1 Simulating Link Failure (Level 1)

1.1 Objective

To model link failure, understand its impact on network performance.

1.2 Theory

A link failure can occur due to a) faults in the physical link and b) failure of the connected port. When a link fails, packets cannot be transported. This also means that established routes to destinations may become unavailable. In such cases, the routing protocol must recompute an alternate path around the failure.

In NetSim, only WAN links (connecting two routers) can be failed. Right click on a WAN link between two routers and the Link Properties Window is as shown below Figure 1-1.

Figure 1-1: Wired Link Properties Window

Link Up Time refers to the time(s) at which the link is functional and Link Down Time refers to the time (s) at which a link fails. Click on Up_Time or Down_Time to understand the configuration options.

NOTE: Link failure can be set only for "WAN Interfaces".

1.3 Network Setup

Open NetSim and click on **Experiments> Internetworks> Network Performance> Advanced Simulating Link Failure** then click on the tile in the middle panel to load the example as shown in below Figure 1-2.
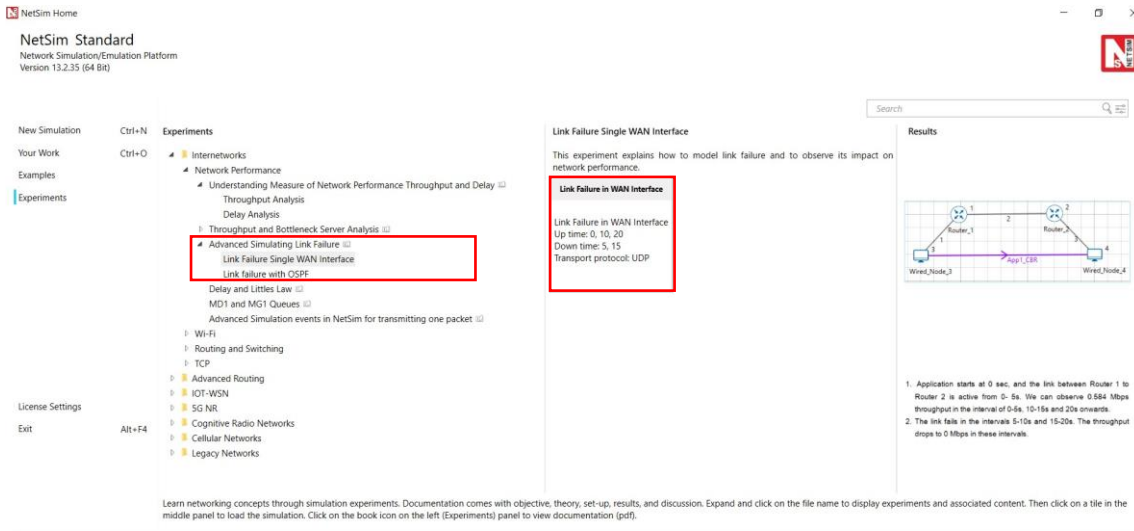

Figure 1-2: List of scenarios for the example of Advanced Simulating Link Failure

1.3.1 Link Failure Single WAN Interface

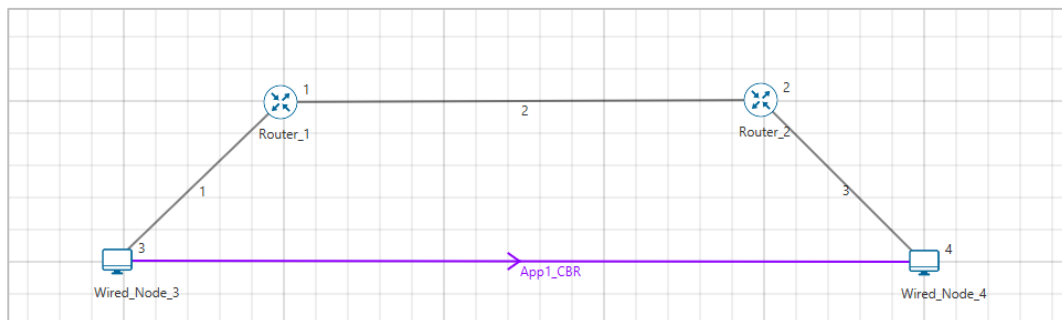NetSim UI displays the configuration file corresponding to this experiment as shown below Figure 1-3.

