Rapid Spanning Tree Protocol

Foreword

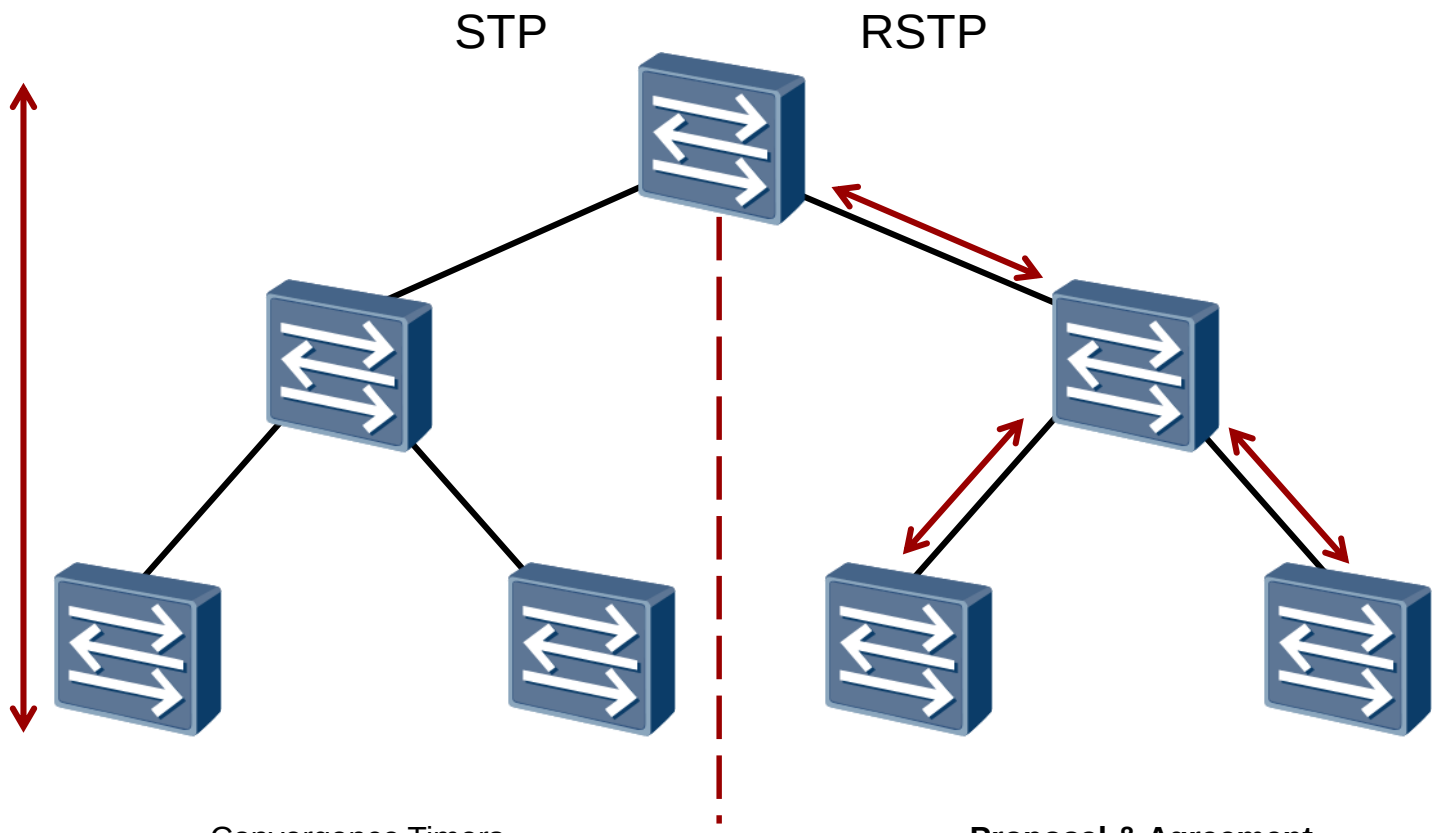
The original STP standard was defined in 1998 for which a number of limitations were discovered, particularly in the time needed for convergence to occur. In light of this, Rapid Spanning Tree Protocol (RSTP) was introduced. The fundamental characteristics of RSTP are understood to follow the basis of STP, therefore the characteristic differences found within RSTP are emphasized within this section.

Objectives

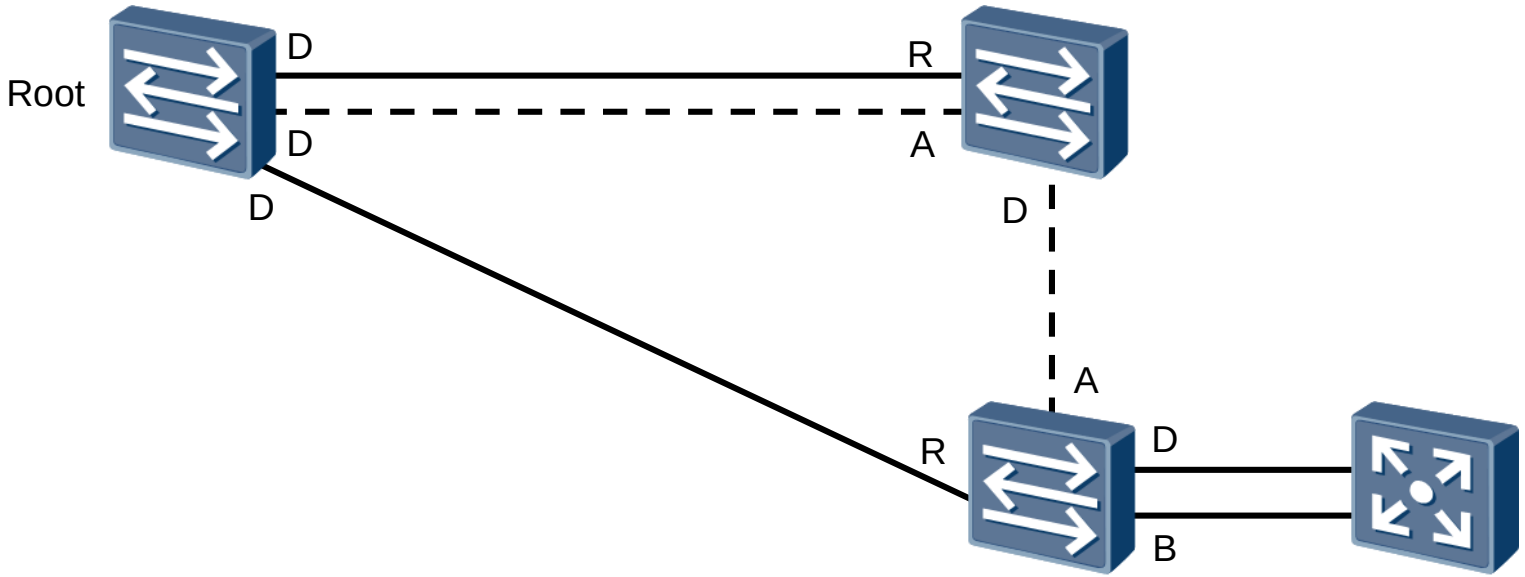
Upon completion of this section, trainees will be able to:

- Describe the characteristics associated with RSTP.
- Configure RSTP parameters.

STP Weakness

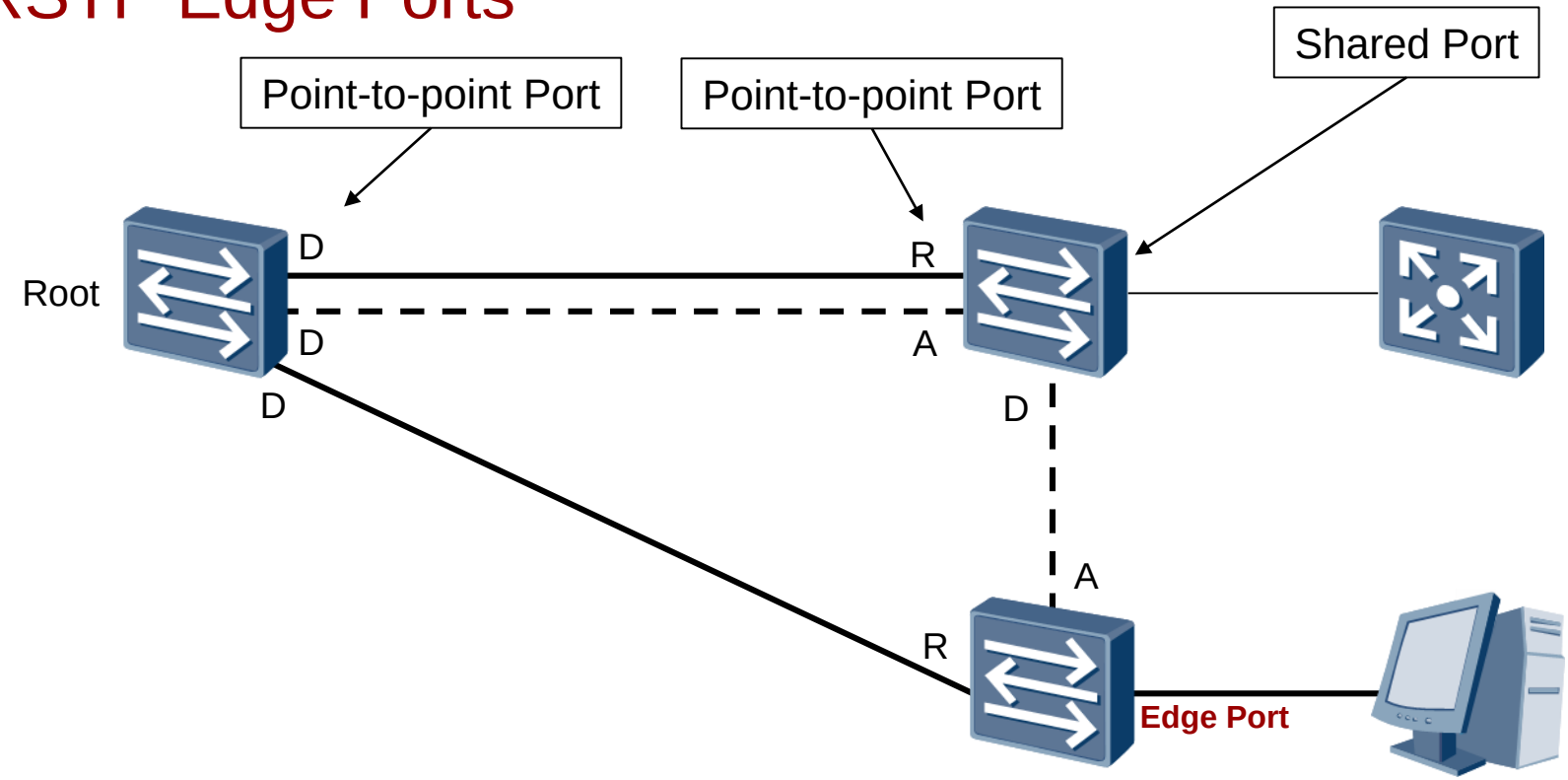


RSTP Port Roles



Roles	Description
Backup	A backup path to downstream nodes, where redundant links exist on the same LAN segment as the designated port.
Alternate	An alternate path to the root bridge that differs from the path provided by the root port of the switch.

