RIP: Routing Information Protocol
A Routing Protocol Based on the Distance-Vector Algorithm

Group 4

due November 14th, 2019

Question 1

Obtain and analyze the graphs that compare the sent RIP traffic for both scenarios.

The chart comparing RIP updates for the Failure and No Failure scenario can be seen in figure 1. The figure looks at the total number of updates to Router 1's routing table in both scenarios over the 10 minute period. In the bottom chart illustrating the No Failure scenario, the router tables are only updated once at the beginning of the simulation. The router table is updated 7 times across the four routers, and only at the very beginning. This is simply showing the initial exchange of advertisements that converges to a stable configuration of routes.

In the Failure scenario seen in the top chart, we can see the router tables have (presumably) the same initial 7 updates at the beginning of the simulation, but between 3 to 4 minutes there is a second and third round of updates. The timing of the second round of updates corresponds with when the failure is introduced. When the link failure occurs in the simulation, Router 1 notes that its link is no longer active and gets an advertisement from Router 3, causing it to update its table several times. At the next advertisement cycle, the route going through router 4 finally gets relayed to router 1 which causes it to make the final wave of updates.

It is odd that the entire cycle is complete within 20 seconds of the failure, as RIP's main way of detecting these failures is a timeout after a certain number of missed advertisements. This seems to suggest that the simulator implements the failure as a loud rather than silent failure, such that the Router is immediately aware of the problem.

