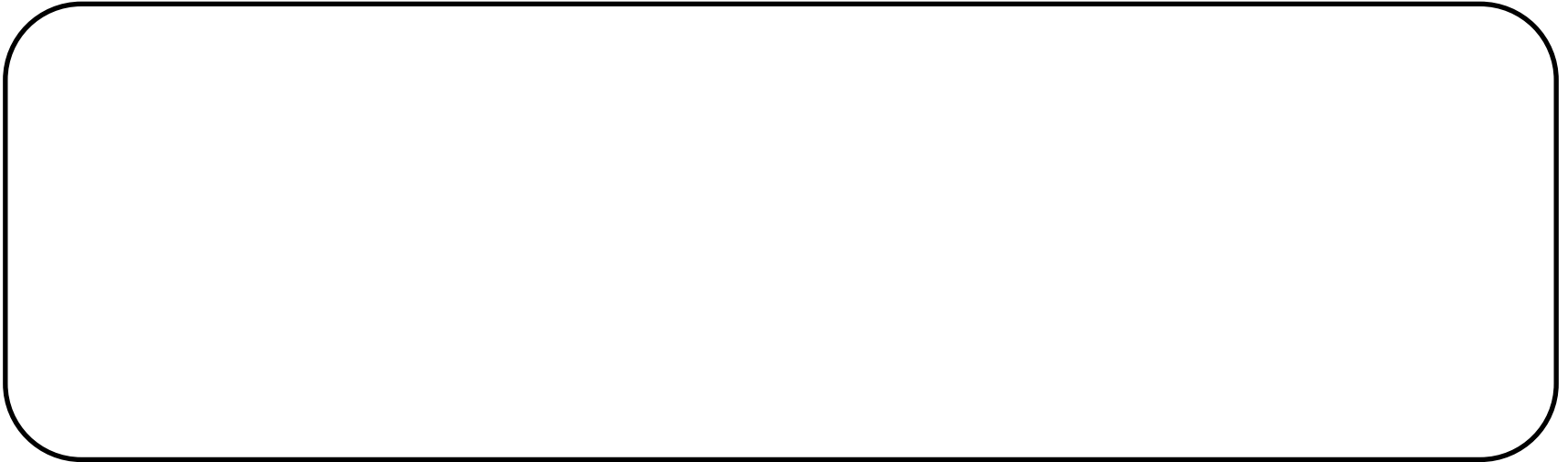


ATP. Lecture 4



Spanning Tree

Objectives

A large, empty rounded rectangular box with a black border, intended for writing objectives or notes.A second large, empty rounded rectangular box with a black border, identical to the one above, for additional notes or objectives.



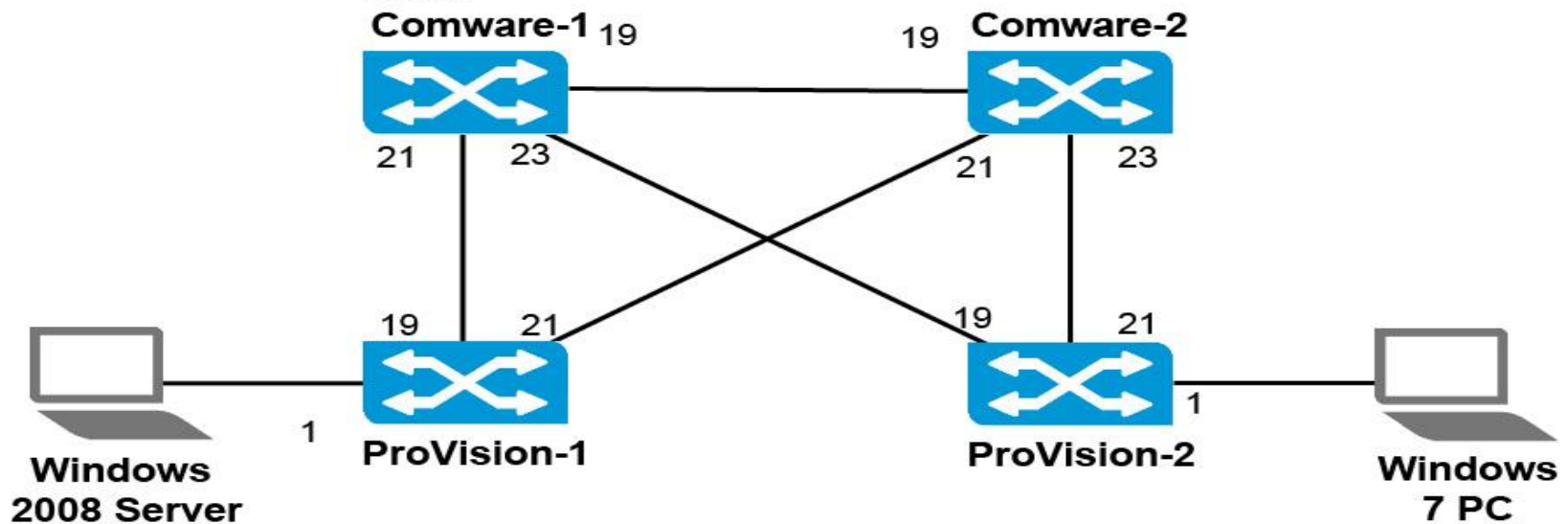
Spanning Tree

Issues adding redundant links to the topology

**Failure of a network link
may make the network unavailable to users**

**you can
install redundant links**

**a path continues to exist across
the network even if one link or even one switch fails.**



Issues adding redundant links to the topology

does not ensure **can**
use those links correctly

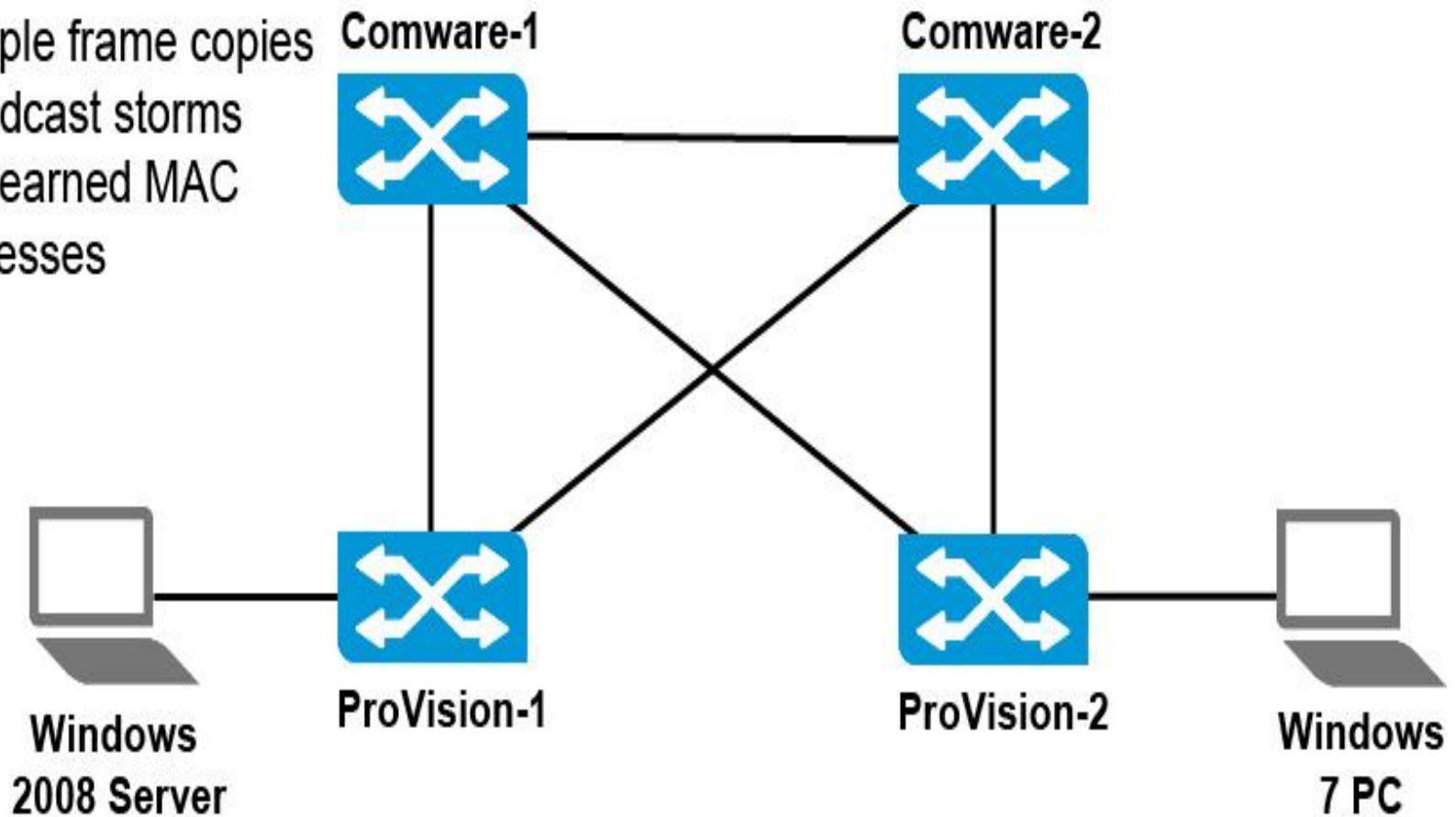
without a
protocol to manage the links results in
network loops

To function properly, an Ethernet network
must have only one active pathway between
any two devices

Issues adding redundant links to the topology

Loops in Ethernet cause:

- Multiple frame copies
- Broadcast storms
- Mis-learned MAC addresses



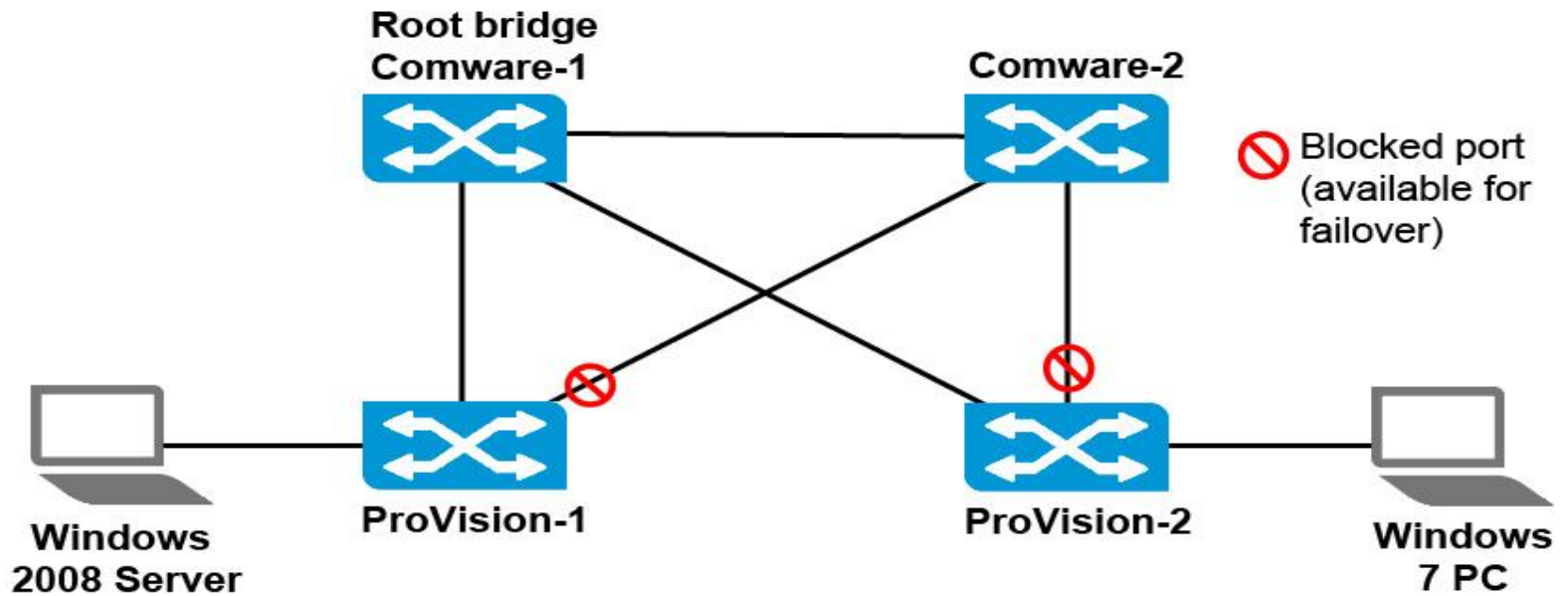
Overview of STP

Several
STP
versions
exist:

- **The original standard Spanning Tree Protocol (STP)**
- **Rapid Spanning Tree Protocol (RSTP)**
- **Multiple Spanning Tree Protocol (MSTP)**

Spanning tree solution

- One shortest path between each switch and the root (elected by BPDU)
- Other paths blocked



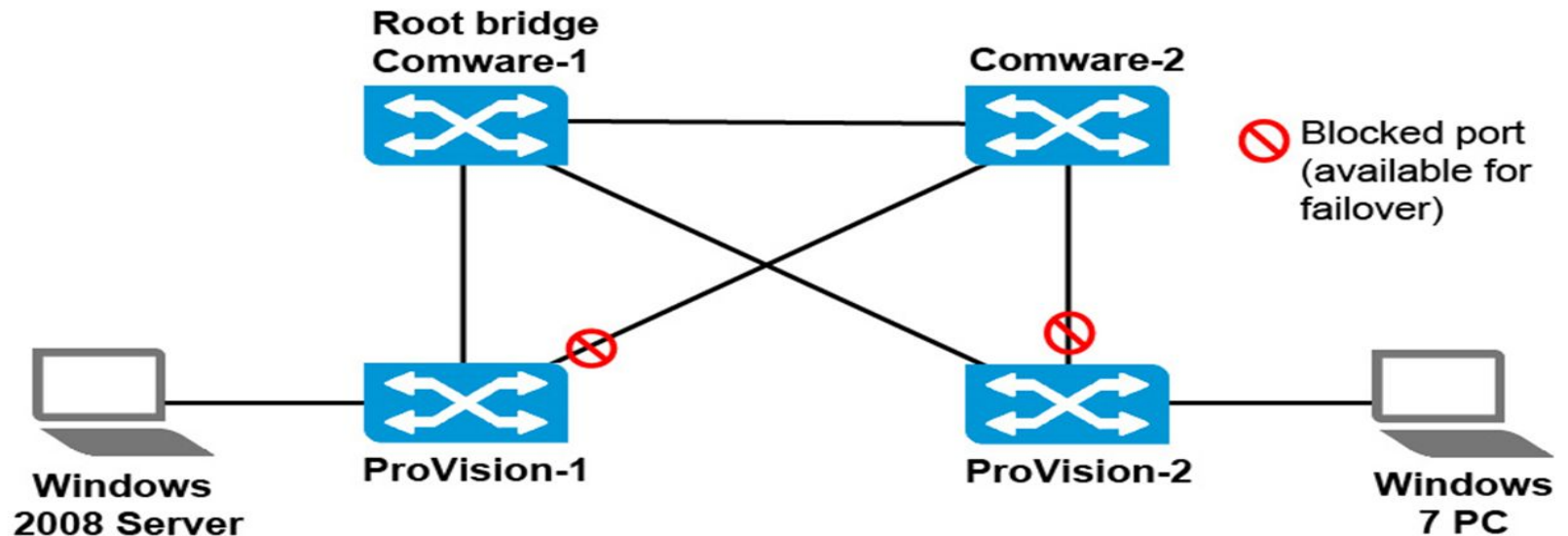
Spanning tree solution

**The spanning tree switches elect the root
Protocol Data Units (BPDUs)**

Bridge

Comware-1 will be configured as the primary root

- One shortest path between each switch and the root (elected by BPDU)
- Other paths blocked

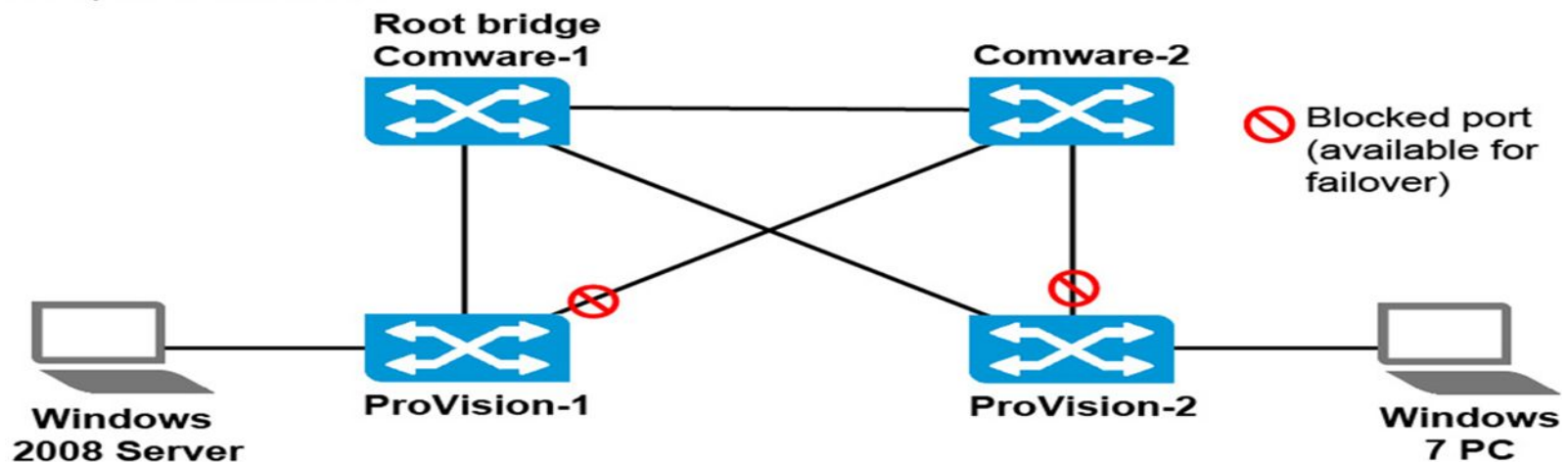


Spanning tree solution

Every other spanning tree bridge has a lowest cost path to the root. The links in the lowest cost paths forward traffic.

Because links that are not part of this tree are blocked, the network has no loops.

- One shortest path between each switch and the root (elected by BPDU)
- Other paths blocked



The original standard Spanning Tree Protocol (STP)

electing a root bridge
calculating the best path to that bridge
blocking alternate paths

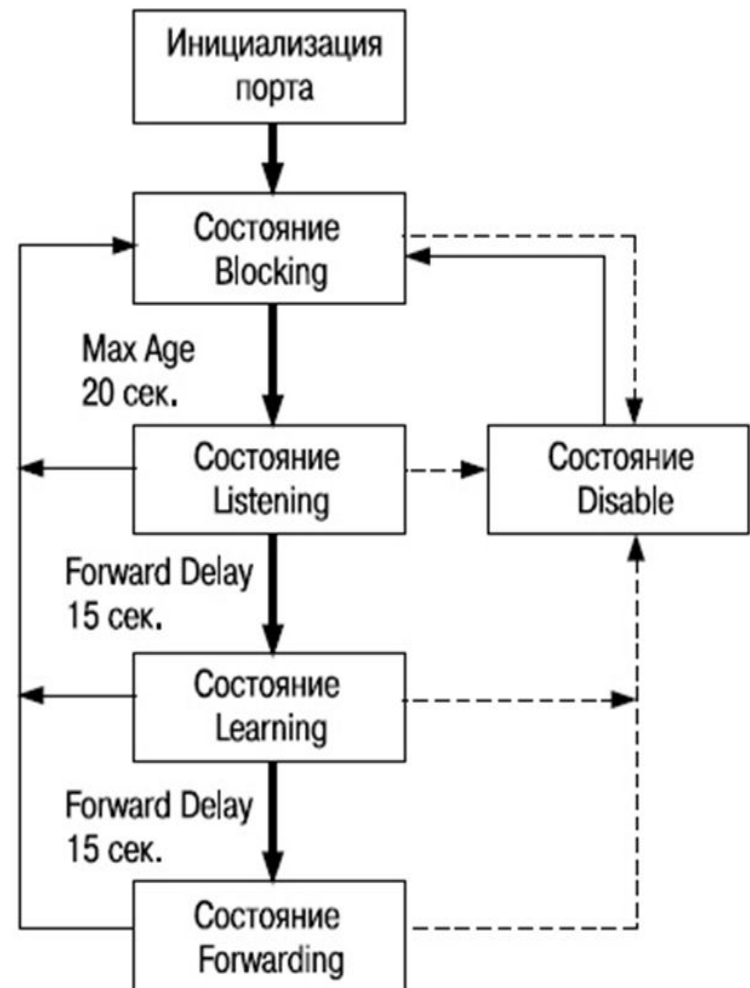
However, STP was designed in a time when a minute or so for convergence was acceptable.

before the ports can start forwarding.

