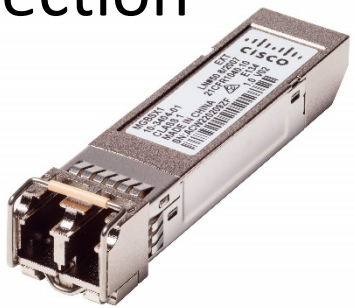
Unidirectional Link Problem

- Many Cisco switches support GBIC/SFP (Gigabit Interface Converter / Small Form-Factor Pluggable) modular ports
- The ports take copper or fiber transceivers and are typically used for switch-to-switch connections
- Fiber cables typically have one strand for sending data and another strand for receiving data, with the opposite order on the other side.
- If one strand fails it results in a unidirectional link failure
- The interface status can still show as up/up, but data (including BPDUs) can only be transmitted in one direction



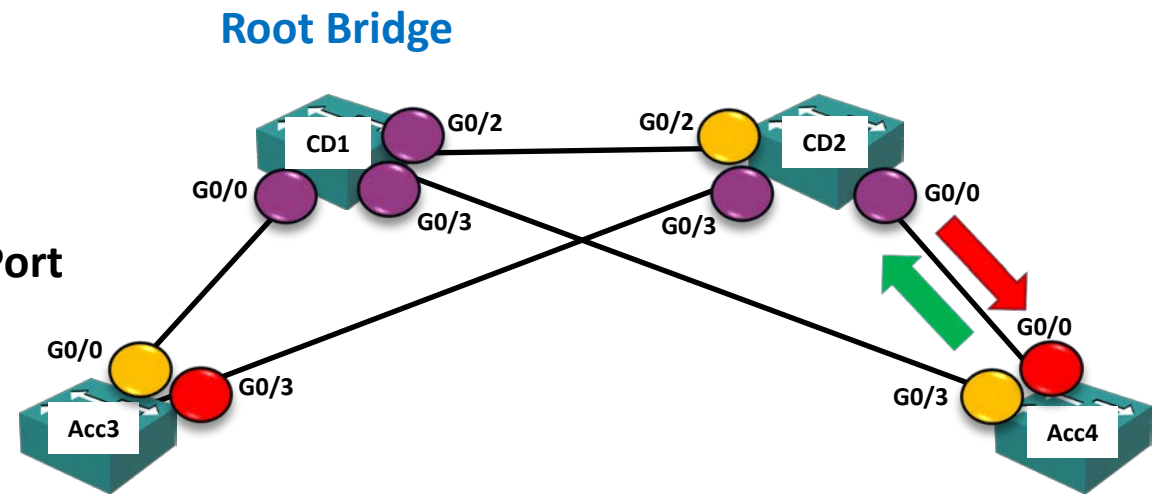
Unidirectional Link Problem Example

- The transmit strand from CD2 to Acc4 fails. Acc4 no longer receives BPDUs on the link
- The transmit strand from Acc4 to CD2 is still up. It is currently a Blocking Port so does not send BPDUs

Root Port

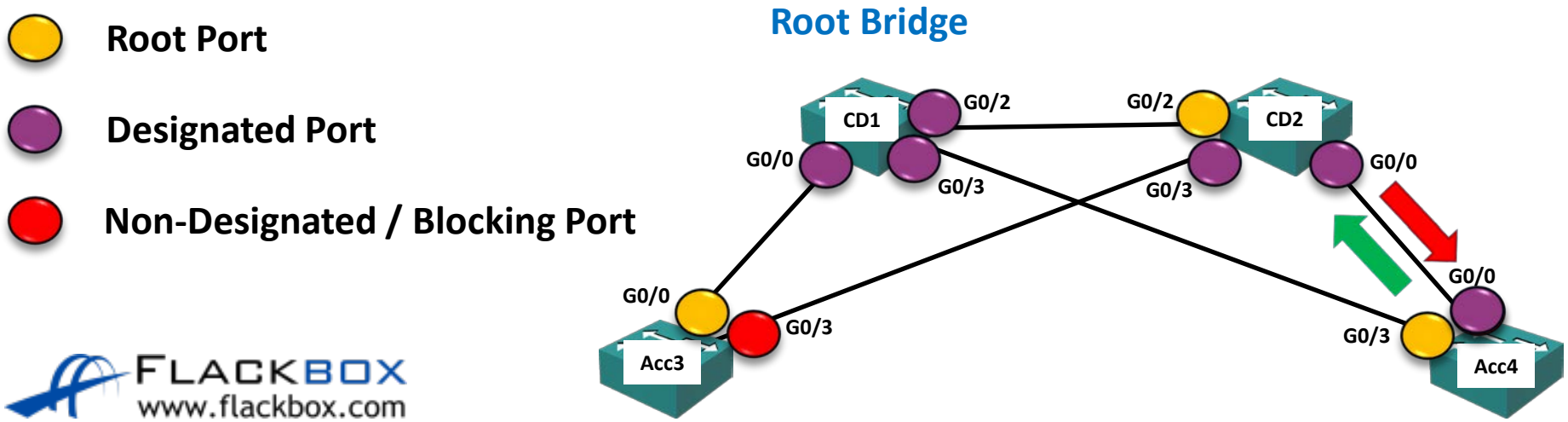
Designated Port

Non-Designated / Blocking Port



Unidirectional Link Problem Example (Cont.)

