Assignment 4
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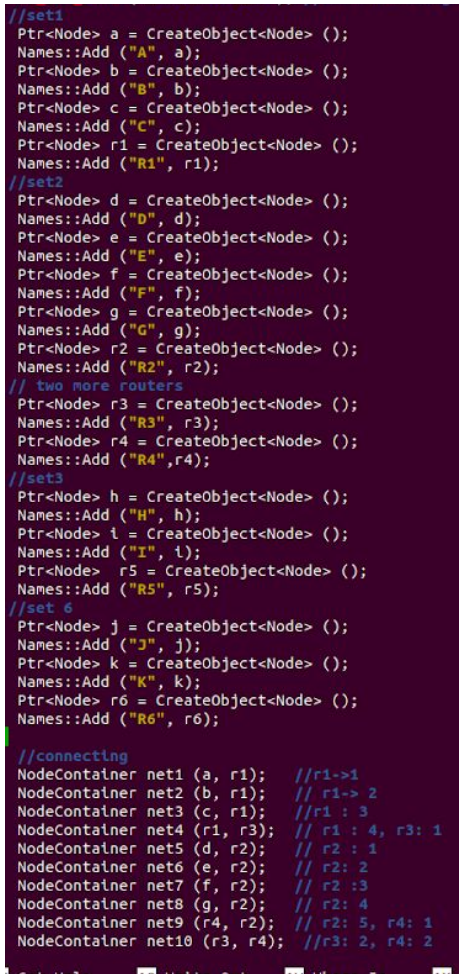
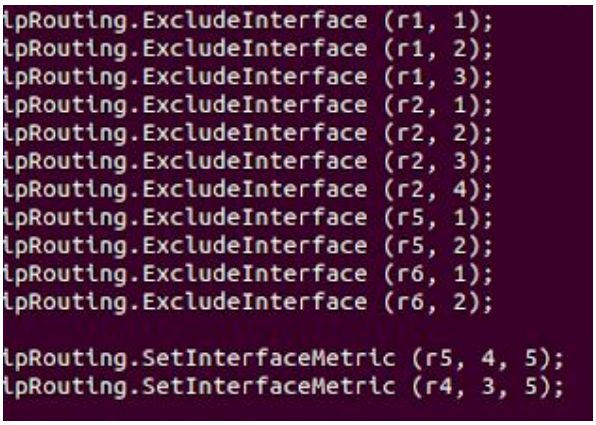
Simulation Scenario

Answer1. (a). Created all the routers and hosts.



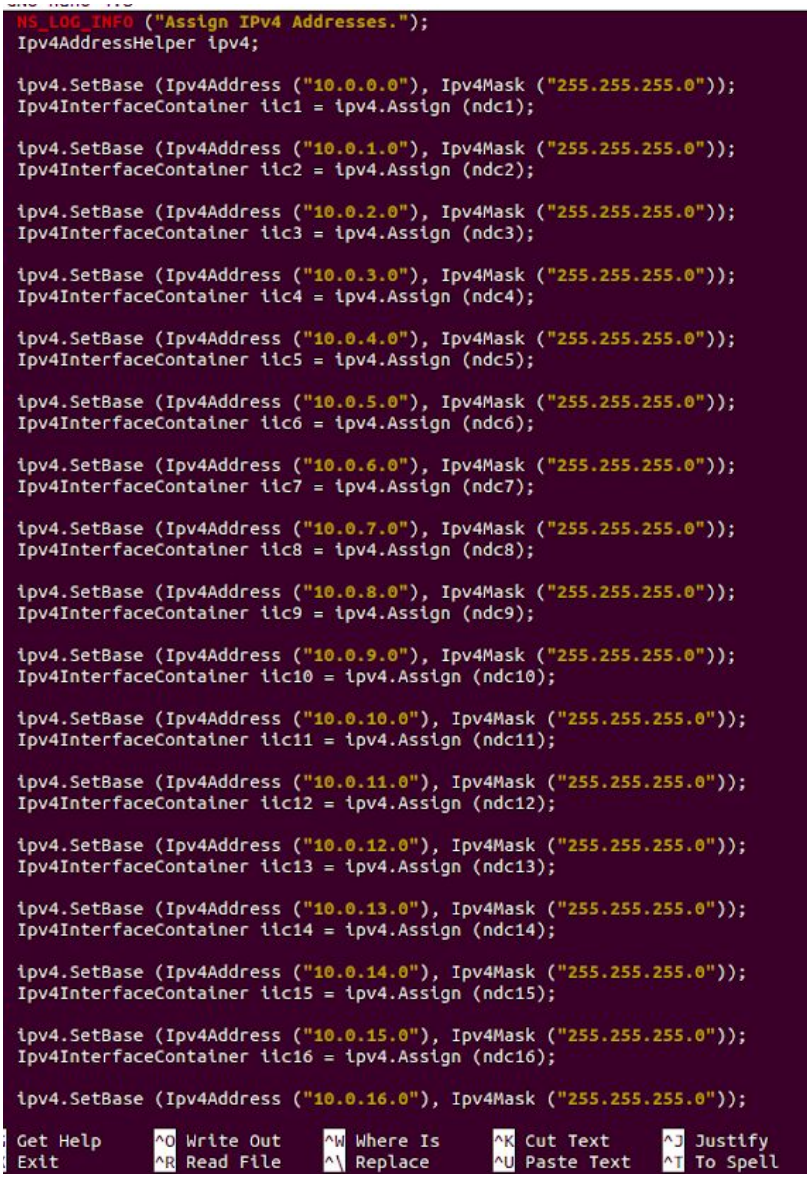
```
//set1
 Ptr<Node> a = CreateObject<Node> ();
 Names::Add ("A", a);
 Ptr<Node> b = CreateObject<Node> ();
 Names::Add ("B", b);
 Ptr<Node> c = CreateObject<Node> ();
 Names::Add ("C", c);
 Ptr<Node> r1 = CreateObject<Node> ();
 Names::Add ("R1", r1);
//set2
 Ptr<Node> d = CreateObject<Node> ();
 Names::Add ("D", d);
 Ptr<Node> e = CreateObject<Node> ();
 Names::Add ("E", e);
 Ptr<Node> f = CreateObject<Node> ();
 Names::Add ("F", f);
 Ptr<Node> g = CreateObject<Node> ();
 Names::Add ("G", g);
 Ptr<Node> r2 = CreateObject<Node> ();
 Names::Add ("R2", r2);
// two more routers
 Ptr<Node> r3 = CreateObject<Node> ();
 Names::Add ("R3", r3);
 Ptr<Node> r4 = CreateObject<Node> ();
 Names::Add ("R4",r4);
//set3
 Ptr<Node> h = CreateObject<Node> ();
 Names::Add ("H", h);
 Ptr<Node> i = CreateObject<Node> ();
 Names::Add ("I", i);
 Ptr<Node>  r5 = CreateObject<Node> ();
 Names::Add ("R5", r5);
//set 6
 Ptr<Node> j = CreateObject<Node> ();
 Names::Add ("J", j);
 Ptr<Node> k = CreateObject<Node> ();
 Names::Add ("K", k);
 Ptr<Node> r6 = CreateObject<Node> ();
 Names::Add ("R6", r6);

 //connecting
 NodeContainer net1 (a, r1);   //r1->1
 NodeContainer net2 (b, r1);   // r1-> 2
 NodeContainer net3 (c, r1);   //r1 : 3
 NodeContainer net4 (r1, r3);  // r1 : 4, r3: 1
 NodeContainer net5 (d, r2);   // r2 : 1
 NodeContainer net6 (e, r2);   // r2: 2
 NodeContainer net7 (f, r2);   // r2 :3
 NodeContainer net8 (g, r2);   // r2: 4
 NodeContainer net9 (r4, r2);  // r2: 5, r4: 1
 NodeContainer net10 (r3, r4);  //r3: 2, r4: 2
```

