CS 6043: Computer Networking

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HOMEWORK #4

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1. Consider the network shown below. Suppose AS3 and AS2 are running OSPF for their intra-AS routing protocol. Suppose AS1 and AS4 are running RIP for their intra-AS routing protocol. Suppose eBGP and iBGP are used for the inter-AS routing protocol. Initially suppose there is no physical link between AS2 and AS4.

a) Router 3c learns about prefix x from which routing protocol: OSPF, RIP, eBGP, or iBGP?

Ans:

eBGP (External Border Gateway Protocol)

b) Router 3a learns about x from which routing protocol?

Ans:

iBGP (Internal Border Gateway Protocol)

c) Router 1c learns about x from which routing protocol?

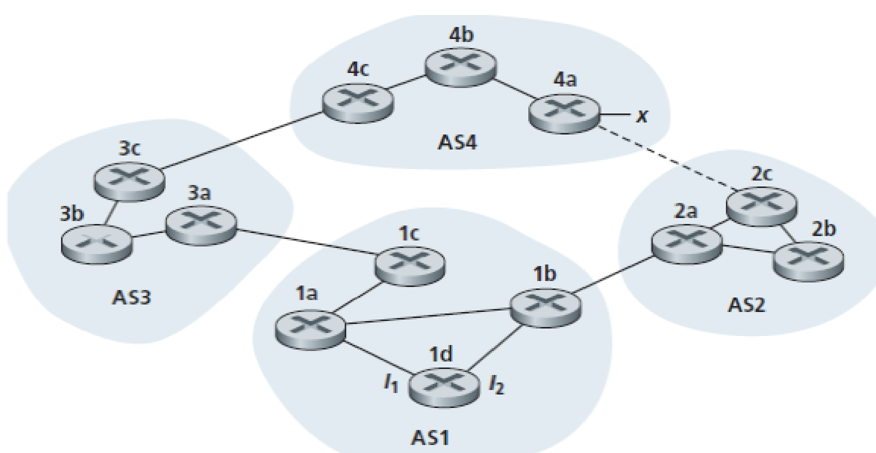
Ans:

eBGP (External Border Gateway Protocol)

d) Router 1d learns about x from which routing protocol?

Ans:

iBGP (Internal Border Gateway Protocol)



2. Referring to the previous problem, once router 1d learns about x it will put an entry (x, I) in its forwarding table.

a) Will I be equal to I_1 or I_2 for this entry? Explain why in one sentence.

Ans:

I1 because this interface begins the least cost path from 1d towards the gateway router 1c

b) Now suppose that there is a physical link between AS2 and AS4, shown by the dotted line. Suppose router 1d learns that x is accessible via AS2 as well as via AS3. Will I be set to I_1 or I_2? Explain why in one sentence.

Ans:
I2, both routes have equal AS-PATH length but I2 begins the path that has the closest NEXT-HOP router

c) Now suppose there is another AS, called AS5, which lies on the path between AS2 and AS4 (not shown in diagram). Suppose router 1d learns that x is accessible via AS2 AS5 AS4 as well as via AS3 AS4. Will I be set to I_1 or I_2? Explain why in one sentence.
Ans:

I1. I1 begins the path that has the shortest AS-PATH.

3. a) Suppose two nodes start to transmit at the same time a packet of length L over a broadcast channel of rate R. Denote the propagation delay between the two nodes as d_{prop}. Will there be a collision if $d_{prop} < L/R$? Why or why not?
Ans:
Yes, there will be a collision, since one node finishes transmitting, it will start receiving the packet from the other nodes.
Otherwise if $d_{prop} > L/R$ there will be no collision. Since the other node is able to finish transmission before new packet arrives.

b) In CSMA/CD, after the fifth collision, what is the probability that a node chooses K = 4? The result K = 4 corresponds to a delay of how many seconds on a 10 Mbps Ethernet?
Ans:
After the 5^{th} collision, the adapter chooses from {0, 1, 2, …….., 31}. The probability that it chooses 4 is 1/32. It waits 204.8 micro seconds.

4. Suppose nodes A and B are on the same 10 Mbps broadcast channel, and the propagation delay between the two nodes is 245 bit times. Suppose A and B send Ethernet frames at the same time, the frames collide, and then A and B choose different values of K in the CSMA/CD algorithm. Assuming no other nodes are active, can the retransmissions from A and B collide? For our purposes, it suffices to work out the following example. Suppose A and B begin transmission at t = 0 bit times. They both detect collisions at t = 245 bit times. Suppose $K_A = 0$ and $K_B = 1$. At what time does B schedule its retransmission? At what time does A begin transmission? (Note: The nodes must wait for an idle channel after returning to Step 2—see protocol.) At what time does A's signal reach B? Does B refrain from transmitting at its scheduled time?

Ans:

First, you need to know the inter frame space (IFS) for Ethernet, which is 96 bit times and the length of the jam signal which is a four to six bytes' pattern. Here, for this exercise, we assume a six-byte JAM pattern which consequently lasts for 48 bit times.

Time, t	Event
0 245 293 293+245=538 538+96=634 293+512=805 634+245=879	A and B begin transmission A and B detect collision A and B finish transmitting jam signal B's last bit arrives at A; A detects an idle channel A starts transmitting B returns to Step2 B must sense idle channel for 96 bit times before it transmits A's transmission reaches B

Because A's retransmission reaches B before B's scheduled retransmission time (805+96), B refrains from transmitting while A retransmits. Thus A and B do not collide. Thus the factor 512 appearing in the exponential back off algorithm is sufficiently large.

5. In this problem, you will put together much of what you have learned about Internet protocols. Suppose you walk into a room, connect to Ethernet, and want to download a Web page. What are all the protocol steps that take place, starting from powering on your PC to getting the Web page? Assume there is nothing in our DNS or browser caches when you power on your PC. (Hint: the steps include the use of Ethernet, DHCP, ARP, DNS, TCP, and HTTP protocols.)
Explicitly indicate in your steps how you obtain the IP and MAC addresses of a gateway router.

Ans:

The steps are as follows:

1. First use DHCP to obtain an IP address. My computer first creates a special IP datagram destined to 255.255.255.255 in the DHCP server discovery step. Then puts it in a Ethernet frame and broadcast it in the Ethernet. Then following the steps in the DHCP protocol, my computer is able to get an IP address with a given time.
2. Then the DHCP server on the Ethernet gives my computer a list of first-hop routers' IP addresses, the subnet mask of my computer resides, and the addresses of local DNS servers.
3. My computer will use ARP protocol to get the the first-hop router's MAC addresses and the local DNS server.
4. My computer will get the IP address of the Web page. If the local DNS server does not have the IP address, then my computer will use DNS protocol to find the IP address of the Web page.

5. After my computer has the IP address of the Web page, if the Web page doesn't locate in a local Web server, then it will send out the HTTP request. The HTTP request message will be encapsulated into TCP ⇒ IP packets, and finally ⇒ Ethernet frames. My computer sends the Ethernet frames to the first-hop router. When the router receives, it passes the frames to the Network layer, checks the routing table, and then sends the packets to the right interface.
6. Then the IP packets will be routed through the Internet to reach the correct Web server.
7. The original Web page server will send back the Web page to my computer through HTTP response. Those messages will be encapsulated into TCP packets ⇒ IP packets. Those IP packets follow IP routes and finally reach my first-hop router, and then the router will encapsulate them into Ethernet frames and forward the packets to my computer.