CN Assignment 4

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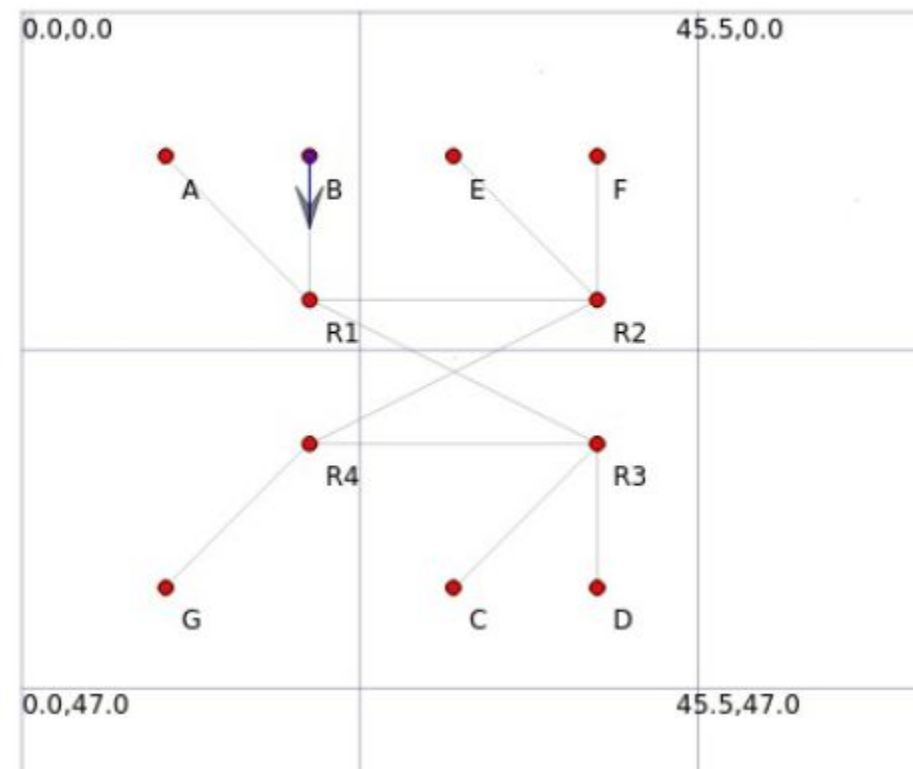
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Custom Topology

Host Nodes - A, B, C, D, E, F, G   7 Host Nodes and 4 Routers

Bidirectional Connections, Custom Coordinates and data rates link wise

NS3 Modules

```cpp
#include "ns3/core-module.h"
#include "ns3/network-module.h"
#include "ns3/point-to-point-module.h"
#include "ns3/internet-module.h"
#include "ns3/applications-module.h"
#include "ns3/flow-monitor-module.h"
#include "ns3/netanim-module.h"
#include "ns3/error-model.h"
#include <iomanip>
#include <map>
#include <vector>
#include <string>
#include <fstream>
#include <set>
#include <utility>
```

