CSF 432: Intro to Network and System Security

Week 07 - Review

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Sources: Professor Messer's CompTIA N10-007 Network+ Course Notes

Copper Cabling

Cable Category	Maximum Supported Ethernet Standard	Maximum Supported Distance
Category 3	10BASE-T	100 meters
Category 5	100BASE-TX, 1000BASE-T	100 meters
Category 5e (enhanced)	100BASE-TX 1000BASE-T	100 meters
Category 6	10GBASE-T	37 to 55 meters
Category 6A (augmented)	10GBASE-T	100 meters
Category 7	10GBASE-T	100 meters

Copper Cabling

The importance of cable

- Fundamental to network communication
  - Incredibly important foundation
- Usually only get one good opportunity at building your cabling infrastructure
  - Make it good!
- The vast majority of wireless communication uses cables
  - Unless you're an amateur radio operator

Copper Cabling

Twisted pair copper cabling

- Balanced pair operation
  - Two wires with equal and opposite signals
  - Transmit+, Transmit- / Receive+, Receive-
- The twist keeps a single wire constantly moving away from the interference
  - The opposite signals are compared on the other end
- Pairs in the same cable have different twist rates

Copper Cabling

Twisted pair copper cabling

- UTP (Unshielded Twisted Pair)
  - No additional shielding
  - The most common twisted pair cabling

- STP (Shielded Twisted Pair)
  - Additional shielding protects against interference
  - Shield each pair and/or the overall cable
  - Requires the cable to be grounded

- Abbreviations
  - U = Unshielded, S = Braided shielding, F = Foil shielding
- (Overall cable) / (individual pairs)TP
  - Braided shielding around the entire cable and foil around the pairs is S/FTP
  - Foil around the cable and no shielding around the pairs is F/UTP

Copper Cabling

Network cabling standards

- Electronic Industries Alliance (EIA)
  - Alliance of trade associations
  - Develops standards for the industry
  - Standards start with RS-# (Recommended Standard) or EIA-#
- Telecommunications Industry Association (TIA)
  - Standards, market analysis, government affairs, etc.
  - ANSI/TIA/EIA-568 - Commercial Building Telecommunications Cabling Standard
- International ISO/IEC 11801 cabling standards
  - Defines classes of networking standards

Copper Cabling

Plenum space

- Building air circulation - Heating and air conditioning system
- Concerns in the case of a fire - Smoke and toxic fumes
- Worst-case planning - Important concerns for any structure

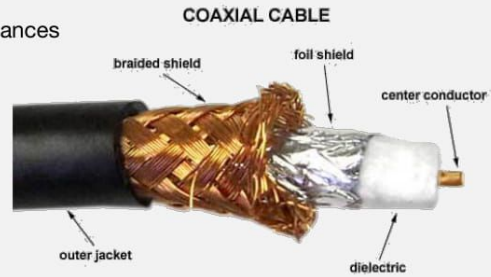
Plenum-rated cable

- Traditional cable jacket
  - Polyvinyl chloride (PVC)
- Fire-rated cable jacket
  - Fluorinated ethylene polymer (FEP) or low-smoke polyvinyl chloride (PVC)
- Plenum-rated cable may not be as flexible
  - May not have the same bend radius

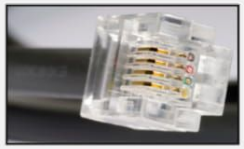
Copper Cabling

Coaxial cables

- Two or more forms share a common axis
- RG-6 used in television/digital cable
  - And high-speed Internet over cable
- RG-59 used as patch cables
  - Not designed for long distances