RSTP Edge Ports



- Systems that do not participate in RSTP connect to edge ports.
- Edge ports do not process BDPU and instantly forward data.
- If Edge receives a BPDU it becomes a normal STP port.

Port States of RSTP

STP	RSTP	Port Role
Disabled	Discarding	Disabled
Blocking	Discarding	Alternate or Backup
Listening	Not Used	Root or Designated
Learning	Learning	Root or Designated
Forwarding	Forwarding	Root or Designated

RST BPDU

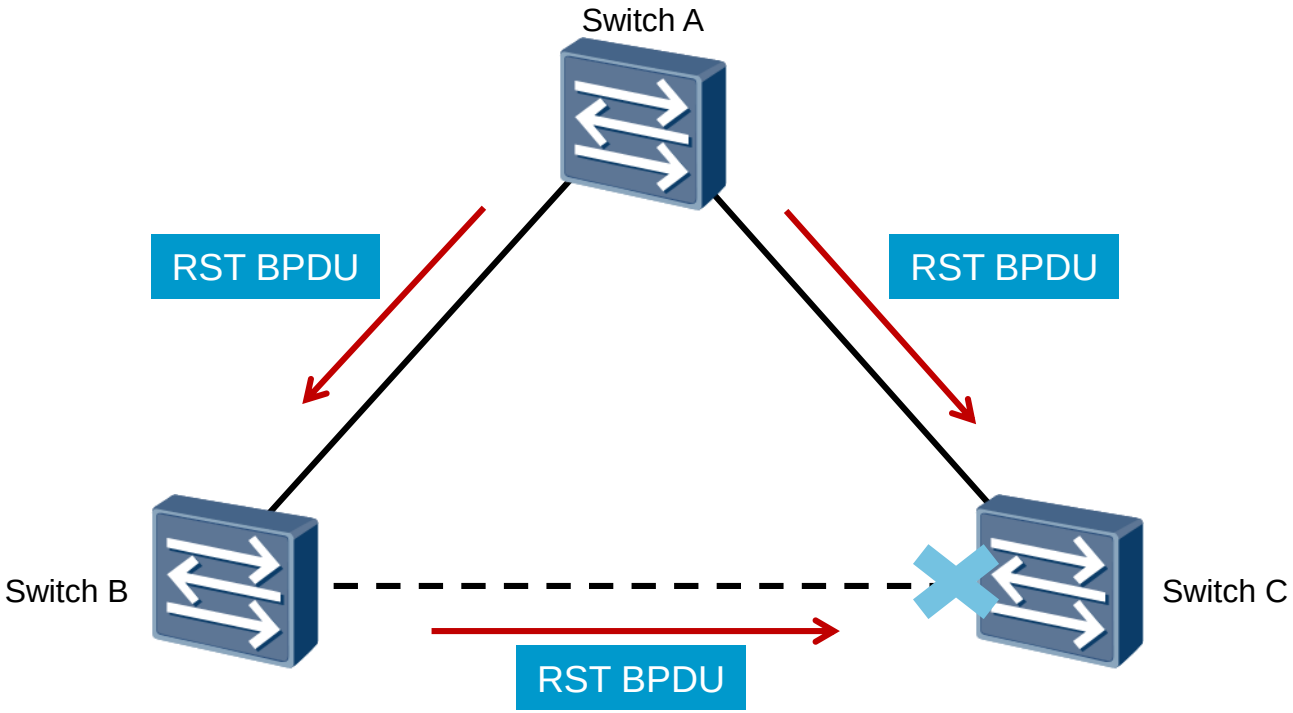
PID	PVI	BPDU Type	Flags	Root ID	RPC	Bridge ID	Port ID	Message Age	Max Age	Hello Time	Fwd Delay

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
TCA	Agreement	Forwarding	Learning	Port Role		Proposal	TC

Port Role = 00 Unknown
01 Alternate/Backup Port
10 Root Port
11 Designated Port

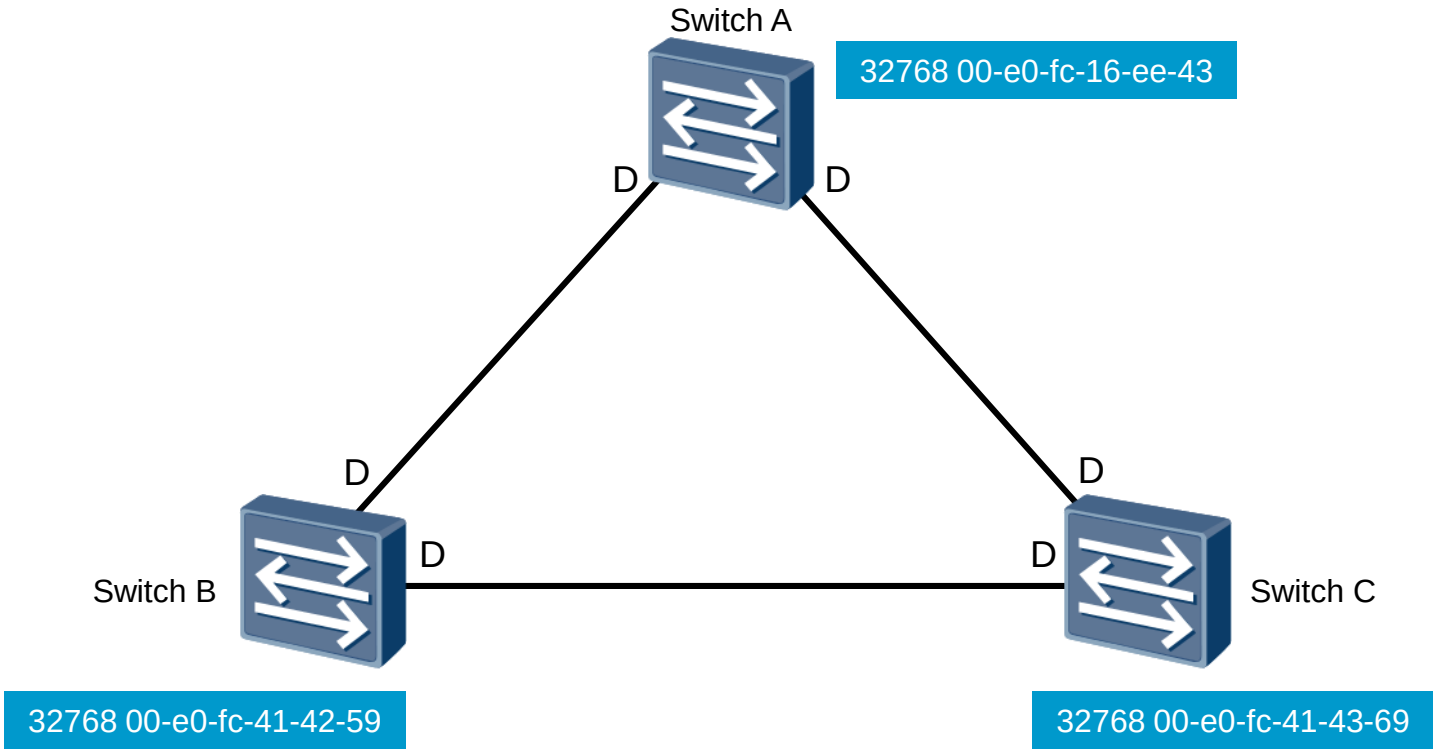
- Unused fields of the STP BPDU are active within RSTP.
- New capabilities are introduced as part of RSTP.