The original standard Spanning Tree Protocol (STP)

Summary of the port states in STP

Disabled	STP is disabled by default
Blocking	The port drops all the data and listens to BPDUs
Listening	The port drops all the data, listens to BPDUs and it will be used in the active topology
Learning	The port drops all the data, listens to BPDUs and it is learning MAC addresses
Forwarding	The port forwards data and it's learning MAC addresses



Rapid Spanning Tree Protocol (RSTP)

RSTP, 802.1w

RSTP has better convergence than STP due to these factors:

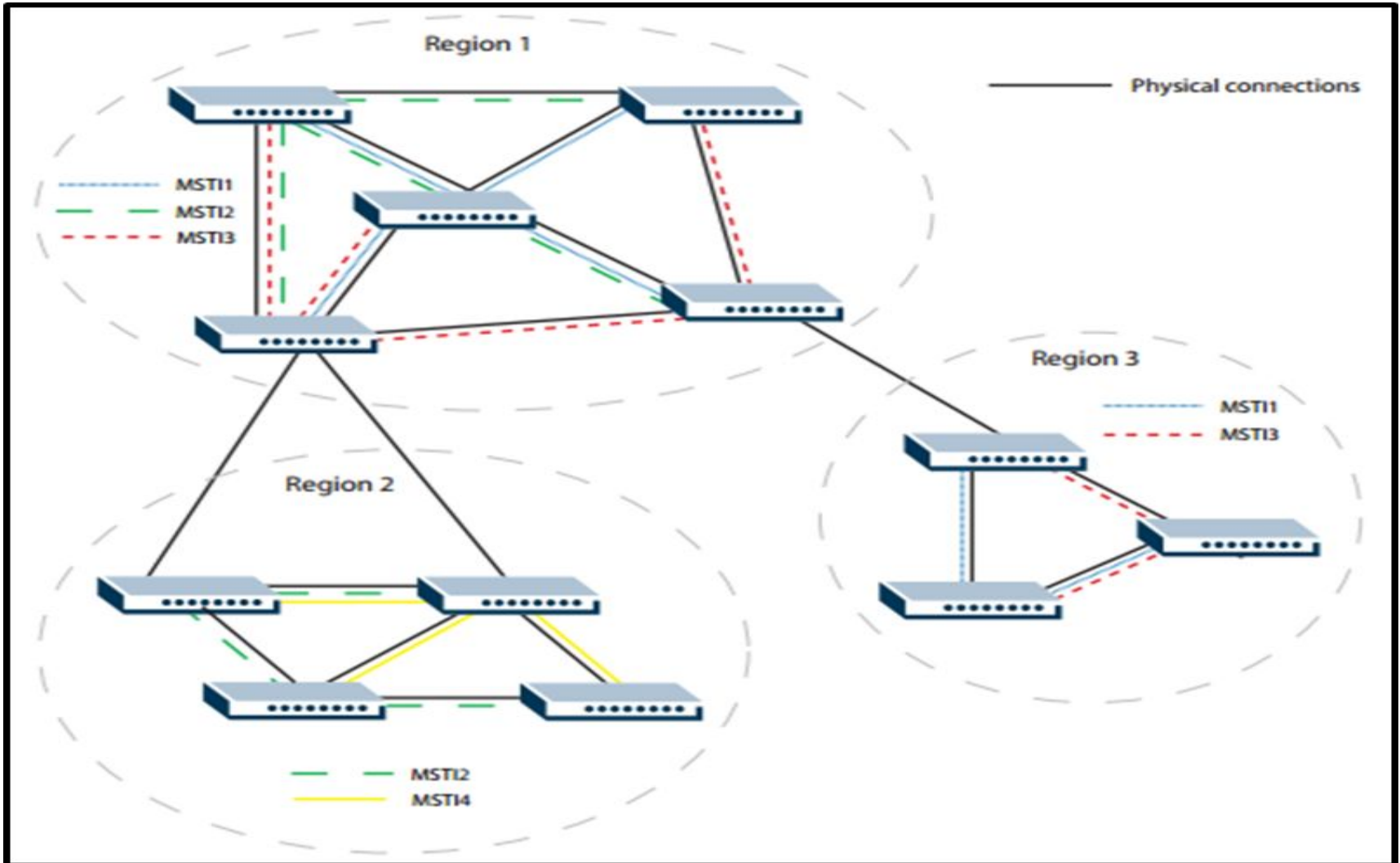
- **Direct and indirect failure detection and recovery**
- **Faster transition between port roles**
- **Point-to-point link designation**
- **Edge port designation**

Multiple Spanning Tree Protocol (MSTP)

An extension to RSTP, known as **Multiple Spanning Tree Protocol (MSTP)**, allows for a separate STP configuration for **each VLAN group in the network**

Multiple Spanning Tree Protocol (MSTP) is a protocol that **allows groups of VLANs to have different spanning tree topologies** within an Ethernet Network. MSTP was introduced in IEEE 802.1s **to use multiple spanning trees**, providing for traffic belonging to different VLANs to flow over potentially different paths within the virtual bridged LAN. **This allows for better load balancing and more efficient use of available resources.**

Multiple Spanning Tree Protocol (MSTP)



Rapid Spanning Tree Protocol (RSTP)

Spanning tree port roles and states

RSTP provides rapid recovery by including port roles in the computation of port states

The port roles and states are summarized in Table on the next slides

Spanning tree port roles

Root port

- This is the port closest to the root bridge

Designated port

- It is designated if it can send the best BPDU on its segment

Alternate port

- Alternate path to a designated port. It is blocked

Backup port

- Alternative port to a bridge that is already connected

Disabled port

- Blocked port

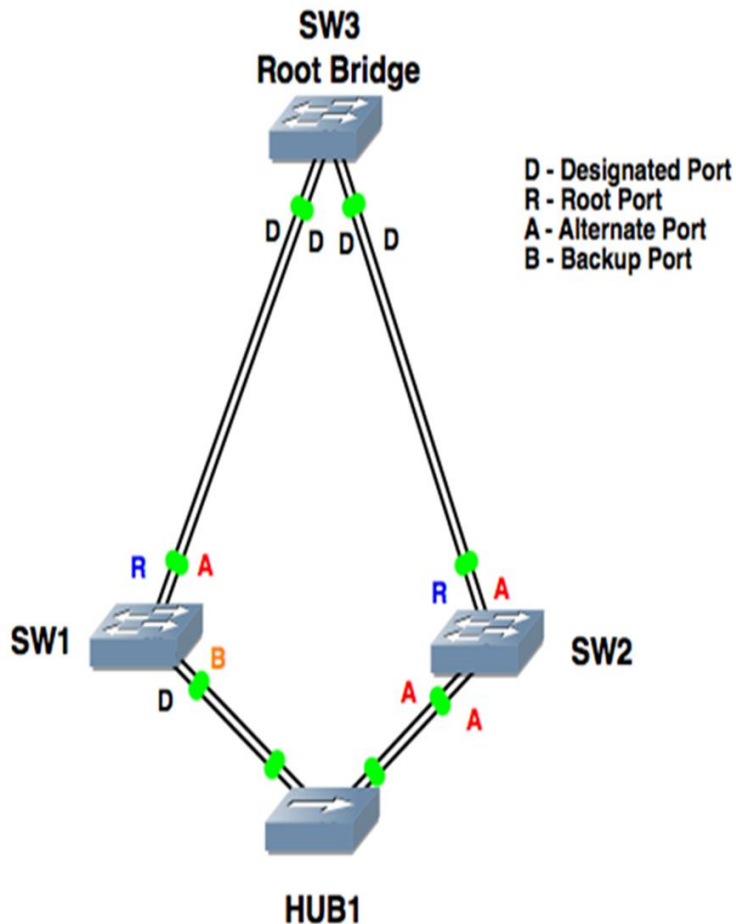
Edge port

- Port not included in the topology

Spanning tree port states

STATE	MEANING
DISABLED	STP operations are disabled on the port.
DISCARDING	The port does not participate in frame forwarding. The forwarding process discards received frames and does not submit forwarded frames for transmission.
LEARNING	The port is enabled for receiving frames only, and the learning process can add new source address information to the forwarding database. The port does not forward any frames.
FORWARDING	The normal state for a switch port. The forwarding process and the Spanning Tree entity are enabled for transmit and receive operations on the port.

Spanning tree port roles and states



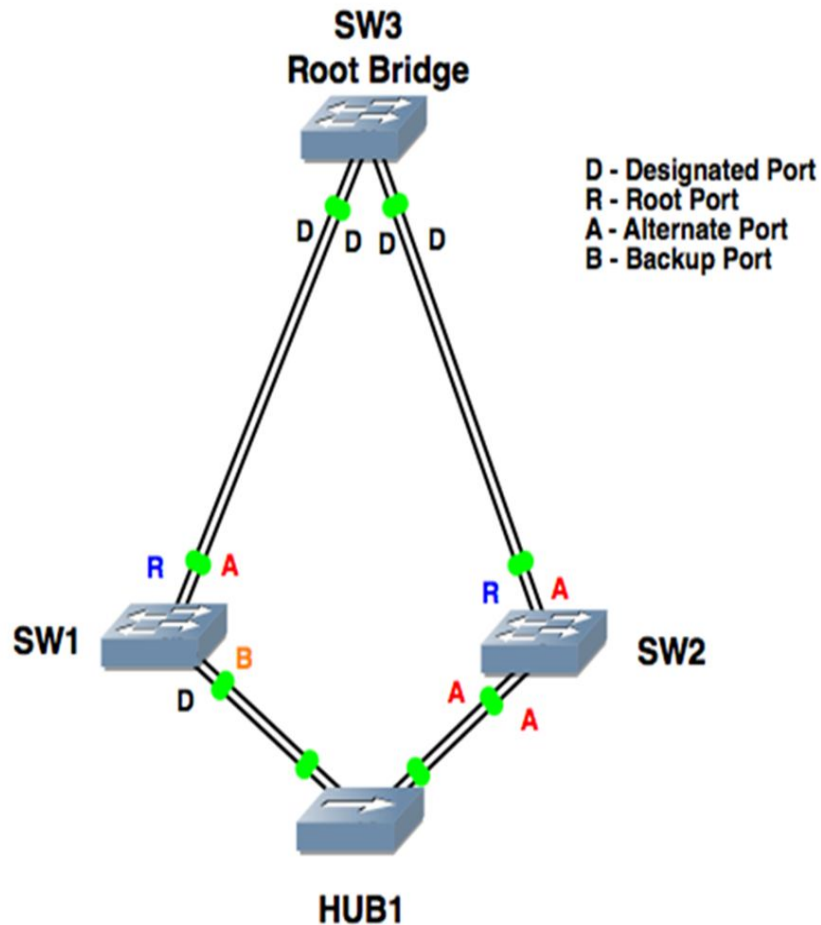
The port that is closer to the root switch is **Designated port**. The port on the other side of the link is the **Root port**.

A switch can only have **one root port** because it can have only one best path

designated and root ports

Because both the **designated port and root port are in a forwarding state, the link is active**

Spanning tree port roles and states



**The port on one side is
Designated**

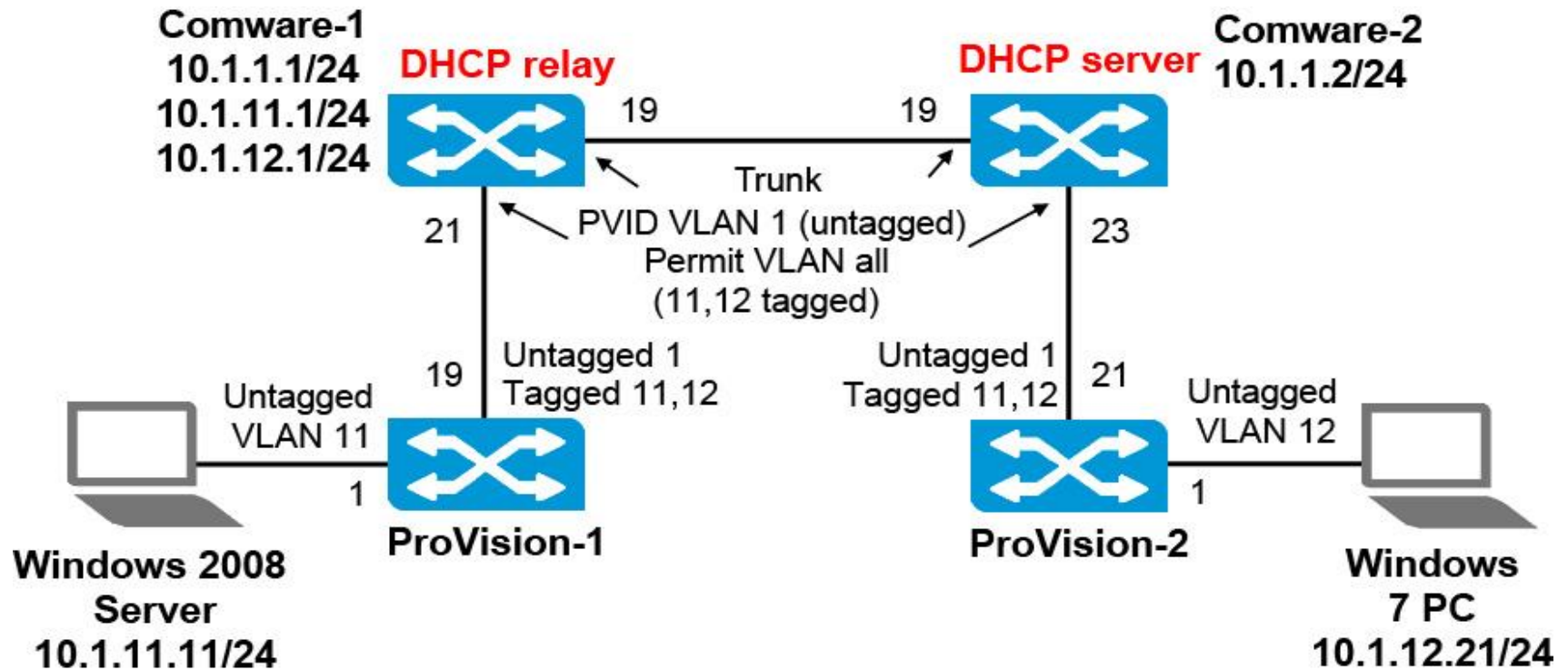
The port on the other side

Alternate

Backup

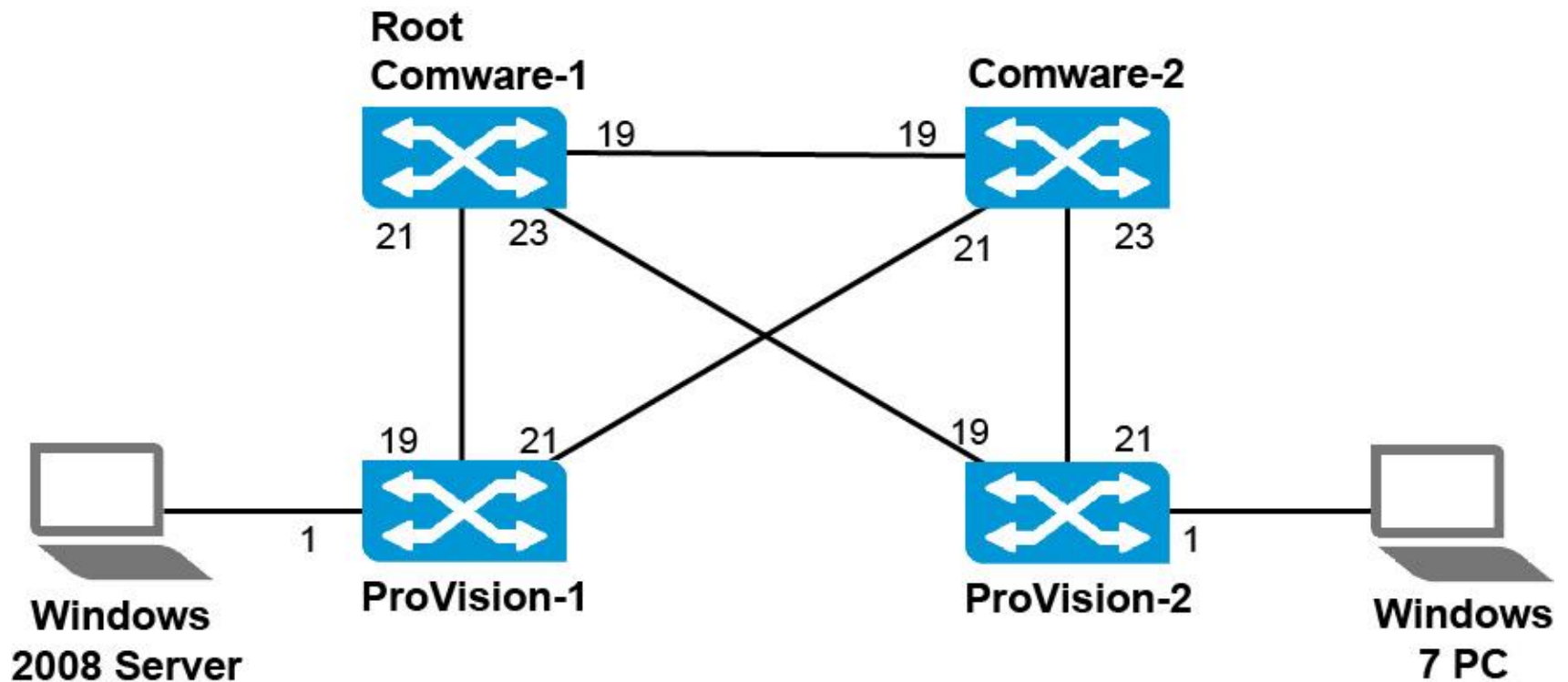
Configuration example: RSTP

Starting network configuration



Configuration example: RSTP

Add redundant links



Configure Comware-1 as the root

[Comware-1] stp root primary

Enable spanning tree on each switch

. Recall that STP is disabled by default on both the Comware and ProVision switches

[Comware-1] stp enable

[Comware-2] stp enable

ProVision-1(config)# spanning-tree

ProVision-2(config)# spanning-tree

Verify the root bridge

Comware-1

Comware-1

```
[Comware-1]display stp
-----[CIST Global Info][Mode MSTP]-----
CIST Bridge           :0.d07e-28ce-c94f
Bridge Times          :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
CIST Root/ERPC        :0.d07e-28ce-c94f / 0
CIST RegRoot/IRPC     :0.d07e-28ce-c94f / 0
CIST RootPortId       :0.0
<-output omitted->
```

0.d07e-28ce-c94f

Verify the root bridge

Comware-1

```
[Comware-1]display stp root
```

MSTID	Root Bridge ID	ExtPathCost	IntPathCost	Root Port
0	0.d07e-28ce-c94f	0	0	

Comware-2

```
[Comware-2] display stp root
```

MSTID	Root Bridge ID	ExtPathCost	IntPathCost	Root Port
0	0.d07e-28ce-c94f	20	0	GigabitEthernet1/0/19

Verify the root bridge

ProVision-1

```
ProVision-2(config)# show spanning-tree root-history cst
Status and Counters - CST Root Changes History
MST Instance ID      : 0

Root Changes Counter : 2

Current Root Bridge ID : 0:d07e28-cec94f

Root Bridge ID      Date      Time
-----
```

Verify the root bridge

ProVision-2

```
ProVision-2(config)# show spanning-tree root-history cst
```

```
Status and Counters - CST Root Changes History
```

```
MST Instance ID      : 0
```

```
Root Changes Counter : 2
```

```
Current Root Bridge ID : 0:d07e28-cec94f
```

```
Root Bridge ID      Date      Time
```

```
-----
```

Add redundant links

Comware-1

```
[Comware-1] interface g1/0/23
[Comware-1-GigabitEthernet1/0/23] port link-type trunk
[Comware-1-GigabitEthernet1/0/23] port trunk permit vlan all
[Comware-1-GigabitEthernet1/0/23] undo shutdown
[Comware-1-GigabitEthernet1/0/23] quit
```

Comware-2

```
[Comware-2] interface g1/0/21
[Comware-2-GigabitEthernet1/0/21] port link-type trunk
[Comware-2-GigabitEthernet1/0/21] port trunk permit vlan all
[Comware-2-GigabitEthernet1/0/21] undo shutdown
[Comware-2-GigabitEthernet1/0/21] quit
```

Add redundant links

ProVision-1

```
ProVision-1(config)# vlan 11 tagged 21
ProVision-1(config)# vlan 12 tagged 21
ProVision-1(config)# interface 21 enable
```

```
ProVision-1(config)# show interface 21
Status and Counters - Port Counters for port 21
Name :
MAC Address : e4115b-cccc53
Link Status : Up
<-output omitted->
```

