

## Assignment 3

# Routing Protocols

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Mazen Elmesery 49

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## Problem statement

- Create a script that simulates the following topology, with those nodes having point to points links, and internet stack installed.
- When computing the routes, the GlobalRouting implementation in NS3 keeps all routes to the node in the database, You are required to update this part to filter the routes keeping only the route with the min number of hops (least cost).

## Modifications

### Initializations

```
address.SetBase ("10.1.1.0", "255.255.255.0");
NetDeviceContainer devices;
devices = p0p1.Install (nodes.Get (0), nodes.Get (1));
Ipv4InterfaceContainer interfaces = address.Assign (devices);

devices = p0p2.Install (nodes.Get (0), nodes.Get (2));
address.SetBase ("10.1.2.0", "255.255.255.0");
interfaces = address.Assign (devices);

devices = p1p2.Install (nodes.Get (1), nodes.Get (2));
address.SetBase ("10.1.3.0", "255.255.255.0");
interfaces = address.Assign (devices);

devices = p1p3.Install (nodes.Get (1), nodes.Get (3));
address.SetBase ("10.1.4.0", "255.255.255.0");
interfaces = address.Assign (devices);

devices = p1p4.Install (nodes.Get (1), nodes.Get (4));
address.SetBase ("10.1.5.0", "255.255.255.0");
interfaces = address.Assign (devices);

devices = p2p4.Install (nodes.Get (2), nodes.Get (4));
address.SetBase ("10.1.6.0", "255.255.255.0");
interfaces = address.Assign (devices);

devices = p3p4.Install (nodes.Get (3), nodes.Get (4));
```

```

address.SetBase ("10.1.7.0", "255.255.255.0");
interfaces = address.Assign (devices);

devices = p4p5.Install (nodes.Get (4), nodes.Get (5));
address.SetBase ("10.1.8.0", "255.255.255.0");
interfaces = address.Assign (devices);

Ipv4GlobalRoutingHelper::PopulateRoutingTables ();

```

### Modification in original code

Added (=) at the if statement in “global-route-manager-impl.cc” to filter the routes keeping only the route with the min number of hops (least cost).

```

SPFVertex* cw;
cw = candidate.Find (w_lsa->GetLinkStateId ());
if (cw->GetDistanceFromRoot () <= distance)
{

```

## Output

```

Node: 0, Time: +0.0ns, Local time: +0.0ns, Ipv4ListRouting table
  Priority: 0 Protocol: ns3::Ipv4StaticRouting
Node: 0, Time: +0.0ns, Local time: +0.0ns, Ipv4StaticRouting table
Destination      Gateway          Genmask          Flags Metric Ref    Use
Iface
127.0.0.0         0.0.0.0          255.0.0.0        U      0      -      -    0
10.1.1.0          0.0.0.0          255.255.255.0    U      0      -      -    1
10.1.2.0          0.0.0.0          255.255.255.0    U      0      -      -    2

  Priority: -10 Protocol: ns3::Ipv4GlobalRouting
Node: 0, Time: +0.0ns, Local time: +0.0ns, Ipv4GlobalRouting table
Destination      Gateway          Genmask          Flags Metric Ref    Use
Iface
10.1.1.2          10.1.1.2         255.255.255.255  UH     -      -      -    1
10.1.3.1          10.1.1.2         255.255.255.255  UH     -      -      -    1
10.1.4.1          10.1.1.2         255.255.255.255  UH     -      -      -    1

