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Spanning-Tree LoopGuard and UDLD

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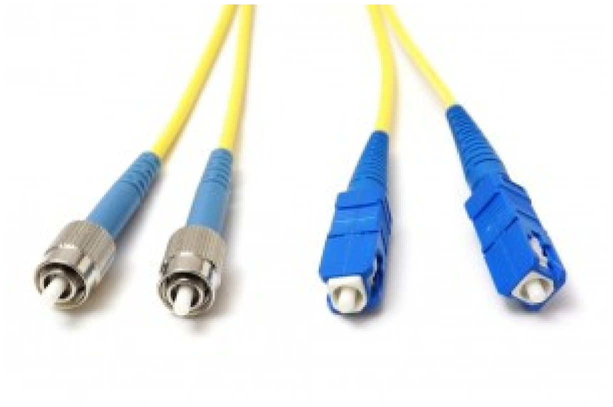
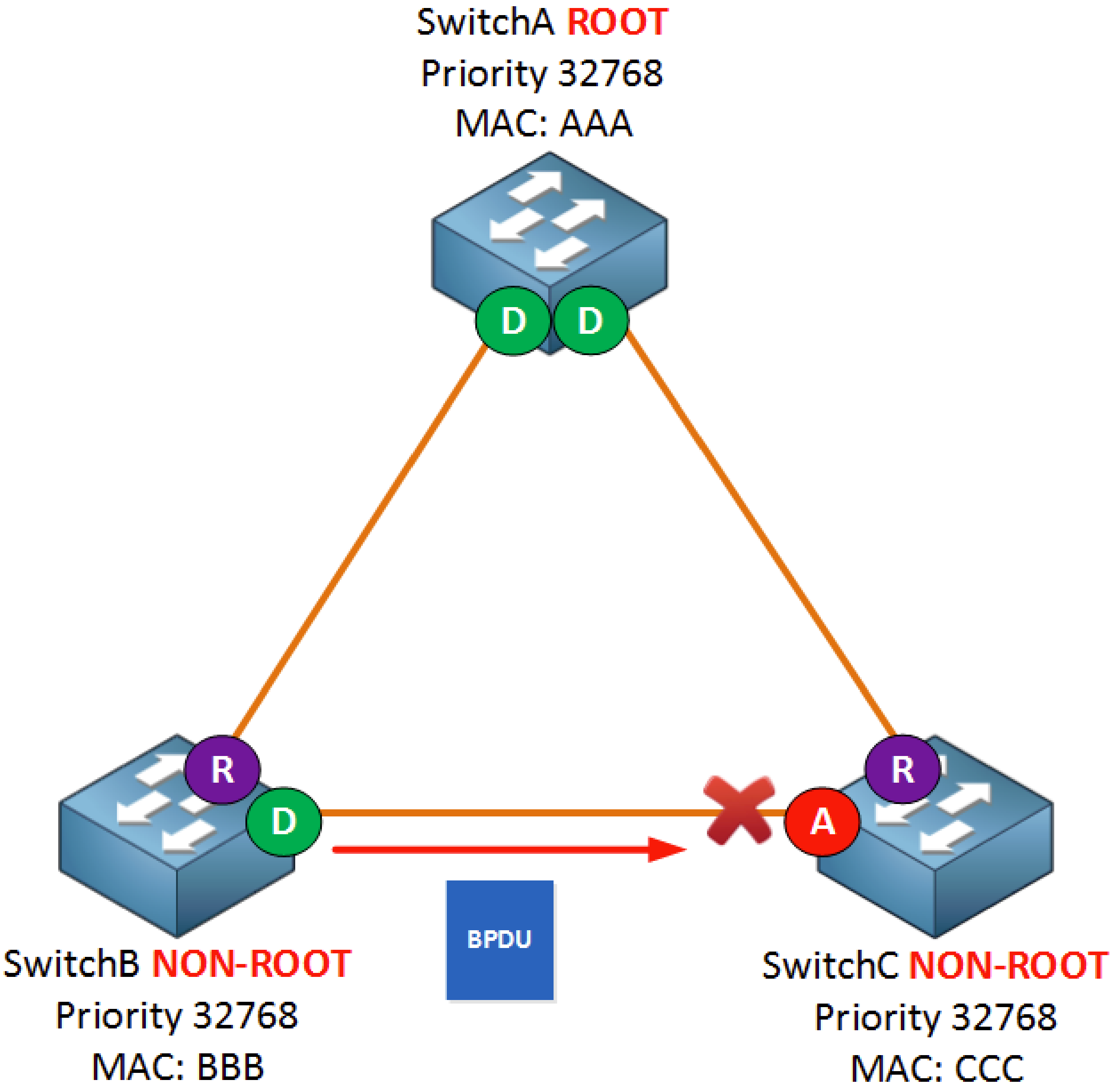
If you ever used fiber cables you might have noticed that there is a different connector to transmit and receive traffic.