Copper Connectors



RJ-11 Connector

RJ-45 Connector

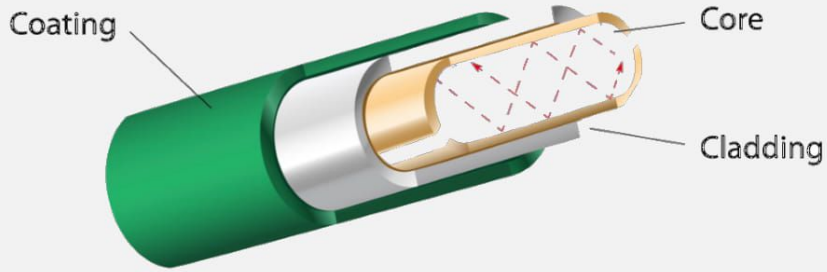
DB-9 connector

DB-25 connector

F-connector

BNC connector

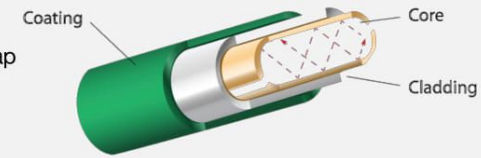
Optical Fiber



Optical Fiber

Fiber communication

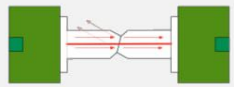
- ☑ Transmission by light
  - ☑ The visible spectrum
- ☑ No RF signal
  - ☑ Very difficult to monitor or tap
- ☑ Signal slow to degrade
- ☑ Transmission over long distances
  - ☑ Immune to radio interference - There's no RF



Optical Fiber

UPC vs. APC

UPC - Ultra-Polished Connectors



APC - Angle-Polished Connectors

- ☑ Controlling light-Laws of physics apply
- ☑ Return loss-Light reflected back to the source
- ☑ UPC (Ultra-polished connectors)
  - ☑ Ferrule end-face radius polished at a zero degree angle
  - ☑ High return loss
- ☑ APC (Angle-polished connectors)
  - ☑ Ferrule end-face radius polished at an eight degree angle
  - ☑ Lower return loss, generally higher insertion loss than UPC

Optical Fiber Connectors

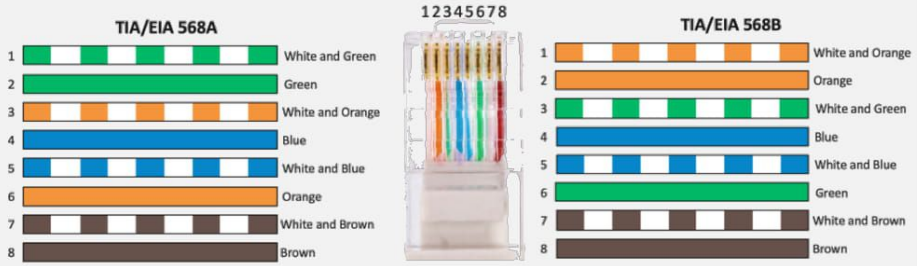
ST - Straight Tip

SC - Subscriber Connector

LC - Lucent Connector

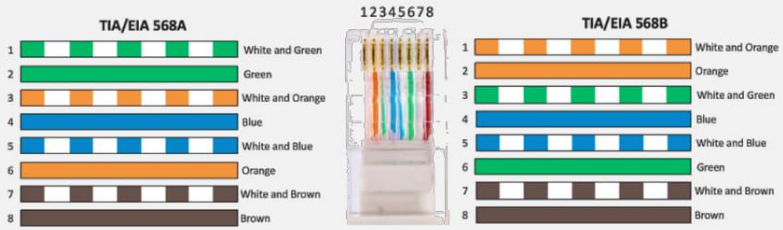
MT-RJ - Mechanical Transfer Registered Jack

