Koushik Sahu
118CS0597
Network Simulation Lab – I
20th September 2021

Code:

```
#include "ns3/core-module.h"
#include "ns3/network-module.h"
#include "ns3/internet-module.h"
#include "ns3/point-to-point-module.h"
#include "ns3/applications-module.h"
#include "ns3/netanim-module.h"

using namespace ns3;

NS_LOG_COMPONENT_DEFINE ("FirstScriptExample");

int
main (int argc, char *argv[])
{
  CommandLine cmd (__FILE__);
  cmd.Parse (argc, argv);

  Time::SetResolution (Time::NS);
  LogComponentEnable ("UdpEchoClientApplication", LOG_LEVEL_INFO);
  LogComponentEnable ("UdpEchoServerApplication", LOG_LEVEL_INFO);

  NodeContainer nodes;
  nodes.Create (3);

  PointToPointHelper pointToPoint;
  pointToPoint.SetDeviceAttribute ("DataRate", StringValue ("5Mbps"));
  pointToPoint.SetChannelAttribute ("Delay", StringValue ("2ms"));

  NetDeviceContainer device1, device2;
  device1 = pointToPoint.Install (nodes.Get(0), nodes.Get(1));
  device2 = pointToPoint.Install (nodes.Get(2), nodes.Get(1));

  InternetStackHelper stack;
  stack.Install (nodes);

  Ipv4AddressHelper address1, address2;
  address1.SetBase ("10.1.1.0", "255.255.255.0");
  address2.SetBase ("198.168.1.0", "255.255.255.0");

  Ipv4InterfaceContainer interface1 = address1.Assign (device1);
  Ipv4InterfaceContainer interface2 = address2.Assign (device2);

  UdpEchoServerHelper echoServer1 (90);
  UdpEchoServerHelper echoServer2 (91);
```

```
  ApplicationContainer serverApps = echoServer1.Install (nodes.Get (1));
  serverApps.Start (Seconds (1.0));
  serverApps.Stop (Seconds (10.0));

  UdpEchoClientHelper echoClient1 (interface1.GetAddress (1), 90);
  echoClient1.SetAttribute ("MaxPackets", UintegerValue (1));
  echoClient1.SetAttribute ("Interval", TimeValue (Seconds (1.0)));
  echoClient1.SetAttribute ("PacketSize", UintegerValue (1024));

  UdpEchoClientHelper echoClient2 (interface2.GetAddress (1), 91);
  echoClient2.SetAttribute ("MaxPackets", UintegerValue (1));
  echoClient2.SetAttribute ("Interval", TimeValue (Seconds (1.0)));
  echoClient2.SetAttribute ("PacketSize", UintegerValue (1024));

  ApplicationContainer clientApp1 = echoClient1.Install (nodes.Get (0));
  clientApp1.Start (Seconds (2.0));
  clientApp1.Stop (Seconds (10.0));

  ApplicationContainer clientApp2 = echoClient2.Install (nodes.Get (2));
  clientApp2.Start (Seconds (7.0));
  clientApp2.Stop (Seconds (10.0));

  pointToPoint.EnablePcapAll("p2p");

  AsciiTraceHelper ascii;
  pointToPoint.EnableAsciiAll(ascii.CreateFileStream("p2p.tr"));

  AnimationInterface anim("anim.xml");
  anim.SetConstantPosition(nodes.Get(0), 10.0, 10.0);
  anim.SetConstantPosition(nodes.Get(1), 20.0, 20.0);
  anim.SetConstantPosition(nodes.Get(2), 30.0, 30.0);

  Simulator::Run ();
  Simulator::Destroy ();
  return 0;
}
```

Output screenshots:

```
Waf: Entering directory `/home/koushik/softwares/ns-lab/ns-3-allinone/ns-3.34/build'
Waf: Leaving directory `/home/koushik/softwares/ns-lab/ns-3-allinone/ns-3.34/build'
Build commands will be stored in build/compile_commands.json
'build' finished successfully (0.947s)
AnimationInterface WARNING:Node:0 Does not have a mobility model. Use SetConstantPosition if it is stationary
AnimationInterface WARNING:Node:1 Does not have a mobility model. Use SetConstantPosition if it is stationary
AnimationInterface WARNING:Node:2 Does not have a mobility model. Use SetConstantPosition if it is stationary
AnimationInterface WARNING:Node:0 Does not have a mobility model. Use SetConstantPosition if it is stationary
AnimationInterface WARNING:Node:1 Does not have a mobility model. Use SetConstantPosition if it is stationary
AnimationInterface WARNING:Node:2 Does not have a mobility model. Use SetConstantPosition if it is stationary
At time +2s client sent 1024 bytes to 10.1.1.2 port 90
At time +2.00369s server received 1024 bytes from 10.1.1.1 port 49153
At time +2.00369s server sent 1024 bytes to 10.1.1.1 port 49153
At time +2.00737s client received 1024 bytes from 10.1.1.2 port 90
At time +7s client sent 1024 bytes to 198.168.1.2 port 91
```