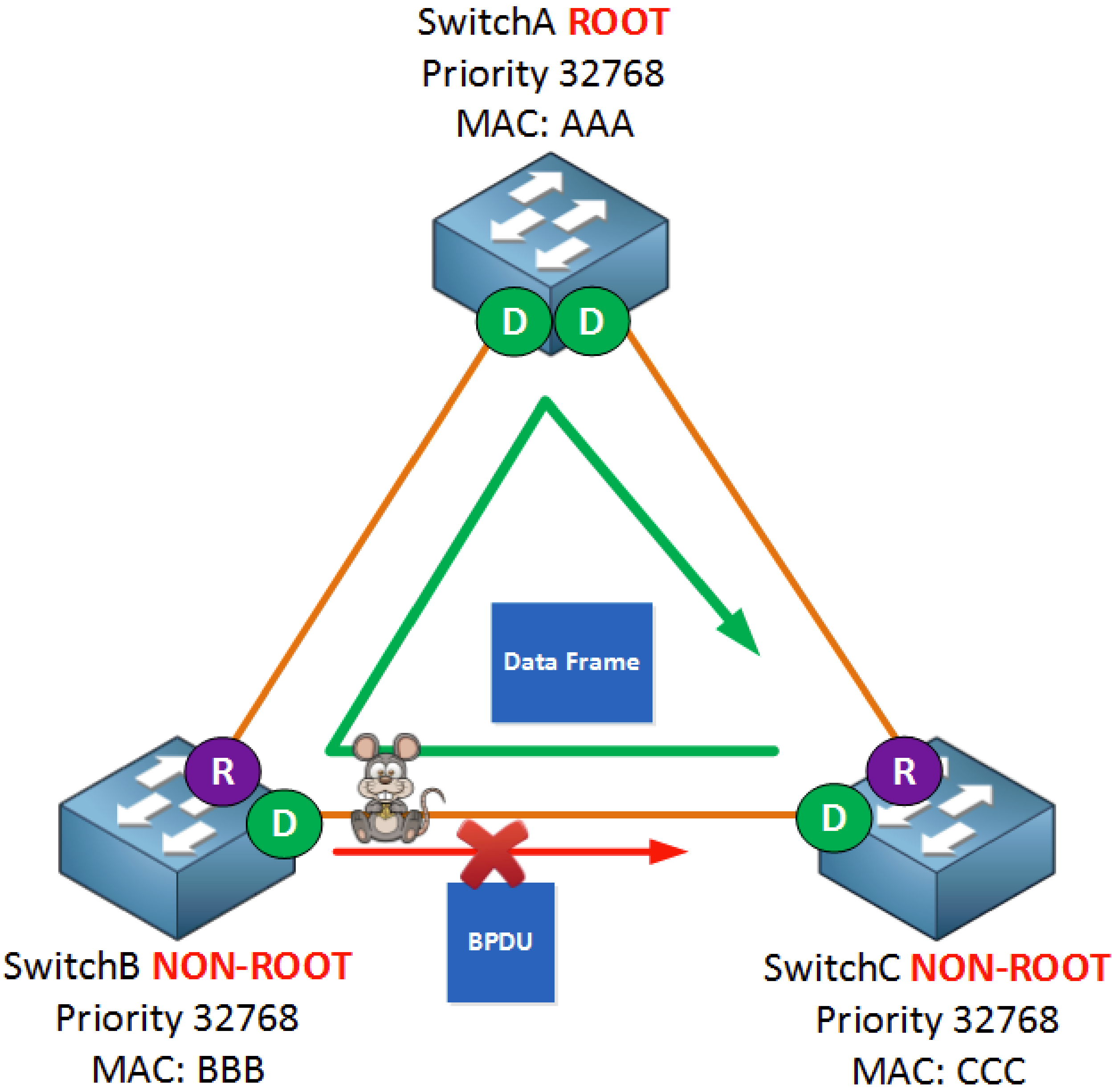
If one of the cables (transmit or receive) fails we'll have a **unidirectional link failure** and this can cause spanning tree loops. There are two protocols that can take care of this problem:

