Routing Protocols; RIP & OSPF Simulation using Riverbed Modeller (OPNET)

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Brief Abstract

In this lab, Routing Information Protocol (RIP) and Open Shortest Path First (OSPF) are simulated using Riverbed. Both simulations compare the traffic after a link failure. In OSPF, areas assigning and load balancing are also observed.

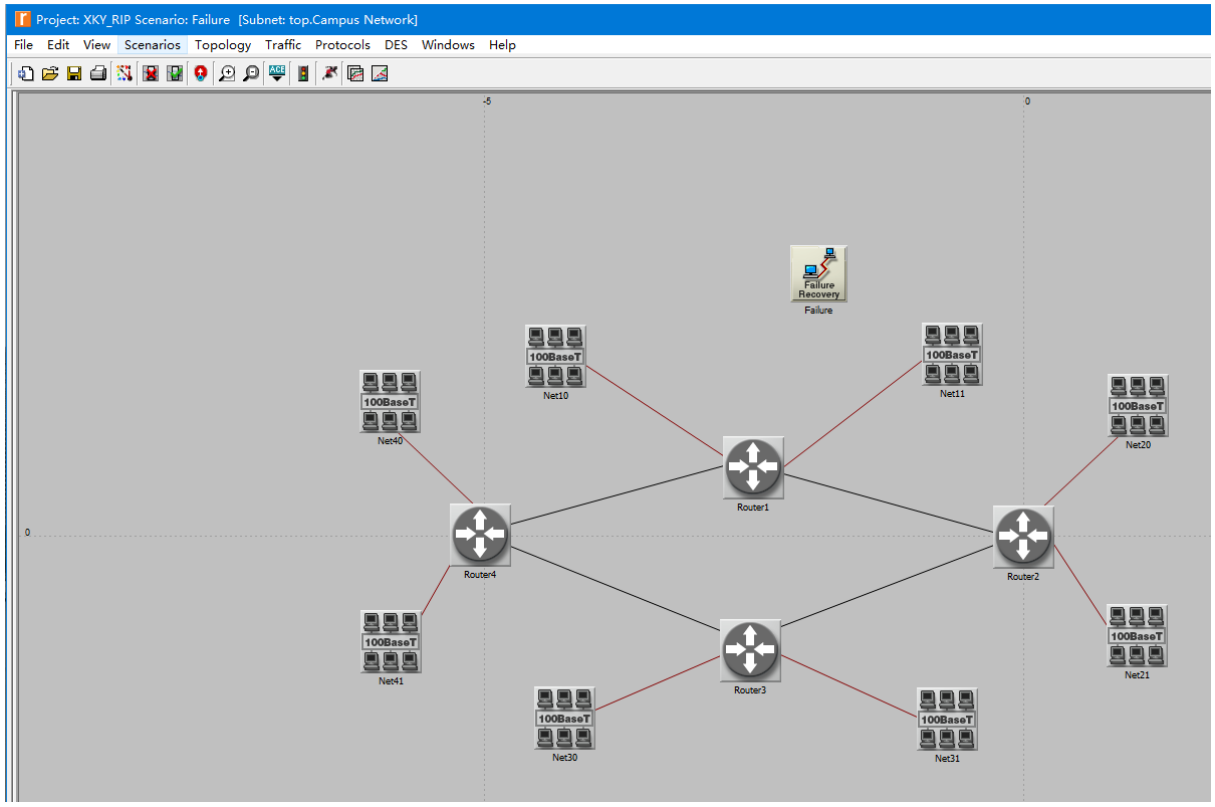


Figure 1 – Failure Scenario

RIP Questions

1. Obtain and analyze the graphs that compare the sent RIP traffic for both scenarios. Make sure to change the draw style for the graphs to Bar Chart.

