

# Islamic University of Technology

CSE 4840

Internetworking Protocols Lab

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## Lab 3

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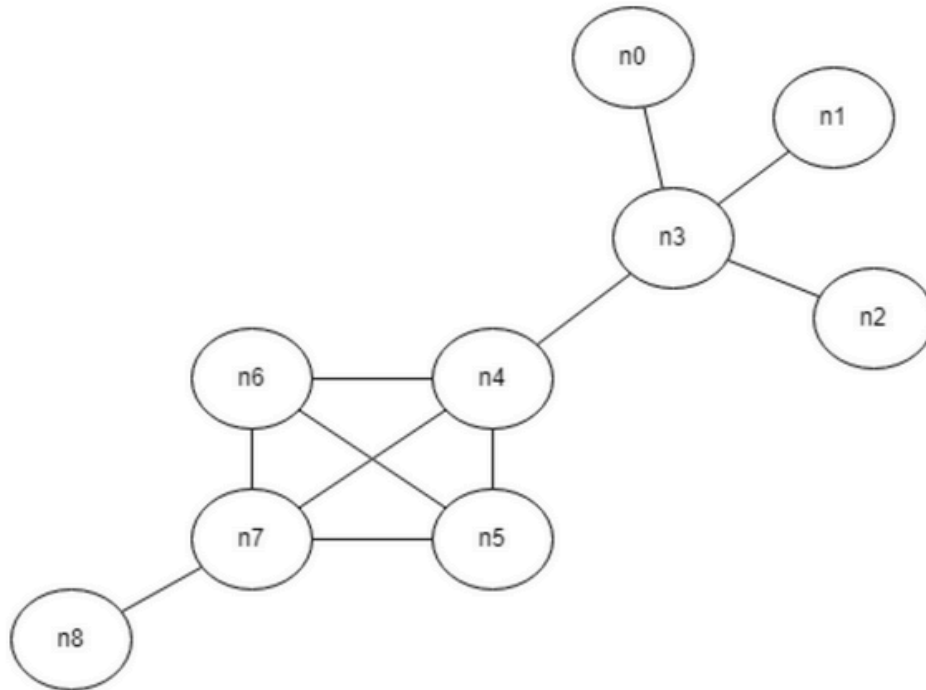
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## Objective

Configure RIP routing protocols for a given network topology using ns-3. Monitor the routing tables at specified time intervals and observe the impact of link teardown events.



## Code

```
Ptr<Ipv4StaticRouting> staticRouting;
staticRouting = Ipv4RoutingHelper::GetRouting<Ipv4StaticRouting>(
    n0->GetObject<Ipv4>()->GetRoutingProtocol());
staticRouting->SetDefaultRoute("10.0.0.2", 1);
staticRouting = Ipv4RoutingHelper::GetRouting<Ipv4StaticRouting>(
    n1->GetObject<Ipv4>()->GetRoutingProtocol());
staticRouting->SetDefaultRoute("10.0.1.2", 1);
staticRouting = Ipv4RoutingHelper::GetRouting<Ipv4StaticRouting>(
    n2->GetObject<Ipv4>()->GetRoutingProtocol());
staticRouting->SetDefaultRoute("10.0.2.2", 1);
staticRouting = Ipv4RoutingHelper::GetRouting<Ipv4StaticRouting>(
    n8->GetObject<Ipv4>()->GetRoutingProtocol());
staticRouting->SetDefaultRoute("10.0.10.1", 1);
```

```

    if (printRoutingTables)
    {
        RipHelper routingHelper;

        Ptr<OutputStreamWrapper> routingStream =
Create<OutputStreamWrapper>(&std::cout);
        std::vector<uint32_t> intervals = {20, 40, 60, 80};
        for (uint32_t i : intervals)
        {
            for (uint32_t j = 0; j < routers.GetN(); j++)
            {
                routingHelper.PrintRoutingTableAt(Seconds(i), routers.Get(j),
routingStream);
            }
        }
    }

    NS_LOG_INFO("Create Applications.");
    uint32_t packetSize = 1024;
    Time interPacketInterval = Seconds(1.0);
    V4PingHelper ping("10.0.10.2");

    ping.SetAttribute("Interval", TimeValue(interPacketInterval));
    ping.SetAttribute("Size", UIntegerValue(packetSize));
    if (showPings)
    {
        ping.SetAttribute("Verbose", BooleanValue(true));
    }
    ApplicationContainer apps;
    apps.Add(ping.Install(n0));
    apps.Add(ping.Install(n1));
    apps.Add(ping.Install(n2));
    apps.Start(Seconds(1.0));
    apps.Stop(Seconds(150.0));

    Simulator::Schedule(Seconds(30), &TearDownLink, n4, n7, 4, 1);
    Simulator::Schedule(Seconds(50), &TearDownLink, n5, n6, 2, 2);

