Switching and Bridging

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The Need for Switching

- Not all computers can communicate directly
  - Physical limitations
  - Ethernet max 1024 hosts
  - Ethernet max 2500m
- **Switch**: where messages are switched (from one interface to another)

Types of Switching

- Packet Switching
- Circuit Switching
- Source Routing

Packet Switching

Each packet carries destination information
There is a “circuit” from source to destination

Routing: how to route from source to destination?
A circuit has to be setup before packets can be transferred.

Similar to packet switching, but source decides the route.

Asynchronous Transfer Mode (ATM)

Internet Protocol (IP) has this as an option
### Forwarding Table at the Bridge

- **Address**  |  **Iface**  
- 0x1111     |  1  
- 0x2222     |  1  
- 0x3333     |  1  
- 0x4444     |  2  
- 0x5555     |  2  
- 0x6666     |  2  

### Learning the Forwarding Table
- **Manual configuration** => cumbersome
- **Learning**:
  - On seeing a frame with a particular **source address** on an interface, make an entry
  - If no entry exists for a destination, **broadcast** on all interfaces other than the receiving interface

### Problem: Bridging Loops
- **Why might this happen?**
  - Configuration error
  - On purpose: fault-tolerance
- **Problem**: loops in forwarding
- **Solution**: spanning-tree

### Spanning Tree in the Bridged Network
- **Define a graph**
  - Consider each bridge and each LAN-segment as a node
  - And each interface/port as a link
- **A spanning tree in this graph is defined**
- **Which spanning tree?**
Defining the Spanning Tree

- Each bridge has to select its active interfaces
- Define a root bridge: smallest id
  - All of its interfaces are active
- Each bridge computes the shortest path to the root bridge, and notes this interface
- In a LAN segment, a bridge is designated to be responsible for forwarding frames toward the root bridge
  - Closest to the root, smaller-id to break ties

Spanning Tree Algorithm

- Dynamic, distributed algorithm
- Each bridge starts by thinking itself to be the root
  - Configuration messages are sent with: sending bridge’s id (Y), id of the node it considers to be the root (X), and the distance from X (d)
- From among the configuration messages sent and received, it stores the “best” configuration

Choosing the “Best” Configuration Message

- Among two messages m1 and m2
  - One which identifies a smaller root id is better, or
  - One which has a shorter distance to the root, or
  - One which has a smaller sending bridge id
- Once a bridge identifies itself to be not the root, it stops generating configuration messages
- Root sends configuration messages periodically
**Limitations of Bridging**

- Spanning tree algorithm scales linearly
- Broadcast frames are sent everywhere
  - Example: ARP, DHCP

**Summary**

- Switching: packet, circuit, source routing
- Ethernet bridging
  - Learning bridges
  - Spanning tree protocol