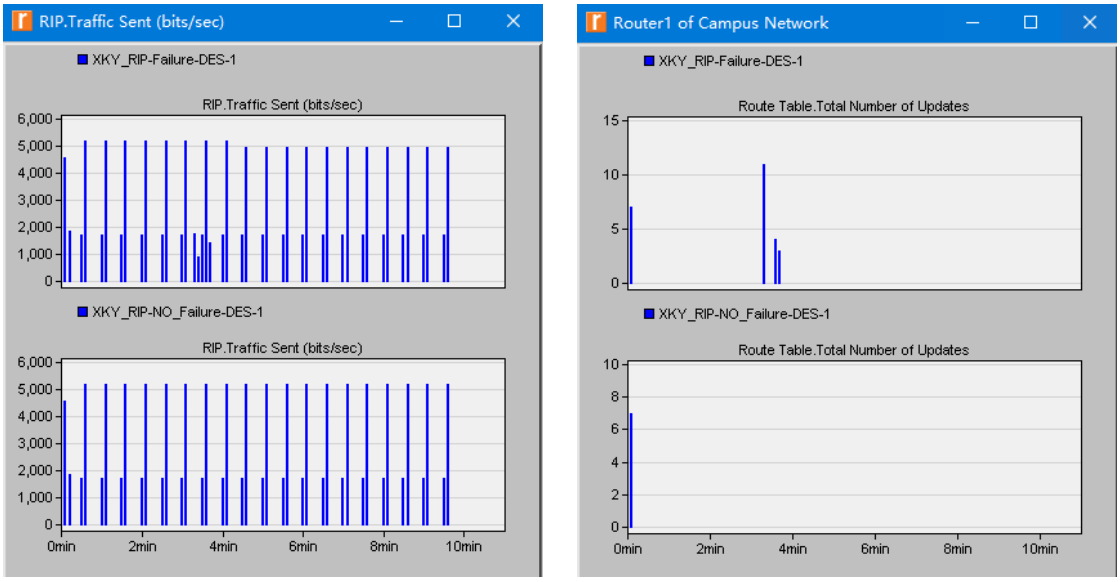


Figure 2 – Sent RIP Traffic & Number of Updates Comparison

A: In the simulation, the link between Router1 and Router2 fails 200 seconds.
From the graph, in the failure scenario there exists a busier traffic around 200 second, which shows the routers are sending update messages after their routing tables are changed (caused by triggered update from another router).
Besides, the graph shows routers send their advertisements every 30 seconds.

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

	Destination	Source Protocol	Route Preference	Metric	Next Hop Address	Next Hop Node	Outgoing Interface	Outgoing LSP	Insertion Time (secs)
1	192.0.0.0/24	Direct	0	0	192.0.0.1	Campus Network.Router1	IF0	N/A	0.000
2	192.0.1.0/24	Direct	0	0	192.0.1.1	Campus Network.Router1	IF1	N/A	0.000
3	192.0.3.0/24	Direct	0	0	192.0.3.1	Campus Network.Router1	IF11	N/A	0.000
4	192.0.4.0/24	Direct	0	0	192.0.4.1	Campus Network.Router1	LB0	N/A	0.000
5	192.0.5.0/24	RIP	120	3	192.0.3.2	Campus Network.Router4	IF11	N/A	224.191
6	192.0.6.0/24	RIP	120	3	192.0.3.2	Campus Network.Router4	IF11	N/A	224.191
7	192.0.7.0/24	RIP	120	2	192.0.3.2	Campus Network.Router4	IF11	N/A	217.176
8	192.0.8.0/24	RIP	120	3	192.0.3.2	Campus Network.Router4	IF11	N/A	224.191
9	192.0.9.0/24	RIP	120	1	192.0.3.2	Campus Network.Router4	IF11	N/A	7.176
10	192.0.10.0/24	RIP	120	1	192.0.3.2	Campus Network.Router4	IF11	N/A	7.176
11	192.0.11.0/24	RIP	120	1	192.0.3.2	Campus Network.Router4	IF11	N/A	7.176
12	192.0.12.0/24	RIP	120	1	192.0.3.2	Campus Network.Router4	IF11	N/A	7.176
13	192.0.13.0/24	RIP	120	2	192.0.3.2	Campus Network.Router4	IF11	N/A	217.176
14	192.0.14.0/24	RIP	120	2	192.0.3.2	Campus Network.Router4	IF11	N/A	217.176
15	192.0.15.0/24	RIP	120	2	192.0.3.2	Campus Network.Router4	IF11	N/A	217.176
16									
17	Gateway of last resort is	not set							

Figure 3 – Forwarding Table of Router1 (Failure Scenario)

	Destination	Source Protocol	Route Preference	Metric	Next Hop Address	Next Hop Node	Outgoing Interface	Outgoing LSP	Insertion Time (secs)
1	192.0.0.0/24	Direct	0	0	192.0.0.1	Campus Network.Router1	IF0	N/A	0.000
2	192.0.1.0/24	Direct	0	0	192.0.1.1	Campus Network.Router1	IF1	N/A	0.000
3	192.0.2.0/24	Direct	0	0	192.0.2.1	Campus Network.Router1	IF10	N/A	0.000
4	192.0.3.0/24	Direct	0	0	192.0.3.1	Campus Network.Router1	IF11	N/A	0.000
5	192.0.4.0/24	Direct	0	0	192.0.4.1	Campus Network.Router1	LB0	N/A	0.000
6	192.0.5.0/24	RIP	120	1	192.0.2.2	Campus Network.Router2	IF10	N/A	5.850
7	192.0.6.0/24	RIP	120	1	192.0.2.2	Campus Network.Router2	IF10	N/A	5.850
8	192.0.7.0/24	RIP	120	1	192.0.2.2	Campus Network.Router2	IF10	N/A	5.850
9	192.0.8.0/24	RIP	120	1	192.0.2.2	Campus Network.Router2	IF10	N/A	5.850
10	192.0.9.0/24	RIP	120	1	192.0.3.2	Campus Network.Router4	IF11	N/A	7.176
11	192.0.10.0/24	RIP	120	1	192.0.3.2	Campus Network.Router4	IF11	N/A	7.176
12	192.0.11.0/24	RIP	120	1	192.0.3.2	Campus Network.Router4	IF11	N/A	7.176
13	192.0.12.0/24	RIP	120	1	192.0.3.2	Campus Network.Router4	IF11	N/A	7.176
14	192.0.13.0/24	RIP	120	2	192.0.2.2	Campus Network.Router2	IF10	N/A	11.390
15	192.0.14.0/24	RIP	120	2	192.0.2.2	Campus Network.Router2	IF10	N/A	11.390
16	192.0.15.0/24	RIP	120	2	192.0.2.2	Campus Network.Router2	IF10	N/A	11.390
17									
18	Gateway of last resort is	not set							