Add redundant links

ProVision-2

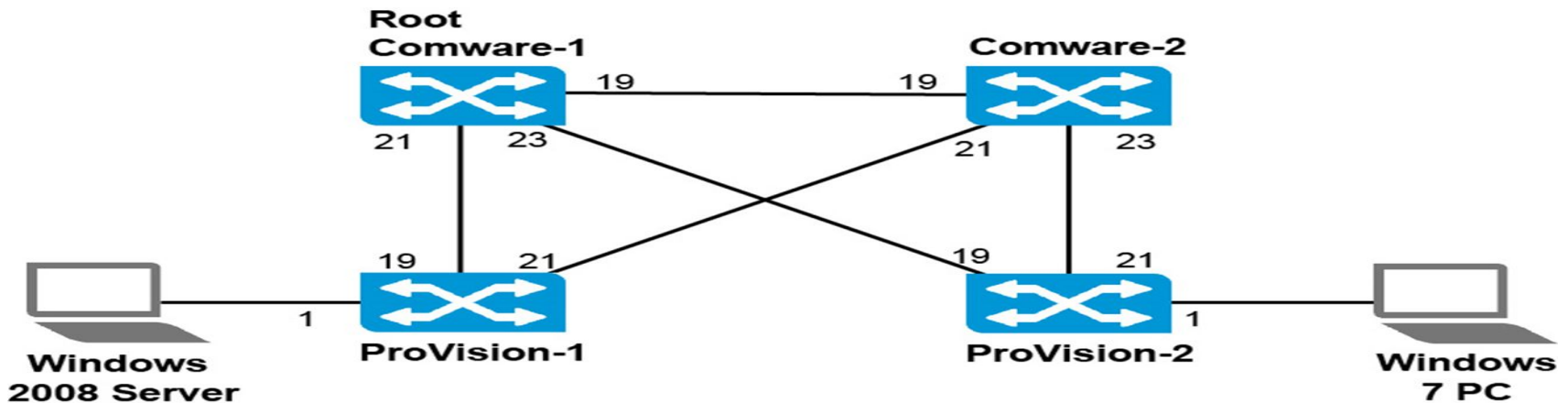
```
ProVision-2(config)# vlan 11 tagged 19
ProVision-2(config)# vlan 12 tagged 19
ProVision-2(config)# interface 19 enable
```

```
ProVision-2(config)# show interface 19
Status and Counters - Port Counters for port 19
Name :
MAC Address : e4115b-ccd215
Link Status :Up
<-output omitted->
```


Add redundant links

```
[Comware-1] display lldp neighbor-information list
```

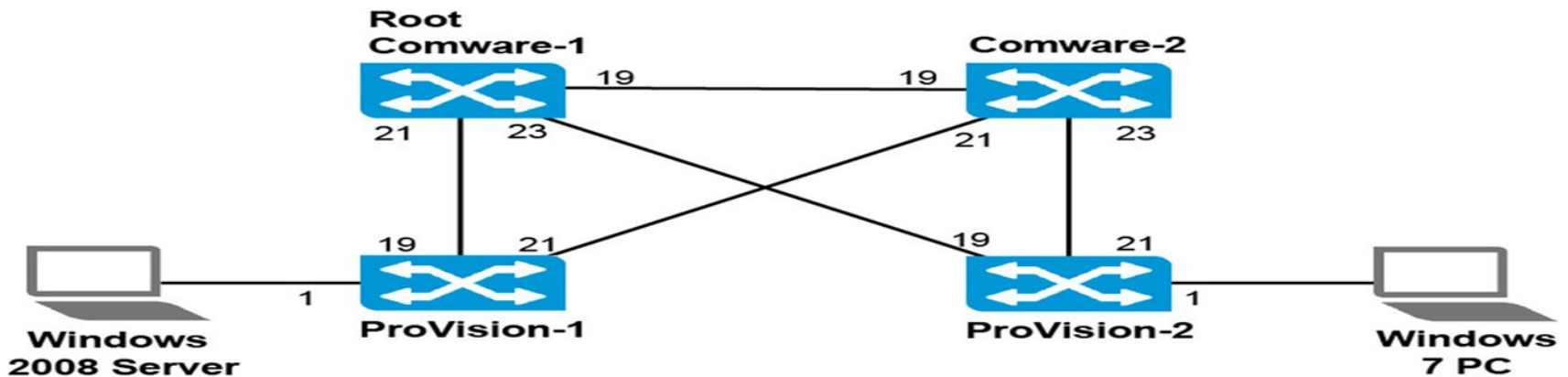
System Name	Local Interface	Chassis ID	Port ID
Comware-2	GE1/0/19	d07e-28ce-d31e	GigabitEthernet1/0/19
ProVision-1	GE1/0/21	d4c9-ef85-1680	19
ProVision-2	GE1/0/23	d4c9-ef84-fe80	19



Add redundant links

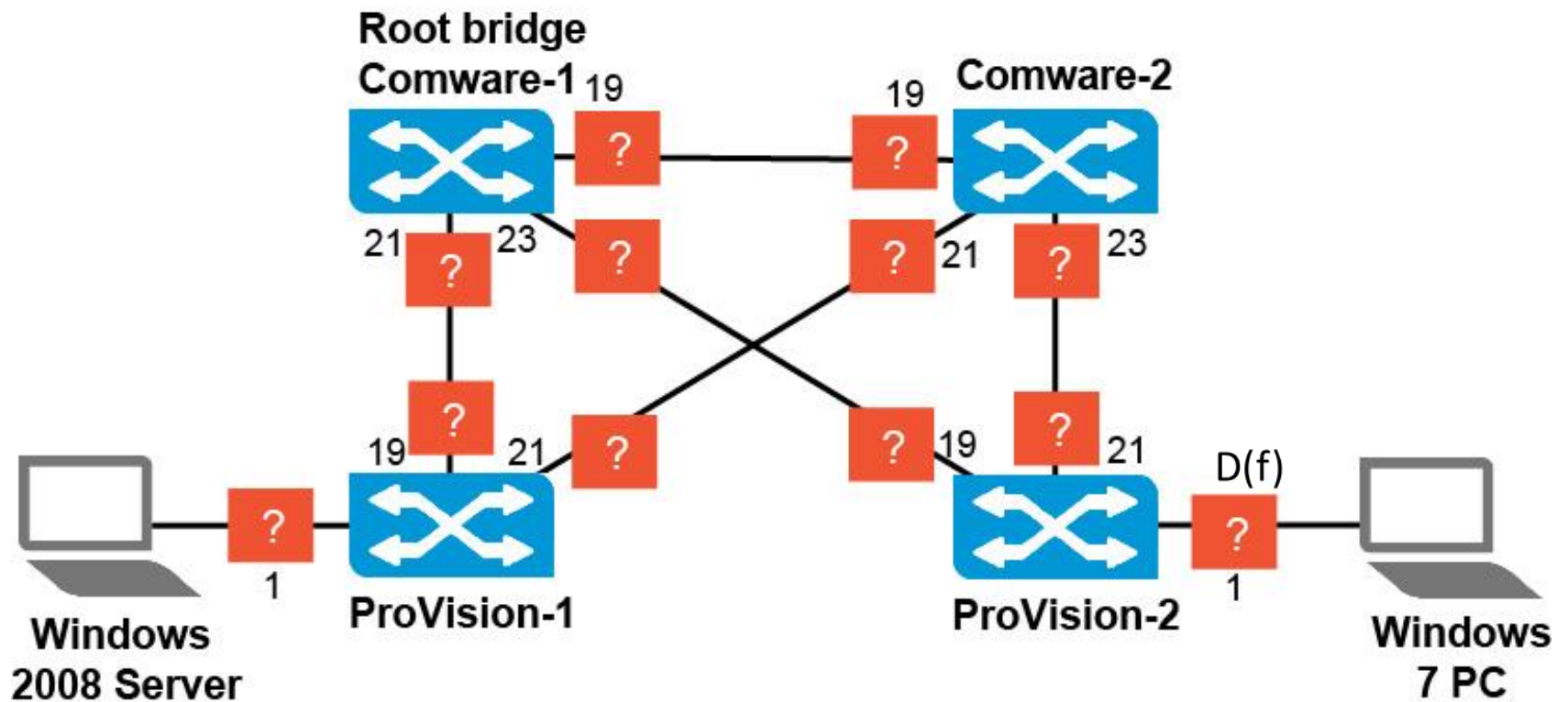
```
[Comware-2] display lldp neighbor-information list
```

System Name	Local Interface	Chassis ID	Port ID
Comware-1	GE1/0/19	d07e-28ce-c94f	GigabitEthernet1/0/19
ProVision-1	GE1/0/21	d4c9-ef85-1680	21
ProVision-2	GE1/0/23	d4c9-ef84-fe80	21



Verify the topology

show display



Verify the topology

[Comware-1] display stp brief

MSTID	Port	Role	STP State	Protection
0	GigabitEthernet1/0/19	DESI	FORWARDING	NONE
0	GigabitEthernet1/0/21	DESI	FORWARDING	NONE
0	GigabitEthernet1/0/23	DESI	FORWARDING	NONE

[Comware-2] display stp brief

MSTID	Port	Role	STP State	Protection
0	GigabitEthernet1/0/19	ROOT	FORWARDING	NONE
0	GigabitEthernet1/0/21	DESI	FORWARDING	NONE
0	GigabitEthernet1/0/23	DESI	FORWARDING	NONE

Verify the topology

ProVision-1

```
ProVision-1(config)# show spanning-tree 1,19,21 instance ist
<-output omitted->
```

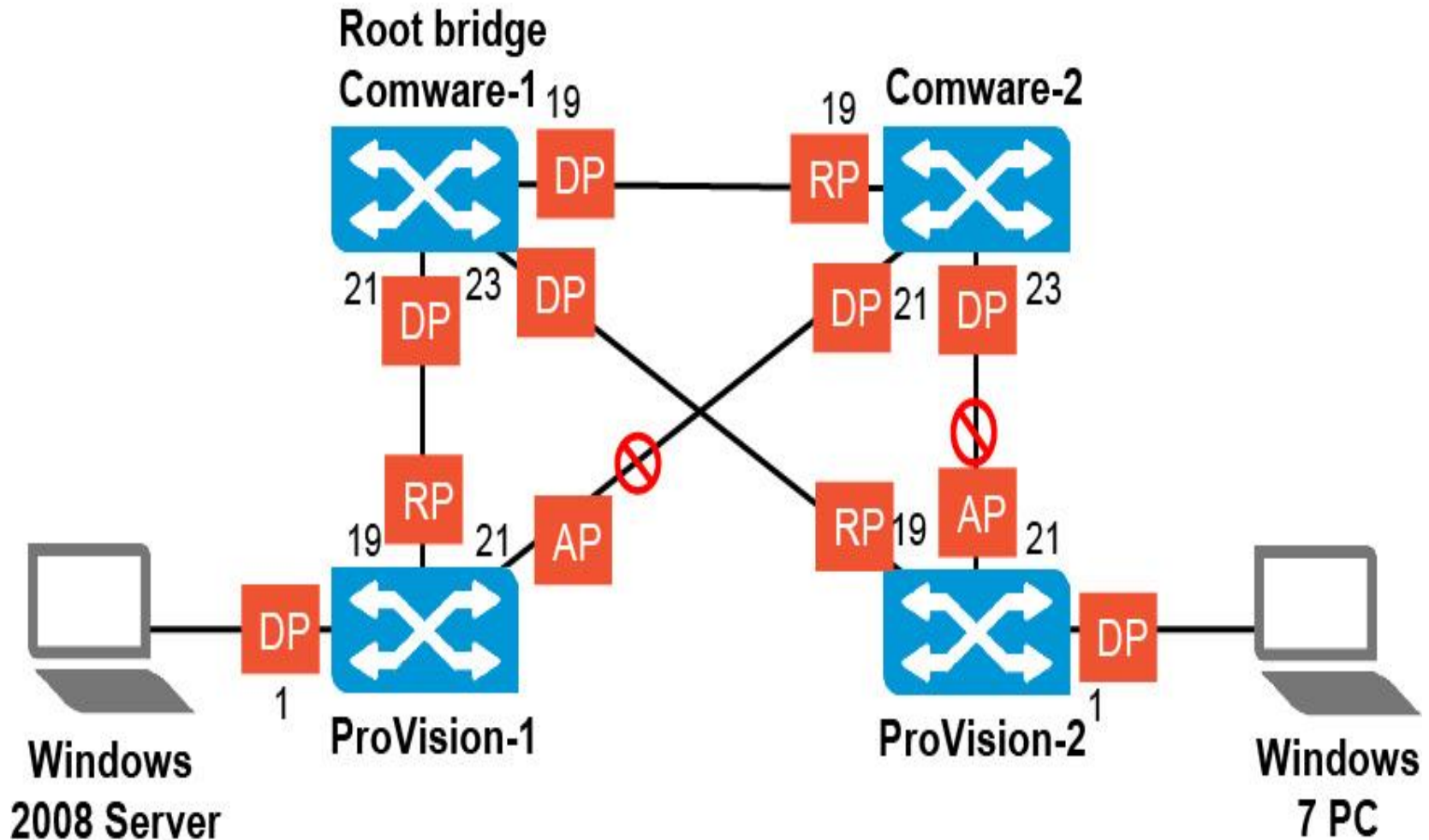
Port	Type	Cost	Priority	Role	State	Designated Bridge
1	100/1000T	20000	128	Designated	Forwarding	d4c9ef-851680
19	100/1000T	20000	128	Root	Forwarding	d07e28-cec94f
21	100/1000T	20000	128	Alternate	Blocking	d07e28-ced31e

ProVision-2

```
ProVision-2(config)# show spanning-tree 1,19,21 instance ist
<-output omitted->
```

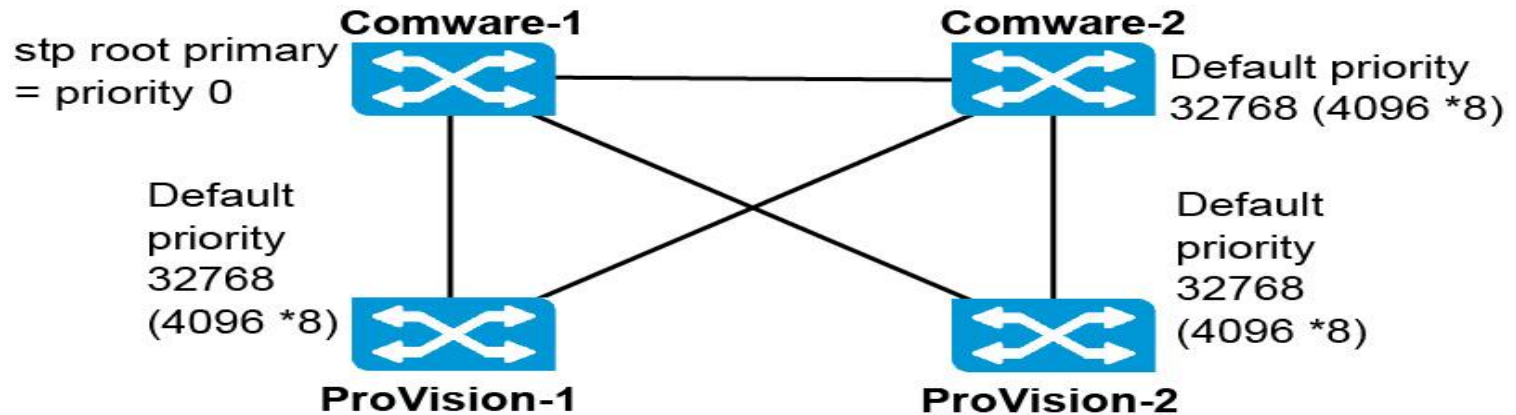
Port	Type	Cost	Priority	Role	State	Designated Bridge
1	100/1000T	20000	128	Designated	Forwarding	d4c9ef-84fe80
19	100/1000T	20000	128	Root	Forwarding	d07e28-cec94f
21	100/1000T	20000	128	Alternate	Blocking	d07e28-ced31e

Verify the topology



Root election

stp root primary



Guideline: Set a lower priority to make a switch win the election

priority value to 0

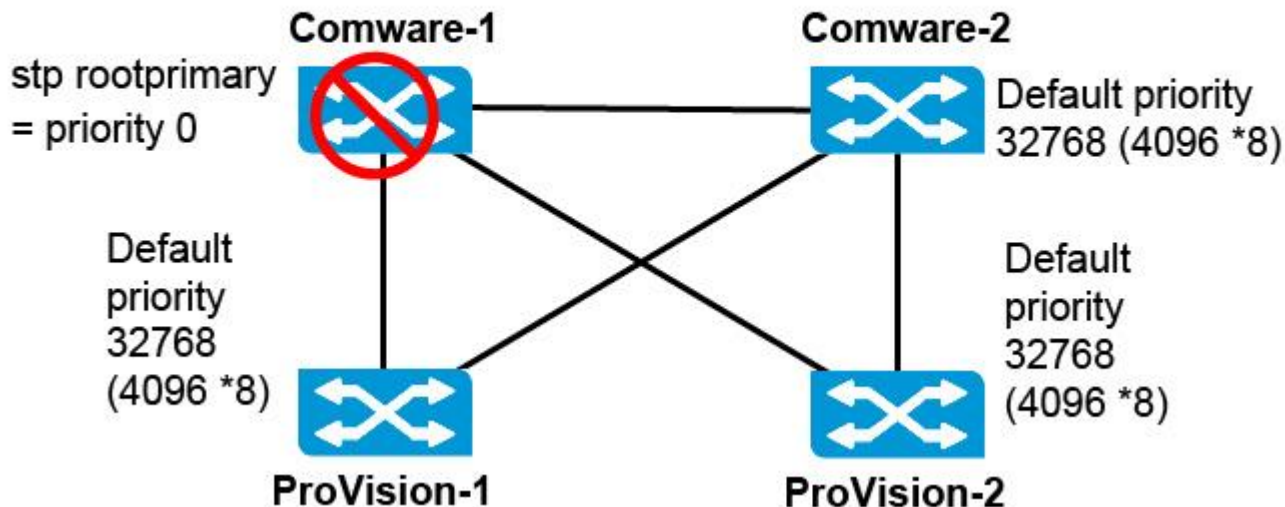
A lower priority value gives a higher priority for being elected root

Root election

is actually difficult to predict which switch becomes root in this case

What happens when the priority is the same (for example, all at default)?

Bridge ID = Priority + system ID (MAC address)
Root bridge = Lowest bridge ID



They actually use their bridge ID for the election.