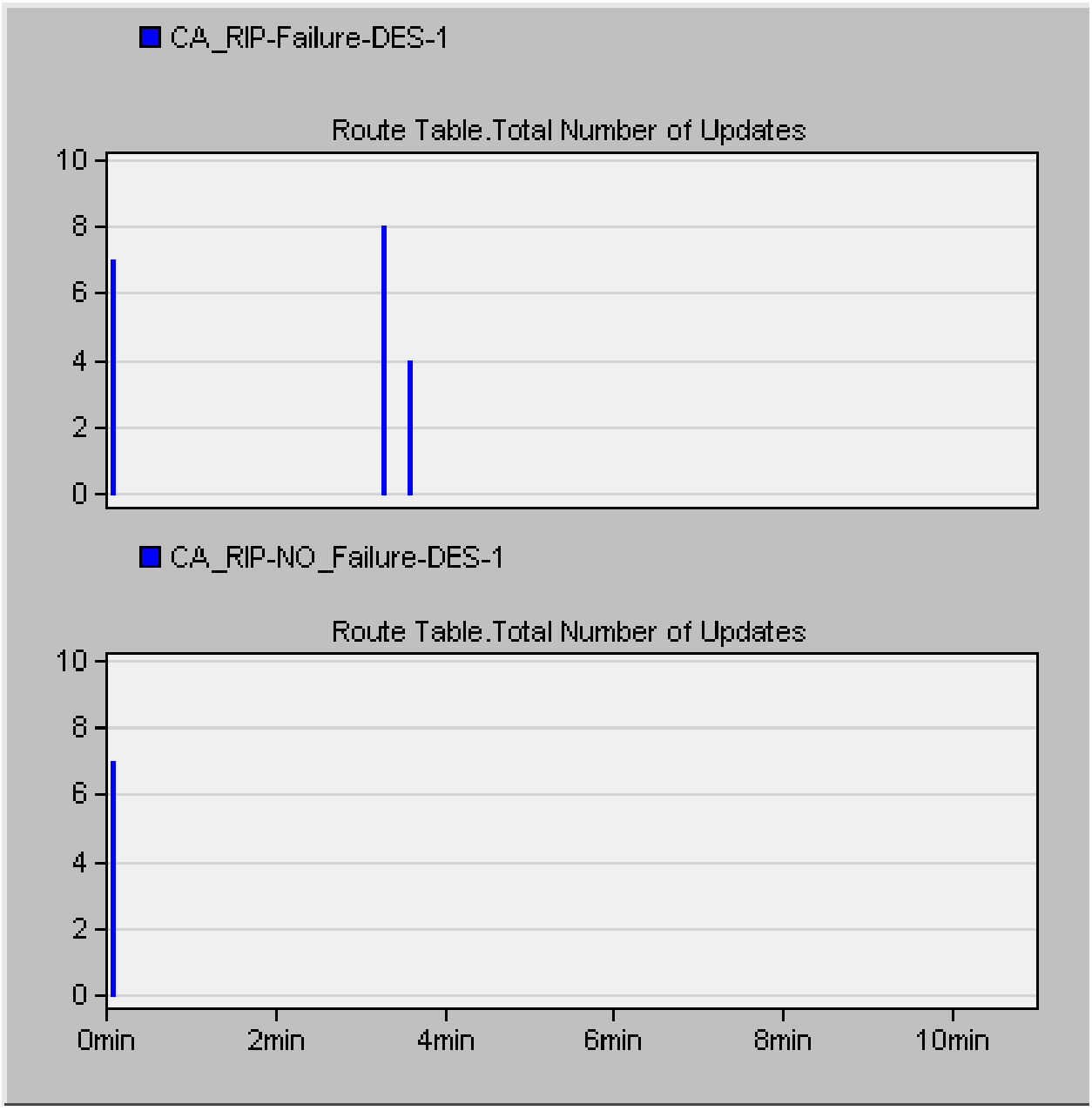

Figure 1: Comparing Failure and No Failure scenario

Question 2

Describe and explain the effect of the failure of the link connecting Router1 to Router2 on the routing tables.

The Routing Tables for Router 1 in the No Failure and Failure scenarios can be seen in 3 and 4 respectively. For reference, the IP addresses of all interfaces, including the loop-back interfaces of the routers, are provided in figure 2. The Failure scenario has the same IP addresses, and is omitted. Unsurprisingly, there are quite a few routes that have increased length, and all of these are routes that had previously been passed to router 2. The routes to 192.0.5.0/24 and 192.0.6.0 and 192.0.8.0/24 have increased to length 3, denoting that they went through router 2, and 192.0.7.0/24 has increased to 2 suggesting that this is the IP for the interface between routers 4 and 2. It's also worth noting that the route to 192.0.3.0/24 has gone to 16; this suggests that the address is unreachable, as 16 is the longest possible hop chain length in RIP. This is the address for the interface between routers 1 and 2 which is broken, and its corresponding destination is conspicuously missing in the forwarding table.

It is worth noting that there are four destinations that are routed to Router 2 is the non-failure scenario. This may shed some light on the fact that the Failure scenario updates happened in multiples of four; each of these four entries was updated when Router 2 failed to advertise and when Router 3's advertisement was processed, and then the final update happened when Router 4's advertised route propagated across the network. The fact that the route to IF11 was not accounted for in the updates seems odd, but it would seem that an update is only registered when the next hop address is changed; since this entry is specifically routed toward the broken interface, there can be no viable path and the path is never updated.