(b). Set the value of path between R4 and R5 as 5



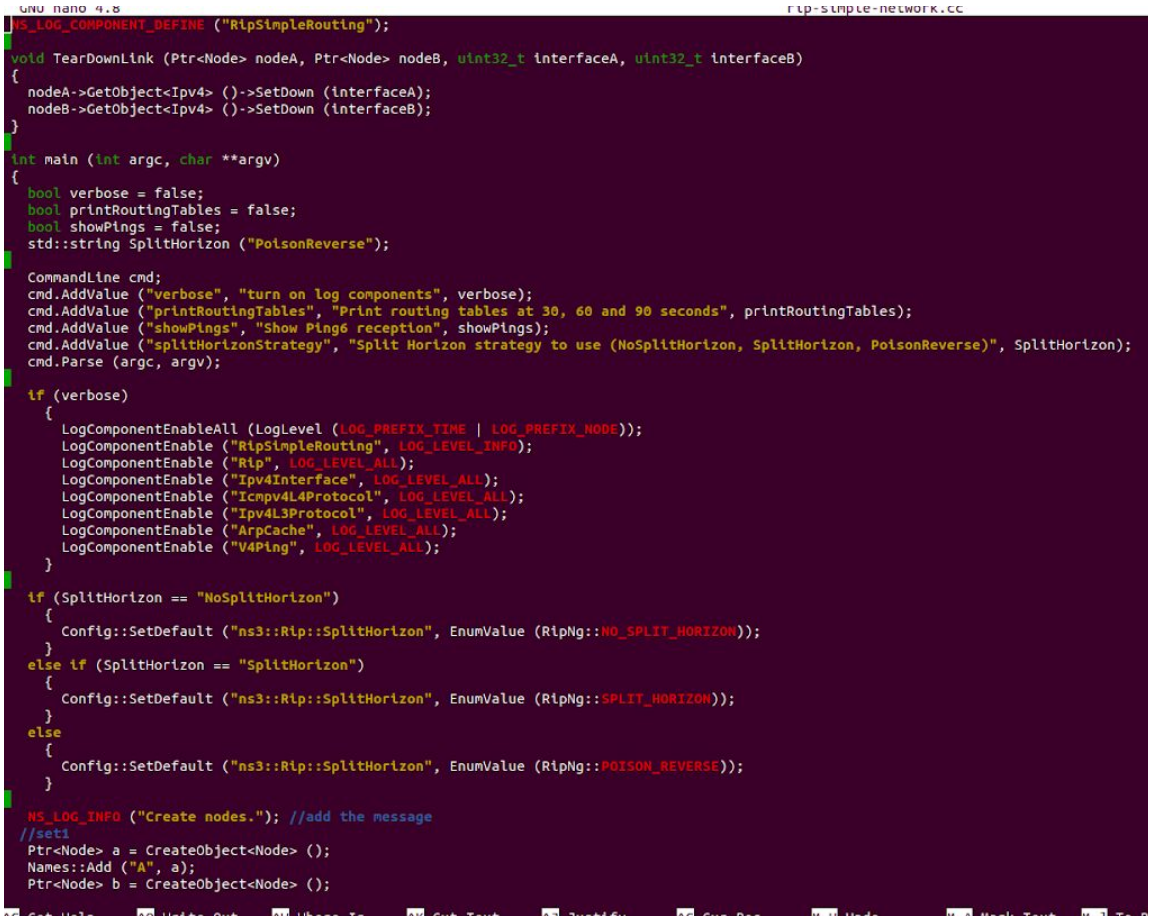
```
ipRouting.ExcludeInterface (r1, 1);
ipRouting.ExcludeInterface (r1, 2);
ipRouting.ExcludeInterface (r1, 3);
ipRouting.ExcludeInterface (r2, 1);
ipRouting.ExcludeInterface (r2, 2);
ipRouting.ExcludeInterface (r2, 3);
ipRouting.ExcludeInterface (r2, 4);
ipRouting.ExcludeInterface (r5, 1);
ipRouting.ExcludeInterface (r5, 2);
ipRouting.ExcludeInterface (r6, 1);
ipRouting.ExcludeInterface (r6, 2);

ipRouting.SetInterfaceMetric (r5, 4, 5);
ipRouting.SetInterfaceMetric (r4, 3, 5);
```

Answer2. Assigning IPs to all the nodes and router



```
NS_LOG_INFO ("Assign IPv4 Addresses.");
Ipv4AddressHelper ipv4;

ipv4.SetBase (Ipv4Address ("10.0.0.0"), Ipv4Mask ("255.255.255.0"));
Ipv4InterfaceContainer iic1 = ipv4.Assign (ndc1);

ipv4.SetBase (Ipv4Address ("10.0.1.0"), Ipv4Mask ("255.255.255.0"));
Ipv4InterfaceContainer iic2 = ipv4.Assign (ndc2);

ipv4.SetBase (Ipv4Address ("10.0.2.0"), Ipv4Mask ("255.255.255.0"));
Ipv4InterfaceContainer iic3 = ipv4.Assign (ndc3);

ipv4.SetBase (Ipv4Address ("10.0.3.0"), Ipv4Mask ("255.255.255.0"));
Ipv4InterfaceContainer iic4 = ipv4.Assign (ndc4);

ipv4.SetBase (Ipv4Address ("10.0.4.0"), Ipv4Mask ("255.255.255.0"));
Ipv4InterfaceContainer iic5 = ipv4.Assign (ndc5);

ipv4.SetBase (Ipv4Address ("10.0.5.0"), Ipv4Mask ("255.255.255.0"));
Ipv4InterfaceContainer iic6 = ipv4.Assign (ndc6);

ipv4.SetBase (Ipv4Address ("10.0.6.0"), Ipv4Mask ("255.255.255.0"));
Ipv4InterfaceContainer iic7 = ipv4.Assign (ndc7);

ipv4.SetBase (Ipv4Address ("10.0.7.0"), Ipv4Mask ("255.255.255.0"));
Ipv4InterfaceContainer iic8 = ipv4.Assign (ndc8);

ipv4.SetBase (Ipv4Address ("10.0.8.0"), Ipv4Mask ("255.255.255.0"));
Ipv4InterfaceContainer iic9 = ipv4.Assign (ndc9);

ipv4.SetBase (Ipv4Address ("10.0.9.0"), Ipv4Mask ("255.255.255.0"));
Ipv4InterfaceContainer iic10 = ipv4.Assign (ndc10);

ipv4.SetBase (Ipv4Address ("10.0.10.0"), Ipv4Mask ("255.255.255.0"));
Ipv4InterfaceContainer iic11 = ipv4.Assign (ndc11);

ipv4.SetBase (Ipv4Address ("10.0.11.0"), Ipv4Mask ("255.255.255.0"));
Ipv4InterfaceContainer iic12 = ipv4.Assign (ndc12);

ipv4.SetBase (Ipv4Address ("10.0.12.0"), Ipv4Mask ("255.255.255.0"));
Ipv4InterfaceContainer iic13 = ipv4.Assign (ndc13);

ipv4.SetBase (Ipv4Address ("10.0.13.0"), Ipv4Mask ("255.255.255.0"));
Ipv4InterfaceContainer iic14 = ipv4.Assign (ndc14);

ipv4.SetBase (Ipv4Address ("10.0.14.0"), Ipv4Mask ("255.255.255.0"));
Ipv4InterfaceContainer iic15 = ipv4.Assign (ndc15);

ipv4.SetBase (Ipv4Address ("10.0.15.0"), Ipv4Mask ("255.255.255.0"));
Ipv4InterfaceContainer iic16 = ipv4.Assign (ndc16);

ipv4.SetBase (Ipv4Address ("10.0.16.0"), Ipv4Mask ("255.255.255.0"));

^G Get Help   ^O Write Out   ^W Where Is   ^K Cut Text   ^J Justify
^X Exit       ^R Read File   ^\ Replace    ^U Paste Text ^T To Spell
```

