Bridges and Switches

- Repeaters cannot be used as LAN switches
  - Length limitations are violated

- A LAN switch (bridge) has multiple interfaces
  - It picks up all data from one interface and copies it to the other interface
  - Capacity of a LAN switch is $Bn$, where $B$ is the bandwidth of each port and $n$ is the number of ports.
Learning Bridges

- Simple optimization to reduce bandwidth usage
  - Learn the direction of the message source.
  - Do not retransmit the message if the source and the destination are in the same direction.

- Learning bridges maintain a forwarding table. The table accumulates entries over time
The learning bridge fails when the network topology has a loop.

- Why?

Loops are not necessarily bad. They provide redundancy that can be used to recover from failures.

To handle loops, bridges implement the spanning tree algorithm.

- The spanning tree algorithm imposes a logical tree over the physical topology
- Data is only transferred along links that belong to the spanning tree
Spanning Tree Algorithm

- Each bridge has unique id (e.g., B1, B2, B3)

- Select bridge with smallest id as root

- Select bridge on each LAN closest to root as designated bridge (use id to break ties)

- Each bridge forwards frames over each LAN for which it is the designated bridge
Spanning Tree Algorithm (contd.)

- Bridges exchange configuration messages called CBPDU’s (Configuration Bridge Protocol Data Unit)
  - id for bridge sending the message
  - id for what the sending bridge believes to be root bridge
  - distance (hops) from sending bridge to root bridge

- Each bridge records the current best configuration message for each port

- Initially, each bridge believes it is the root
Spanning Tree Algorithm (contd.)

- When a bridge learns that it is not the root it stops generating configuration messages
  - in steady state, only root generates configuration messages

- When the bridge learns that it is not the designated bridge, it stops forwarding configuration messages
  - in steady state, only designated bridges forward config messages

- Root continues to periodically send config messages

- If any bridge does not receive successive config messages, it starts generating config messages claiming to be the root
  - This is used to recover from root failure
Broadcast and Multicast

■ Forward all broadcast/multicast frames
  ● current practice

■ Learn when no group members downstream

■ Learning is accomplished by having each member of the multicast group send a frame to bridge multicast address with G in source field
  ● This implies the presence of a downstream receiver
Limitations of Bridges

■ Do not scale
  ● spanning tree algorithm does not scale
  ● single large broadcast domains do not scale

■ Do not accommodate heterogeneity
  ● Bridges support ethernet to ethernet, ethernet to 802.5 and 802.5 to 802.5.

■ Caution: beware of transparency
  ● Applications that assume that they are executing on a single LAN will fail.
  ● Latency increases in large LANs, so does jitter