RST BPDU



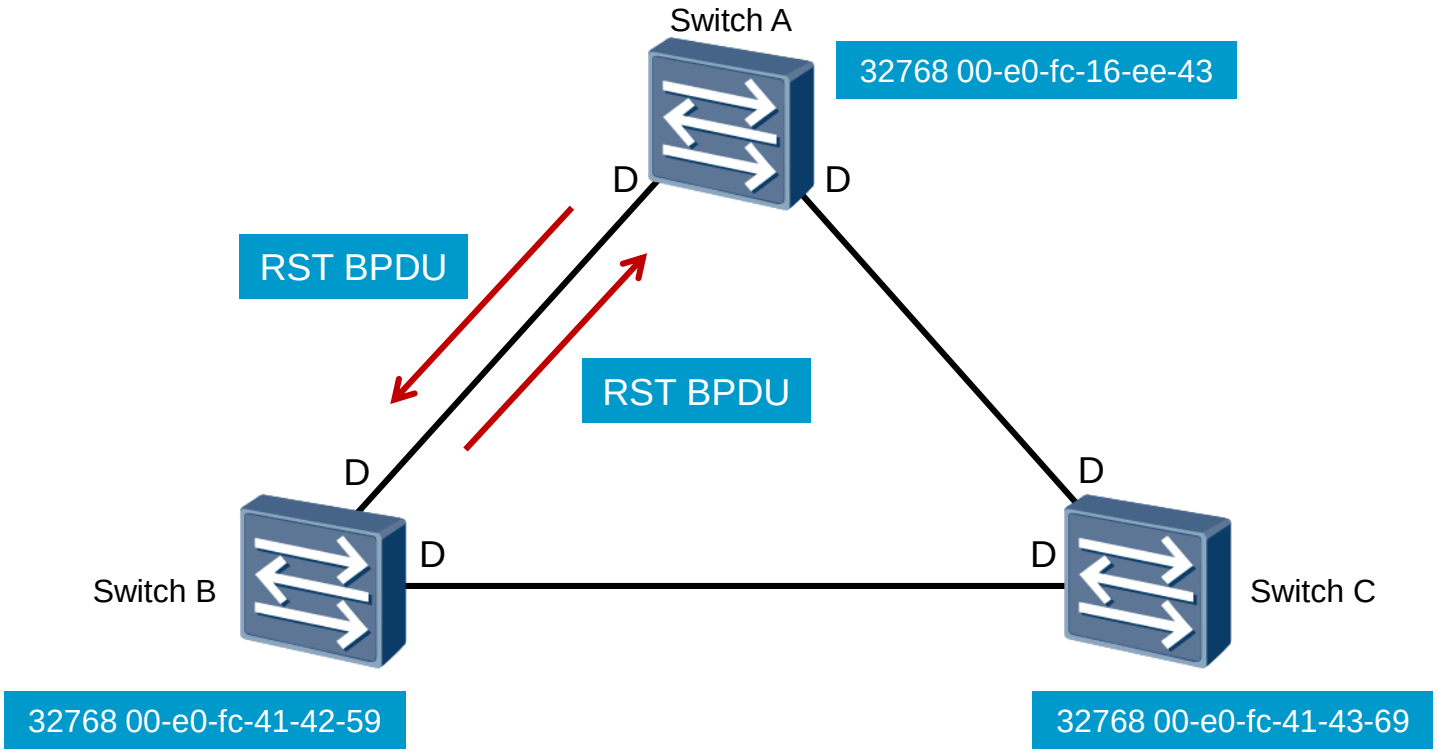
- Designated switches generate their own BDPU at Hello time, **regardless** of whether an RST BPDU has been received.

RSTP Convergence



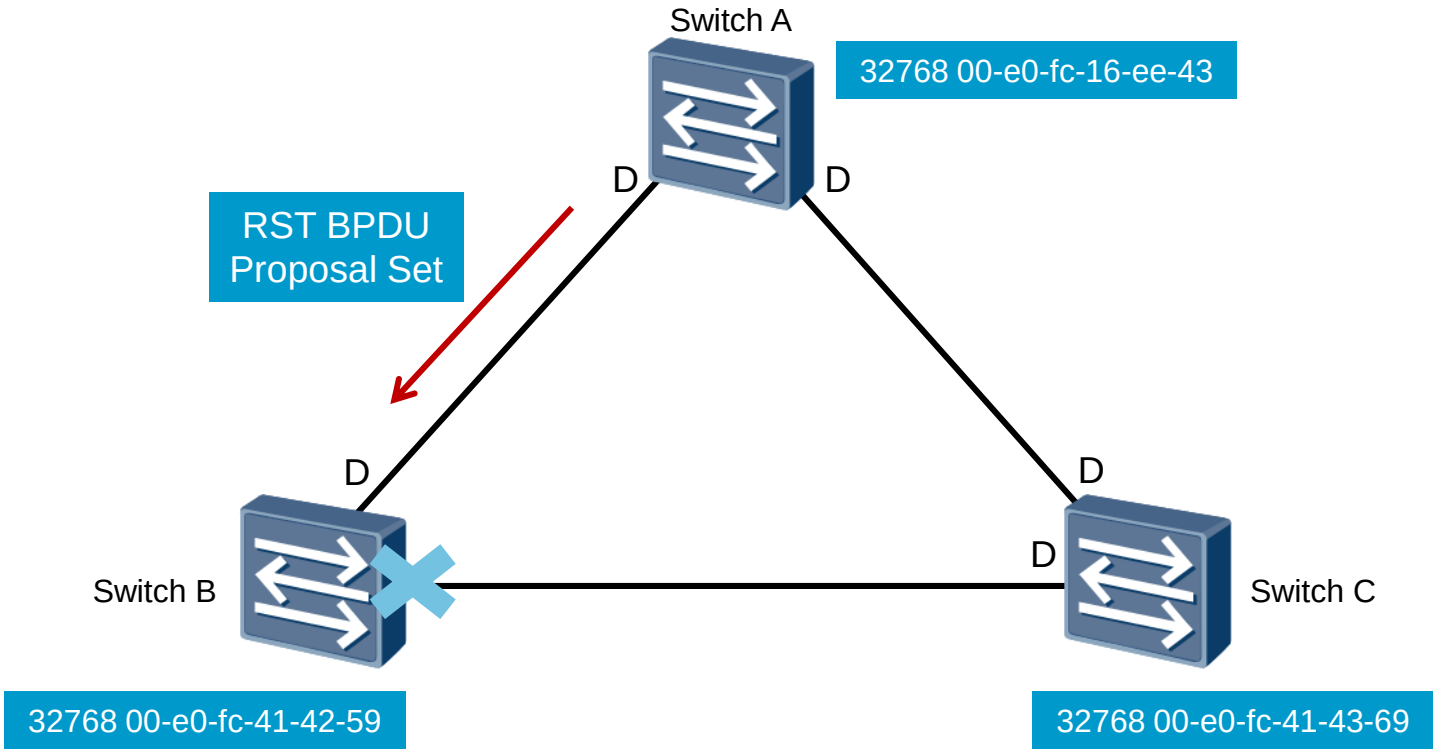
- All RSTP enabled switches begin as root and send RST BPDU.
- Ports are set to a designated role and a discarding state.

RST BPDU Proposal



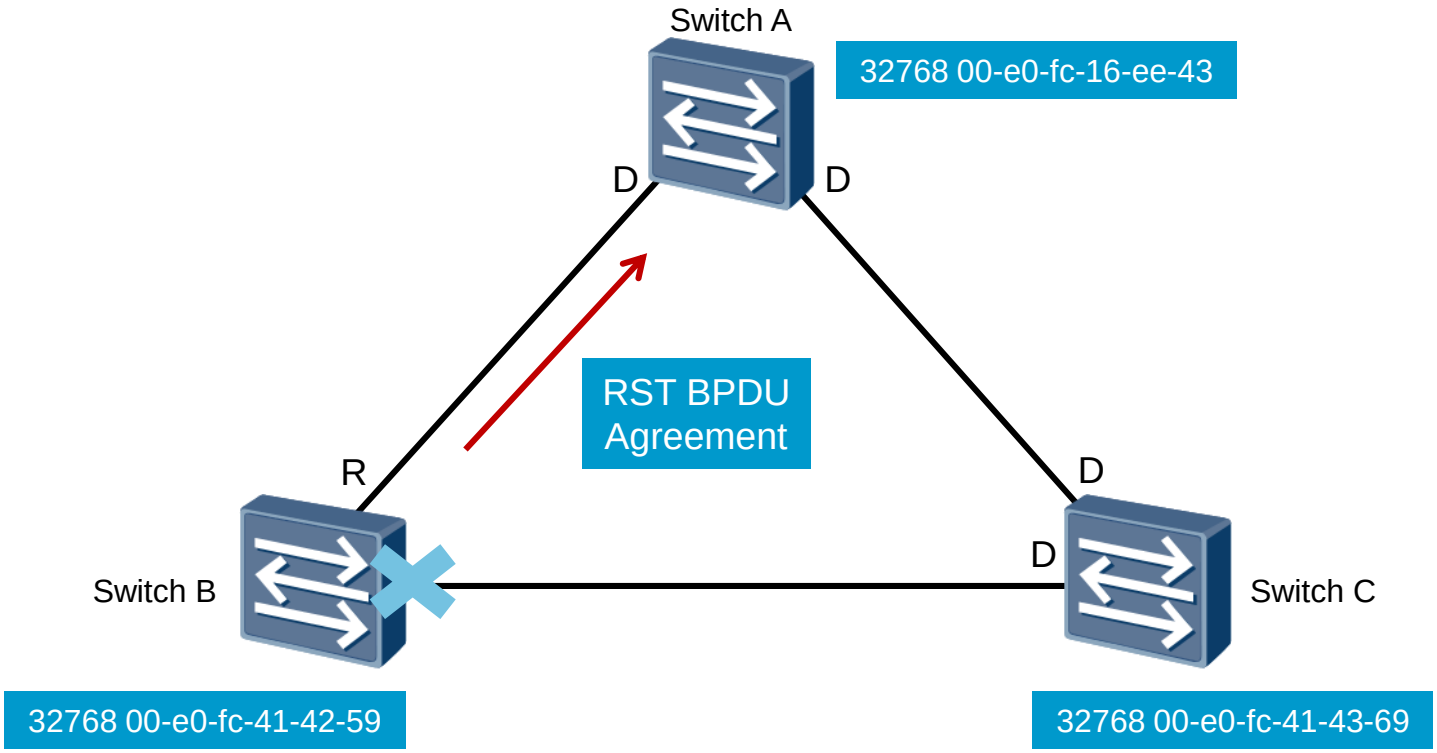
- Proposals are sent in RST BPDU during root election.
- A switch will ignore a proposal if it has a better bridge ID.