Answer3. (a). Using RIP routing algorithm with Ipv4 and Poison Reverse as split horizon technique.



```
NS_LOG_COMPONENT_DEFINE ("RipSimpleRouting");

void TearDownLink (Ptr<Node> nodeA, Ptr<Node> nodeB, uint32_t interfaceA, uint32_t interfaceB)
{
  nodeA->GetObject<Ipv4> ()->SetDown (interfaceA);
  nodeB->GetObject<Ipv4> ()->SetDown (interfaceB);
}

int main (int argc, char **argv)
{
  bool verbose = false;
  bool printRoutingTables = false;
  bool showPings = false;
  std::string SplitHorizon ("PoisonReverse");

  CommandLine cmd;
  cmd.AddValue ("verbose", "turn on log components", verbose);
  cmd.AddValue ("printRoutingTables", "Print routing tables at 30, 60 and 90 seconds", printRoutingTables);
  cmd.AddValue ("showPings", "Show Ping6 reception", showPings);
  cmd.AddValue ("splitHorizonStrategy", "Split Horizon strategy to use (NoSplitHorizon, SplitHorizon, PoisonReverse)", SplitHorizon);
  cmd.Parse (argc, argv);

  if (verbose)
    {
      LogComponentEnableAll (LogLevel (LOG_PREFIX_TIME | LOG_PREFIX_NODE));
      LogComponentEnable ("RipSimpleRouting", LOG_LEVEL_INFO);
      LogComponentEnable ("Rip", LOG_LEVEL_ALL);
      LogComponentEnable ("Ipv4Interface", LOG_LEVEL_ALL);
      LogComponentEnable ("Icmpv4L4Protocol", LOG_LEVEL_ALL);
      LogComponentEnable ("Ipv4L3Protocol", LOG_LEVEL_ALL);
      LogComponentEnable ("ArpCache", LOG_LEVEL_ALL);
      LogComponentEnable ("V4Ping", LOG_LEVEL_ALL);
    }

  if (SplitHorizon == "NoSplitHorizon")
    {
      Config::SetDefault ("ns3::Rip::SplitHorizon", EnumValue (RipNg::NO_SPLIT_HORIZON));
    }
  else if (SplitHorizon == "SplitHorizon")
    {
      Config::SetDefault ("ns3::Rip::SplitHorizon", EnumValue (RipNg::SPLIT_HORIZON));
    }
  else
    {
      Config::SetDefault ("ns3::Rip::SplitHorizon", EnumValue (RipNg::POISON_REVERSE));
    }

  NS_LOG_INFO ("Create nodes."); //add the message
 //set1
  Ptr<Node> a = CreateObject<Node> ();
  Names::Add ("A", a);
  Ptr<Node> b = CreateObject<Node> ();
```

(b). Breaking the connection after 25 sec.

```
AsciiTraceHelper ascii;
csma.EnableAsciiAll (ascii.CreateFileStream ("rip-simple-routing.tr"));
csma.EnablePcapAll ("rip-simple-routing", true);

Simulator::Schedule (Seconds (25), &TearDownLink, r3, r4, 2, 2);

/* Now, do the actual simulation. */
NS_LOG_INFO ("Run Simulation.");
Simulator::Stop (Seconds (90.0));
Simulator::Run ();
Simulator::Destroy ();
NS_LOG_INFO ("Done.");
```

Answer4. Pinging for 80sec by A to K and G to H parallely

```
PING  10.0.15.1 56(84) bytes of data.
PING  10.0.10.1 56(84) bytes of data.
1032 bytes from 10.0.10.1: icmp_seq=4 ttl=61 time=53 ms
1032 bytes from 10.0.10.1: icmp_seq=5 ttl=61 time=29 ms
1032 bytes from 10.0.10.1: icmp_seq=6 ttl=60 time=41 ms
1032 bytes from 10.0.15.1: icmp_seq=6 ttl=60 time=59 ms
1032 bytes from 10.0.15.1: icmp_seq=7 ttl=60 time=37 ms
1032 bytes from 10.0.10.1: icmp_seq=7 ttl=60 time=41 ms
1032 bytes from 10.0.15.1: icmp_seq=8 ttl=60 time=37 ms
1032 bytes from 10.0.10.1: icmp_seq=8 ttl=60 time=41 ms
1032 bytes from 10.0.15.1: icmp_seq=9 ttl=60 time=37 ms
1032 bytes from 10.0.10.1: icmp_seq=9 ttl=60 time=40 ms
1032 bytes from 10.0.15.1: icmp_seq=10 ttl=60 time=37 ms
1032 bytes from 10.0.10.1: icmp_seq=10 ttl=60 time=41 ms
1032 bytes from 10.0.15.1: icmp_seq=11 ttl=60 time=37 ms
1032 bytes from 10.0.10.1: icmp_seq=11 ttl=60 time=41 ms
1032 bytes from 10.0.15.1: icmp_seq=12 ttl=60 time=37 ms
1032 bytes from 10.0.10.1: icmp_seq=12 ttl=60 time=40 ms
1032 bytes from 10.0.15.1: icmp_seq=13 ttl=60 time=37 ms
1032 bytes from 10.0.10.1: icmp_seq=13 ttl=60 time=40 ms
1032 bytes from 10.0.15.1: icmp_seq=14 ttl=60 time=37 ms
1032 bytes from 10.0.10.1: icmp_seq=14 ttl=60 time=41 ms
1032 bytes from 10.0.15.1: icmp_seq=15 ttl=60 time=37 ms
1032 bytes from 10.0.10.1: icmp_seq=15 ttl=60 time=41 ms
1032 bytes from 10.0.15.1: icmp_seq=16 ttl=60 time=37 ms
1032 bytes from 10.0.10.1: icmp_seq=16 ttl=60 time=41 ms
1032 bytes from 10.0.15.1: icmp_seq=17 ttl=60 time=37 ms
1032 bytes from 10.0.10.1: icmp_seq=17 ttl=60 time=40 ms
1032 bytes from 10.0.15.1: icmp_seq=18 ttl=60 time=37 ms
1032 bytes from 10.0.10.1: icmp_seq=18 ttl=60 time=40 ms
1032 bytes from 10.0.15.1: icmp_seq=19 ttl=60 time=37 ms
1032 bytes from 10.0.10.1: icmp_seq=19 ttl=60 time=41 ms
1032 bytes from 10.0.15.1: icmp_seq=20 ttl=60 time=37 ms
1032 bytes from 10.0.10.1: icmp_seq=20 ttl=60 time=41 ms
1032 bytes from 10.0.15.1: icmp_seq=21 ttl=60 time=37 ms
1032 bytes from 10.0.10.1: icmp_seq=21 ttl=60 time=41 ms
1032 bytes from 10.0.15.1: icmp_seq=22 ttl=60 time=37 ms
1032 bytes from 10.0.10.1: icmp_seq=22 ttl=60 time=40 ms
1032 bytes from 10.0.15.1: icmp_seq=23 ttl=60 time=37 ms
1032 bytes from 10.0.10.1: icmp_seq=23 ttl=60 time=41 ms
1032 bytes from 10.0.10.1: icmp_seq=34 ttl=61 time=29 ms
1032 bytes from 10.0.10.1: icmp_seq=35 ttl=61 time=29 ms
1032 bytes from 10.0.15.1: icmp_seq=35 ttl=59 time=44 ms
1032 bytes from 10.0.10.1: icmp_seq=36 ttl=61 time=29 ms
1032 bytes from 10.0.15.1: icmp_seq=36 ttl=59 time=44 ms
1032 bytes from 10.0.10.1: icmp_seq=37 ttl=61 time=29 ms
1032 bytes from 10.0.15.1: icmp_seq=37 ttl=59 time=44 ms
1032 bytes from 10.0.10.1: icmp_seq=38 ttl=61 time=29 ms
1032 bytes from 10.0.15.1: icmp_seq=38 ttl=59 time=44 ms
1032 bytes from 10.0.10.1: icmp_seq=39 ttl=61 time=29 ms
1032 bytes from 10.0.15.1: icmp_seq=39 ttl=59 time=44 ms
1032 bytes from 10.0.10.1: icmp_seq=40 ttl=61 time=29 ms
1032 bytes from 10.0.15.1: icmp_seq=40 ttl=59 time=44 ms
1032 bytes from 10.0.10.1: icmp_seq=41 ttl=61 time=29 ms
1032 bytes from 10.0.15.1: icmp_seq=41 ttl=59 time=44 ms
```

