Physical Layer Protocols
Physical Layer Connection
Types of Connections

Connecting to the Wired LAN

Home Router

Connect your computer to the Ethernet port (1, 2, 3, or 4).
Connecting to the Wireless LAN with Range Extender

Wired Connection Using an Ethernet NIC
Purpose of the Physical Layer
The Physical Layer

Source Node
- Application
- Presentation
- Session
- Transport
- Network
- Data Link
- Physical

Encapsulation and De-encapsulation

Destination Node
- Application
- Presentation
- Session
- Transport
- Network
- Data Link
- Physical

Application Data

Segments
- DATA
- DATA
- DATA

Packet
- Header
- DATA

Frame
- Header
- DATA
- Trailer

Bits
- 1 0 1 0 0 1 1 1 0 0 1

Signal
Physical Layer Media

**Outbound (Tx) signal**

**Electrical Signals** - Copper cable

**Light Pulse** - Fiber-optic cable

**Microwave Signals** - Wireless
Physical Layer Characteristics
Functions

Manchester Encoding

Modulation

Frequency Modulation (FM)

Amplitude Modulation (AM)
Network Media
Copper Cabling
Copper Media

Unshielded Twisted-Pair (UTP) cable

Shielded Twisted-Pair (STP) cable

Coaxial cable
Unshielded Twisted-Pair Cable

- **Outer Jacket**: Protects the copper wire from physical damage.
- **Twisted-Pair**: Protects the signal from interference.
- **Color-Coded Plastic Insulation**: Electrically isolates wires from each other and identifies each pair.
Shielded Twisted-Pair Cable
Coaxial Cable

Coaxial Connectors

- BNC
- N type
- F type
UTP Cabling
Properties of UTP Cabling
UTP Cabling Standards

Category 3 Cable (UTP)
- Used for voice communication
- Most often used for phone lines

Category 5 and 5e Cable (UTP)
- Used for data transmission
- Cat5 supports 100 Mb/s and can support 1000 Mb/s, but it is not recommended
- Cat5e supports 1000 Mb/s

Category 6 Cable (UTP)
- Used for data transmission
- An added separator is between each pair of wires allowing it to function at higher speeds
- Supports 1000 Mb/s – 10 Gb/s, though 10 Gb/s is not recommended
UTP Connectors

RJ-45 UTP Plugs

RJ-45 UTP Socket

Bad connector - Wires are exposed, untwisted, and not entirely covered by the sheath.

Good connector - Wires are untwisted to the extent necessary to attach the connector.
Types of UTP Cable

<table>
<thead>
<tr>
<th>Cable Type</th>
<th>Standard</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethernet Straight-through</td>
<td>Both ends T568A or both ends T568B</td>
<td>Connects a network host to a network device such as a switch or hub.</td>
</tr>
<tr>
<td>Ethernet Crossover</td>
<td>One end T568A, other end T568B</td>
<td>• Connects two network hosts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Connects two network intermediary devices (switch to switch, or router to router)</td>
</tr>
<tr>
<td>Rollover</td>
<td>Cisco proprietary</td>
<td>Connects a workstation serial port to a router console port, using an adapter.</td>
</tr>
</tbody>
</table>
Fiber Optic Cabling
Fiber Media Cable Design

Jacket
Typically a PVC jacket that protects the fiber against abrasion, moisture, and other contaminants. This outer jacket composition can vary depending on the cable usage.

Buffer
Used to help shield the core and cladding from damage.

Cladding
Made from slightly different chemicals than those used to create the core. It tends to act like a mirror by reflecting light back into the core of the fiber. This keeps light in the core as it travels down the fiber.

Core
The core is actually the light transmission element at the center of the optical fiber. This core is typically silica or glass. Light pulses travel through the fiber core.

Strengthening Material
Surrounds the buffer, prevents the fiber cable from being stretched when it is being pulled. The material used is often the same material used to produce bulletproof vests.
Types of Fiber Media

Single Mode

- Small core
- Less dispersion
- Suited for long distance applications
- Uses lasers as the light source
- Commonly used with campus backbones for distances of several thousand meters

Produces single straight path for light
Types of Fiber Media (cont.)

Multimode

- Larger core than single mode cable
- Allows greater dispersion and therefore, loss of signal
- Suited for long distance applications, but shorter than single mode
- Uses LEDs as the light source
- Commonly used with LANs or distances of a couple hundred meters within a campus network
Fiber versus Copper

<table>
<thead>
<tr>
<th>Implementation Issues</th>
<th>UTP Cabling</th>
<th>Fiber-optic Cabling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bandwidth supported</td>
<td>10 Mb/s - 10 Gb/s</td>
<td>10 Mb/s - 100 Gb/s</td>
</tr>
<tr>
<td>Distance</td>
<td>Relatively short</td>
<td>Relatively high</td>
</tr>
<tr>
<td></td>
<td>(1 - 100 meters)</td>
<td>(1 - 100,000 meters)</td>
</tr>
<tr>
<td>Immunity to EMI and RFI</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Completely immune)</td>
</tr>
<tr>
<td>Immunity to electrical hazards</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Completely immune)</td>
</tr>
<tr>
<td>Media and connector costs</td>
<td>Lowest</td>
<td>Highest</td>
</tr>
<tr>
<td>Installation skills required</td>
<td>Lowest</td>
<td>Highest</td>
</tr>
<tr>
<td>Safety precautions</td>
<td>Lowest</td>
<td>Highest</td>
</tr>
</tbody>
</table>
Wireless Media
Types of Wireless Media
Wireless LAN