RSTP Synchronization Process



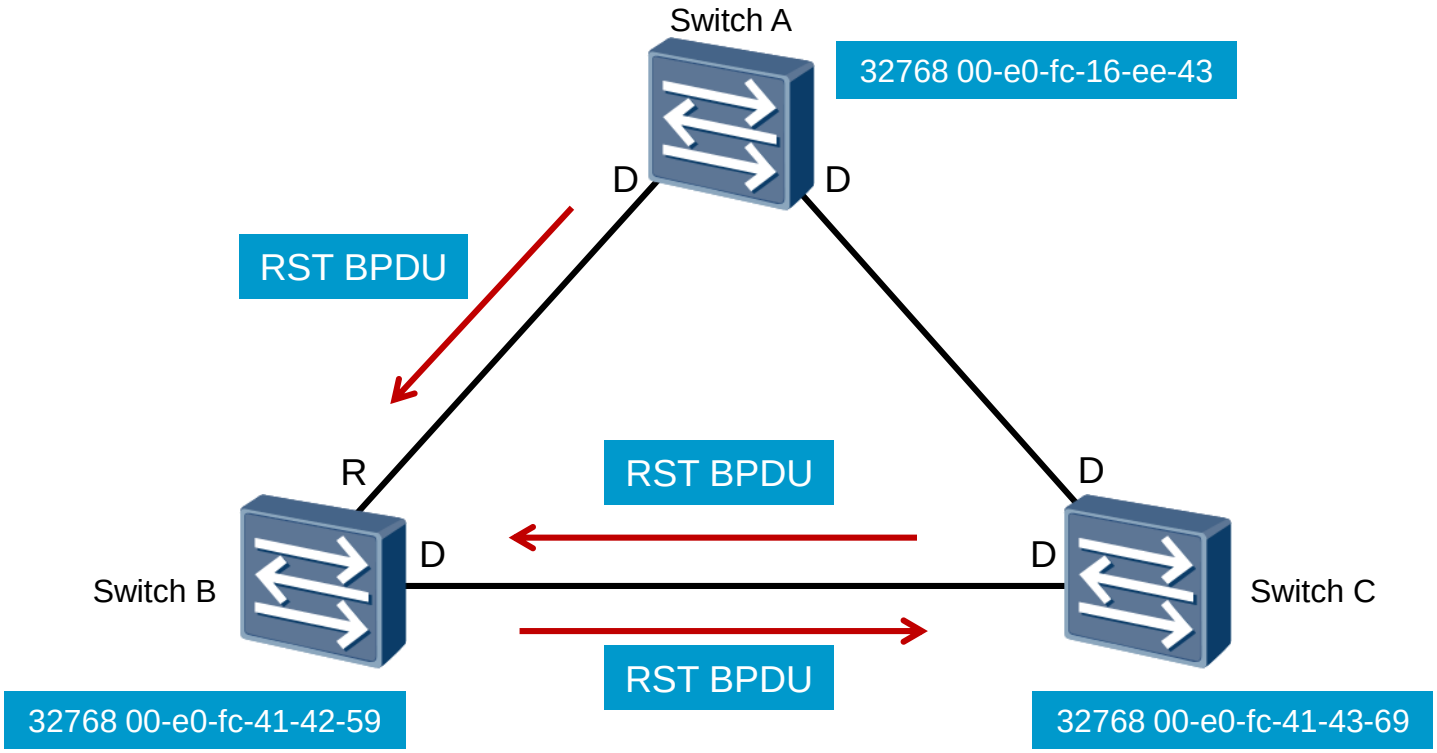
- Upon receiving a superior BPDU, Switch B will cease to send RST BDPU containing proposals and begin to synchronize.

RST BPDU Agreement



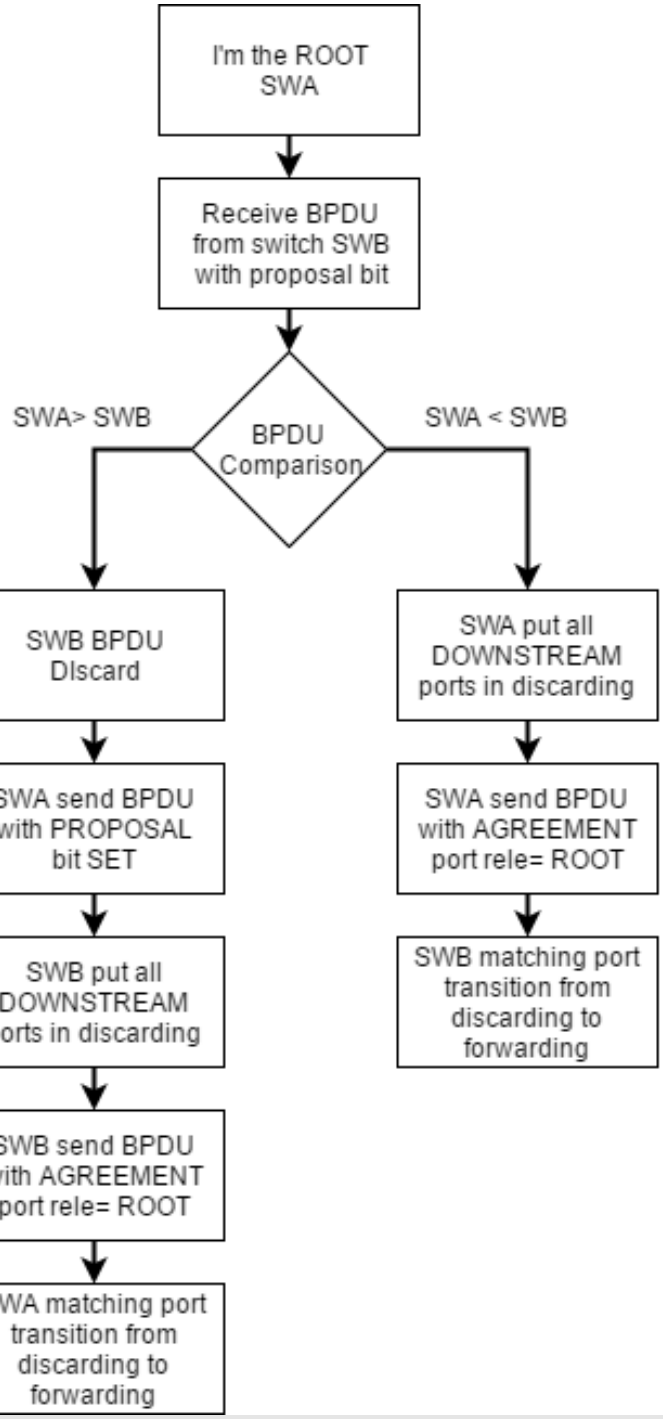
- Once all downstream non-edge designated ports have been blocked, Switch B will send an agreement with the RST BPDU.

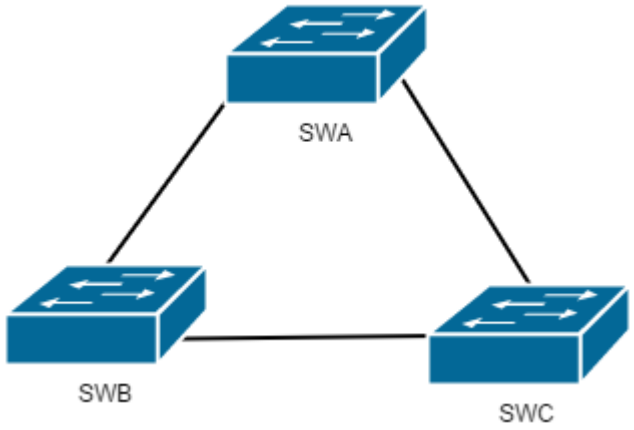
RSTP Converged Link



- The downstream port is again unblocked and a new round of synchronization occurs between Switch B and Switch C.

RSTP C





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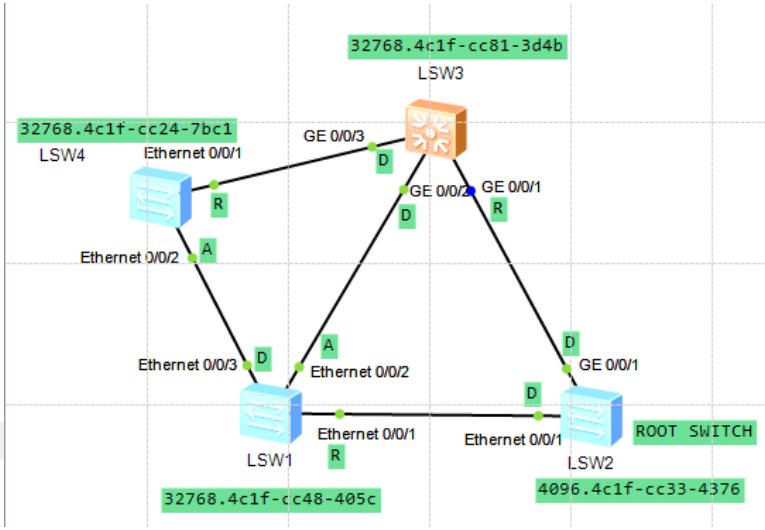
RSTP Converged Link