Figure 4 – Forwarding Table of Router1 (NO Failure Scenario)

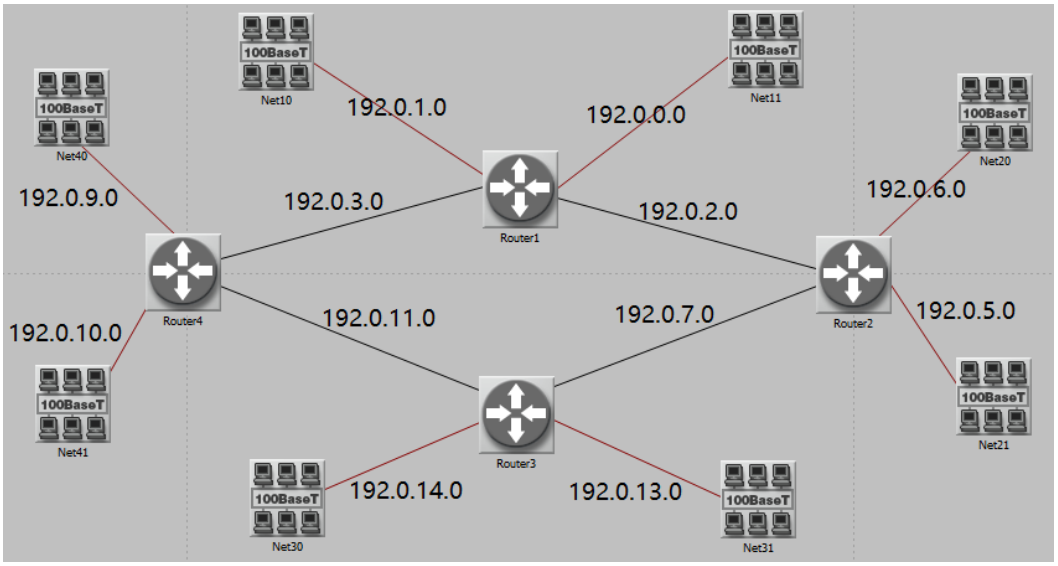


Figure 5 – NO Failure Scenario (With IP Address)

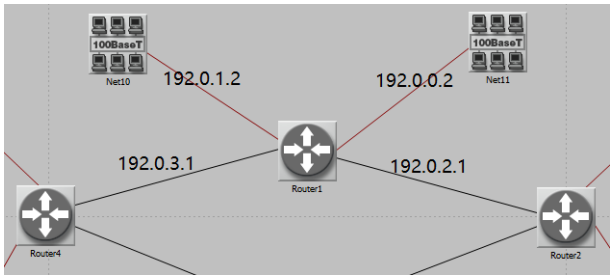


Figure 6 – IP Address associated with Router1

A: After link connecting Router1 to Router2 fails, Router1 to Router2 needs to go through Router4 and Router3, Router1 to Router3 can only go through Router4, so the Metric to destination 192.0.5.0/24 and 192.0.6.0/24 increases from 2 to 3, and some destinations' insertion time also increase largely.

3. Create another scenario as a duplicate of the Failure scenario. Name the new scenario Q3_Recover. In this new scenario 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.

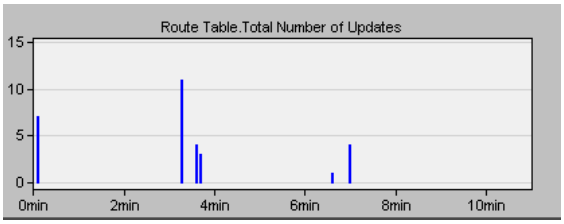


Figure 7 – Q3_Recover Number of Updates

A: From the graph, another update now happens at around 400 second.

