CCNA Switching

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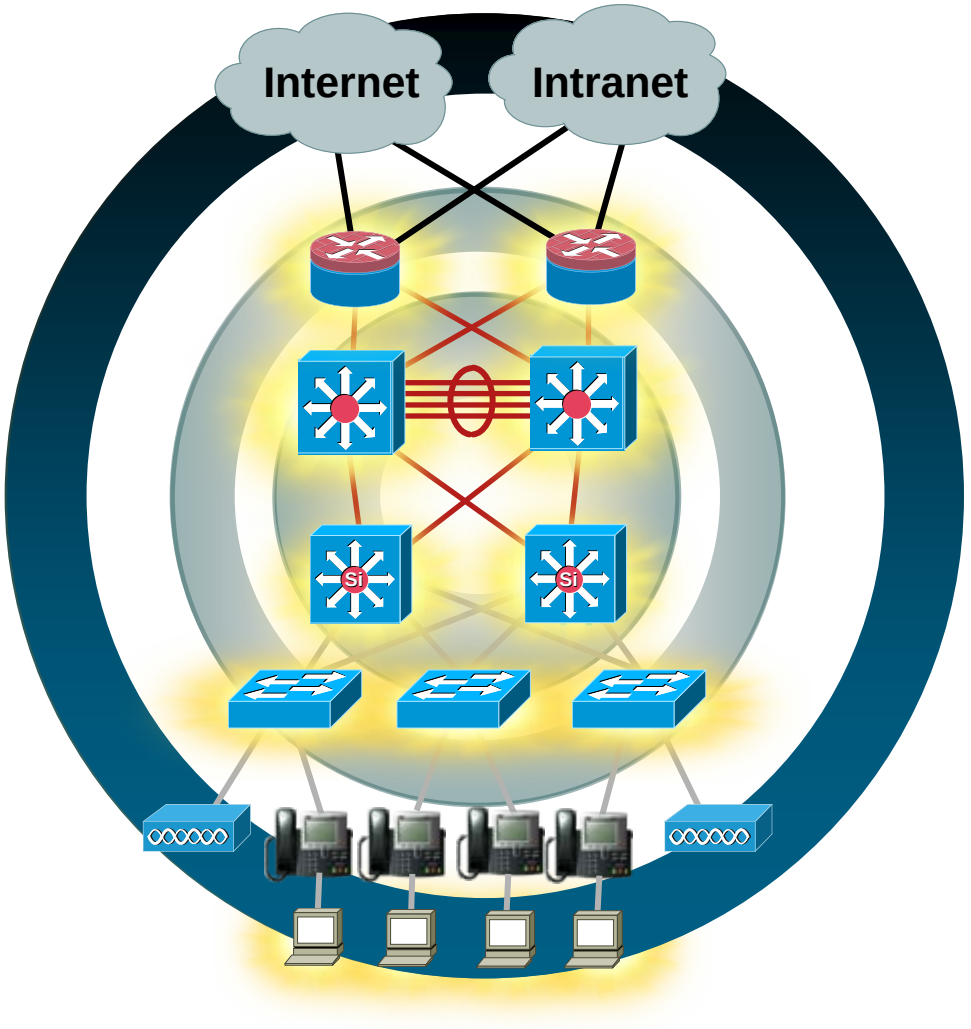
Agenda

- High Availability Campus Design Overview
- STP Operations
- STP Variances
- Rapid PVST+ Configuration
- Troubleshooting Spanning Tree Protocol

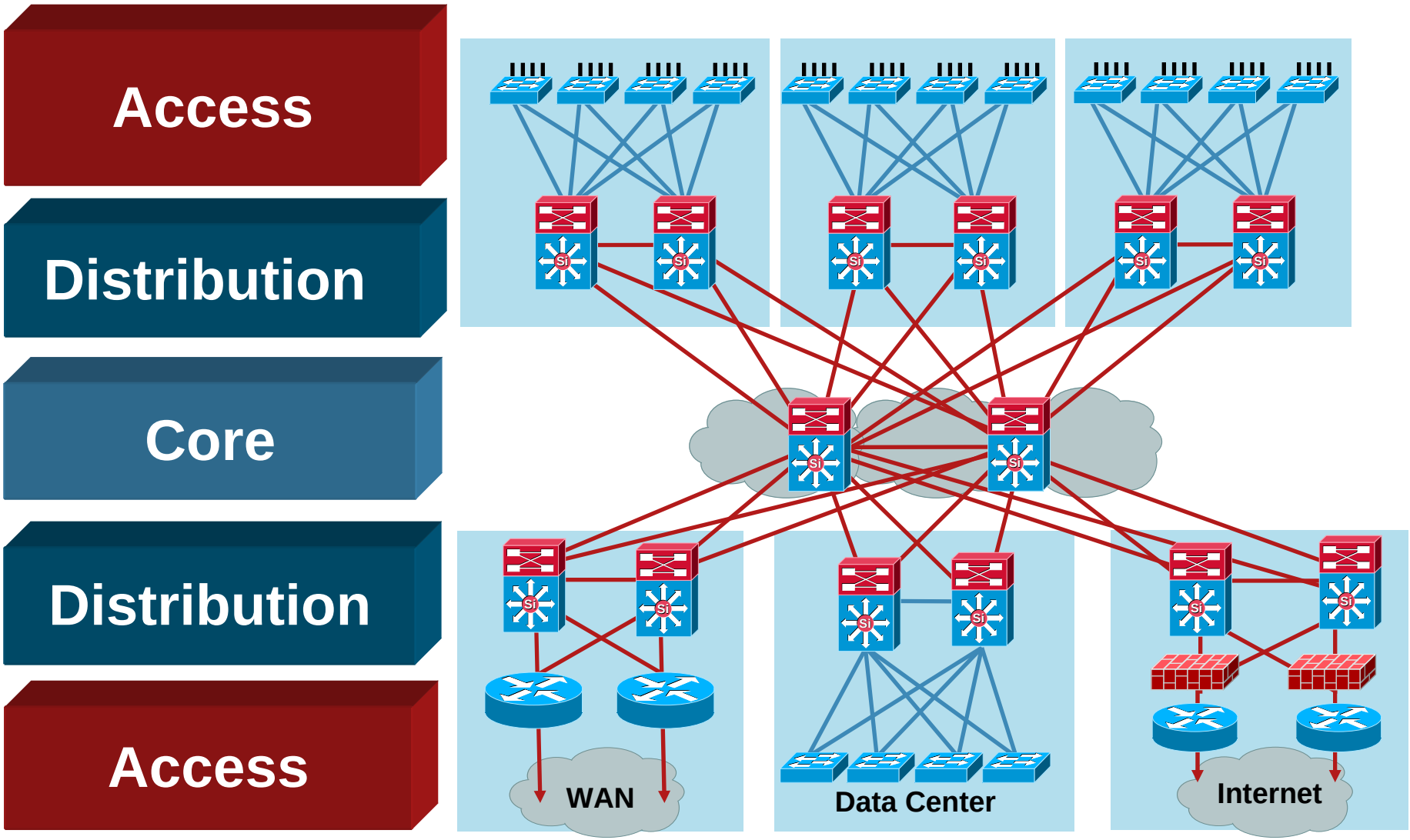
Spanning Tree Protocol

High Availability Campus Design

- Modularity, structure, and hierarchy
- Network redundancy and network protocols
  - Link redundancy (trunks, channels and fiber)
  - Redundancy in the distribution block
  - Redundancy and routing design
- Resilient campus network design



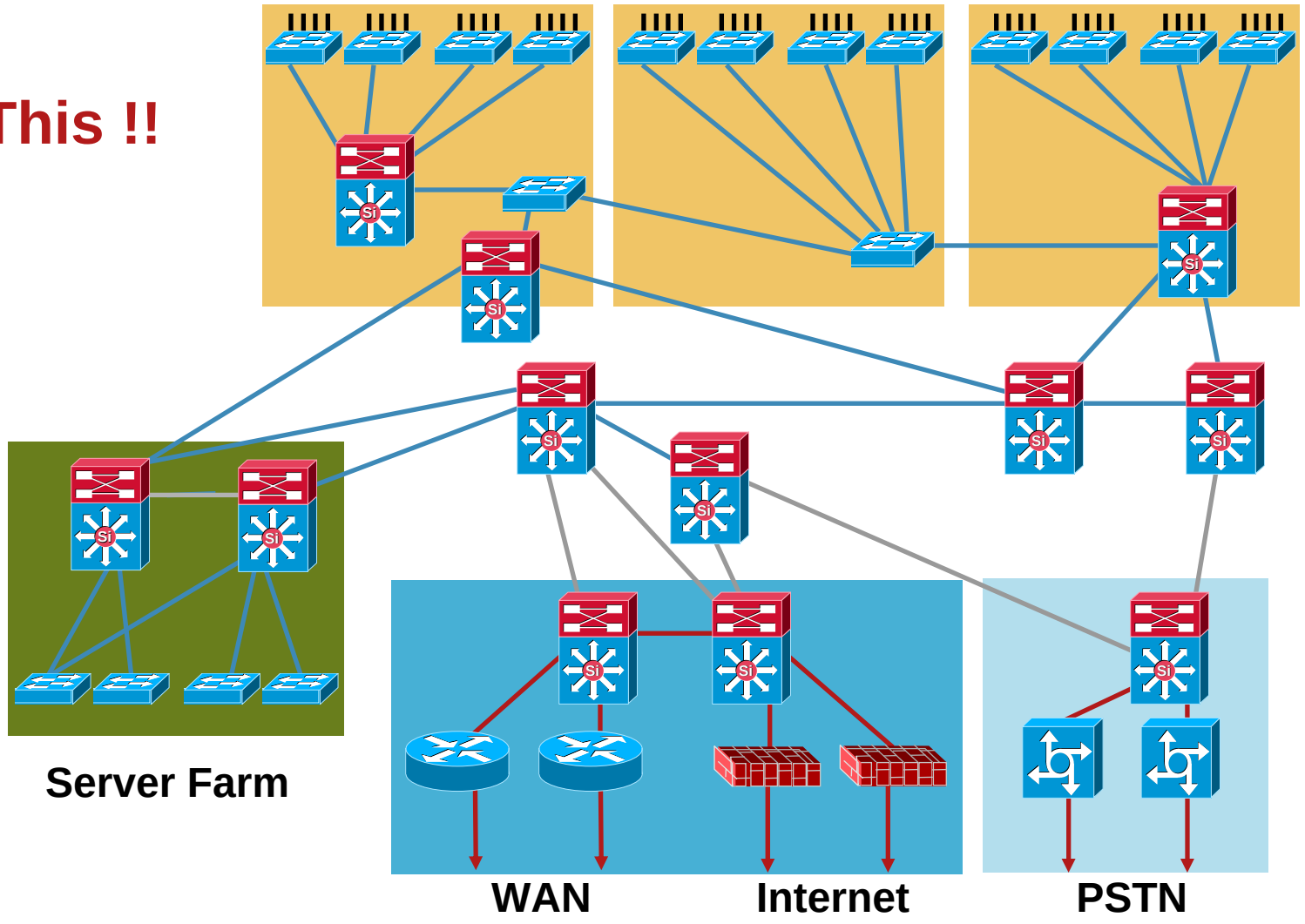
High Availability Campus Design Structure, Modularity, and Hierarchy



Hierarchical Campus Network

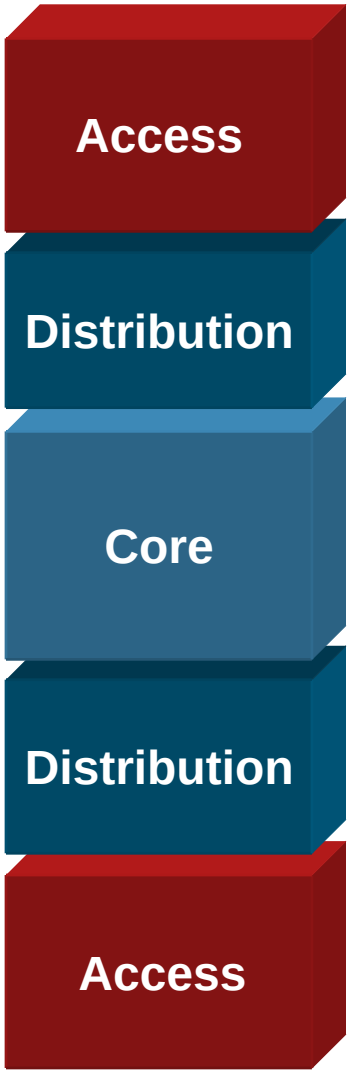
Structure, Modularity and Hierarchy

Not This !!