```

# Result

At 20 seconds

Node: 4, Time: +20s, Local time: +20s, Ipv4ListRouting table

Priority: 0 Protocol: ns3::Rip

Node: 4, Time: +20s, Local time: +20s, IPv4 RIP table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use
Iface						
10.0.7.0	10.0.3.2	255.255.255.0	UGS	3	-	4
10.0.8.0	10.0.3.2	255.255.255.0	UGS	3	-	4
10.0.10.0	10.0.3.2	255.255.255.0	UGS	3	-	4
10.0.9.0	10.0.3.2	255.255.255.0	UGS	3	-	4
10.0.6.0	10.0.3.2	255.255.255.0	UGS	2	-	4
10.0.5.0	10.0.3.2	255.255.255.0	UGS	2	-	4
10.0.4.0	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: 5, Time: +20s, Local time: +20s, Ipv4ListRouting table

Priority: 0 Protocol: ns3::Rip

Node: 5, Time: +20s, Local time: +20s, IPv4 RIP table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use
Iface						
10.0.2.0	10.0.3.1	255.255.255.0	UGS	2	-	1
10.0.1.0	10.0.3.1	255.255.255.0	UGS	2	-	1
10.0.0.0	10.0.3.1	255.255.255.0	UGS	2	-	1
10.0.9.0	10.0.5.2	255.255.255.0	UGS	2	-	3
10.0.10.0	10.0.6.2	255.255.255.0	UGS	2	-	4
10.0.8.0	10.0.4.2	255.255.255.0	UGS	2	-	2
10.0.7.0	10.0.4.2	255.255.255.0	UGS	2	-	2
10.0.3.0	0.0.0.0	255.255.255.0	U	1	-	1
10.0.4.0	0.0.0.0	255.255.255.0	U	1	-	2
10.0.5.0	0.0.0.0	255.255.255.0	U	1	-	3
10.0.6.0	0.0.0.0	255.255.255.0	U	1	-	4

Node: 6, Time: +20s, Local time: +20s, Ipv4ListRouting table

Priority: 0 Protocol: ns3::Rip

Node: 6, Time: +20s, Local time: +20s, IPv4 RIP table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use
Iface						
10.0.0.0	10.0.4.1	255.255.255.0	UGS	3	-	1
10.0.1.0	10.0.4.1	255.255.255.0	UGS	3	-	1
10.0.2.0	10.0.4.1	255.255.255.0	UGS	3	-	1
10.0.10.0	10.0.4.1	255.255.255.0	UGS	3	-	1
10.0.9.0	10.0.7.2	255.255.255.0	UGS	2	-	2
10.0.6.0	10.0.4.1	255.255.255.0	UGS	2	-	1
10.0.3.0	10.0.4.1	255.255.255.0	UGS	2	-	1

10.0.5.0	10.0.7.2	255.255.255.0	UGS	2	-	-	2
10.0.4.0	0.0.0.0	255.255.255.0	U	1	-	-	1
10.0.7.0	0.0.0.0	255.255.255.0	U	1	-	-	2
10.0.8.0	0.0.0.0	255.255.255.0	U	1	-	-	3