```

10.1.5.1	10.1.1.2	255.255.255.255	UH	-	-	-	1
10.1.2.2	10.1.2.2	255.255.255.255	UH	-	-	-	2
10.1.3.2	10.1.2.2	255.255.255.255	UH	-	-	-	2
10.1.6.1	10.1.2.2	255.255.255.255	UH	-	-	-	2
10.1.4.2	10.1.1.2	255.255.255.255	UH	-	-	-	1
10.1.7.1	10.1.1.2	255.255.255.255	UH	-	-	-	1
10.1.5.2	10.1.1.2	255.255.255.255	UH	-	-	-	1
10.1.5.2	10.1.2.2	255.255.255.255	UH	-	-	-	2
10.1.6.2	10.1.1.2	255.255.255.255	UH	-	-	-	1
10.1.6.2	10.1.2.2	255.255.255.255	UH	-	-	-	2
10.1.7.2	10.1.1.2	255.255.255.255	UH	-	-	-	1
10.1.7.2	10.1.2.2	255.255.255.255	UH	-	-	-	2
10.1.8.1	10.1.1.2	255.255.255.255	UH	-	-	-	1
10.1.8.1	10.1.2.2	255.255.255.255	UH	-	-	-	2
10.1.8.2	10.1.1.2	255.255.255.255	UH	-	-	-	1
10.1.8.2	10.1.2.2	255.255.255.255	UH	-	-	-	2
10.1.1.0	10.1.1.2	255.255.255.0	UG	-	-	-	1
10.1.3.0	10.1.1.2	255.255.255.0	UG	-	-	-	1
10.1.4.0	10.1.1.2	255.255.255.0	UG	-	-	-	1
10.1.5.0	10.1.1.2	255.255.255.0	UG	-	-	-	1
10.1.4.0	10.1.1.2	255.255.255.0	UG	-	-	-	1
10.1.7.0	10.1.1.2	255.255.255.0	UG	-	-	-	1
10.1.5.0	10.1.1.2	255.255.255.0	UG	-	-	-	1
10.1.5.0	10.1.2.2	255.255.255.0	UG	-	-	-	2
10.1.6.0	10.1.1.2	255.255.255.0	UG	-	-	-	1
10.1.6.0	10.1.2.2	255.255.255.0	UG	-	-	-	2
10.1.7.0	10.1.1.2	255.255.255.0	UG	-	-	-	1
10.1.7.0	10.1.2.2	255.255.255.0	UG	-	-	-	2
10.1.8.0	10.1.1.2	255.255.255.0	UG	-	-	-	1
10.1.8.0	10.1.2.2	255.255.255.0	UG	-	-	-	2
10.1.8.0	10.1.1.2	255.255.255.0	UG	-	-	-	1
10.1.8.0	10.1.2.2	255.255.255.0	UG	-	-	-	2
10.1.2.0	10.1.2.2	255.255.255.0	UG	-	-	-	2
10.1.3.0	10.1.2.2	255.255.255.0	UG	-	-	-	2
10.1.6.0	10.1.2.2	255.255.255.0	UG	-	-	-	2

Node: 1, Time: +0.0ns, Local time: +0.0ns, Ipv4ListRouting table

Priority: 0 Protocol: ns3::Ipv4StaticRouting

Node: 1, Time: +0.0ns, Local time: +0.0ns, Ipv4StaticRouting table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use
Iface						

```

127.0.0.0      0.0.0.0      255.0.0.0      U    0    -    -    0
10.1.1.0      0.0.0.0      255.255.255.0  U    0    -    -    1
10.1.3.0      0.0.0.0      255.255.255.0  U    0    -    -    2
10.1.4.0      0.0.0.0      255.255.255.0  U    0    -    -    3
10.1.5.0      0.0.0.0      255.255.255.0  U    0    -    -    4

```

Priority: -10 Protocol: ns3::Ipv4GlobalRouting

Node: 1, Time: +0.0ns, Local time: +0.0ns, Ipv4GlobalRouting table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use
Iface						
10.1.1.1	10.1.1.1	255.255.255.255	UH	-	-	1
10.1.2.1	10.1.1.1	255.255.255.255	UH	-	-	1
10.1.2.2	10.1.3.2	255.255.255.255	UH	-	-	2
10.1.3.2	10.1.3.2	255.255.255.255	UH	-	-	2
10.1.6.1	10.1.3.2	255.255.255.255	UH	-	-	2
10.1.4.2	10.1.4.2	255.255.255.255	UH	-	-	3
10.1.7.1	10.1.4.2	255.255.255.255	UH	-	-	3
10.1.5.2	10.1.5.2	255.255.255.255	UH	-	-	4
10.1.6.2	10.1.5.2	255.255.255.255	UH	-	-	4
10.1.7.2	10.1.5.2	255.255.255.255	UH	-	-	4
10.1.8.1	10.1.5.2	255.255.255.255	UH	-	-	4
10.1.8.2	10.1.5.2	255.255.255.255	UH	-	-	4
10.1.1.0	10.1.1.1	255.255.255.0	UG	-	-	1
10.1.2.0	10.1.1.1	255.255.255.0	UG	-	-	1
10.1.2.0	10.1.3.2	255.255.255.0	UG	-	-	2
10.1.3.0	10.1.3.2	255.255.255.0	UG	-	-	2
10.1.6.0	10.1.3.2	255.255.255.0	UG	-	-	2
10.1.4.0	10.1.4.2	255.255.255.0	UG	-	-	3
10.1.7.0	10.1.4.2	255.255.255.0	UG	-	-	3
10.1.5.0	10.1.5.2	255.255.255.0	UG	-	-	4
10.1.6.0	10.1.5.2	255.255.255.0	UG	-	-	4
10.1.7.0	10.1.5.2	255.255.255.0	UG	-	-	4
10.1.8.0	10.1.5.2	255.255.255.0	UG	-	-	4
10.1.8.0	10.1.5.2	255.255.255.0	UG	-	-	4