Custom Data Rate

```cpp
// Host-to-Router links with capacities from Table 3
p2p.SetChannelAttribute("Delay", StringValue("2ms"));
p2p.SetDeviceAttribute("DataRate", StringValue("1Mbps")); // A - R1
hostDevices[0] = p2p.Install(NodeContainer(hosts.Get(0), routers.Get(0)));
p2p.SetDeviceAttribute("DataRate", StringValue("1Mbps")); // B - R1
hostDevices[1] = p2p.Install(NodeContainer(hosts.Get(1), routers.Get(0)));
p2p.SetDeviceAttribute("DataRate", StringValue("1Mbps")); // C - R3
hostDevices[2] = p2p.Install(NodeContainer(hosts.Get(2), routers.Get(2)));
p2p.SetDeviceAttribute("DataRate", StringValue("2Mbps")); // D - R3
hostDevices[3] = p2p.Install(NodeContainer(hosts.Get(3), routers.Get(2)));
p2p.SetDeviceAttribute("DataRate", StringValue("1Mbps")); // E - R2
hostDevices[4] = p2p.Install(NodeContainer(hosts.Get(4), routers.Get(1)));
p2p.SetDeviceAttribute("DataRate", StringValue("1Mbps")); // F - R2
hostDevices[5] = p2p.Install(NodeContainer(hosts.Get(5), routers.Get(1)));
p2p.SetDeviceAttribute("DataRate", StringValue("1Mbps")); // G - R4
hostDevices[6] = p2p.Install(NodeContainer(hosts.Get(6), routers.Get(3)));
// Router-to-Router links with capacities from Table 3
p2p.SetDeviceAttribute("DataRate", StringValue("3Mbps")); // R1 - R2
routerDevices.Add(p2p.Install(NodeContainer(routers.Get(0), routers.Get(1))));
p2p.SetDeviceAttribute("DataRate", StringValue("2.5Mbps")); // R1 - R3
routerDevices.Add(p2p.Install(NodeContainer(routers.Get(0), routers.Get(2))));
p2p.SetDeviceAttribute("DataRate", StringValue("1.5Mbps")); // R3 - R4
routerDevices.Add(p2p.Install(NodeContainer(routers.Get(2), routers.Get(3))));
p2p.SetDeviceAttribute("DataRate", StringValue("1Mbps")); // R2 - R4
routerDevices.Add(p2p.Install(NodeContainer(routers.Get(1), routers.Get(3))));
// Create an Error Model
```

Poisson Distributed Traffic

```
Traffic Matrix:
        A      B      C      D      E      F      G
A       0     87     77     86     81     61     75
B      70      0     94     96     80     83     84
C      77     74      0     79     85     67     75
D      85     66    104      0     61     80     91
E      81     91     78     76      0     93     78
F      77     69     71     78     90      0     77
G      84     74     83     81     66     80      0
```

Related Function

```cpp
void GenerateTrafficMatrix(const std::vector<std::string>& hosts, double lambda) {
    std::random_device rd;
    std::mt19937 gen(rd());
    std::poisson_distribution<> poissonDist(lambda);
    for (const auto& src : hosts) {
        for (const auto& dst : hosts) {
            if (src != dst) {
                uint32_t trafficLoad = poissonDist(gen); // Poisson-distributed traffic load
                trafficMatrix[std::make_pair(src, dst)] = trafficLoad;
            }
        }
    }
} void PopulateIpToNodeNameMapping(ns3::NodeContainer hosts, ns3::NodeContainer routers, ns3::Ipv4InterfaceContainer interfaces)
}
```

Packet Length

Packet length: Workstations/servers generate or consume packets of size 1024 bits.

```
echoClient.SetAttribute("MaxPackets", UintegerValue(100));
echoClient.SetAttribute("Interval", TimeValue(Seconds(0.01)));
echoClient.SetAttribute("PacketSize", UintegerValue(1024));
ApplicationContainer clientApps = echoClient.Install(hosts.Get(1));
clientApps.Start(Seconds(2.0));
```