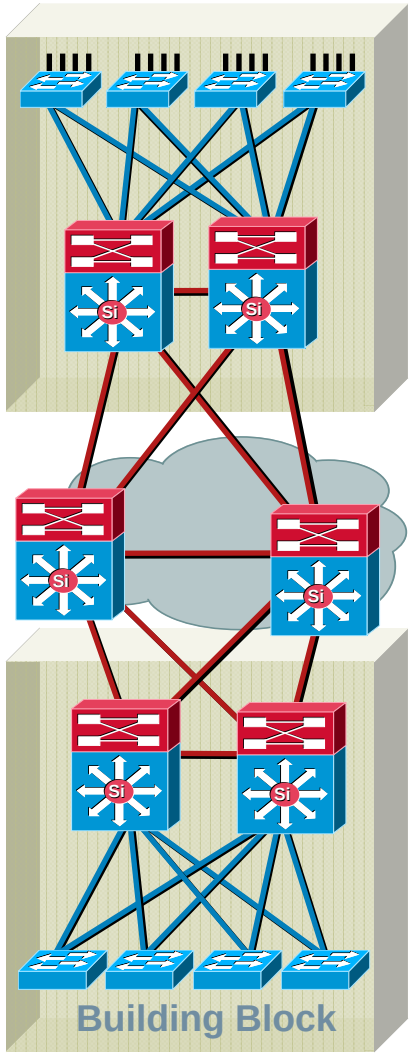


Hierarchical Network Design

Without a Rock Solid Foundation the Rest Doesn't Matter



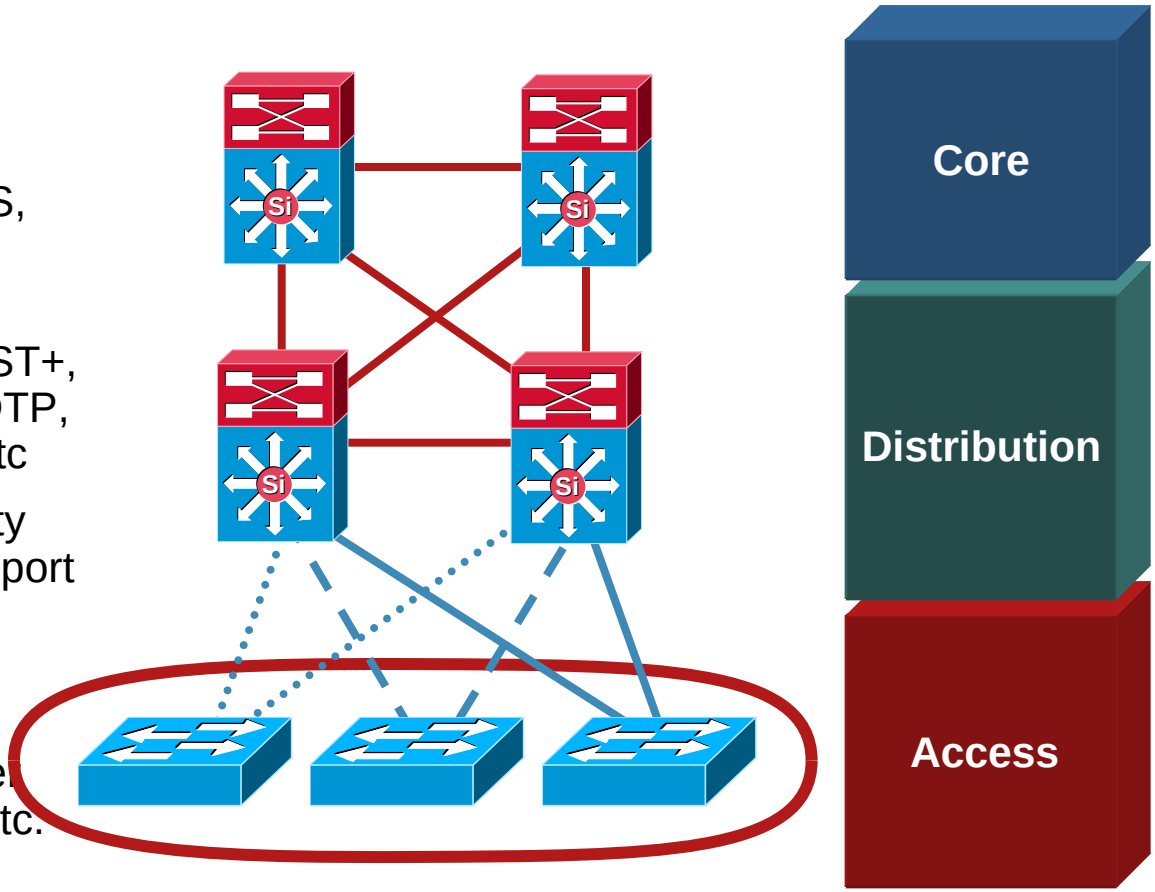
- Offers hierarchy—each layer has specific role
- Modular topology—building blocks
- Easy to grow, understand, and troubleshoot
- Creates small fault domains—Clear demarcations and isolation
- Promotes load balancing and redundancy
- Promotes deterministic traffic patterns
- Incorporates balance of both Layer 2 and Layer 3 technology, leveraging the strength of both
- Utilizes Layer 3 Routing for load balancing, fast convergence, scalability, and control



Access Layer

Feature Rich Environment

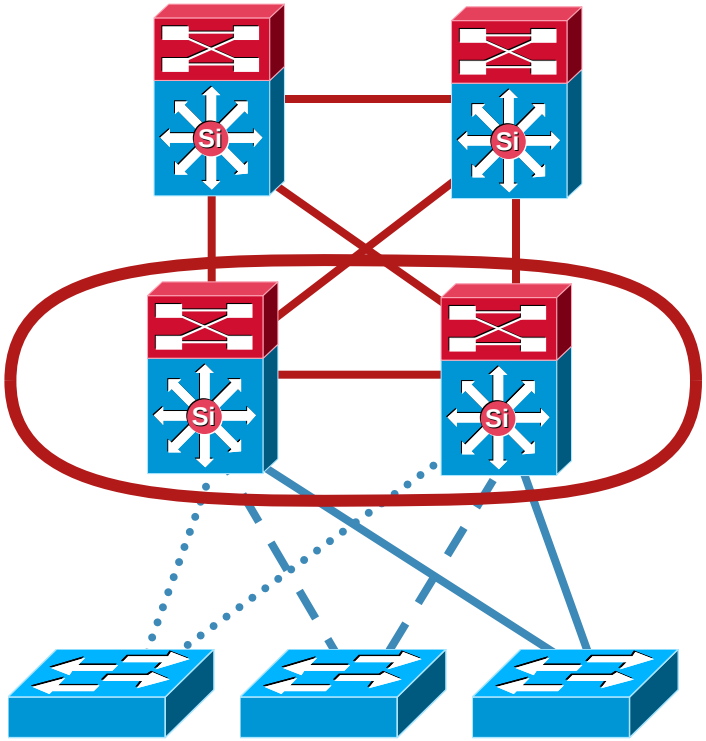
- **It's not just about connectivity**
- Layer 2/Layer 3 feature rich environment; convergence, HA, security, QoS, IP multicast, etc.
- Intelligent network services: QoS, trust boundary, broadcast suppression, IGMP snooping
- Intelligent network services: PVST+, Rapid PVST+, EIGRP, OSPF, DTP, PAgP/LACP, UDLD, FlexLink, etc
- Cisco Catalyst integrated security features IBNS (802.1x), (CISF): port security, DHCP snooping, DAI, IPSG, etc.
- Automatic phone discovery, conditional trust boundary, power over Ethernet, auxiliary VLAN, etc.
- Spanning tree toolkit: Portfast, UplinkFast, BackboneFast, LoopGuard, BPDUGuard, BPDUFilter, RootGuard, etc.



Distribution Layer

Policy, Convergence, QoS, and High Availability

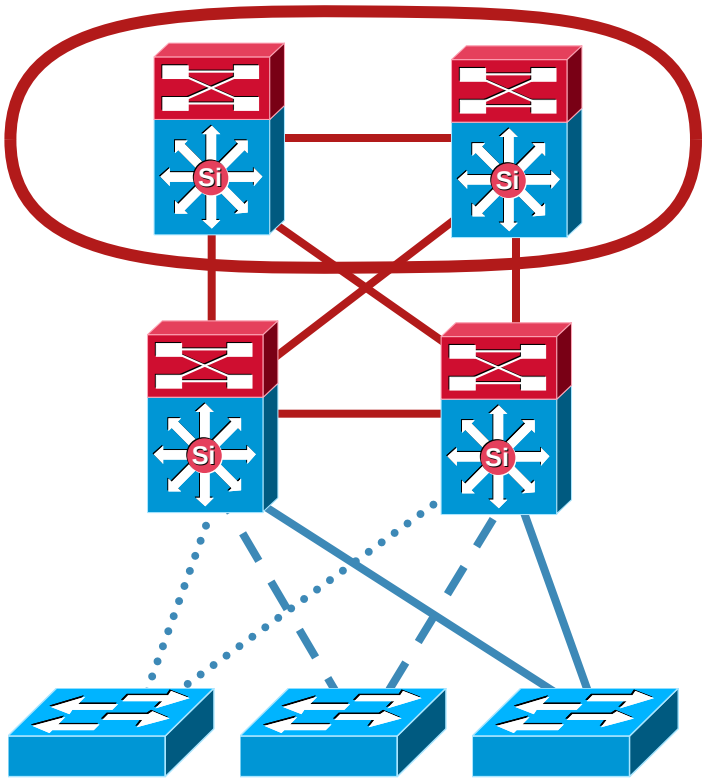
- Availability, load balancing, QoS and provisioning are the important considerations at this layer
- Aggregates wiring closets (access layer) and uplinks to core
- Protects core from high density peering and problems in access layer
- Route summarization, fast convergence, redundant path load sharing
- HSRP or GLBP to provide first hop redundancy



Core Layer

Scalability, High Availability, and Fast Convergence

- Backbone for the network - connects network building blocks
- Performance and stability vs. complexity - less is more in the core
- Aggregation point for distribution layer
- Separate core layer helps in scalability during future growth
- Keep the design technology-independent

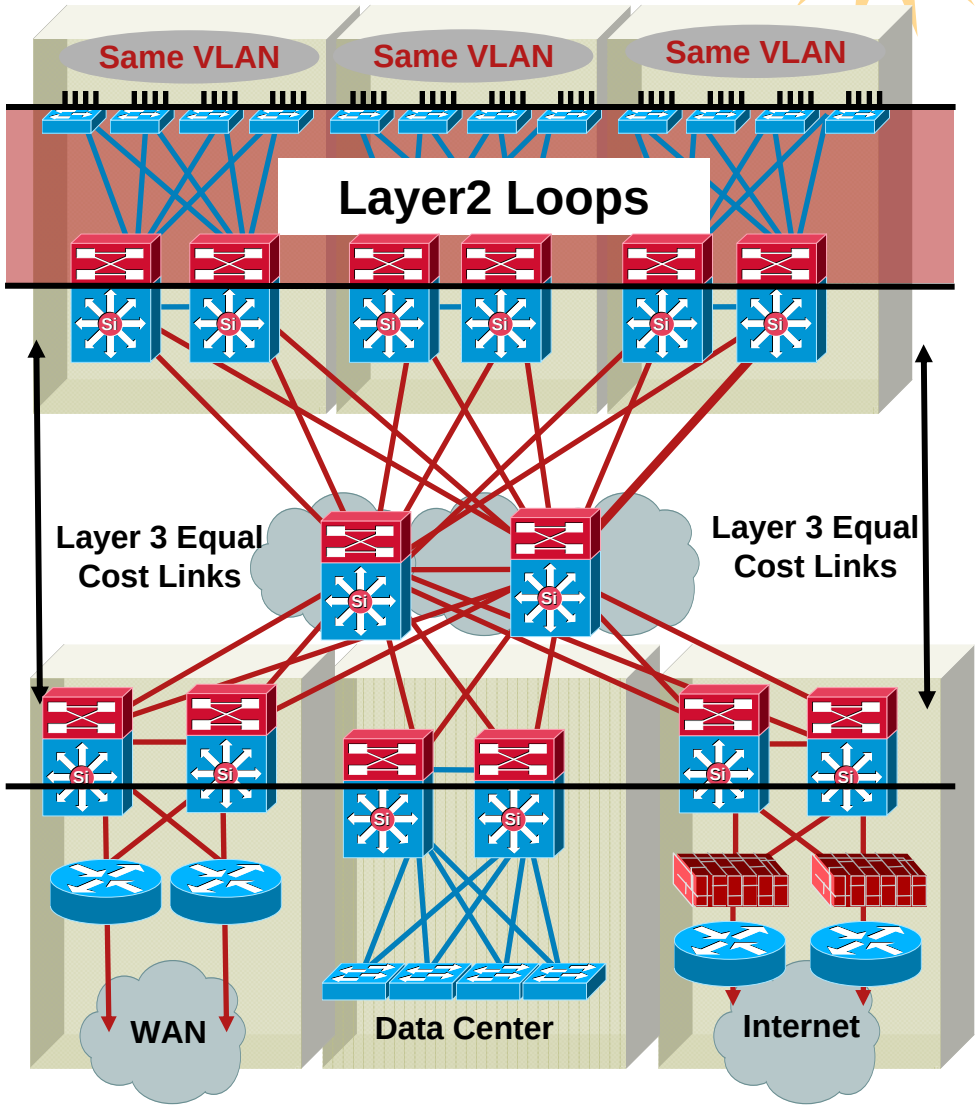


Foundation Services

- Layer 3 routing protocols
- Layer 2 redundancy—spanning tree
  - PVST+ - STP (802.1D-1998)
  - Rapid PVST+ - RSTP (802.D-2004)
- Trunking protocols—(isl/.1q)
- Unidirectional link detection
- Load balancing
  - Etherchannel link aggregation
  - CEF equal cost load balancing
- First hop redundancy protocols
  - VRRP, HSRP, and GLBP