Figure 1-3: Network set up for studying the Link Failure Single WAN Interface

1.3.1.1 Procedure

The following set of procedures were done to generate this sample:

Step 1: In the **"Internetworks"** library, and a network scenario is designed in NetSim comprising of 2 Wired Nodes and 2 Routers.

Step 2: By default, Link Failure **Up Time** is set to 0,10,20 and **Down Time** is set to 5,15. This means the link is up 0-5s, 10-15s and 20s onwards, and it is down 5-10s and 15-20s.

Step 3: Packet Trace is enabled in NetSim GUI. At the end of the simulation, a .csv file containing all the packet information is available for performing packet level analysis.

Step 4: Right click on the Application Flow **App1 CBR** and select Properties or click on the Application icon present in the top ribbon/toolbar.

A CBR Application is generated from Wired Node 3 i.e., Source to Wired Node 4 i.e., Destination with Packet Size remaining 1460 Bytes and Inter Arrival Time remaining 20000µs.

Step 5: Transport protocol set as UDP.

Step 6: Enable the plots and run the simulation for 50 Seconds.

1.3.1.2   Output

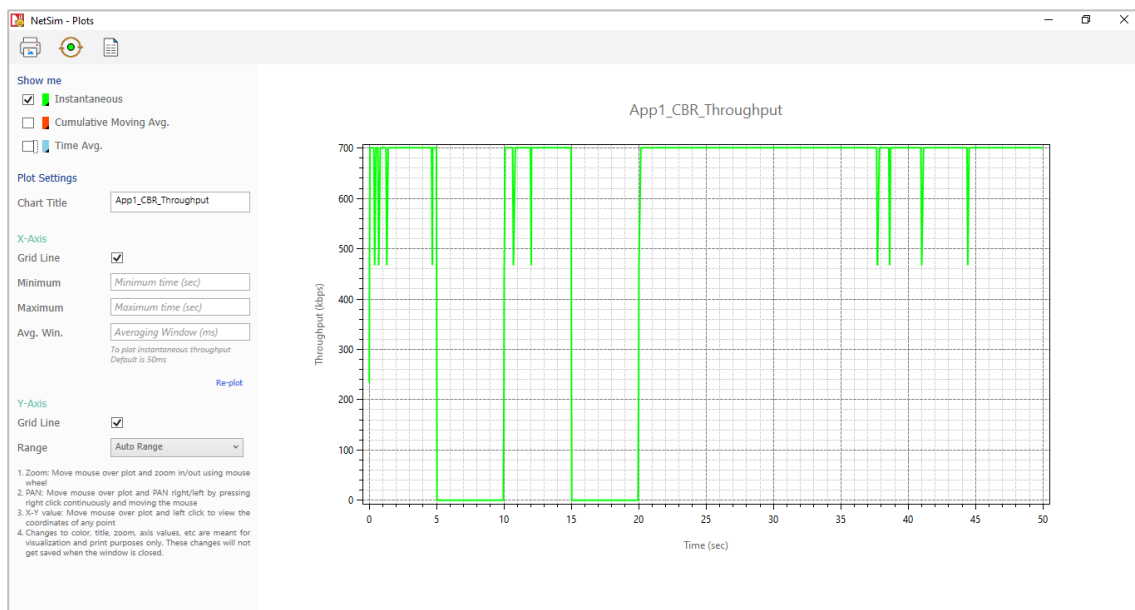Go to NetSim Simulation Result Window and open the Application Throughput plot. We can notice the following:

Figure 1-4: Application Throughput plot for APP1_CBR

1. Application starts at 0 sec, and the link between Router 1 to Router 2 is active from 0-5s. We can observe 0.584 Mbps throughput in the interval of 0-5s, 10-15s and 20s onwards.
2. The link fails in the intervals 5-10s and 15-20s. The throughput drops to 0 Mbps in these intervals.