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	10.1.1.1	10.1.1.2	UDP	1054	49153 → 90 Len=1024
2	0.007372	10.1.1.2	10.1.1.1	UDP	1054	90 → 49153 Len=1024

```
▸ Frame 1: 1054 bytes on wire (8432 bits), 1054 bytes captured (8432 bits)
▸ Point-to-Point Protocol
▸ Internet Protocol Version 4, Src: 10.1.1.1, Dst: 10.1.1.2
▸ User Datagram Protocol, Src Port: 49153, Dst Port: 90
▸ Data (1024 bytes)
```

```
0000  00 21 45 00 04 1c 00 00  00 00 40 11 00 00 0a 01   ·!E····· ··@·····
0010  01 01 0a 01 01 02 c0 01  00 5a 04 08 00 00 00 00   ········ ·Z······
0020  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ········ ········
0030  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ········ ········
```

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	10.1.1.1	10.1.1.2	UDP	1054	49153 → 90 Len=1024
2	0.000000	10.1.1.2	10.1.1.1	UDP	1054	90 → 49153 Len=1024

```
▸ Frame 1: 1054 bytes on wire (8432 bits), 1054 bytes captured (8432 bits)
▸ Point-to-Point Protocol
▸ Internet Protocol Version 4, Src: 10.1.1.1, Dst: 10.1.1.2
▸ User Datagram Protocol, Src Port: 49153, Dst Port: 90
▸ Data (1024 bytes)
```

```
0000  00 21 45 00 04 1c 00 00  00 00 40 11 00 00 0a 01   ·!E····· ··@·····
0010  01 01 0a 01 01 02 c0 01  00 5a 04 08 00 00 00 00   ········ ·Z······
0020  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ········ ········
```

```
0000  00 21 45 00 04 1c 00 00  00 00 40 11 00 00 0a 01   ·!E····· ··@·····
0010  01 02 0a 01 01 01 00 5a  c0 01 04 08 00 00 00 00   ·······Z ········
0020  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ········ ········
```

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	198.168.1.1	198.168.1.2	UDP	1054	49153 → 91 Len=1024
2	0.005779	198.168.1.2	198.168.1.1	ICMP	58	Destination unreachable (Port unreachable)

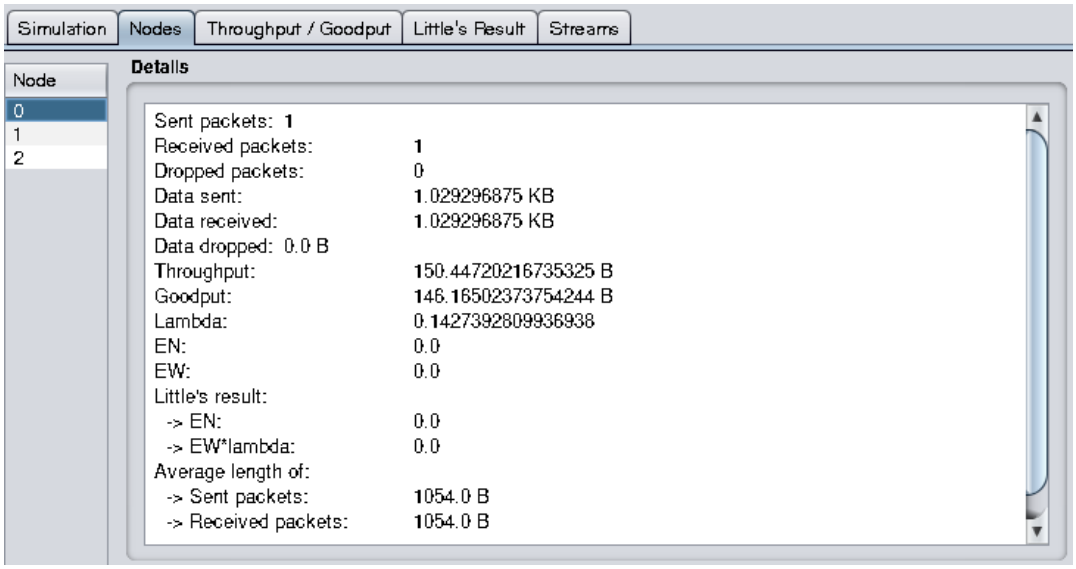
```
▸ Frame 1: 1054 bytes on wire (8432 bits), 1054 bytes captured (8432 bits)
▸ Point-to-Point Protocol
▸ Internet Protocol Version 4, Src: 198.168.1.1, Dst: 198.168.1.2
▾ User Datagram Protocol, Src Port: 49153, Dst Port: 91
```