	Destination	Source Protocol	Route Preference	Metric	Next Hop Address	Next Hop Node	Outgoing Interface	Outgoing LSP	Insertion Time (secs)
1	192.0.0.0/24	Direct	0	0	192.0.0.1	Campus Network.Router1	IF0	N/A	0.000
2	192.0.1.0/24	Direct	0	0	192.0.1.1	Campus Network.Router1	IF1	N/A	0.000
3	192.0.2.0/24	Direct	0	0	192.0.2.1	Campus Network.Router1	IF10	N/A	400.000
4	192.0.3.0/24	Direct	0	0	192.0.3.1	Campus Network.Router1	IF11	N/A	0.000
5	192.0.4.0/24	Direct	0	0	192.0.4.1	Campus Network.Router1	LB0	N/A	0.000
6	192.0.5.0/24	RIP	120	1	192.0.2.2	Campus Network.Router2	IF10	N/A	425.850
7	192.0.6.0/24	RIP	120	1	192.0.2.2	Campus Network.Router2	IF10	N/A	425.850
8	192.0.7.0/24	RIP	120	1	192.0.2.2	Campus Network.Router2	IF10	N/A	425.850
9	192.0.8.0/24	RIP	120	1	192.0.2.2	Campus Network.Router2	IF10	N/A	425.850
10	192.0.9.0/24	RIP	120	1	192.0.3.2	Campus Network.Router4	IF11	N/A	7.176
11	192.0.10.0/24	RIP	120	1	192.0.3.2	Campus Network.Router4	IF11	N/A	7.176
12	192.0.11.0/24	RIP	120	1	192.0.3.2	Campus Network.Router4	IF11	N/A	7.176
13	192.0.12.0/24	RIP	120	1	192.0.3.2	Campus Network.Router4	IF11	N/A	7.176
14	192.0.13.0/24	RIP	120	2	192.0.3.2	Campus Network.Router4	IF11	N/A	217.176
15	192.0.14.0/24	RIP	120	2	192.0.3.2	Campus Network.Router4	IF11	N/A	217.176
16	192.0.15.0/24	RIP	120	2	192.0.3.2	Campus Network.Router4	IF11	N/A	217.176
17									
18	Gateway of last resort is	not set							

Figure 8 – Forwarding Table of Router1 (Q3_Recover Scenario)

A: There is no major difference from NO_Failure Scenario, only several Insertion Time increases nearly 200 or 400secs.

OSPF Questions

1. Explain why the Areas and Balanced scenarios result in different routes than those observed in the No_Areas scenario, for the same pair of routers.

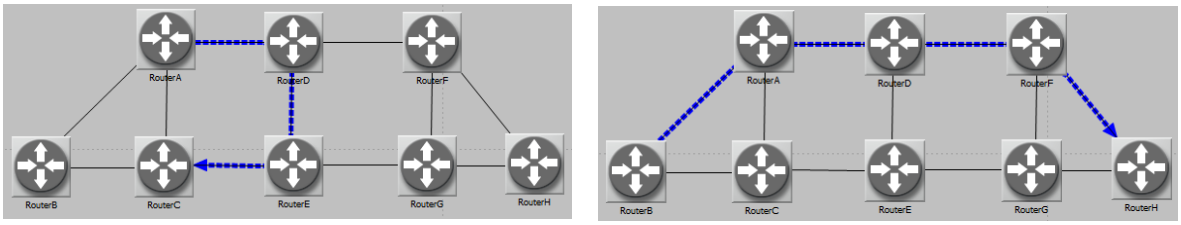


Figure 9 – NO_Areas Scenario A to C & B to H

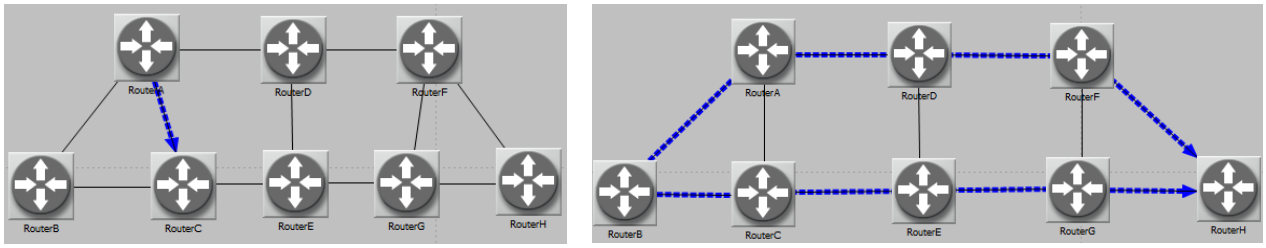


Figure 10 – Areas Scenario A to C & Balanced Scenario B to H

In No_Areas scenario, all routers belong to one area, so the shortest route between A and C can choose 5+5+5=15. In Balanced scenario, the load is balanced.