Root election

The bridge ID is:

- Priority + system ID (MAC address)

Priority value	Step	Comware root command	Priority value	Step
0	0	root primary	32768	8
4096	1	root secondary	36864	9
8092	2		40960	10
12288	3		45056	11
16384	4		49152	12
20480	5		53248	13
24576	6		57344	14
28672	7		61440	15

is more significant

**have the same priority
address**

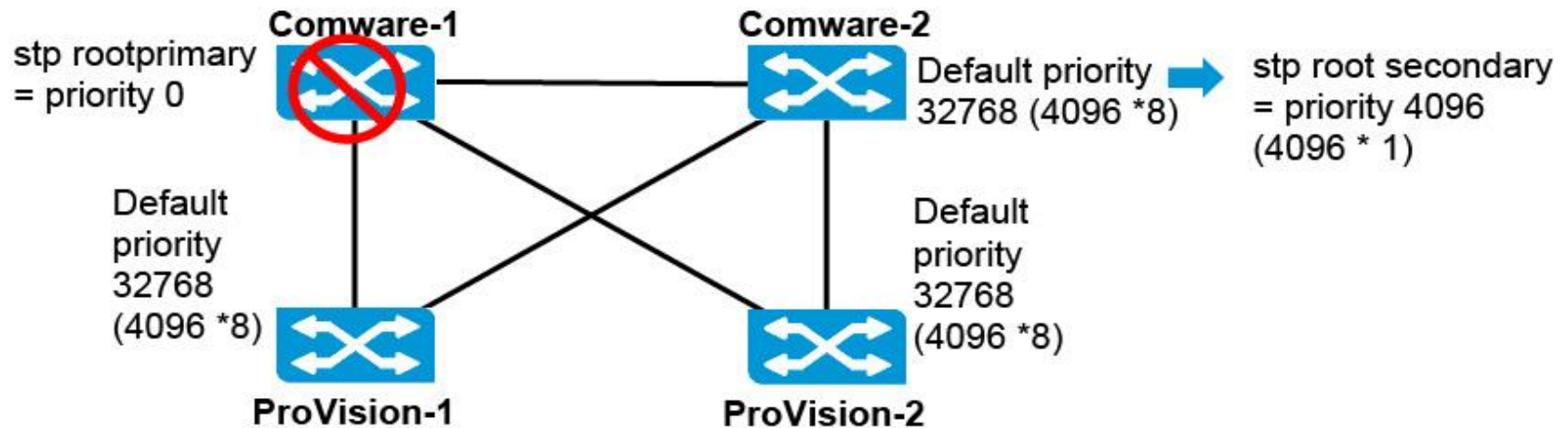
with the lowest MAC

Root election

root and the desired backup (or secondary) root

Bridge ID = Priority + system ID (MAC address)

Root bridge = Lowest bridge ID



Guideline: Set a lower priority to make a switch win the election

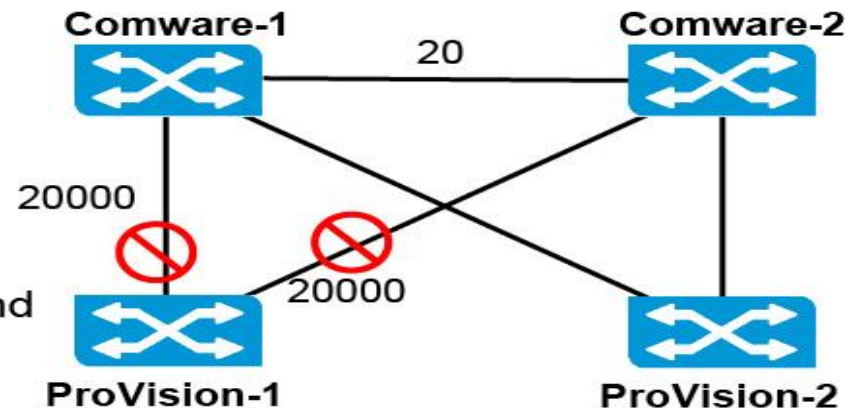
Guideline: Always set a primary root (priority 0) and a secondary root (priority 1) for backup

Port costs

Sometimes links have different bandwidth, so the ports have different costs. Sometimes switches are using different ways to set the port cost.

switches are using different path cost standards

- Path cost on a port =
Cost advertised by upstream BPDU
+ Port cost
- Root path cost = Path cost through
root port (lowest cost path)
- Port cost:
 - Determined based on bandwidth and
path cost standard (default)
 - Can be adjusted manually



Guideline: Set a consistent path cost standard (802.1t standard) on every switch

Port costs

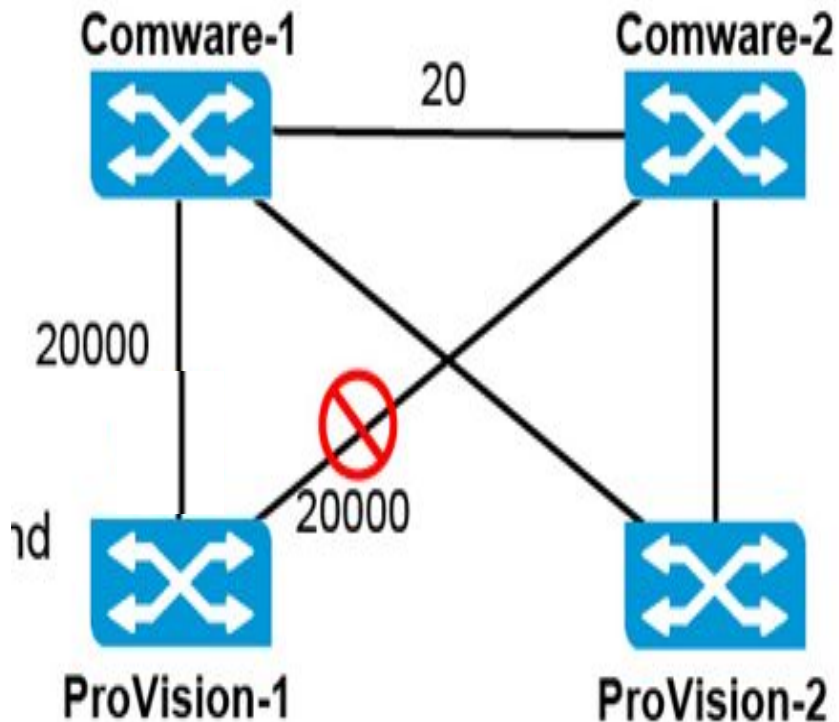
The cost for reaching the root on any port is:

- **The cost advertised in the BPDUs + The port cost**

DEFAULT PORT COSTS

Connection Type	RSTP/MSTP	STP (802.1D pre-2004)	Comware proprietary (default setting)
10 Gbps	2000	-	2
1 Gbps	20,000	4	20
100 Mbps	200,000	10	200
10 Mbps	2,000,000	100	2000

Port costs



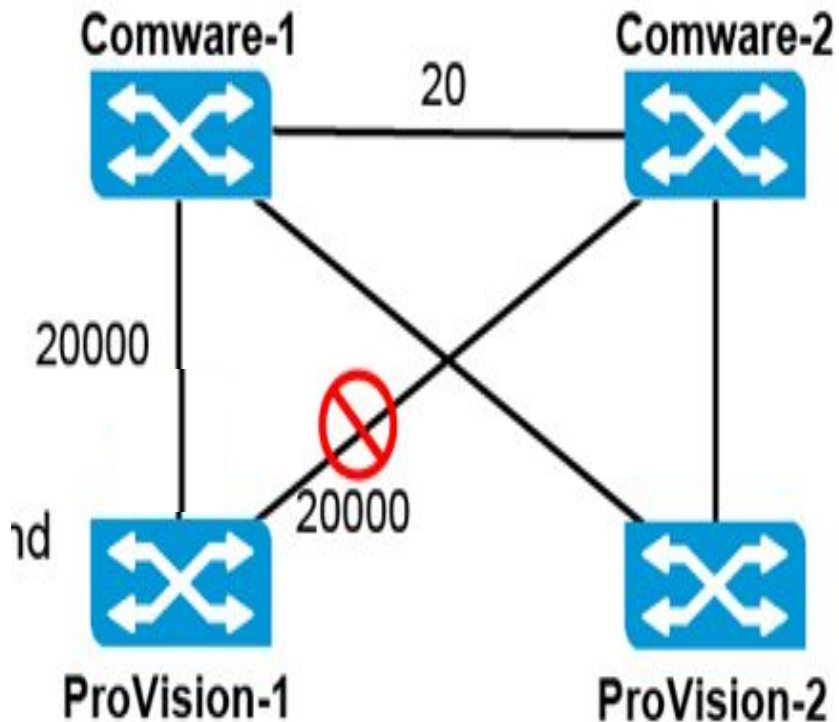
**cost for reaching
the root on Comware-2's root
port**

$$0 + 20 = 20$$

root path cost

its

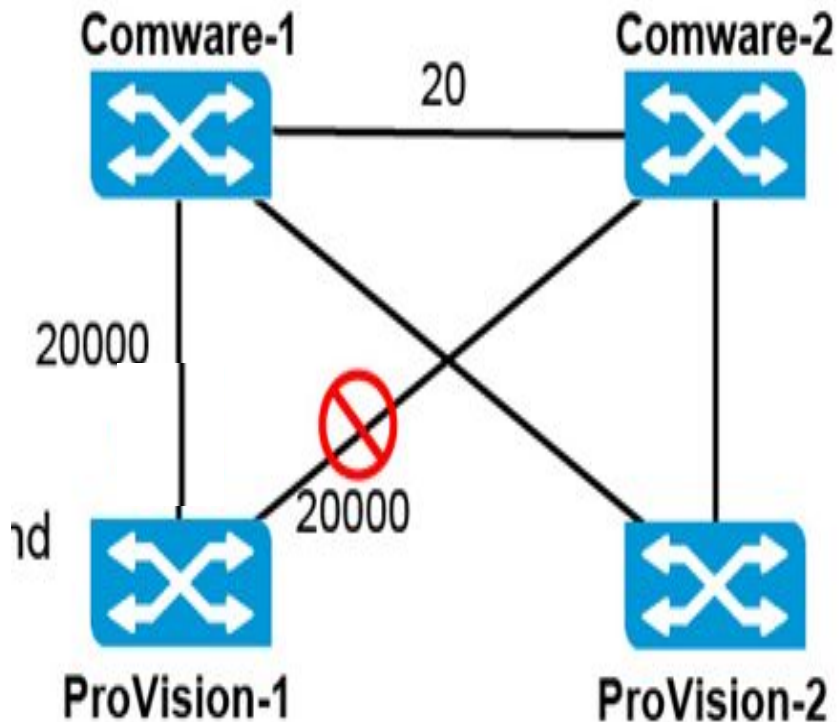
Port costs



ProVision-1's cost for reaching the root on its root port

$$0 + 20,000 = 20,000$$

Port costs



ProVision-1's alternate port

Therefore, the path cost to the root is: $20 + 20,000 = 20,020$.

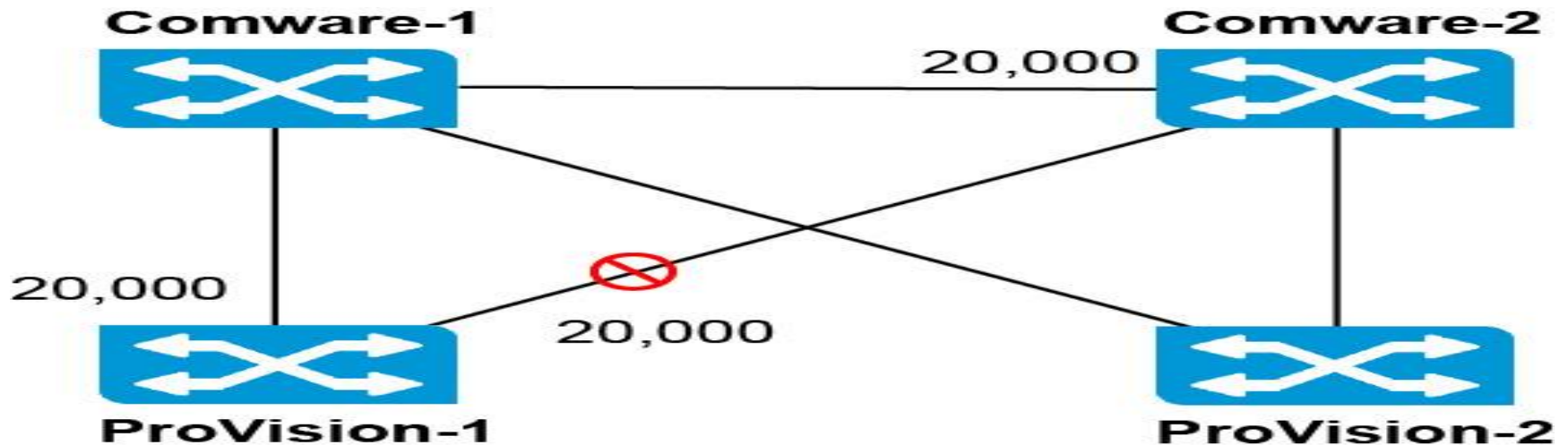
Port costs

**As a best practice,
you should set consistent costs on all switches**

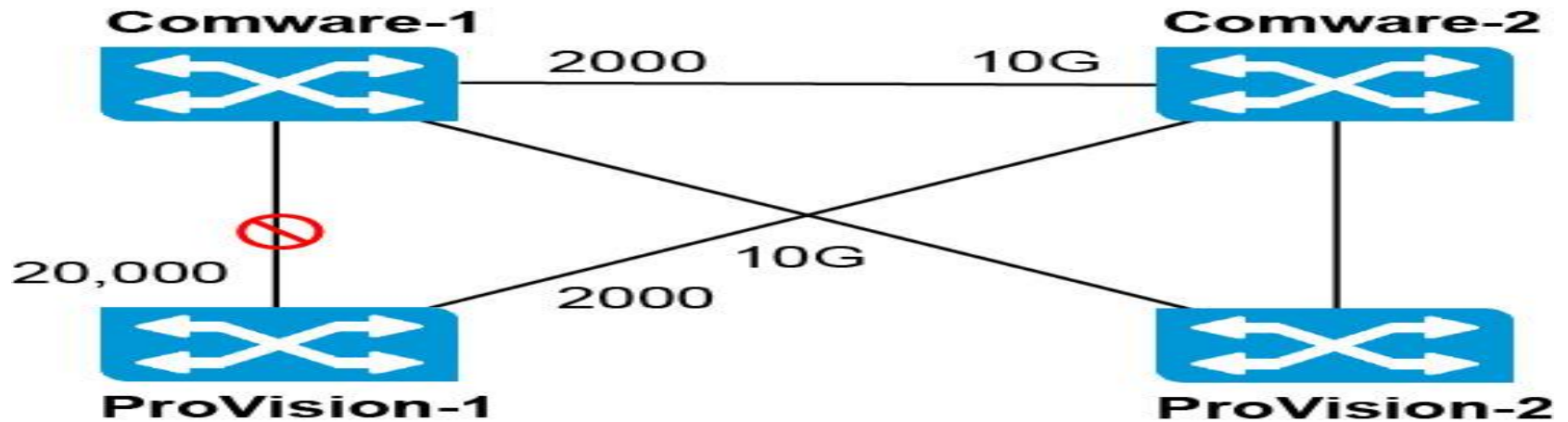
stp pathcost dot1t.

Port costs

Note that **Comware-2 and ProVision-1 now have equal root path costs.**



Port costs

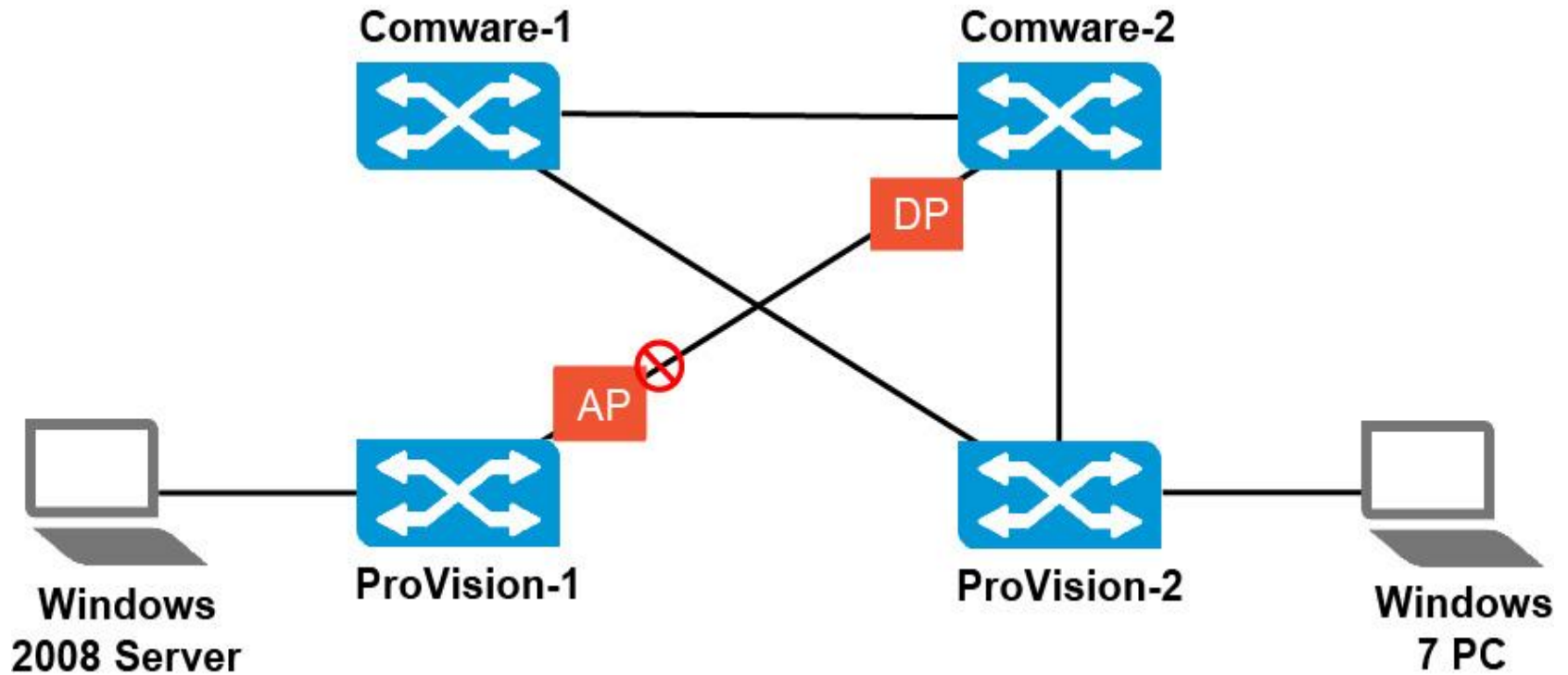


$$0 + 20,000 = 20,000$$

$$2000 + 2000 = 4000$$

Therefore, the direct GbE link to Comware-1 actually becomes the alternate port, and the 10GbE link to Comware-2 becomes the root port

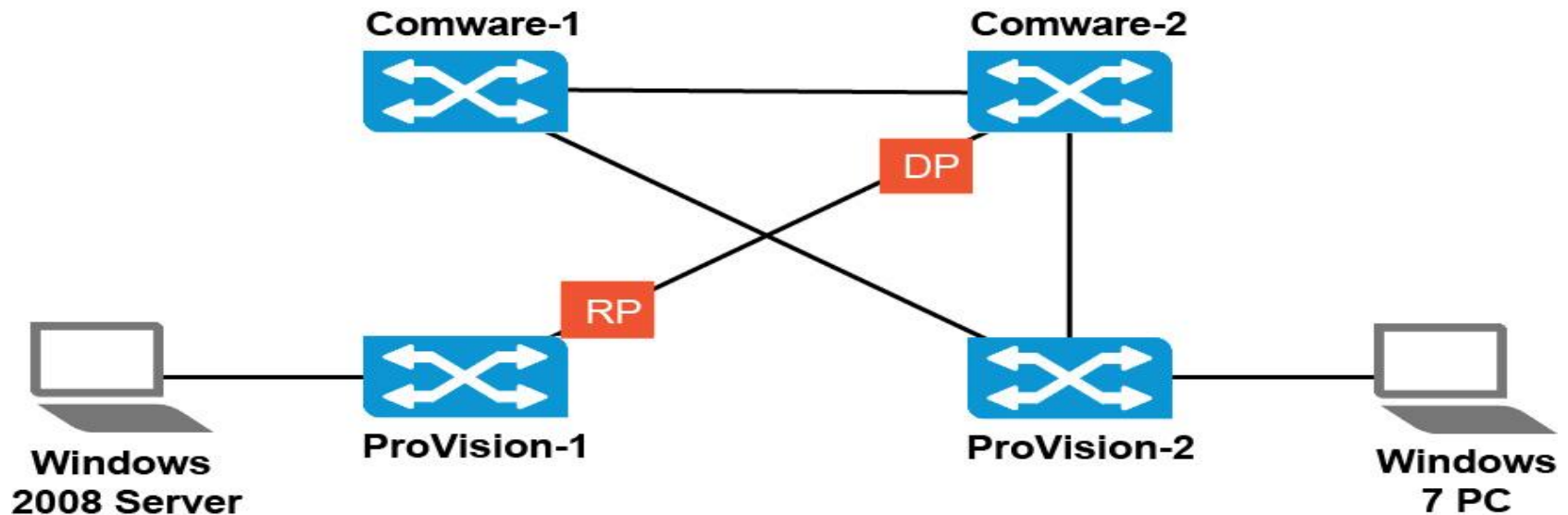
Failing over from a root to an alternate port



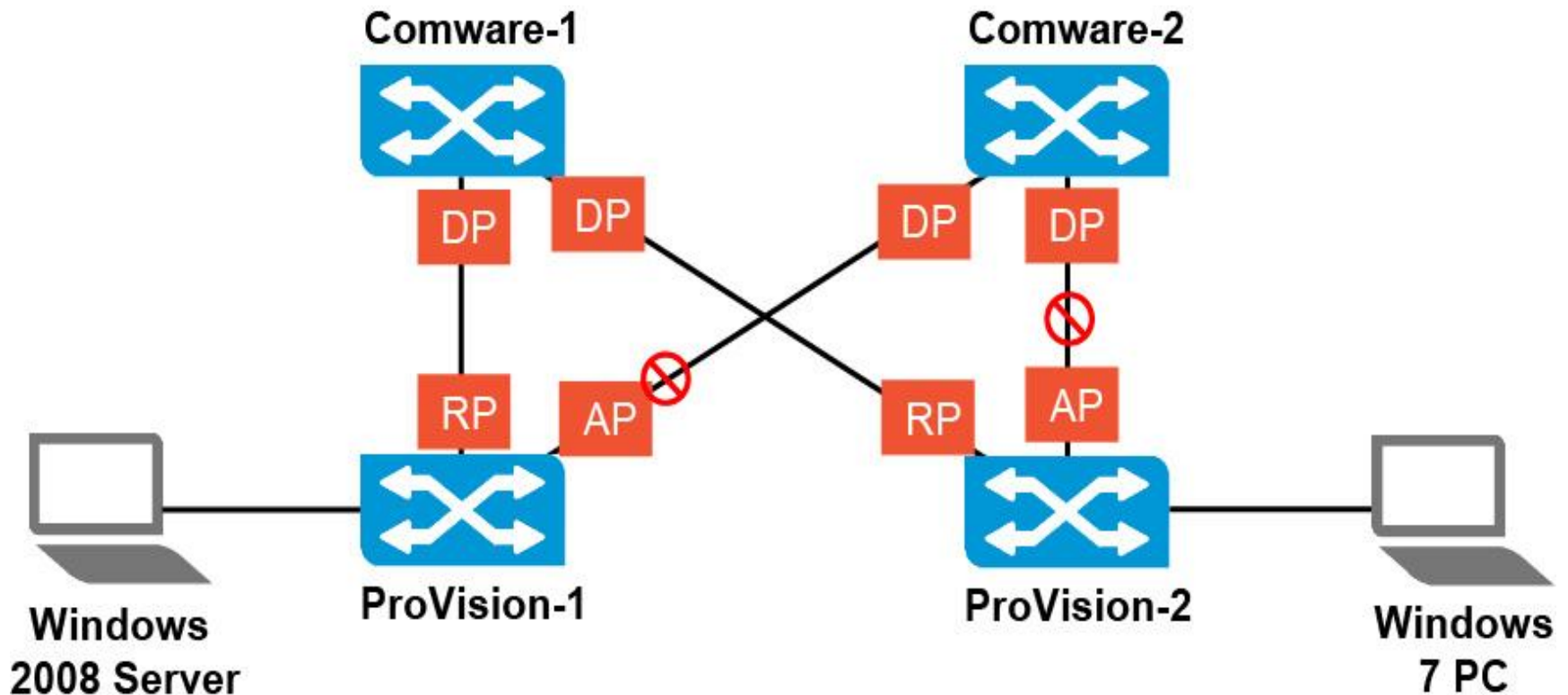
Failing over from a root to an alternate port

alternate port to a root port

it changes its



Failing over from a **root** to a **designated** port



Failing over from a **root** to a **designated** port

more complicated must transition one of its designated ports to a root port.