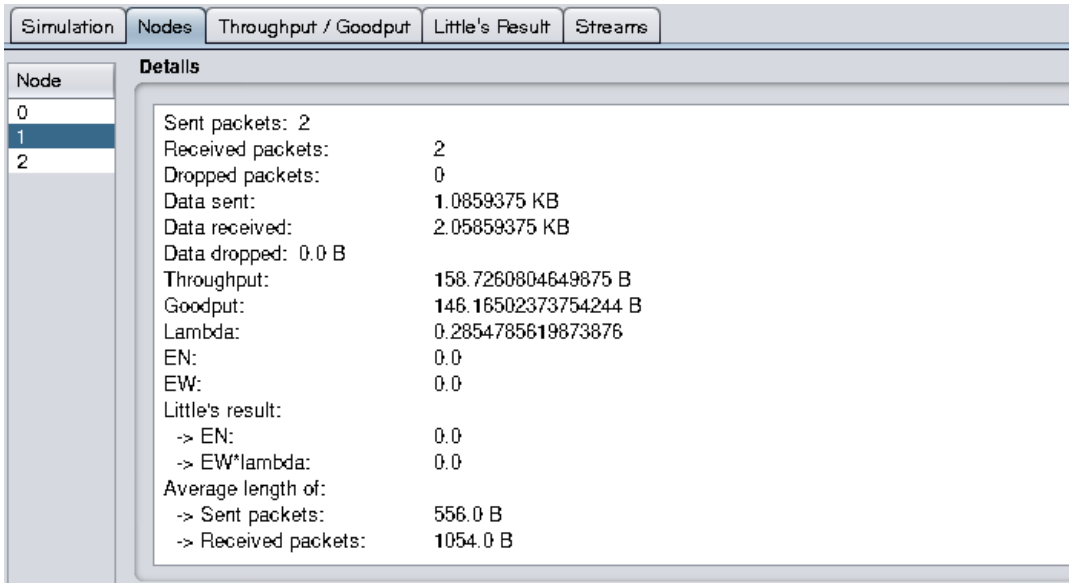
```
0000  00 21 45 00 04 1c 00 00  00 00 40 11 00 00 c6 a8   ·!E····· ··@·····
0010  01 01 c6 a8 01 02 c0 01  00 5b 04 08 00 00 00 00   ········ ·[······
0020  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ········ ········
```

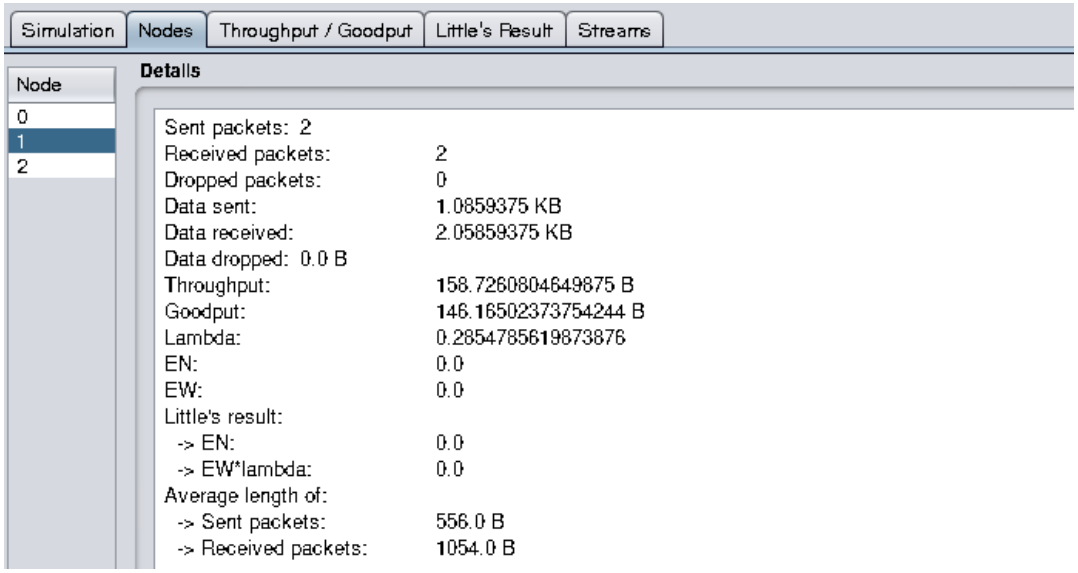
Simulation | Nodes | Throughput / Goodput | Little's Result | Streams

