

CS244a: An Introduction to Computer Networks

Handout 11: Interconnecting LANs



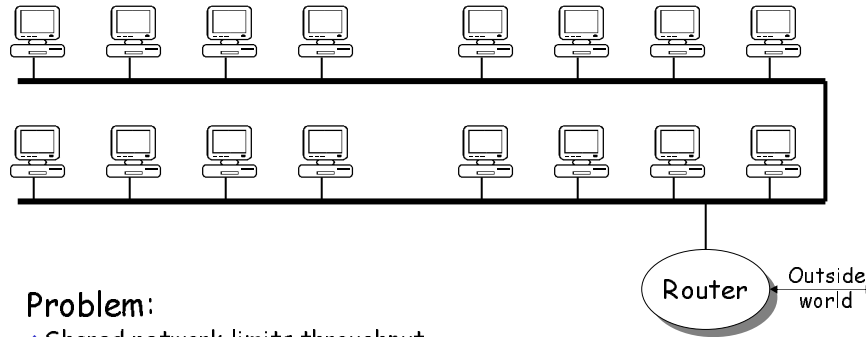
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Interconnecting LANs

- ❖ Bridges (aka Ethernet switches) were introduced to allow the interconnection of several local area networks (LANs) without a router.
- ❖ By partitioning a large LAN into multiple smaller networks, there are fewer collisions, and more parallel communications.
- ❖ It is now common for the port of an Ethernet switch to connect to just one (or a small number of) hosts.

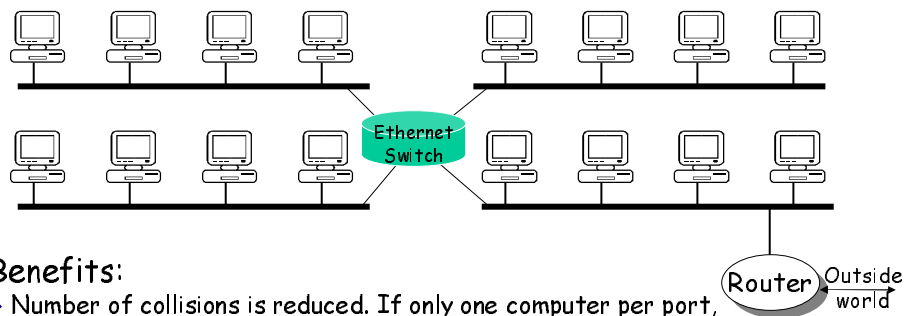
An Ethernet Network



Problem:

- ❖ Shared network limits throughput.
- ❖ Lots of collisions reduces efficiency.

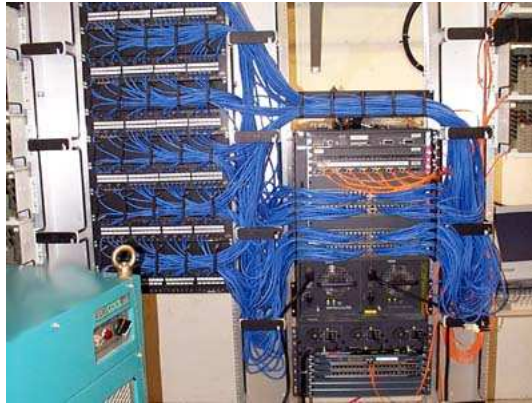
Ethernet Switching



Benefits:

- ❖ Number of collisions is reduced. If only one computer per port, no collisions can take place (each cable is now a self-contained point-to-point Ethernet link).
- ❖ Capacity is increased: the switch can forward multiple frames to different computers at the same time.

One Ethernet Switch in EE Building

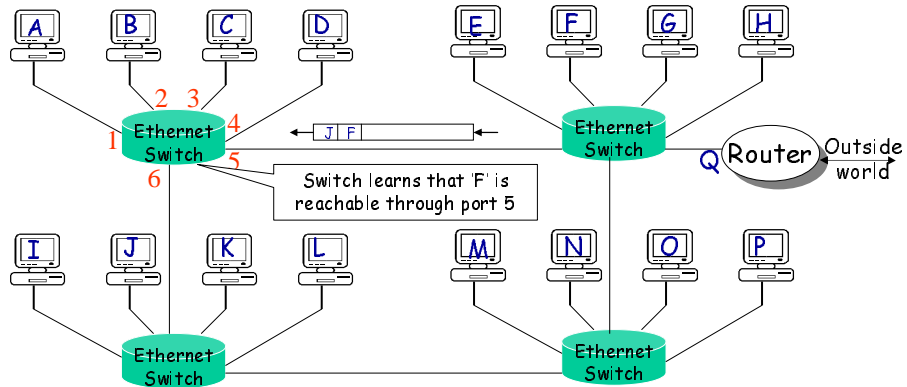


Ethernet Switching

1. Examines the header of each arriving frame.
2. If the Ethernet DA is in its table, it forwards the frame to the correct output port(s).
3. If the Ethernet DA is not in its table, it broadcasts the frame to all ports (except the one through which it arrived).
4. The table is **learned** by examining the Ethernet SA of arriving packets.