- LoopGuard
- UDLD (Unidirectional Link Detection)

Let's start by taking a close look at what will happen if we have a unidirectional link failure:



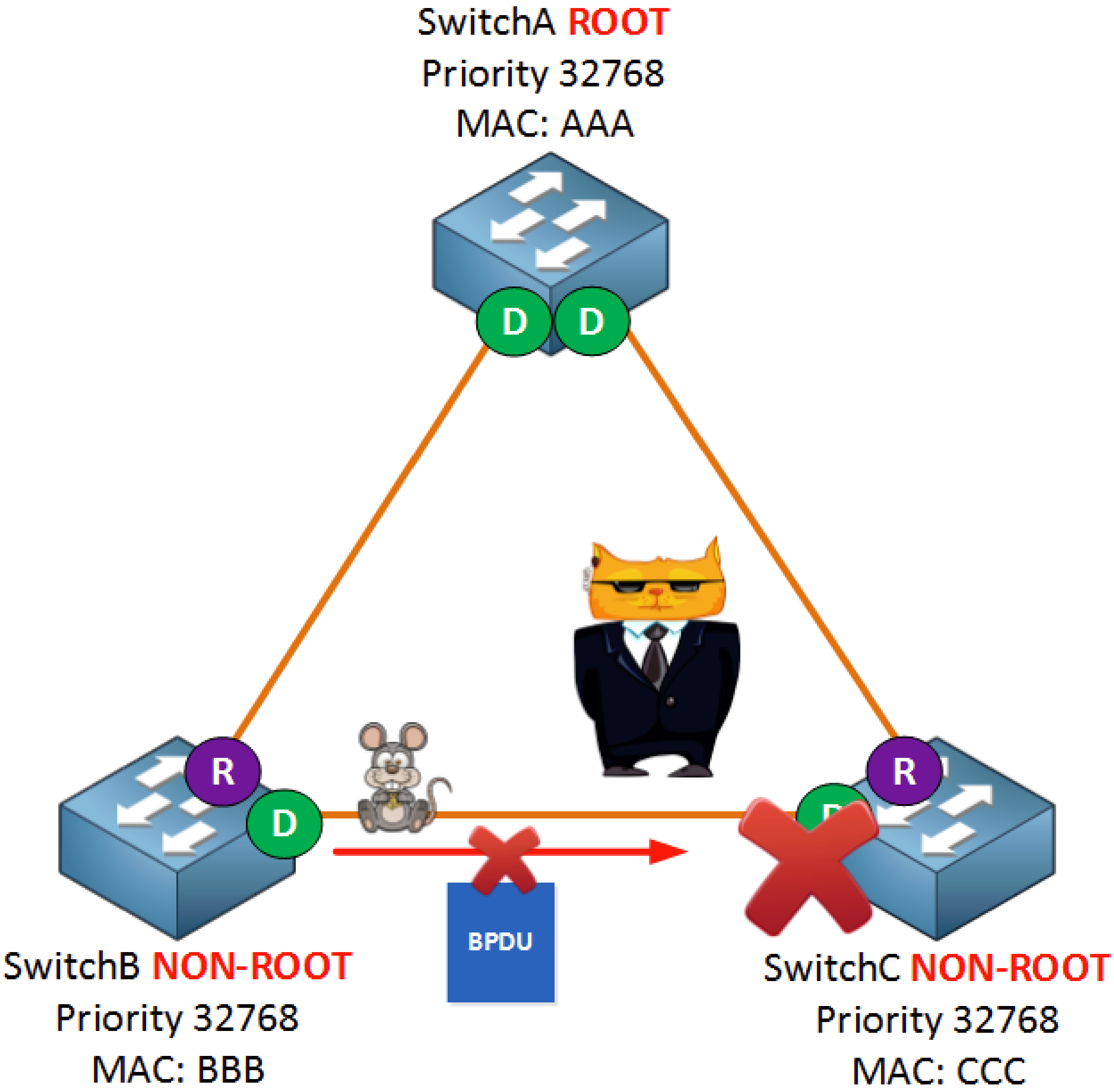
Imagine the links between the switches are fiber links. In reality there's a different connector for transmit and receive. SwitchC is receiving BPDUs from SwitchB and as a result the interface has become an alternate port and is in blocking mode.