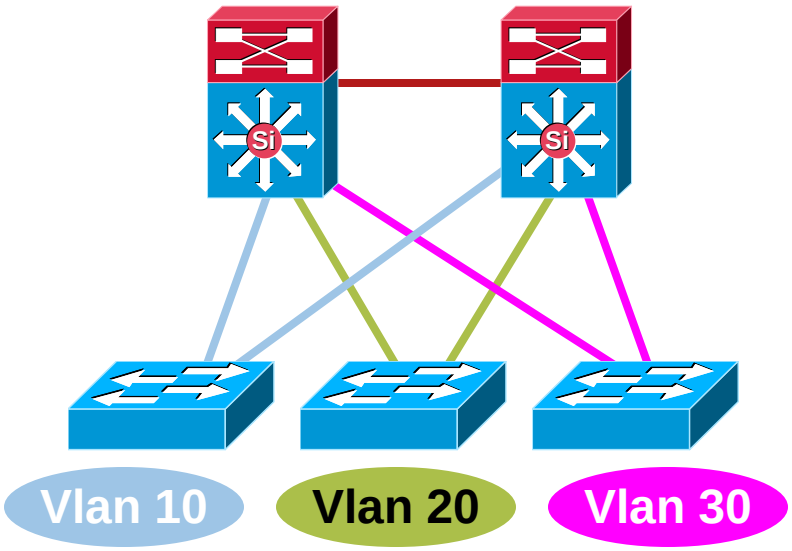
Best Practices—Spanning Configuration

- **Only** when you have to!
- More common in the data center
- Required when a VLAN spans access layer switches
- Required to protect against ‘user side’ loops
- Use Rapid PVST+ for best convergence
- Take advantage of the Spanning Tree Toolkit

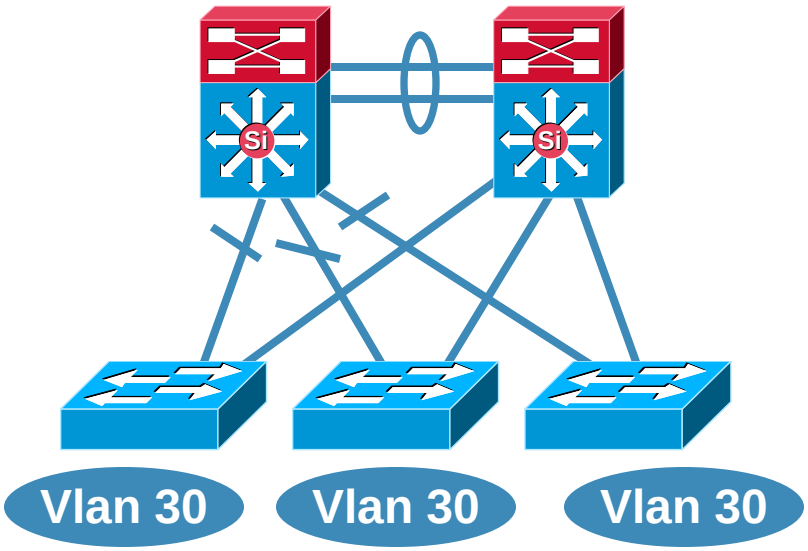


Multilayer Network Design

Layer 2 Access with Layer 3 Distribution



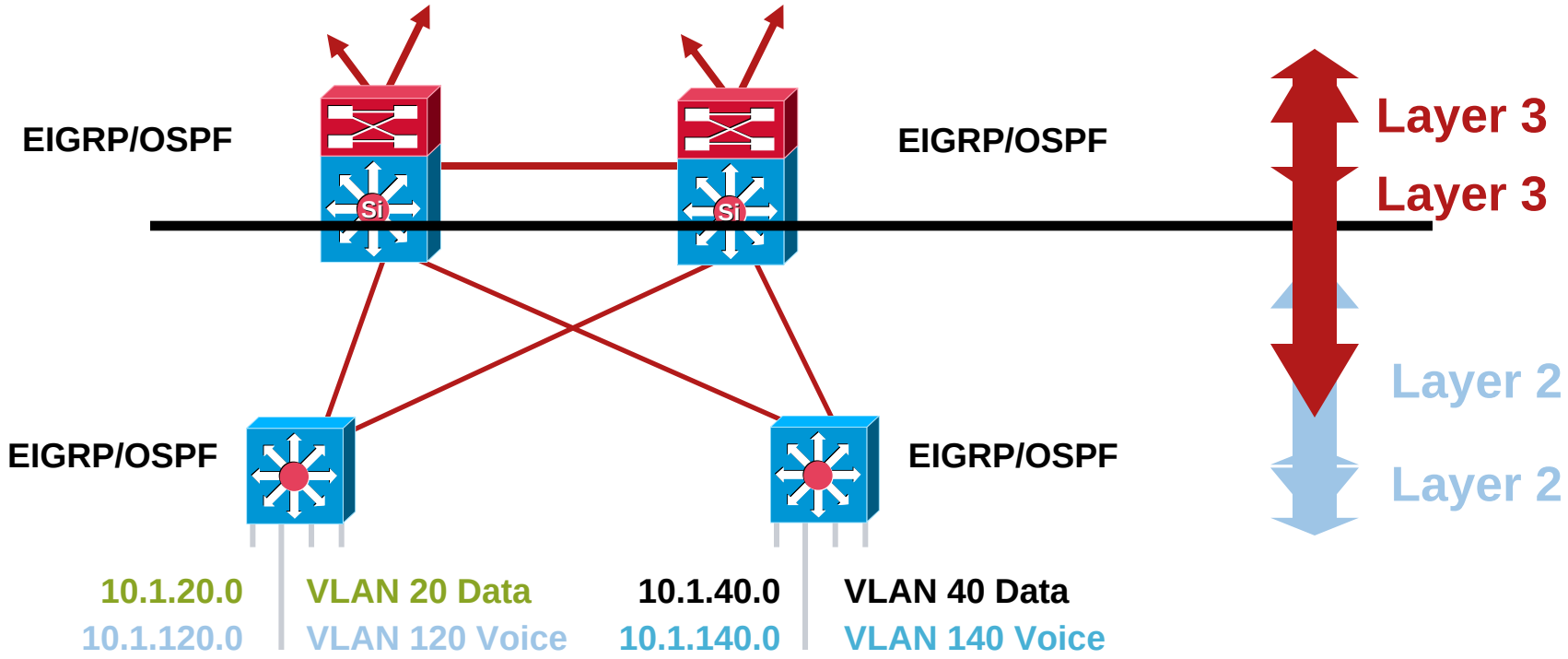
- Each access switch has unique VLANs
- No layer 2 loops
- Layer 3 link between distribution
- No blocked links



- At least some VLANs span multiple access switches
- Layer 2 loops
- Layer 2 and 3 running over link between distribution
- Blocked links

Routing to the Edge

Layer 3 Distribution with Layer 3 Access



- Move the Layer 2/3 demarcation to the network edge
- Upstream convergence times triggered by hardware detection of light lost from upstream neighbor
- Beneficial for the right environment

STP Operations

Three step process STP uses to create a loop-free topology

STP Convergence Steps	
Step 1: Elect a Root Bridge	The switch with the lowest Bridge ID wins; the standard Bridge ID is 2-byte priority followed by a MAC address unique for the switch
Step 2: Elect the Root Ports	The one port on the each switch with the least cost path back to the root
Step 3: Elect the Designated and Non-Designated Ports	When multiple switches connect to the same segment; this is the switch that forwards the least cost Hello onto the segment

STP Operations

STP Port States and BPDU Timers in the Operation of STP

Port States

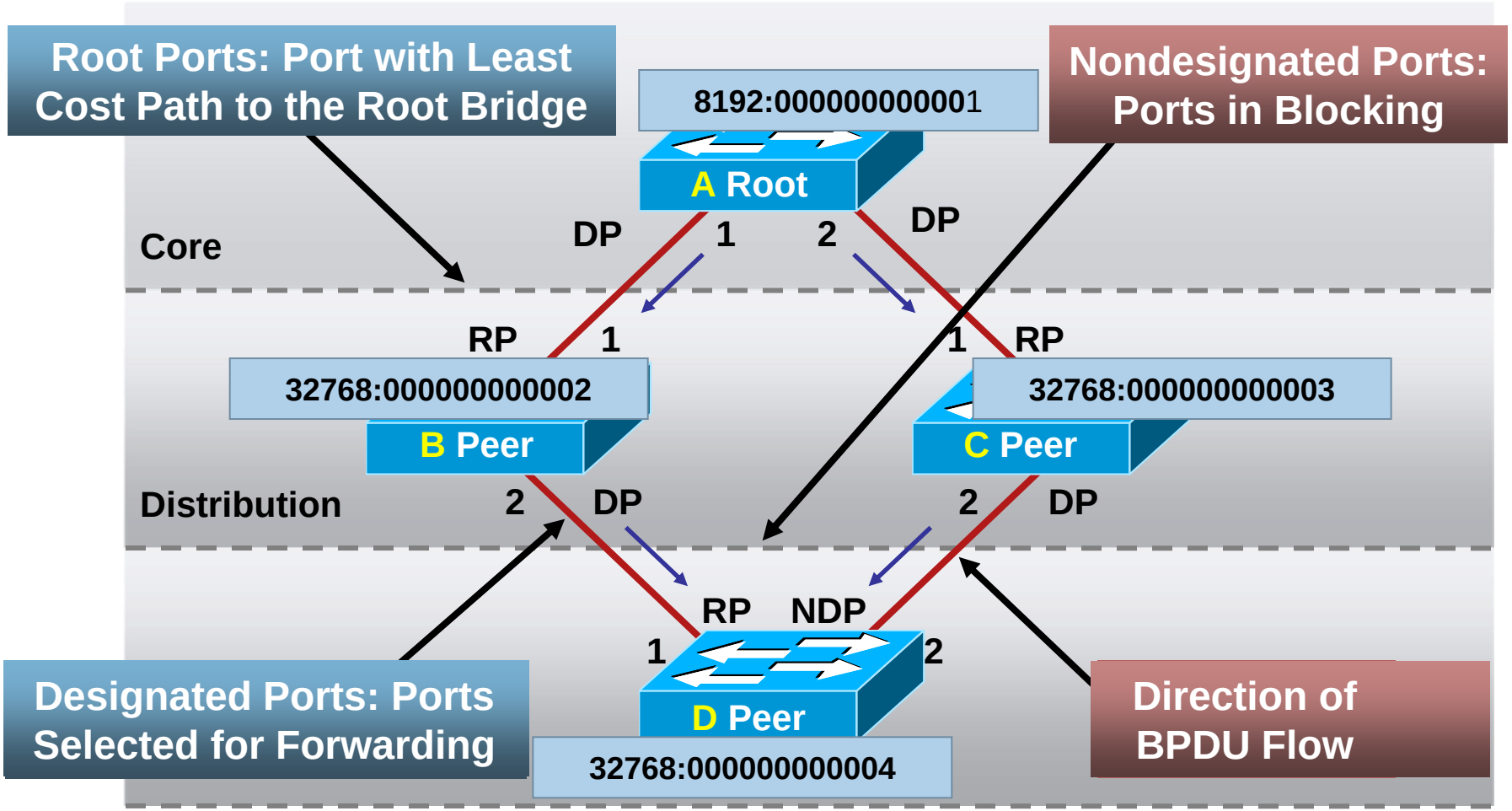
Processes	Blocking	Listening	Learning	Forwarding	Disable
Receives and process BPDUs	✓	✓	✓	✓	✗
Forward data frames received on interface	✗	✗	✗	✓	✗
Forward data frames switched from another interface	✗	✗	✗	✓	✗
Learn MAC address	✗	✗	✓	✓	✗

