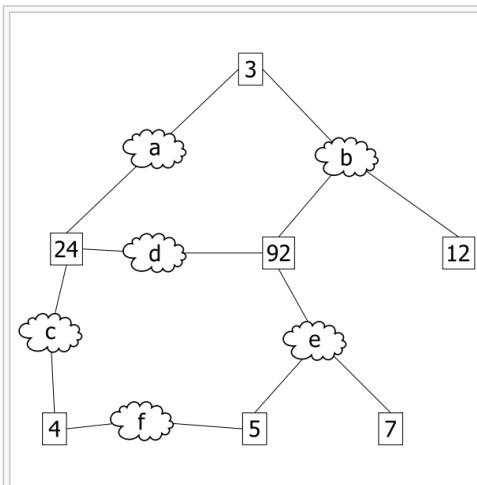


Networking Fundamentals (IV)

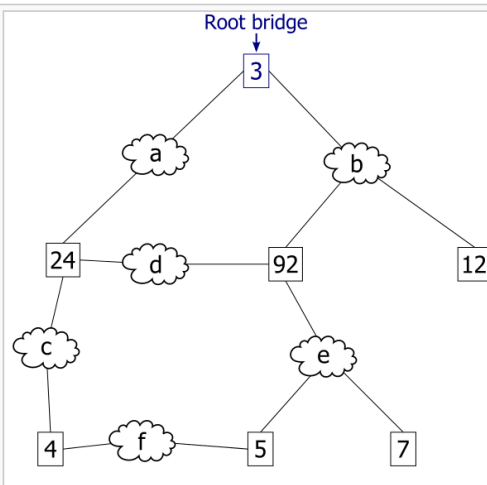
Spanning Tree Protocols

- In a complex subnet, different sections will be connected via switches. When wiring those switches together via bridging switches, it's possible that loops will be created. Physically remove those wires is not trivial. Also, the loops in the network topology help to increase resiliency of the network.
- The way to solve the loops is using **Spanning Tree Protocols** (STP)
 - The protocol temporarily disables links to break loops
 - It also monitors health of active links and re-enable links if network partitioning is detected
 - tradeoff: link health monitoring overhead vs. repair latency
- Process (REF: https://en.wikipedia.org/wiki/Spanning_Tree_Protocol)
 - Select a **root bridge**:
 - the bridge is the one with the **smallest (lowest) bridge ID**
 - each bridge has configurable priority and a MAC address
 - the bridge ID is the concatenation of the bridge priority and the MAC address (e.g., the ID of a bridge with priority 32768 and MAC 0200.0000.1111 is 32768.0200.0000.1111)
 - the bridge priority default is 32768 and can only be configured in multiples of 4096
 - Determine the **root ports** (RPs)
 - each bridge determines the cost of each possible path from itself to the root
 - the root bridge sends BPDUs (Bridge Protocol Data Unit) with path cost equal to zero
 - once a non-root bridge gets a BPDU it increments the path cost by adding the cost of the incoming link and propagates it on the network
 - the **port** that get the BPDU **with the smallest path cost from the root to the bridge** becomes the RP of the bridge
 - Determine the **designated port** (DP)
 - the bridges on a network segment collectively determine which bridge has the least-cost path from the network segment to the root
 - lowest bridge ID if the bridges have the same cost
 - lowest port ID if the bridge IDs are the same
 - the **port** connecting this bridge to the network segment **with the least-cost path from the network segment to the root** is the DP for the segment
 - Disable all other root paths
 - any active port that is not a RP or a DP is a **blocked port** (BP)