Node: 7, Time: +20s, Local time: +20s, Ipv4ListRouting table

Priority: 0 Protocol: ns3::Rip

Node: 7, Time: +20s, Local time: +20s, IPv4 RIP table

Destination Iface	Gateway	Genmask	Flags	Metric	Ref	Use
10.0.0.0	10.0.5.1	255.255.255.0	UGS	3	-	1
10.0.1.0	10.0.5.1	255.255.255.0	UGS	3	-	1
10.0.2.0	10.0.5.1	255.255.255.0	UGS	3	-	1
10.0.4.0	10.0.5.1	255.255.255.0	UGS	2	-	1
10.0.3.0	10.0.5.1	255.255.255.0	UGS	2	-	1
10.0.10.0	10.0.5.1	255.255.255.0	UGS	3	-	1
10.0.8.0	10.0.7.1	255.255.255.0	UGS	2	-	2
10.0.6.0	10.0.5.1	255.255.255.0	UGS	2	-	1
10.0.5.0	0.0.0.0	255.255.255.0	U	1	-	1
10.0.7.0	0.0.0.0	255.255.255.0	U	1	-	2
10.0.9.0	0.0.0.0	255.255.255.0	U	1	-	3

Node: 8, Time: +20s, Local time: +20s, Ipv4ListRouting table

Priority: 0 Protocol: ns3::Rip

Node: 8, Time: +20s, Local time: +20s, IPv4 RIP table

Destination Iface	Gateway	Genmask	Flags	Metric	Ref	Use
10.0.0.0	10.0.6.1	255.255.255.0	UGS	3	-	1
10.0.1.0	10.0.6.1	255.255.255.0	UGS	3	-	1
10.0.2.0	10.0.6.1	255.255.255.0	UGS	3	-	1
10.0.7.0	10.0.9.1	255.255.255.0	UGS	2	-	3
10.0.5.0	10.0.6.1	255.255.255.0	UGS	2	-	1
10.0.4.0	10.0.6.1	255.255.255.0	UGS	2	-	1
10.0.3.0	10.0.6.1	255.255.255.0	UGS	2	-	1
10.0.6.0	0.0.0.0	255.255.255.0	U	1	-	1
10.0.8.0	0.0.0.0	255.255.255.0	U	1	-	2
10.0.9.0	0.0.0.0	255.255.255.0	U	1	-	3
10.0.10.0	0.0.0.0	255.255.255.0	U	1	-	4

## At 40 seconds

Node: 4, Time: +40s, Local time: +40s, Ipv4ListRouting table

Priority: 0 Protocol: ns3::Rip

Node: 4, Time: +40s, Local time: +40s, IPv4 RIP table

Destination Iface	Gateway	Genmask	Flags	Metric	Ref	Use
----------------------	---------	---------	-------	--------	-----	-----

10.0.7.0	10.0.3.2	255.255.255.0	UGS	3	-	-	4
10.0.8.0	10.0.3.2	255.255.255.0	UGS	3	-	-	4
10.0.9.0	10.0.3.2	255.255.255.0	UGS	3	-	-	4
10.0.5.0	10.0.3.2	255.255.255.0	UGS	2	-	-	4
10.0.4.0	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: 5, Time: +40s, Local time: +40s, Ipv4ListRouting table

Priority: 0 Protocol: ns3::Rip

Node: 5, Time: +40s, Local time: +40s, IPv4 RIP table

Destination Iface	Gateway	Genmask	Flags	Metric	Ref	Use
10.0.2.0	10.0.3.1	255.255.255.0	UGS	2	-	1
10.0.1.0	10.0.3.1	255.255.255.0	UGS	2	-	1
10.0.0.0	10.0.3.1	255.255.255.0	UGS	2	-	1
10.0.9.0	10.0.5.2	255.255.255.0	UGS	2	-	3
10.0.8.0	10.0.4.2	255.255.255.0	UGS	2	-	2
10.0.7.0	10.0.4.2	255.255.255.0	UGS	2	-	2
10.0.3.0	0.0.0.0	255.255.255.0	U	1	-	1
10.0.4.0	0.0.0.0	255.255.255.0	U	1	-	2
10.0.5.0	0.0.0.0	255.255.255.0	U	1	-	3