[1]Return to blocking if not lowest cost path to root bridge

BPDU Timers

Hello Time	▪ The hello time is the time between each BPDU frame that is sent on a port ▪ This is equal to 2 seconds by default, but can be tuned to be between 1 and 10 seconds
Forward Delay	▪ The forward delay is the time spent in the listening and learning state ▪ This is by default equal to 15 seconds for each state, but can be tuned to be between 4 and 30 seconds
Maximum Age	▪ The max age timer controls the maximum length of time a switch port saves configuration BPDU information ▪ This is 20 seconds by default, but can be tuned to be between 6 and 40 seconds

Layer 2 Spanning Tree

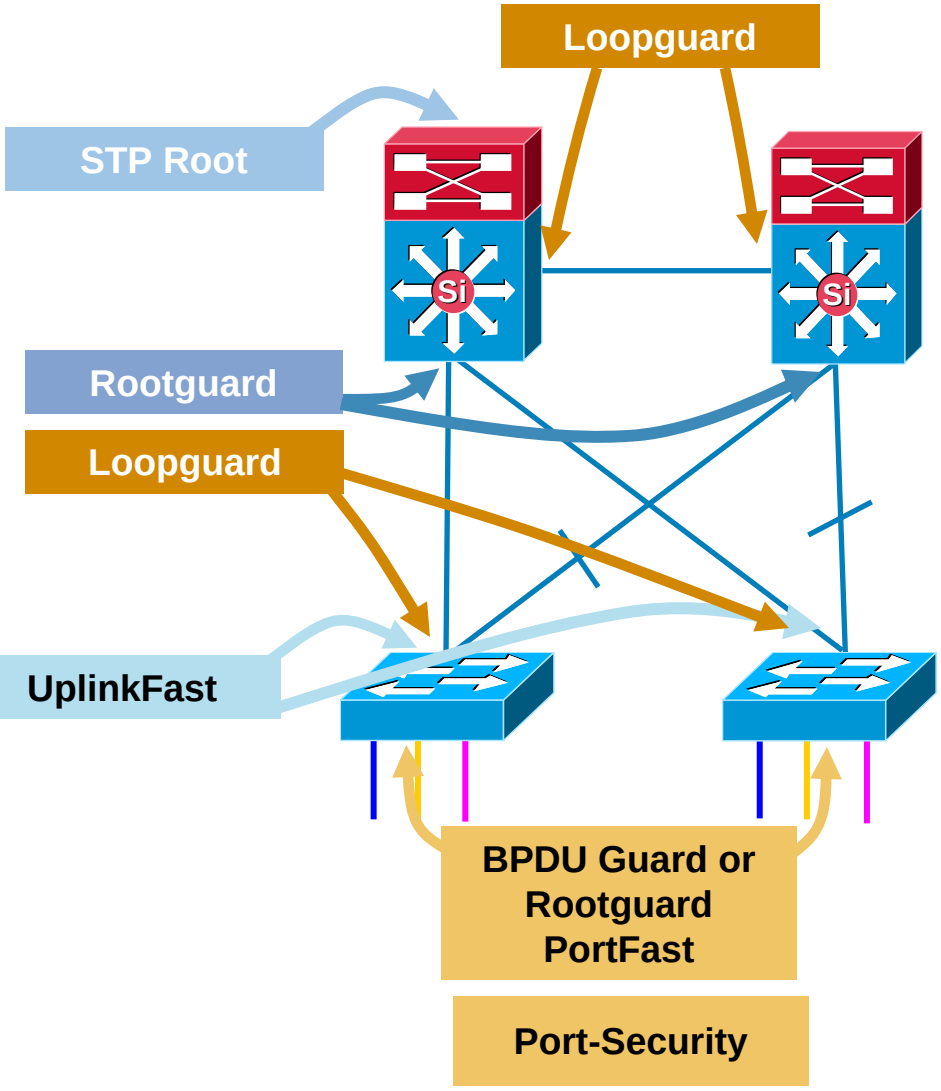


Layer 2 Hardening

Spanning Tree Should Behave the Way You Expect

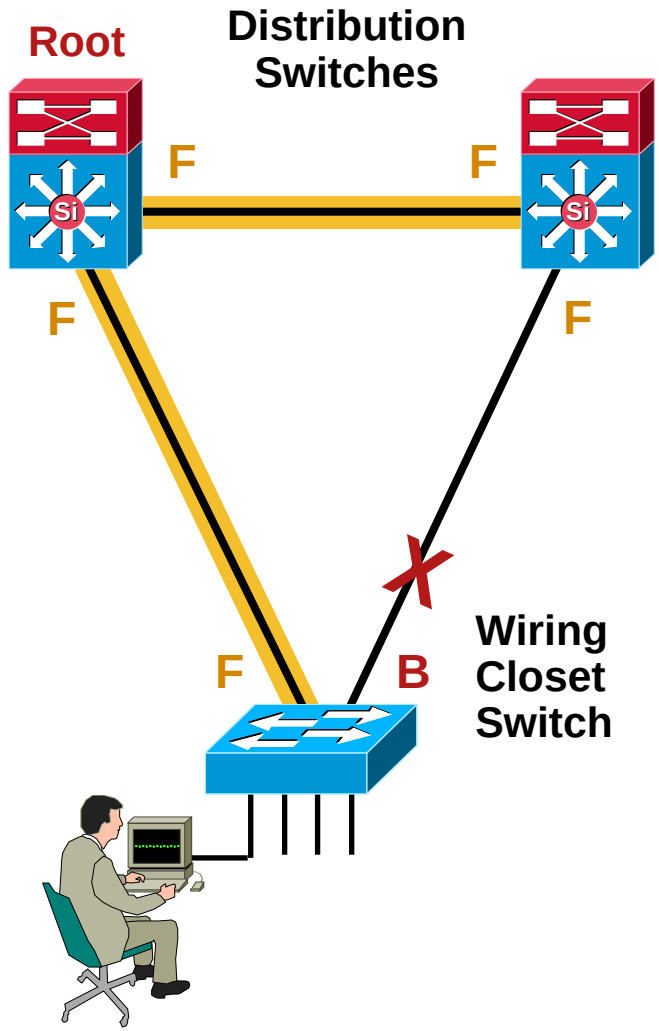
- **Place the Root where you want it**
  - Root Primary/Secondary Macro
  - HSRP/GLBP
- **The root bridge should stay where you put it**
  - Rootguard
  - Loopguard
  - UplinkFast
  - UDLD
- **Only end station traffic should b**

  seen on an edge port
  - BPDU Guard
  - Root Guard
  - PortFast
  - Port-security



Spanning Tree Features

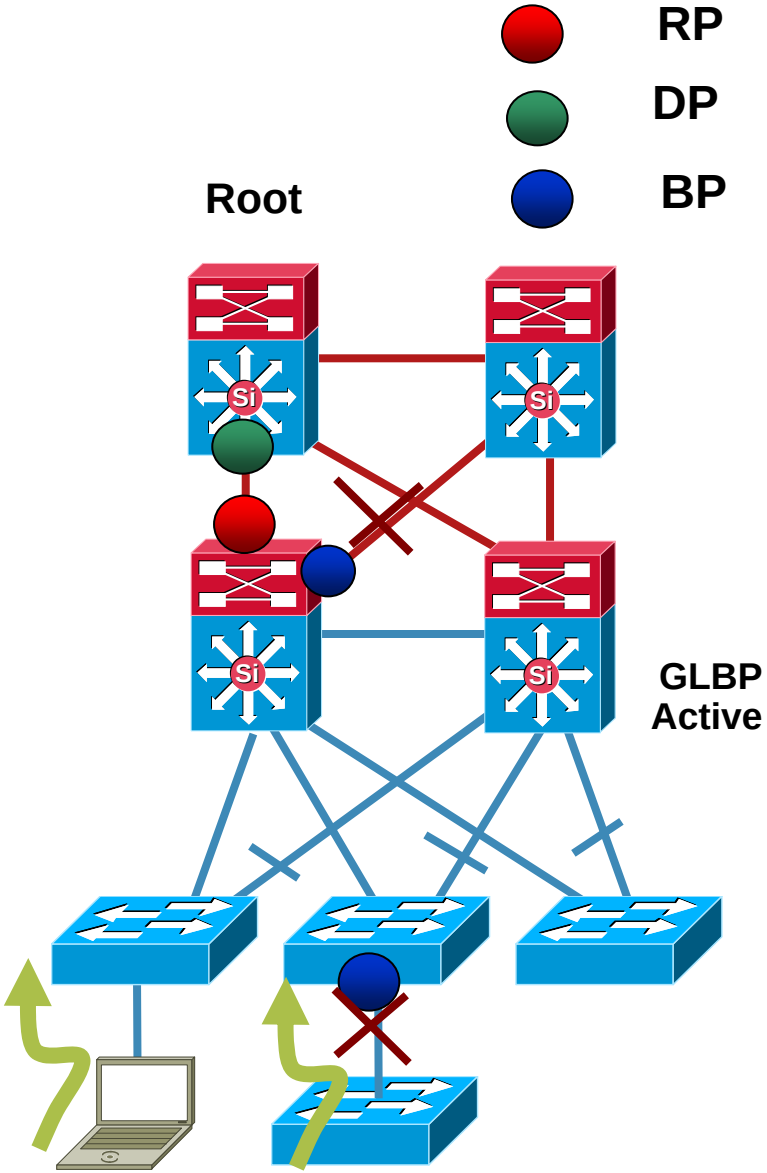
- PortFast*: Bypass listening-learning phase for access port
- UplinkFast: Three to five seconds convergence after link failure
- BackboneFast: Cuts convergence time by Max_Age for indirect failure
- LoopGuard*: Prevents alternate or root port from becoming designated in absence of BPDUs
- RootGuard*: Prevents external switches from becoming root
- BPDUGuard*: Disable PortFast enabled port if a BPDU is received
- BPDUFilter*: Do not send or receive BPDUs on PortFast-enabled ports



*Also Supported with MST and Rapid PVST+

What Is Root Guard?

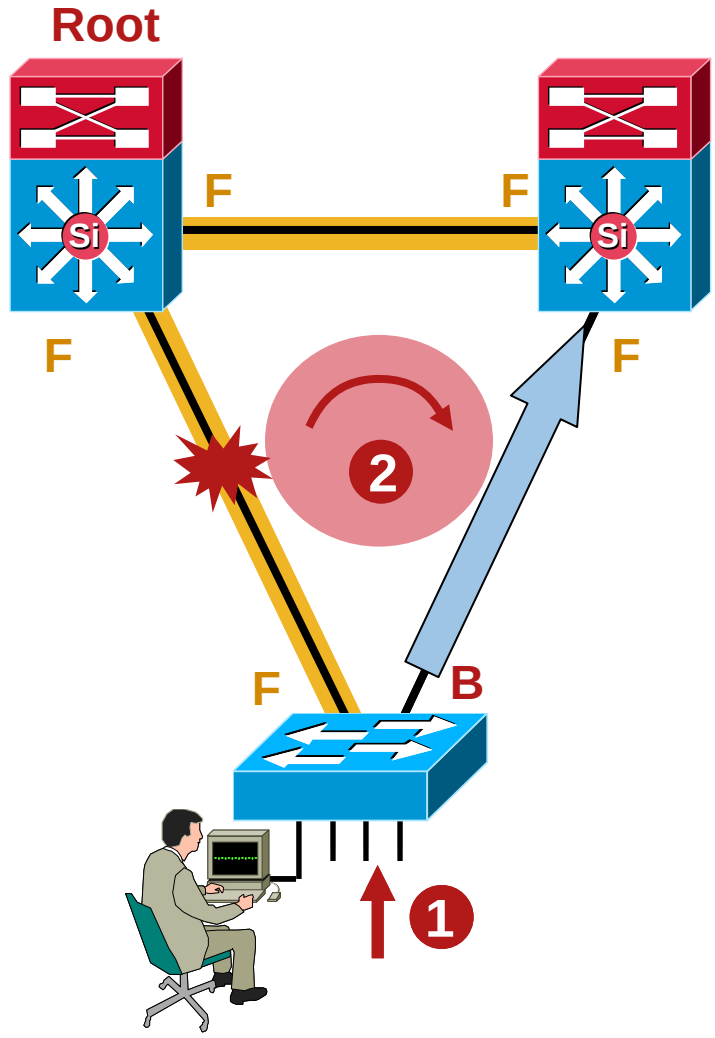
- Root guard forces a Layer 2 LAN interface to be a designated port
- If spanning-tree calculations cause a port to be selected as the root port, the port transitions to the **root-inconsistent** (blocked) state to prevent the customer's switch from becoming the root switch or being in the path to the root.




```
SW(config)# interface fa0/3
SWconfig-if)# spanning-tree rootguard
```

