[Switch] Spanning Tree Protocol (STP)

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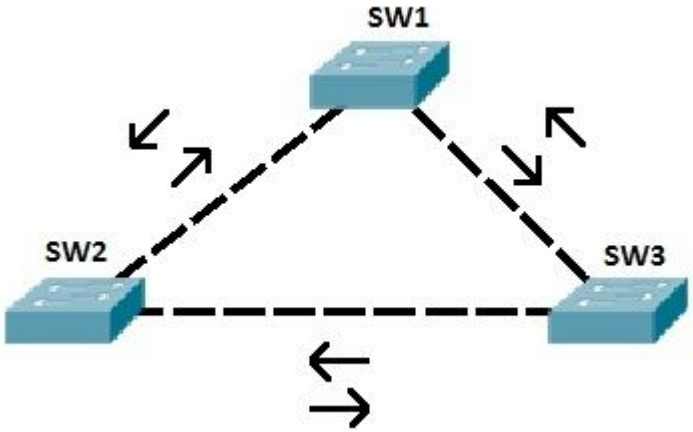
What is STP ?

Spanning Tree Protocol (STP) is a network protocol designed to prevent layer 2 loops. It is standardized as **IEEE 802.D** protocol. **STP blocks some ports on switches with redundant links to prevent broadcast storms and ensure loop-free topology**. With STP in place, you can have redundant links between switches to provide redundancy.

Overview

To better understand the importance of STP and how to use STP to prevent broadcast storms on a network with redundant links, consider the following example.



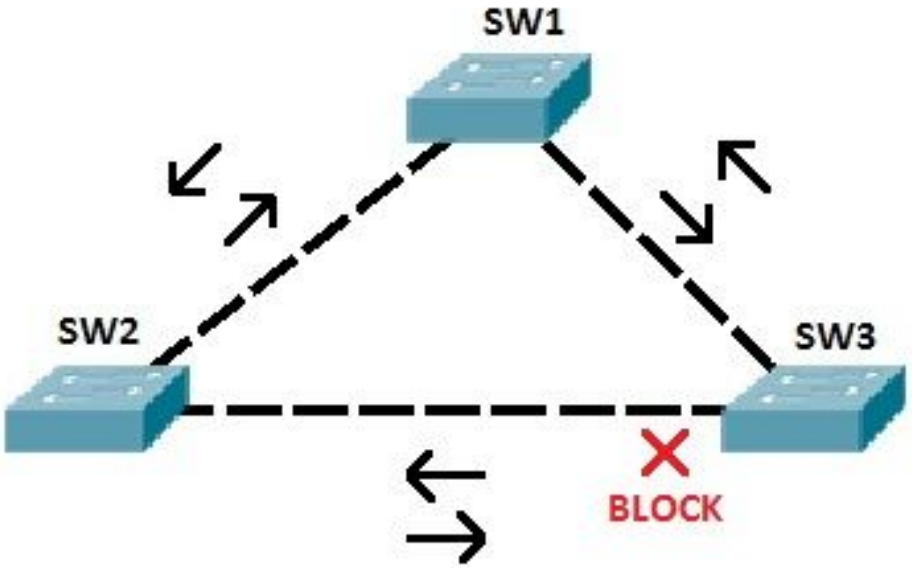
Explaination

SW2 sends a broadcast frame to SW1 and SW3. Both switches receive the frame and forward the frame out every port, except the port the frame was received on. SW1 sends the frame to SW3.

SW3 receives the frame, and sends the frame back to SW2. SW2 then again forwards the frame to SW1! The same thing also happens in the opposite direction.

Without STP in place, these frames would loop forever. STP prevents loops by placing one of the switch ports into blocking state.

Solution



Concept of STP

In the topology above, STP has placed one port on SW3 into the blocking state. That way, if SW3 receives a broadcast frame from SW1, it will not forward it out the port connected to SW2.

NOTE

STP enables layer 2 redundancy. In the example above, if the link between SW3 and SW1 fails, STP would converge and unblock the port on SW3.

How STP Works ?