1.3.2   Link Failure with OSPF

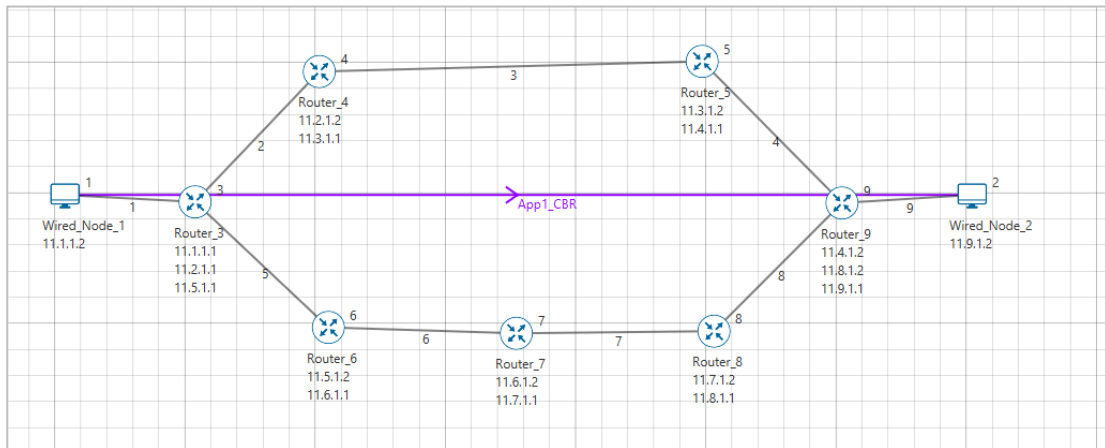NetSim UI displays the configuration file corresponding to this experiment as shown Figure 1-5.

Figure 1-5: Network set up for studying the Link Failure with OSPF

1.3.2.1   Procedure

Without link failure: The following set of procedures were done to generate this sample:

Step 1: In the **"Internetworks"** library, and a network scenario is designed in NetSim comprising of 2 Wired Nodes and 7 Routers.

Step 2: By default, Link Failure **Up Time** is set to 0 and **Down Time** is set to 100000.

Step 3: Packet Trace is enabled in NetSim GUI. At the end of the simulation, a .csv file containing all the packet information is available for performing packet level analysis.

Step 4: Right click on the Application Flow **App1 CBR** and select Properties or click on the Application icon present in the top ribbon/toolbar.

A CBR Application is generated from Wired Node 1 i.e., Source to Wired Node 2 i.e., Destination with Packet Size remaining 1460 Bytes and Inter Arrival Time remaining 20000µs.

Additionally, the **"Start Time(s)"** parameter is set to 30, while configuring the application. This time is usually set to be greater than the time taken for OSPF Convergence (i.e., exchange of OSPF information between all the routers), and it increases as the size of the network increases.

Step 5: Transport protocol set as TCP.

Step 6: Enable the plots and run the simulation for 80 Seconds.

With link failure: The following changes in settings are done from the previous sample:

Step 1: In Link 3 Properties, Link Failure **Up Time** is set to 0 and **Down Time** is set to 50. This means that the link would fail at 50 Seconds.

Step 2: Enable the plots and run the simulation for 80 Seconds.

1.3.2.2　Output

Go to NetSim Packet Animation Window, click on Play button. We can notice the following:

- Initially OSPF Control Packets are exchanged between all the routers.
- Once after the exchange of control packets, the data packets are sent from the source to the destination.
- The packets are routed to the Destination via, **N1 > R3 > R4 > R5 > R9 > N2** as shown below Figure 1-6.
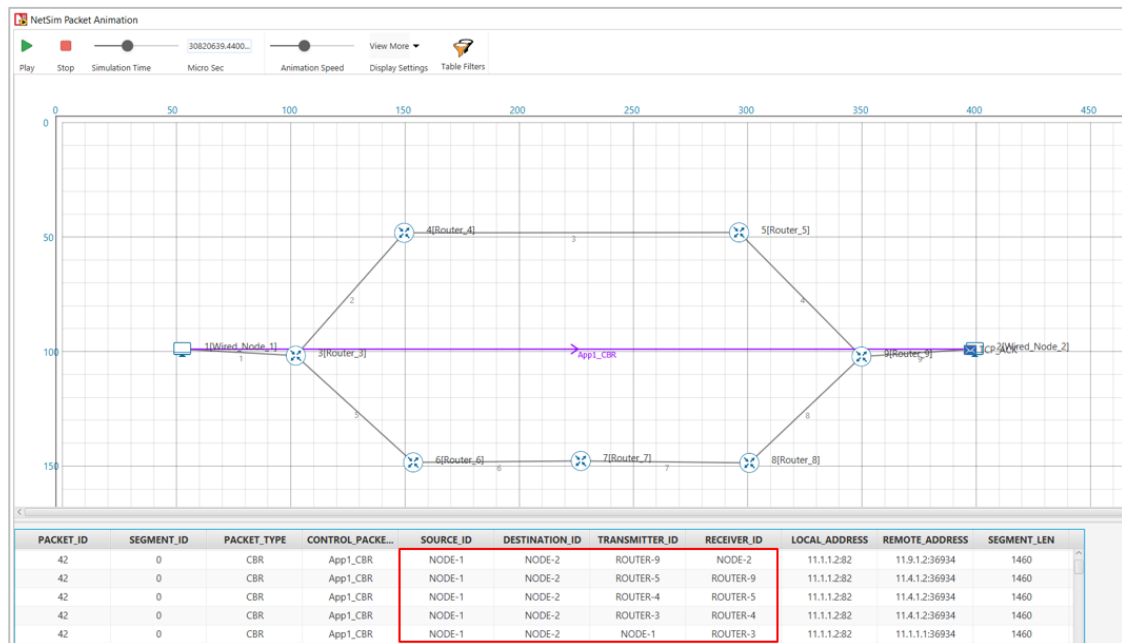