2. Using the simulation log, examine the generated routing table in RouterA for each of the three scenarios. Explain the values assigned to the Metric column of each route.

```
# Node Name: Campus Network.RouterA
#  Iface Name            IP Address       Subnet Mask      Connected Link
#  ----------            ---------------  ---------------  ----------------
   IF0                      192.0.0.2        255.255.255.252  Campus Network.RouterA <-> RouterD
   IF1                      192.0.0.10       255.255.255.252  Campus Network.RouterA <-> RouterB
   IF2                      192.0.0.14       255.255.255.252  Campus Network.RouterC <-> RouterA
   LB0                      192.0.1.1        255.255.255.0    Not connected to any link.
```

Figure 11 – Interface IP address (RouterA)

	Destination	Source Protocol	Route Preference	Metric	Next Hop Address	Next Hop Node	Outgoing Interface	Outgoing LSP	Insertion Time (secs)
1	192.0.0.0/30	Direct	0	0	192.0.0.2	Campus Network.RouterA	IF0	N/A	0.000
2	192.0.0.4/30	OSPF 1	110	10	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
3	192.0.0.8/30	Direct	0	0	192.0.0.10	Campus Network.RouterA	IF1	N/A	0.000
4	192.0.0.12/30	Direct	0	0	192.0.0.14	Campus Network.RouterA	IF2	N/A	0.000
5	192.0.0.16/30	OSPF 1	110	35	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
6	192.0.0.20/30	OSPF 1	110	10	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
7	192.0.0.24/30	OSPF 1	110	15	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
8	192.0.0.28/30	OSPF 1	110	20	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
9	192.0.0.32/30	OSPF 1	110	15	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
10	192.0.0.36/30	OSPF 1	110	25	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
11	192.0.0.40/30	OSPF 1	110	20	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
12	192.0.1.0/24	Direct	0	0	192.0.1.1	Campus Network.RouterA	LB0	N/A	0.000
13									
14	Gateway of last resort is	not set							

Figure 12 – NO_Areas Scenario Forwarding Table (RouterA)

	Destination	Source Protocol	Route Preference	Metric	Next Hop Address	Next Hop Node	Outgoing Interface	Outgoing LSP	Insertion Time (secs)
1	192.0.0.0/30	Direct	0	0	192.0.0.2	Campus Network.RouterA	IF0	N/A	0.000
2	192.0.0.4/30	OSPF 1	110	10	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
3	192.0.0.8/30	Direct	0	0	192.0.0.10	Campus Network.RouterA	IF1	N/A	0.000
4	192.0.0.12/30	Direct	0	0	192.0.0.14	Campus Network.RouterA	IF2	N/A	0.000
5	192.0.0.16/30	OSPF 1	110	40	192.0.0.13	Campus Network.RouterC	IF2	N/A	32.176
6		OSPF 1	110	40	192.0.0.9	Campus Network.RouterB	IF1	N/A	32.176
7	192.0.0.20/30	OSPF 1	110	10	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
8	192.0.0.24/30	OSPF 1	110	15	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
9	192.0.0.28/30	OSPF 1	110	20	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
10	192.0.0.32/30	OSPF 1	110	15	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
11	192.0.0.36/30	OSPF 1	110	25	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
12	192.0.0.40/30	OSPF 1	110	20	192.0.0.1	Campus Network.RouterD	IF0	N/A	34.148
13	192.0.1.0/24	Direct	0	0	192.0.1.1	Campus Network.RouterA	LB0	N/A	0.000
14	192.0.2.0/24	OSPF 1	110	6	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
15	192.0.3.0/24	OSPF 1	110	11	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
16	192.0.4.0/24	OSPF 1	110	21	192.0.0.9	Campus Network.RouterB	IF1	N/A	32.176
17	192.0.5.0/24	OSPF 1	110	21	192.0.0.13	Campus Network.RouterC	IF2	N/A	32.176
18	192.0.6.0/24	OSPF 1	110	11	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
19	192.0.7.0/24	OSPF 1	110	16	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
20	192.0.8.0/24	OSPF 1	110	21	192.0.0.1	Campus Network.RouterD	IF0	N/A	34.971
21									
22	Gateway of last resort is	not set							

Figure 13 – Areas Scenario Forwarding Table (RouterA)