Node: 6, Time: +40s, Local time: +40s, Ipv4ListRouting table

Priority: 0 Protocol: ns3::Rip

Node: 6, Time: +40s, Local time: +40s, IPv4 RIP table

Destination Iface	Gateway	Genmask	Flags	Metric	Ref	Use
10.0.0.0	10.0.4.1	255.255.255.0	UGS	3	-	1
10.0.1.0	10.0.4.1	255.255.255.0	UGS	3	-	1
10.0.2.0	10.0.4.1	255.255.255.0	UGS	3	-	1
10.0.9.0	10.0.7.2	255.255.255.0	UGS	2	-	2
10.0.3.0	10.0.4.1	255.255.255.0	UGS	2	-	1
10.0.5.0	10.0.7.2	255.255.255.0	UGS	2	-	2
10.0.4.0	0.0.0.0	255.255.255.0	U	1	-	1
10.0.7.0	0.0.0.0	255.255.255.0	U	1	-	2
10.0.8.0	0.0.0.0	255.255.255.0	U	1	-	3

Node: 7, Time: +40s, Local time: +40s, Ipv4ListRouting table

Priority: 0 Protocol: ns3::Rip

Node: 7, Time: +40s, Local time: +40s, IPv4 RIP table

Destination Iface	Gateway	Genmask	Flags	Metric	Ref	Use
10.0.0.0	10.0.5.1	255.255.255.0	UGS	3	-	1
10.0.1.0	10.0.5.1	255.255.255.0	UGS	3	-	1
10.0.2.0	10.0.5.1	255.255.255.0	UGS	3	-	1
10.0.4.0	10.0.5.1	255.255.255.0	UGS	2	-	1
10.0.3.0	10.0.5.1	255.255.255.0	UGS	2	-	1

```

10.0.8.0      10.0.7.1      255.255.255.0  UGS  2      -      -      2
10.0.5.0      0.0.0.0       255.255.255.0  U    1      -      -      1
10.0.7.0      0.0.0.0       255.255.255.0  U    1      -      -      2
10.0.9.0      0.0.0.0       255.255.255.0  U    1      -      -      3

```

```

Node: 8, Time: +40s, Local time: +40s, Ipv4ListRouting table
  Priority: 0 Protocol: ns3::Rip

```

```

Node: 8, Time: +40s, Local time: +40s, IPv4 RIP table

```

Destination Iface	Gateway	Genmask	Flags	Metric	Ref	Use
10.0.0.0	10.0.9.1	255.255.255.0	UGS	4	-	3
10.0.1.0	10.0.9.1	255.255.255.0	UGS	4	-	3
10.0.2.0	10.0.9.1	255.255.255.0	UGS	4	-	3
10.0.7.0	10.0.9.1	255.255.255.0	UGS	2	-	3
10.0.5.0	10.0.9.1	255.255.255.0	UGS	2	-	3
10.0.4.0	10.0.9.1	255.255.255.0	UGS	3	-	3
10.0.3.0	10.0.9.1	255.255.255.0	UGS	3	-	3
10.0.8.0	0.0.0.0	255.255.255.0	U	1	-	2
10.0.9.0	0.0.0.0	255.255.255.0	U	1	-	3
10.0.10.0	0.0.0.0	255.255.255.0	U	1	-	4

## At 60 seconds

```

Node: 4, Time: +60s, Local time: +60s, Ipv4ListRouting table
  Priority: 0 Protocol: ns3::Rip

```

```

Node: 4, Time: +60s, Local time: +60s, IPv4 RIP table

```

Destination Iface	Gateway	Genmask	Flags	Metric	Ref	Use
10.0.8.0	10.0.3.2	255.255.255.0	UGS	3	-	4
10.0.9.0	10.0.3.2	255.255.255.0	UGS	3	-	4
10.0.5.0	10.0.3.2	255.255.255.0	UGS	2	-	4
10.0.4.0	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: 5, Time: +60s, Local time: +60s, Ipv4ListRouting table
  Priority: 0 Protocol: ns3::Rip

```