SW3 -> SW1




```
Spanning Tree Protocol
    Protocol Identifier: Spanning Tree Protocol (0x0000)
    Protocol Version Identifier: Rapid Spanning Tree (2)
    BPDU Type: Rapid/Multiple Spanning Tree (0x02)
    BPDU flags: 0x4e, Agreement, Port Role: Designated, Proposal
        0... .... = Topology Change Acknowledgment: No
        .1.. .... = Agreement: Yes
        ..0. .... = Forwarding: No
        ...0 .... = Learning: No
        .... 11.. = Port Role: Designated (3)
        .... ..1. = Proposal: Yes
        .... ...0 = Topology Change: No
    Root Identifier: 0 / 0 / 4c:1f:cc:33:43:76
    Root Path Cost: 220000
    Bridge Identifier: 32768 / 0 / 4c:1f:cc:81:3d:4b
    Port identifier: 0x8001
    Message Age: 2
    Max Age: 20
    Hello Time: 2
    Forward Delay: 15
    Version 1 Length: 0
```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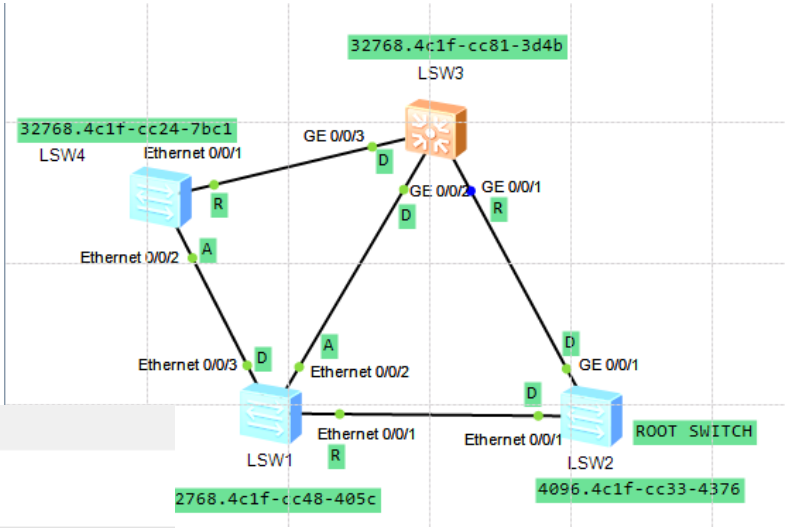
RSTP Converged Link



SW2 -> SW3

```
Spanning Tree Protocol
   Protocol Identifier: Spanning Tree Protocol (0x0000)
   Protocol Version Identifier: Rapid Spanning Tree (2)
   BPDU Type: Rapid/Multiple Spanning Tree (0x02)
   BPDU flags: 0x4e, Agreement, Port Role: Designated, Proposal
      0... .... = Topology Change Acknowledgment: No
      .1.. .... = Agreement: Yes
      ..0. .... = Forwarding: No
      ...0 .... = Learning: No
      .... 11.. = Port Role: Designated (3)
      .... ..1. = Proposal: Yes
      .... ...0 = Topology Change: No
   Root Identifier: 0 / 0 / 4c:1f:cc:33:43:76
   Root Path Cost: 0
   Bridge Identifier: 0 / 0 / 4c:1f:cc:33:43:76
   Port identifier: 0x8017
   Message Age: 0
   Max Age: 20
   Hello Time: 2
   Forward Delay: 15
   Version 1 Length: 0
```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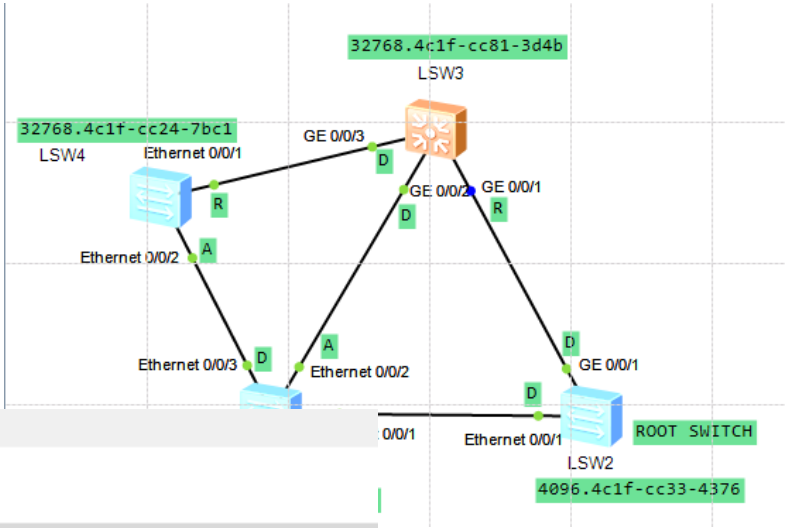
RSTP Converged Link



SW3 -> SW2

```
Spanning Tree Protocol
   Protocol Identifier: Spanning Tree Protocol (0x0000)
   Protocol Version Identifier: Rapid Spanning Tree (2)
   BPDU Type: Rapid/Multiple Spanning Tree (0x02)
   BPDU flags: 0x79, Agreement, Forwarding, Learning, Port Role: Root, Topology Change
      0... .... = Topology Change Acknowledgment: No
      .1.. .... = Agreement: Yes
      ..1. .... = Forwarding: Yes
      ...1 .... = Learning: Yes
      .... 10.. = Port Role: Root (2)
      .... ..0. = Proposal: No
      .... ...1 = Topology Change: Yes
   Root Identifier: 0 / 0 / 4c:1f:cc:33:43:76
   Root Path Cost: 20000
   Bridge Identifier: 32768 / 0 / 4c:1f:cc:81:3d:4b
   Port identifier: 0x8001
   Message Age: 0
   Max Age: 20
   Hello Time: 2
   Forward Delay: 15
   Version 1 Length: 0
```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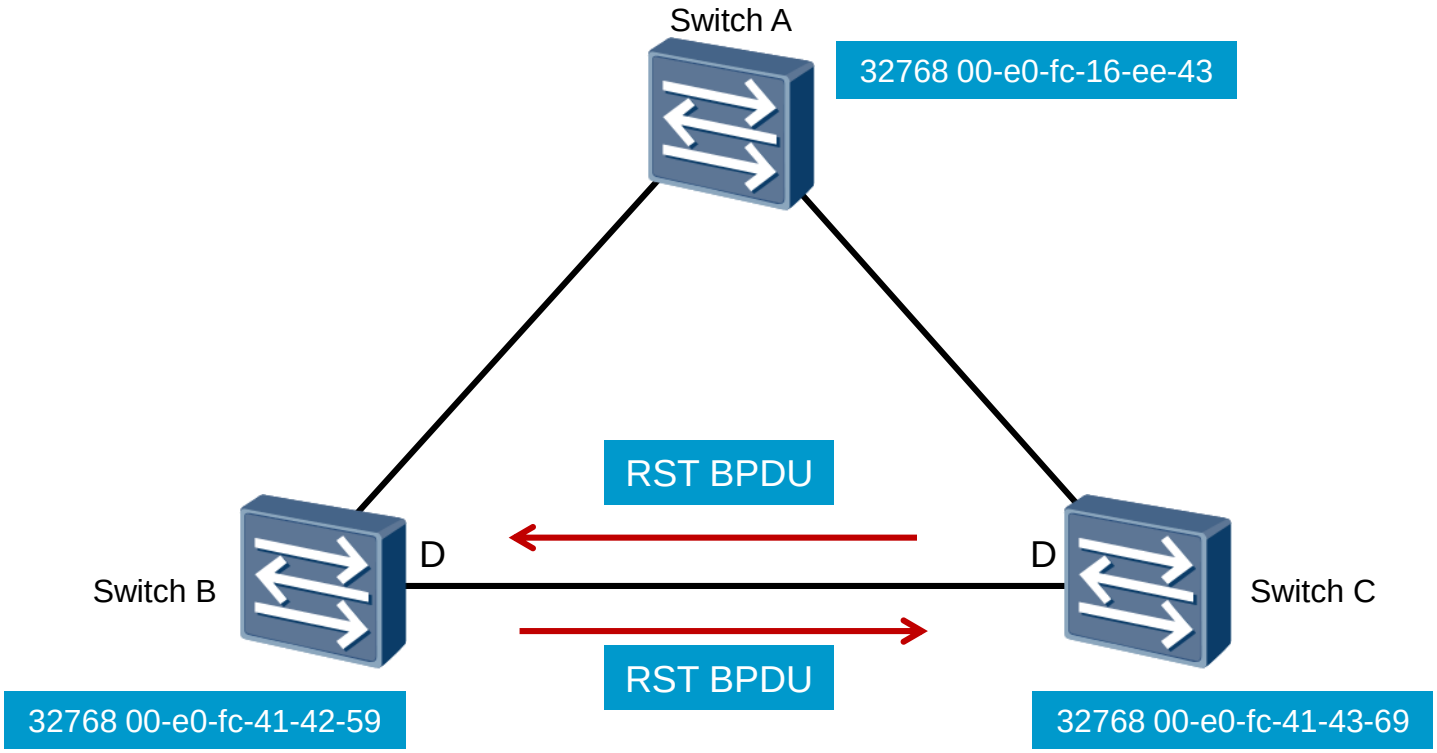
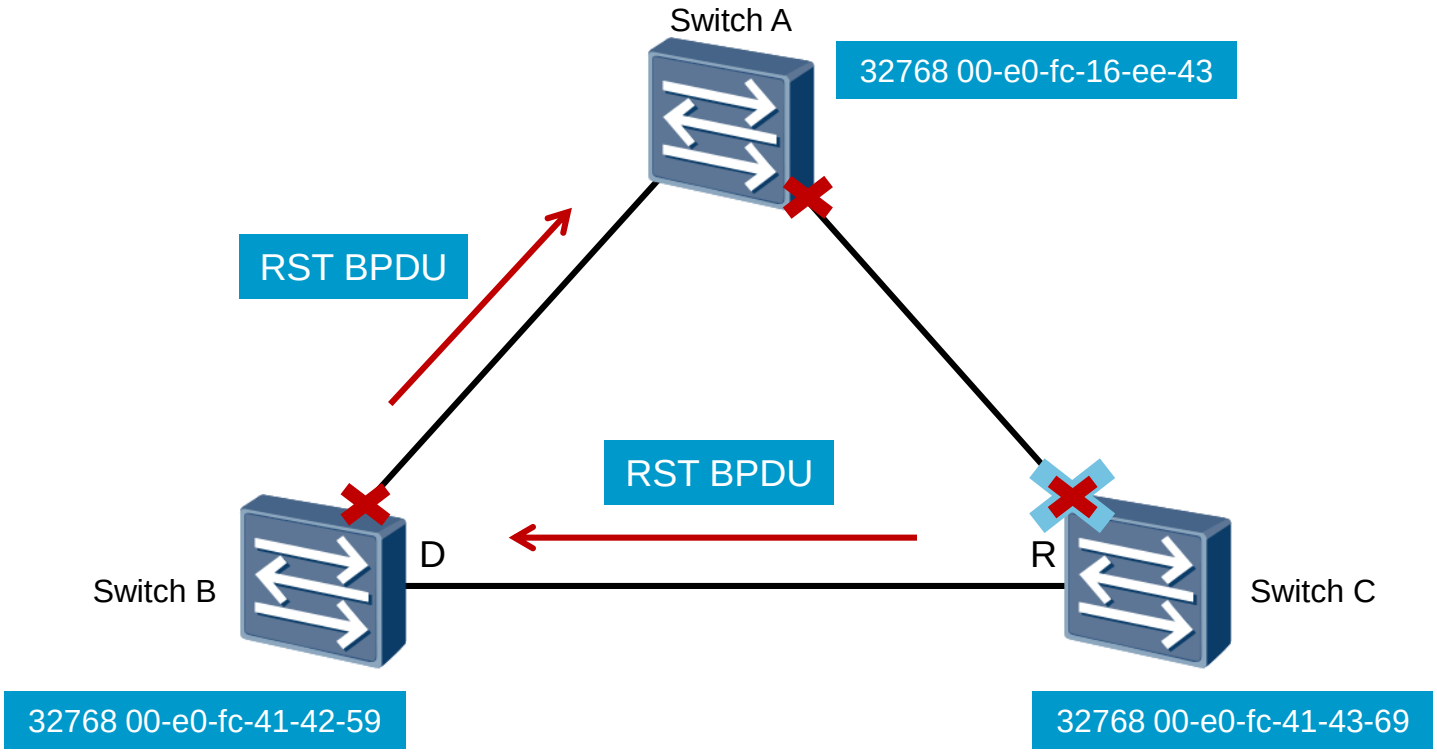
Link/Root Failure



