Lecture 8: L2 in the Data Center

CSE 222A: Computer Communication Networks
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Thanks: Alex C. Snoeren and Jennifer Rexford
Lecture 7 Overview

- Overview traditional L2 approaches
- PortLand paper discussion
The Beauty of Ethernet

- Flat addressing and self-learning enables plug-and-play networking
- Permanent and location independent addresses also simplify
  - Host mobility
  - Access-control policies
  - Network troubleshooting
Ethernet Scaling Challenges

- Flooding-based delivery
  - Frames to unknown destinations are flooded

- Broadcasting for basic service
  - Bootstrapping relies on broadcasting
  - Vulnerable to resource exhaustion attacks

- Inefficient forwarding paths
  - Loops are fatal due to broadcast storms; uses STP
  - Forwarding along a single tree leads to inefficiency and lower utilization
Enterprise networks comprised of Ethernet-based IP subnets interconnected by routers

Ethernet Bridging
- Flat addressing
- Self-learning
- Flooding
- Forwarding along a tree

Broadcast Domain (LAN or VLAN)

IP Routing (e.g., OSPF)
- Hierarchical addressing
- Subnet configuration
- Host configuration
- Forwarding along shortest paths
## Comparing L2/L3

<table>
<thead>
<tr>
<th>Architectures Features</th>
<th>Ethernet Bridging</th>
<th>IP Routing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ease of configuration</td>
<td><img src="thumb" alt="Like" /></td>
<td><img src="thumb" alt="Dislike" /></td>
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<tr>
<td>Optimality in addressing</td>
<td><img src="thumb" alt="Like" /></td>
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<tr>
<td>Host mobility</td>
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<td>Path efficiency</td>
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<td>Load distribution</td>
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<td>Convergence speed</td>
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<td>Tolerance to loop</td>
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Potential solution: VLANs

- Scope broadcast traffic
- Simplify access control policies
- Decentralize network management
- Enable host mobility
Problem: Limited Granularity

- Limited number of VLANs
  - Placing multiple groups in the same VLAN
  - Reusing limited VLANs

- Limited number of hosts per VLAN
  - Divide a large group into multiple VLANs

- One VLAN per access port
  - Supporting VLANs on the end host
  - Supporting multiple groups at the router
Complex Configuration

- Host address assignment
  - Wasting IP addresses
  - Complex host address assignment

- Spanning tree computation
  - Limitation of automated trunk configuration
  - Enabling extra links to survive failures
  - Distributing load over the root bridges
PortLand Discussion

- What are the challenges?
- How might you address them?
- What does PortLand do?
- What’s left?
For Next Class...

- Read and review Helios paper
- Work on the project
  - Feedback on the proposal mid this week