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

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)
- RGnnx/U product names
  - designate loss/distance at certain frequencies