Ethernet Switching

Learning addresses

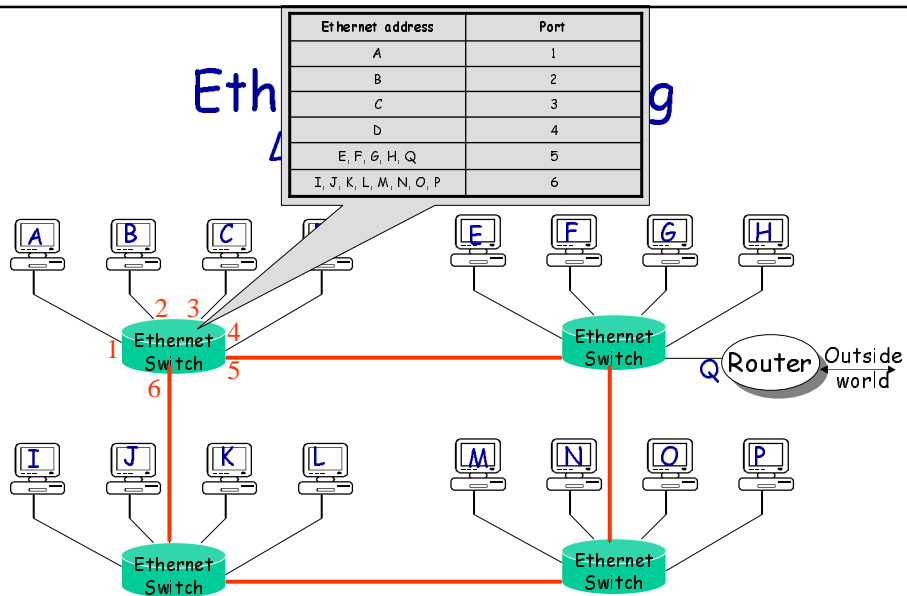


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Preventing loops

Spanning Tree Protocol

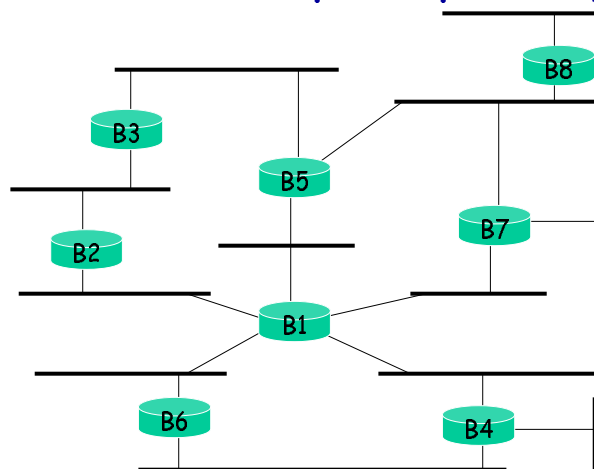
- ❖ The network of switches is a graph.
- ❖ The Spanning Tree Protocol finds a a subgraph that spans all the vertices without loops.
 - Spanning => all switches are included.
 - Tree => the topology has no loops.
- ❖ The distributed protocol runs:
 - To determine which switch is the root of the tree, and
 - Switches only forward on ports that are part of the tree.

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Example Spanning Tree



Protocol operation:

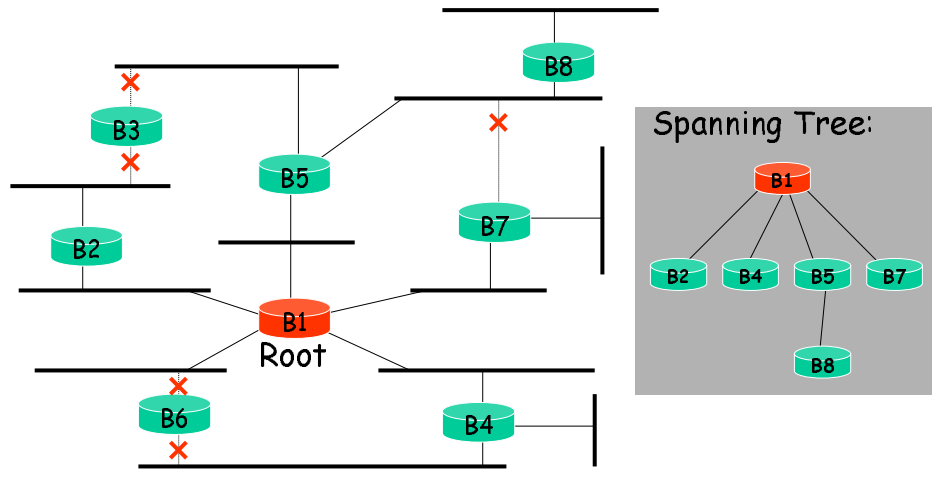
1. Picks a **root**
2. For each LAN, picks a **designated** switch that is closest to the root.
3. All switches on a LAN send packets towards the **root** via the **designated** switch.

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Example Spanning Tree



Spanning Tree Protocol

1. Periodically, all switches broadcast:
(ID of sender, ID of root, distance from sender to root).
2. Initially, every switch claims to be root: sets distance field to 0.
3. Every switch broadcasts until it hears a "better" message:
 - a. A root with a smaller ID
 - b. A root with equal ID, but with shorter distance
 - c. Ties broken by smaller ID of sender.
4. If a switch hears a better message, retransmit message (add 1 to distance).
5. If not the designated switch for a LAN, it stops sending configuration messages to that LAN.

Eventually:

- Only the root generates configuration messages.
- Other switch send configuration messages to LANs for which they are the designated switch.