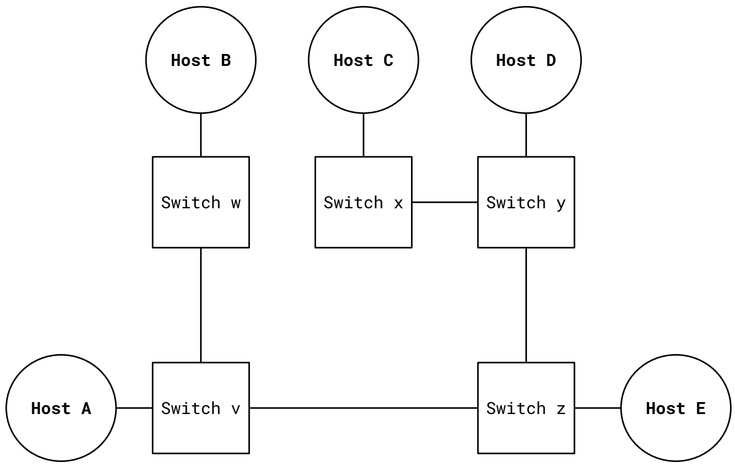
CS 168 Fall 2017 | Introduction to the Internet Scott Shenker | Discussion 3: Routing I

1 Learning Switches



The diagram above shows a L2 network that uses learning switches. Initially, none of the switches have any forwarding state. The following questions describe events that happen in sequential order, i.e. the events in question 2 occur after the events in question 1, etc.

(1) **Host A** sends a packet to **Host D**. List all switches that receive this packet during the sending process.

Solution: v, w, z, y, x (The packet is broadcasted)

(2) **Host A** sends another packet to **Host D**. List all switches that receive this packet during the sending process.

Solution: v, w, z, y, x (The packet is still broadcasted. In question 1, none of the switches learned anything about **Host D**)

(3) **Host E** sends a packet to **Host A**. List all switches that receive this packet during the sending process.

Solution: z, v (Both **Switch z** and **Switch v** learned about **Host A** from part (1)).

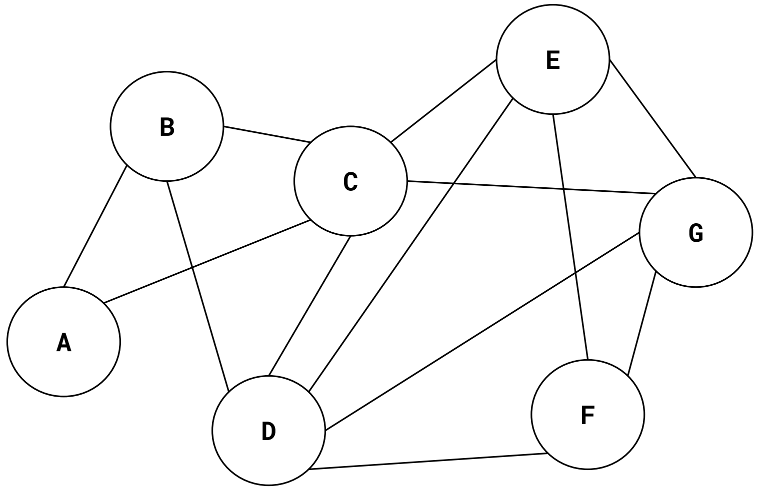
(4) **Host D** sends a packet to **Host E**. List all switches that receive this packet during the sending process.

Solution: y, x, z (**Host D** sends the packet to **Switch y**, which floods the packet to **Switch x** and **Switch z**. **Switch z** already knows about **Host E**, so it directly sends the packet to **Host E**.)

(5) Suppose the link between **Host A** and **Switch v** goes down, and **Host A** then attaches itself to **Switch z** using a new link. **Switch v** deletes **Host A** from its forwarding state. No changes are made to the forwarding states of any other switch. What happens when **Host B** sends a packet to **Host A**?