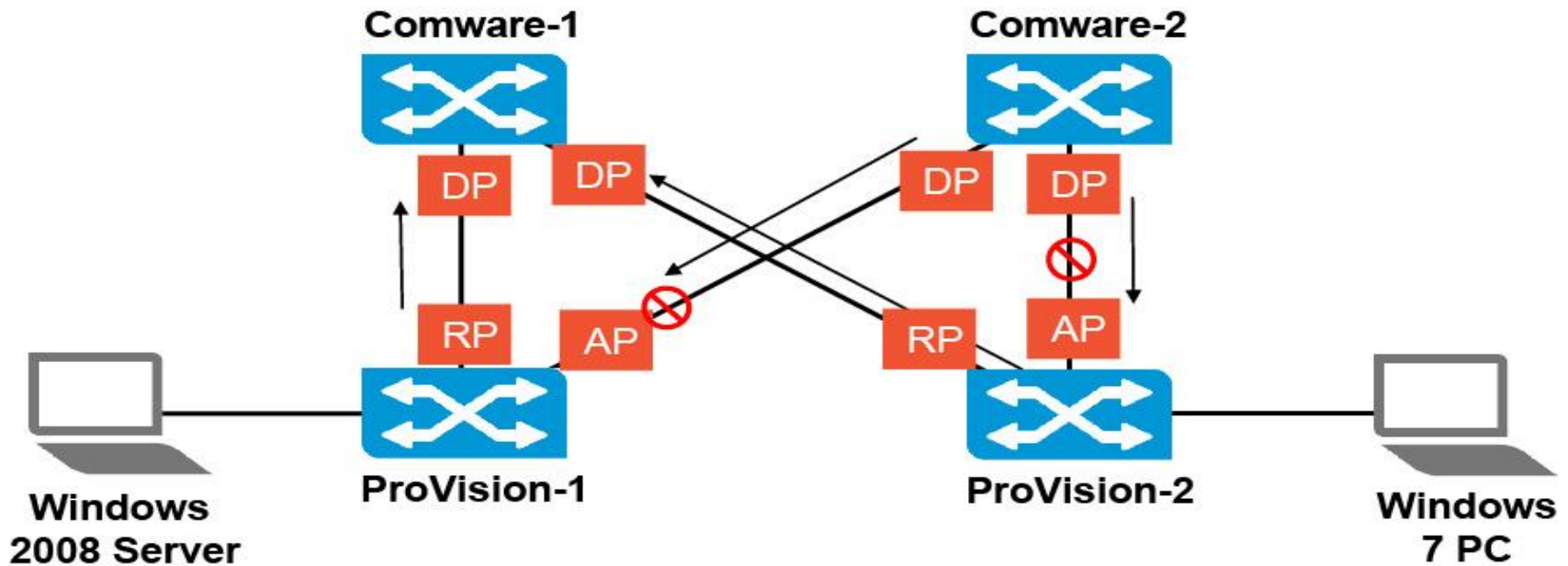
Several events occur when Comware-2 detects that it has lost its root port:

that Comware-2 is now the root. It has lost contact with the root, and it believes that it has the best priority

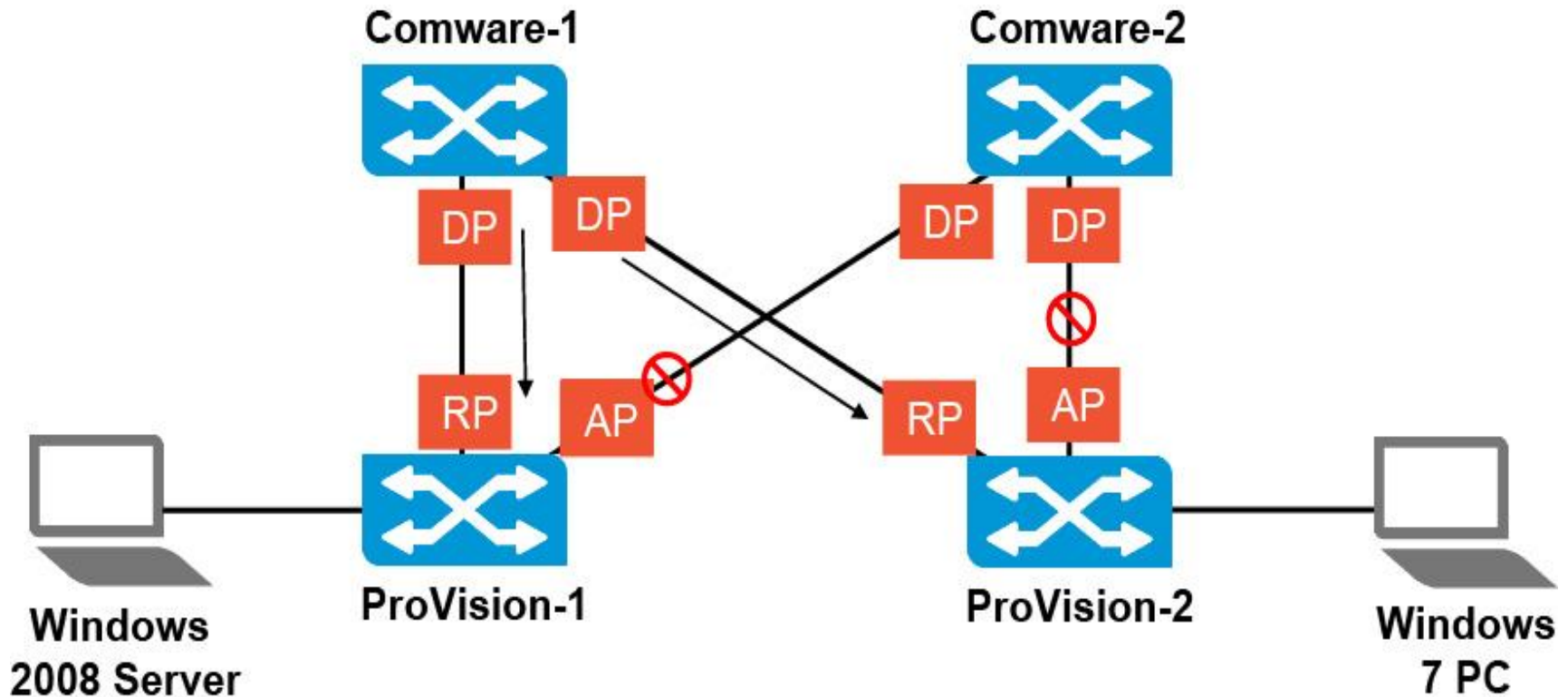
Failing over from a **root** to a **designated** port

would have caused the ProVision switch ports to undergo a lengthy reconvergence process.

simply rapidly propagate a topology change
toward the root



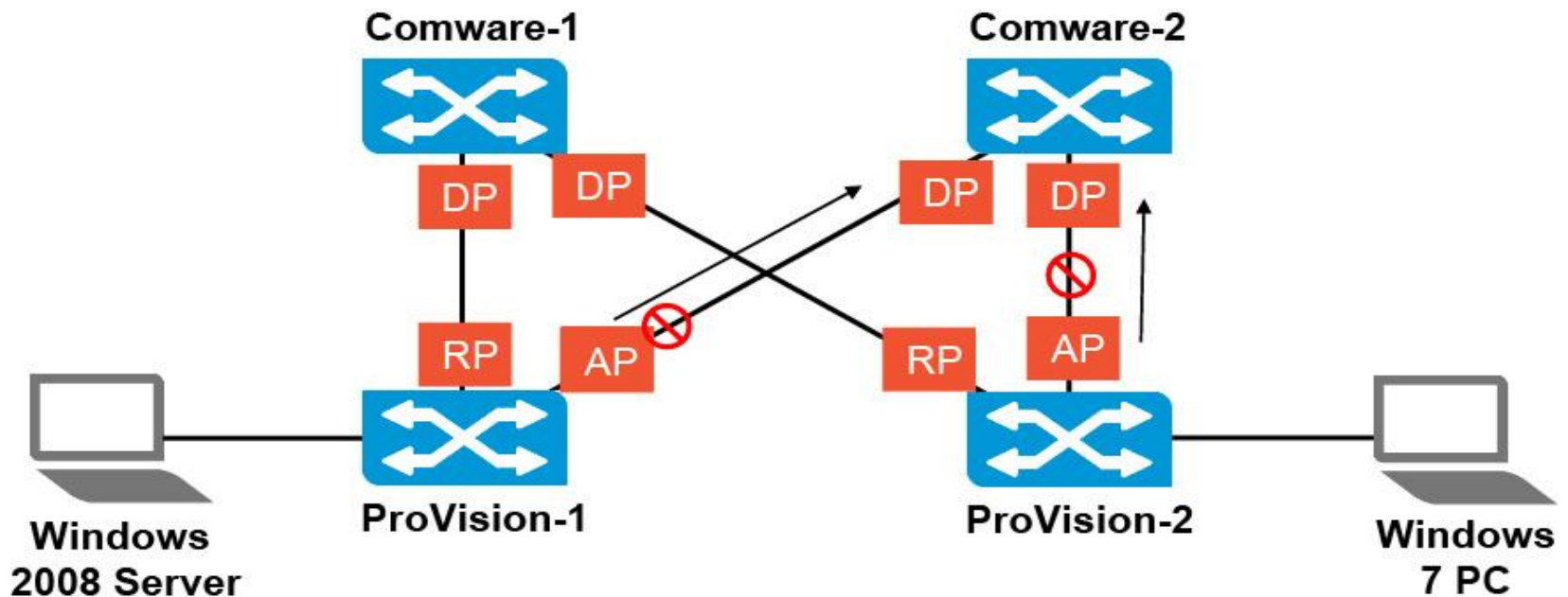
Failing over from a **root** to a **designated** port



Failing over from a **root** to a **designated** port

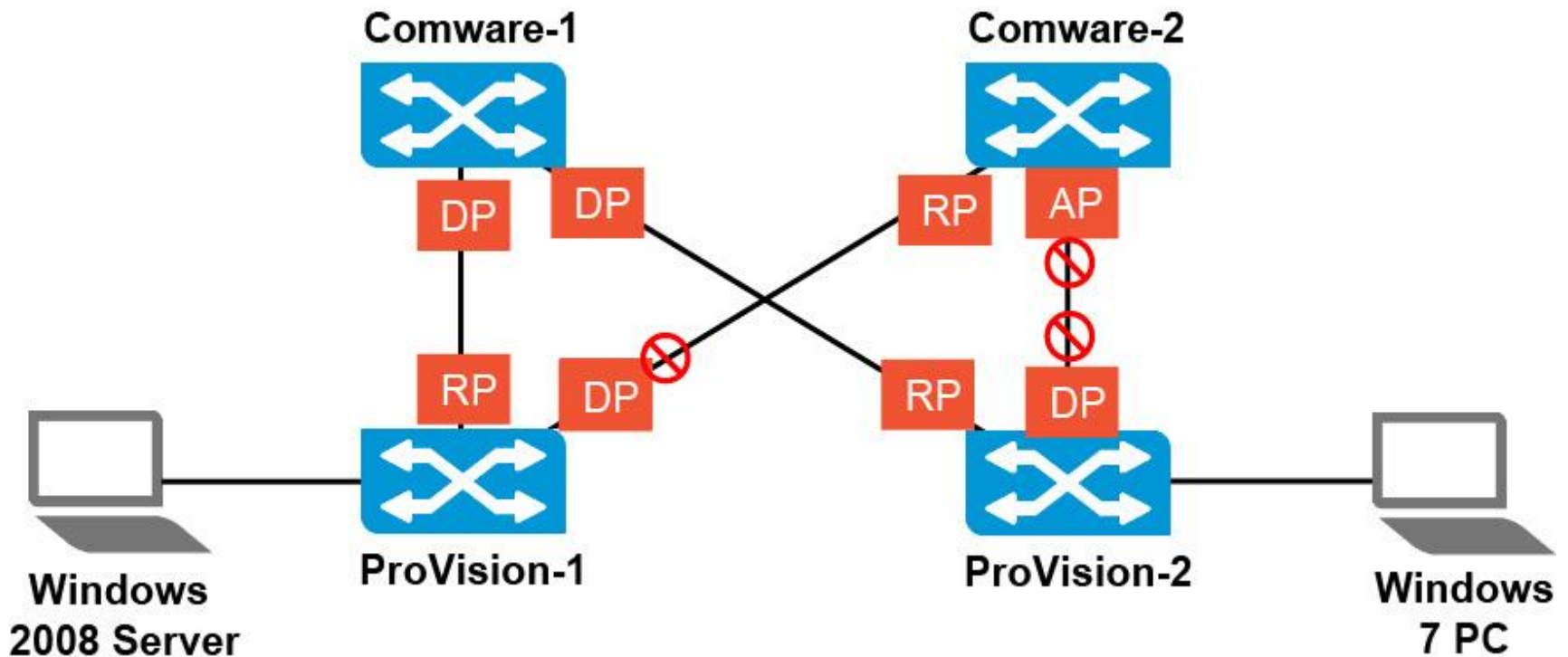
that Comware-1 has a better path to the root

The ProVision port asserts itself as now offering a better connection to the root.



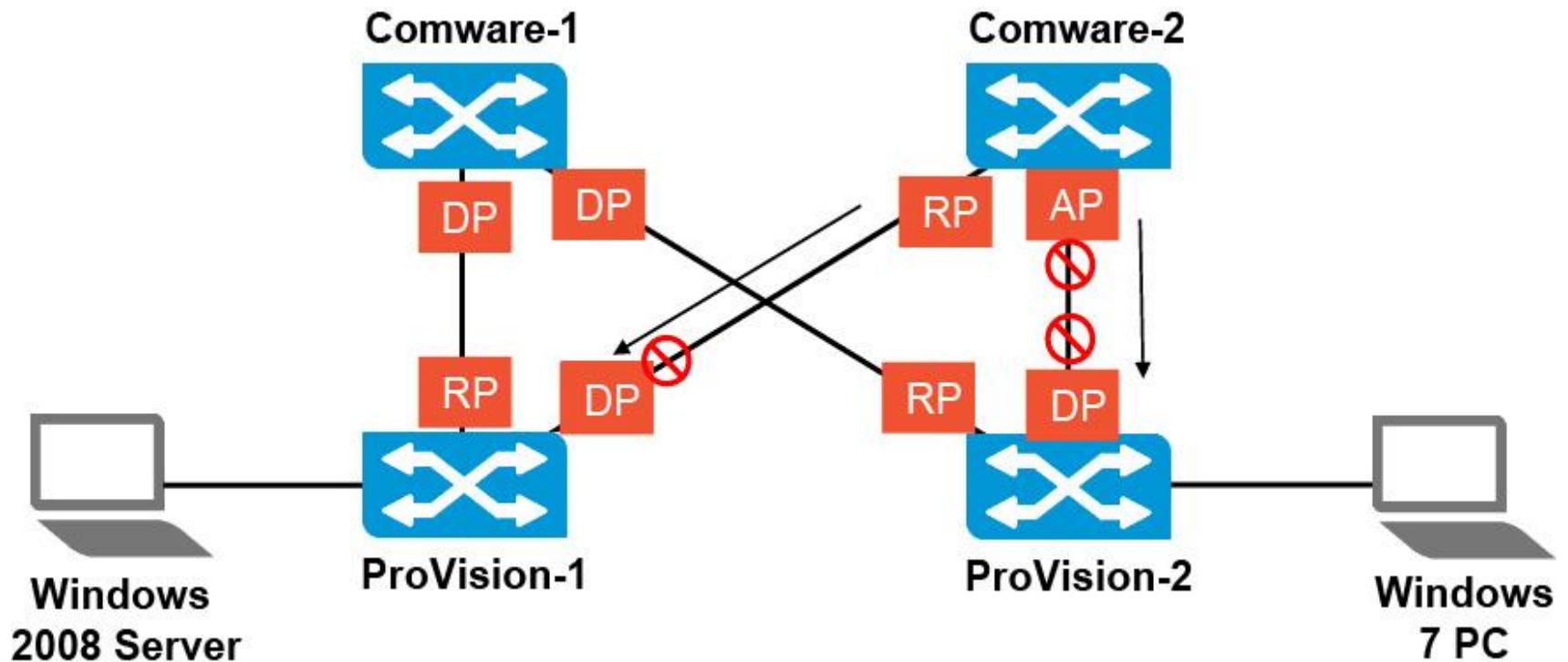
Failing over from a **root** to a **designated** port

and sets the root port



Failing over from a **root** to a **designated** port

then let their designated ports transition to forwarding



Failing over from a **root** to a **designated** port

```
<Comware-2>display stp brief
```

MSTID	Port	Role	STP State	Protection
0	GigabitEthernet1/0/19	ROOT	FORWARDING	NONE
0	GigabitEthernet1/0/21	DESI	FORWARDING	NONE
0	GigabitEthernet1/0/23	DESI	FORWARDING	NONE

```
<Comware-2>
```

```
#Apr 27 04:13:59:596 2000 Comware-2 MSTP/1/PDISC: hwPortMstiStateDiscarding: Instance 0's Port 0.9437204 has been set to discarding state!
```

```
%Apr 27 04:13:59:767 2000 Comware-2 MSTP/6/MSTP_DISCARDING: Instance 0's GigabitEthernet1/0/21 has been set to discarding state.
```

```
%Apr 27 04:13:59:927 2000 Comware-2 MSTP/6/MSTP_NOTIFIED_TC: Instance 0's GigabitEthernet1/0/23 was notified a topology change.
```

