Wiring and Transmission

ITL
Transmission Media

• Guided Media
  – Twisted Pair
  – Coaxial Cable
  – Optical Fiber

• Unguided Media
  – “Broadcast”-type radio transmission
    • Wireless LANs, Cell Phones, PCS
  – Satellite
  – Point-to-Point Microwave
Transmission Systems by Function

• Basic multiplexing
  – DS-n (T1, DS3)
  – SONET (OC-3, OC-12, etc)
  – WDM

• Multiplexing and Other Functions
  – Ethernet
  – Frame Relay
  – ATM
Detour - what does our network look like?
Local Calling
US Artifact: “LATA”
Local Access and Transport Area
Long-Distance Competition
Local Competition
US: iLEC and cLECs
Wireless
What about the Internet
Wire-Based Competition using Voice over IP
More Detour: Public policy and Regulatory History

- It may be history, but
  - Policy decision drive network topology
    1. Technology has to adapt to implement policy decisions
    2. Policy creates “loopholes”, or side-effects that make otherwise irrational technology choices attractive.
Key US Policy Choices

• Carterphone - 1968
  – De-Couple CPE from the network providers, force interface standards
• Specialized Common Carriers 1971-1972
  – What do you carry and who do you serve?
• After the MFJ - 1982
  – Customer-driven provider selection
Policy Choices cont...

• The Telecom Act of 1996
  – Local competition requires interconnection and Number portability
  – The “Carrier of Last Resort”
    • Universal Service Fund
    • Bypassed by VoIP
  – Number portability and emergency services
Transmission Systems by Network Location
Logical Network

- LAN (Local Area Network), Jack Wiring
  - to
- Switch, “Layer 3 Switch”, Wiring Hub...
  - to
- Campus Backbone LAN, Passive Backbone
  - to
- Router, PBX
  - to
- WAN (Internet, PSTN)
Structured (Physical) Wiring

- Main Cross-Connect (Main Distribution Frame)
  - Riser Cable ("Backbone")
- Intermediate Cross-Connect (Int. Dist. Frame)
  - Horizontal Wiring
- Jack Field
  - Drop Cable
- Workstation
Wiring Standards

• Building Wiring Standards
  – Electronic Industries Association
  – Telecommunications Industry Association
  – EIA/TIA 568 Commercial Building Wiring Standard

• “Outside Plant”
  – Bell Labs technical publications
  – Now maintained by Telcordia (formerly Bellcore)
RJ-What?

- As an aside for the eternally curious:

  The RJxx nomenclature appears in the legal documents used by the FCC to identify permitted methods to connect telecom equipment to the network

- For the really, really curious:

  Title 47 CFR, Part 68, Subpart F, Section 502
# LAN Twisted Pair Standards

<table>
<thead>
<tr>
<th>Level/CAT</th>
<th>Speed/Features</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>1Mbps</td>
</tr>
<tr>
<td>2</td>
<td>4Mbps</td>
</tr>
<tr>
<td>3</td>
<td>16Mbps</td>
</tr>
<tr>
<td>4</td>
<td>20Mbps</td>
</tr>
<tr>
<td>5</td>
<td>100Mbps 1000 Mbps (4 pair) 100m max distance</td>
</tr>
<tr>
<td>5E</td>
<td>100Mbps 1000 Mbps (4 pair)</td>
</tr>
<tr>
<td>6</td>
<td>200-250MHz</td>
</tr>
</tbody>
</table>

Note: always packaged as 4-pair cable
Local Loop

- 26 gauge (0.016in) to 19 gauge (0.036in)
- Grouped into (twisted) pairs
- Color coding for 25 pairs, grouped for larger cable
- Cable size 6 pairs to 3600 pairs
Fiber

- **Multimode (lower capacity)**
  - 62.5/125 (also 50/125)
    - 2km at 100Mbps, 220m at 1Gbps, 35m at 10Gbps

- **Single mode (highest capacity)**
  - 9/125
    - 100km at 100Mbps, 70km at 100Mbps, 40km at 10Gbps

From L-Com, Inc. at http://www.l-com.com/content/TechnicalResources.html
Coax

- Used to connect high-frequency equipment to antennas
  - Many types of connectors
    - UHF (300MHz), Mini-UHF (2GHz)
    - SMB, BNC (4GHz)
    - MCX, SMC, TNC, N (12GHz), SMA (18GHz)
- RGnnnx/U product names
  - designate loss/distance at certain frequencies

From L-Com, Inc. at http://www.l-com.com/content/TechnicalResources.html