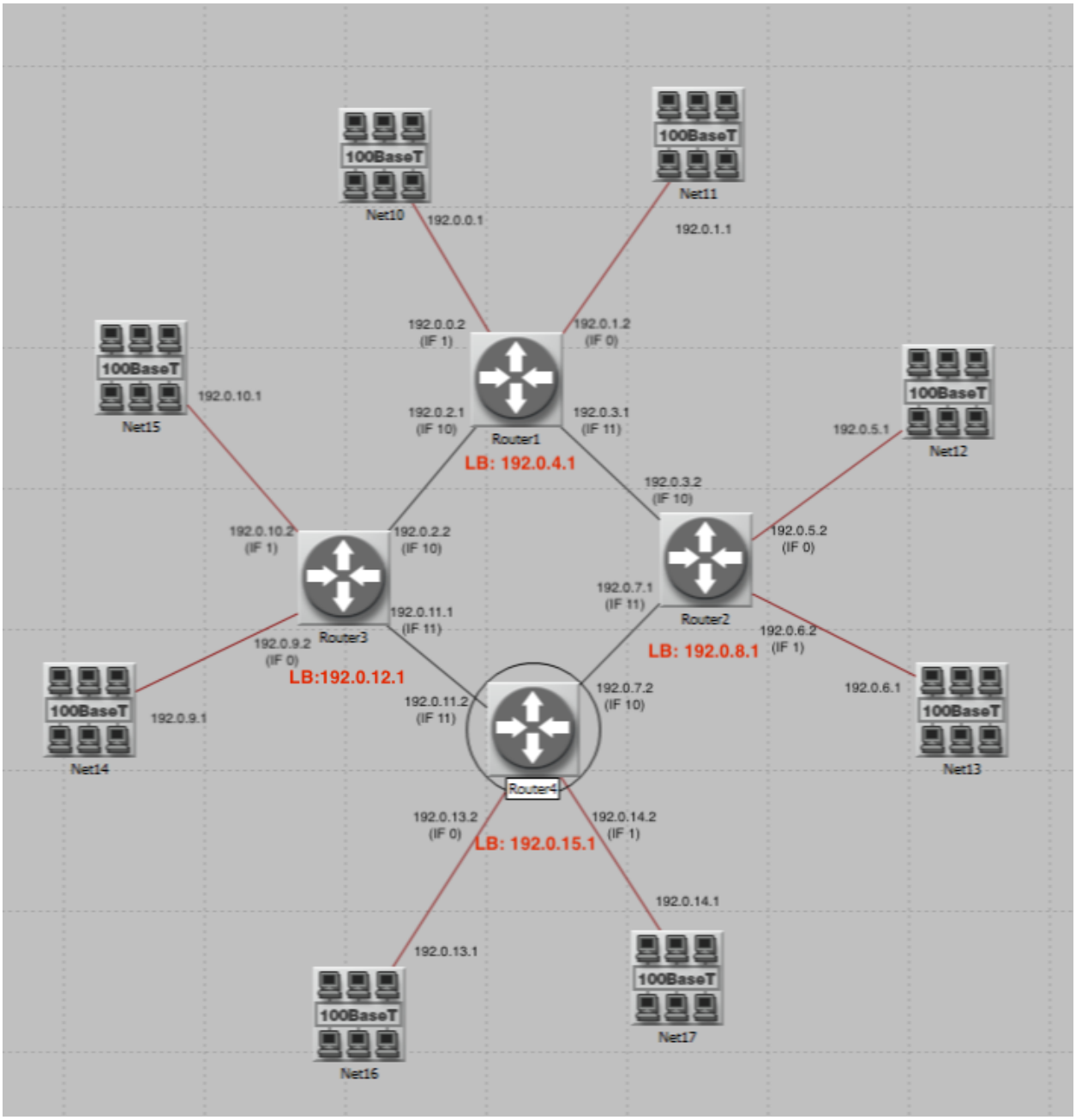

Figure 2: Annotated network graph with Interface IP addresses

	VRF Name	Destination	Metric	Next Hop Address	Next Hop Node	Outgoing Interface
1	None	192.0.0.0/24	0	192.0.0.2	Campus Network.Router1	IF0
2		192.0.1.0/24	0	192.0.1.2	Campus Network.Router1	IF1
3		192.0.2.0/24	0	192.0.2.1	Campus Network.Router1	IF10
4		192.0.3.0/24	0	192.0.3.1	Campus Network.Router1	IF11
5		192.0.4.0/24	0	192.0.4.1	Campus Network.Router1	LB0
6		192.0.5.0/24	1	192.0.3.2	Campus Network.Router2	IF11
7		192.0.6.0/24	1	192.0.3.2	Campus Network.Router2	IF11
8		192.0.7.0/24	1	192.0.3.2	Campus Network.Router2	IF11
9		192.0.8.0/24	1	192.0.3.2	Campus Network.Router2	IF11
10		192.0.9.0/24	1	192.0.2.2	Campus Network.Router3	IF10
11		192.0.10.0/24	1	192.0.2.2	Campus Network.Router3	IF10
12		192.0.11.0/24	1	192.0.2.2	Campus Network.Router3	IF10
13		192.0.12.0/24	1	192.0.2.2	Campus Network.Router3	IF10
14		192.0.13.0/24	2	192.0.2.2	Campus Network.Router3	IF10
15		192.0.14.0/24	2	192.0.2.2	Campus Network.Router3	IF10
16		192.0.15.0/24	2	192.0.2.2	Campus Network.Router3	IF10