Routing Table

```
Node: 0, Time: +1s, Local time: +1s, Ipv4GlobalRouting table
Destination   Gateway     Genmask       Flags Metric Ref  Use Iface
0.0.0.0       10.1.0.2    0.0.0.0       UG    -    -    - 1
```

```
Node: 1, Time: +1s, Local time: +1s, Ipv4GlobalRouting table
Destination   Gateway     Genmask       Flags Metric Ref  Use Iface
0.0.0.0       10.1.1.2    0.0.0.0       UG    -    -    - 1
```

```
Node: 2, Time: +1s, Local time: +1s, Ipv4GlobalRouting table
Destination   Gateway     Genmask       Flags Metric Ref  Use Iface
0.0.0.0       10.1.2.2    0.0.0.0       UG    -    -    - 1
```

```
Node: 3, Time: +1s, Local time: +1s, Ipv4GlobalRouting table
Destination   Gateway     Genmask       Flags Metric Ref  Use Iface
0.0.0.0       10.1.3.2    0.0.0.0       UG    -    -    - 1
```

```
Node: 4, Time: +1s, Local time: +1s, Ipv4GlobalRouting table
Destination   Gateway     Genmask       Flags Metric Ref  Use Iface
0.0.0.0       10.1.4.2    0.0.0.0       UG    -    -    - 1
```

```
Node: 5, Time: +1s, Local time: +1s, Ipv4GlobalRouting table
Destination   Gateway     Genmask       Flags Metric Ref  Use Iface
0.0.0.0       10.1.5.2    0.0.0.0       UG    -    -    - 1
```

```
Node: 6, Time: +1s, Local time: +1s, Ipv4GlobalRouting table
Destination   Gateway     Genmask       Flags Metric Ref  Use Iface
0.0.0.0       10.1.6.2    0.0.0.0       UG    -    -    - 1
```

```
Node: 7, Time: +1s, Local time: +1s, Ipv4GlobalRouting table
Destination   Gateway     Genmask           Flags Metric Ref  Use Iface
10.1.0.1      10.1.0.1    255.255.255.255 UH   -    -    - 1
10.1.1.1      10.1.1.1    255.255.255.255 UH   -    -    - 2
10.1.4.2      10.1.8.1    255.255.255.255 UH   -    -    - 3
10.1.5.2      10.1.8.1    255.255.255.255 UH   -    -    - 3
10.1.8.1      10.1.8.1    255.255.255.255 UH   -    -    - 3
10.1.13.1     10.1.8.1    255.255.255.255 UH   -    -    - 3
10.1.2.2      10.1.10.1   255.255.255.255 UH   -    -    - 4
10.1.3.2      10.1.10.1   255.255.255.255 UH   -    -    - 4
10.1.10.1     10.1.10.1   255.255.255.255 UH   -    -    - 4
10.1.11.1     10.1.10.1   255.255.255.255 UH   -    -    - 4
10.1.4.1      10.1.8.1    255.255.255.255 UH   -    -    - 3
10.1.5.1      10.1.8.1    255.255.255.255 UH   -    -    - 3
10.1.6.2      10.1.8.1    255.255.255.255 UH   -    -    - 3
10.1.6.2      10.1.10.1   255.255.255.255 UH   -    -    - 4
10.1.12.1     10.1.8.1    255.255.255.255 UH   -    -    - 3
10.1.12.1     10.1.10.1   255.255.255.255 UH   -    -    - 4
10.1.14.1     10.1.8.1    255.255.255.255 UH   -    -    - 3
10.1.14.1     10.1.10.1   255.255.255.255 UH   -    -    - 4
10.1.2.1      10.1.10.1   255.255.255.255 UH   -    -    - 4
10.1.3.1      10.1.10.1   255.255.255.255 UH   -    -    - 4
10.1.6.1      10.1.8.1    255.255.255.255 UH   -    -    - 3
10.1.6.1      10.1.10.1   255.255.255.255 UH   -    -    - 4
10.1.0.0      10.1.0.1    255.255.255.0  UG   -    -    - 1
10.1.1.0      10.1.1.1    255.255.255.0  UG   -    -    - 2
10.1.4.0      10.1.8.1    255.255.255.0  UG   -    -    - 3
10.1.5.0      10.1.8.1    255.255.255.0  UG   -    -    - 3
10.1.7.0      10.1.8.1    255.255.255.0  UG   -    -    - 3
10.1.14.0     10.1.8.1    255.255.255.0  UG   -    -    - 3
10.1.4.0      10.1.8.1    255.255.255.0  UG   -    -    - 3
```

```
Node: 9, Time: +1s, Local time: +1s, Ipv4GlobalRouting table
Destination     Gateway        Genmask          Flags Metric Ref    Use Iface
10.1.2.1        10.1.2.1       255.255.255.255 UH    -     -    -  1
10.1.3.1        10.1.3.1       255.255.255.255 UH    -     -    -  2
10.1.0.2        10.1.9.1       255.255.255.255 UH    -     -    -  3
10.1.1.2        10.1.9.1       255.255.255.255 UH    -     -    -  3
10.1.7.1        10.1.9.1       255.255.255.255 UH    -     -    -  3
10.1.9.1        10.1.9.1       255.255.255.255 UH    -     -    -  3
10.1.6.2        10.1.12.1      255.255.255.255 UH    -     -    -  4
10.1.12.1       10.1.12.1      255.255.255.255 UH    -     -    -  4
10.1.14.1       10.1.12.1      255.255.255.255 UH    -     -    -  4
10.1.0.1        10.1.9.1       255.255.255.255 UH    -     -    -  3
10.1.1.1        10.1.9.1       255.255.255.255 UH    -     -    -  3
10.1.4.2        10.1.9.1       255.255.255.255 UH    -     -    -  3
10.1.4.2        10.1.12.1      255.255.255.255 UH    -     -    -  4
10.1.5.2        10.1.9.1       255.255.255.255 UH    -     -    -  3
10.1.5.2        10.1.12.1      255.255.255.255 UH    -     -    -  4
10.1.8.1        10.1.9.1       255.255.255.255 UH    -     -    -  3
10.1.8.1        10.1.12.1      255.255.255.255 UH    -     -    -  4
10.1.13.1       10.1.9.1       255.255.255.255 UH    -     -    -  3
10.1.13.1       10.1.12.1      255.255.255.255 UH    -     -    -  4
10.1.6.1        10.1.12.1      255.255.255.255 UH    -     -    -  4
10.1.4.1        10.1.9.1       255.255.255.255 UH    -     -    -  3
10.1.4.1        10.1.12.1      255.255.255.255 UH    -     -    -  4
10.1.5.1        10.1.9.1       255.255.255.255 UH    -     -    -  3
10.1.5.1        10.1.12.1      255.255.255.255 UH    -     -    -  4
10.1.2.0        10.1.2.1       255.255.255.0   UG    -     -    -  1
10.1.3.0        10.1.3.1       255.255.255.0   UG    -     -    -  2
10.1.0.0        10.1.9.1       255.255.255.0   UG    -     -    -  3
10.1.1.0        10.1.9.1       255.255.255.0   UG    -     -    -  3
10.1.8.0        10.1.9.1       255.255.255.0   UG    -     -    -  3
10.1.10.0       10.1.9.1       255.255.255.0   UG    -     -    -  3
10.1.0.0        10.1.9.1       255.255.255.0   UG    -     -    -  3
10.1.1.0        10.1.9.1       255.255.255.0   UG    -     -    -  3
10.1.4.0        10.1.9.1       255.255.255.0   UG    -     -    -  3
10.1.4.0        10.1.12.1      255.255.255.0   UG    -     -    -  4
10.1.5.0        10.1.9.1       255.255.255.0   UG    -     -    -  3
10.1.5.0        10.1.12.1      255.255.255.0   UG    -     -    -  4
10.1.7.0        10.1.9.1       255.255.255.0   UG    -     -    -  3
10.1.7.0        10.1.12.1      255.255.255.0   UG    -     -    -  4
10.1.14.0       10.1.9.1       255.255.255.0   UG    -     -    -  3
10.1.14.0       10.1.12.1      255.255.255.0   UG    -     -    -  4
10.1.4.0        10.1.9.1       255.255.255.0   UG    -     -    -  3
10.1.4.0        10.1.12.1      255.255.255.0   UG    -     -    -  4
```

```
Node: 10, Time: +1s, Local time: +1s, Ipv4GlobalRouting table
Destination     Gateway         Genmask         Flags Metric Ref   Use Iface
10.1.6.1        10.1.6.1        255.255.255.255 UH    -      -    -  1
10.1.2.2        10.1.11.1       255.255.255.255 UH    -      -    -  2
10.1.3.2        10.1.11.1       255.255.255.255 UH    -      -    -  2
10.1.10.1       10.1.11.1       255.255.255.255 UH    -      -    -  2
10.1.11.1       10.1.11.1       255.255.255.255 UH    -      -    -  2
10.1.4.2        10.1.13.1       255.255.255.255 UH    -      -    -  3
10.1.5.2        10.1.13.1       255.255.255.255 UH    -      -    -  3
10.1.8.1        10.1.13.1       255.255.255.255 UH    -      -    -  3
10.1.13.1       10.1.13.1       255.255.255.255 UH    -      -    -  3
10.1.2.1        10.1.11.1       255.255.255.255 UH    -      -    -  2
10.1.3.1        10.1.11.1       255.255.255.255 UH    -      -    -  2
10.1.0.2        10.1.11.1       255.255.255.255 UH    -      -    -  2
10.1.0.2        10.1.13.1       255.255.255.255 UH    -      -    -  3
10.1.1.2        10.1.11.1       255.255.255.255 UH    -      -    -  2
10.1.1.2        10.1.13.1       255.255.255.255 UH    -      -    -  3
10.1.7.1        10.1.11.1       255.255.255.255 UH    -      -    -  2
10.1.7.1        10.1.13.1       255.255.255.255 UH    -      -    -  3
10.1.9.1        10.1.11.1       255.255.255.255 UH    -      -    -  2
10.1.9.1        10.1.13.1       255.255.255.255 UH    -      -    -  3
10.1.4.1        10.1.13.1       255.255.255.255 UH    -      -    -  3
10.1.5.1        10.1.13.1       255.255.255.255 UH    -      -    -  3
10.1.0.1        10.1.11.1       255.255.255.255 UH    -      -    -  2
10.1.0.1        10.1.13.1       255.255.255.255 UH    -      -    -  3
10.1.1.1        10.1.11.1       255.255.255.255 UH    -      -    -  2
10.1.1.1        10.1.13.1       255.255.255.255 UH    -      -    -  3
10.1.6.0        10.1.6.1        255.255.255.0   UG    -      -    -  1
10.1.2.0        10.1.11.1       255.255.255.0   UG    -      -    -  2
10.1.3.0        10.1.11.1       255.255.255.0   UG    -      -    -  2
10.1.9.0        10.1.11.1       255.255.255.0   UG    -      -    -  2
10.1.12.0       10.1.11.1       255.255.255.0   UG    -      -    -  2
10.1.2.0        10.1.11.1       255.255.255.0   UG    -      -    -  2
10.1.3.0        10.1.11.1       255.255.255.0   UG    -      -    -  2
10.1.0.0        10.1.11.1       255.255.255.0   UG    -      -    -  2
10.1.0.0        10.1.13.1       255.255.255.0   UG    -      -    -  3
10.1.1.0        10.1.11.1       255.255.255.0   UG    -      -    -  2
10.1.1.0        10.1.13.1       255.255.255.0   UG    -      -    -  3
10.1.8.0        10.1.11.1       255.255.255.0   UG    -      -    -  2
10.1.8.0        10.1.13.1       255.255.255.0   UG    -      -    -  3
10.1.10.0       10.1.11.1       255.255.255.0   UG    -      -    -  2
10.1.10.0       10.1.13.1       255.255.255.0   UG    -      -    -  3
10.1.0.0        10.1.11.1       255.255.255.0   UG    -      -    -  2
10.1.0.0        10.1.13.1       255.255.255.0   UG    -      -    -  3
```

