
RÉSEAUX ET MOBILITÉ

PART I: INTERNET

EXAM

Duration: 2 hours

2004 February 12

Do not forget to put your names on *all* sheets of your solution.

All problems have the same weight in the final appreciation.

If you need to make assumptions in order to solve some questions, write them down explicitly.

PROBLEM 1. Sources 1 and 2 share a common link with capacity c . The rate x_i of source i is also constrained by $x_i \leq r_i$, for some fixed numbers r_i , $i = 1, 2$. We have $c = 7\text{Mb/s}$, $r_1 = 2\text{Mb/s}$, $r_2 = 6\text{Mb/s}$.

1. Assume that the two rates x_1 and x_2 are allocated according to max-min fairness. What are their values ?
2. Same question with proportional fairness.

PROBLEM 2. 1. Why do bridges have to build a spanning tree whereas routers do not ?

2. What happens to packets if there is a routing loop with bridges ? with routers ?

3. Is it possible for a link-state algorithm to use the Bellman-Ford algorithm ? Why or why not ?

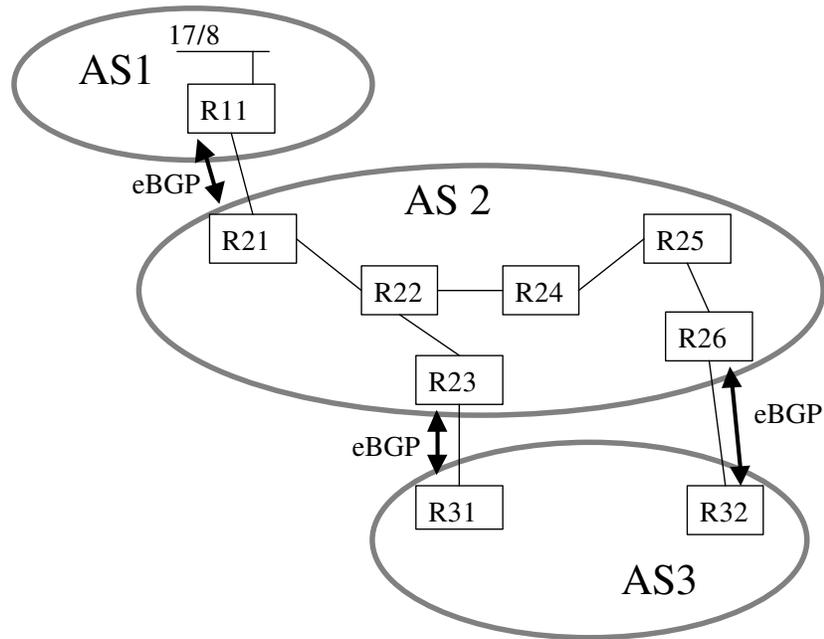
PROBLEM 3. Consider the network with point to point links and costs as given in Table 1.

	A	B	C	D
A		1	X	8
B	1		1	1
C	X	1		1
D	8	1	1	

Table 1: Costs $c(i, j)$ for Exercise 3

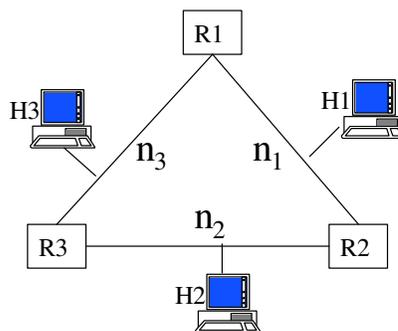
1. Give the routing tables built at A using the distance vector method.
2. Assume the link between nodes A and B fails. B sees the failure and computes new distances. Just after that, B receives from C an old distance vector, sent by C before C could notice the failure. Explain what will happen and comment

PROBLEM 4. Consider the network below. Assume that AS1 advertizes the route 17/8 via R11.



1. Explain in at most 2 lines by which mechanisms AS3 will learn a route to 17/8. Explain in at most 2 lines the protocols used between all routers that play a role in propagating the information from R11 to AS3.
2. AS1 is a customer of AS2, and AS3 is a peer of AS2. AS2 would like that the traffic from AS3 to 17/8 flows via R23 and not via R26, in order to reduce the amount of traffic on the backbone of AS2. How can AS2 implement this (at most 2 lines) ? Explain the steps that happen at routers R23 and R26 to implement this (at most 2 lines).

PROBLEM 5. 1. Consider the intranet below.



There are three Ethernet segments at 10 Mb/s, each corresponding to a net : subnet prefix noted n_1 , n_2 and n_3 . Every Ethernet segment is connected to two routers as indicated on the figure. There is no external connection to this intranet. The Ethernet segments are shared media, there is no Ethernet switching equipment.

On segment i there is a host H_i , which sends traffic to host $H_{(i \bmod 3)+1}$ (for example, host H_1 sends traffic to host H_2).

The default router for host H_i is router R_i .

We assume that the IP routing tables in R1, R2 and R3 are setup by OSPF. The link cost, used by OSPF to compute the metrics of the paths, is c_i for network n_i , with $c_1 = 10$, $c_2 = 20$ and $c_3 = 40$.

- (a) Give the routing tables at the three routers.
 - (b) Give the paths followed by traffic originated by hosts H_1 , H_2 and H_3 .
2. We now replace the routers R_1 , R_2 and R_3 by bridges B_1 , B_2 and B_3 . The LAN segment costs are as in the previous section. The identifier of the bridges are B_1 , B_2 and B_3 . All bridges have equal priority.
- (a) Give one possible realization of the set of paths followed by traffic originated by hosts H_1 , H_2 and H_3 .
 - (b) Compare bridging versus routing in this example. Which of the two is more efficient? What could be done to improve the situation?

PROBLEM 6. Joe (A) is in the Kalahari desert and sends reports via satellite to the base camp (B). B is connected to a server C via a cabled connection. B acts as a router between A and C. The bit rates are:

- between A and B: 2 Mb/s
- between B and C: 100 kb/s

Joe has one TCP connection between A and C (connection 1). In addition, the base camp also has one TCP connection (connection 2) between B and C. The round trip times are:

- connection 1: 400 msec
- connection 2: 40 msec

1. Give an estimate of the throughputs x_1 and x_2 of connections 1 and 2 (assume they can utilize the links fully, thus ignoring overhead).
2. Assume Joe now replaces connection 1 by 10 parallel connections. Give an estimate of the throughput achieved by Joe.