Chapter 7
Transmission Media
Figure 7.1 Transmission medium and physical layer

Sender
Physical layer

Transmission medium
Cable or air

Receiver
Physical layer
Figure 7.2 Classes of transmission media

Transmission media

- Guided (wired)
  - Twisted-pair cable
  - Coaxial cable
  - Fiber-optic cable
- Unguided (wireless)
  - Free space
Figure 7.3  Twisted-pair cable
Figure 7.4  *UTP and STP cables*
### Table 7.1 Categories of unshielded twisted-pair cables

<table>
<thead>
<tr>
<th>Category</th>
<th>Specification</th>
<th>Data Rate (Mbps)</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unshielded twisted-pair used in telephone</td>
<td>&lt; 0.1</td>
<td>Telephone</td>
</tr>
<tr>
<td>2</td>
<td>Unshielded twisted-pair originally used in T-lines</td>
<td>2</td>
<td>T-1 lines</td>
</tr>
<tr>
<td>3</td>
<td>Improved CAT 2 used in LANs</td>
<td>10</td>
<td>LANs</td>
</tr>
<tr>
<td>4</td>
<td>Improved CAT 3 used in Token Ring networks</td>
<td>20</td>
<td>LANs</td>
</tr>
<tr>
<td>5</td>
<td>Cable wire is normally 24 AWG with a jacket and outside sheath</td>
<td>100</td>
<td>LANs</td>
</tr>
<tr>
<td>5E</td>
<td>An extension to category 5 that includes extra features to minimize the crosstalk and electromagnetic interference</td>
<td>125</td>
<td>LANs</td>
</tr>
<tr>
<td>6</td>
<td>A new category with matched components coming from the same manufacturer. The cable must be tested at a 200-Mbps data rate.</td>
<td>200</td>
<td>LANs</td>
</tr>
<tr>
<td>7</td>
<td>Sometimes called SSTP (shielded screen twisted-pair). Each pair is individually wrapped in a helical metallic foil followed by a metallic foil shield in addition to the outside sheath. The shield decreases the effect of crosstalk and increases the data rate.</td>
<td>600</td>
<td>LANs</td>
</tr>
</tbody>
</table>
Figure 7.5 UTP connector
Figure 7.7 Coaxial cable
Figure 7.8 BNC connectors
Figure 7.11  *Optical fiber*
Figure 7.12  *Propagation modes*
Figure 7.13 *Modes*

a. Multimode, step index

b. Multimode, graded index

c. Single mode
Figure 7.14 Fiber construction

- Outer jacket
- Plastic buffer
- Du Pont Kevlar for strength
- Cladding
- Glass or plastic core
Figure 7.15  *Fiber-optic cable connectors*
UNGUIDED MEDIA: WIRELESS

*Unguided media transport electromagnetic waves without using a physical conductor. This type of communication is often referred to as wireless communication.*
Figure 7.18  Propagation methods

- **Ground propagation** (below 2 MHz)
- **Sky propagation** (2–30 MHz)
- **Line-of-sight propagation** (above 30 MHz)
<table>
<thead>
<tr>
<th>Band</th>
<th>Range</th>
<th>Propagation</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLF (very low frequency)</td>
<td>3–30 kHz</td>
<td>Ground</td>
<td>Long-range radio navigation</td>
</tr>
<tr>
<td>LF (low frequency)</td>
<td>30–300 kHz</td>
<td>Ground</td>
<td>Radio beacons and navigational locators</td>
</tr>
<tr>
<td>MF (middle frequency)</td>
<td>300 kHz–3 MHz</td>
<td>Sky</td>
<td>AM radio</td>
</tr>
<tr>
<td>HF (high frequency)</td>
<td>3–30 MHz</td>
<td>Sky</td>
<td>Citizens band (CB), ship/aircraft communication</td>
</tr>
<tr>
<td>VHF (very high frequency)</td>
<td>30–300 MHz</td>
<td>Sky and line-of-sight</td>
<td>VHF TV, FM radio</td>
</tr>
<tr>
<td>UHF (ultrahigh frequency)</td>
<td>300 MHz–3 GHz</td>
<td>Line-of-sight</td>
<td>UHF TV, cellular phones, paging, satellite</td>
</tr>
<tr>
<td>SHF (superhigh frequency)</td>
<td>3–30 GHz</td>
<td>Line-of-sight</td>
<td>Satellite communication</td>
</tr>
<tr>
<td>EHF (extremely high frequency)</td>
<td>30–300 GHz</td>
<td>Line-of-sight</td>
<td>Radar, satellite</td>
</tr>
</tbody>
</table>
Figure 7.19 Wireless transmission waves

- Wireless transmission
  - Radio wave
  - Microwave
  - Infrared
Figure 7.20 Omnidirectional antenna
Radio waves are used for multicast communications, such as radio and television, and paging systems.
Figure 7.21  *Unidirectional antennas*

a. Dish antenna

b. Horn antenna
Microwaves are used for unicast communication such as cellular telephones, satellite networks, and wireless LANs.
Infrared signals can be used for short-range communication in a closed area using line-of-sight propagation.