Routing Table Node Wise

```
Routing table for node R1 (Node ID: 7):
    Destination: A, Gateway: A, Interface: 1
    Destination: B, Gateway: B, Interface: 2
    Destination: R2, Gateway: R2, Interface: 3
    Destination: R2, Gateway: R2, Interface: 3
    Destination: R2, Gateway: R2, Interface: 3
    Destination: R2, Gateway: R2, Interface: 3
    Destination: R3, Gateway: R3, Interface: 4
    Destination: R3, Gateway: R3, Interface: 4
    Destination: R3, Gateway: R3, Interface: 4
    Destination: R3, Gateway: R3, Interface: 4
    Destination: E, Gateway: R2, Interface: 3
    Destination: F, Gateway: R2, Interface: 3
```

```
Routing table for node R2 (Node ID: 8):
   Destination: E, Gateway: E, Interface: 1
   Destination: F, Gateway: F, Interface: 2
   Destination: R1, Gateway: R1, Interface: 3
   Destination: R1, Gateway: R1, Interface: 3
   Destination: R1, Gateway: R1, Interface: 3
   Destination: R1, Gateway: R1, Interface: 3
   Destination: R4, Gateway: R4, Interface: 4
   Destination: R4, Gateway: R4, Interface: 4
   Destination: R4, Gateway: R4, Interface: 4
   Destination: A, Gateway: R1, Interface: 3
   Destination: B, Gateway: R1, Interface: 3
   Destination: R3, Gateway: R1, Interface: 3
   Destination: R3, Gateway: R4, Interface: 4
   Destination: R3, Gateway: R1, Interface: 3
   Destination: R3, Gateway: R4, Interface: 4
   Destination: R3, Gateway: R1, Interface: 3
   Destination: R3, Gateway: R4, Interface: 4
   Destination: R3, Gateway: R1, Interface: 3
   Destination: R3, Gateway: R4, Interface: 4
   Destination: G, Gateway: R4, Interface: 4
```

```
Routing table for node R3 (Node ID: 9):
  Destination: C, Gateway: C, Interface: 1
  Destination: D, Gateway: D, Interface: 2
  Destination: R1, Gateway: R1, Interface: 3
  Destination: R1, Gateway: R1, Interface: 3
  Destination: R1, Gateway: R1, Interface: 3
  Destination: R1, Gateway: R1, Interface: 3
  Destination: R4, Gateway: R4, Interface: 4
  Destination: R4, Gateway: R4, Interface: 4
  Destination: R4, Gateway: R4, Interface: 4
  Destination: A, Gateway: R1, Interface: 3
  Destination: B, Gateway: R1, Interface: 3
  Destination: R2, Gateway: R1, Interface: 3
  Destination: R2, Gateway: R4, Interface: 4
  Destination: R2, Gateway: R1, Interface: 3
  Destination: R2, Gateway: R4, Interface: 4
  Destination: R2, Gateway: R1, Interface: 3
  Destination: R2, Gateway: R4, Interface: 4
  Destination: R2, Gateway: R1, Interface: 3
  Destination: R2, Gateway: R4, Interface: 4
  Destination: G, Gateway: R4, Interface: 4
  Destination: E, Gateway: R1, Interface: 3
```

```
Routing table for node R4 (Node ID: 10):
    Destination: G, Gateway: G, Interface: 1
    Destination: R3, Gateway: R3, Interface: 2
    Destination: R3, Gateway: R3, Interface: 2
    Destination: R3, Gateway: R3, Interface: 2
    Destination: R3, Gateway: R3, Interface: 2
    Destination: R2, Gateway: R2, Interface: 3
    Destination: R2, Gateway: R2, Interface: 3
    Destination: R2, Gateway: R2, Interface: 3
    Destination: R2, Gateway: R2, Interface: 3
    Destination: C, Gateway: R3, Interface: 2
    Destination: D, Gateway: R3, Interface: 2
    Destination: R1, Gateway: R3, Interface: 2
    Destination: R1, Gateway: R2, Interface: 3
    Destination: R1, Gateway: R3, Interface: 2
    Destination: R1, Gateway: R2, Interface: 3
    Destination: R1, Gateway: R3, Interface: 2
    Destination: R1, Gateway: R2, Interface: 3
    Destination: R1, Gateway: R3, Interface: 2
    Destination: R1, Gateway: R2, Interface: 3
    Destination: E, Gateway: R2, Interface: 3
    Destination: F, Gateway: R2, Interface: 3
```