Node: 2, Time: +0.0ns, Local time: +0.0ns, Ipv4ListRouting table

Priority: 0 Protocol: ns3::Ipv4StaticRouting

Node: 2, Time: +0.0ns, Local time: +0.0ns, Ipv4StaticRouting table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use
Iface						
127.0.0.0	0.0.0.0	255.0.0.0	U	0	-	0

10.1.2.0	0.0.0.0	255.255.255.0	U	0	-	-	1
10.1.3.0	0.0.0.0	255.255.255.0	U	0	-	-	2
10.1.6.0	0.0.0.0	255.255.255.0	U	0	-	-	3

Priority: -10 Protocol: ns3::Ipv4GlobalRouting

Node: 2, Time: +0.0ns, Local time: +0.0ns, Ipv4GlobalRouting table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use
Iface						
10.1.1.1	10.1.2.1	255.255.255.255	UH	-	-	- 1
10.1.2.1	10.1.2.1	255.255.255.255	UH	-	-	- 1
10.1.1.2	10.1.3.1	255.255.255.255	UH	-	-	- 2
10.1.3.1	10.1.3.1	255.255.255.255	UH	-	-	- 2
10.1.4.1	10.1.3.1	255.255.255.255	UH	-	-	- 2
10.1.5.1	10.1.3.1	255.255.255.255	UH	-	-	- 2
10.1.5.2	10.1.6.2	255.255.255.255	UH	-	-	- 3
10.1.6.2	10.1.6.2	255.255.255.255	UH	-	-	- 3
10.1.7.2	10.1.6.2	255.255.255.255	UH	-	-	- 3
10.1.8.1	10.1.6.2	255.255.255.255	UH	-	-	- 3
10.1.4.2	10.1.3.1	255.255.255.255	UH	-	-	- 2
10.1.4.2	10.1.6.2	255.255.255.255	UH	-	-	- 3
10.1.7.1	10.1.3.1	255.255.255.255	UH	-	-	- 2
10.1.7.1	10.1.6.2	255.255.255.255	UH	-	-	- 3
10.1.8.2	10.1.6.2	255.255.255.255	UH	-	-	- 3
10.1.1.0	10.1.2.1	255.255.255.0	UG	-	-	- 1
10.1.2.0	10.1.2.1	255.255.255.0	UG	-	-	- 1
10.1.1.0	10.1.3.1	255.255.255.0	UG	-	-	- 2
10.1.3.0	10.1.3.1	255.255.255.0	UG	-	-	- 2
10.1.4.0	10.1.3.1	255.255.255.0	UG	-	-	- 2
10.1.5.0	10.1.3.1	255.255.255.0	UG	-	-	- 2
10.1.4.0	10.1.3.1	255.255.255.0	UG	-	-	- 2
10.1.4.0	10.1.6.2	255.255.255.0	UG	-	-	- 3
10.1.7.0	10.1.3.1	255.255.255.0	UG	-	-	- 2
10.1.7.0	10.1.6.2	255.255.255.0	UG	-	-	- 3
10.1.5.0	10.1.6.2	255.255.255.0	UG	-	-	- 3
10.1.6.0	10.1.6.2	255.255.255.0	UG	-	-	- 3
10.1.7.0	10.1.6.2	255.255.255.0	UG	-	-	- 3
10.1.8.0	10.1.6.2	255.255.255.0	UG	-	-	- 3
10.1.8.0	10.1.6.2	255.255.255.0	UG	-	-	- 3

