

6.263/16.37 Problem Set 2

MIT, Fall 2005

Issued: Tuesday September 20

Due: Tuesday September 27

Reading: Lecture notes, and 5.2 & 5.3 from [BG].

Recommended Reading: 4.2 (Routing) from [PD]

Problem 1: From [BG], do problem: 5.10

Problem 2: Traceroute is a program that allows you to discover the path (sequence of routers) from a sender to a receiver. For more information, check traceroute man's page. Use trace route to discover the number of hops and the delay from no-knife.mit.edu to the following destinations:

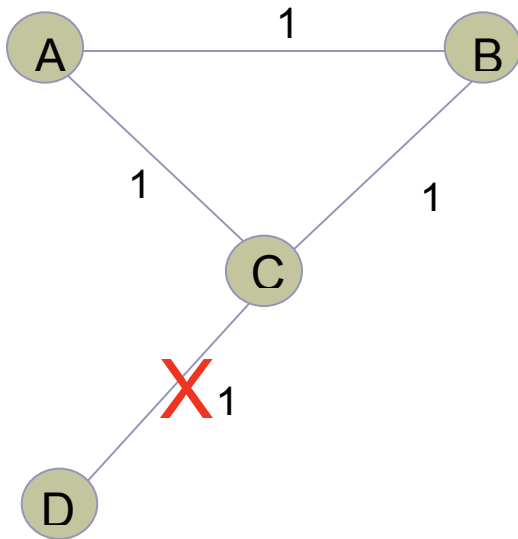
www.yahoo.com

www.cnn.com

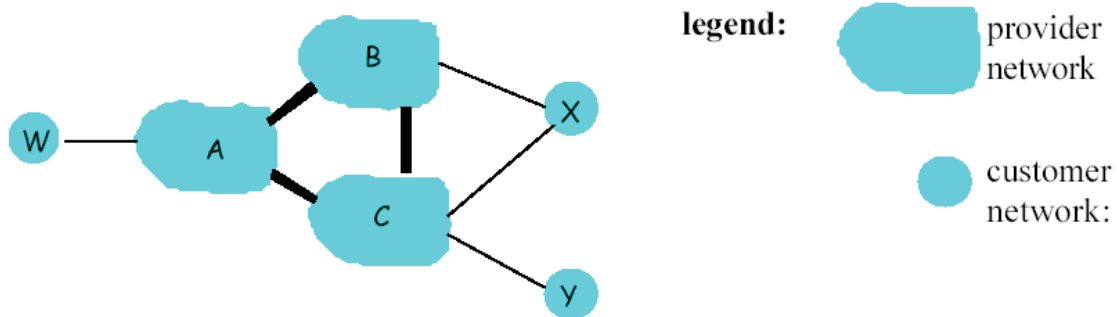
www.berkeley.edu

Problem 3: Give brief answers to the following

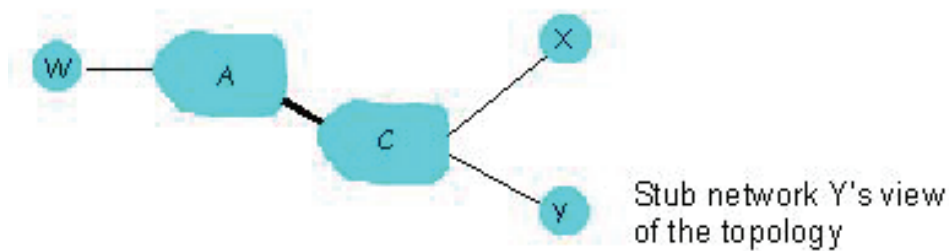
- 1- In an AS that is running I-BGP, is OSPF still needed?
- 2- Why is BGP implemented on top of TCP?
- 3- Show that Split-Horizon fails in the following network, where link C-D fails



Problem 4: Consider the network shown in the figure below. Note that BGP sends path information among networks, and based on that path information, a receiver of BGP information can learn about the overall network topology (that is, each advertised BGP path indicates a series of ASs that are connected in series).