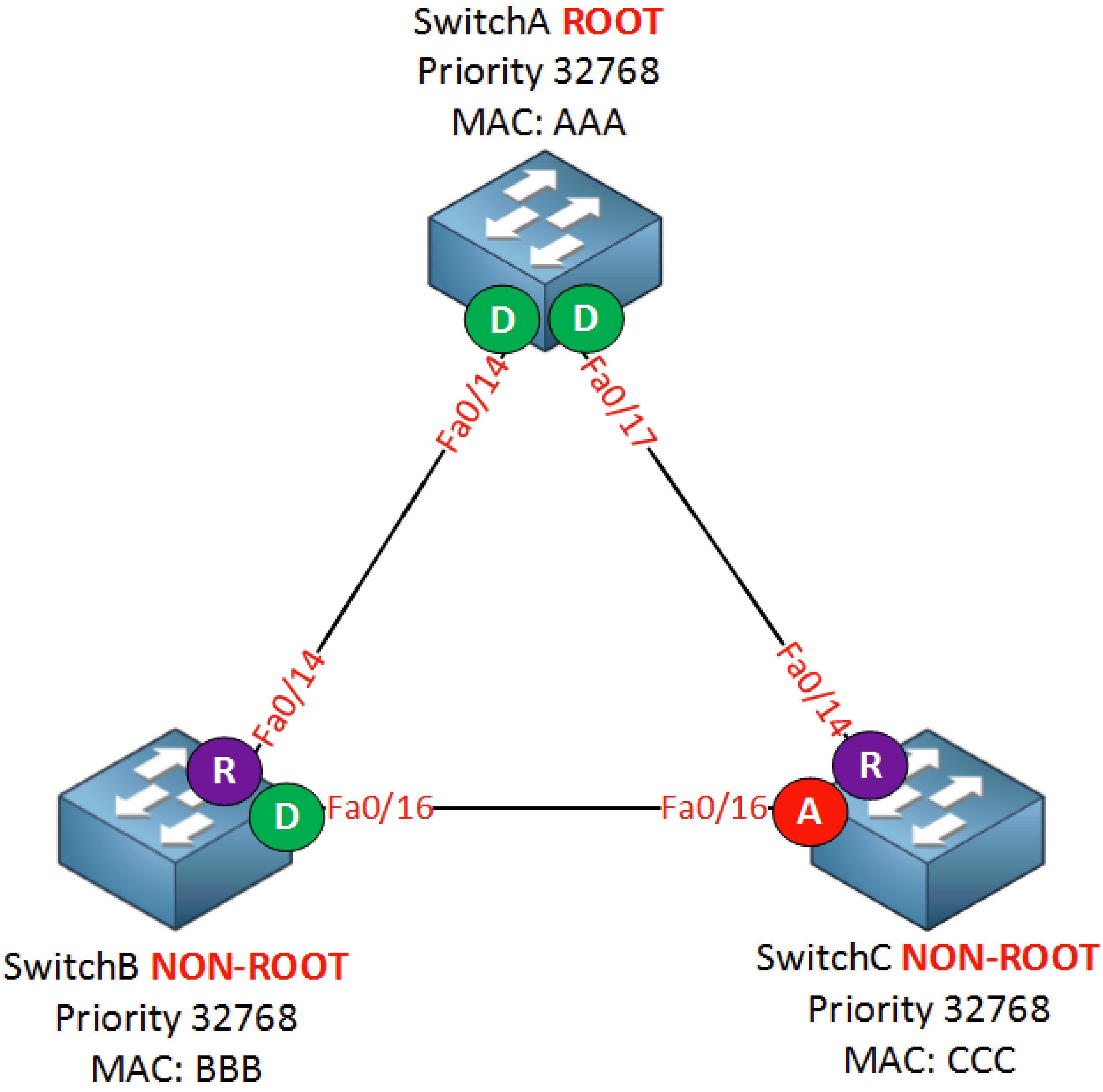
Now something goes wrong…the transmit connector on SwitchB towards SwitchC ~~was eaten by mice~~ failed due to unknown reasons. As a result SwitchC is not receiving any BPDUs from SwitchB but it can still send traffic to SwitchB.