Copper Termination Standards

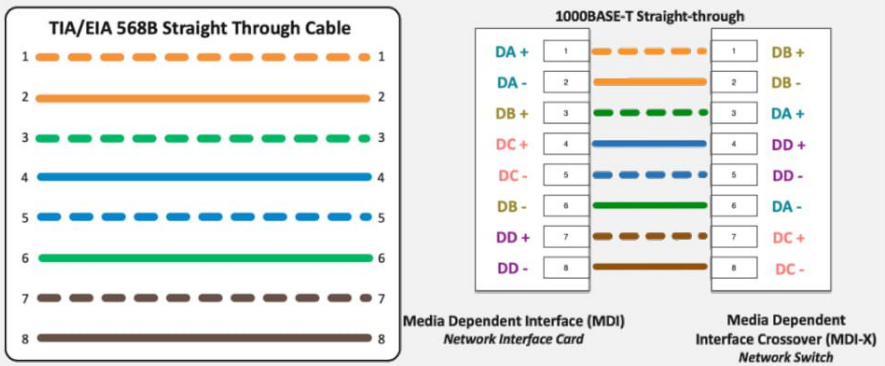


Copper Termination Standards

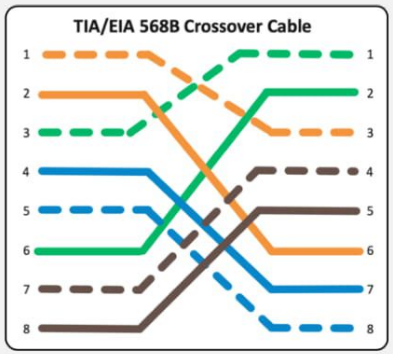
- Pin assignments in EIA/TIA-568-B - Eight conductor 100-ohm balanced twisted-pair cabling
- 568A and 568B are different pin assignments for 8P8C connectors
  - Specification assigns the 568A pin-out to horizontal cabling - Many organizations have traditionally used 568B
- You can't terminate one side of the cable with 568A and the other with 568B - You'll run into problems

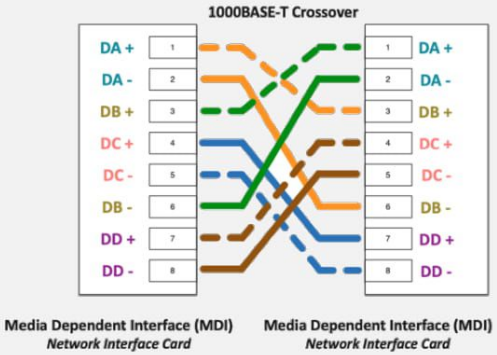


Copper Termination Standards

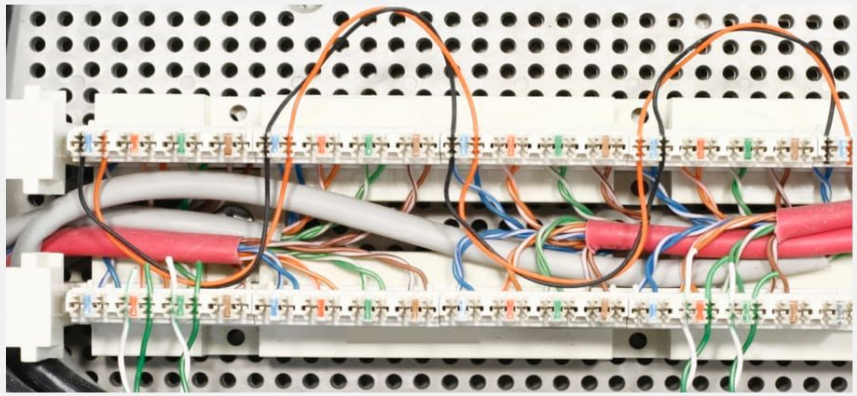


Copper Termination Standards





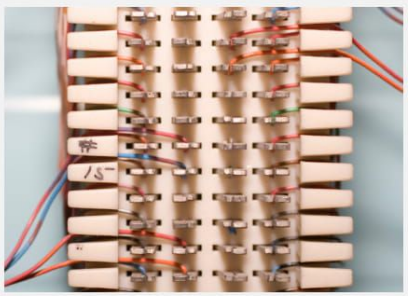
Network Termination Points



Network Termination Points

66 block

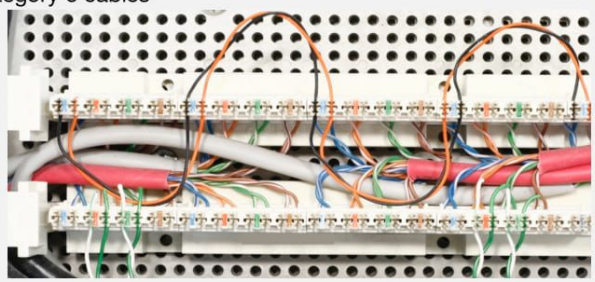
- A patch panel for analog voice
  - And some digital links
- Left side is patched to the right
  - Easy to follow the path
- Wire and a punch-down tool
  - No additional connectors required
- Generally replaced by 110 blocks
  - Still seen in many installations



