Extending LANs: Fiber Modems, Repeaters, Bridges, and Switches

Chapter 11

Distance Limitation of LANs
- Delay limits the cable length
- Power of the signal limits the cable length

Technology Comparison Chart

<table>
<thead>
<tr>
<th>Technology</th>
<th>Media</th>
<th>Speed (Mb/s)</th>
<th>Max Segment Length (meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Token Ring</td>
<td>copper</td>
<td>4, 16</td>
<td>100</td>
</tr>
<tr>
<td>10Base T</td>
<td>cat 3 twisted pair</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>10Base F</td>
<td>multi-mode fiber</td>
<td>10</td>
<td>2,000</td>
</tr>
<tr>
<td>10Base F</td>
<td>single mode fiber</td>
<td>10</td>
<td>25,000</td>
</tr>
<tr>
<td>10Base 5</td>
<td>large coax</td>
<td>10</td>
<td>500</td>
</tr>
<tr>
<td>10Base 2</td>
<td>small coax</td>
<td>10</td>
<td>185</td>
</tr>
<tr>
<td>100Base TX</td>
<td>cat 5 twisted pair</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>100Base FX</td>
<td>single-mode fiber</td>
<td>100</td>
<td>20,000</td>
</tr>
<tr>
<td>ATM</td>
<td>varies</td>
<td>1.5 - 2,400</td>
<td>varies</td>
</tr>
</tbody>
</table>

Fiber Extensions
- Used to Extend a LAN Segment Beyond it's Distance Limitation on traditional media
- Used extensively in large Ethernet Installations
- A fiber modem is at each end.
- Collisions are detected at the transceiver connected to the fiber modem (by AUI cable).
- Each Host requires its own fiber.

Repeaters
- Used to Extend Ethernet LANs
- No more than 4 repeaters are allowed between Hosts
- A HUB is a type of Repeater

Typical Installation of Repeaters
Bridges

- Bridges are more intelligent than Repeaters
- They can filter frames
  - A bridge will forward only the frames with addresses on the destination segment.
  - It will filter (remove) all other frames and noise including collisions and jam signals.
- Typically bridges buffer the entire packet. Thus, bad packets can be discarded at the bridge.
- The use of Bridges in a network may increase the overall traffic capacity of the network.

A Bridged LAN

- A Bridge uses the frames physical (MAC) address to learn which hosts are on which segments and to filter frames.

Example Learning Bridge

<table>
<thead>
<tr>
<th>Event</th>
<th>Segment 1 List</th>
<th>Segment 2 List</th>
</tr>
</thead>
<tbody>
<tr>
<td>bridge hosts</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>U sends to V</td>
<td>U</td>
<td>–</td>
</tr>
<tr>
<td>V sends to U</td>
<td>U, V</td>
<td>–</td>
</tr>
<tr>
<td>Z broadcasts</td>
<td>U, V</td>
<td>Z</td>
</tr>
<tr>
<td>Y sends to V</td>
<td>U, V, Z</td>
<td>Y</td>
</tr>
<tr>
<td>X sends to W</td>
<td>U, V, Z, Y</td>
<td>X</td>
</tr>
<tr>
<td>W sends to Z</td>
<td>U, V, W, Z, Y</td>
<td></td>
</tr>
</tbody>
</table>

Extending Bridged LANs

- Bridges can be used together with fiber to span longer distances.
- Optical fiber and fiber modems span the distance.
- Bridges connect to LAN’s like hosts.

Extending LANs with Bridges

- The number of bridges between hosts is NOT limited to 4 as in the case of repeaters and hubs since the bridges do not pass collisions.

Bridging Across Longer Distances

- The distance between bridges is not limited by delay like repeaters due to not passing collisions.
- In this example, bridges at both ends of the link make certain that local traffic is NOT sent to the satellite.
Distributed Spanning Tree

- Connections among bridges can form a loop.
- A loop is a problem for broadcast frames since they are not stopped by bridges (they can circulate forever).
- Distributed Spanning Tree Algorithm is the solution.

Switching

- Each port is on its own LAN segment.
- Each LAN segment is connected to all other LAN segments in the switch by a virtual bridge.
- So, a switch operates like several interconnected bridges.

LAN Design Considerations

- Ethernet, Token Ring, FDDI, ATM
- Distance between Hosts
- Number of hosts
- Groupings of hosts
- Data rate requirements for each host
- Hubs or switches or both
- Longer distance connections with bridges and optical fiber