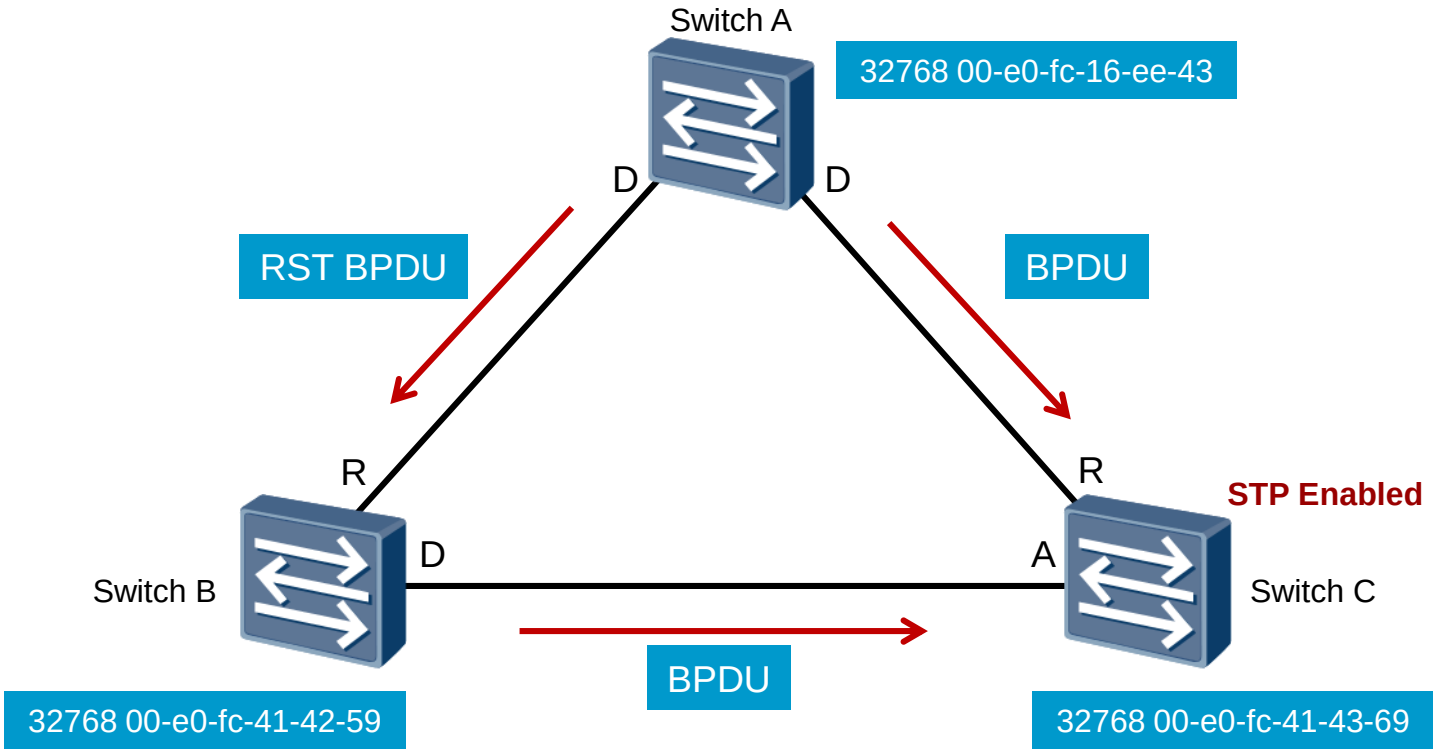
- Loss of upstream RST BPDU signals link/device failure.
- Proposal and agreement based convergence will ensue.

Topology Change Process



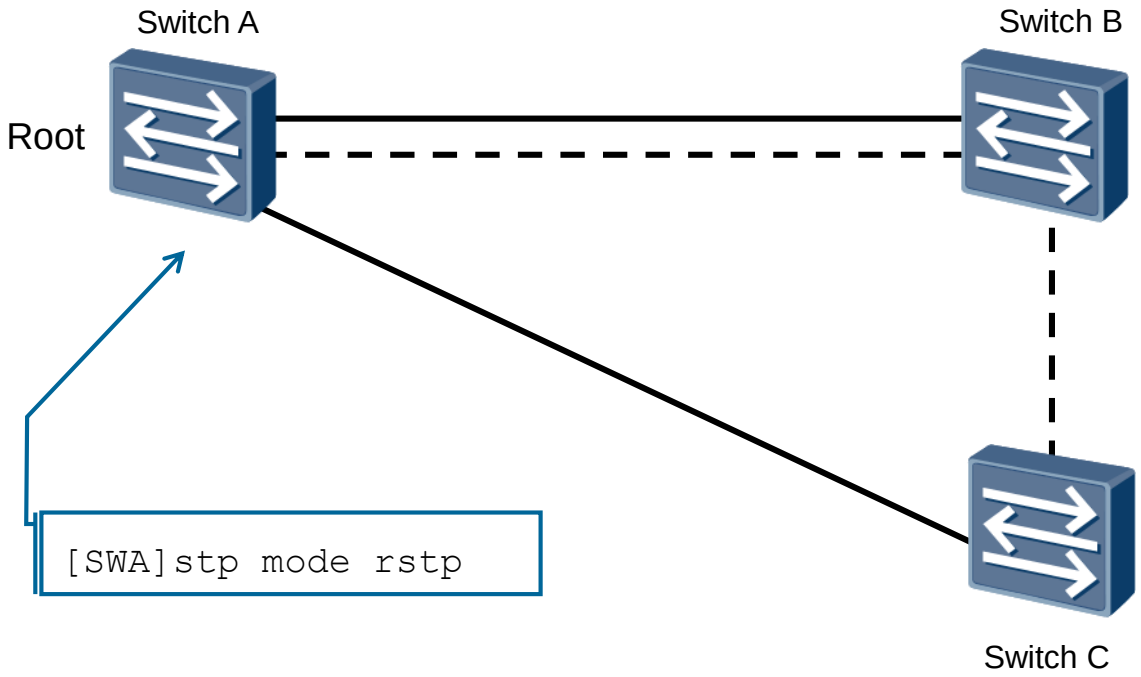
- During the sending of an agreement, addresses are flushed for all ports except the port on which the RST BPDU was received.

STP Inter-Operation



- RSTP switch ports will revert to STP when connected to a LAN segment containing an STP enabled device.

