HW I – CS 6390 - Summer 2017

All questions count equally. We do grade for effort not just correctness, so try your best.

PLEAE ANSWER EACH QUESTION IN A SEPARATE PAGE (long story as to why…).

Question 1 (IP Addressing and Subnetting)

Assume you have two hosts, A and B, in a subnet 214.29.0.0/24. The subnet consists of an Ethernet. Assume you have a third host C that does not have an Ethernet (Ipad? ☺) and you want this host to be able to communicate with A and B. B and C have 802.11 (wifi) connectivity, so they can be configured to talk to each other (manually most likely).

a) Assuming that 214.29.0.0/24 are the only addresses available, if you configure the wifi between B and C as a subnet, what does that do to the number of addresses available for the Ethernet?

b) Instead of creating a new subnet, an alternative method for connecting C is to use proxy ARP and routing and to give C an address from 214.29.0.0/24. I.e., B agrees to route traffic to and from C and also answers ARP queries for C received over the Ethernet.

   i. Give all packets sent, with physical addresses, as A uses ARP to locate and then send one IP message to C

   ii. What peculiar change do we have to do to B's routing table to implement this?

Question 2 (CIDR)

Consider CIDR. Assume that routing domains (i.e. ASms) advertise address blocks (i.e. network numbers in CIDR) even though a subset of the addresses contained in the address block is not contained within the routing domain.

Show me a scenario in which packets are routed to the wrong domain because of this.

Question 3 (Internet Basics)

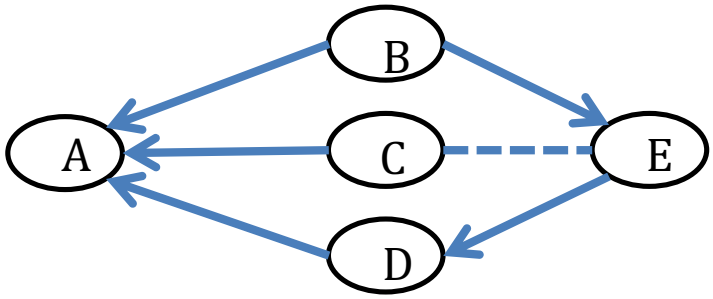
a) Why do routers at the core of the Internet need to be aware of network numbers and not just autonomous system numbers?

b) Why usually do all the routers within an AS at the core of the Internet speak BGP (i.e. all routers within a core AS must speak BGP)

c) Give me two reasons why BGP advertise the entire AS-path to the destination (as opposed to simply advertising the number of AS-hops to the destination).

d) In a LAN (such as Ethernet) why is it necessary for the LAN to be able to do a broadcast if we are considering including the LAN into the Internet (i.e. run IP on the machines in the LAN).

Question 4: Routing Policies



Recall that in inter-domain routing, the main issue is to enforce financial relations between different ASes. Typically, an ISP (i.e., a network provider) tries to maximize its monetary gain by providing service and a customer network tries to minimize its expenses. Based on this general comment, consider the above network segment that shows five autonomous systems (ASes) having BGP neighboring relations. The specific relations among them are as follows:

i. B is a provider of both A and E
ii. C is a provider of A but is a peer of E
iii. D is a provider of A but is a customer of E

Consider a BGP route advertisement that originates from A and reaches E thru B, C, and D.

a. Considering the relations between E and its neighbors, which one of these updates E would be willing to accept/adapt and why?
b. How would you as a network administrator of E configure your BGP routers to enforce your decision above?

Consider the data traffic from senders in AS A for destinations in AS E.

c. What is the AS level path that E would prefer for this data traffic to reach itself, i.e., which of its neighbors E would prefer to receive this traffic from (B or C or D)?
d. Do an internet search on "AS Path Prepending". With this knowledge, what can E do to cause the traffic to propagate on that desired AS level path?
e. What are the conditions that need to hold so that E can achieve this outcome for A-to-E traffic to flow on E's desired AS level path?

Question 5 (Dispute Graphs)

a. Consider the system in slide 27 of the BGP divergence slides (the sytem with a single solution and node 5 ends with an empty path). Draw the dispute graph for this system (NOT the dispute wheel)
b. Add a path 3 1 0 at node 3 and make it higher ranked than 3 0. Show me the dispute graph of this new system.
c. Two parts (justify your answers)
    i. Does the system have a stable state?
    ii. Does the system converge? (i.e. always reach a stable state?)

Question 6 (Hierarchical BGP)

Give me an example of a system that satisfies the restrictions on the export policies and also satisfies guideline A, but its provider-customer graph is not acyclic and the system has a dispute wheel (show your system and the dispute wheel of the system).