Because SwitchC is not receiving anymore BPDUs on its alternate port it will go into forwarding mode. We now have a **one way loop** as indicated by the green arrow.

One of the methods we can use to solve our unidirectional link failure is to configure **LoopGuard.** When a switch is sending but not receiving BPDUs on the interface, LoopGuard will place the interface in the **loop-inconsistent state** and block all traffic:



Let’s take a look what this looks like on actual switches. I will use the same topology:



Let's enable loopguard:

```
SwitchA(config)#spanning-tree loopguard default
```

```
SwitchB(config)#spanning-tree loopguard default
```

```
SwitchC(config)#spanning-tree loopguard default
```

Use the spanning-tree loopguard default command to enable LoopGuard globally. I don't have any fiber connectors so I'm unable to create a unidirectional link failure. I can simulate it however by using BPDUfilter on SwitchB's fa0/16 interface. SwitchC won't receive any BPDUs anymore on its alternate port which will cause it to go into forwarding mode:

```
SwitchB(config)#interface fa0/16
SwitchB(config-if)#spanning-tree portfast trunk
SwitchB(config-if)#spanning-tree bpdufilter enable
```

Here's what will happen:

```
SwitchC#
*Mar  1 00:17:14.431: %SPANTREE-2-LOOPGUARD_BLOCK: Loop guard blocking port
FastEthernet0/16 on VLAN0001.
```

Normally this would cause a loop but luckily we have LoopGuard configured. You can see this error message appearing in your console, problem solved!

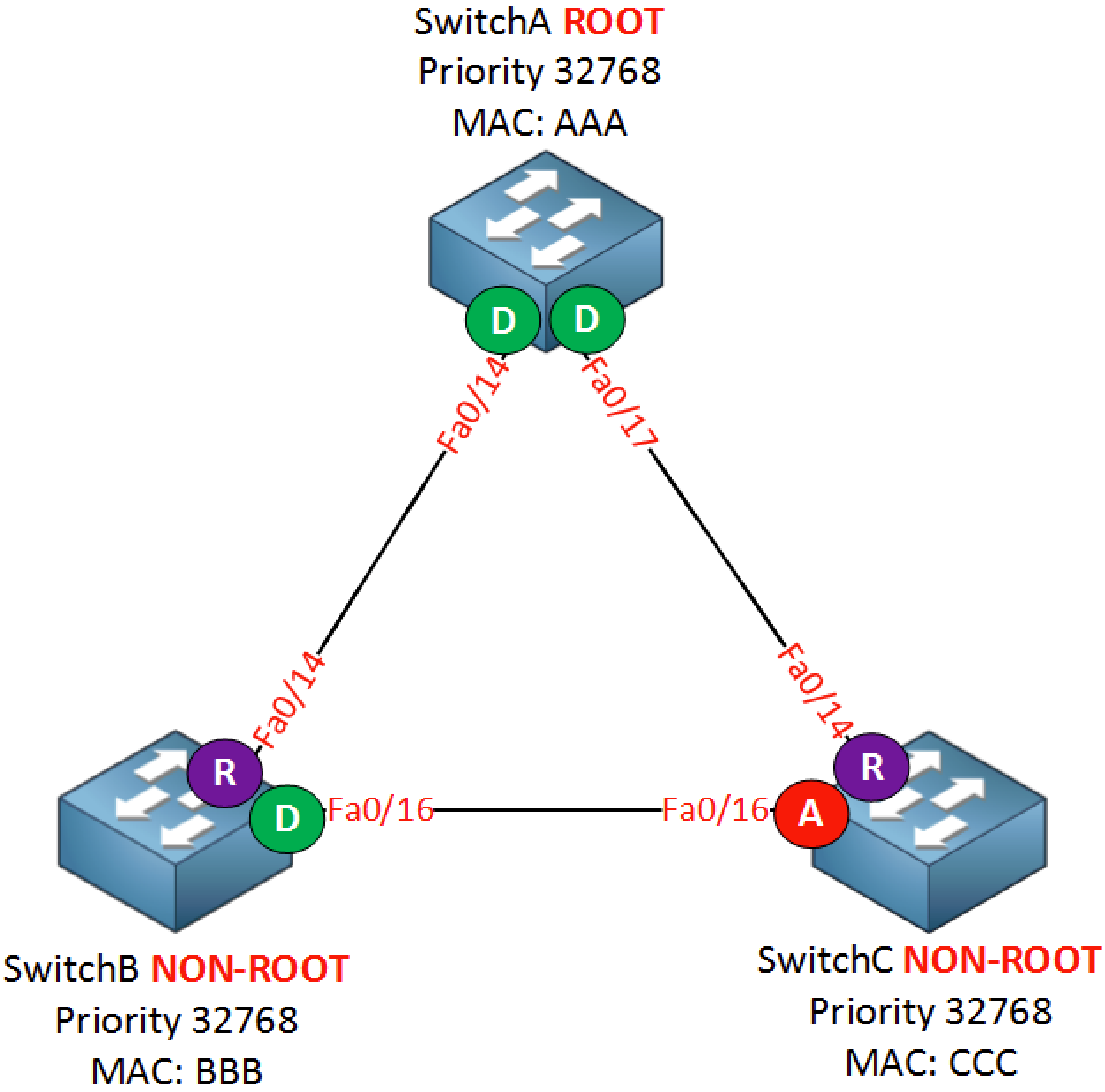
If you want you don't have to configure LoopGuard globally, you can also do it on the interface level like this:

```
SwitchC(config-if)#spanning-tree guard loop
```