Figure 1-6: Animation window for without link failure

With link failure

- We create a Link Failure in Link 3, between Router 4 and Router 5 at 50s.
- Since the packets are not able to reach the destination, the routing protocol recomputes an alternate path to the Destination.
- This can be observed in the Packet Trace.
- Go to the Results Dashboard and click on Open Packet Trace option present in the Left-Hand-Side of the window and do the following:
- Filter Control Packet Type/App Name to APP1 CBR and Transmitter ID to Router 3.

PACKET_ID	SEGMENT_ID	PACKET_TYPE	CONTROL_PACKET_TYPE/APP_NAME	SOURCE_ID	DESTINATION_ID	TRANSMITTER_ID	RECEIVER_ID
994	0	CBR	App1_CBR	NODE-1	NODE-2	ROUTER-3	ROUTER-4
995	0	CBR	App1_CBR	NODE-1	NODE-2	ROUTER-3	ROUTER-4
996	0	CBR	App1_CBR	NODE-1	NODE-2	ROUTER-3	ROUTER-4
997	0	CBR	App1_CBR	NODE-1	NODE-2	ROUTER-3	ROUTER-4
998	0	CBR	App1_CBR	NODE-1	NODE-2	ROUTER-3	ROUTER-4
999	0	CBR	App1_CBR	NODE-1	NODE-2	ROUTER-3	ROUTER-4
1000	0	CBR	App1_CBR	NODE-1	NODE-2	ROUTER-3	ROUTER-4
1001	0	CBR	App1_CBR	NODE-1	NODE-2	ROUTER-3	ROUTER-4
1001	0	CBR	App1_CBR	NODE-1	NODE-2	ROUTER-3	ROUTER-6
1002	0	CBR	App1_CBR	NODE-1	NODE-2	ROUTER-3	ROUTER-6
1003	0	CBR	App1_CBR	NODE-1	NODE-2	ROUTER-3	ROUTER-6
1004	0	CBR	App1_CBR	NODE-1	NODE-2	ROUTER-3	ROUTER-6
1005	0	CBR	App1_CBR	NODE-1	NODE-2	ROUTER-3	ROUTER-6
1006	0	CBR	App1_CBR	NODE-1	NODE-2	ROUTER-3	ROUTER-6
1007	0	CBR	App1_CBR	NODE-1	NODE-2	ROUTER-3	ROUTER-6
1008	0	CBR	App1_CBR	NODE-1	NODE-2	ROUTER-3	ROUTER-6
1009	0	CBR	App1_CBR	NODE-1	NODE-2	ROUTER-3	ROUTER-6

Figure 1-7: Packet Trace

- We can notice that packets are changing its route from,

  N1 > R3 > R4 > R5 > R9 > N2 to **N1 > R3 > R6 > R7 > R8 > R9 > N2** at 50 s of simulation time, since the link between R4 and R5 fails at 50 s.