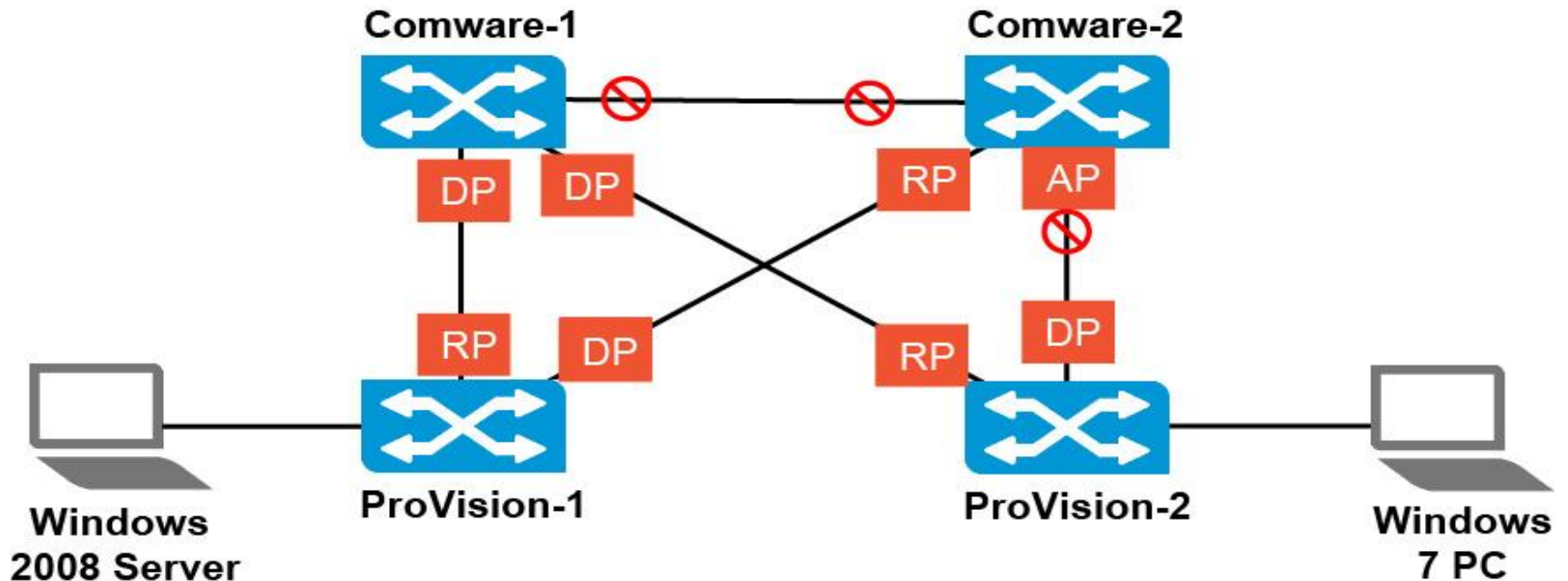
```
%Apr 27 04:14:00:088 2000 Comware-2 IFNET/3/LINK_UPDOWN: GigabitEthernet 1/0/19 link status is DOWN.
```

```
%Apr 27 04:14:01:160 2000 Comware-2 MSTP/6/MSTP_NOTIFIED_TC: Instance 0's GigabitEthernet1/0/23 was notified a topology change.
```

```
<Comware-2>display stp brief
```

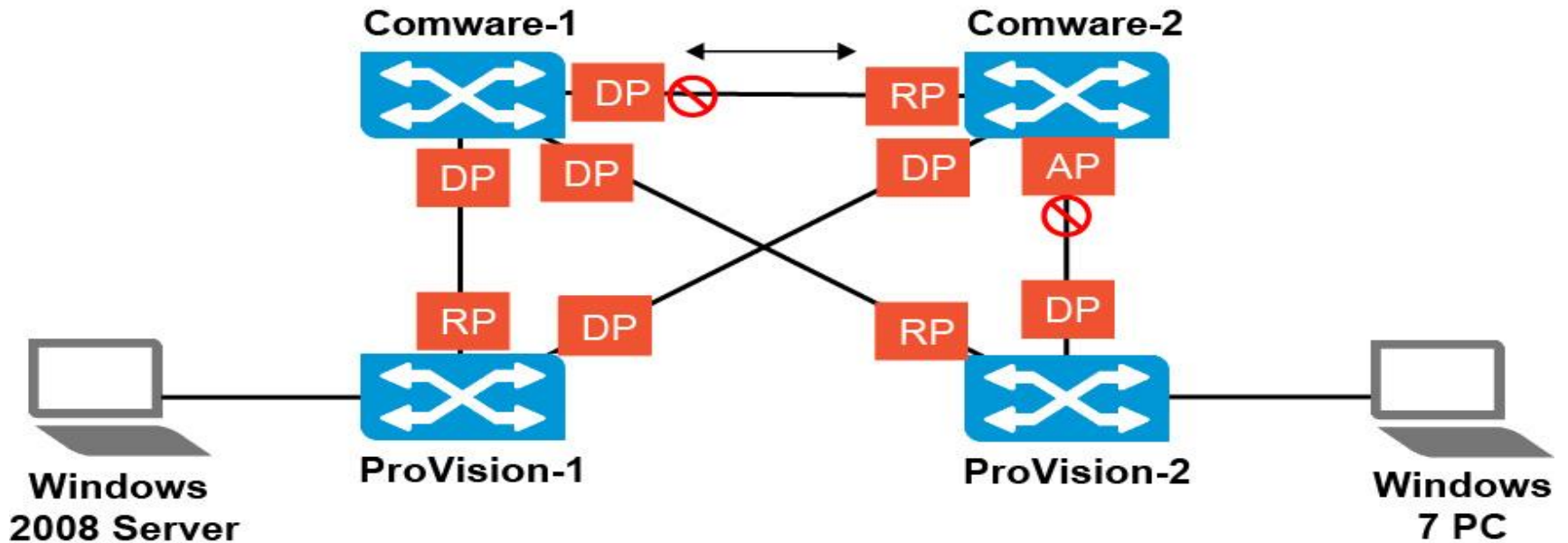
MSTID	Port	Role	STP State	Protection
0	GigabitEthernet1/0/21	ROOT	DISCARDING	NONE
0	GigabitEthernet1/0/23	ALTE	FORWARDING	NONE

Reconvergence when a better path is added



Reconvergence when a better path is added

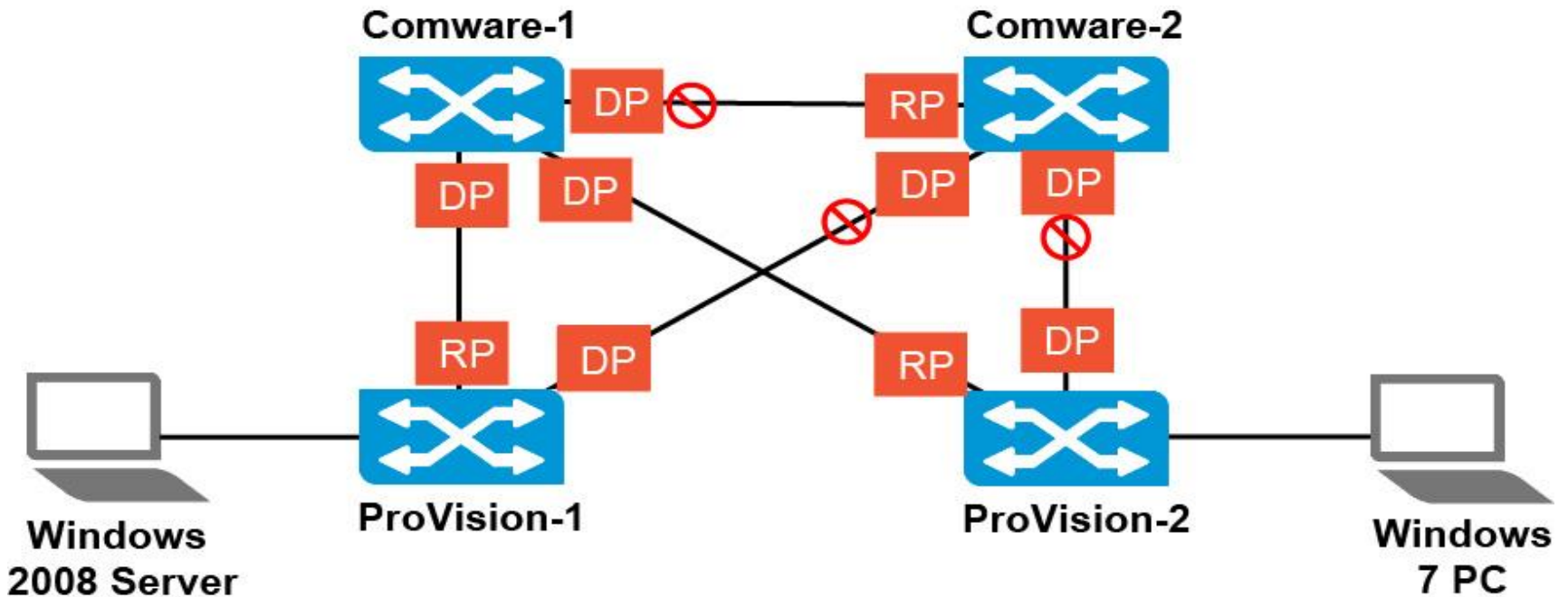
becomes its root port



Reconvergence when a better path is added

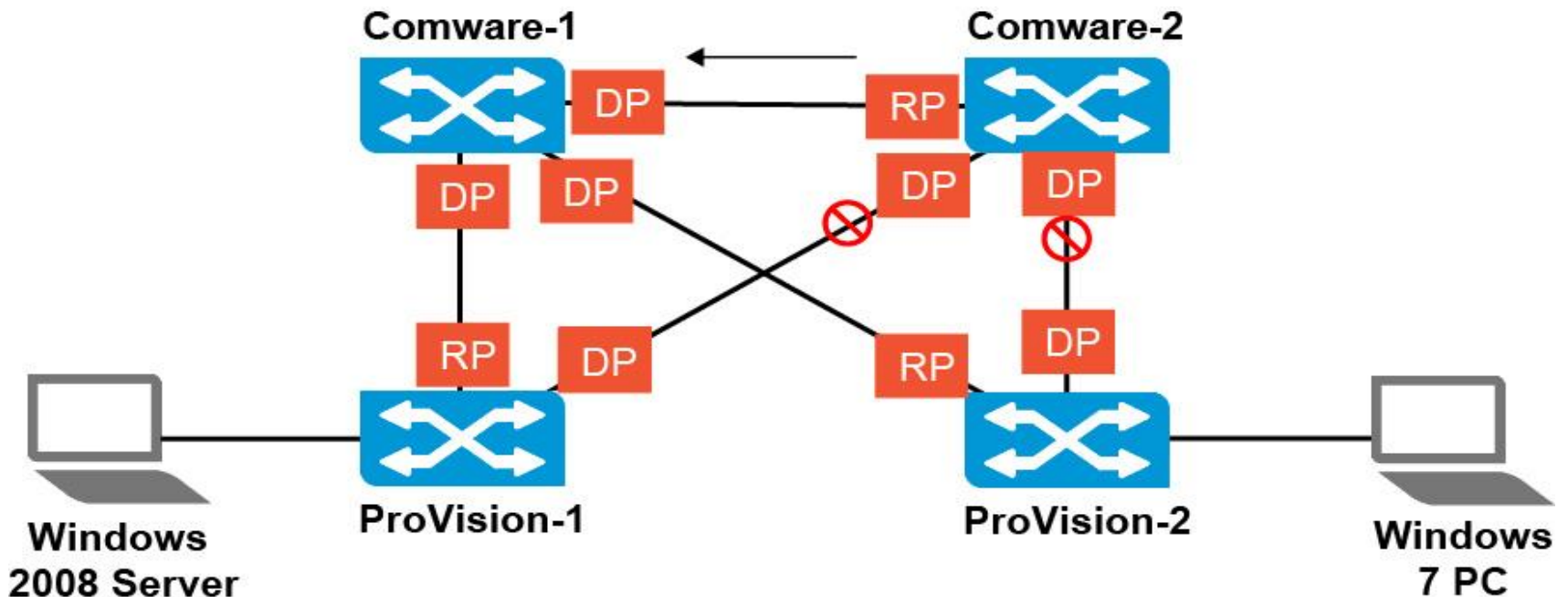
Comware-2 sets any other port that is currently forwarding to discarding

so the ports are designated



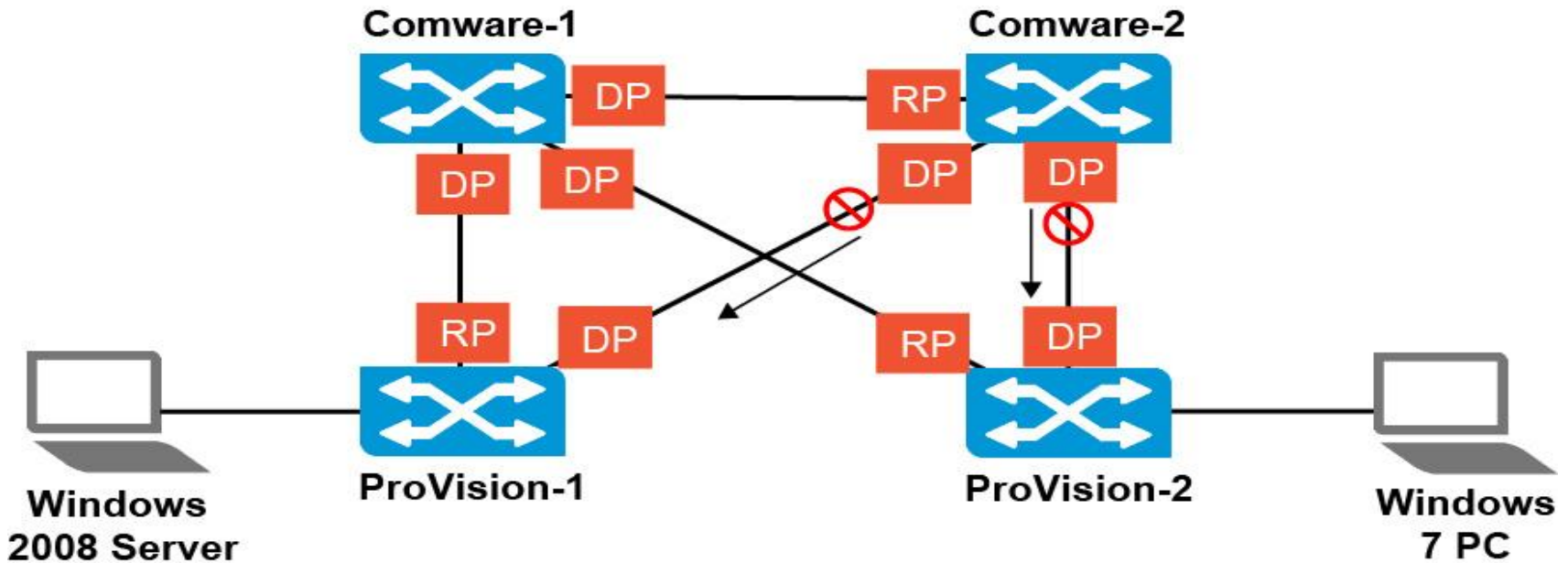
Reconvergence when a better path is added

that it has a single root port
and other ports are discarding

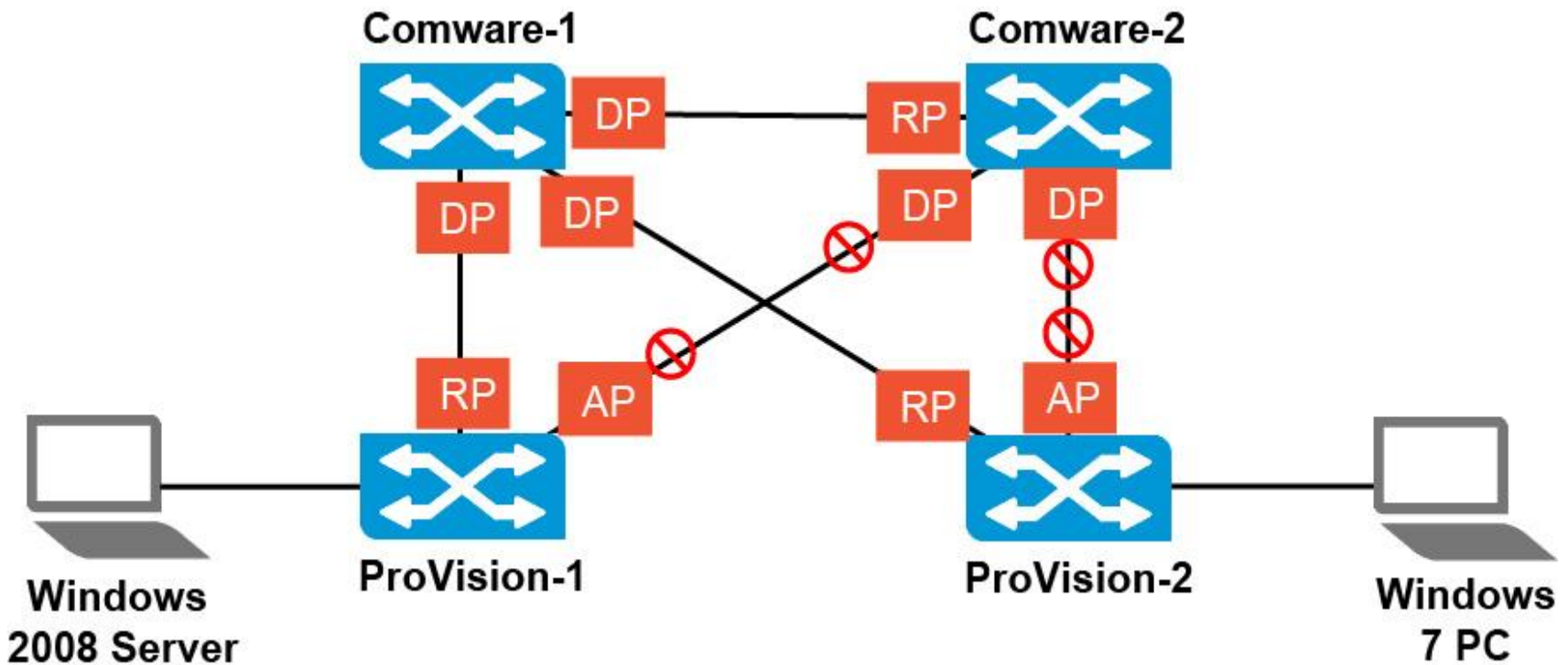


Reconvergence when a better path is added

to move any discarding designated ports to a forwarding state.

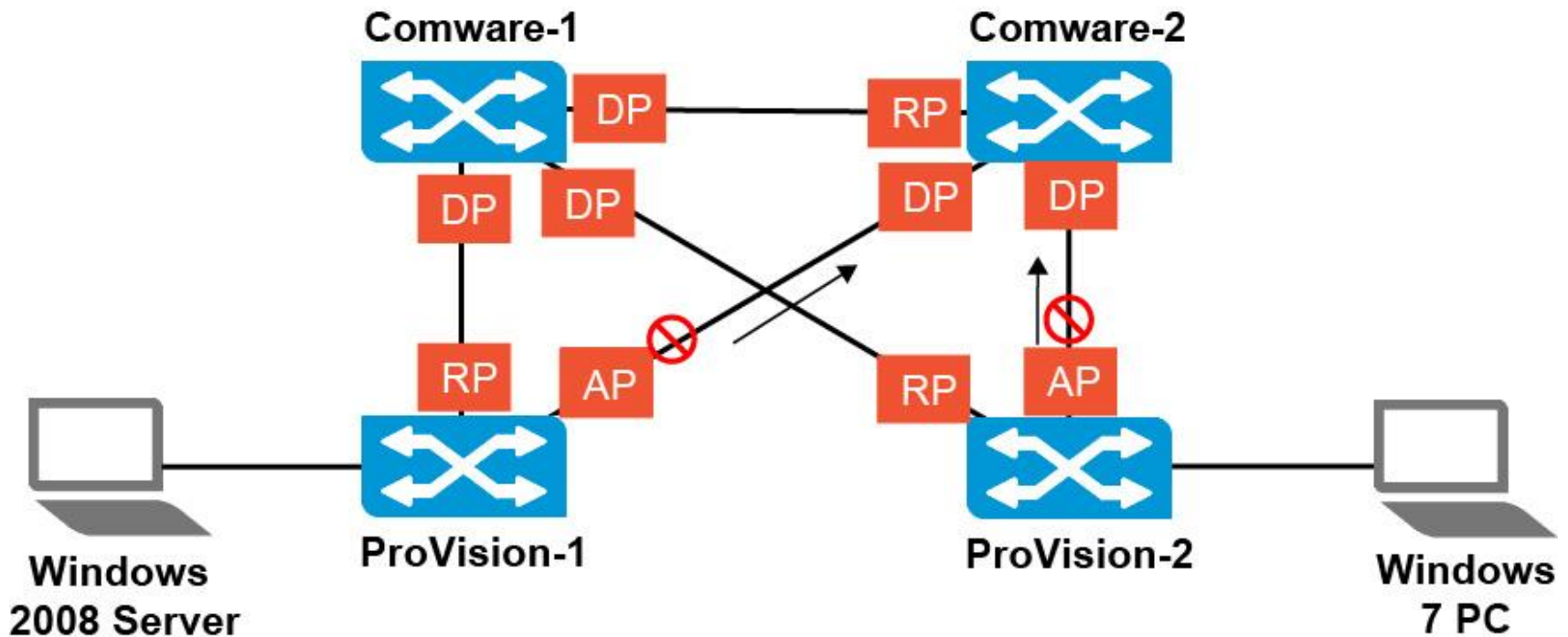


Reconvergence when a better path is added



Reconvergence when a better path is added

other ports are blocking



Spanning tree edge ports

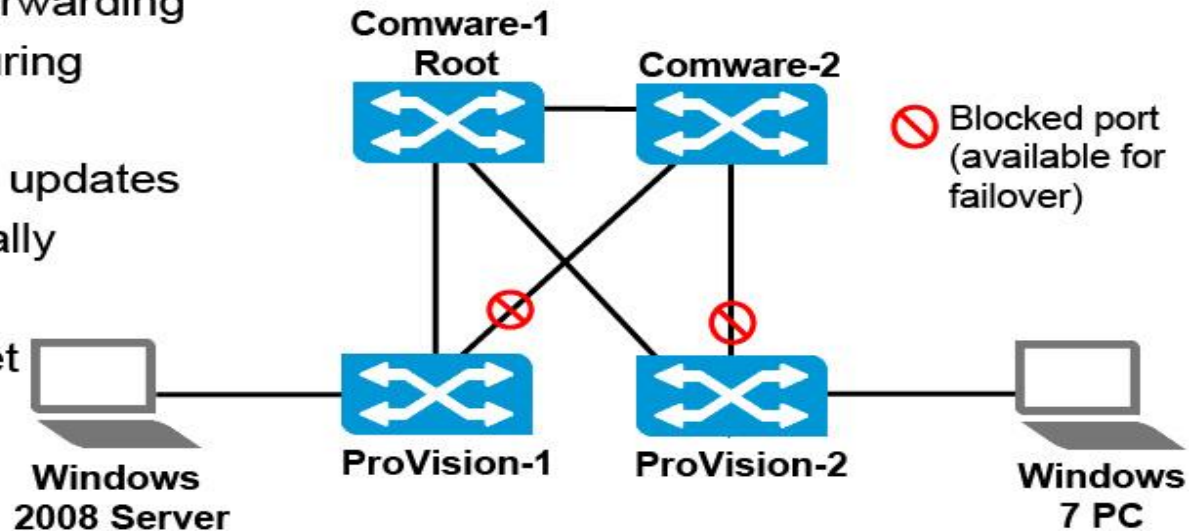
endpoints

two ports that connect to

they can never introduce loops

The edge ports have the designated role, and they are allowed to transition to forwarding immediately.

