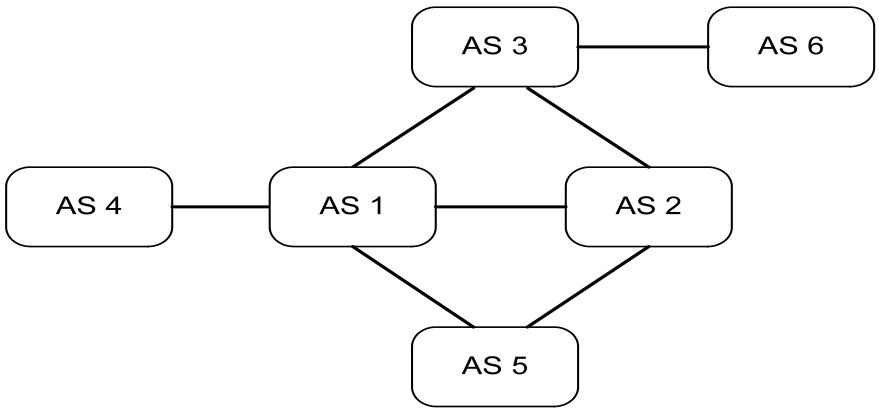
ECE 461 – Internetworking

Problem Sheet 5

Problem 1. Policy Based Routing in BGP

The figure shows a network with six autonomous systems. AS4 "owns" the prefix 10.0.1.0/24 and sends an advertisement to AS1 with the following prefix, and ORIGIN and AS-PATH attributes:
10.0.1.0/24, ORIGIN{AS4}, AS-PATH{AS4}.



a. Assume that no routing policies are employed (i.e., no advertised routes are selectively ignored and all known routes are advertised). Explain how the other autonomous systems process and disseminate the advertisement for prefix 10.0.1.0/24. Indicate which autonomous systems advertise the prefix to their neighboring autonomous systems. Provide the ORIGIN and AS-PATH attributes used in the advertisements.

b. Now consider that autonomous systems AS1, AS2, and AS3 are transit networks, and AS4, AS5, and AS6 are stub networks. For each autonomous system, explain how the processing and advertisement for prefix 10.0.1.0/24 should be changed (compared with your answer to (a)).

a.

AS-4 to AS 1: 10.0.1.0/24, ORIGIN{AS4}, AS-PATH{AS4}

AS-1 to AS-3, AS-1 to AS-2, AS-1 to AS-5: 10.0.1.0/24, ORIGIN{AS4}, AS-PATH{AS4, AS1}

AS-3 to AS-2, AS-3 to AS-6: 10.0.1.0/24, ORIGIN{AS4}, AS-PATH{AS4, AS1, AS3}
AS-2 to AS-3, AS-2 to AS-5: 10.0.1.0/24, ORIGIN{AS4}, AS-PATH{AS4, AS1, AS2}
AS-5 to AS-2: 10.0.1.0/24, ORIGIN{AS4}, AS-PATH{AS4, AS1, AS5}

AS-2 to AS-3: 10.0.1.0/24, ORIGIN{AS4}, AS-PATH{AS4, AS1, AS5,AS2}
AS-2 to AS-5: 10.0.1.0/24, ORIGIN{AS4}, AS-PATH{AS4, AS1, AS3,AS2}
AS-3 to AS-6: 10.0.1.0/24, ORIGIN{AS4}, AS-PATH{AS4, AS1, AS5,AS2,AS3}

AS-3 to AS-6: 10.0.1.0/24, ORIGIN{AS4}, AS-PATH{AS4, AS1,AS2,AS3}

b. Policies are added:

AS 5 → a stub network does not advertise any network other than those originating in AS 5

AS 2 → as transit networks with peering relationships it should not advertise to AS 3 that it can carry traffic to AS 1.

AS 3 → as transit networks with peering relationships it should not advertise to AS 2 that it can carry traffic to AS 1.