	Destination	Source Protocol	Route Preference	Metric	Next Hop Address	Next Hop Node	Outgoing Interface	Outgoing LSP	Insertion Time (secs)
1	192.0.0.0/30	Direct	0	0	192.0.0.2	Campus Network.RouterA	IF0	N/A	0.000
2	192.0.0.4/30	OSPF 1	110	10	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
3	192.0.0.8/30	Direct	0	0	192.0.0.10	Campus Network.RouterA	IF1	N/A	0.000
4	192.0.0.12/30	Direct	0	0	192.0.0.14	Campus Network.RouterA	IF2	N/A	0.000
5	192.0.0.16/30	OSPF 1	110	35	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
6	192.0.0.20/30	OSPF 1	110	10	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
7	192.0.0.24/30	OSPF 1	110	15	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
8	192.0.0.28/30	OSPF 1	110	20	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
9	192.0.0.32/30	OSPF 1	110	15	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
10	192.0.0.36/30	OSPF 1	110	25	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
11	192.0.0.40/30	OSPF 1	110	20	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
12	192.0.1.0/24	Direct	0	0	192.0.1.1	Campus Network.RouterA	LB0	N/A	0.000
13	192.0.2.0/24	OSPF 1	110	6	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
14	192.0.3.0/24	OSPF 1	110	11	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
15	192.0.4.0/24	OSPF 1	110	21	192.0.0.9	Campus Network.RouterB	IF1	N/A	32.176
16	192.0.5.0/24	OSPF 1	110	16	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
17	192.0.6.0/24	OSPF 1	110	11	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
18	192.0.7.0/24	OSPF 1	110	16	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
19	192.0.8.0/24	OSPF 1	110	21	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
20									
21	Gateway of last resort is	not set							

Figure 14 – Balanced Scenario Forwarding Table (RouterA)

A: Router metrics are used for routing decisions. The route will go in the direction of the gateway with the lowest metric.

3. Modeler allows you to examine the link-state database that is used by each router to build the directed graph of the network. Examine this database for RouterA in the No_Areas scenario. Show how RouterA utilizes this database to create a map for the topology of the network and draw this map (This is the map that will be used later by the router to create its routing table.)

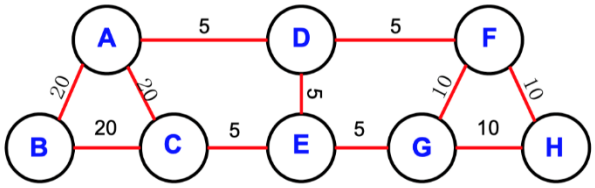
Performance.OSPF Router Link LSDB at 600 seconds for Campus Network.RouterA

File Edit View Help

	Process Tag (Area ID)	Link State ID	Adv Router ID	Sequence Number	LSA Age	LSA Timestamp		Link Type	Link ID	Link Data	
1	1 (0.0.0.0)	192.0.1.1	192.0.1.1	97	3	22.371		Stub Network	192.0.1.1	255.255.255.0	1
2		A					D	Point-To-Point	192.0.0.22	192.0.0.2	5
3								Stub Network	192.0.0.0	255.255.255.252	5
4							B	Point-To-Point	192.0.0.18	192.0.0.10	20
5								Stub Network	192.0.0.8	255.255.255.252	20
6							C	Point-To-Point	192.0.0.26	192.0.0.14	20
7								Stub Network	192.0.0.12	255.255.255.252	20
8											
9		192.0.0.18	192.0.0.18	98	3	22.465	A	Point-To-Point	192.0.1.1	192.0.0.9	20
10		B						Stub Network	192.0.0.8	255.255.255.252	20
11							C	Point-To-Point	192.0.0.26	192.0.0.18	20
12								Stub Network	192.0.0.16	255.255.255.252	20
13											
14		192.0.0.34	192.0.0.34	123	5	24.295	C	Point-To-Point	192.0.0.26	192.0.0.25	5
15		E						Stub Network	192.0.0.24	255.255.255.252	5
16							D	Point-To-Point	192.0.0.22	192.0.0.21	5
17								Stub Network	192.0.0.20	255.255.255.252	5
18							G	Point-To-Point	192.0.0.38	192.0.0.34	5
19								Stub Network	192.0.0.32	255.255.255.252	5
20											
21		192.0.0.38	192.0.0.38	124	6	24.503	E	Point-To-Point	192.0.0.34	192.0.0.33	5
22		G						Stub Network	192.0.0.32	255.255.255.252	5
23							F	Point-To-Point	192.0.0.42	192.0.0.29	10
24								Stub Network	192.0.0.28	255.255.255.252	10
25							H	Point-To-Point	192.0.0.41	192.0.0.38	10
26								Stub Network	192.0.0.36	255.255.255.252	10
27											
28		192.0.0.41	192.0.0.41	137	5	24.836	F	Point-To-Point	192.0.0.42	192.0.0.41	10
29		H						Stub Network	192.0.0.40	255.255.255.252	10
30							G	Point-To-Point	192.0.0.38	192.0.0.37	10
31								Stub Network	192.0.0.36	255.255.255.252	10
32											
33		192.0.0.42	192.0.0.42	150	4	24.971	D	Point-To-Point	192.0.0.22	192.0.0.5	5
34		F						Stub Network	192.0.0.4	255.255.255.252	5
35							G	Point-To-Point	192.0.0.38	192.0.0.30	10
36								Stub Network	192.0.0.28	255.255.255.252	10
37							H	Point-To-Point	192.0.0.41	192.0.0.42	10
38								Stub Network	192.0.0.40	255.255.255.252	10
39											
40		192.0.0.22	192.0.0.22	151	3	27.284	A	Point-To-Point	192.0.1.1	192.0.0.1	5
41		D						Stub Network	192.0.0.0	255.255.255.252	5
42							F	Point-To-Point	192.0.0.42	192.0.0.6	5
43								Stub Network	192.0.0.4	255.255.255.252	5
44							E	Point-To-Point	192.0.0.34	192.0.0.22	5
45								Stub Network	192.0.0.20	255.255.255.252	5
46											
47		192.0.0.26	192.0.0.26	152	4	27.371	B	Point-To-Point	192.0.0.18	192.0.0.17	20
48		C						Stub Network	192.0.0.16	255.255.255.252	20
49							A	Point-To-Point	192.0.1.1	192.0.0.13	20
50								Stub Network	192.0.0.12	255.255.255.252	20
51							E	Point-To-Point	192.0.0.34	192.0.0.26	5
52								Stub Network	192.0.0.24	255.255.255.252	5