RTT values and Packet loss for A to K and G to H:

```
1032 bytes from 10.0.15.1: icmp_seq=79 ttl=59 time=44 ms
--- 10.0.15.1 ping statistics ---
80 packets transmitted, 63 received, 21% packet loss, time 80000ms
rtt min/avg/max/mdev = 37/42.35/59/3.781 ms
--- 10.0.10.1 ping statistics ---
80 packets transmitted, 66 received, 17% packet loss, time 80000ms
rtt min/avg/max/mdev = 29/32.55/53/5.818 ms
```

Tracing

Answer1. Number of packets for icmp

(a) For A:

Measurement	Captured	Displayed	Marked
Packets	147	143 (97.3%)	—
Time span, s	79.040	79.035	—
Average pps	1.9	1.8	—
Average packet size, B	1043	1070	—
Bytes	153266	153010 (99.8%)	0
Average bytes/s	1,939	1,935	—
Average bits/s	15 k	15 k	—

For G:

Statistics

Measurement	Captured	Displayed	Marked
Packets	150	146 (97.3%)	—
Time span, s	79.021	79.016	—
Average pps	1.9	1.8	—
Average packet size, B	1043	1070	—
Bytes	156476	156220 (99.8%)	0
Average bytes/s	1,980	1,977	—
Average bits/s	15 k	15 k	—

For H:

Statistics

Measurement	Captured	Displayed	Marked
Packets	136	132 (97.1%)	—
Time span, s	74.996	74.990	—
Average pps	1.8	1.8	—
Average packet size, B	1040	1070	—
Bytes	141496	141240 (99.8%)	0
Average bytes/s	1,886	1,883	—
Average bits/s	15 k	15 k	—

For K:

Statistics

Measurement	Captured	Displayed	Marked
Packets	130	126 (96.9%)	—
Time span, s	72.998	72.993	—
Average pps	1.8	1.7	—
Average packet size, B	1039	1070	—
Bytes	135076	134820 (99.8%)	0
Average bytes/s	1,850	1,847	—
Average bits/s	14 k	14 k	—

(b)Number of packets for ARP:

For A:

Measurement	Captured	Displayed	Marked
Packets	147	4 (2.7%)	—
Time span, s	79.040	6.049	—
Average pps	1.9	0.7	—
Average packet size, B	1043	64	—
Bytes	153266	256 (0.2%)	0
Average bytes/s	1,939	42	—
Average bits/s	15 k	338	—

For G:

Statistics

Measurement	Captured	Displayed	Marked
Packets	150	4 (2.7%)	—
Time span, s	79.021	4.038	—
Average pps	1.9	1.0	—
Average packet size, B	1043	64	—
Bytes	156476	256 (0.2%)	0
Average bytes/s	1,980	63	—
Average bits/s	15 k	507	—

For H:

Statistics

Measurement	Captured	Displayed	Marked
Packets	136	4 (2.9%)	—
Time span, s	74.996	0.015	—
Average pps	1.8	266.3	—
Average packet size, B	1040	64	—
Bytes	141496	256 (0.2%)	0
Average bytes/s	1,886	17 k	—
Average bits/s	15 k	136 k	—

For K:

Statistics

Measurement	Captured	Displayed	Marked
Packets	130	4 (3.1%)	—
Time span, s	72.998	0.011	—
Average pps	1.8	362.9	—
Average packet size, B	1039	64	—
Bytes	135076	256 (0.2%)	0
Average bytes/s	1,850	23 k	—
Average bits/s	14 k	185 k	—

Answer2.

After 10 sec.

```
  Priority: 0 Protocol: ns3::Rip
Node: 3, Time: +10.0s, Local time: +10.0s, IPv4 RIP table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.10.0       10.0.3.2        255.255.255.0   UGS   3      -      -   4
10.0.11.0       10.0.3.2        255.255.255.0   UGS   3      -      -   4
10.0.13.0       10.0.3.2        255.255.255.0   UGS   3      -      -   4
10.0.7.0        10.0.3.2        255.255.255.0   UGS   4      -      -   4
10.0.6.0        10.0.3.2        255.255.255.0   UGS   4      -      -   4
10.0.5.0        10.0.3.2        255.255.255.0   UGS   4      -      -   4
10.0.4.0        10.0.3.2        255.255.255.0   UGS   4      -      -   4
10.0.8.0        10.0.3.2        255.255.255.0   UGS   3      -      -   4
10.0.16.0       10.0.3.2        255.255.255.0   UGS   3      -      -   4
10.0.15.0       10.0.3.2        255.255.255.0   UGS   4      -      -   4
10.0.14.0       10.0.3.2        255.255.255.0   UGS   4      -      -   4
10.0.12.0       10.0.3.2        255.255.255.0   UGS   2      -      -   4
10.0.9.0        10.0.3.2        255.255.255.0   UGS   2      -      -   4
10.0.0.0        0.0.0.0         255.255.255.0   U     1      -      -   1
10.0.1.0        0.0.0.0         255.255.255.0   U     1      -      -   2
10.0.2.0        0.0.0.0         255.255.255.0   U     1      -      -   3
10.0.3.0        0.0.0.0         255.255.255.0   U     1      -      -   4

Node: 8, Time: +10.0s, Local time: +10.0s, Ipv4ListRouting table
  Priority: 0 Protocol: ns3::Rip
Node: 8, Time: +10.0s, Local time: +10.0s, IPv4 RIP table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.14.0       10.0.8.1        255.255.255.0   UGS   3      -      -   5
10.0.15.0       10.0.8.1        255.255.255.0   UGS   3      -      -   5
10.0.16.0       10.0.8.1        255.255.255.0   UGS   2      -      -   5
10.0.13.0       10.0.8.1        255.255.255.0   UGS   2      -      -   5
10.0.9.0        10.0.8.1        255.255.255.0   UGS   2      -      -   5
10.0.2.0        10.0.8.1        255.255.255.0   UGS   4      -      -   5
10.0.1.0        10.0.8.1        255.255.255.0   UGS   4      -      -   5
10.0.0.0        10.0.8.1        255.255.255.0   UGS   4      -      -   5
10.0.3.0        10.0.8.1        255.255.255.0   UGS   3      -      -   5
10.0.12.0       10.0.8.1        255.255.255.0   UGS   3      -      -   5
10.0.10.0       10.0.8.1        255.255.255.0   UGS   4      -      -   5
10.0.11.0       10.0.8.1        255.255.255.0   UGS   4      -      -   5
10.0.4.0        0.0.0.0         255.255.255.0   U     1      -      -   1
10.0.5.0        0.0.0.0         255.255.255.0   U     1      -      -   2
10.0.6.0        0.0.0.0         255.255.255.0   U     1      -      -   3
10.0.7.0        0.0.0.0         255.255.255.0   U     1      -      -   4
10.0.8.0        0.0.0.0         255.255.255.0   U     1      -      -   5

Node: 9, Time: +10.0s, Local time: +10.0s, Ipv4ListRouting table
  Priority: 0 Protocol: ns3::Rip
Node: 9, Time: +10.0s, Local time: +10.0s, IPv4 RIP table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.14.0       10.0.9.2        255.255.255.0   UGS   3      -      -   2
10.0.15.0       10.0.9.2        255.255.255.0   UGS   3      -      -   2
10.0.16.0       10.0.9.2        255.255.255.0   UGS   2      -      -   2
10.0.8.0        10.0.9.2        255.255.255.0   UGS   2      -      -   2
10.0.4.0        10.0.9.2        255.255.255.0   UGS   3      -      -   2
10.0.5.0        10.0.9.2        255.255.255.0   UGS   3      -      -   2
10.0.6.0        10.0.9.2        255.255.255.0   UGS   3      -      -   2
10.0.7.0        10.0.9.2        255.255.255.0   UGS   3      -      -   2
10.0.13.0       10.0.12.1       255.255.255.0   UGS   2      -      -   3
```