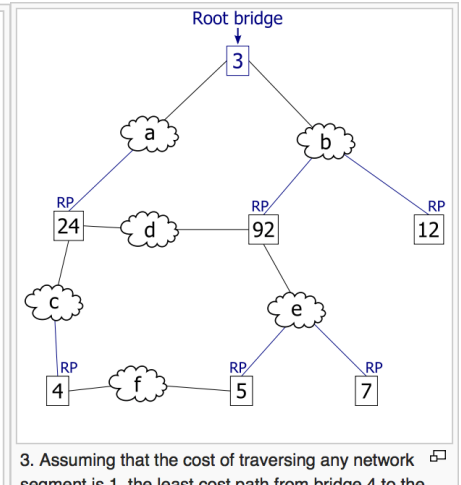
Spanning Tree Protocol Example



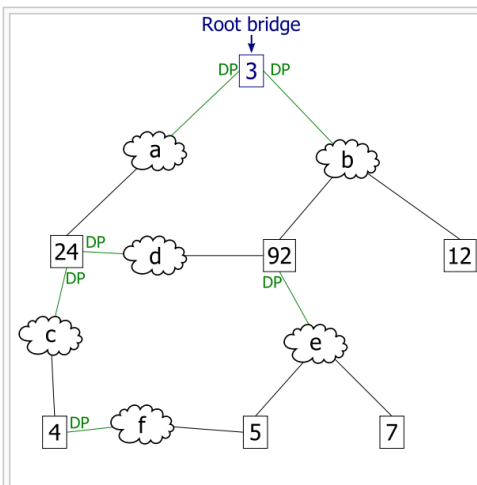
1. An example network. The numbered boxes represent bridges (the number represents the bridge ID). The lettered clouds represent network segments.



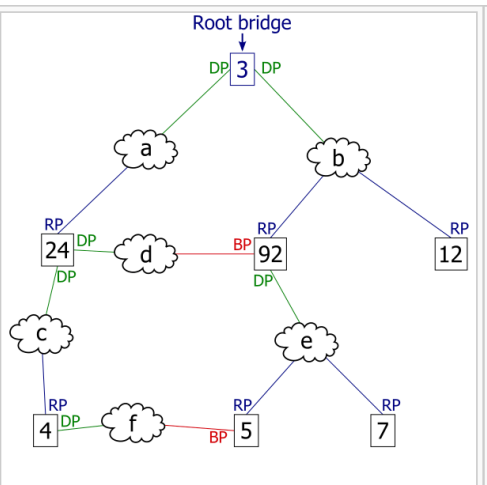
2. The smallest bridge ID is 3. Therefore, bridge 3 is the root bridge.



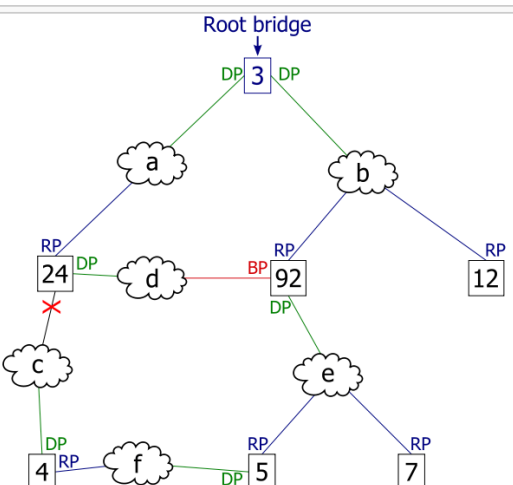
3. Assuming that the cost of traversing any network segment is 1, the least cost path from bridge 4 to the root bridge goes through network segment c. Therefore, the root port for bridge 4 is the one on network segment c.



4. The least cost path to the root from network segment e goes through bridge 92. Therefore, the designated port for network segment e is the port that connects bridge 92 to network segment e.



5. This diagram illustrates all port states as computed by the spanning tree algorithm. Any active port that is not a root port or a designated port is a blocked port.



6. After link failure the spanning tree algorithm computes and spans new least-cost tree.

REF: https://en.wikipedia.org/wiki/Spanning_Tree_Protocol

Disclaimer: Notes adapted from the textbook and online resources.