Figure 15 – RouterA's Link-State Database

A: The map:



4. Create another scenario as a duplicate of the No_Areas scenario. Name the new scenario Q4_No_Areas_Failure. In this new scenario simulate a failure of the link connecting RouterD and RotuerE. Have this failure start after 100 seconds. Rerun the simulation. Show how that link failure affects the content of the link- state database and routing table of RouterA. (You will need to disable the global attribute OSPF Sim Efficiency. This will allow OSPF to update the routing table if there is any change in the network.)

	Process Tag (Area ID)	Link State ID	Adv Router ID	Sequence Number	LSA Age	LSA Timestamp		Link Type	Link ID	Link Data	
1	1 (0.0.0.0)	192.0.1.1	192.0.1.1	97	3	22.371		Stub Network	192.0.1.1	255.255.255.0	1
2								Point-To-Point	192.0.0.22	192.0.0.2	5
3		A					D	Stub Network	192.0.0.0	255.255.255.252	5
4								Point-To-Point	192.0.0.18	192.0.0.10	20
5							B	Stub Network	192.0.0.8	255.255.255.252	20
6								Point-To-Point	192.0.0.26	192.0.0.14	20
7							C	Stub Network	192.0.0.12	255.255.255.252	20
8											
9		192.0.0.18	192.0.0.18	98	3	22.465		Point-To-Point	192.0.1.1	192.0.0.9	20
10		B					A	Stub Network	192.0.0.8	255.255.255.252	20
11								Point-To-Point	192.0.0.26	192.0.0.18	20
12							C	Stub Network	192.0.0.16	255.255.255.252	20
13											
14		192.0.0.38	192.0.0.38	124	6	24.503		Point-To-Point	192.0.0.34	192.0.0.33	5
15							E	Stub Network	192.0.0.32	255.255.255.252	5
16		G						Point-To-Point	192.0.0.42	192.0.0.29	10
17							F	Stub Network	192.0.0.28	255.255.255.252	10
18								Point-To-Point	192.0.0.41	192.0.0.38	10
19							H	Stub Network	192.0.0.36	255.255.255.252	10
20											
21		192.0.0.41	192.0.0.41	137	5	24.836		Point-To-Point	192.0.0.42	192.0.0.41	10
22							F	Stub Network	192.0.0.40	255.255.255.252	10
23		H						Point-To-Point	192.0.0.38	192.0.0.37	10
24							G	Stub Network	192.0.0.36	255.255.255.252	10
25											
26		192.0.0.42	192.0.0.42	150	4	24.971		Point-To-Point	192.0.0.22	192.0.0.5	5
27							D	Stub Network	192.0.0.4	255.255.255.252	5
28		F						Point-To-Point	192.0.0.38	192.0.0.30	10
29							G	Stub Network	192.0.0.28	255.255.255.252	10
30								Point-To-Point	192.0.0.41	192.0.0.42	10
31							H	Stub Network	192.0.0.40	255.255.255.252	10
32											
33		192.0.0.26	192.0.0.26	152	4	27.371		Point-To-Point	192.0.0.18	192.0.0.17	20
34		C					B	Stub Network	192.0.0.16	255.255.255.252	20
35								Point-To-Point	192.0.1.1	192.0.0.13	20
36							A	Stub Network	192.0.0.12	255.255.255.252	20
37								Point-To-Point	192.0.0.34	192.0.0.26	5
38							E	Stub Network	192.0.0.24	255.255.255.252	5
39											
40		192.0.0.22	192.0.0.22	249	3	100.000		Point-To-Point	192.0.1.1	192.0.0.1	5
41		D					A	Stub Network	192.0.0.0	255.255.255.252	5
42								Point-To-Point	192.0.0.42	192.0.0.6	5
43							F	Stub Network	192.0.0.4	255.255.255.252	5
44											
45		192.0.0.34	192.0.0.34	262	5	100.000		Point-To-Point	192.0.0.26	192.0.0.25	5
46		E					C	Stub Network	192.0.0.24	255.255.255.252	5
47								Point-To-Point	192.0.0.38	192.0.0.34	5
48							G	Stub Network	192.0.0.32	255.255.255.252	5