Setting the Mode

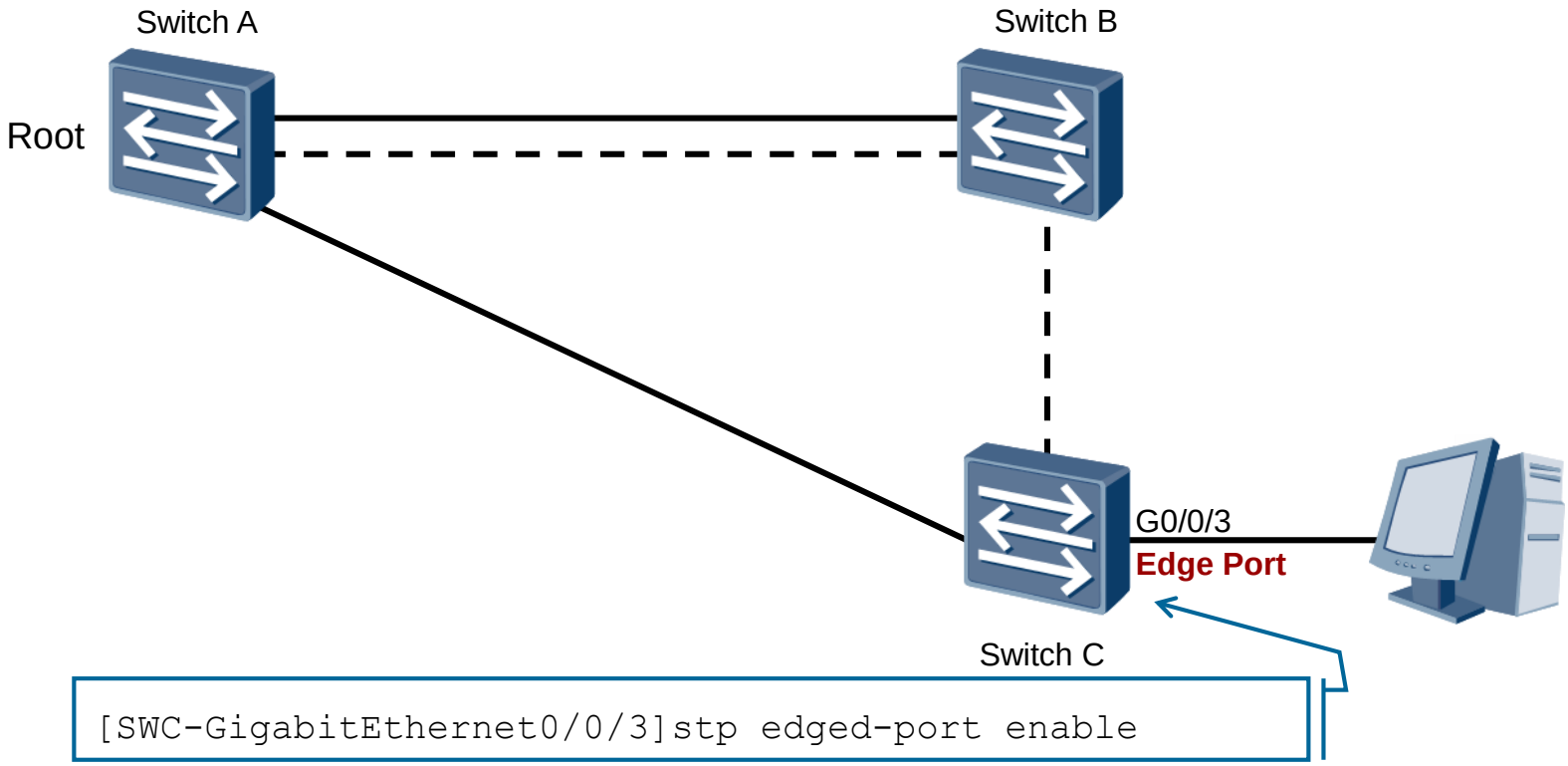


- The *stp mode rstp* command allows all ports of the switch to generate RST BPDU.

Configuration Validation

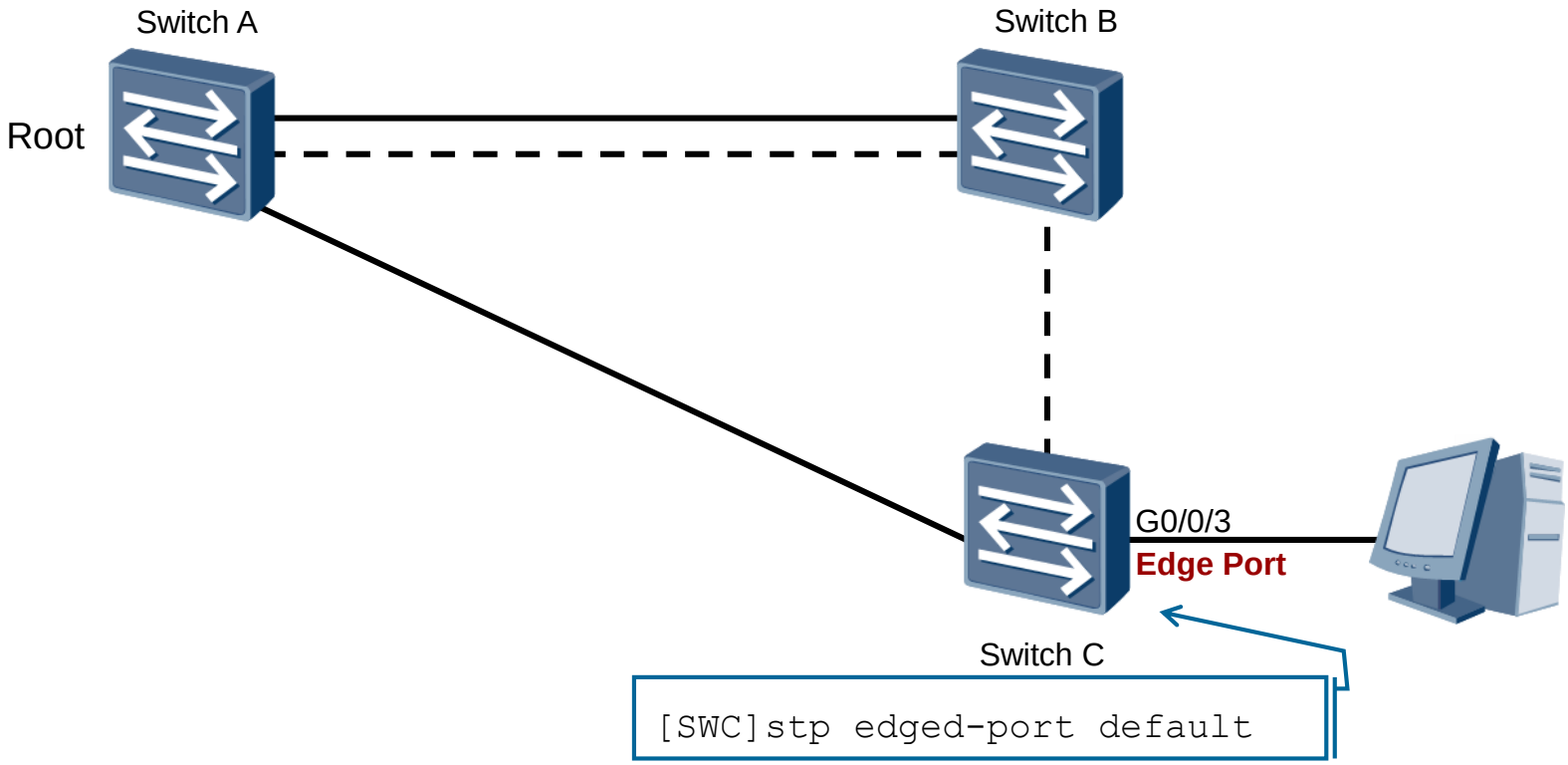
```
[SWA]display stp
-------[CIST Global Info][Mode RSTP]-------
CIST Bridge          :32768.00-e0-fc-16-ee-43
Bridge Times         :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
CIST Root/ERPC       :32768.00-e0-fc-16-ee-43 / 0
CIST RegRoot/IRPC    :32768.00-e0-fc-16-ee-43 / 0
CIST RootPortId      :0.0
BPDU-Protection      :Disabled
TC or TCN received   :37
TC count per hello   :0
STP Converge Mode    :Normal
Share region-configuration :Enabled
Time since last TC   :0 days 0h:14m:43s
```

Setting the Edge Port



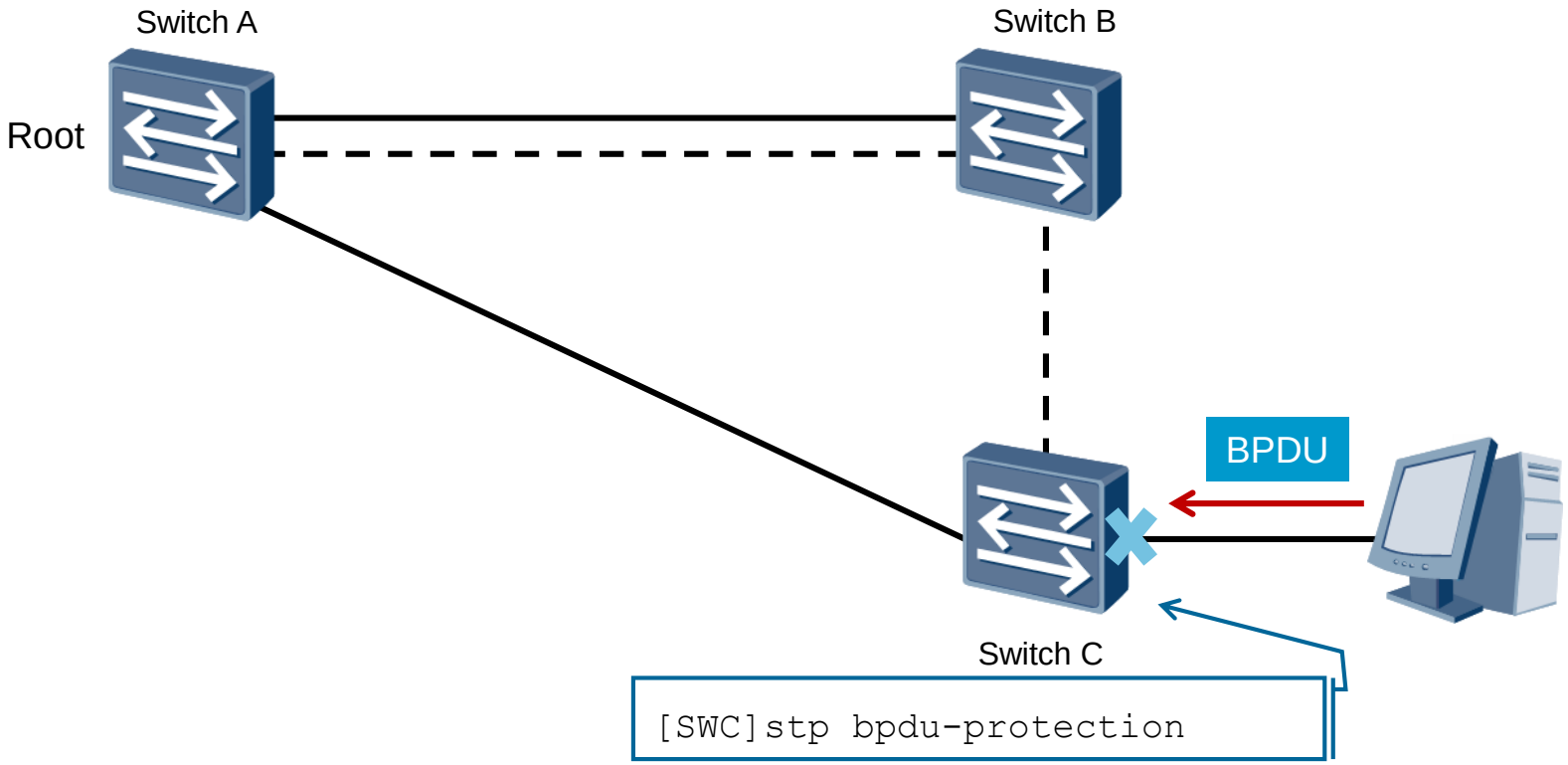
- Allows for transition of the edge port to forwarding without delay.
- Interfaces on the S5700 are non-edge ports by default.