UplinkFast

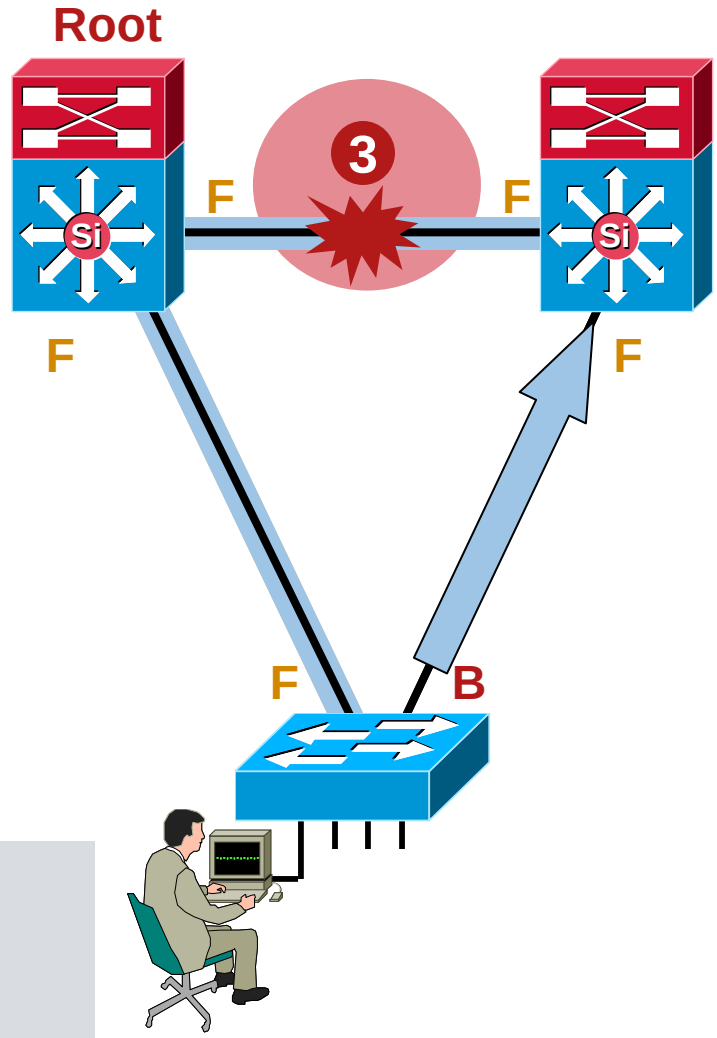
- Spanning Tree enhancement to reduce failover convergence time
- Used when recovery path is known and predictable
- Enabled on access switch
- Bypasses ‘listening’ and ‘learning’ stages of STP
- Reduces failover time to 2–3 seconds from 30 seconds
- Auto-populates upstream address tables (dummy mcast)



Switch(config)# spanning-tree uplinkfast

BackboneFast

- Spanning Tree enhancement to reduce failover convergence time
- Targeted at **indirect** failures
- Enabled on all switches
- Bypasses ‘max-age’
- Reduces failover time to 30 seconds from 50 seconds

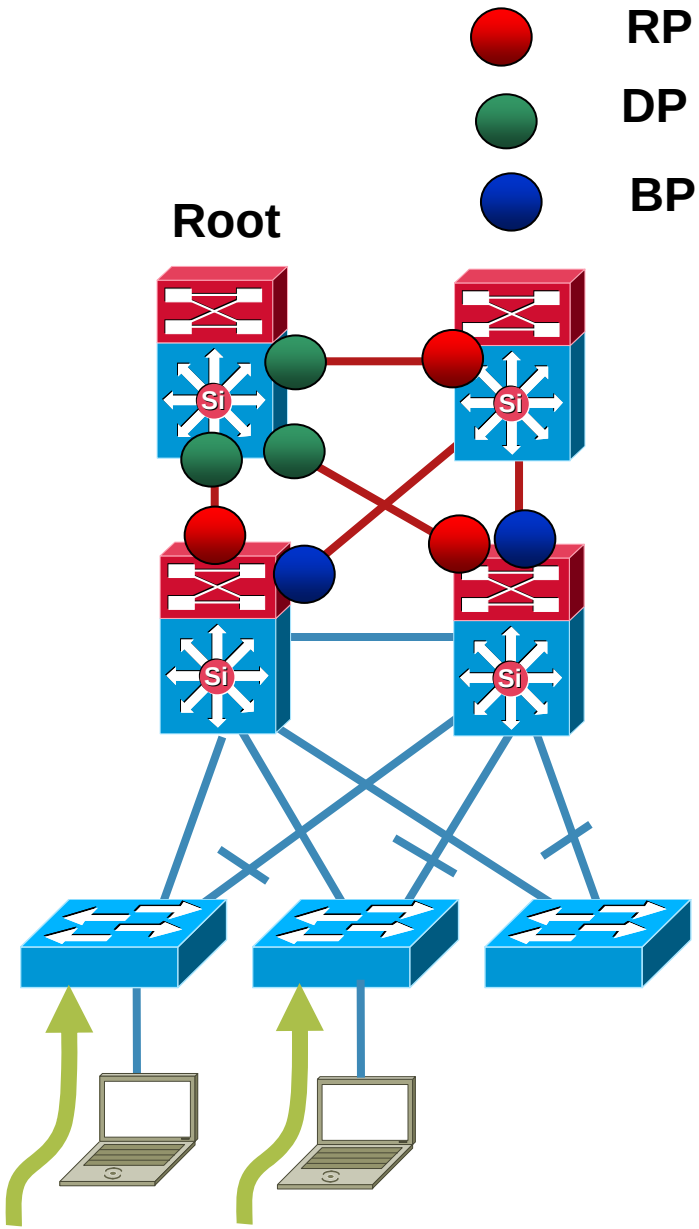


Switch(config)# **spanning-tree backbonefast**

PortFast

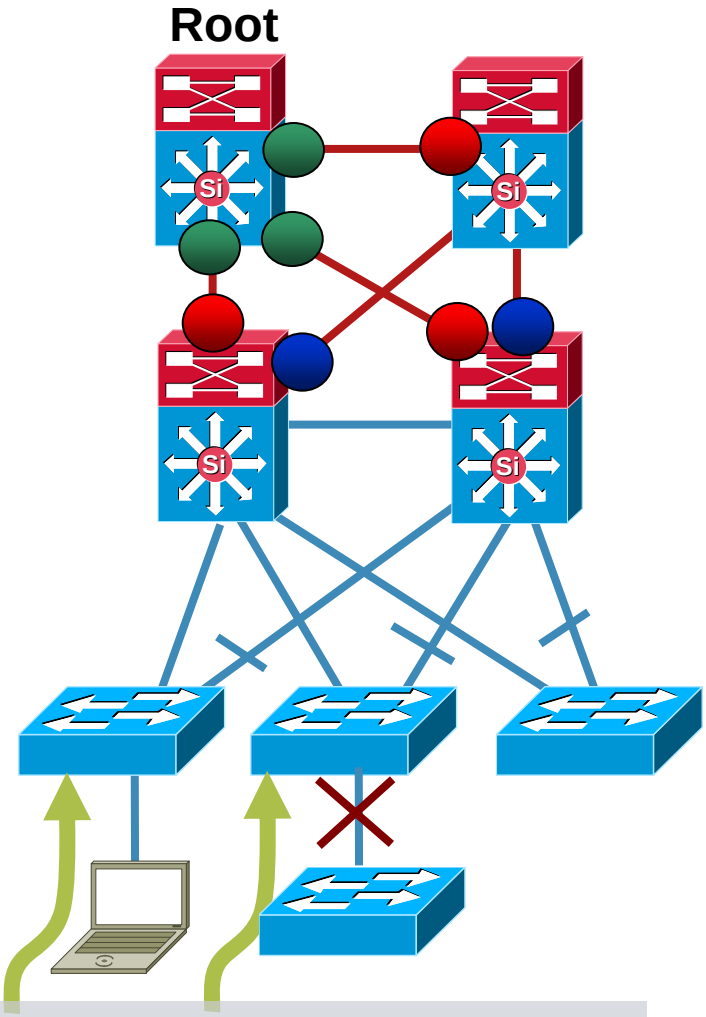
- Used on Access Ports (Edge Port) that are NOT connected to other switches or hubs
- Optimizes the convergence by simply ignoring the Listening and Learning states of the port
- Immediately puts the port into Forwarding state when the port is physically working

Switch(config-if)# spanning-tree portfast



What Is BPDU Guard?

- PortFast BPDU guard can prevent loops by moving PortFast-configured interfaces that receive BPDUs to errdisable, rather than running Spanning Tree across that port
- This keeps ports configured with PortFast from being incorrectly connected to another switch



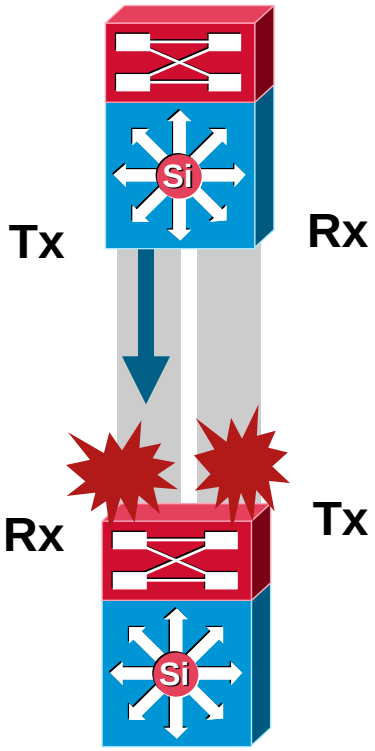
Switch(config)# spanning-tree portfast bpduguard
or
Switch(config-if)# spanning-tree bpduguard enable

1w2d: %SPANTREE-2-BLOCK_BPDUGUARD: Received BPDU on port FastEthernet3/1 with BPDU Guard enabled. Disabling port.
1w2d: %PM-4-ERR_DISABLE: bpduguard error detected on Fa3/1, putting Fa3/1 in err-disable state

Link Redundancy—UDLD

Aggressive Mode UDLD

- Default UDLD timers (15 second hellos) are intended to take down link prior to 802.1d spanning tree listening/learning transition
- Aggressive mode—after aging on a previously bi-directional link—tries eight times (once per second) to reestablish connection then err-disables port
- Aggressive mode protects against
  - One side of a link has a port stuck (both Tx and Rx)
  - One side of a link remains up while the other side of the link has gone down




```
! Global configuration
udld aggressive
udld message time 7

! Interface
interface GigabitEthernet8/1
 udld port aggressive
```

Spanning Tree Verification

```
3550# show spanning-tree

VLAN0001
 Spanning tree enabled protocol ieee
 Root ID  Priority  24577
       Address   0005.ddc5.8300
       This bridge is the root
       Hello Time  2 sec Max Age 20 sec Forward Delay 15 sec

 Bridge ID Priority  24577 (priority 24576 sys-id-ext 1)
       Address   0005.ddc5.8300
       Hello Time  2 sec Max Age 20 sec Forward Delay 15 sec
       Aging Time 15
Interface    Role Sts Cost   Prio.Nbr Type
---------------- ---- --- --------- -------- ----------------------
Gi0/12      Desg FWD 19    128.12  P2p
Po1        Desg FWD 3     128.65  P2p
(etc, for additional vlans)
```

```
3550# show spanning-tree summary
Switch is in pvst mode
Root bridge for: VLAN0001
EtherChannel misconfig guard is enabled
Extended system ID  is enabled
Portfast       is disabled by default
PortFast BPDU Guard is disabled by default
Portfast BPDU Filter is disabled by default
Loopguard      is disabled by default
UplinkFast      is disabled
BackboneFast     is disabled
Pathcost method used is short

Name          Blocking Listening Learning Forwarding STP Active
--------------------- -------- --------- -------- ---------- ----------
VLAN0001           0     0    0     2     2
VLAN0005           0     0    0     2     2
--------------------- -------- --------- -------- ---------- ----------
2 vlans            0     0    0     4     4
```

Spanning Tree Best Practice

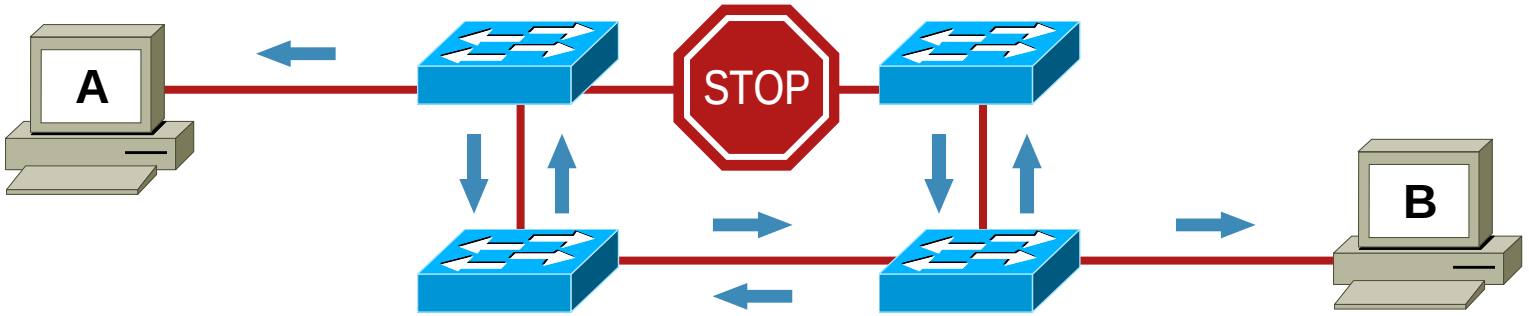
"How Can I Have a Spanning Tree Loop? I Don't Have Spanning Tree Enabled?"