Figure 16 – RouterA's Link-State Database

	Destination	Source Protocol	Route Preference	Metric	Next Hop Address	Next Hop Node	Outgoing Interface	Outgoing LSP	Insertion Time (secs)
1	192.0.0.0/30	Direct	0	0	192.0.0.2	Campus Network.RouterA	IF0	N/A	0.000
2	192.0.0.4/30	OSPF 1	110	10	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
3	192.0.0.8/30	Direct	0	0	192.0.0.10	Campus Network.RouterA	IF1	N/A	0.000
4	192.0.0.12/30	Direct	0	0	192.0.0.14	Campus Network.RouterA	IF2	N/A	0.000
5	192.0.0.16/30	OSPF 1	110	40	192.0.0.13	Campus Network.RouterC	IF2	N/A	105.000
6		OSPF 1	110	40	192.0.0.9	Campus Network.RouterB	IF1	N/A	105.000
7	192.0.0.24/30	OSPF 1	110	25	192.0.0.13	Campus Network.RouterC	IF2	N/A	105.000
8	192.0.0.28/30	OSPF 1	110	20	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
9	192.0.0.32/30	OSPF 1	110	25	192.0.0.1	Campus Network.RouterD	IF0	N/A	105.000
10	192.0.0.36/30	OSPF 1	110	30	192.0.0.1	Campus Network.RouterD	IF0	N/A	105.000
11	192.0.0.40/30	OSPF 1	110	20	192.0.0.1	Campus Network.RouterD	IF0	N/A	32.176
12	192.0.1.0/24	Direct	0	0	192.0.1.1	Campus Network.RouterA	LB0	N/A	0.000
13									
14	Gateway of last resort is	not set							

Figure 17 – Failure Scenario Forwarding Table (RouterA)

A: In link- state database, the D-E link is missing. In Forwarding Table, some “next hop” changed.

5. For both No_Areas and Q4_No_Areas_Failure scenario, collect the Traffic Sent (bits/sec) statistic (one of the Global Statistics under OSPF). Rerun the simulation for those two scenarios and obtain the graph that compares the OSPF’s Traffic Sent (bits/sec) in both scenarios. Comment on the obtained graph.

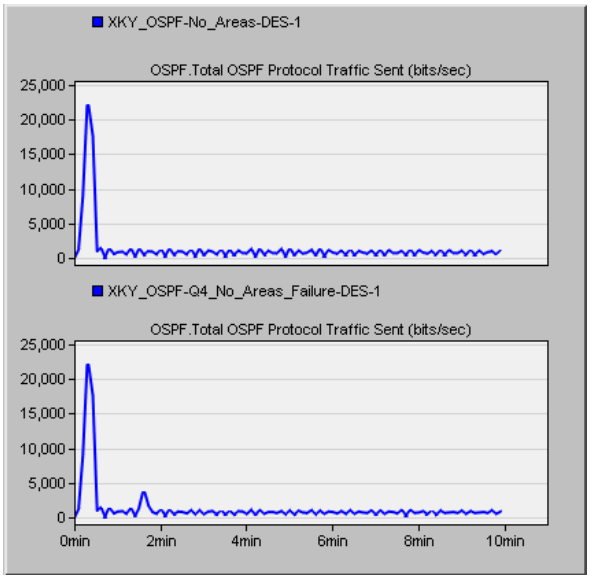


Figure 18 –Traffic Sent Comparison

A: In Q4 scenario, when D-E link failure happens at 100sec, the traffic increases a lot in a short period. This may due to update messages.

Conclusion

This lab is mainly focused on two Routing Protocols.
In the RIP part, the number of updates is observed after link-failure and link-recover, showing the routers are sending update messages.
In the OSPF part, No_Areas, Areas and Balanced Scenarios are observed and compared. Failure also causes routers sending messages to update Link-State Database.
Results have reached expectation.
The data offered by Riverbed is very detailed.

Nov.27 2019