Node: 3, Time: +0.0ns, Local time: +0.0ns, Ipv4ListRouting table

Priority: 0 Protocol: ns3::Ipv4StaticRouting

```

Node: 3, Time: +0.0ns, Local time: +0.0ns, Ipv4StaticRouting table
Destination      Gateway          Genmask          Flags Metric Ref    Use
Iface
127.0.0.0        0.0.0.0          255.0.0.0        U      0      -      -    0
10.1.4.0         0.0.0.0          255.255.255.0    U      0      -      -    1
10.1.7.0         0.0.0.0          255.255.255.0    U      0      -      -    2

```

Priority: -10 Protocol: ns3::Ipv4GlobalRouting

```

Node: 3, Time: +0.0ns, Local time: +0.0ns, Ipv4GlobalRouting table
Destination      Gateway          Genmask          Flags Metric Ref    Use
Iface
10.1.1.2         10.1.4.1        255.255.255.255 UH      -      -      -    1
10.1.3.1         10.1.4.1        255.255.255.255 UH      -      -      -    1
10.1.4.1         10.1.4.1        255.255.255.255 UH      -      -      -    1
10.1.5.1         10.1.4.1        255.255.255.255 UH      -      -      -    1
10.1.5.2         10.1.7.2        255.255.255.255 UH      -      -      -    2
10.1.6.2         10.1.7.2        255.255.255.255 UH      -      -      -    2
10.1.7.2         10.1.7.2        255.255.255.255 UH      -      -      -    2
10.1.8.1         10.1.7.2        255.255.255.255 UH      -      -      -    2
10.1.1.1         10.1.4.1        255.255.255.255 UH      -      -      -    1
10.1.2.1         10.1.4.1        255.255.255.255 UH      -      -      -    1
10.1.2.2         10.1.4.1        255.255.255.255 UH      -      -      -    1
10.1.2.2         10.1.7.2        255.255.255.255 UH      -      -      -    2
10.1.3.2         10.1.4.1        255.255.255.255 UH      -      -      -    1
10.1.3.2         10.1.7.2        255.255.255.255 UH      -      -      -    2
10.1.6.1         10.1.4.1        255.255.255.255 UH      -      -      -    1
10.1.6.1         10.1.7.2        255.255.255.255 UH      -      -      -    2
10.1.8.2         10.1.7.2        255.255.255.255 UH      -      -      -    2
10.1.1.0         10.1.4.1        255.255.255.0    UG      -      -      -    1
10.1.3.0         10.1.4.1        255.255.255.0    UG      -      -      -    1
10.1.4.0         10.1.4.1        255.255.255.0    UG      -      -      -    1
10.1.5.0         10.1.4.1        255.255.255.0    UG      -      -      -    1
10.1.1.0         10.1.4.1        255.255.255.0    UG      -      -      -    1
10.1.2.0         10.1.4.1        255.255.255.0    UG      -      -      -    1
10.1.2.0         10.1.4.1        255.255.255.0    UG      -      -      -    1
10.1.2.0         10.1.7.2        255.255.255.0    UG      -      -      -    2
10.1.3.0         10.1.4.1        255.255.255.0    UG      -      -      -    1
10.1.3.0         10.1.7.2        255.255.255.0    UG      -      -      -    2
10.1.6.0         10.1.4.1        255.255.255.0    UG      -      -      -    1
10.1.6.0         10.1.7.2        255.255.255.0    UG      -      -      -    2
10.1.5.0         10.1.7.2        255.255.255.0    UG      -      -      -    2

```

```

10.1.6.0      10.1.7.2      255.255.255.0  UG  -  -  -  2
10.1.7.0      10.1.7.2      255.255.255.0  UG  -  -  -  2
10.1.8.0      10.1.7.2      255.255.255.0  UG  -  -  -  2
10.1.8.0      10.1.7.2      255.255.255.0  UG  -  -  -  2