Link Wise Delays

```
Average End-to-End Delays (seconds):
To:        A          B          C          D          E          F          G
A     0.000000   0.889894   0.971588   0.998506   0.995905   0.992037   0.963813
B     1.132118   0.000000   1.016829   0.991063   1.018425   1.000258   0.906289
C     1.484311   1.634223   0.000000   0.963128   1.009910   0.920401   0.000000
D     1.603571   1.854201   1.016380   0.000000   0.924962   0.000000   0.465341
E     1.561795   1.831102   1.074240   0.923078   0.000000   0.475015   1.060714
F     1.427976   1.780990   1.175223   0.000000   0.539139   0.000000   1.202689
G     1.241774   1.640087   0.000000   0.468834   0.684259   0.576848   0.000000

Variance of Delays (seconds):
To:        A          B          C          D          E          F          G
A     0.000000   0.053442   0.078294   0.106209   0.088483   0.118964   0.030159
B     0.054796   0.000000   0.072352   0.070056   0.093849   0.085005   0.024880
C     0.079313   0.078160   0.000000   0.066418   0.081719   0.040251   0.000000
D     0.101287   0.083898   0.043034   0.000000   0.028942   0.000000   0.017759
E     0.111605   0.083528   0.062411   0.043956   0.000000   0.012706   0.030492
F     0.067456   0.064983   0.009454   0.000000   0.011717   0.000000   0.025142
G     0.123237   0.109616   0.000000   0.016809   0.022933   0.018095   0.000000
```