STP uses the **Spanning-Tree Algorithm (SPA)** to create a topology database of the network. To prevent loops, SPA places some interfaces into forwarding state and some interfaces into blocking state. How does STP decides in which state to port will be placed? A couple of criteria exist:

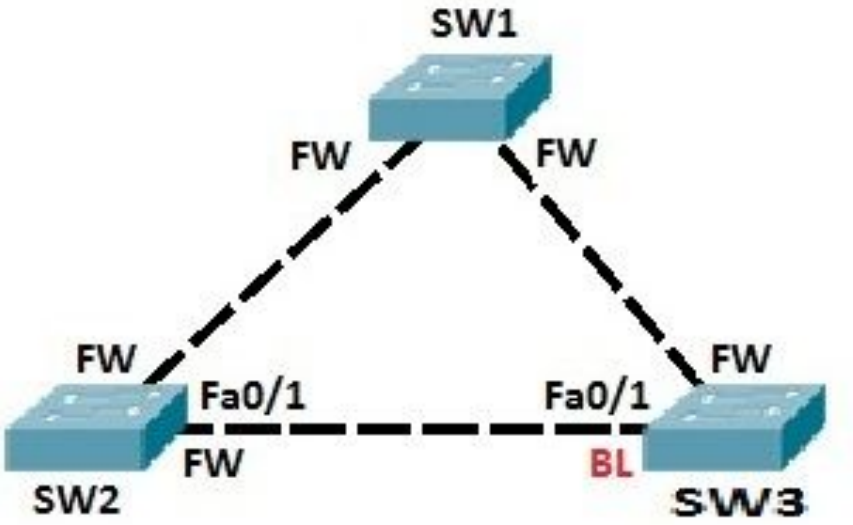
1. all switches in a network **elect a root bridge (switch)**. All working interfaces on the root bridge are placed in forwarding state. The switch with the lowest switch ID will become the root bridge.

2. all other switches, called “non root bridges”, determine the best path to get to the root bridge. The **port used to reach the root bridge (root port) is placed in forwarding state**.

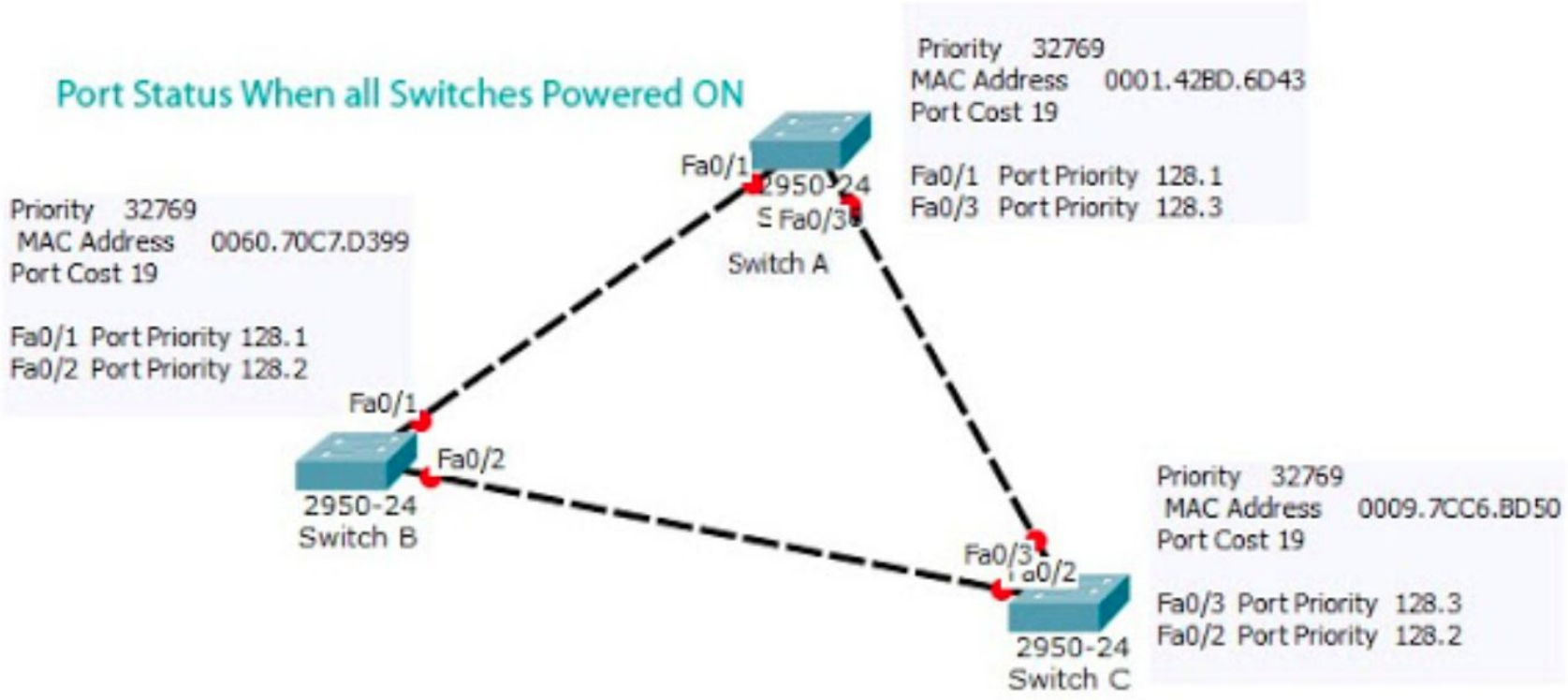
3. on the shared Ethernet segments, the switch with the **lowest cost to reach the root bridge is placed into forwarding state**.