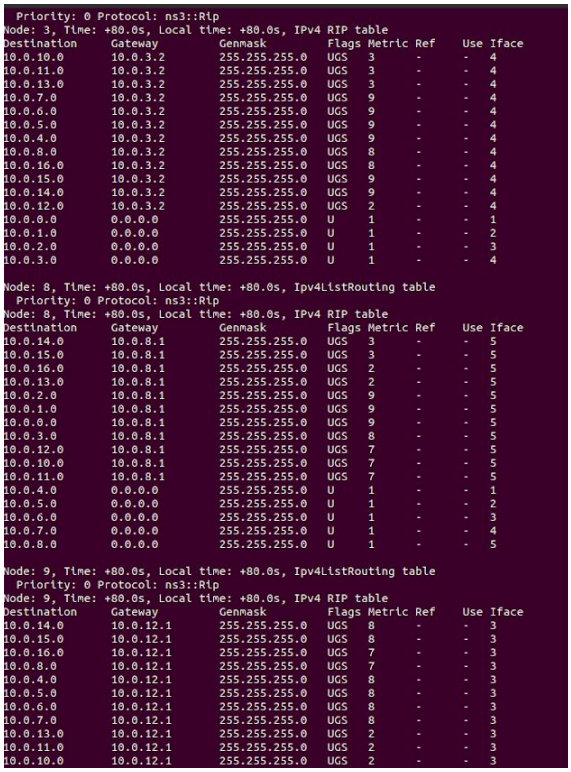
```
  Priority: 0 Protocol: ns3::Rip
Node: 10, Time: +10.0s, Local time: +10.0s, IPv4 RIP table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.15.0       10.0.16.1       255.255.255.0   UGS   2      -      -   4
10.0.14.0       10.0.16.1       255.255.255.0   UGS   2      -      -   4
10.0.11.0       10.0.9.1        255.255.255.0   UGS   3      -      -   2
10.0.10.0       10.0.9.1        255.255.255.0   UGS   3      -      -   2
10.0.12.0       10.0.9.1        255.255.255.0   UGS   2      -      -   2
10.0.3.0        10.0.9.1        255.255.255.0   UGS   2      -      -   2
10.0.0.0        10.0.9.1        255.255.255.0   UGS   3      -      -   2
10.0.1.0        10.0.9.1        255.255.255.0   UGS   3      -      -   2
10.0.2.0        10.0.9.1        255.255.255.0   UGS   3      -      -   2
10.0.7.0        10.0.8.2        255.255.255.0   UGS   2      -      -   1
10.0.6.0        10.0.8.2        255.255.255.0   UGS   2      -      -   1
10.0.5.0        10.0.8.2        255.255.255.0   UGS   2      -      -   1
10.0.4.0        10.0.8.2        255.255.255.0   UGS   2      -      -   1
10.0.8.0        0.0.0.0         255.255.255.0   U     1      -      -   1
10.0.9.0        0.0.0.0         255.255.255.0   U     1      -      -   2
10.0.13.0       0.0.0.0         255.255.255.0   U     1      -      -   3
10.0.16.0       0.0.0.0         255.255.255.0   U     1      -      -   4

Node: 13, Time: +10.0s, Local time: +10.0s, Ipv4ListRouting table
  Priority: 0 Protocol: ns3::Rip
Node: 13, Time: +10.0s, Local time: +10.0s, IPv4 RIP table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.14.0       10.0.12.2       255.255.255.0   UGS   4      -      -   3
10.0.15.0       10.0.12.2       255.255.255.0   UGS   4      -      -   3
10.0.16.0       10.0.12.2       255.255.255.0   UGS   3      -      -   3
10.0.8.0        10.0.12.2       255.255.255.0   UGS   3      -      -   3
10.0.4.0        10.0.12.2       255.255.255.0   UGS   4      -      -   3
10.0.5.0        10.0.12.2       255.255.255.0   UGS   4      -      -   3
10.0.6.0        10.0.12.2       255.255.255.0   UGS   4      -      -   3
10.0.7.0        10.0.12.2       255.255.255.0   UGS   4      -      -   3
10.0.9.0        10.0.12.2       255.255.255.0   UGS   2      -      -   3
10.0.3.0        10.0.12.2       255.255.255.0   UGS   2      -      -   3
10.0.0.0        10.0.12.2       255.255.255.0   UGS   3      -      -   3
10.0.1.0        10.0.12.2       255.255.255.0   UGS   3      -      -   3
10.0.2.0        10.0.12.2       255.255.255.0   UGS   3      -      -   3
10.0.10.0       0.0.0.0         255.255.255.0   U     1      -      -   1
10.0.11.0       0.0.0.0         255.255.255.0   U     1      -      -   2
10.0.12.0       0.0.0.0         255.255.255.0   U     1      -      -   3
10.0.13.0       0.0.0.0         255.255.255.0   U     1      -      -   4

Node: 16, Time: +10.0s, Local time: +10.0s, Ipv4ListRouting table
  Priority: 0 Protocol: ns3::Rip
Node: 16, Time: +10.0s, Local time: +10.0s, IPv4 RIP table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.13.0       10.0.16.2       255.255.255.0   UGS   2      -      -   3
10.0.9.0        10.0.16.2       255.255.255.0   UGS   2      -      -   3
10.0.8.0        10.0.16.2       255.255.255.0   UGS   2      -      -   3
10.0.4.0        10.0.16.2       255.255.255.0   UGS   3      -      -   3
10.0.5.0        10.0.16.2       255.255.255.0   UGS   3      -      -   3
10.0.6.0        10.0.16.2       255.255.255.0   UGS   3      -      -   3
10.0.7.0        10.0.16.2       255.255.255.0   UGS   3      -      -   3
10.0.2.0        10.0.16.2       255.255.255.0   UGS   4      -      -   3
10.0.1.0        10.0.16.2       255.255.255.0   UGS   4      -      -   3
```