Network Termination Points

110 block

- Wire-to-wire patch panel
  - No intermediate interface required
- Replaces the 66 block
  - Patch Category 5 and Category 6 cables
- Wires are “punched” into the block
  - Connecting block is on top
- Additional wires punched into connecting block
  - Patch the top to the bottom



Network Termination Points

Copper patch panel

- ☑ Punch-down block on one side, RJ45 connector on the other
- ☑ Move a connection around - Different switch interfaces
- ☑ The run to the desk doesn't move

Network Termination Points

Fiber distribution panel

- ☑ Permanent fiber installation - Patch panel at both ends
- ☑ Fiber bend radius - Breaks when bent too tightly
- ☑ Often includes a service loop
- ☑ Extra fiber for future changes

Network Transceivers

Network Transceivers

Transceiver

- ☑ Transmitter and receiver
- ☑ Usually in a single component
- ☑ Provides a modular interface
- ☑ Add the transceiver that matches your network

Network Transceivers

GBIC

- Gigabit Interface Converter
- An early transceiver standard
- Common on Gigabit and fiber channel networks
  - Copper and fiber support
- Relative large, and effectively replaced by SFPs

Network Transceivers

SFP and SFP+

- Small Form-factor Pluggable (SFP)
  - Commonly used to provide 1 Gbit/s fiber
  - 1 Gbit/s RJ45 SFPs also available
- Enhanced Small Form-factor Pluggable (SFP+)
  - Exactly the same size as SFPs
  - Supports data rates up to 16 Gbit/s
  - Common with 10 Gigabit Ethernet

Network Transceivers

QSFP

- Quad Small Form-factor Pluggable
  - 4-channel SFP = Four 1 Gbit/s = 4 Gbit/s
  - QSFP+ is four-channel SFP+ = Four 10 Gbit/sec = 40 Gbit/sec
- Combine four SFPs into a single transceiver
  - Cost savings in fiber and equipment
- Bi-Directional (BiDi) QSFP and QSFP+
  - Additional efficiency over a single fiber run

Network Transceivers

Duplex communication

- Two fibers
  - Transmit and receive

Network Transceivers

Bi-Directional (BiDi) Transceivers

- Traffic in both directions with a single fiber
  - Use two different wavelengths
- Reduce the number of fiber runs by half

Ethernet Standards

Ethernet Standards

100 Mbit/s Ethernet over copper

- 100BASE-TX
  - "Fast Ethernet"
  - Category 5 or better twisted pair copper - two pair
  - 100 meters maximum length

1000 Mbit/s (1 Gbit/s) Ethernet

- 1000BASE-T
  - Category 5 or better twisted pair copper - four pair
  - 100 meters maximum length

Ethernet Standards

1000 Mbit/s (1 Gbit/s) Ethernet (cont.)

- 1000BASE-SX
  - Gigabit Ethernet using NIR (near infrared) light wavelength
  - Usually over multi-mode fiber
  - 220 meters to 500 meters, depending on fiber type
- 1000BASE-LX
  - Gigabit Ethernet using long wavelength laser
  - Multi-mode fiber to 550 meters
  - Single-mode fiber to 5 kilometers

Ethernet Standards

10 Gbit/s Ethernet

- 10GBASE-T
  - 2006 standard
  - Frequency use of 500 MHz
    - Well above the 125 MHz for gigabit Ethernet
  - Twisted pair copper cables
    - Cat 6 – 55 meters
    - Cat 6A (augmented) – 100 meters
    - Cat 7 - 100 meters

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