Figure 3: Routing Table in No Failure scenario

	VRF Name	Destination	Metric	Next Hop Address	Next Hop Node	Outgoing Interface
1	None	192.0.0.0/24	0	192.0.0.2	Campus Network.Router1	IF0
2		192.0.1.0/24	0	192.0.1.2	Campus Network.Router1	IF1
3		192.0.2.0/24	0	192.0.2.1	Campus Network.Router1	IF10
4		192.0.3.0/24	16	192.0.3.1	Campus Network.Router1	IF11
5		192.0.4.0/24	0	192.0.4.1	Campus Network.Router1	LB0
6		192.0.5.0/24	3	192.0.2.2	Campus Network.Router3	IF10
7		192.0.6.0/24	3	192.0.2.2	Campus Network.Router3	IF10
8		192.0.7.0/24	2	192.0.2.2	Campus Network.Router3	IF10
9		192.0.8.0/24	3	192.0.2.2	Campus Network.Router3	IF10
10		192.0.9.0/24	1	192.0.2.2	Campus Network.Router3	IF10
11		192.0.10.0/24	1	192.0.2.2	Campus Network.Router3	IF10
12		192.0.11.0/24	1	192.0.2.2	Campus Network.Router3	IF10
13		192.0.12.0/24	1	192.0.2.2	Campus Network.Router3	IF10
14		192.0.13.0/24	2	192.0.2.2	Campus Network.Router3	IF10
15		192.0.14.0/24	2	192.0.2.2	Campus Network.Router3	IF10
16		192.0.15.0/24	2	192.0.2.2	Campus Network.Router3	IF10

Figure 4: Routing Table in Failure scenario

Question 3

Create another scenario Q3_Recover. Have the link connecting Router1 to Router2 recover after 400 seconds. Generate and analyze the graph that shows the effect of this recovery on the Total Number of Updates in the routing table of Router1. Check the contents of Router1's routing table. Compare this table with the corresponding routing tables generated in the NO_Failure and Failure scenarios.

The updates and routing table for Router 1 in the Recovery case are found in figures 5 and 6, respectively. In this case, the routing table generated after reconnecting the network is again identical to the No Failure scenario. All of the hop addresses are the same, which is unsurprising.

The slightly more interesting part is the update chart, figure 5. In this case the same behavior is seen as before up to the 400 second mark, as specified. However, at 400 seconds, a single update is seen as the IF11 interface is restored. This is different from the failure case, as there seemed to be no update to the table to reflect the increased cost of the interface itself (as discussed in question 2). In this case, however, there is an extra update that cannot be accounted for in the routes moving through router 2. This is perhaps evidence that the fluke identified in Question 2 is merely an idiosyncrasy of the simulator's implementation of connection failures.

About 25 seconds (one advertisement cycle, potentially) after the restoration of the link, there are updates as Router 1 incorporates Router 2 into its table again. These 4 changes are undoubtedly exactly those changes seen between figures 4 and 6.