```

Node: 4, Time: +0.0ns, Local time: +0.0ns, Ipv4ListRouting table

Priority: 0 Protocol: ns3::Ipv4StaticRouting

Node: 4, Time: +0.0ns, Local time: +0.0ns, Ipv4StaticRouting table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use
Iface						
127.0.0.0	0.0.0.0	255.0.0.0	U	0	-	- 0
10.1.5.0	0.0.0.0	255.255.255.0	U	0	-	- 1
10.1.6.0	0.0.0.0	255.255.255.0	U	0	-	- 2
10.1.7.0	0.0.0.0	255.255.255.0	U	0	-	- 3
10.1.8.0	0.0.0.0	255.255.255.0	U	0	-	- 4

Priority: -10 Protocol: ns3::Ipv4GlobalRouting

Node: 4, Time: +0.0ns, Local time: +0.0ns, Ipv4GlobalRouting table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use
Iface						
10.1.1.2	10.1.5.1	255.255.255.255	UH	-	-	- 1
10.1.3.1	10.1.5.1	255.255.255.255	UH	-	-	- 1
10.1.4.1	10.1.5.1	255.255.255.255	UH	-	-	- 1
10.1.5.1	10.1.5.1	255.255.255.255	UH	-	-	- 1
10.1.2.2	10.1.6.1	255.255.255.255	UH	-	-	- 2
10.1.3.2	10.1.6.1	255.255.255.255	UH	-	-	- 2
10.1.6.1	10.1.6.1	255.255.255.255	UH	-	-	- 2
10.1.4.2	10.1.7.1	255.255.255.255	UH	-	-	- 3
10.1.7.1	10.1.7.1	255.255.255.255	UH	-	-	- 3
10.1.8.2	10.1.8.2	255.255.255.255	UH	-	-	- 4
10.1.1.1	10.1.5.1	255.255.255.255	UH	-	-	- 1
10.1.1.1	10.1.6.1	255.255.255.255	UH	-	-	- 2
10.1.2.1	10.1.5.1	255.255.255.255	UH	-	-	- 1
10.1.2.1	10.1.6.1	255.255.255.255	UH	-	-	- 2
10.1.1.0	10.1.5.1	255.255.255.0	UG	-	-	- 1
10.1.3.0	10.1.5.1	255.255.255.0	UG	-	-	- 1
10.1.4.0	10.1.5.1	255.255.255.0	UG	-	-	- 1
10.1.5.0	10.1.5.1	255.255.255.0	UG	-	-	- 1
10.1.1.0	10.1.5.1	255.255.255.0	UG	-	-	- 1
10.1.1.0	10.1.6.1	255.255.255.0	UG	-	-	- 2
10.1.2.0	10.1.5.1	255.255.255.0	UG	-	-	- 1



```

10.1.2.0      10.1.6.1      255.255.255.0  UG  -  -  -  2
10.1.2.0      10.1.6.1      255.255.255.0  UG  -  -  -  2
10.1.3.0      10.1.6.1      255.255.255.0  UG  -  -  -  2
10.1.6.0      10.1.6.1      255.255.255.0  UG  -  -  -  2
10.1.4.0      10.1.7.1      255.255.255.0  UG  -  -  -  3
10.1.7.0      10.1.7.1      255.255.255.0  UG  -  -  -  3
10.1.8.0      10.1.8.2      255.255.255.0  UG  -  -  -  4

```

Node: 5, Time: +0.0ns, Local time: +0.0ns, Ipv4ListRouting table

Priority: 0 Protocol: ns3::Ipv4StaticRouting

Node: 5, Time: +0.0ns, Local time: +0.0ns, Ipv4StaticRouting table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use
Iface						
127.0.0.0	0.0.0.0	255.0.0.0	U	0	-	0
10.1.8.0	0.0.0.0	255.255.255.0	U	0	-	1

Priority: -10 Protocol: ns3::Ipv4GlobalRouting

Node: 5, Time: +0.0ns, Local time: +0.0ns, Ipv4GlobalRouting table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use
Iface						
0.0.0.0	10.1.8.1	0.0.0.0	UG	-	-	1

At time 2s client sent 1024 bytes to 10.1.8.2 port 9

