Structured Network Cabling
CIS 399
Day 1, Morning Session 2

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We all have some ugly wiring
Structured Cabling Systems

• Only two types of cabling:
  – Unshielded twisted pair copper – provides service to individual computers and between network closets
  – Fiber optic cabling – provides service to buildings and between network closets

• Everything is run in a star configuration
Unshielded Twisted Pair Cable

• Run in star configuration from Network Closet location to individual outlets in offices or labs.
• Run at least two cables to every outlet – I recommend four if you can afford it.
• Run at least six cables between network closets if the distance is less than 90 meters
• Question: what type of cable to run? Cat5, cat5e, Cat6, ???
What type of UTP

- What speed does each type support?

<table>
<thead>
<tr>
<th>Cable Type</th>
<th>Max Speed</th>
<th>Max Distance</th>
<th>Cost Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category 5</td>
<td>100Mbs</td>
<td>100m</td>
<td>1x</td>
</tr>
<tr>
<td>Category 5e</td>
<td>1000Mbs</td>
<td>100m</td>
<td>1x</td>
</tr>
<tr>
<td>Category 6</td>
<td>1000Mbs</td>
<td>100m</td>
<td>1.3x</td>
</tr>
<tr>
<td>Category 6a</td>
<td>10,000Mbs</td>
<td>57m</td>
<td>1.3x</td>
</tr>
<tr>
<td>Category 6a</td>
<td>10,000Mbs</td>
<td>100m</td>
<td>2x</td>
</tr>
</tbody>
</table>

- Strongly recommend category 5e cabling.
Unshielded Twisted Pair Cable

- Labeling is a key to reduce work later
Fiber Optic Cabling

• Two basic types of fiber
  – Multi Mode limited to 2km @ 100Mbs
  – Single Mode 70km @ virtually unlimited

• Multiple types of multi mode
  – 62.5 micron core
  – 50 micron core

• Multiple types of single mode
  – Optimized for 1310 and 1550 nm operation
  – Optimized for WDM operation
Physics of Fiber
What type of Fiber?

- Multi mode Fiber
  - 62.5 micron
    - 100baseFX for 2km, optical interface cost $250 USD
    - 1000baseSX for 275m, optical interface cost $250 USD
    - 1000baseLX for 500m, optical interface cost $750 USD
    - 10GbaseSR for 33m, optical interface cost $2000 USD
    - 10GbaseLRM for 220m, optical interface cost $1500 USD (not widely avail)
  - 50 micron laser optimized
    - 100baseFX for 2km, optical interface cost $250 USD
    - 1000baseSX for 550m, optical interface cost $250 USD
    - 1000baseLX for 500m, optical interface cost $750 USD
    - 10GbaseSR for 300m, optical interface cost $2000 USD
    - 10GbaseLRM for 220m, optical interface cost $1500 USD (not widely avail)

- Single mode Fiber
  - 100baseFX not supported
  - 1000baseSX not supported
  - 1000baseLX for 5km (most vendors support 10km), cost $750 USD
  - 1000baseLH (not a standard) 70 km with 1550nm lasers, cost $3000 USD
  - 10GbaseLR for 10km, optical interface cost $3000 USD
  - 10GbaseER for 30-40km, optical interface cost $8500 USD
Going Fast on Fiber

- Multi mode Fiber
  - 62.5 micron
    - 1Gbs to 500m
    - 10Gbs to 220m
  - 50 micron laser optimized
    - 1Gbs to 500m
    - 10Gbs to 300m
- Single mode Fiber
  - 1Gbs to 70km
  - 10Gbs to 70km
How About Going Even Faster?

- Dispersion becomes your enemy at 10Gbs and above (40 and 100Gbs very hard)
- Even single mode fiber has dispersion
  - Chromatic Dispersion (CD) Even slightly different colors of light travel different speeds
  - Polarization Mode Dispersion (PMD) Slight variations from true roundness causes differently polarized light to travel different distances.
The Solution Today is WDM

- **Wave Division Multiplexing (WDM)**
  - Provisioning multiple Gigabit or 10 Gigabit using different colors of light
  - **Coarse (CWDM)**
    - Fewer waves, low cost
    - 1310nm frequency spectrum
    - Not suitable for amplification – short haul (70km)
  - **Dense (DWDM)** more waves
    - More waves, higher cost
    - 1550nm frequency spectrum
    - Suitable for EDFA amplification – long haul (1000s of km)
WDM Simple Single Span

Single Fiber

Transmitter
Transmitter
Transmitter
Transmitter

Receiver
Receiver
Receiver
Receiver

Transmitter
Transmitter
Transmitter
Transmitter

Receiver
Receiver
Receiver
Receiver

Single Fiber
Optical Add Drop Multiplexor
Can Build Complex Networks
Varying Service Models

- Internet Service Provider (ISP) provides Internet and circuit to your site
- ISP is different from provider of circuits
- Best situation when you have choices in both ISP and provider of telecom or fiber services
  - Competition is the key
Fiber Optic Topology

- Fiber Types
  - Multi mode: don’t bother if run is over 200M
  - Single mode: use fiber optimized for 1310/1550nm
- Run in star configuration from core network location to individual buildings
- Also run in star configuration inside of buildings from main phone closet to other closets
- To reduce costs, can run large fiber cable from core to some remote location, then smaller cables from there to surrounding buildings
Star Configuration

- Plan for future -- Install enough fiber
  - Minimum: 6 multimode plus 6 single mode from core to each building
  - Minimum: 6 multimode plus 6 single mode from building entrance network closet to every other network closet in the building.
Construction Hints

• Use outdoor cable between buildings
  – Armored (to protect against rodents)
  – Loose tube
• Use indoor cabling inside buildings
  – tight buffer
• Standardize on Connectors
  – Multi mode: ST or SC (epoxy or hot melt)
  – Single mode: SC or LC (fusion splice factory pigtails, however hand polish is OK if done properly)
Fiber Optic Cable Construction

• Fiber has bend radius issues
More Construction Hints

• For cable installed in underground conduit:
  – No more than 200m between pull points
  – Reduce distance by 50m for every 90 degrees of bend
Fiber Optic Cable Construction

• Leave slack loops
Structured Cabling Summary

• Install cabling in star configuration – don’t daisy chain
• Install cat5e or cat6a – cat6 is a waste of money if the runs are over 57m
• If runs are under 200M, then multi mode is OK
• Must do single mode if runs over 200M
Thank You

Questions