```

Node: 5, Time: +60s, Local time: +60s, IPv4 RIP table

```

Destination Iface	Gateway	Genmask	Flags	Metric	Ref	Use
10.0.2.0	10.0.3.1	255.255.255.0	UGS	2	-	1
10.0.1.0	10.0.3.1	255.255.255.0	UGS	2	-	1
10.0.0.0	10.0.3.1	255.255.255.0	UGS	2	-	1
10.0.9.0	10.0.5.2	255.255.255.0	UGS	2	-	3

10.0.8.0	10.0.4.2	255.255.255.0	UGS	2	-	-	2
10.0.3.0	0.0.0.0	255.255.255.0	U	1	-	-	1
10.0.4.0	0.0.0.0	255.255.255.0	U	1	-	-	2
10.0.5.0	0.0.0.0	255.255.255.0	U	1	-	-	3

Node: 6, Time: +60s, Local time: +60s, Ipv4ListRouting table

Priority: 0 Protocol: ns3::Rip

Node: 6, Time: +60s, Local time: +60s, IPv4 RIP table

Destination Iface	Gateway	Genmask	Flags	Metric	Ref	Use
10.0.0.0	10.0.4.1	255.255.255.0	UGS	3	-	- 1
10.0.1.0	10.0.4.1	255.255.255.0	UGS	3	-	- 1
10.0.2.0	10.0.4.1	255.255.255.0	UGS	3	-	- 1
10.0.3.0	10.0.4.1	255.255.255.0	UGS	2	-	- 1
10.0.4.0	0.0.0.0	255.255.255.0	U	1	-	- 1
10.0.8.0	0.0.0.0	255.255.255.0	U	1	-	- 3

Node: 7, Time: +60s, Local time: +60s, Ipv4ListRouting table

Priority: 0 Protocol: ns3::Rip

Node: 7, Time: +60s, Local time: +60s, IPv4 RIP table

Destination Iface	Gateway	Genmask	Flags	Metric	Ref	Use
10.0.0.0	10.0.5.1	255.255.255.0	UGS	3	-	- 1
10.0.1.0	10.0.5.1	255.255.255.0	UGS	3	-	- 1
10.0.2.0	10.0.5.1	255.255.255.0	UGS	3	-	- 1
10.0.4.0	10.0.5.1	255.255.255.0	UGS	2	-	- 1
10.0.3.0	10.0.5.1	255.255.255.0	UGS	2	-	- 1
10.0.5.0	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	-	- 3

Node: 8, Time: +60s, Local time: +60s, Ipv4ListRouting table

Priority: 0 Protocol: ns3::Rip

Node: 8, Time: +60s, Local time: +60s, IPv4 RIP table

Destination Iface	Gateway	Genmask	Flags	Metric	Ref	Use
10.0.0.0	10.0.9.1	255.255.255.0	UGS	4	-	- 3
10.0.1.0	10.0.9.1	255.255.255.0	UGS	4	-	- 3
10.0.2.0	10.0.9.1	255.255.255.0	UGS	4	-	- 3
10.0.5.0	10.0.9.1	255.255.255.0	UGS	2	-	- 3
10.0.4.0	10.0.8.1	255.255.255.0	UGS	2	-	- 2
10.0.3.0	10.0.9.1	255.255.255.0	UGS	3	-	- 3
10.0.8.0	0.0.0.0	255.255.255.0	U	1	-	- 2
10.0.9.0	0.0.0.0	255.255.255.0	U	1	-	- 3
10.0.10.0	0.0.0.0	255.255.255.0	U	1	-	- 4



## At 80 seconds

Node: 4, Time: +80s, Local time: +80s, Ipv4ListRouting table

Priority: 0 Protocol: ns3::Rip

Node: 4, Time: +80s, Local time: +80s, IPv4 RIP table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use
Iface						
10.0.8.0	10.0.3.2	255.255.255.0	UGS	3	-	4
10.0.10.0	10.0.3.2	255.255.255.0	UGS	8	-	4
10.0.9.0	10.0.3.2	255.255.255.0	UGS	3	-	4
10.0.5.0	10.0.3.2	255.255.255.0	UGS	2	-	4