The other protocol we can use to deal with unidirectional link failures is called **UDLD (UniDirectional Link Detection).** This protocol is not part of the spanning tree toolkit but it does help us to prevent loops.

Simply said UDLD is a layer 2 protocol that works like a keepalive mechanism. You send hello messages, you receive them and life is good. As soon as you still send hello messages but don't receive them anymore you know something is wrong and we'll block the interface.

Let's use the same topology but configure UDLD this time. Don't forget to get rid of loopguard first…



```
SwitchA(config)#udld ?
  aggressive  Enable UDLD protocol in aggressive mode on fiber ports except
              where locally configured
  enable      Enable UDLD protocol on fiber ports except where locally
              configured
  message     Set UDLD message parameters
```

There are a number of methods how you can configure UDLD. You can do it globally with the udld command but this will only activate UDLD **for fiber links**!

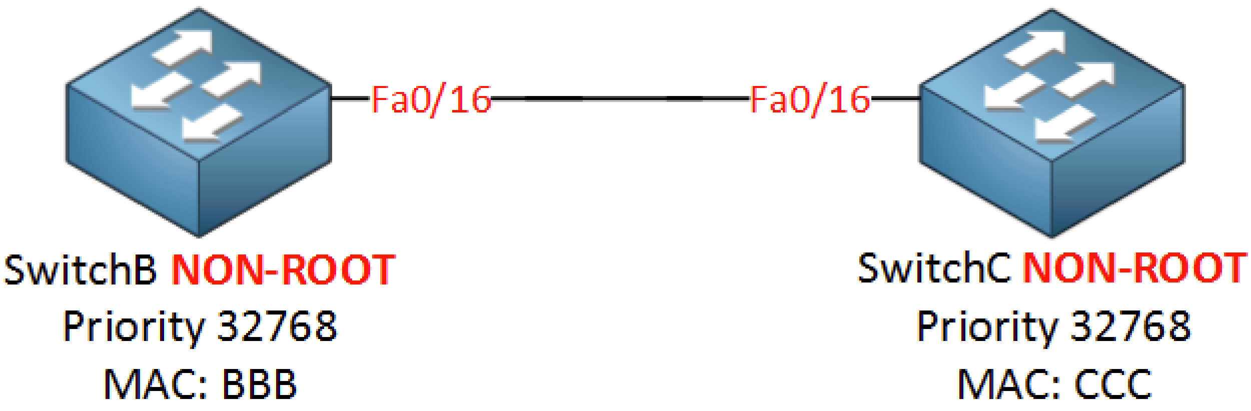
There are two options for UDLD:

- **Normal** (default)
- **Aggressive**

When you set UDLD to **normal** it will mark the port as **undetermined** but it won't shut the interface when something is wrong. This is only used to "inform" you but it won't stop loops.

Aggressive is a better solution, when it loses connectivity to a neighbor it will send a UDLD frame 8 times in a second. If the neighbor does not respond the interface will be put in **err-disable** mode.

