### 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 $B_n$, 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.

### Spanning Tree

- 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

- 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