- Because G0/0 on Acc4 no longer receives BPDUs from CD2 it transitions to a forwarding Designated Port
- When a port is Up and not receiving BPDUs (e.g. a port connected to a PC) it becomes a forwarding Designated Port
- G0/0 on CD2 remains a forwarding Designated Port because it receives inferior BPDUs from Acc4



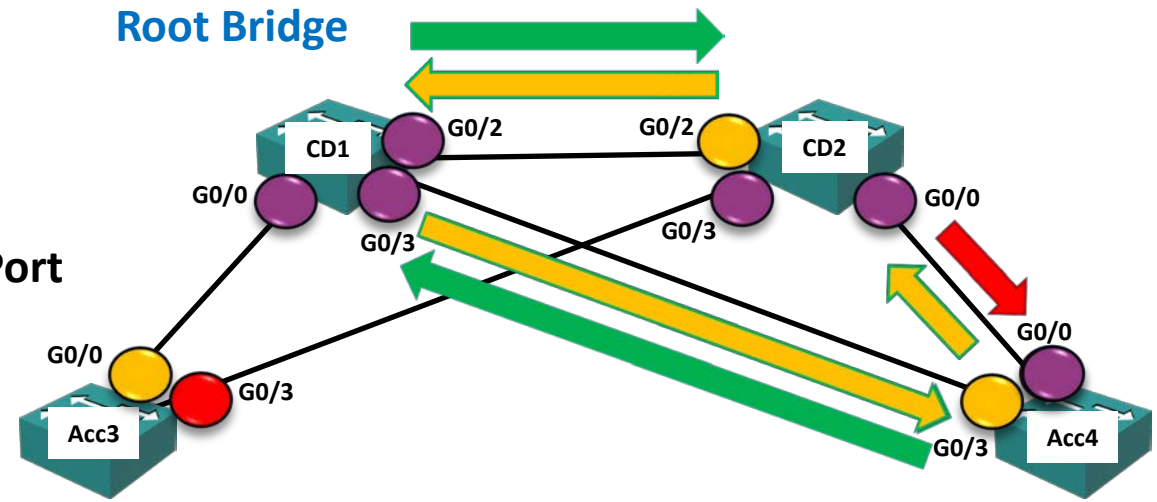
Unidirectional Link Problem Example (Cont.)

- There is now a one-way loop between the switches when the Blocking Port becomes a Designated Port

Root Port

Designated Port

Non-Designated / Blocking Port



Unidirectional Link Problem Solutions

Two methods are available to prevent the unidirectional link problem on Cisco switches:

- Loop Guard
  - This is a Spanning Tree feature available in PVST+, RPVST+ and MST
- UDLD Unidirectional Link Detection
  - This is a Layer 2 protocol which is not part of Spanning Tree

Loop Guard on Root and Non-Designated Ports

- BPDUs are expected to be received on Root Ports and Blocking Ports
- If BPDUs are not received on a Loop Guard protected Root Port or Blocking Port, it will be placed in the loop-inconsistent state with all traffic blocked (rather than becoming a Designated Port)
- As well as Unidirectional Link Failures, Loop Guard also protects against software failure or data corruption preventing BPDUs being sent on a link
- The port is automatically re-enabled when BPDUs are received again