Let's use two switches to demonstrate UDLD:



Let's enable UDLD:

```
SwitchB(config)#interface fa0/16
SwitchB(config-if)#udld port aggressive
```

```
SwitchC(config)#interface fa0/16
SwitchC(config-if)#udld port aggressive
```

We'll use SwitchB and SwitchC to demonstrate UDLD. I'll use aggressive mode so we can see that the interface goes down when something is wrong. To see what is going on in real time we'll use a debug:

```
SwitchB#debug udld events
UDLD events debugging is on
```

```
SwitchC#
New_entry = 34422DC (Fa0/16)
Found an entry from same device (Fa0/16)
Cached entries = 2 (Fa0/16)
Entry (0x242BB9C) deleted: 1 entries cached
Cached entries = 1 (Fa0/16)
Checking if multiple neighbors (Fa0/16)
Single neighbor detected (Fa0/16)
Checking if link is bidirectional (Fa0/16)
Found my own ID pair in 2way conn list (Fa0/16)
```

Now the tricky part will be to simulate a unidirectional link failure. LoopGuard was easier because it was based on BPDUs. UDLD runs its own layer 2 protocol by using the proprietary MAC address 0100.0ccc.cccc. We can create a filter to block the UDLD traffic:

```
SwitchC(config)#mac access-list extended UDLD-FILTER
SwitchC(config-ext-macl)#deny any host 0100.0ccc.cccc
SwitchC(config-ext-macl)#permit any any
SwitchC(config-ext-macl)#exit
SwitchC(config)#interface fa0/16
SwitchC(config-if)#mac access-group UDLD-FILTER in
```

This is a creative way to cause trouble. By filtering the MAC address of UDLD on one side it will think that there is an unidirectional link failure! Here's what you will see:

```
SwitchB#
UDLD FSM updated port, bi-flag udld_empty_echo, phase udld_detection (Fa0/16)
timeout timer = 0 (Fa0/16)
Phase set to EXT.  (Fa0/16)
New_entry = 370CED0 (Fa0/16)
Found an entry from same device (Fa0/16)
Cached entries = 2 (Fa0/16)
Entry (0x3792BE0) deleted: 1 entries cached
Cached entries = 1 (Fa0/16)
Zero IDs in 2way conn list (Fa0/16)
Zero IDs in 2way conn list (Fa0/16)
UDLD disabled port, packet received in extended detection (Fa0/16)
%UDLD-4-UDLD_PORT_DISABLED: UDLD disabled interface Fa0/16, unidirectional
```

```
link detected
%PM-4-ERR_DISABLE: udld error detected on Fa0/16, putting Fa0/16 in err-
disable state
```

You’ll see a lot of debug information flying by but the end result will be that the port is now in err-disable state. Here's a show command you can use to check it:

```
SwitchB#show udld fastEthernet 0/16

Interface Fa0/16
---
Port enable administrative configuration setting: Enabled / in aggressive mode
Port enable operational state: Enabled / in aggressive mode
Current bidirectional state: Unidirectional
Current operational state: Disabled port
```

You can verify it by using the **show udld command**.

LoopGuard and UDLD both solve the same problem: Unidirectional Link failures. They have some overlap but there are a number of differences, here’s an overview:

	LoopGuard	**UDLD**
Configuration	Global / per port	Global (for fiber) / per port
Per VLAN?	Yes	No, per port
Autorecovery	Yes	Yes - requires err-disable timeout.
Protection against STP failures because of unidirectional link failures	Yes - need to enable it on all root and alternate ports	Yes - need to enable it on all interfaces
Protection against STP failures because no BPDUs are sent	Yes	No

Protection against miswiring	No	Yes

That's all there is to it. I hope you enjoyed this lesson about LoopGuard and UDLD.

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- January 24, 2015 at 13:19 #11318 Reply

Yevgeniy O
Participant
great, tnx for this topic

January 24, 2015 at 13:35 #11319 Reply

Yevgeniy O
Participant

question, do them work together?
or Cisco doesnt approve to enable them together?

January 24, 2015 at 13:35 #11320 Reply

Yevgeniy O
Participant
also does them proprietary?

January 25, 2015 at 16:04 #11321 Reply

Michael M
Participant
Because there is overlap I personally wouldnt use them togeather. Generally I have seen UDLD used more in the real world but as always..mileage may vary.