Solution: The packet arrives at **Switch w**, which then sends the packet to **Switch v**, which then floods the packet because it has no entry for **Host A**. Note that **Switch v** will only send the packet to **Switch z**. **Switch z** will then drop the packet to avoid sending the packet back the way it came from.

2 Spanning Tree Protocol



The diagram above shows a L2 network where all links have equal cost. We want to apply the Spanning Tree Protocol. Choose the switch with the lowest alphabetical ID as the root, and when there are multiple shortest paths to the root, choose the path that uses the neighbor switch with the lowest alphabetical ID.

(1) Let **XY** denote the link that connects **Switch X** and **Switch Y**. List all links that are a part of the spanning tree after the STP protocol converges.

Solution: AB, AC, BD, CE, CG, DF

(2) Assume that at some point during the STP protocol, **Switch F** believes that **Switch A** is the root and **Switch D** believes that **Switch B** is the root. Is it possible that **Switch C** also believes that **Switch B** is the root?

Solution: No. Either **Switch G** or **Switch E** must have advertised to **Switch F** that **Switch A** was the root. Since **Switch D** still thinks that **Switch B** is the root, this advertisement of **Switch A** as the root must have come from **Switch C**.

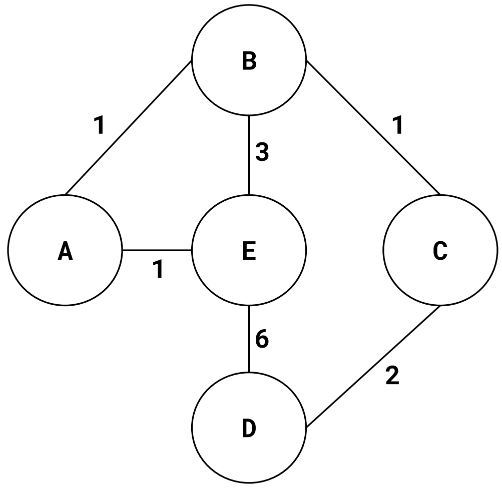
(3) After the STP protocol has converged, **Switch A** and all links contingent on **Switch A** go down. List all links that are a part of the new spanning tree after the STP protocol converges again.

Solution: BC, BD, CE, CG, DF

(4) **Switch A** and all links contingent on **Switch A** finally come back up, and the STP protocol begins to run again. However, **Switch F** forgets to send any update messages to its neighbors. After the protocol converges, does the resulting set of links form a valid spanning tree?

Solution: Yes. In fact, the resulting set of links is the same as the one from problem 1. This is because **Switch F** is not a part of the shortest path to **Switch A** from any other switch.

3 Link-State Routing



(1) **Router E** begins to calculate its shortest paths to all other routers. Fill in the following table that contains routing information for **Router E**. Columns represent destination routers. You may use any shortest path algorithm (i.e. Dijkstras) to calculate shortest paths.

	A	B	C	D
Shortest path (i.e. E $\rightarrow$ A $\rightarrow$ B)	E $\rightarrow$ A	E $\rightarrow$ A $\rightarrow$ B	E $\rightarrow$ A $\rightarrow$ B $\rightarrow$ C	E $\rightarrow$ A $\rightarrow$ B $\rightarrow$ C $\rightarrow$ D
Path cost	1	2	3	5

(2) Assuming all other routers have also computed their shortest routes, what path does a packet take from **Router E** to **Router D**?

Solution: E $\rightarrow$ A $\rightarrow$ B $\rightarrow$ C $\rightarrow$ D

(3) Assume that the cost of the link between **Router C** and **Router D** suddenly increases from 2 to 20. Is it possible that packets now enter a loop?

Solution: Yes. As an example, **Router C** and **Router D** will both update their routing information immediately, but the topology change will not immediately reach **Router B**. Therefore, if **Router B** tries to send a packet to **Router D**, the packet will be sent to **Router C**, which will send the packet back to **Router B**, and so on and so forth.