Evolving Internet: Homework

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To be sent by e-mail to Walid.Dabbous@inria.fr before 23:59 Thursday October 24, 2024. Provide a short, personal and clear explanation.

Question 1 : CIDR Routing

Consider the following routing table.

Address / Mask	Next Hop
208.12.0.0/16	Router 2
208.12.16.0/24	Router 4
135.46.56.0/22	Router 4
135.46.60.0/22	Router 3
default	Router 2

- What do the first two lines mean? Hint: compare the `/24` prefixes in line 2 with the `/16` prefix in line 1.
- For each of the following IP addresses, what would Router 1 do at the reception of a packet with this IP address as the destination address? (explain why by showing bit by bit address-prefix matching):

  135.46.63.10, 135.46.57.14, 208.12.16.0, 208.12.31.0.

Question 2 : Address management

As the name suggests, CIDR (Classless Inter Domain Routing) is a classless IP addressing approach. We no longer consider an address as belonging implicitly to one of the

three classes A, B or C. In CIDR we associate explicitly to every IP address a network mask of length l (denoted $/l$) that defines the prefix that characterizes the network to which this address belongs. The network addresses are now always used with the prefix that can be of arbitrary size (e.g. /13, /17 or /22).

1. Consider the network designated by the CIDR prefix 193.53.32.0/20. What would be the number of hosts in this network, excluding the reserved addresses?

2. Suppose that an old client restores back to the operator there network prefixes: one class A: 17.0.0.0, one class B: 134.15.0.0 and one class C: 194.65.32.0 that were formerly allocated to this client. These addresses will never be used again by their former owner. Is is possible, according to the CIDR approach to the operator to allocate to a new client the following three prefixes: 17.46.64.0/19, 134.15.0.0/20 and 194.65.32.0/21? Explain why in each case.

3. A company asks its Internet Service Provider (ISP) for 800 addresses. What should provider do if he was using classful addressing A, B, C to meet his client needs and what are the disadvantages?

4. We assume that the above mentioned ISP owns the 202.0.64.0/18 CIDR block to perform its activities. Each provider is free to subdivide its address space as wanted to allocate addresses to customers. For a customer requesting 800 addresses which prefix the ISP will allocate to the customer if at the time of application the first free network address is 202.0.80.0?

Question 3 : Distance Vector Routing

Consider the network in the figure below. It uses the distance vector technique between routers A, B, C, D and E.

1. We consider first that we use the basic technique without any improvement. At startup, nodes send their distance vector (DV) in the following order: at t = 0, for A, at t = 5sec for B, at t = 10sec for C, at t = 15sec for D and at t = 20sec for E. Then the same cycle is repeated every 30 seconds. What are the initial distance vectors (i.e. before starting) sent by all the nodes, and what are their final DVs (i.e. after the convergence).

2. Now consider that the technique of split horizon with poison reverse is used for all the rest of this exercise. Why is this technique used? After convergence of system: what is the DV sent by D to B? And the DV sent by E to C?

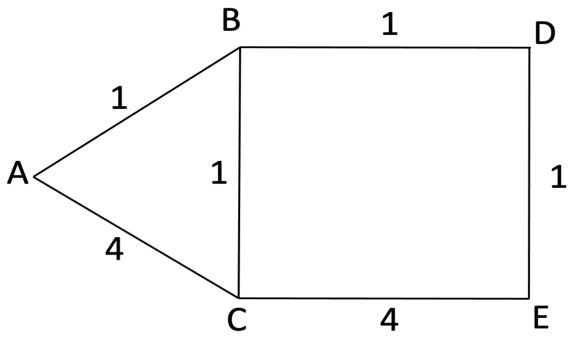

Figure 1: Distance vector routing example

3. At time t = 102 sec, the BA link fails (and will not be restored). Describe what happens until convergence. Is there going to be counting up to infinity?

4. At time t = 287 sec, the link AC also falls down. Describe what's happening until convergence. (Nodes keep the same cycle of transmission of DV except that A disappears).

5. We consider that the option "triggered updates" is supported too. What will happen then there after the failure of link AC at t = 287 sec? Explain the origin of the problem. Will the DUAL version solve this problem? And if yes how?

Question 4 : BGP Routing

In BGP, border routers exchange route announcements that contain a prefix and an AS path. The semantics of a route announced by a router to its neighbor is then: "I agree to relay traffic coming from you to the network identified by the attached prefix and along the path indicated by the attached AS path". As we saw in the course, there are three steps to handle route advertisements: first, the route import policy which determines the routes to exclude, the decision process which consists in ordering routes and choosing the best route that will be adopted and the route export policy which consists to choose which neighbors to advertise the adopted route to. To achieve a routing policy, BGP routers can control any of these three steps: Change the import policy to exclude routes that they do not want to use, modify some attributes to select certain routes instead of others and decide not to export routes to some neighbors.

1. What does the term 'provider-customer transit link' between two autonomous systems mean? And the term 'peering link'?

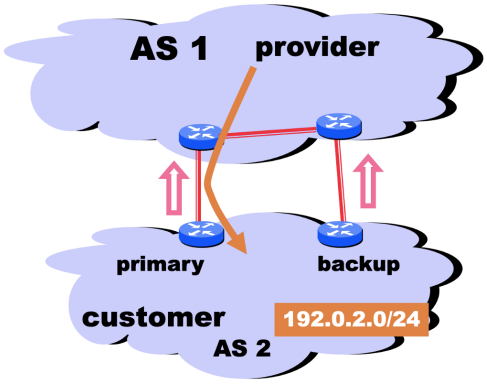

Figure (a)

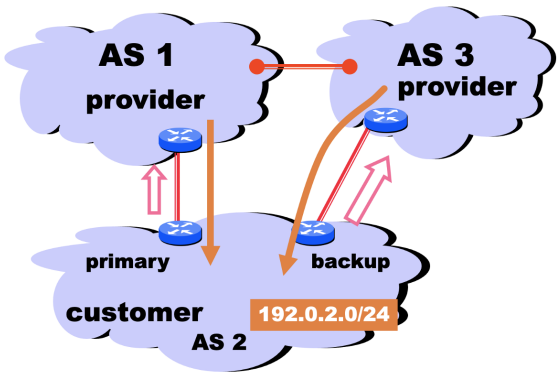

Figure (b)

2. Explain in your own words how the BGP route import and selection rules (Customer ¿ peer ¿ provider) and the BGP route export rules (explained in the course) allow taking into account commercial relations between customers and providers.

3. See the network in figure (a) above. The agreement between the customer and the provider states that traffic to the customer's network should pass through the primary link except in the case of failure. In this case, the back-up link can be used. How to reflect this in the route announcement done by the customer's router connected to the back-up link? (Consider using one of two attributes LOCAL_PREF or AS_PATH).

4. Now consider the network of figure (b) above. Providers AS1 and AS3 have a peering agreement. The client AS2 announces its prefix to both providers. To reflect the fact that the link to AS3 should be used as a back-up, the client chooses to adopt the same solution as in 3 (Figure (a) with a single provider). Does the solution proposed in the previous question work in this case? (Consider the order of priority for route import and selection rules).

5. Bonus question: Why is the Community attribute used for? Can you propose a solution for the b) case using this attribute ?