After 40 secs

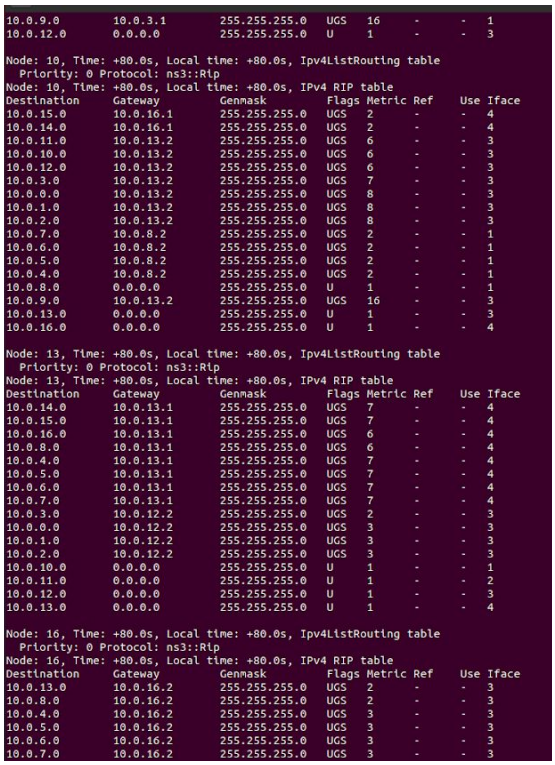
```
  Priority: 0 Protocol: ns3::Rip
Node: 3, Time: +40.0s, Local time: +40.0s, IPv4 RIP table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.10.0       10.0.3.2        255.255.255.0   UGS   3      -      -   4
10.0.11.0       10.0.3.2        255.255.255.0   UGS   3      -      -   4
10.0.13.0       10.0.3.2        255.255.255.0   UGS   3      -      -   4
10.0.7.0        10.0.3.2        255.255.255.0   UGS   9      -      -   4
10.0.6.0        10.0.3.2        255.255.255.0   UGS   9      -      -   4
10.0.5.0        10.0.3.2        255.255.255.0   UGS   9      -      -   4
10.0.4.0        10.0.3.2        255.255.255.0   UGS   9      -      -   4
10.0.8.0        10.0.3.2        255.255.255.0   UGS   8      -      -   4
10.0.16.0       10.0.3.2        255.255.255.0   UGS   8      -      -   4
10.0.15.0       10.0.3.2        255.255.255.0   UGS   9      -      -   4
10.0.14.0       10.0.3.2        255.255.255.0   UGS   9      -      -   4
10.0.12.0       10.0.3.2        255.255.255.0   UGS   2      -      -   4
10.0.0.0        0.0.0.0         255.255.255.0   U     1      -      -   1
10.0.1.0        0.0.0.0         255.255.255.0   U     1      -      -   2
10.0.2.0        0.0.0.0         255.255.255.0   U     1      -      -   3
10.0.3.0        0.0.0.0         255.255.255.0   U     1      -      -   4

Node: 8, Time: +40.0s, Local time: +40.0s, Ipv4ListRouting table
  Priority: 0 Protocol: ns3::Rip
Node: 8, Time: +40.0s, Local time: +40.0s, IPv4 RIP table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.14.0       10.0.8.1        255.255.255.0   UGS   3      -      -   5
10.0.15.0       10.0.8.1        255.255.255.0   UGS   3      -      -   5
10.0.16.0       10.0.8.1        255.255.255.0   UGS   2      -      -   5
10.0.13.0       10.0.8.1        255.255.255.0   UGS   2      -      -   5
10.0.2.0        10.0.8.1        255.255.255.0   UGS   9      -      -   5
10.0.1.0        10.0.8.1        255.255.255.0   UGS   9      -      -   5
10.0.0.0        10.0.8.1        255.255.255.0   UGS   9      -      -   5
10.0.3.0        10.0.8.1        255.255.255.0   UGS   8      -      -   5
10.0.12.0       10.0.8.1        255.255.255.0   UGS   7      -      -   5
10.0.10.0       10.0.8.1        255.255.255.0   UGS   7      -      -   5
10.0.11.0       10.0.8.1        255.255.255.0   UGS   7      -      -   5
10.0.4.0        0.0.0.0         255.255.255.0   U     1      -      -   1
10.0.5.0        0.0.0.0         255.255.255.0   U     1      -      -   2
10.0.6.0        0.0.0.0         255.255.255.0   U     1      -      -   3
10.0.7.0        0.0.0.0         255.255.255.0   U     1      -      -   4
10.0.8.0        0.0.0.0         255.255.255.0   U     1      -      -   5

Node: 9, Time: +40.0s, Local time: +40.0s, Ipv4ListRouting table
  Priority: 0 Protocol: ns3::Rip
Node: 9, Time: +40.0s, Local time: +40.0s, IPv4 RIP table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.14.0       10.0.12.1       255.255.255.0   UGS   8      -      -   3
10.0.15.0       10.0.12.1       255.255.255.0   UGS   8      -      -   3
10.0.16.0       10.0.12.1       255.255.255.0   UGS   7      -      -   3
10.0.8.0        10.0.12.1       255.255.255.0   UGS   7      -      -   3
10.0.4.0        10.0.12.1       255.255.255.0   UGS   8      -      -   3
10.0.5.0        10.0.12.1       255.255.255.0   UGS   8      -      -   3
10.0.6.0        10.0.12.1       255.255.255.0   UGS   8      -      -   3
10.0.7.0        10.0.12.1       255.255.255.0   UGS   8      -      -   3
10.0.13.0       10.0.12.1       255.255.255.0   UGS   2      -      -   3
10.0.11.0       10.0.12.1       255.255.255.0   UGS   2      -      -   3
10.0.10.0       10.0.12.1       255.255.255.0   UGS   2      -      -   3
```

```
Node: 10, Time: +40.0s, Local time: +40.0s, Ipv4ListRouting table
  Priority: 0 Protocol: ns3::Rip
Node: 10, Time: +40.0s, Local time: +40.0s, IPv4 RIP table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.15.0       10.0.16.1       255.255.255.0   UGS   2      -      -   4
10.0.14.0       10.0.16.1       255.255.255.0   UGS   2      -      -   4
10.0.11.0       10.0.13.2       255.255.255.0   UGS   6      -      -   3
10.0.10.0       10.0.13.2       255.255.255.0   UGS   6      -      -   3
10.0.12.0       10.0.13.2       255.255.255.0   UGS   6      -      -   3
10.0.3.0        10.0.13.2       255.255.255.0   UGS   7      -      -   3
10.0.0.0        10.0.13.2       255.255.255.0   UGS   8      -      -   3
10.0.1.0        10.0.13.2       255.255.255.0   UGS   8      -      -   3
10.0.2.0        10.0.13.2       255.255.255.0   UGS   8      -      -   3
10.0.7.0        10.0.8.2        255.255.255.0   UGS   2      -      -   1
10.0.6.0        10.0.8.2        255.255.255.0   UGS   2      -      -   1
10.0.5.0        10.0.8.2        255.255.255.0   UGS   2      -      -   1
10.0.4.0        10.0.8.2        255.255.255.0   UGS   2      -      -   1
10.0.8.0        0.0.0.0         255.255.255.0   U     1      -      -   1
10.0.13.0       0.0.0.0         255.255.255.0   U     1      -      -   3
10.0.16.0       0.0.0.0         255.255.255.0   U     1      -      -   4

Node: 13, Time: +40.0s, Local time: +40.0s, Ipv4ListRouting table
  Priority: 0 Protocol: ns3::Rip
Node: 13, Time: +40.0s, Local time: +40.0s, IPv4 RIP table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.14.0       10.0.13.1       255.255.255.0   UGS   7      -      -   4
10.0.15.0       10.0.13.1       255.255.255.0   UGS   7      -      -   4
10.0.16.0       10.0.13.1       255.255.255.0   UGS   6      -      -   4
10.0.8.0        10.0.13.1       255.255.255.0   UGS   6      -      -   4
10.0.4.0        10.0.13.1       255.255.255.0   UGS   7      -      -   4
10.0.5.0        10.0.13.1       255.255.255.0   UGS   7      -      -   4
10.0.6.0        10.0.13.1       255.255.255.0   UGS   7      -      -   4
10.0.7.0        10.0.13.1       255.255.255.0   UGS   7      -      -   4
10.0.3.0        10.0.12.2       255.255.255.0   UGS   2      -      -   3
10.0.0.0        10.0.12.2       255.255.255.0   UGS   3      -      -   3
10.0.1.0        10.0.12.2       255.255.255.0   UGS   3      -      -   3
10.0.2.0        10.0.12.2       255.255.255.0   UGS   3      -      -   3
10.0.10.0       0.0.0.0         255.255.255.0   U     1      -      -   1
10.0.11.0       0.0.0.0         255.255.255.0   U     1      -      -   2
10.0.12.0       0.0.0.0         255.255.255.0   U     1      -      -   3
10.0.13.0       0.0.0.0         255.255.255.0   U     1      -      -   4

Node: 16, Time: +40.0s, Local time: +40.0s, Ipv4ListRouting table
  Priority: 0 Protocol: ns3::Rip
Node: 16, Time: +40.0s, Local time: +40.0s, IPv4 RIP table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.13.0       10.0.16.2       255.255.255.0   UGS   2      -      -   3
10.0.8.0        10.0.16.2       255.255.255.0   UGS   2      -      -   3
10.0.4.0        10.0.16.2       255.255.255.0   UGS   3      -      -   3
10.0.5.0        10.0.16.2       255.255.255.0   UGS   3      -      -   3
10.0.6.0        10.0.16.2       255.255.255.0   UGS   3      -      -   3
10.0.7.0        10.0.16.2       255.255.255.0   UGS   3      -      -   3
10.0.2.0        10.0.16.2       255.255.255.0   UGS   9      -      -   3
10.0.1.0        10.0.16.2       255.255.255.0   UGS   9      -      -   3
```