Cisco Recommends Leaving STP-Enabled for the Following Reasons:

- **If there is a loop (induced by mispatching, bad cable, and so on), STP will prevent detrimental effects to the network caused by multicast and broadcast data**
- **Protection against an EtherChannel breaking down**
- **Most networks are configured with STP, giving it maximum field exposure; more exposure generally equates to stable code**
- **Protection against dual attached NICs misbehaving (or bridging enabled on servers)**
- **The software for many protocols (such as PAgP, IGMP snooping, and trunking) is closely related to STP; running without STP may lead to undesirable results**

Spanning Tree Standards and Features

Spanning Tree Toolkit, 802.1D, 802.1s, 802.1w



- 802.1D/1998: Legacy standard for bridging and Spanning Tree (STP)
- 802.1D/2004: Updated bridging and STP standard; includes 802.1s, 802.1t, and 802.1w
- 802.1s: Multiple Spanning Tree Protocol (MSTP)—maps multiple VLANs into the same Spanning Tree instance
- 802.1t: MAC address reduction/extended system ID—moves some BPDU bits to high-numbered VLANs from the priority field, which constrains the possible values for bridge priority; unique “MAC” per chassis not port
- 802.1w: Rapid Spanning Tree Protocol (RSTP)—improved convergence over 1998 STP by adding roles to ports and enhancing BPDU exchanges
- Cisco Features: Per VLAN Spanning Tree (PVST), PVST+, UpLinkFast, BackboneFast, BPDU Guard, RootGuard, LoopGuard, UDLD

STP Variance

IEEE	DEC STP pre-IEEE
	802.1D—Classic STP
	802.1w—Rapid STP (RSTP)
	802.1s—Multiple STP (MST)
	802.1t—802.1d maintenance

Cisco Spanning-Tree toolkit

STP enhancements to 802.1(d,s,w)

PortFast
Lets the access port bypass the listening and learning phases

UplinkFast
Provides 3-to-5 second convergence after link failure

BackboneFast
Cuts convergence time by MaxAge for indirect failure

Loop Guard
Prevents the alternate or root port from being elected unless Bridge Protocol Data Units (BPDUs) are present

Root Guard
Prevents external switches from becoming the root

BPDU Guard
Disables a PortFast-enabled port if a BPDU is received

BPDU Filter
Prevents sending/receiving BPDUs on PortFast-enabled ports

STP Variance

Cisco Proprietary

Per-VLAN Spanning Tree Plus (PVST+)
Provides a separate 802.1D spanning tree instance for each VLAN configured in the network. This includes PortFast, UplinkFast, BackboneFast, BPDU Guard, BPDU Filter, Root Guard, and Loop Guard.

Rapid PVST+
Provides an instance of RSTP (802.1w) per VLAN. This includes PortFast, BPDU Guard, BPDU Filter, Root Guard, and Loop Guard.

MST
Provides up to 16 instances of RSTP (802.1w) and combines many VLANS with the same physical and logical topology into a common RSTP instance. This includes, PortFast, BPDU Guard, BPDU Filter, Root Guard, and Loop Guard.

Optimizing L2 Convergence

PVST+, Rapid PVST+ or MST

- Rapid-PVST+ greatly improves the restoration times for any VLAN that requires a topology convergence due to link UP
- Rapid-PVST+ also greatly improves convergence time over Backbone fast for any indirect link failures
- PVST+ (802.1d)

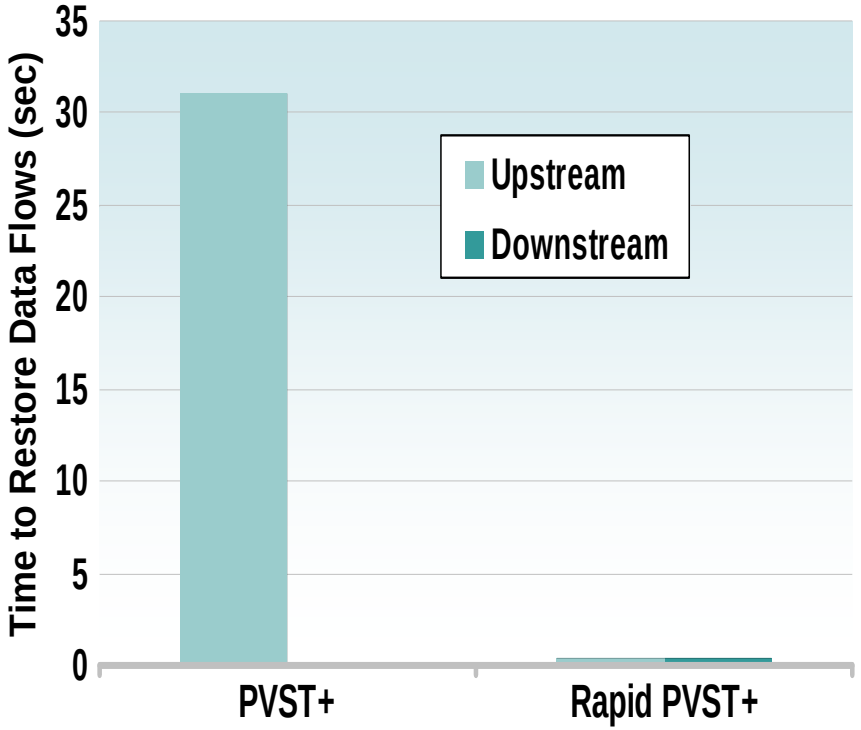
  Traditional Spanning Tree Implementation
- Rapid PVST+ (802.1w)

  Scales to large size (~10,000 logical ports)

  Easy to implement, proven, scales
- MST (802.1s)

  Permits very large scale STP implementations (~30,000 logical ports)

  Not as flexible as Rapid PVST+



RAPID SPANNING TREE 802.1w

RSTP: New Concepts

- New Port Roles and States
- Modified BPDU
- Proposal/Agreement messages between bridges
- BPDU handling
- New topology change mechanism
- PVST+/802.1D Compatibility

Rapid PVST+

- Rapid PVST+ is the IEEE 802.1w (RSTP) standard implemented per VLAN.
- Each Rapid PVST+ instance on a VLAN has a single root switch. You can enable and disable STP on a per-VLAN basis when you are running Rapid PVST+.
- Rapid PVST+ uses point-to-point wiring to provide rapid convergence of the spanning tree.
- The spanning tree reconfiguration can occur in less than 1 second with Rapid PVST+ (in contrast to 50 seconds with the default settings in the 802.1D STP).

Rapid PVST+ roles (1)

Rapid PVST+ defines 4 port roles:

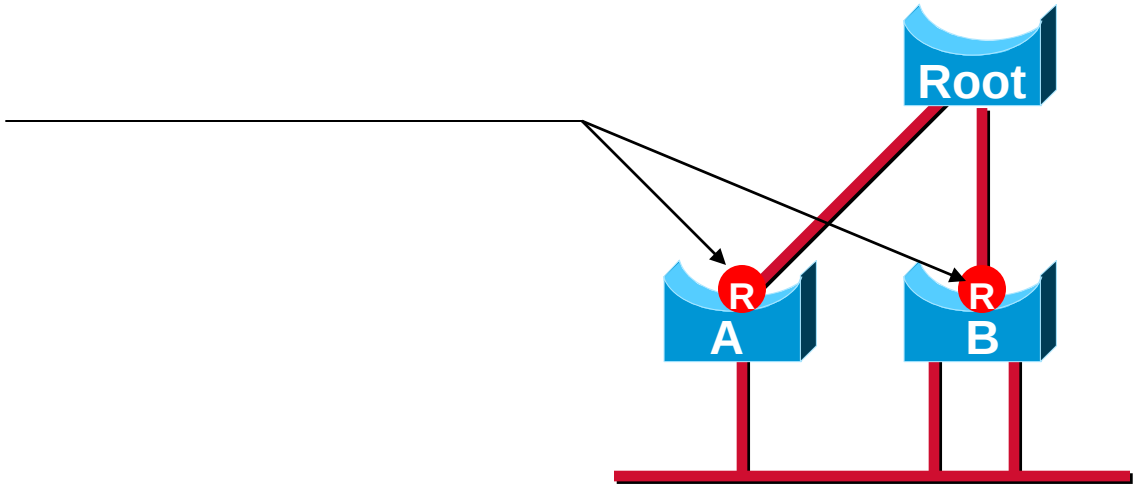
- Root port - If Rapid PVST+ selects a new root port, it blocks the old root port and immediately transitions the new root port to the forwarding state.
- Designated port
- Alternate port
- Backup port

} **Both blocking**

Port state (blocking, forwarding, learning) is independent from the role

Rapid PVST+ roles (2)

- Root Port

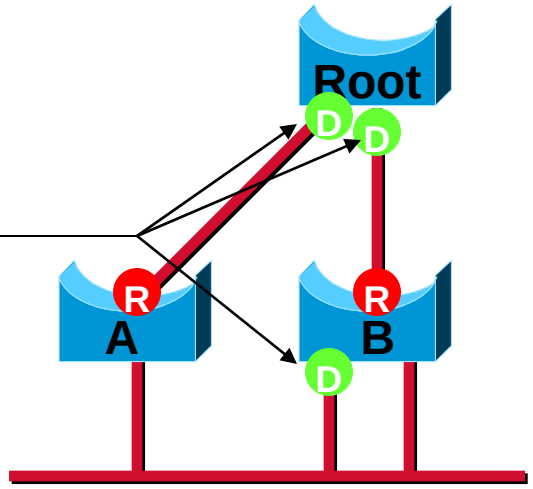


Root Port:

Port receiving the best BPDU for the bridge – shortest path to the Root in terms of path cost

Rapid PVST+ roles (3)

- **Root Port**
- **Designated Port**

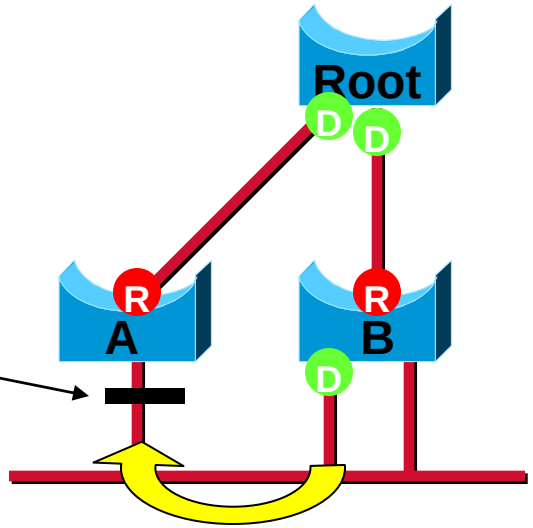


Designated Port:

Port sending the best BPDU on a segment

Rapid PVST+ roles (4)