Setting the Edge Port



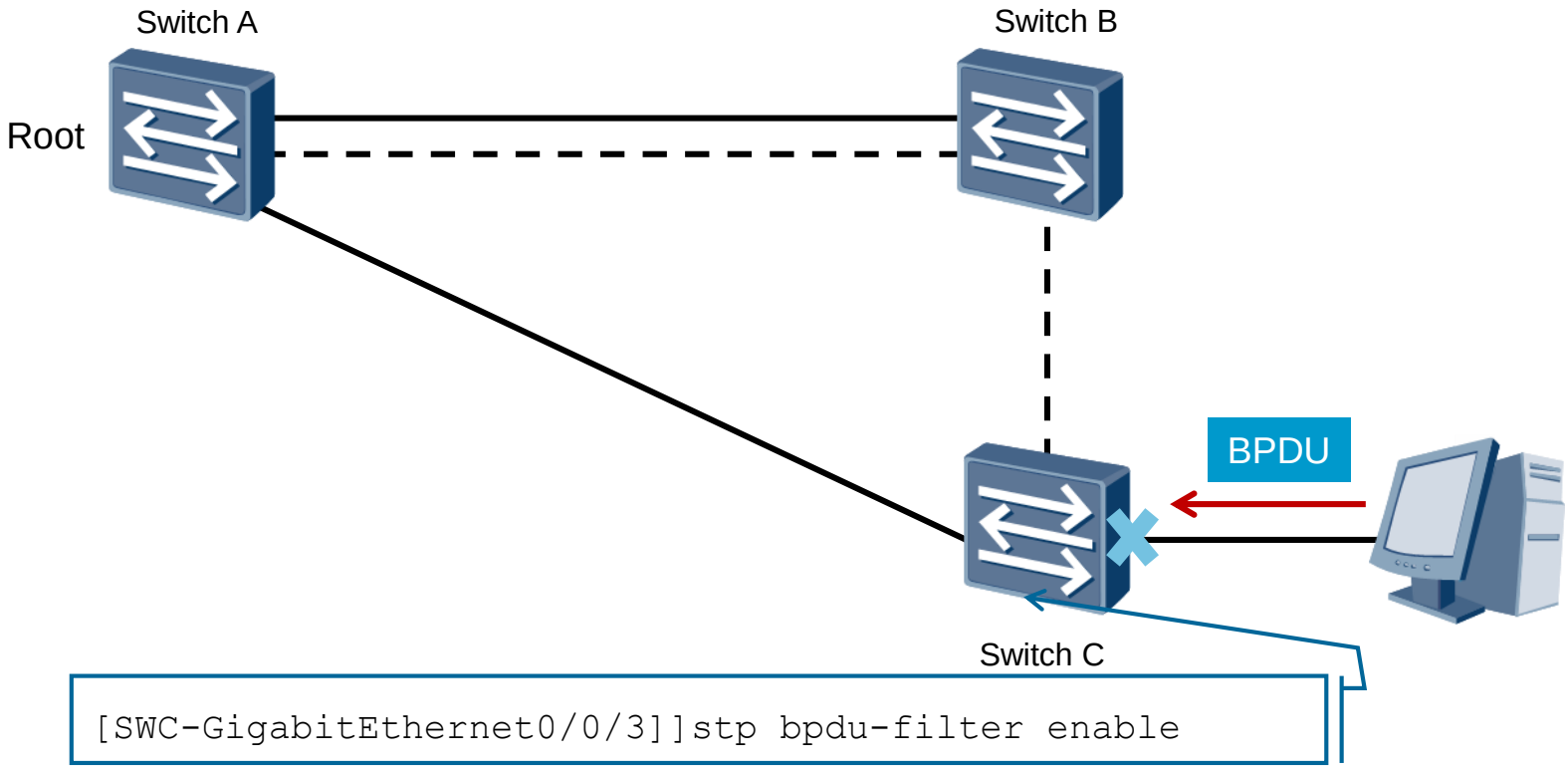
- All ports on the switch will be configured as edge ports.
- Care should be taken with this command to avoid STP loops.

BPDU Protection



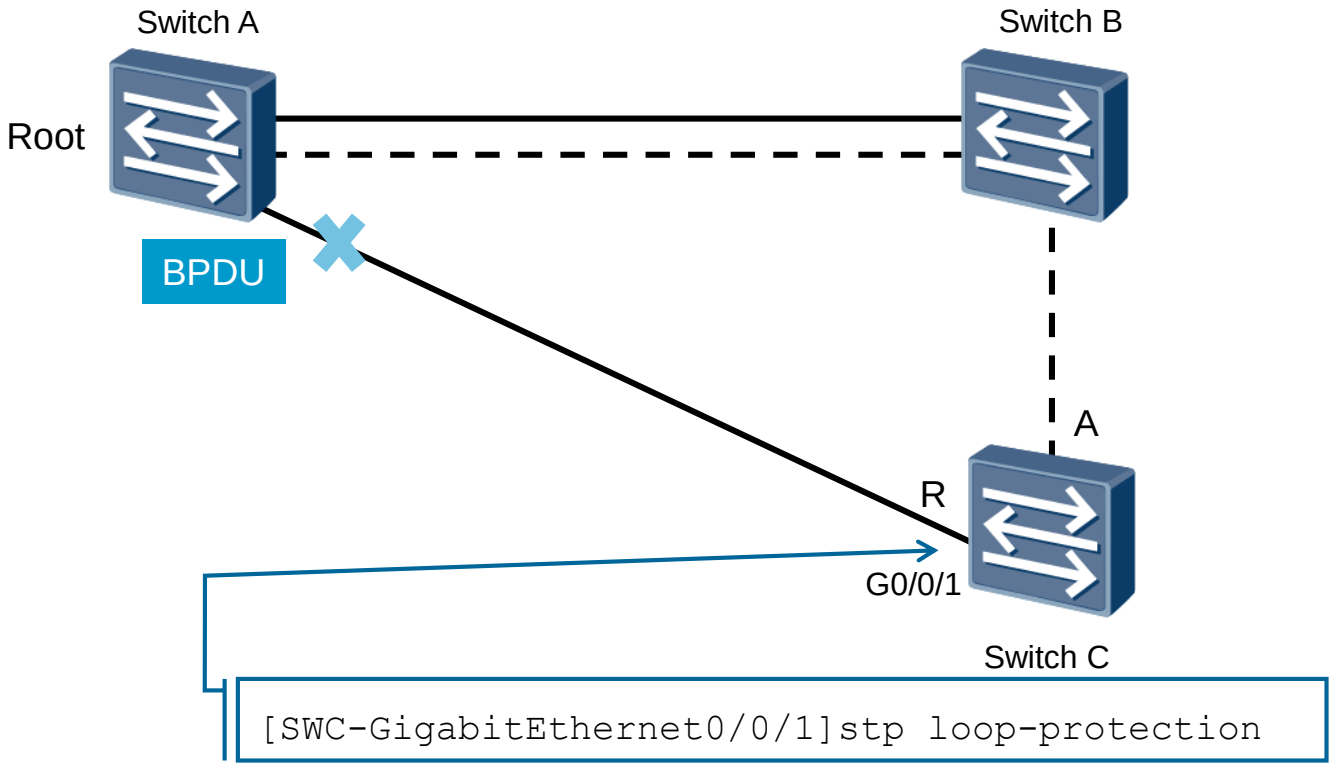
- BPDU protection prevents the malicious injection of BPDU into RSTP.

BPDU Filter



- BPDU filtering prevents a port from sending stp frames (BPDU packets) on the link.

Loop Protection



- If BDPU fail to be received by the downstream switch, the root port is blocked to prevent switching loops from occurring.

Configuration Validation

```
[SWC]display stp interface GigabitEthernet 0/0/1
----[CIST][Port1(GigabitEthernet0/0/1)][FORWARDING]----
 Port Protocol            :Enabled
 Port Role                :Root Port
 Port Priority            :128
 Port Cost(Dot1T )        :Config=auto / Active=20000
 Designated Bridge/Port   :32768.00-e0-fc-16-ee-43 / 128.1
 Port Edged               :Config=default / Active=disabled
 Point-to-point           :Config=auto / Active=true
 Transit Limit            :147 packets/hello-time
 Protection Type          :Loop
 Port STP Mode            :RSTP
 Port Protocol Type       :Config=auto / Active=dot1s
 BPDU Encapsulation       :Config=stp / Active=stp
......
```

Summary

- What is the purpose of the sync that occurs during the RSTP proposal and agreement process?

Thank you

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