After 80 secs.



```
  Priority: 0 Protocol: ns3::Rip
Node: 3, Time: +80.0s, Local time: +80.0s, IPv4 RIP table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.10.0       10.0.3.2        255.255.255.0   UGS   3      -      -   4
10.0.11.0       10.0.3.2        255.255.255.0   UGS   3      -      -   4
10.0.13.0       10.0.3.2        255.255.255.0   UGS   3      -      -   4
10.0.7.0        10.0.3.2        255.255.255.0   UGS   9      -      -   4
10.0.6.0        10.0.3.2        255.255.255.0   UGS   9      -      -   4
10.0.5.0        10.0.3.2        255.255.255.0   UGS   9      -      -   4
10.0.4.0        10.0.3.2        255.255.255.0   UGS   9      -      -   4
10.0.8.0        10.0.3.2        255.255.255.0   UGS   8      -      -   4
10.0.16.0       10.0.3.2        255.255.255.0   UGS   8      -      -   4
10.0.15.0       10.0.3.2        255.255.255.0   UGS   9      -      -   4
10.0.14.0       10.0.3.2        255.255.255.0   UGS   9      -      -   4
10.0.12.0       10.0.3.2        255.255.255.0   UGS   2      -      -   4
10.0.0.0        0.0.0.0         255.255.255.0   U     1      -      -   1
10.0.1.0        0.0.0.0         255.255.255.0   U     1      -      -   2
10.0.2.0        0.0.0.0         255.255.255.0   U     1      -      -   3
10.0.3.0        0.0.0.0         255.255.255.0   U     1      -      -   4

Node: 8, Time: +80.0s, Local time: +80.0s, Ipv4ListRouting table
  Priority: 0 Protocol: ns3::Rip
Node: 8, Time: +80.0s, Local time: +80.0s, IPv4 RIP table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.14.0       10.0.8.1        255.255.255.0   UGS   3      -      -   5
10.0.15.0       10.0.8.1        255.255.255.0   UGS   3      -      -   5
10.0.16.0       10.0.8.1        255.255.255.0   UGS   2      -      -   5
10.0.13.0       10.0.8.1        255.255.255.0   UGS   2      -      -   5
10.0.2.0        10.0.8.1        255.255.255.0   UGS   9      -      -   5
10.0.1.0        10.0.8.1        255.255.255.0   UGS   9      -      -   5
10.0.0.0        10.0.8.1        255.255.255.0   UGS   9      -      -   5
10.0.3.0        10.0.8.1        255.255.255.0   UGS   8      -      -   5
10.0.12.0       10.0.8.1        255.255.255.0   UGS   7      -      -   5
10.0.10.0       10.0.8.1        255.255.255.0   UGS   7      -      -   5
10.0.11.0       10.0.8.1        255.255.255.0   UGS   7      -      -   5
10.0.4.0        0.0.0.0         255.255.255.0   U     1      -      -   1
10.0.5.0        0.0.0.0         255.255.255.0   U     1      -      -   2
10.0.6.0        0.0.0.0         255.255.255.0   U     1      -      -   3
10.0.7.0        0.0.0.0         255.255.255.0   U     1      -      -   4
10.0.8.0        0.0.0.0         255.255.255.0   U     1      -      -   5

Node: 9, Time: +80.0s, Local time: +80.0s, Ipv4ListRouting table
  Priority: 0 Protocol: ns3::Rip
Node: 9, Time: +80.0s, Local time: +80.0s, IPv4 RIP table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.14.0       10.0.12.1       255.255.255.0   UGS   8      -      -   3
10.0.15.0       10.0.12.1       255.255.255.0   UGS   8      -      -   3
10.0.16.0       10.0.12.1       255.255.255.0   UGS   7      -      -   3
10.0.8.0        10.0.12.1       255.255.255.0   UGS   7      -      -   3
10.0.4.0        10.0.12.1       255.255.255.0   UGS   8      -      -   3
10.0.5.0        10.0.12.1       255.255.255.0   UGS   8      -      -   3
10.0.6.0        10.0.12.1       255.255.255.0   UGS   8      -      -   3
10.0.7.0        10.0.12.1       255.255.255.0   UGS   8      -      -   3
10.0.13.0       10.0.12.1       255.255.255.0   UGS   2      -      -   3
10.0.11.0       10.0.12.1       255.255.255.0   UGS   2      -      -   3
10.0.10.0       10.0.12.1       255.255.255.0   UGS   2      -      -   3
```