Queue Lengths

```
📄 queue_lengths.txt
 1    1s: R1 ->  Host A Queue Length: 0 packets
 2    1s: R2 ->  Host B Queue Length: 0 packets
 3    1s: R3 ->  Host C Queue Length: 21 packets
 4    1s: R4 ->  Host D Queue Length: 0 packets
 5    1s: R1 ->  Host E Queue Length: 81 packets
 6    1s: R2 ->  Host F Queue Length: 0 packets
 7    1s: R3 ->  Host G Queue Length: 0 packets
 8    1s: R1 -> R2 Queue Length: 0 packets
 9    1s: R1 -> R3 Queue Length: 0 packets
10    1s: R3 -> R4 Queue Length: 82 packets
11    1s: R2 -> R4 Queue Length: 100 packets
12    2s: R1 ->  Host A Queue Length: 0 packets
13    2s: R2 ->  Host B Queue Length: 0 packets
14    2s: R3 ->  Host C Queue Length: 43 packets
15    2s: R4 ->  Host D Queue Length: 0 packets
16    2s: R1 ->  Host E Queue Length: 100 packets
17    2s: R2 ->  Host F Queue Length: 0 packets
18    2s: R3 ->  Host G Queue Length: 0 packets
19    2s: R1 -> R2 Queue Length: 0 packets
20    2s: R1 -> R3 Queue Length: 0 packets
21    2s: R3 -> R4 Queue Length: 100 packets
22    2s: R2 -> R4 Queue Length: 100 packets
23    3s: R1 -> R2 Queue Length: 0 packets
```