Question 7: Ethernet Multicast

a) Why is it necessary that membership reports be flooded throughout all network segments? Briefly explain.

b) Assume that instead of the algorithm presented in class for Ethernet multicast, we do a flood-and-prune approach as in DVMRP. Would this be possible (it is not implemented like this of course, but could it be done? If not, explain why not, if yes, explain in general terms how this would work (the steps that would be necessary in this new protocol)

Question 8: Reverse Path Flooding

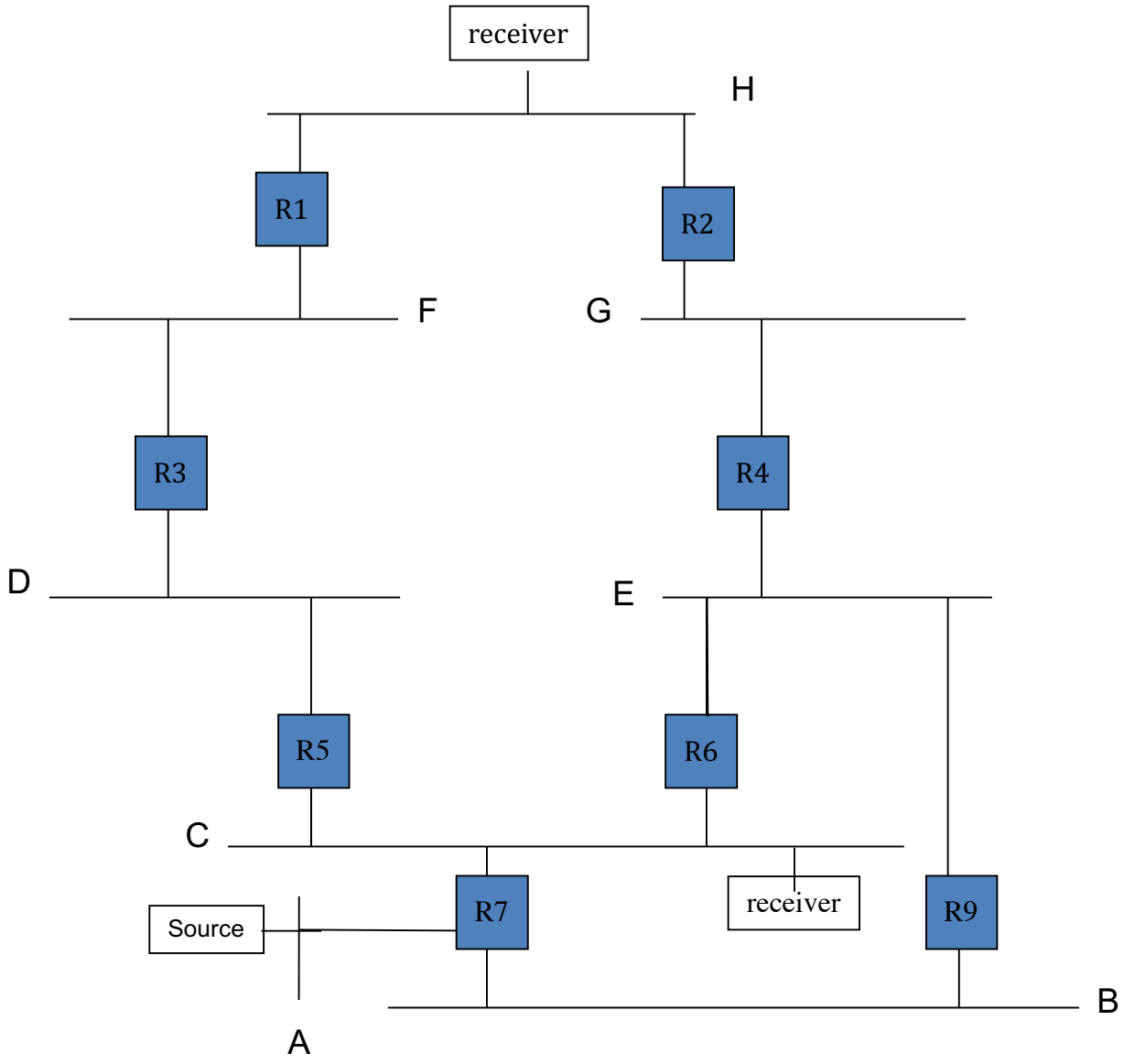
a) Consider reverse path flooding (RPF) in a network with point-to-point links (what we covered in class). Assume that you also know that your unicast routing is based on distance vector routing (basic distance vector routing without split horizon/poisoned revers). Assume that each link has a positive (greater than 0) cost. Taking this into consideration, how can you improve the efficiency of RPF (i.e. reduce the number of messages it transmits?)

b) Same as a) above, except that now your unicast routing protocol is link-state routing.

Question 9: DVMRP

Consider the collection of subnets below (the blue boxes are routers, the subnet "name" is along side of it i.e. A, B, etc). You can break unicast next-hop ties in alphabetical order (i.e. LAN X wins as next hop over LAN Y if both are equidistant to the source), for determining the parent of the LAN, break ties in favor of lower router number.

i. In Reverse Path Broadcasting (RPB), identify for each LAN, which router is the parent router of the LAN with respect to source S.
ii. In Truncated Reverse Path Broadcast, indicate which LANs are leaf LANs, and which leaf LANs will be truncated.
iii. In Reverse Path Multicasting (basically the full-blown DVMRP), identify which routers send Non-Membership Reports, and to whom do they send them.
iv. After pruning, identify the LANS over which multicast messages from S are sent to group


receiver
H
R1
R2
F
G
R3
R4
D
E
R5
R6
C
Source
R7
receiver
R9
B
A