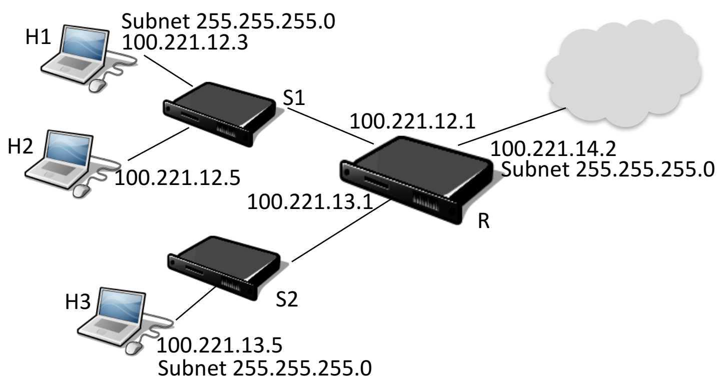
Homework 2: IP

Due: 11:59 PM, Oct 20, 2016

Contents

1 IP Forwarding

Consider this diagram and answer the following questions:



1. Why does the router R have three IP addresses?

    Because it is part of three subnets. In fact, the router is precisely the element that connects these three subnets and allows nodes in one to talk to nodes in the others.

2. If H2 has only one entry in its routing table, what is the prefix and the IP of the next hop for this entry?

    If it has only one entry, it is the default route, also called the default gateway. The prefix is 0.0.0.0/0, and the IP address is that of the router's interface which is connected to this network, 100.221.12.1.

3. When a packet is sent from H2 to H3 (assume H2 knows H3's IP address), what is the layer 2 MAC address put in the frame sent by H2? (You can say 'the MAC address of interface X on Y')

H2 first checks to see if H3 is in a different subnet, by masking H3 **with H2's network mask**, and comparing with H2's address masked with H2's mask:

100.221.13.5 & 255.255.255.0 = 100.221.13.0 != 100.221.12.5 & 255.255.255.0

Given that they are different, H2 then goes to its routing table, and looks up H3's address using longest prefix match. The only entry in the table is R's 100.221.12.1 interface (which is in the same subnet).

The answer is **the MAC address of router R's interface that has the ip address 100.221.12.1**.

4. How does H2 obtain this MAC address? (What protocol does it use, and what is the argument in the protocol message sent by H2?)

H2 obtains this address using ARP, by asking 'Who has IP 100.221.12.1?'. Note that after the first lookup, H2 may find this mapping in its own local ARP cache.

5. When a packet is sent from H2 to H1 (assume H2 knows H1's IP address), what is the layer 2 MAC address in the frame sent by H2? Why?

It is H1's own MAC address, because H1 is in the same subnet as H2.

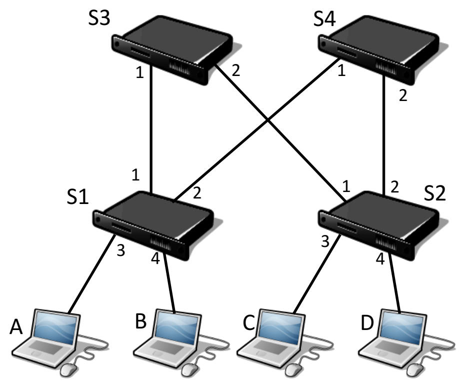
6. If you configure H1's network mask to be 255.255.254.0, does this change the set of nodes it can reach? Why or why not?

Yes. The new mask has one less bit (it is a /23 instead of a /24), so that the nodes will ignore the LSB of the third byte of the address. Now H2 will think that all the nodes in subnet 100.221.13.0/24 are in its subnet. Thus, it will not be able to reach the nodes there. Instead, H2 will issue futile ARP requests for H3's address, and no one will answer.

H2 will still be able to reach all the nodes in the 100.221.14.0/24 subnet, as they will have a different subnet mask: H2 will send the packets there through the router.

2 Spanning Tree

Consider the following network:

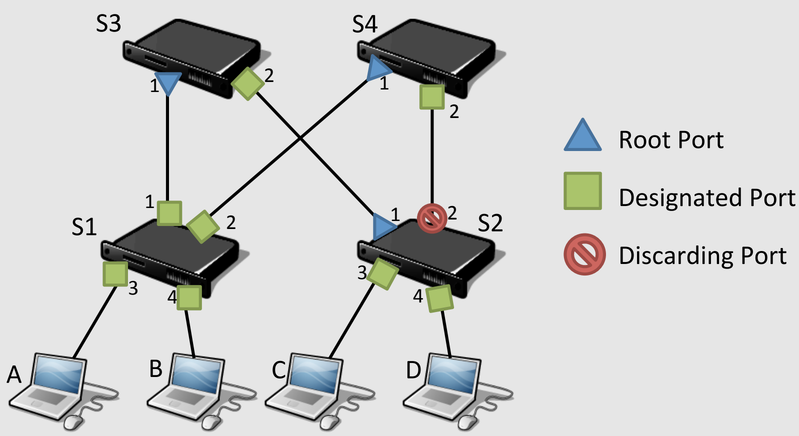


1. If this is a standard Ethernet network, why do we need the Spanning Tree Protocol on this topology?

Because there is a loop in the topology, which would cause packet loops and broadcast storms.

2. What is the final state of the network once the STP converges? (For each switch port, mention whether it is in one of the three states: root port, designated port, or discarding port). Assume that ties are broken based on the numeric switch id.

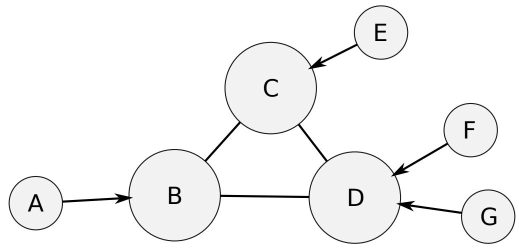
See the figure below.



Port	Status	Port	Status	Port	Status	Port	Status
S1.1	Designated	S2.1	Root	S3.1	Root	S4.1	Root
S1.2	Designated	S2.2	Discarding	S3.2	Designated	S4.2	Designated
S1.3	Designated	S2.3	Designated				
S1.4	Designated	S2.4	Designated				

3 BGP

In the figure below, the circles represent ASes, arrows point from customer to providers, and lines connect peer ASes. Assume that the ASes follow the Gao-Rexford model.



1. List all AS-level announcements that B receives to reach G. Is the set of announcements different from the set of all possible paths? Why?

DG is the only one. It is different from the set of all possible paths, which would include CDG, because C does not announce to B the routes it learns from D. This is because C does not announce to peers routes it learns from other peers.

2. If B and D decide to not peer anymore, A will stop being able to talk to G and F. Why?

Because of the same reason, C does not advertise any of the routes it learns from D to B.

3. What changes would B and D have to do to the way they relate to other ASes (assuming they still don't want to talk to each other), so that the broken routes get re-established? (hint: this will involve money). Why?

They will have to become customers of C, because when they are paying C money, C will advertise the routes it learns from D to B, and from B to D.

4. List two problems that could arise if BGP were to use a distance vector protocol instead of a path vector protocol.

Some possible problems:

(a) It would be much easier for loops to form.
(b) There could be count-to-infinity problems, which would be pretty bad at the level of ASes.
(c) ASes would not be able to inspect the whole path to apply policies.

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`https://piazza.com/class/isqj37mfnyz26r?cid=6`.