Based on the BGP information that Y receives from C, Y will have the following "view" of the network topology:

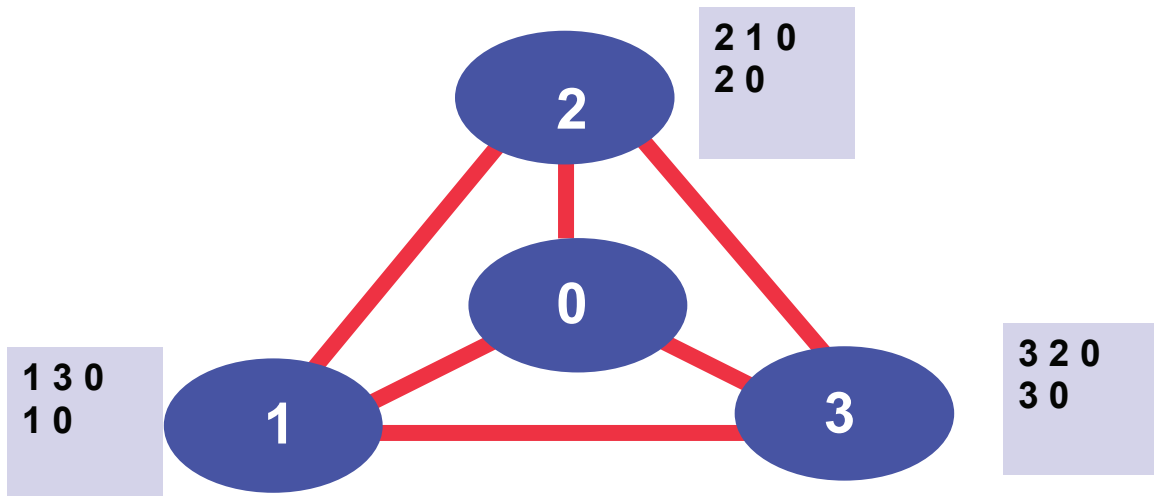


- Why network Y does not know about the existence of network B?
- What are the paths that networks B and C will advertise to network X?
- Draw a diagram similar to the one above, showing the view of the topology at network X, based on the BGP advertisements it receives.

Problem 5: Consider the following topology, where the nodes are ASes. We are concerned only with routes to destination 0. The numbers on the side tell you the policy controlling how each AS like to reach destination 0. For example, AS2 prefers the indirect route $2 \diamond 1 \diamond 0$ to the direct route $2 \diamond 0$. Assume that at time $t=0$ all ASes are using their direct route to destination 0.

- 3.1) Show that there is no stable route assignment (i.e., regardless of the current route assignment, some AS will always change the route.)
- 3.2) This kind of unstable routes are called persistent loops. Explain how they are different from the transient loops that you see during the convergence of distance vector.

- Can BGP show transient loops too? If the network state does not change and the protocol is working properly without any bugs, can OSPF or RIP show persistent loops? Explain.
- In BGP, if the ASes are completely free which policies to choose the protocol might show persistent loops. Can you slightly constrain the policy space that the ASes can use, as to prevent routing loops? Explain.



Problem 6: From [BG], do problem 5.18

Problem 7: Give an example of a graph in which any spanning tree is an MST. Your graph should contain more than 3 nodes and some cycles.

Problem 8: Consider two graphs G and G' , which are identical except for the weights of the edges. Weight of edge e of graph G is $w(e) \geq 0$, and weight of edge e of Graph G' is $a \cdot w(e) + b$, where a and b are constants.

- 7.1) Are the minimum spanning trees of G and G' identical? Justify (If your answer is positive, then prove your answer. If your answer is negative, then give counter examples).
- 7.2) Are the shortest paths between any two vertices in the two graphs identical? Justify your answer. (If your answer is positive, then prove your answer. If your answer is negative, then give counter examples).
- 7.3) If you answer negative for 7.1 or 7.2, can you think of conditions on a and b , for which your answer would be positive?