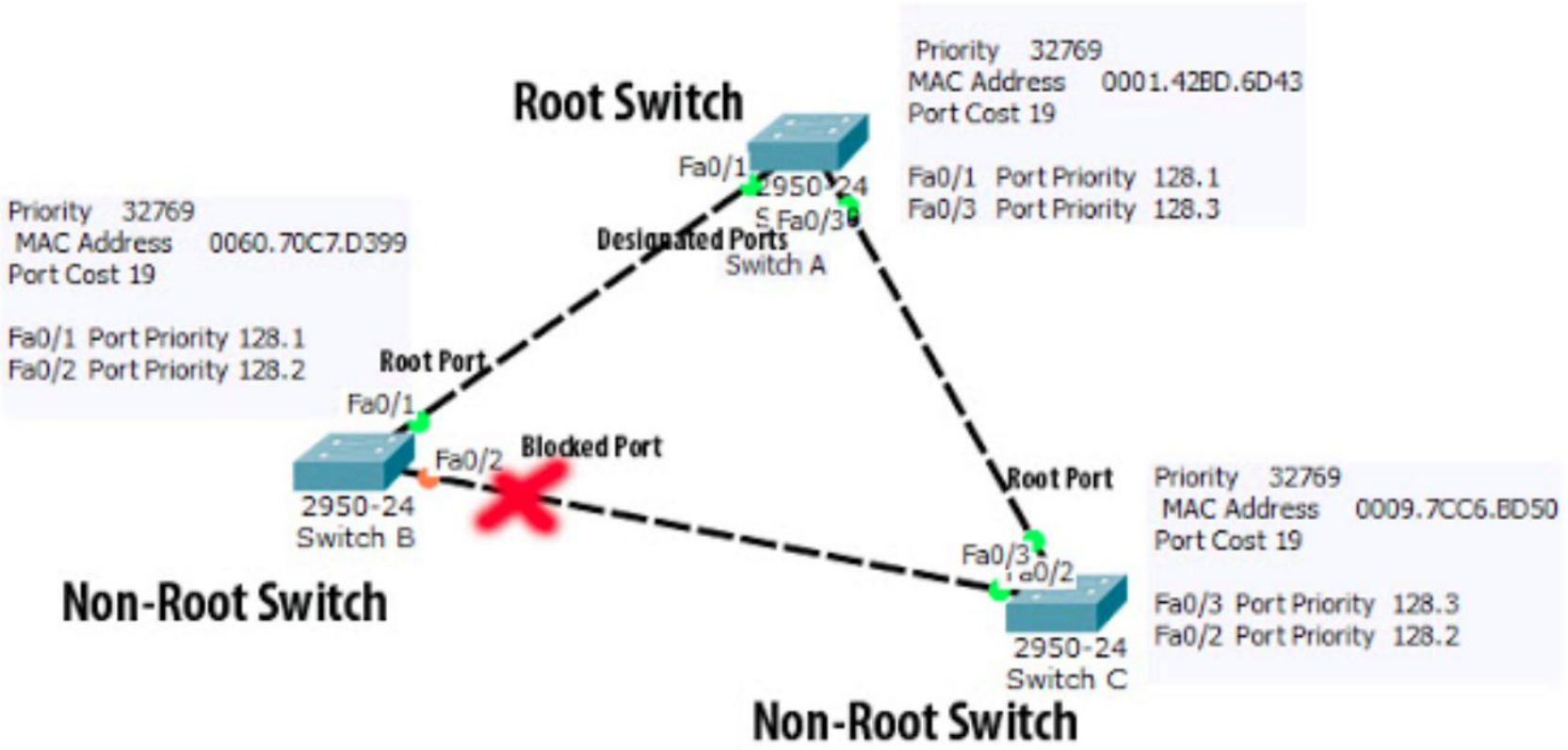
4. all **other interfaces are placed in blocking state** and will not forward frames.