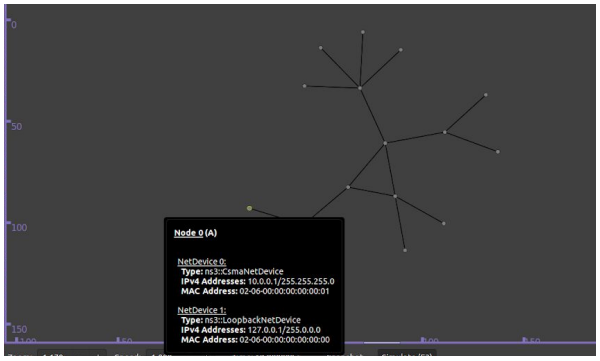
```
10.0.9.0        10.0.3.1        255.255.255.0   UGS   16     -      -   1
10.0.12.0       0.0.0.0         255.255.255.0   U     1      -      -   3

Node: 10, Time: +80.0s, Local time: +80.0s, Ipv4ListRouting table
  Priority: 0 Protocol: ns3::Rip
Node: 10, Time: +80.0s, Local time: +80.0s, IPv4 RIP table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.15.0       10.0.16.1       255.255.255.0   UGS   2      -      -   4
10.0.14.0       10.0.16.1       255.255.255.0   UGS   2      -      -   4
10.0.11.0       10.0.13.2       255.255.255.0   UGS   6      -      -   3
10.0.10.0       10.0.13.2       255.255.255.0   UGS   6      -      -   3
10.0.12.0       10.0.13.2       255.255.255.0   UGS   6      -      -   3
10.0.3.0        10.0.13.2       255.255.255.0   UGS   7      -      -   3
10.0.0.0        10.0.13.2       255.255.255.0   UGS   8      -      -   3
10.0.1.0        10.0.13.2       255.255.255.0   UGS   8      -      -   3
10.0.2.0        10.0.13.2       255.255.255.0   UGS   8      -      -   3
10.0.7.0        10.0.8.2        255.255.255.0   UGS   2      -      -   1
10.0.6.0        10.0.8.2        255.255.255.0   UGS   2      -      -   1
10.0.5.0        10.0.8.2        255.255.255.0   UGS   2      -      -   1
10.0.4.0        10.0.8.2        255.255.255.0   UGS   2      -      -   1
10.0.8.0        0.0.0.0         255.255.255.0   U     1      -      -   1
10.0.9.0        10.0.13.2       255.255.255.0   UGS   16     -      -   3
10.0.13.0       0.0.0.0         255.255.255.0   U     1      -      -   3
10.0.16.0       0.0.0.0         255.255.255.0   U     1      -      -   4

Node: 13, Time: +80.0s, Local time: +80.0s, Ipv4ListRouting table
  Priority: 0 Protocol: ns3::Rip
Node: 13, Time: +80.0s, Local time: +80.0s, IPv4 RIP table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.14.0       10.0.13.1       255.255.255.0   UGS   7      -      -   4
10.0.15.0       10.0.13.1       255.255.255.0   UGS   7      -      -   4
10.0.16.0       10.0.13.1       255.255.255.0   UGS   6      -      -   4
10.0.8.0        10.0.13.1       255.255.255.0   UGS   6      -      -   4
10.0.4.0        10.0.13.1       255.255.255.0   UGS   7      -      -   4
10.0.5.0        10.0.13.1       255.255.255.0   UGS   7      -      -   4
10.0.6.0        10.0.13.1       255.255.255.0   UGS   7      -      -   4
10.0.7.0        10.0.13.1       255.255.255.0   UGS   7      -      -   4
10.0.3.0        10.0.12.2       255.255.255.0   UGS   2      -      -   3
10.0.0.0        10.0.12.2       255.255.255.0   UGS   3      -      -   3
10.0.1.0        10.0.12.2       255.255.255.0   UGS   3      -      -   3
10.0.2.0        10.0.12.2       255.255.255.0   UGS   3      -      -   3
10.0.10.0       0.0.0.0         255.255.255.0   U     1      -      -   1
10.0.11.0       0.0.0.0         255.255.255.0   U     1      -      -   2
10.0.12.0       0.0.0.0         255.255.255.0   U     1      -      -   3
10.0.13.0       0.0.0.0         255.255.255.0   U     1      -      -   4

Node: 16, Time: +80.0s, Local time: +80.0s, Ipv4ListRouting table
  Priority: 0 Protocol: ns3::Rip
Node: 16, Time: +80.0s, Local time: +80.0s, IPv4 RIP table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.13.0       10.0.16.2       255.255.255.0   UGS   2      -      -   3
10.0.8.0        10.0.16.2       255.255.255.0   UGS   2      -      -   3
10.0.4.0        10.0.16.2       255.255.255.0   UGS   3      -      -   3
10.0.5.0        10.0.16.2       255.255.255.0   UGS   3      -      -   3
10.0.6.0        10.0.16.2       255.255.255.0   UGS   3      -      -   3
10.0.7.0        10.0.16.2       255.255.255.0   UGS   3      -      -   3
```

Answer 3. The router 4 is Node10. In the 10 sec, the values routing tables can be seen. When the connection between R3 and R4 is broken, then at 40 sec, the Node 10 is trying to find the route i.e the 10.0.9.0 address. We can see no ips in the routing table for router 4 having ips with 10.0.9.0. Then after 80 secs, it will try to get the path but will not be able to find the path and should assign it infinity, but here max hops are 15, so will give a value 16.

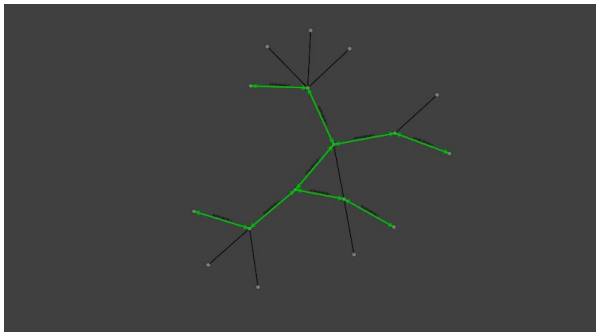
Visualisation

Answer1. To be shown at the time of demo.

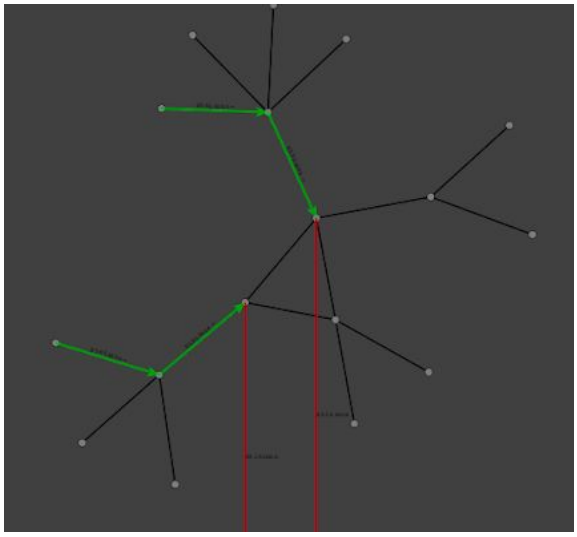
Answer2. Initial nodes and routers: We can see the nodes from A to k and routers from 1 to 6



Pinging A to K, G to H: We can see the ping between A to K and between G to H



Breaking the link: Now we can see the breaking the link between R3 and R4.



Final establishment of connections: After that the routers again try to communicate to get the distances and the final route is established between A to K and G to H.