10.0.4.0	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: 5, Time: +80s, Local time: +80s, Ipv4ListRouting table

Priority: 0 Protocol: ns3::Rip

Node: 5, Time: +80s, Local time: +80s, IPv4 RIP table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use
Iface						
10.0.2.0	10.0.3.1	255.255.255.0	UGS	2	-	1
10.0.1.0	10.0.3.1	255.255.255.0	UGS	2	-	1
10.0.0.0	10.0.3.1	255.255.255.0	UGS	2	-	1
10.0.9.0	10.0.5.2	255.255.255.0	UGS	2	-	3
10.0.10.0	10.0.4.2	255.255.255.0	UGS	7	-	2
10.0.8.0	10.0.4.2	255.255.255.0	UGS	2	-	2
10.0.3.0	0.0.0.0	255.255.255.0	U	1	-	1
10.0.4.0	0.0.0.0	255.255.255.0	U	1	-	2
10.0.5.0	0.0.0.0	255.255.255.0	U	1	-	3
10.0.6.0	10.0.3.1	255.255.255.0	UGS	16	-	1

Node: 6, Time: +80s, Local time: +80s, Ipv4ListRouting table

Priority: 0 Protocol: ns3::Rip

Node: 6, Time: +80s, Local time: +80s, IPv4 RIP table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use
Iface						
10.0.0.0	10.0.4.1	255.255.255.0	UGS	3	-	1
10.0.1.0	10.0.4.1	255.255.255.0	UGS	3	-	1
10.0.2.0	10.0.4.1	255.255.255.0	UGS	3	-	1
10.0.10.0	10.0.8.2	255.255.255.0	UGS	6	-	3
10.0.9.0	10.0.4.1	255.255.255.0	UGS	3	-	1
10.0.3.0	10.0.4.1	255.255.255.0	UGS	2	-	1
10.0.5.0	10.0.4.1	255.255.255.0	UGS	2	-	1
10.0.4.0	0.0.0.0	255.255.255.0	U	1	-	1
10.0.8.0	0.0.0.0	255.255.255.0	U	1	-	3

Node: 7, Time: +80s, Local time: +80s, Ipv4ListRouting table

Priority: 0 Protocol: ns3::Rip

Node: 7, Time: +80s, Local time: +80s, IPv4 RIP table

Destination Iface	Gateway	Genmask	Flags	Metric	Ref	Use
10.0.0.0	10.0.5.1	255.255.255.0	UGS	3	-	1
10.0.1.0	10.0.5.1	255.255.255.0	UGS	3	-	1
10.0.2.0	10.0.5.1	255.255.255.0	UGS	3	-	1
10.0.4.0	10.0.5.1	255.255.255.0	UGS	2	-	1
10.0.3.0	10.0.5.1	255.255.255.0	UGS	2	-	1
10.0.10.0	10.0.5.1	255.255.255.0	UGS	8	-	1
10.0.8.0	10.0.5.1	255.255.255.0	UGS	3	-	1
10.0.6.0	10.0.9.2	255.255.255.0	UGS	16	-	3
10.0.5.0	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	-	3

Node: 8, Time: +80s, Local time: +80s, Ipv4ListRouting table

Priority: 0 Protocol: ns3::Rip

Node: 8, Time: +80s, Local time: +80s, IPv4 RIP table

Destination Iface	Gateway	Genmask	Flags	Metric	Ref	Use
10.0.0.0	10.0.9.1	255.255.255.0	UGS	4	-	3
10.0.1.0	10.0.9.1	255.255.255.0	UGS	4	-	3
10.0.2.0	10.0.9.1	255.255.255.0	UGS	4	-	3
10.0.5.0	10.0.9.1	255.255.255.0	UGS	2	-	3
10.0.4.0	10.0.8.1	255.255.255.0	UGS	2	-	2
10.0.3.0	10.0.9.1	255.255.255.0	UGS	3	-	3
10.0.8.0	0.0.0.0	255.255.255.0	U	1	-	2
10.0.9.0	0.0.0.0	255.255.255.0	U	1	-	3
10.0.10.0	0.0.0.0	255.255.255.0	U	1	-	4