

# Day 2: Interfaces and Cables

## CCNA 200-301 Study Guide: Physical Interfaces and Cabling

### 1.0 The Foundation of Networking: The Physical Layer

While often overlooked in favor of more complex topics like routing and switching, the Physical Layer is the fundamental building block upon which all network communication depends. If the physical connection is flawed, no amount of configuration at higher layers can compensate.

Its strategic importance is reflected in the CCNA curriculum under the "Network Fundamentals" domain, which constitutes 20% of the total exam score. Mastery of this layer involves developing a diagnostic mindset to solve common connectivity problems.

This guide addresses the following CCNA exam objectives:

- 1.3: Compare physical interface and cabling types (Fiber, Copper, Connections).
- 1.4: Identify interface and cable issues (collisions, errors, duplex/speed mismatches).

### 2.0 Core Concepts: Bits, Bytes, and Network Speed

Understanding the difference between bits and bytes is essential for evaluating network performance correctly.

- Bit: The smallest unit of data, represented as a binary 1 or 0.
- Byte: A group of 8 bits.
- Measurement Standard: Network bandwidth is measured in bits per second (bps), while storage is measured in Bytes (B).

## Network Speed Unit Conversions

Abbreviation	Name	Equivalent
Kbps	Kilobits per second	1,000 bps
Mbps	Megabits per second	1,000,000 bps
Gbps	Gigabits per second	1,000,000,000 bps
Tbps	Terabits per second	1,000,000,000,000 bps

## 3.0 Copper Cabling: The Workhorse of Ethernet

Unshielded Twisted Pair (UTP) is the most ubiquitous form of network media. It is defined by the IEEE 802.3 standards.

### Physical Characteristics of UTP

- Shielding: "Unshielded" means it lacks metallic foil, making it susceptible to Electromagnetic Interference (EMI).
- Twisted Pairs: Wires are twisted to cancel out EMI and reduce crosstalk.
- Connector: Uses an 8-pin RJ-45 connector.
- Distance Limitation: Maximum effective distance of 100 meters.
- Duplex: Modern copper Ethernet operates in Full-Duplex (simultaneous send/receive), eliminating collisions.

### Common Ethernet Standards (Copper)

Speed	Common Name	IEEE Standard	Cable Cat	Pairs Used
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100 Mbps	Fast Ethernet	802.3u	Cat5	2
1 Gbps	Gigabit Ethernet	802.3ab	Cat5e	4
10 Gbps	10 Gigabit Ethernet	802.3an	Cat6/6a	4

## 4.0 Wiring Schemes, Pinouts, and Device Connections

You must understand how devices transmit (TX) and receive (RX) data on specific pins.

### Device Grouping (MDI vs. MDI-X)

- Group A (MDI): Transmit on pins 1 and 2. (PCs, Routers, Wireless APs).
- Group B (MDI-X): Transmit on pins 3 and 6. (Switches, Hubs).

### Cable Selection

- Straight-Through Cable: Connects devices from different groups (e.g., PC to Switch). Pins are wired 1-to-1.
- Crossover Cable: Connects devices from the same group (e.g., Switch to Switch). Pin 1 is swapped with 3; Pin 2 is swapped with 6.
- Auto MDI-X: A modern feature that automatically detects and adjusts pinouts, allowing straight-through cables to be used for almost any connection.

## 5.0 Fiber Optic Cabling: For Speed and Distance

Fiber optics transmit data using pulses of light through a glass or plastic core. It is immune to EMI and supports much longer distances than copper.

Feature	UTP (Copper)	Fiber Optic
Cost	Low	High
Max Distance	Short (100m)	Long (Up to 100km)

EMI Immunity	Low	High (Total)
Security	Low	High

## Fiber Optic Types

1. Multimode (MMF):
  - Source: LED.
  - Core: Wider, allowing multiple paths (modes) of light.
  - Use Case: Short distances (building/campus), typically up to 550m.
2. Single-mode (SMF):
  - Source: Laser.
  - Core: Narrow, allowing only one path of light.
  - Use Case: Long-haul (cities/ISPs), reaching many kilometers.

## Common Fiber Optic Standards

Speed	Standard	Fiber Type	Max Distance
1 Gbps	1000Base-LX	SMF/MMF	5km (SMF) / 550m (MMF)
1 Gbps	1000Base-SX	MMF	550m
10 Gbps	10GBase-LR	SMF	10km
10 Gbps	10GBase-SR	MMF	300m

# 6.0 Physical Layer Troubleshooting Checklist

When a link is down, follow this systematic framework:

1. Distance: Check if the run exceeds 100m for copper.
2. Cable Type: Ensure the correct cable (Straight-through vs. Crossover) is used if Auto MDI-X is disabled.
3. Media Mismatch: Ensure MMF cables are not plugged into SMF optics.
4. Interface Status: Check for speed/duplex mismatches. A mismatch can lead to late collisions, high error counts, and degraded performance.

# Exam Quick Reference

- PC to Switch: Straight-Through.
- Switch to Switch: Crossover.
- Router to Router: Crossover.
- Copper Limit: 100 meters.
- High EMI Environment: Use Fiber.
- Short Distance Fiber: Multimode (MMF).
- Long Distance Fiber: Single-mode (SMF).

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