- Connect to endpoints (one connection, no possibility of a loop)
- Transition directly to forwarding and stay forwarding during convergence
- Do not cause topology updates
- ProVision—Automatically detected by default
- Comware—Must be set manually



Spanning tree edge ports

If the port does not receive a BPDU within 3 seconds, the switch defines the port as an edge port.

ProVision(config)# [no] spanning-tree <int-id-list> auto-edge-port

ProVision(config)# [no] spanning-tree <int-id-list> admin-edge-port

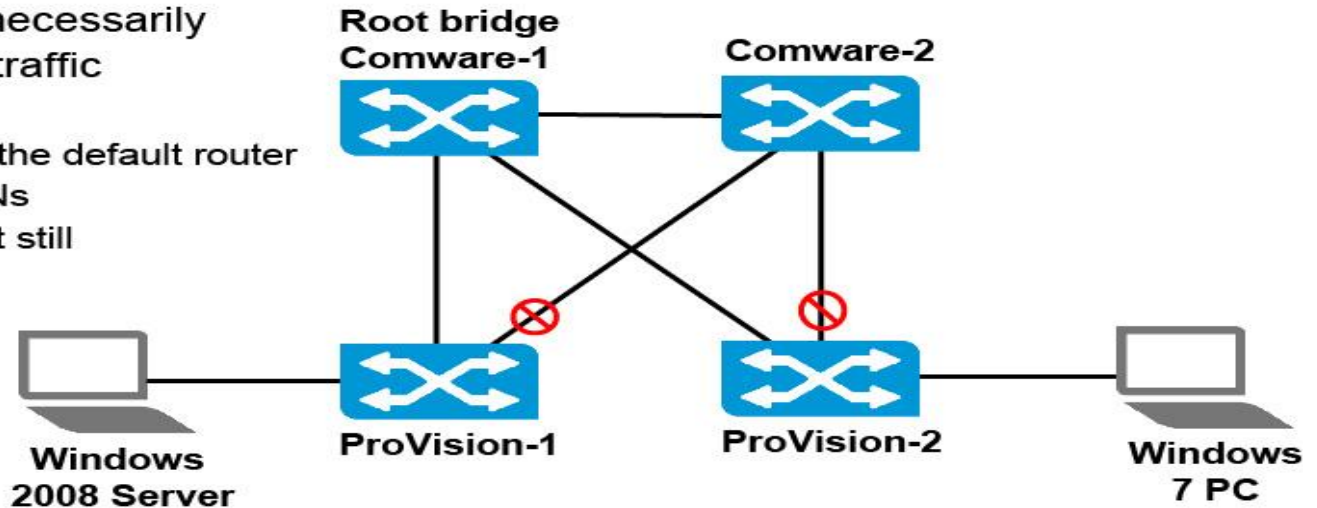
Spanning tree edge ports

[Comware-int-id] stp edged-port enable

[Comware-int-id] stp edged-port disable

Issues with RSTP

- Bandwidth is under-utilized
- Topology is not necessarily optimized for all traffic
- Example:
 - Comware-2 is the default router for some VLANs
 - But traffic must still pass through Comware-1



However, what if you wanted to set up Comware-2 as the default gateway for some VLANs?



Spanning Tree



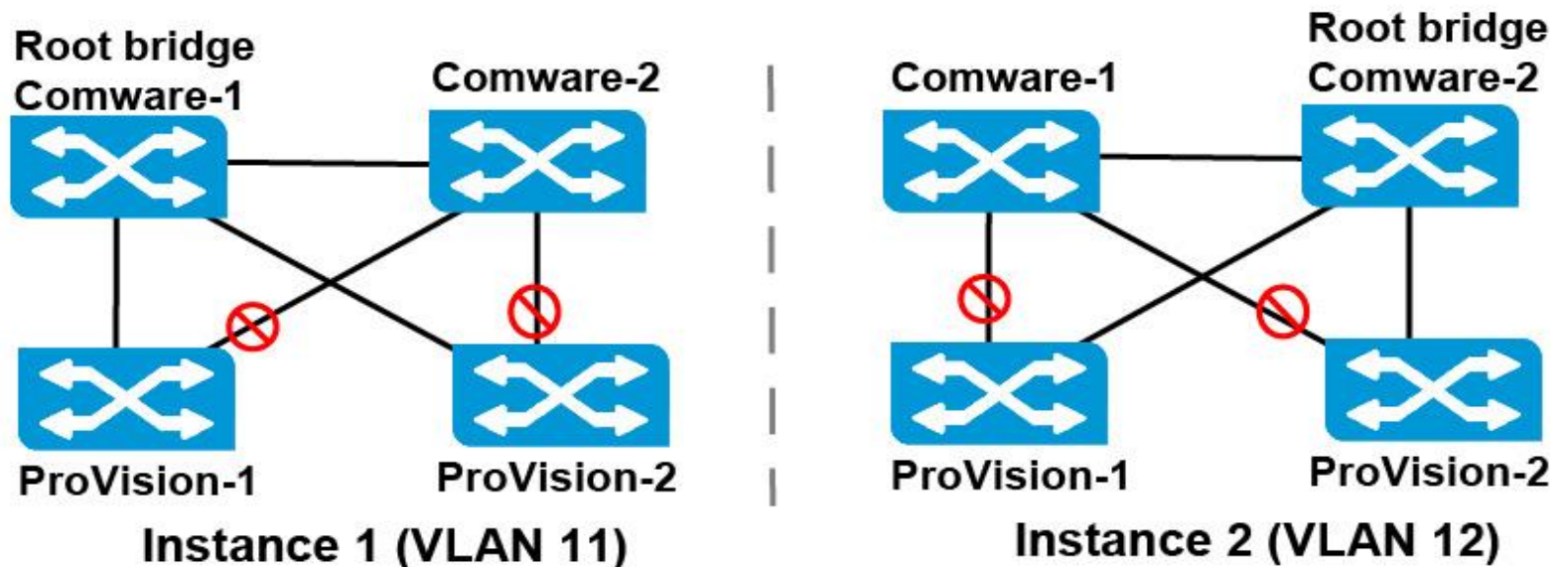
MSTP solution

MSTP allows switches to set up multiple spanning trees, called spanning tree instances

Different spanning tree instances can have different root bridges

MSTP solution

- Multiple spanning tree instances
- A different root and topology for each instance (set of VLANs)
- Load-sharing on redundant links (VLAN-based)



MSTP solution



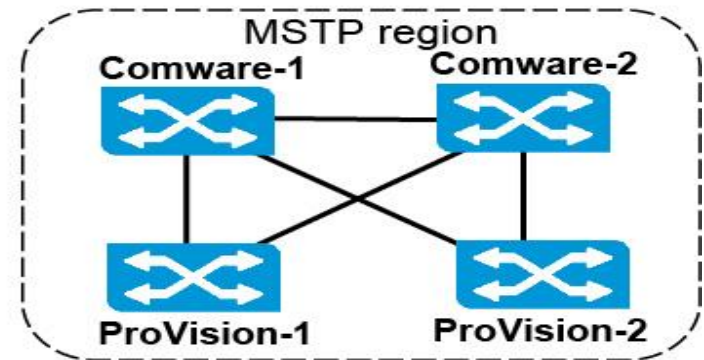
Instance	VLANs	Root	Secondary root
0	1 (and all unused)	Comware-1	Comware-2
1	11	Comware-1	Comware-2
2	12	Comware-2	Comware-1

MSTP region

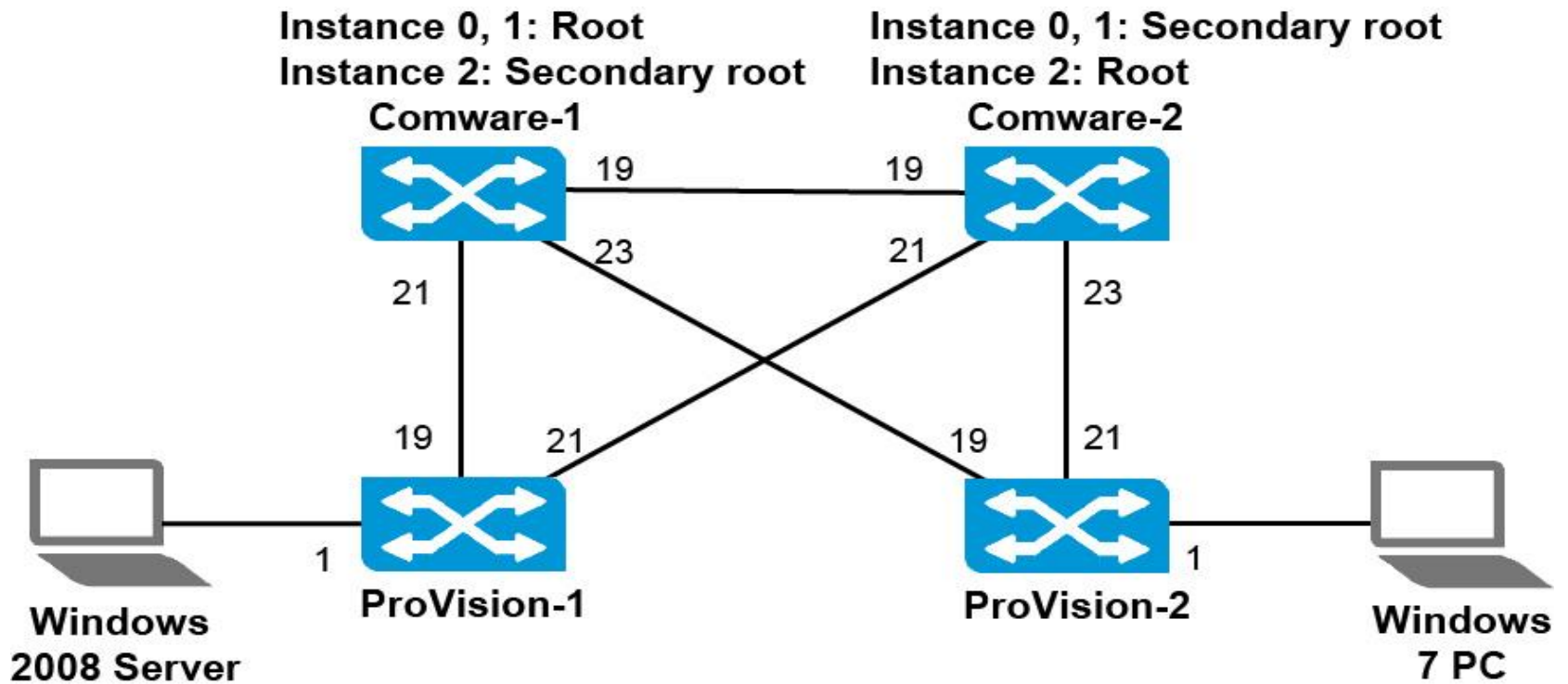
- Region name
- Revision number
- Instance-to-VLAN mapping

- Switches in an MSTP region must match region settings exactly
- Ports inside a region can use all instances

Parameter	Setting for example network
Name	hp
Revision number	1
Instance-to-VLAN mapping	0 = VLAN 1 and all unused VLANs 1 = VLAN 11 2 = VLAN 12



Example configuration: MSTP



Configure MSTP settings on Comware-1

```
[Comware-1] stp region-configuration
```

```
[Comware-1-mst-region] region-name hp  
[Comware-1-mst-region] revision-level 1  
[Comware-1-mst-region] instance 1 vlan 11  
[Comware-1-mst-region] instance 2 vlan 12
```

```
[Comware-1-mst-region] instance 0 vlan 1
```

Configure MSTP settings on Comware-1

```
[Comware-1-mst-region] check region-configuration
Admin configuration
  Format selector      :0
  Region name         :hp
  Revision level      :1
Configuration digest :0xbe0284d20f4d46a8da89c5d9b3b4f78a
Instance   Vlans Mapped
0          1 to 10, 13 to 4094
1          11
2          12
```

```
[Comware-1-mst-region] active region-configuration
[Comware-1-mst-region] quit
```

Configure MSTP settings on Comware-2

```
[Comware-2] stp region-configuration
[Comware-2-mst-region] region-name hp
[Comware-2-mst-region] revision-level 1
[Comware-2-mst-region] instance 1 vlan 11
[Comware-2-mst-region] instance 2 vlan 12
```


Configure MSTP settings on Comware-2

```
[Comware-2-mst-region] check region-configuration
Admin configuration
  Format selector      :0
  Region name         :hp
  Revision level      :1
Configuration digest :0xbe0284d20f4d46a8da89c5d9b3b4f78a
Instance   Vlans Mapped
  0         1 to 10, 13 to 4094
  1         11
  2         12
```

```
[Comware-2-mst-region] active region-configuration
[Comware-2-mst-region] quit
```

Configure MSTP settings on ProVision-1

```
ProVision-1(config)# spanning-tree config-name hp
ProVision-1(config)# spanning-tree config-revision 1
ProVision-1(config)# spanning-tree instance 1 vlan 11
ProVision-1(config)# spanning-tree instance 2 vlan 12
```

Configure MSTP settings on ProVision-1

```
ProVision-1(config)# show spanning-tree mst-config
MST Configuration Identifier Information
MST Configuration Name : hp
MST Configuration Revision : 1
MST Configuration Digest : 0xBE0284D20F4D46A8DA89C5D9B3B4F78A
IST Mapped VLANs : 1-10,13-4094
Instance ID Mapped VLANs
-----
1          11
2          12
```

Configure MSTP settings on ProVision-2

```
ProVision-2(config)# spanning-tree config-name hp
ProVision-2(config)# spanning-tree config-revision 1
ProVision-2(config)# spanning-tree instance 1 vlan 11
ProVision-2(config)# spanning-tree instance 2 vlan 12
```

Configure MSTP settings on ProVision-2

```
ProVision-2(config)# show spanning-tree mst-config
MST Configuration Identifier Information
  MST Configuration Name : hp
  MST Configuration Revision : 1
  MST Configuration Digest : 0xBE0284D20F4D46A8DA89C5D9B3B4F78A
IST Mapped VLANs : 1-10,13-4094
  Instance ID Mapped VLANs
  -----
  1 11
  2 12
```

Configure the instance root settings and set standard costs for Comware switches

Instance	VLANs	Root	Secondary root
0	1 (and all unused)	Comware-1	Comware-2
1	11	Comware-1	Comware-2
2	12	Comware-2	Comware-1

Configure root settings and cost on Comware-1

```
[Comware-1] stp instance 0 root primary
[Comware-1] stp instance 1 root primary
[Comware-1] stp instance 2 root secondary
```

```
[Comware-1] stp pathcost dot1t
```

```
Cost configuration of every port will be reset and auto-calculation is available after
changing current pathcost standard. Continue?[Y/N]:y
```

Configure root settings and cost on Comware-2

```
[Comware-2] stp instance 0 root secondary
[Comware-2] stp instance 1 root secondary
[Comware-2] stp instance 2 root primary
```

```
[Comware-2] stp pathcost dot1t
```

Cost configuration of every port will be reset and auto-calculation is available after changing current pathcost standard. Continue?[Y/N]:y

Verify the configuration

- Comware-1 in instance 0 and 1
- Comware-2 in instance 2

```
[Comware-1] display stp root
```

MSTID	Root Bridge ID	ExtPathCost	IntPathCost	Root Port
0	0.d07e-28ce-c94f	0	0	
1	0.d07e-28ce-c94f	0	0	
2	0.d07e-28ce-d31e	0	20000	GigabitEthernet1/0/19

Verify the configuration

```
[Comware-2] display stp root
```

MSTID	Root Bridge ID	ExtPathCost	IntPathCost	Root Port
0	0.d07e-28ce-c94f 0		20000	GigabitEthernet1/0/19
1	0.d07e-28ce-c94f 0		20000	GigabitEthernet1/0/19
2	0.d07e-28ce-d31e 0		0	

Verify the configuration

for each instance separately.

```
ProVision-1(config)# show spanning-tree root-history ist
Status and Counters - IST Regional Root Changes History
MST Instance ID : 0
Root Changes Counter : 2
Current Root Bridge ID : 0:d07e28-cec94f
<-output omitted->
```

```
ProVision-1(config)# show spanning-tree root-history msti 1
Status and Counters - MST Instance Regional Root Changes History
MST Instance ID : 1
Root Changes Counter : 3
Current Root Bridge ID : 0:d07e28-cec94f
<-output omitted->
```

```
ProVision-1(config)# show spanning-tree root-history msti 2
Status and Counters - MST Instance Regional Root Changes History
MST Instance ID : 2
Root Changes Counter : 4
Current Root Bridge ID : 0:d07e28-ced31e
<-output omitted->
```

Verify the configuration

```
ProVision-2(config)# show spanning-tree root-history ist
Status and Counters - IST Regional Root Changes History
MST Instance ID : 0
Root Changes Counter : 2
Current Root Bridge ID : 0:d07e28-cec94f
<-output omitted->
```

```
ProVision-2(config)# show spanning-tree root-history msti 1
Status and Counters - MST Instance Regional Root Changes History
MST Instance ID : 1
Root Changes Counter : 3
Current Root Bridge ID : 0:d07e28-cec94f
<-output omitted->
```

```
ProVision-2(config)# show spanning-tree root-history msti 2
Status and Counters - MST Instance Regional Root Changes History
MST Instance ID : 2
Root Changes Counter : 4
Current Root Bridge ID : 0:d07e28-ced31e
<-output omitted->
```

Map the topology. Instance 0 topology

```
[Comware-1] display stp instance 0 brief
```

MSTID	Port	Role	STP State	Protection
0	GigabitEthernet1/0/19	DESI	FORWARDING	NONE
0	GigabitEthernet1/0/21	DESI	FORWARDING	NONE
0	GigabitEthernet1/0/23	DESI	FORWARDING	NONE

```
[Comware-2] display stp instance 0 brief
```

MSTID	Port	Role	STP State	Protection
0	GigabitEthernet1/0/19	ROOT	FORWARDING	NONE
0	GigabitEthernet1/0/21	DESI	FORWARDING	NONE
0	GigabitEthernet1/0/23	DESI	FORWARDING	NONE

Map the topology. Instance 0 topology

```
ProVision-1(config)# show spanning-tree 1,19,21 instance ist
```

```
<-output omitted->
```

Port	Type	Cost	Priority	Role	State	Designated Bridge
1	100/1000T	Auto	128	Designated	Forwarding	d07e28-cec94f
19	100/1000T	20000	128	Root	Forwarding	d07e28-cec94f
21	100/1000T	20000	128	Alternate	Blocking	d07e28-cec94f