AS-4 to AS 1: 10.0.1.0/24, ORIGIN{AS4}, AS-PATH{AS4}

AS-1 to AS-3, AS-1 to AS-2, AS-1 to AS-5: 10.0.1.0/24, ORIGIN{AS4}, AS-PATH{AS4, AS1}

AS-3 to AS-6: 10.0.1.0/24, ORIGIN{AS4}, AS-PATH{AS4, AS1, AS3}
AS-2 to AS-5: 10.0.1.0/24, ORIGIN{AS4}, AS-PATH{AS4, AS1, AS2}

b)
AS-4 to AS 1: 10.0.1.0/24, ORIGIN{AS4}, AS-PATH{AS4}

AS-1 to AS-3, AS-2 and AS-5: 10.0.1.0/24, ORIGIN{AS4}, AS-PATH{AS4, AS1}

AS-3 to AS-6: 10.0.1.0/24, ORIGIN{AS4}, AS-PATH{AS4, AS1, AS3}
AS-2 to AS-5: 10.0.1.0/24, ORIGIN{AS4}, AS-PATH{AS4, AS1, AS2}

Problem 2.

Suppose a BGP router sees the following two advertisements for destination network 10.0.1.0/8:

10.0.1.0/8, AS-PATH { 202, 101, 89, 59}

10.0.1.0/8, AS-PATH { 876, 32}

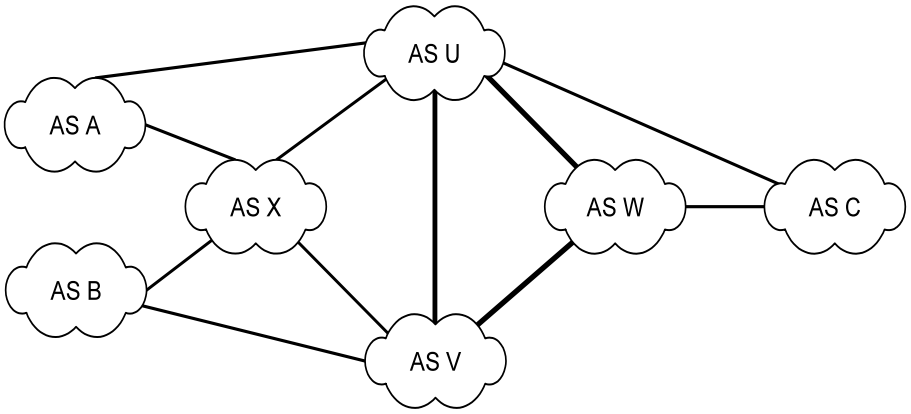
Explain how the second advertised AS-PATH could result in a longer route.

Solution: The first route traverses 4 ASes, the second route only one AS. However, the length of the route is determined by the number of routers traversed. This information is not contained in BGP Update messages.

Problem 3. *(10 Points)*

Consider the network of autonomous systems in the figure, where AS A is a customer of AS X and AS U, and AS B is a customer of AS X and AS V. AS X, in turn, has two provider ASes U and V, while AS C is a customer AS of AS W and AS U. The three ASes U, V and W have peering relationships among themselves.

- AS C owns the prefix 128.1.0.0/16.
- AS A owns two network prefixes 64.1.10.0/24, and 128.101.34.0/24,



The inter-domain routing protocol BGP is used among the ASes to exchange routing information.

a. *(5 points)* For a packet from a host in AS A with the destination IP address 128.1.34.35, which ASes would this packet most likely traverse to reach its final destination? Explain your answer.

b. *(5 points)* Suppose AS A wants the traffic to its prefix 128.101.34.0/24 to come from AS U and the traffic to its prefix 64.1.10.0/24 to come from AS X. Which routes should AS A announce to AS U, and what routes should AS A announce to AS X? For each announcement, provide the prefix and the AS-PATH attribute. Explain your answers.

a) The IP address is in AS C.

Based on the customer/provider relationships both ASX and ASU will advertise the prefix to 128.1.0.0/16. Since the path A → U → C is shorter than A → X → U → C, the shorter path is selected.

b) The announcements should be:

A → U: 128.101.34.0/24, AS-PATH{AS A}
A → X: 64.1.10.0/24, AS-PATH{AS A}

The answer should explain that the number of AS's that are traversed is no indication of the number of IP routers that are traversed. So, the path AS876 → AS32 may have more IP routers than the path AS202→AS101→