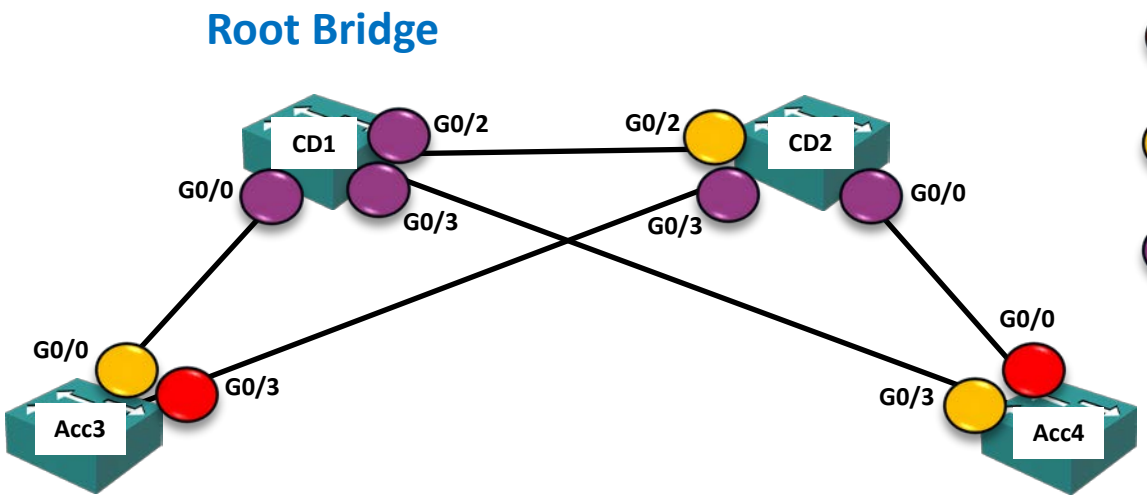
Loop Guard Configuration

- Enable on all switch ports

```
All Switches(config)# spanning-tree loopguard default
```

- Can also be enabled at the interface level

```
Acc4(config)#interface GigabitEthernet 0/0
Acc4(config-if)#spanning-tree guard loop
```



Non-Designated / Blocking Port

Root Port

Designated Port

Loop Guard on Designated Ports

- BPDUs are not expected to be received on Designated Ports
- Loop Guard can be enabled on an interface which is currently a Designated Port, but it will take no action when BPDUs are not received
- End hosts do not send BPDUs. There is no issue if Loop Guard is enabled on a port connected to an end host because it will be a Designated Port

Loop Guard and Root Guard

- Root Guard prevents undesired switches from becoming the Root Bridge.
- It prevents Designated Ports from becoming non-designated Root Ports.
- Loop Guard prevents unidirection link failures from causing loops.
- It prevents Non-Designated (Root and Blocking) Ports from becoming Designated.
- The features are mutually exclusive on ports.
- If Loop Guard is enabled on a port, it disables Root Guard on the port.
- If you want to enable Loop Guard and Root Guard on the same switch, configure them at the interface level (do not use `spanning-tree loopguard default`)

Loop Guard Verification


```
Acc4#show spanning-tree summary
Acc4#show spanning-tree summary
Switch is in pvst mode
Root bridge for: none
Extended system ID                          is enabled
Portfast Default                            is disabled
Portfast Edge BPDU Guard Default            is disabled
Portfast Edge BPDU Filter Default           is disabled
Loopguard Default                           is enabled
PVST Simulation Default                     is enabled but inactive in pvst mode
Bridge Assurance                            is enabled but inactive in pvst mode
EtherChannel misconfig guard                is enabled
Configured Pathcost method used is short
UplinkFast                                  is disabled
BackboneFast                                is disabled

Name                   Blocking Listening Learning Forwarding STP Active
---------------------- -------- --------- -------- ---------- ----------
VLAN0001                      1         0        0          3          4
---------------------- -------- --------- -------- ---------- ----------
1 vlan                        1         0        0          3          4
```

Loop Guard Verification (Cont.)

Loop Guard enabled at interface level on Blocking Port:

```
Acc4#show spanning-tree interface g0/0 detail
 Port 1 (GigabitEthernet0/0) of VLAN0001 is alternate blocking
   Port path cost 4, Port priority 128, Port Identifier 128.1.
   Designated root has priority 24577, address 5254.0003.8b86
   Designated bridge has priority 28673, address 5254.0003.c6e3
   Designated port id is 128.1, designated path cost 4
   Timers: message age 3, forward delay 0, hold 0
   Number of transitions to forwarding state: 4
   Link type is point-to-point by default
   Loop guard is enabled on the port
   BPDU: sent 311, received 2104
```

Loop Guard Verification (Cont.)

Loop Guard default enabled globally. Forwarding Designated port connected to PC.

Loop Guard does not disable port because BPDUs are not expected to be received:

```
Acc4#show spanning-tree interface g0/1 detail
 Port 2 (GigabitEthernet0/1) of VLAN0001 is designated forwarding
   Port path cost 4, Port priority 128, Port Identifier 128.2.
   Designated root has priority 24577, address 5254.0003.8b86
   Designated bridge has priority 32769, address 5254.001c.3e46
   Designated port id is 128.2, designated path cost 4
   Timers: message age 0, forward delay 0, hold 0
   Number of transitions to forwarding state: 1
   Link type is point-to-point by default
   Loop guard is enabled by default on the port
   BPDU: sent 2013, received 0
```

Loop Guard Verification (Cont.)


```
Acc4#show spanning-tree

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID     Priority    24577
              Address     5254.0003.8b86
              Cost        8
              Port        1 (GigabitEthernet0/0)
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    32769  (priority 32768 sys-id-ext 1)
              Address     5254.001c.3e46
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Gi0/0               Root FWD 4         128.1    P2p
Gi0/1               Desg FWD 4         128.2    P2p
Gi0/2               Desg FWD 4         128.3    P2p
Gi0/3               Desg BKN*4         128.4    P2p *LOOP_Inc
```