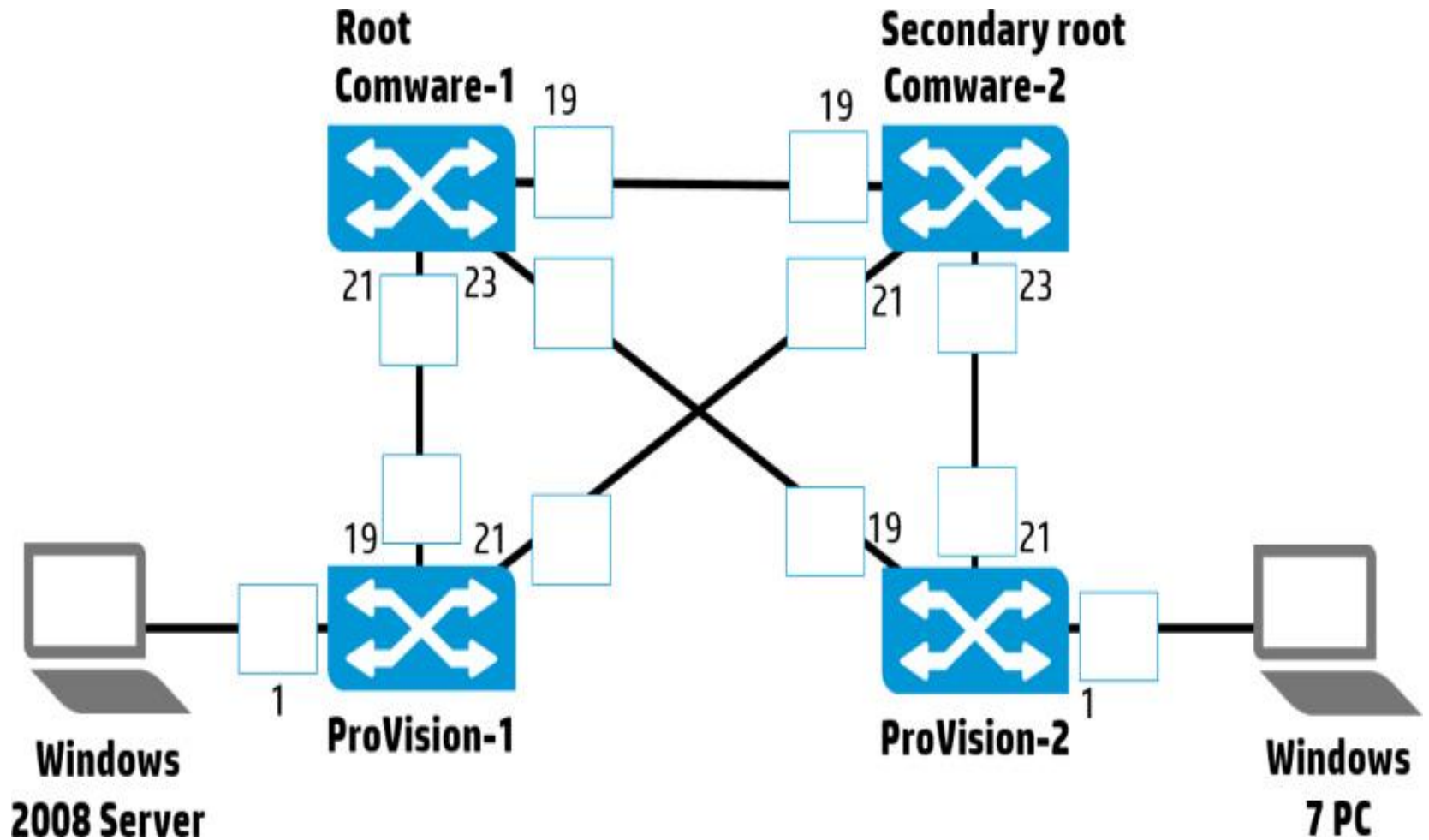
```
ProVision-2(config)# show spanning-tree 1,19,21 instance ist
```

```
<-output omitted->
```

```
Designated
```

Port	Type	Cost	Priority	Role	State	Bridge
1	100/1000T	Auto	128	Designated	Forwarding	d07e28-cec94f
19	100/1000T	20000	128	Root	Forwarding	d07e28-cec94f
21	100/1000T	20000	128	Alternate	Blocking	d07e28-cec94f

Map the topology. Instance 0 topology



Map the topology. Instance 1 topology

```
[Comware-1] display stp instance 1 brief
```

MSTID	Port	Role	STP State	Protection
0	GigabitEthernet1/0/19	DESI	FORWARDING	NONE
0	GigabitEthernet1/0/21	DESI	FORWARDING	NONE
0	GigabitEthernet1/0/23	DESI	FORWARDING	NONE

```
[Comware-2] display stp instance 1 brief
```

MSTID	Port	Role	STP State	Protection
1	GigabitEthernet1/0/19	ROOT	FORWARDING	NONE
1	GigabitEthernet1/0/21	DESI	FORWARDING	NONE
1	GigabitEthernet1/0/23	DESI	FORWARDING	NONE

Map the topology. Instance 1 topology

```
ProVision-1(config)# show spanning-tree 1,19,21 instance 1
```

```
<-output omitted->
```

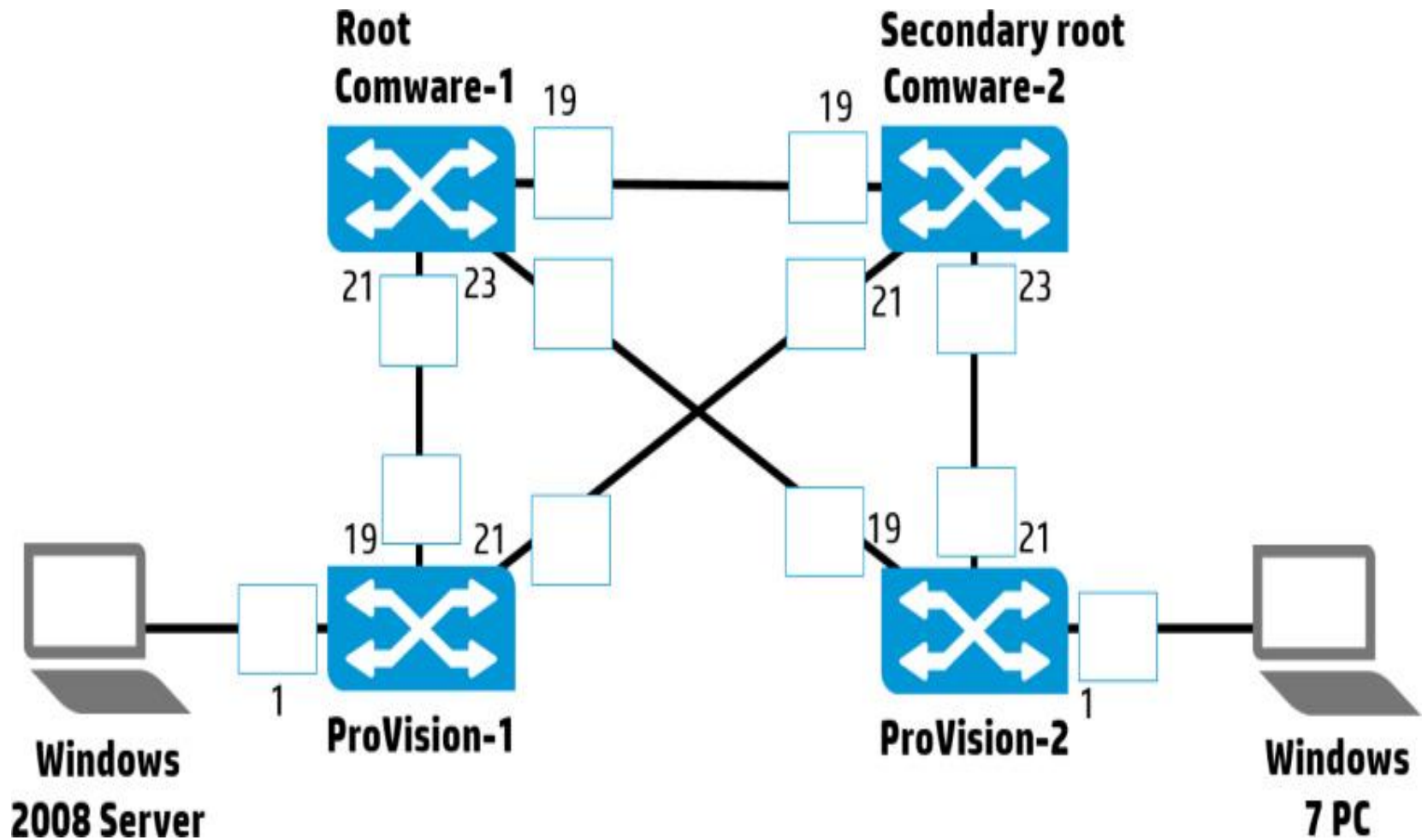
Port	Type	Cost	Priority	Role	State	Designated Bridge
1	100/1000T	20000	128	Designated	Forwarding	d4c9ef-851680
19	100/1000T	20000	128	Root	Forwarding	d07e28-cec94f
21	100/1000T	20000	128	Alternate	Blocking	d07e28-ced31e

```
ProVision-2(config)# show spanning-tree 1,19,21 instance 1
```

```
<-output omitted->
```

Port	Type	Cost	Priority	Role	State	Designated Bridge
1	100/1000T	20000	128	Designated	Forwarding	d4c9ef-84fe80
19	100/1000T	20000	128	Root	Forwarding	d07e28-cec94f
21	100/1000T	20000	128	Alternate	Blocking	d07e28-ced31e

Map the topology. Instance 1 topology



Map the topology. Instance 2 topology

```
[Comware-1] display stp instance 2 brief
```

MSTID	Port	Role	STP State	Protection
2	GigabitEthernet1/0/19	ROOT	FORWARDING	NONE
2	GigabitEthernet1/0/21	DESI	FORWARDING	NONE
2	GigabitEthernet1/0/23	DESI	FORWARDING	NONE

```
[Comware-2] display stp instance 2 brief
```

MSTID	Port	Role	STP State	Protection
2	GigabitEthernet1/0/19	DESI	FORWARDING	NONE
2	GigabitEthernet1/0/21	DESI	FORWARDING	NONE
2	GigabitEthernet1/0/23	DESI	FORWARDING	NONE

Map the topology. Instance 2 topology

```
ProVision-1(config)# show spanning-tree 1,19,21 instance 2
```

```
<-output omitted->
```

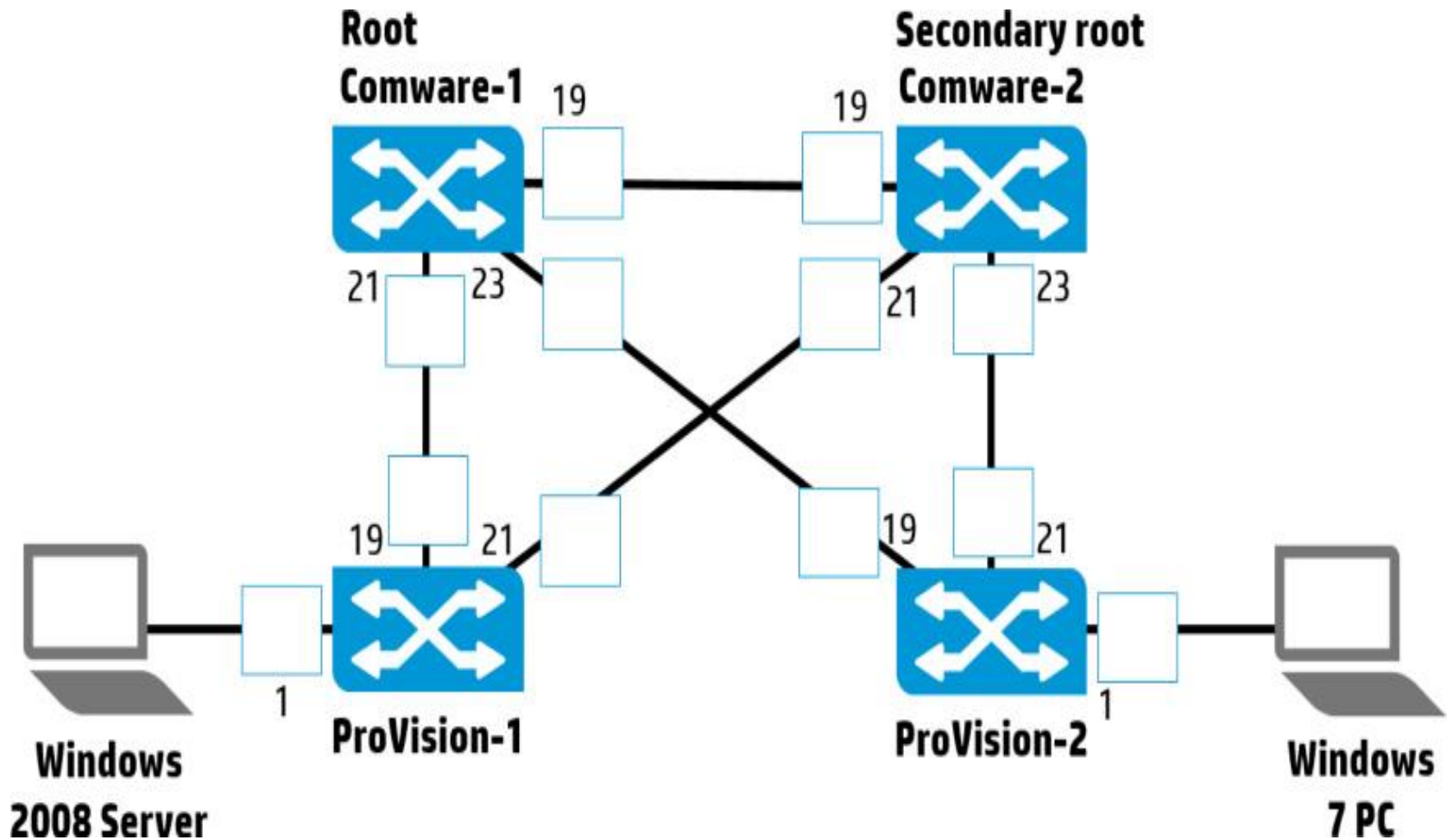
Port	Type	Cost	Priority	Role	State	Designated Bridge
1	100/1000T	20000	128	Designated	Forwarding	d4c9ef-851680
19	100/1000T	20000	128	Alternate	Blocking	d07e28-cec94f
21	100/1000T	20000	128	Root	Forwarding	d07e28-ced31e

```
ProVision-2(config)# show spanning-tree 1,19,21 instance 2
```

```
<-output omitted->
```

Port	Type	Cost	Priority	Role	State	Designated Bridge
1	100/1000T	20000	128	Designated	Forwarding	d4c9ef-84fe80
19	100/1000T	20000	128	Alternate	Blocking	d07e28-cec94f
21	100/1000T	20000	128	Root	Forwarding	d07e28-ced31e

Map the topology. Instance 2 topology



Additional exploration of MSTP: Add a VLAN

Consider what happens if you add a VLAN to a switch that is running MSTP.

```
[Comware-1] vlan 13  
[Comware-1-vlan13] quit
```

```
[Comware-2] vlan 13  
[Comware-2-vlan13] quit
```


Additional exploration of MSTP: Add a VLAN

```
ProVision-1# show spanning-tree
```

```
[Comware-1] stp region-configuration  
[Comware-1-mst-region] instance 1 vlan 13
```

```
[Comware-2] stp region-configuration  
[Comware-2-mst-region] instance 1 vlan 13
```

Additional exploration of MSTP: Add a VLAN

```
[Comware-1-mst-region] active region-configuration  
[Comware-2-mst-region] active region-configuration
```

Although you have not made any changes to the ProVision switches, you will see that this configuration has actually affected them.

Additional exploration of MSTP: Add a VLAN

```
ProVizion-1(config)# show spanning-tree 19,21 instance ist
```

```
<-output omitted->
```

Port	Type	Cost	Priority	Role	State	Bridge
19	100/1000T	20000	128	Root	Forwarding	d07e28-cec94f
21	100/1000T	20000	128	Alternate	Blocking	d07e28-cec94f

```
ProVizion-1(config)# show spanning-tree 19,21 instance 1
```

```
<-output omitted->
```

Port	Type	Cost	Priority	Role	State	Bridge
19	100/1000T	20000	128	Master	Forwarding	d4c9ef-851680
21	100/1000T	20000	128	Alternate	Blocking	d4c9ef-851680

```
ProVizion-1(config)# show spanning-tree 19,21 instance 2
```

```
<-output omitted->
```

Port	Type	Cost	Priority	Role	State	Bridge
19	100/1000T	20000	128	Master	Forwarding	d4c9ef-851680
21	100/1000T	20000	128	Alternate	Blocking	d4c9ef-851680

Master Port is another name for a region's root port in the CIST; this is the port that offers the MSTP region its link to the rest of the CST.

Additional exploration of MSTP: Add a VLAN

```
ProVision-1# show spanning-tree mst-config
MST Configuration Identifier Information
  MST Configuration Name : hp
  MST Configuration Revision : 1
MST Configuration Digest : 0xBE0284D20F4D46A8DA89C5D9B3B4F78A
IST Mapped VLANs : 1-10,13-4094

Instance ID Mapped VLANs
-----
1          11
2          12
```

```
[Comware-1-mst-region] display stp region-configuration  
Oper configuration
```

```
Format selector :0
```

```
Region name :hp
```

```
Revision level :1
```

```
Configuration digest :0xf843355b493955bcd42bee4c4e2ffb00
```

Instance	Vlans Mapped
0	1 to 10, 14 to 4094
1	11, 13
2	12

```
[Comware-2-mst-region] display stp region-configuration  
Oper configuration
```

```
Format selector :0
```

```
Region name :hp
```

```
Revision level :1
```

```
Configuration digest :0xf843355b493955bcd42bee4c4e2ffb00
```

Instance	Vlans Mapped
0	1 to 10, 14 to 4094
1	11, 13
2	12

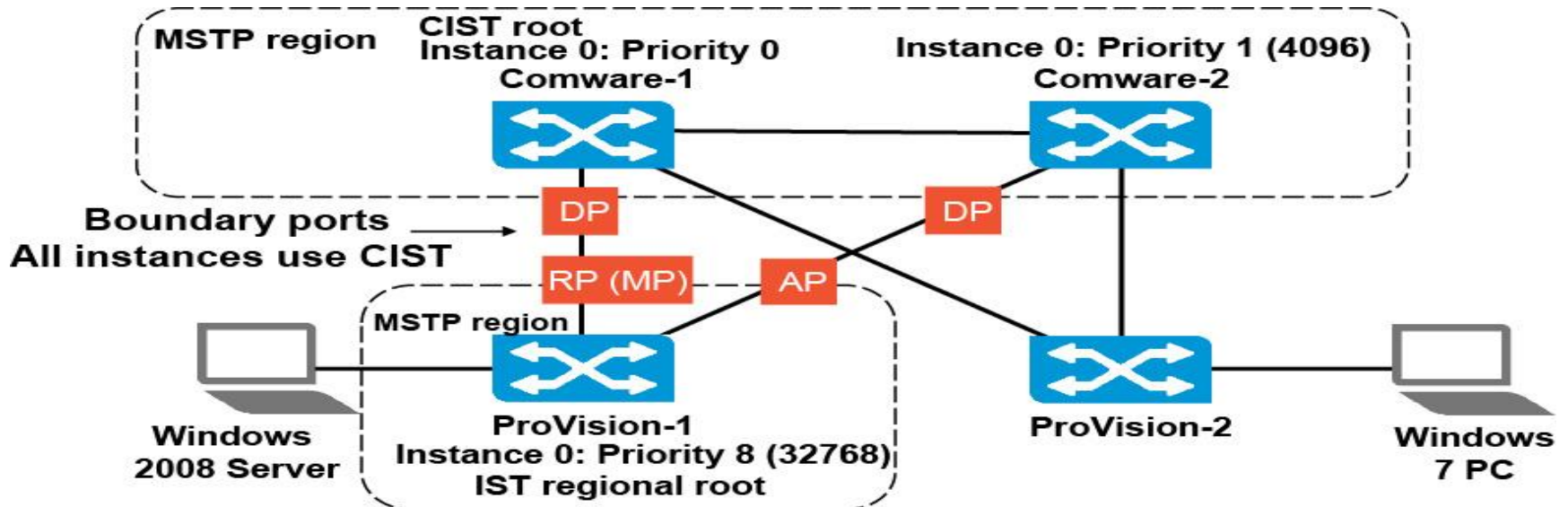
Additional exploration of MSTP: Add a VLAN

as if it was running RSTP

12. Why are ProVision-1's MST region settings now different from the Comware switches' settings?

when switches are in different regions, they interact using RSTP, and the boundary ports between regions are part of a CIST (Common and Internal Spanning Tree)

Additional exploration of MSTP: Add a VLAN



Additional exploration of MSTP: Add a VLAN

Therefore, adding a VLAN and moving that VLAN from instance 0 to another instance in an active network can cause disruptions and nonoptimal link utilization.

Note! Plan in advance and place all VLANs that might be used in the future in the desired instance on all switches.

**Спасибо
за внимание!**