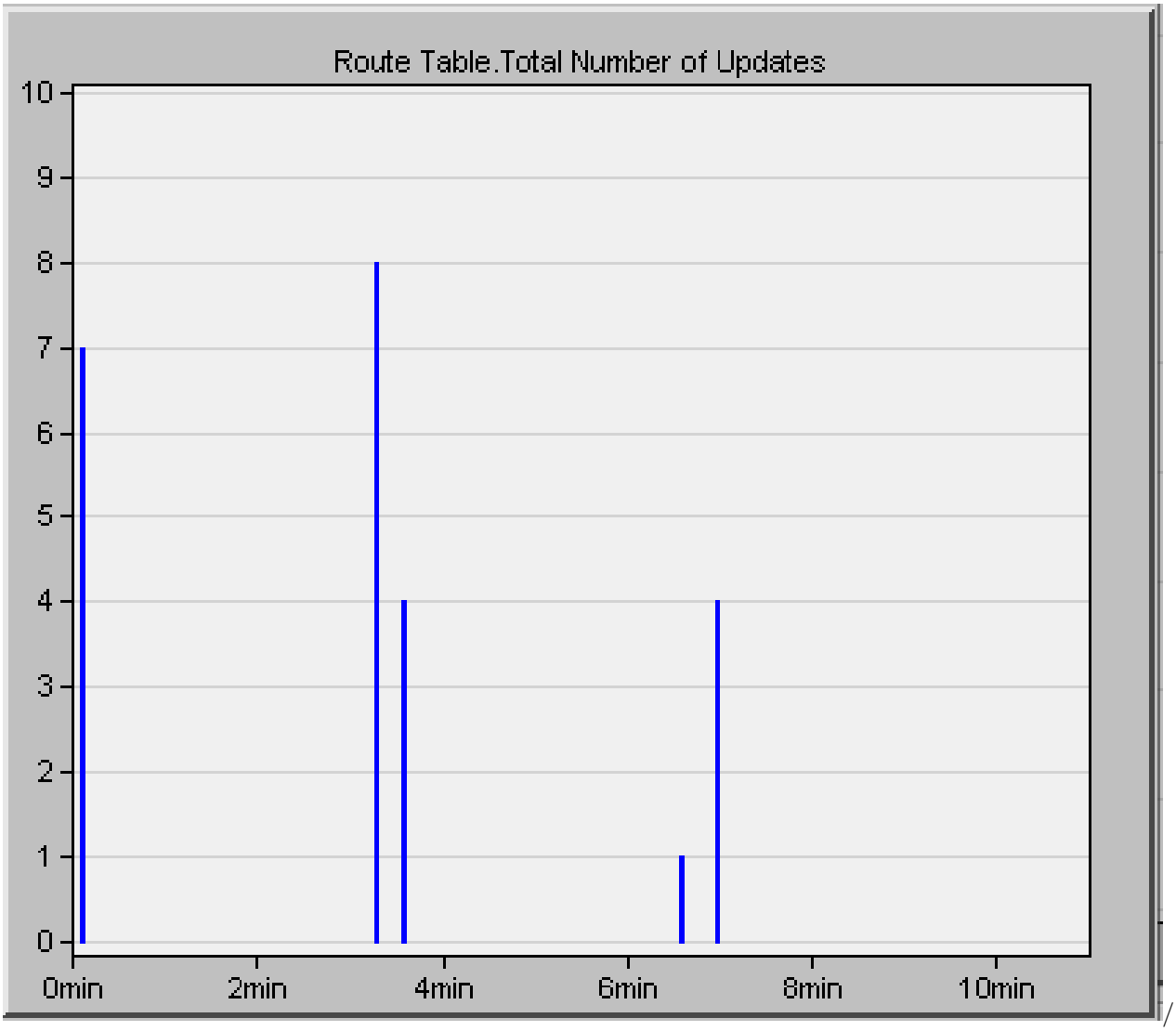

Figure 5: Chart for Q3 Recovery scenario, displaying total number of updates

	VRF Name	Destination	Metric	Next Hop Address	Next Hop Node	Outgoing Interface
1	None	192.0.0.0/24	0	192.0.0.2	Campus Network.Router1	IF0
2		192.0.1.0/24	0	192.0.1.2	Campus Network.Router1	IF1
3		192.0.2.0/24	0	192.0.2.1	Campus Network.Router1	IF10
4		192.0.3.0/24	0	192.0.3.1	Campus Network.Router1	IF11
5		192.0.4.0/24	0	192.0.4.1	Campus Network.Router1	LB0
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9		192.0.8.0/24	1	192.0.3.2	Campus Network.Router2	IF11
10		192.0.9.0/24	1	192.0.2.2	Campus Network.Router3	IF10
11		192.0.10.0/24	1	192.0.2.2	Campus Network.Router3	IF10
12		192.0.11.0/24	1	192.0.2.2	Campus Network.Router3	IF10
13		192.0.12.0/24	1	192.0.2.2	Campus Network.Router3	IF10
14		192.0.13.0/24	2	192.0.2.2	Campus Network.Router3	IF10
15		192.0.14.0/24	2	192.0.2.2	Campus Network.Router3	IF10
16		192.0.15.0/24	2	192.0.2.2	Campus Network.Router3	IF10

Figure 6: Routing Table for Q3 Recovery scenario.