jumping to neighbor wires.
- **Distance:** 100 meters
- **Uses:** Indoor cabling of LANs.
- **Connectors:**
  - RJ-11 for Category 3 cabling (telephone). Uses only 3 pairs of wires.
  - RJ-45 for Category 5 – 8 cables



Speed and Standards

Cable	Speed	Standard	Name
Cat 3	10 Mbps	10Base-T	Ethernet
Cat 5	100 Mbps	100Base-TX	Fast Ethernet
Cat 5e or 6	1 Gbps	1000Base-T	Gigabit Ethernet
Cat 6a or 7	10 Gbps	10GBase-T	10 Gigabit Ethernet
Cat 8	40 Gbps	40GBase-T	[30 meters, alternative to DAC]

Plenum Cable

Plenum cable is a type of electrical cable specifically designed for use in areas within buildings used for air circulation, typically above dropped ceilings or below raised floors, and are crucial for HVAC systems.

- These cables are constructed with materials that resist fire and flame spread.
- They are designed to produce minimal smoke and toxic fumes when exposed to fire, ensuring occupant safety.
- Must comply with stringent fire safety regulations, such as those outlined by the National Fire Protection Association (NFPA).

Networking

Activity: Making Ethernet Cable

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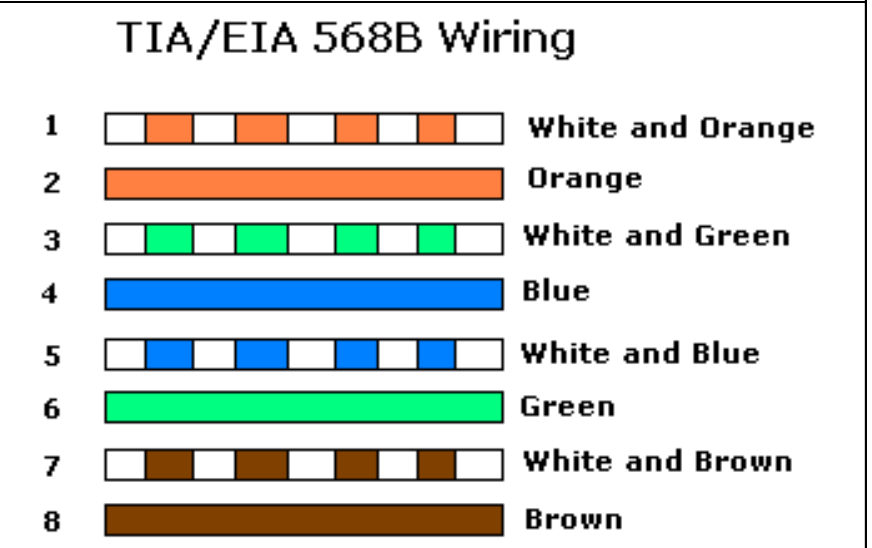
Activity

- Make Ethernet cables, then use cable tester and identify issues
  - Short
  - Mismatched wire pairs
  - Not enough twists
- Confirm that cable carries data between two devices.
- Test attenuation by making a cable longer than 100 meters
- Test EMI effects by running

Wiring Schemes

568A Wiring Scheme	**Transmit on Pins 3 & 6** **Receive on Pins 1 & 2**	
568B Wiring Scheme	**Transmit on 1 & 2** **Receive on 3 & 6**	

Tools for Cablemaking

- **Cable stripper** - used to cut just the outer insulation and leave the other wires untouched.

- **Crimping Tool** - used to squeeze the connector onto the wire. The pressure will push the gold electrical contacts down so that they cut through the insulation of all eight wires and make contact with the copper conductor.

- **Snips** - A specially designed scissor that can easily cut cables of all thickness and also has a notch for cable stripping.

Troubleshooting cable issues

- Interference in digital signals primarily comes from EMI = Electromagnetic Interference
- EMI happens when electrical bits from other sources jump onto the wire carrying the intended signal. Heavy machinery like A/C and overlapping electrical wiring are common sources of EMI.
- *Crosstalk* is a type of EMI when the source of the extra bits is a neighboring wire inside the actual cable.

LAB: Create an Ethernet Cable

- Use lab instructions plus this video https://www.youtube.com/watch?v=ZGBnn-rZOng

LAB: Walljack to Patch Panel Termination

- Use lab instructions plus these 2 videos
- Walljack video: https://www.youtube.com/watch?v=Z7HVbhnCWEQ
- Patch Panel video: https://www.youtube.com/watch?v=TgvmM6R8rQc