Users can also observe this in Packet animation before and after the Link Failure as shown below Figure 1-8/Figure 1-9.
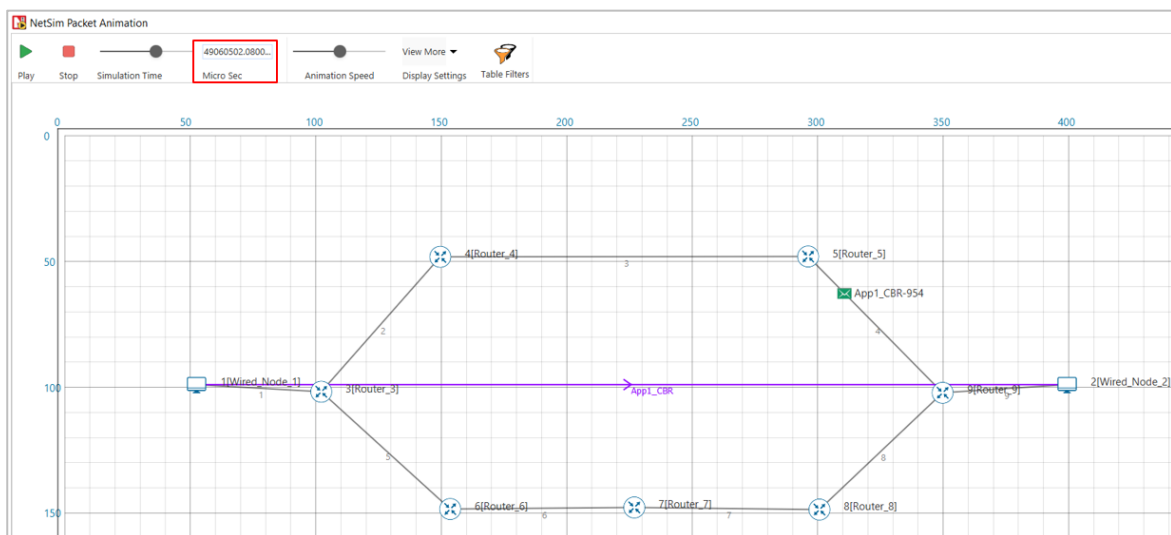

Figure 1-8: Packet animation window before Link Failure showing packet flow for with link failure
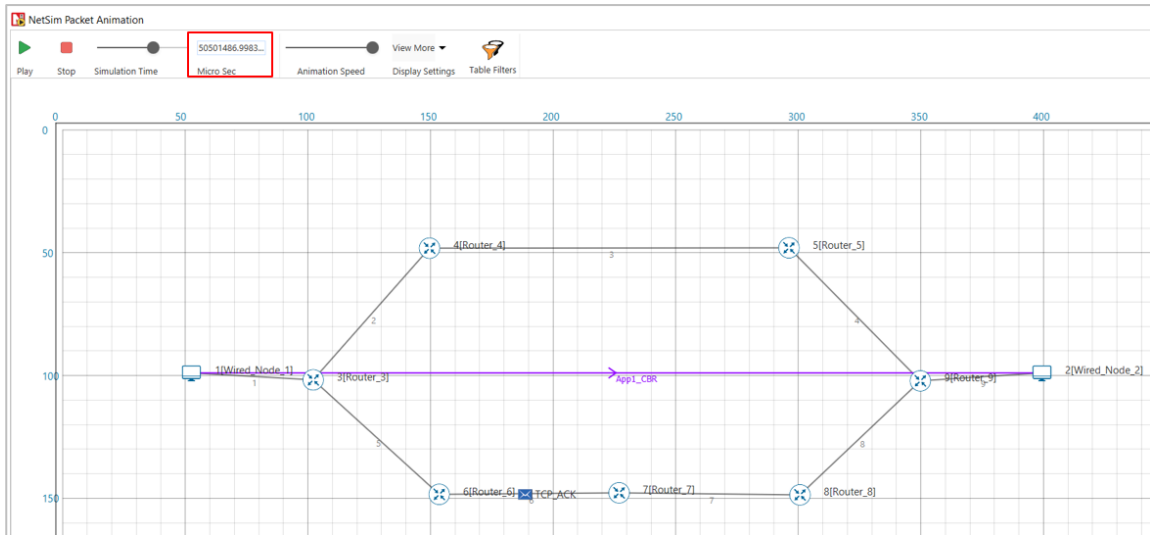
Figure 1-9: Packet animation window after Link Failure showing packet flow for with link failure