January 26, 2015 at 21:21 #11323 Reply

Rene Molenaar
Keymaster
Hi Michael

I agree, best not to run both of them at the same time..

Rene

June 4, 2015 at 12:28 #11326 Reply

Srinivasan C
Participant
Hi Rene,
How “Bridge assurance” differ from these loop preventive mechanism?

Thanks,
Srini

June 4, 2015 at 12:35 #11327 Reply

Rene Molenaar
Keymaster
Hi Srini,

Bridge assurance only works on the 6500 and nexus 7000 (and maybe some other high end platforms). It’s enabled globally and detect things like link aggregation errors, port misconfigurationd, etc. It helps to keep STP working properly.

Rene

June 4, 2015 at 15:37 #11328 Reply

Srinivasan C
Participant
Thanks Rene.

Srini

August 28, 2015 at 06:40 #11329 Reply

Don D
Participant
Hello Renne,

Does UDLD will work from cisco 4500 to a 3rd party switch (IBM g8264)

-I configured the cisco 4500 on a normal mode and on the other side, the port is also on the normal mode
-tried to filter the mac address for udld but the port is still operational.

Do you think that when udld is deployed on cisco with a non cisco equipment, will they still use the udld mac address you mentioned or it is cisco proprietary?

Thank you.

August 28, 2015 at 11:13 #11330 Reply

Rene Molenaar
Keymaster
Hi Don,

Good question…officially UDLD is a Cisco proprietary standard but there is a RFC for it:

https://tools.ietf.org/html/rfc5171

The MAC address should be the same, it's in the RFC.

Rene

August 28, 2015 at 11:24 #11331 Reply

Don D
Participant
Hello Rene, I filter the mac address on the cisco side just like what you did, but the port on the cisco and port on the IBM is still on udld neighbor state. When we remove the transmit strands on one of the fiber cable on cisco, both links are down. Is there any connection with the FEFI on this kind of situation?

Thanks a lot Rene.

August 28, 2015 at 11:54 #11332 Reply

Rene Molenaar
Keymaster
Hi Don,

It's possible, some hardware has something like FEFI to detect a link failure so it can take both links down.

Rene

August 31, 2015 at 01:46 #11333 Reply

Thomas K
Participant
Rene,
Hi. Four questions to help clear my mind when you have a moment.

1. Is there any benefit to configuring UDLD on links between switches that are copper based?

2. If configuring loopguard within an environment on what ports is it recommended to be configured on?

3. Can you elaborate why loopguard doesn't protect against miswiring?

4. What are the ramifications of the following – Protection against STP failures because no BPDUs are sent – where you mention that it is not fixed with UDLD, is it then just relying on normal spanning-tree convergence measures (in otherwords a loop would not form)?

Many thanks.

Thomas

September 6, 2015 at 22:28 #11334 Reply

Rene Molenaar
Keymaster
Hi Thomas,

1. Nope, once something happens on either side…the link will go down. There's no separate transmit or receive connect with copper links. One topic that is related that you might like is BFD:

https://networklessons.com/ip-routing/bidirectional-forwarding-detection-bfd/

2. You should use it on the blocking (alternate) ports but also on root ports, basically any port that could be in blocking mode if the topology changes. You can enable it globally like I did.

3. Loopguard works based on BPDUs (L2 information). If a loopguard enabled non-designated interface doesn't receive BPDUs anymore then the interface will be in a blocking state. Loopguard doesn't know why or how BPDUs went missing, it just acts upon missing BPDUs.

Protocols like UDLD are used as a “keepalive” to ensure that L1 is working (a working physical interface that can transmit and receive).loop-inconsistent blocking state instead of moving through the listening, learning, and forwarding states.

4. UDLD only helps to have a working link between two switches, that’s it. When something is wrong with the link, UDLD will bring it down. When it does, STP can do its job to create a loop-free topology. It’s also possible that there is no loop in the topology anymore one one of the physical links fails.

Rene

September 8, 2015 at 01:59 #11335 Reply

Thomas K
Participant
Thank you for the detailed replies Rene. One thing I am a little stuck on – for item #2, why in the example do we need to enable loop guard globally on switch A, the root switch which only has designated ports? I guess it doesn’t hurt anything, but please confirm it is not really technically needed?

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