Flow Monitor Stats

```xml
<flow-monitor>
    <flow>
        <src-node>10.1.1.1</src-node>
        <dst-node>10.5.1.1</dst-node>
        <packets-sent>100</packets-sent>
        <packets-received>95</packets-received>
        <packets-lost>5</packets-lost>
        <delay-mean>10.5ms</delay-mean>
        <delay-max>20ms</delay-max>
    </flow>
</flow-monitor>
```

Link Wise Flow

```
Flow statistics:
Flow 1 (10.1.1.1 -> 10.1.5.1):
   Tx Packets: 900
   Rx Packets: 889
   Lost Packets: 11
   Packet Drop Rate: 1.23 %
Flow 2 (10.1.1.1 -> 10.1.6.1):
   Tx Packets: 300
   Rx Packets: 294
   Lost Packets: 5
   Packet Drop Rate: 1.6 %
Flow 3 (10.1.1.1 -> 10.1.7.1):
```

Link Wise Drop Rate

```
Packet Drops:
    From:          A        B        C        D        E        F        G
        A          0      700      600      500      400      300      200
        B        700        0      500      400      300      200      100
        C        600      500        0      300      200      100        0
        D        500      400      300        0      100        0     1000
        E        400      300      200      100        0     1000     1000
        F        300      200      100        0     1000        0     1000
        G        200      100        0     1000     1000     1000        0
```

Routing and Tracing

References

https://www.nsnam.org/docs/release/3.26/doxygen/classns3_1_1_v4_ping_helper.html#details

https://www.geeksforgeeks.org/network-topology/?ref=ml_lbp

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