Spanning Tree Protocol
What you need to know

General Idea: A Spanning Tree Protocol (STP) process runs on each Switch. Its purpose is to <u>prevent active loops</u> in the switched network. Switches exchange STP information packets, called <u>Bridge Protocol Data Units (BPDUs)</u>, at regular time intervals. Using information in these BPDUs, each switch assigns a <u>Port Role</u> to each of its ports.   Ports that are assigned the <u>Backup/Alternate Role</u> are then put into <u>Blocking State</u>, where the switch does not send packets in/out of those ports. Cables between switch ports are called <u>Links</u>.

1. Each Switch has a **Bridge ID** (BID), consisting of
    a) Priority Value (2 bytes)
    b) Bridge MAC Address (6 bytes)
2. The Switch with the lowest Bridge ID becomes the **Root Switch**
    a) If Priorities are not equal, then Switch with lowest Priority becomes Root
    b) If Priorities are equal, then Switch with lowest Bridge MAC becomes Root
3. Each Link has a **Link Cost** based on its transmission speed
    a) 10 Mbps Eth = Cost 100; 100 Mbps FastEth = Cost 19; 1 Gbps = Cost 4
4. For each non-Root Switch:
    a) Its **Root Path** is the least-cost path from this Switch to the Root Switch
    b) Its **Root Path Cost** (RPC) is total cost of its Root Path.
5. Port Roles: **Root** Port (R), **Designated** Port (D) , **Backup/Alternate** Port (A)
    a) There is exactly 1 Root Port on each non-Root switch
    b) There is exactly 1 Designated Port connected to each Link
6. Assigning Port Roles
    a) All ports on the Root Switch are <u>Designated</u> ports
    b) For each non-Root Switch, assign its Root Port as follows:
        i)   The port going out to its Root Path is assigned as its <u>Root</u> port
        ii) But if there are multiple equal-cost Root Paths, then the port that connects to the Root Path whose neighbor Switch has lower BID becomes Root port.
    c) For each Link, assign its Designated Port as follows:
        i)   Compare the Root Path Costs of Switches at either end of link.   The port on Switch with lower Root Path Cost becomes <u>Designated</u> Port
        ii) But if both Root Path Costs are equal, then the port on Switch with lower Switch BID becomes Designated Port
    d) All unassigned ports are now assigned as <u>Backup/Alternate</u> Ports
7. Backup/Alternate Ports are put in Blocking State and do not forward packets. Root Ports and Designated Ports are put in Forwarding State
8. Variations on STP Protocol:
    a) Rapid STP (RSTP) – converges faster when network topology changes
        i)   Features: PortFast, BPDU Guard, Root Guard
    b) Per-VLAN STP (PVST+) – runs a separate STP process for each VLAN, so each VLAN has its own Root Switch, Port Roles, and Blocking ports.
    c) PVRST+ - runs a separate RSTP process for each VLAN.