An example will help you understand the concept.



Port Status When all Switches Powered ON




Root Switch
Priority 32769
MAC Address 0001.42BD.6D43
Port Cost 19
Fa0/1 Port Priority 128.1
Fa0/3 Port Priority 128.3
Fa0/1
2950-24
S Fa0/3
Designated Ports
Switch A
Priority 32769
MAC Address 0060.70C7.D399
Port Cost 19
Fa0/1 Port Priority 128.1
Fa0/2 Port Priority 128.2
Root Port
Fa0/1
Fa0/2
Blocked Port
2950-24
Switch B
Non-Root Switch
Root Port
Priority 32769
MAC Address 0009.7CC6.BD50
Port Cost 19
Fa0/3 Port Priority 128.3
Fa0/2 Port Priority 128.2
Fa0/3
Fa0/2
2950-24
Switch C
Non-Root Switch

Explaination

Let’s say that SW1 advertised the lowest switch ID and is elected as the root bridge. All ports on SW1 are placed into forwarding state. SW2 and SW3 choose ports with the lowest cost to reach the root bridge to be the root ports. These ports are also placed into forwarding state.

On the shared Ethernet segment between SW2 and SW3, port Fa0/1 on SW2 has the lowest cost to reach the root bridge. This port is placed into forwarding state.

To prevent loops, port Fa0/1 on SW3 is placed into blocking state.

NOTE

A switch with the lowest switch ID will become the root bridge. A switch ID consists of two components: the switch's priority (by default 32,768 on Cisco switches) and the switch's MAC address.

BPDU

BPDUs (Bridge Protocol Data Units) are used by switches to share information with each other and learn the topology of the network. With BPDUs, the loops in the network are detected.

BPDUs are compared and used to elect a root switch. Hello BPDUs are the most common messages. They list the switch ID of the sender and the root bridge ID.

Lets starts the Demonstration of STP in cisco packet tracer ..

show spanning-tree Command Output Fields

Field	Definition
Role	Current port STP role. Valid values are as follows: • Desg (designated) • Root • Altn (alternate) • Back (backup)
Sts	Current port STP state. Valid values are as follows: • BLK (blocking) • DIS (disabled) • LRN (learning) • FWD (forwarding)
Type	Status information. Valid values are as follows: • P2p/Shr—The interface is considered as a point-to-point (shared) interface by the spanning tree. • Edge—The port is configured as an STP edge port (either globally using the **default** command or directly on the interface) and no BPDU has been received. • Network—The port is configured as an STP network port (either globally using the **default** command or directly on the interface). • *ROOT_Inc, *LOOP_Inc, *PVID_Inc, *BA_Inc, and *TYPE_Inc—The port is in a broken state (BKN*) for an inconsistency. The broken states are Root inconsistent, Loopguard inconsistent, PVID inconsistent, Bridge Assurance inconsistent, or Type inconsistent.