- R Root Port
- D Designated Port
- — Alternate Port

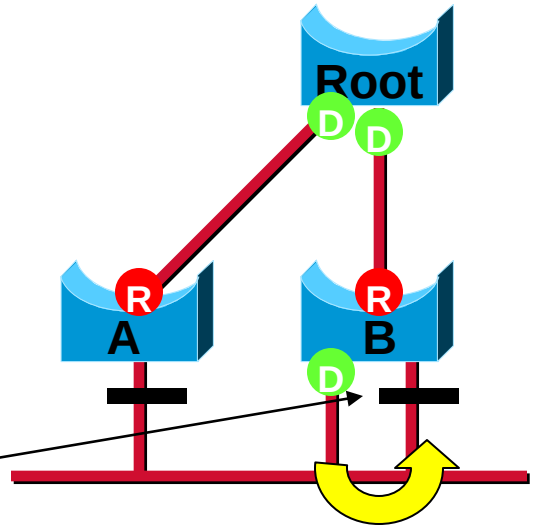


Alternate Port:

Port blocked by BPDUs from a different bridge – redundant path to the Root

Rapid PVST+ roles (5)

- R Root Port
- D Designated Port
- — Alternate Port
- — Backup Port

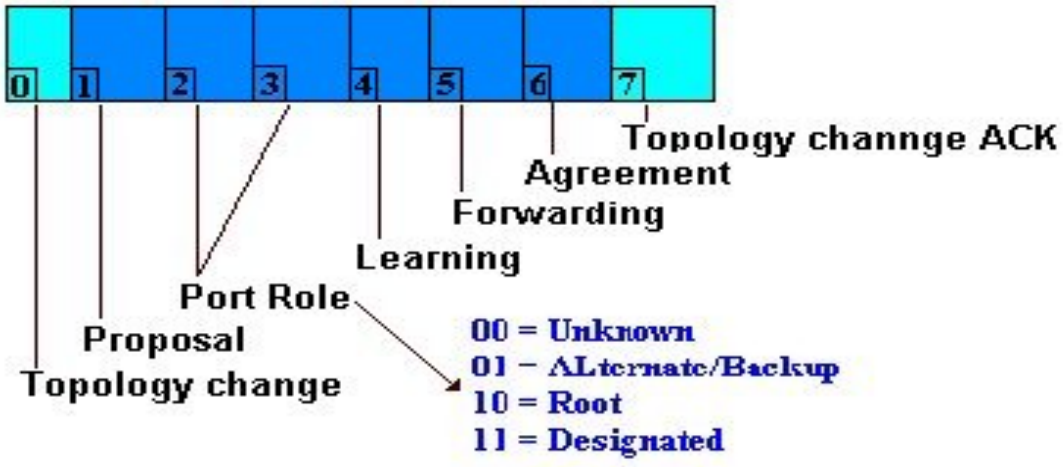


Backup Port:

Port blocked by BPDUs sent from the same bridge – redundant path to a segment

Modified BPDU

- Protocol version now 2 (was 0)
- No more distinct TCN BPDU
- Flag field changes



- **802.1D bridges drop RSTP BPDUs**

Modified BPDU (2)

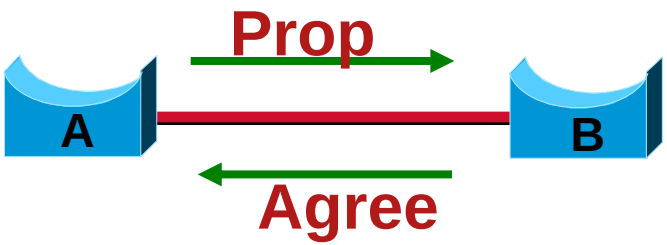
- BPDUs now act as keepalives:
  - All bridges send BPDUs every hello time (PVST+ used to relay BPDUs from the root)
  - Port information invalidated in 3 x hello time max ⇔ 3 BPDUs lost
  - No more Max Age or Message Age fields – a hop count is used instead inside a region

  ⇨ Faster failure detection

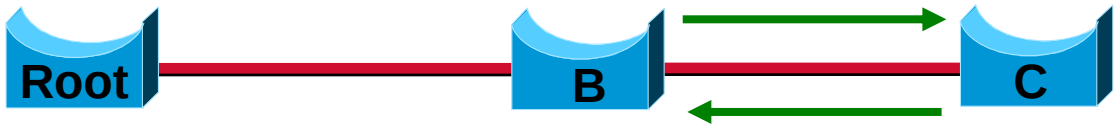
Agreement/Proposal

- Explicit handshake mechanism between bridges
- Upon link up event, bridge sends a proposal to become designated for that segment (designated bridge is the one leading to the root)
- Response is an agreement if remote bridge selects the port on which it received the proposal as its root port
- As soon as agreement is received, port moves to forwarding

Agreement/Proposal



- A has a better priority than B
- A sends a proposal to B to become designated
- B compares the received priority and replies with an agreement – B's port becomes Root Port



- The same process is repeated when a new bridge is inserted

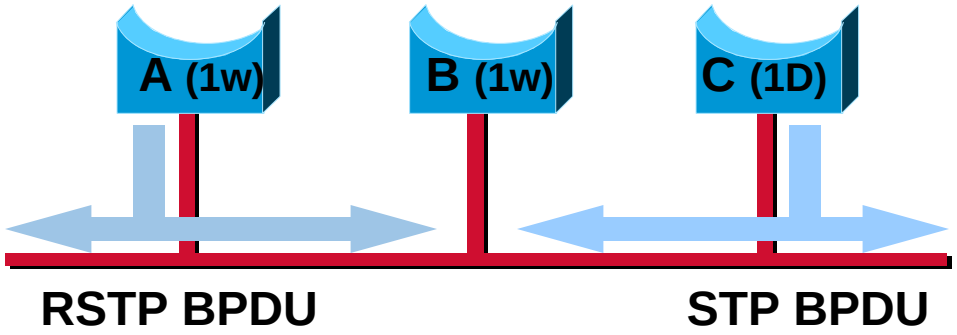
Rapid Transition

- For a rapid transition to occur
  - Make sure you properly identify:
    - » Edge ports (enabled via Portfast)
    - » Point-to-point links (derived from duplex mode by default)
- It is very important to check duplex settings between two bridges – else, no Proposal/Agreement mechanism !

Protocol Migration (1)

Mix of 802.1D and 802.1w Bridges:

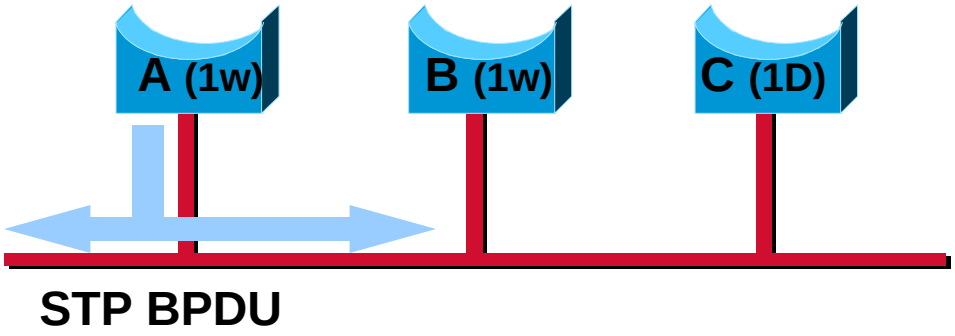
- 1D bridges drop 1w BPDUs ⇨ 1D Bridges always end up sending BPDUs



- **After Migration Delay (3s), RSTP bridge starts sending 802.1D BPDU if it detects a legacy bridge (on a per-port basis).**

Protocol Migration(2)

- **Cannot detect if 802.1D bridge is removed if it is not designated (otherwise it would send BPDUs).**



- **If C goes away, force protocol migration manually (`set spantree mst x/y redetect-neighbor`)**
- **1D-1w interoperability = slow convergence: ⇨ try to avoid it.**

Configuring Rapid-PVST+

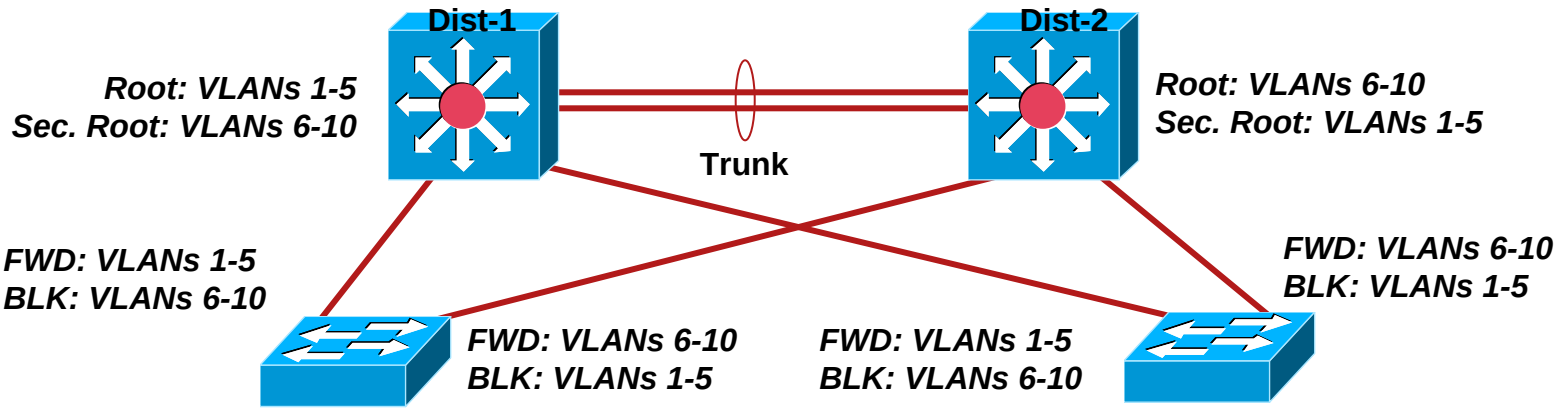
- RSTP fast convergence on a per-VLAN basis
- Each VLAN runs its own RSTP instance and sends its own RSTP BPDU, just like PVST+

```
CiscoIOS# configure terminal
CiscoIOS(config)# spanning-tree mode rapid-pvst+
```

Configuring Rapid-PVST+ in Distribution

Cisco IOS

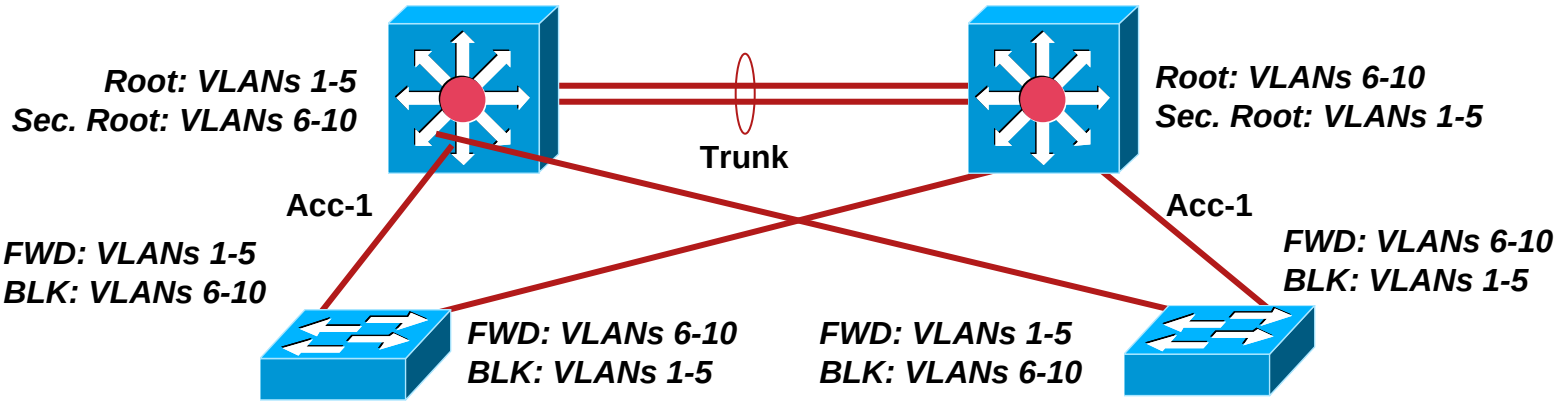
```
spanning-tree extend system-id
spanning-tree mode rapid-pvst+
! Set spanning tree mode to rapid-pvst+
spanning-tree vlan 1-5 root primary
spanning-tree vlan 6-10 root secondary
```



Configuring Rapid-PVST+ in Access

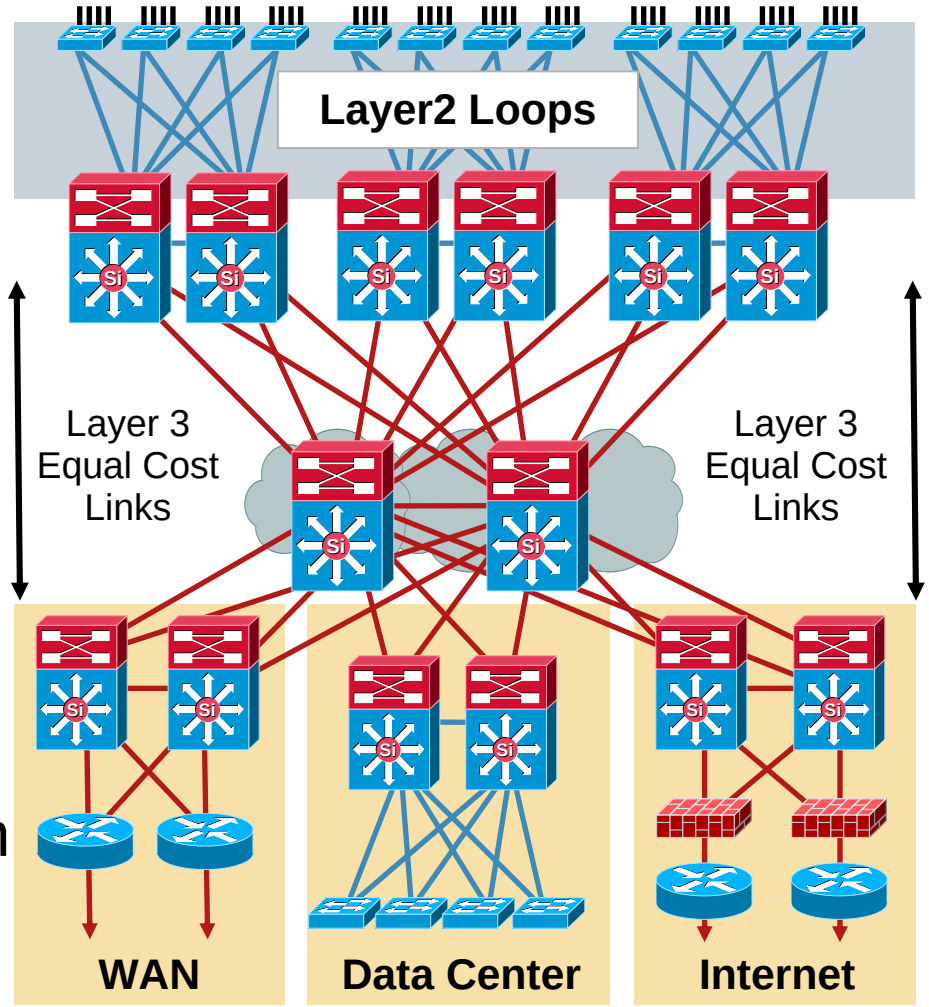
CiscoIOS

spanning-tree extend system-id
! Enable MAC address reduction. This is not a requirement
spanning-tree mode rapid-pvst+
! Set spanning tree mode to rapid-pvst+

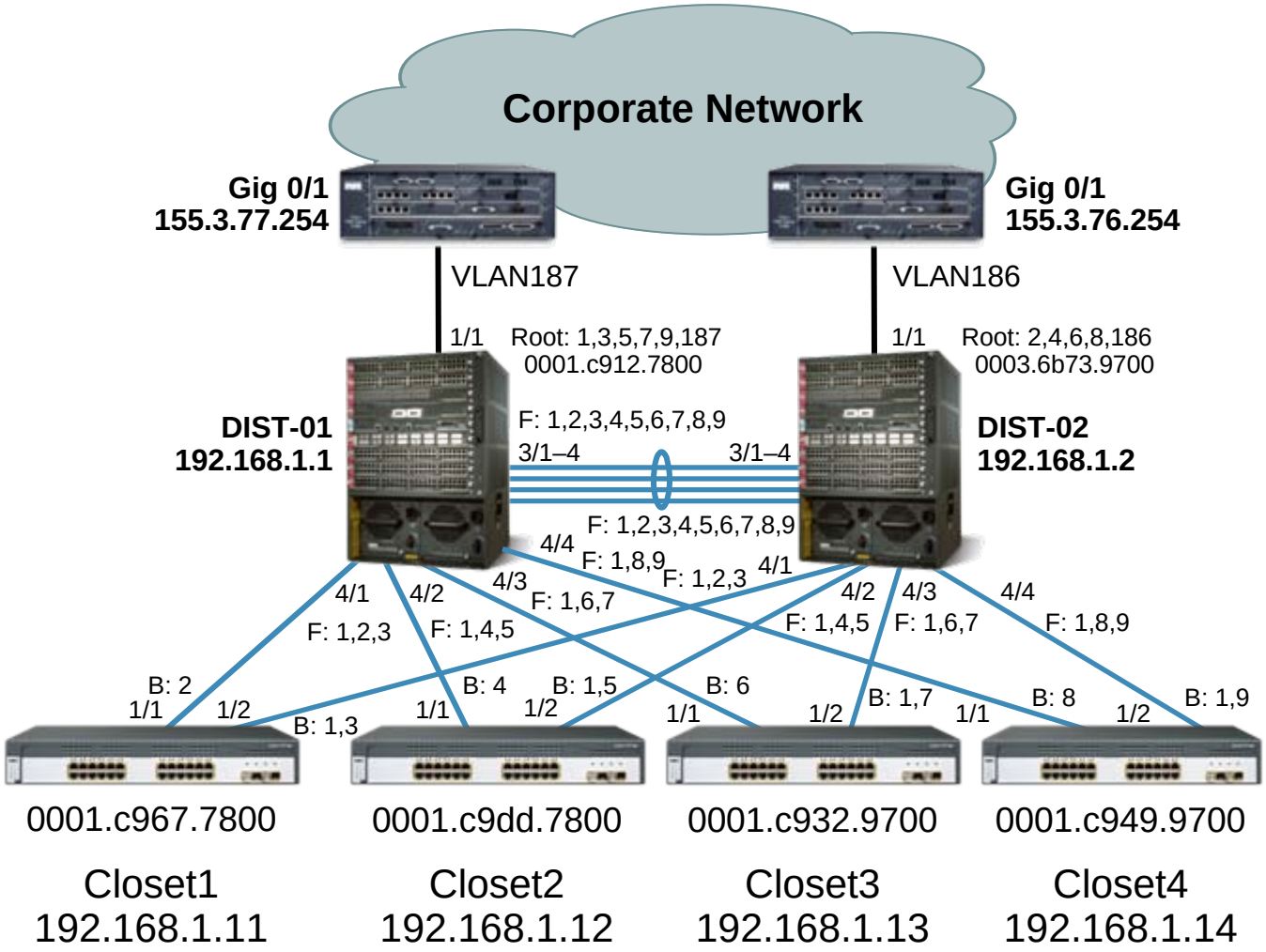


Spanning Tree Protocol Troubleshooting Methodology

- Start now—be proactive
- Divide and conquer
- Document Spanning Tree topology
- Implement Spanning Tree enhancement features
- Develop recovery plan to include data collection for root cause analysis



Spanning Tree Protocol
Documenting Spanning Tree Topology



Spanning Tree Protocol

STP Loop Recovery

- Do not power off switches—pull/shut redundant links
- If possible, initially disable ports that should be blocking
- Check and physically remove the connections to the ports that should be blocking
- Set up remote access to your network and call the TAC

Spanning Tree Protocol

Troubleshooting Commands

```
IOS#show spanning-tree vlan 1 brief

VLAN0001
 Spanning tree enabled protocol ieee
 Root ID          Priority 1
                  Address  0060.8355.7b00
                  Cost     23
                  Port     1 (GigabitEthernet1/1)
                  Hello Time 2 sec  Max Age 20 sec   Forward Delay 15 sec

 Bridge ID        Priority 32769 (priority 32768 sys-id-ext 1)
                  Address  0007.0e8f.0880
                  Hello Time 2 sec  Max Age 20 sec   Forward Delay 15 sec
                  Aging Time 300

Interface                                        Designated
Name     Port ID Prio   Cost Sts  Cost Bridge ID    Port ID
-------------------------        ----------- ------ ------- -------
GigabitEthernet1/1 128.1 128 4 FWD  67 32768 0005.5f33.dc01  128.1
FastEthernet3/48  128.176 128 19 FWD 48 32768 0030.7bdd.5080        128.16
```

Spanning Tree Protocol

Troubleshooting Commands

```
IOS#show spanning-tree vlan 1

VLAN0001
 Spanning tree enabled protocol rstp
 Root ID Priority 32768
    Address  0030.7b4e.4801
    This bridge is the root
    Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

 Bridge ID Priority 32768
    Address  0030.7b4e.4801
    Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
    Aging Time 300

Interface  Role Sts Cost  Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------
Fa2/1   Desg FWD 19  128.129 P2p Peer(STP)
```

Spanning Tree Protocol

Troubleshooting Commands


```
IOS#show spanning-tree summary
Root bridge for: VLAN0010.
Extended system ID is enabled
PortFast BPDU Guard is enabled
EtherChannel misconfiguration guard is disabled
UplinkFast is disabled
BackboneFast is enabled
Default pathcost method used is short

Name      Blocking  Listening Learning  Forwarding          STP Active
--------------------------------- ------------ ------------ --------------- --------
VLAN0001    0    0    0            2     2
VLAN0010    0    0    0            1     1
VLAN1002    0    0    0            1     1
VLAN1003    0    0    0            1     1
VLAN1004    0    0    0            1     1
VLAN1005    0    0    0            1     1
----------------------      ------------ ------------ ------------ ---------------

6 VLANs     0    0    0            7     7
```

Spanning Tree Protocol
Troubleshooting Commands

```
IOS# show proc cpu
CPU utilization for five seconds: 1%/0%; one minute: 2%; five minutes: 2%
 PID Runtime(ms)  Invoked   uSecs  5Sec  1Min  5Min TTY Process
  1       0      1      0 0.00% 0.00% 0.00%  0 Chunk Manager
 <…some output removed…>
 79       0    256      0 0.00% 0.00% 0.00%  0 mls-msc Process
 80    30508  461976     66 0.40% 0.43% 0.44%  0 Spanning Tree
 81     108   27024     3 0.00% 0.00% 0.00%  0 Ethchnl
 <…some output removed…>
 162     12    41    292 0.00% 0.01% 0.00%  1 Virtual Exec
```

```
IOS# show spanning-tree summary
<…some output removed…>

Name           Blocking Listening Learning Forwarding STP Active
---------------------- -------- --------- -------- ---------- ----------
VLAN0001            1     0    0     1     2
<…some output removed…>
VLAN1005            0     0    0     1     1
---------------------- -------- --------- -------- ---------- ----------
282 vlans           1     0    0    282    283
```

Number of Spanning Tree Instances

Spanning Tree Protocol
Troubleshooting Topology Change

```
IOS#show spanning-tree vlan 1 detail

 VLAN0001 is executing the ieee compatible Spanning Tree protocol
 Bridge Identifier has priority 32768, address 0005.7495.9101
 Configured hello time 2, max age 20, forward delay 15
 Current root has priority 32768, address 0001.c912.7800
 Root port is 70 (GigabitEthernet2/6), cost of root path is 4
 Topology change flag not set, detected flag not set
 Number of topology changes 4 last change occurred 02:17:20 ago
   from Port-channel1
 Times: hold 1, topology change 35, notification 2
   hello 2, max age 20, forward delay 15
 Timers: hello 0, topology change 0, notification 0, aging 300

 Port 70 (GigabitEthernet2/6) of VLAN0001 is forwarding
 Port path cost 4, Port priority 128, Port Identifier 128.70.
 Designated root has priority 32768, address 0001.c912.7800
 Designated bridge has priority 32768, address 0001.c912.7800
 Designated port id is 128.70, designated path cost 0
 Timers: message age 2, forward delay 0, hold 0
 Number of transitions to forwarding state: 1
 Link type is point-to-point by default
 BPDU: sent 7, received 4162

 Port 833 (Port-channel1) of VLAN0001 is blocking
 Port path cost 4, Port priority 128, Port Identifier 128.833.
 Designated root has priority 32768, address 0001.c912.7800
 Designated bridge has priority 32768, address 0001.c912.7800
 Designated port id is 128.769, designated path cost 0
 Timers: message age 1, forward delay 0, hold 0
 Number of transitions to forwarding state: 1
 Link type is point-to-point by default
 BPDU: sent 4, received 134836
```