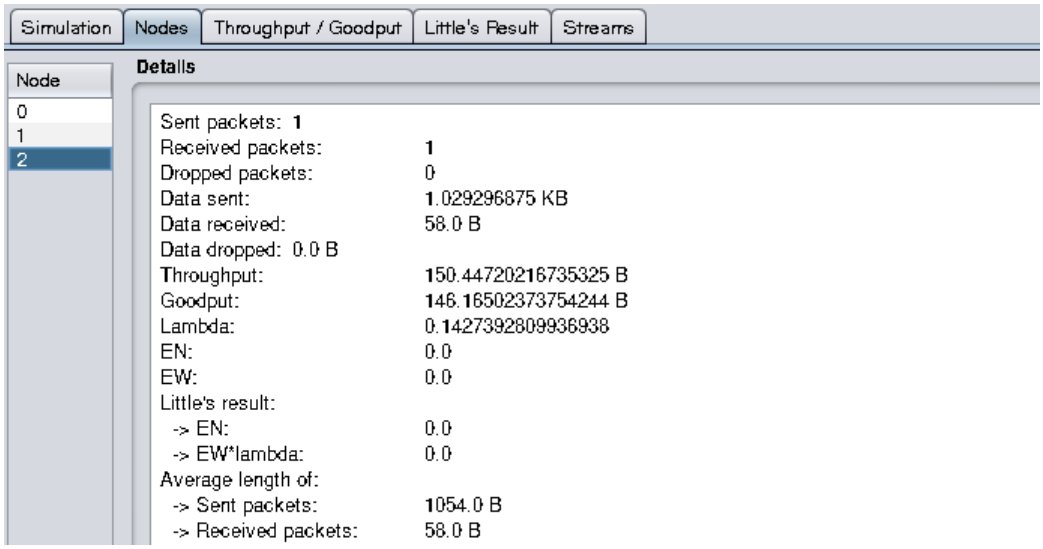
Details

File:	/home/koushik/softwares/ns-lab/ns-3-allinone/ns-3.34/p2p.tr
Lines on file:	12
Total enqueued packets:	4
Total sent packets:	4
Total received packets:	4
Total dropped packets:	0
Total simulation time:	7.00578 seconds
Time of analisys:	0s

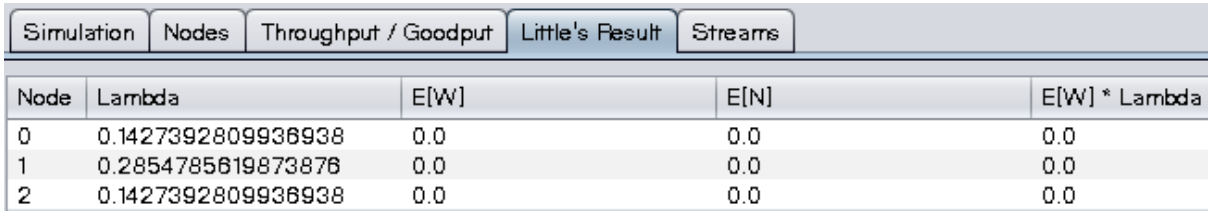

Simulation
Nodes
Throughput / Goodput
Little's Result
Streams
Node
0
1
2
Details
Sent packets: 1
Received packets: 1
Dropped packets: 0
Data sent: 1.029296875 KB
Data received: 1.029296875 KB
Data dropped: 0.0 B
Throughput: 150.44720216735325 B
Goodput: 146.16502373754244 B
Lambda: 0.1427392809936938
EN: 0.0
EW: 0.0
Little's result:
-> EN: 0.0
-> EW*lambda: 0.0
Average length of:
-> Sent packets: 1054.0 B
-> Received packets: 1054.0 B


Simulation
Nodes
Throughput / Goodput
Little's Result
Streams
Node
0
1
2
Details
Sent packets: 2
Received packets: 2
Dropped packets: 0
Data sent: 1.0859375 KB
Data received: 2.05859375 KB
Data dropped: 0.0 B
Throughput: 158.7260804649875 B
Goodput: 146.16502373754244 B
Lambda: 0.2854785619873876
EN: 0.0
EW: 0.0
Little's result:
-> EN: 0.0
-> EW*lambda: 0.0
Average length of:
-> Sent packets: 556.0 B
-> Received packets: 1054.0 B

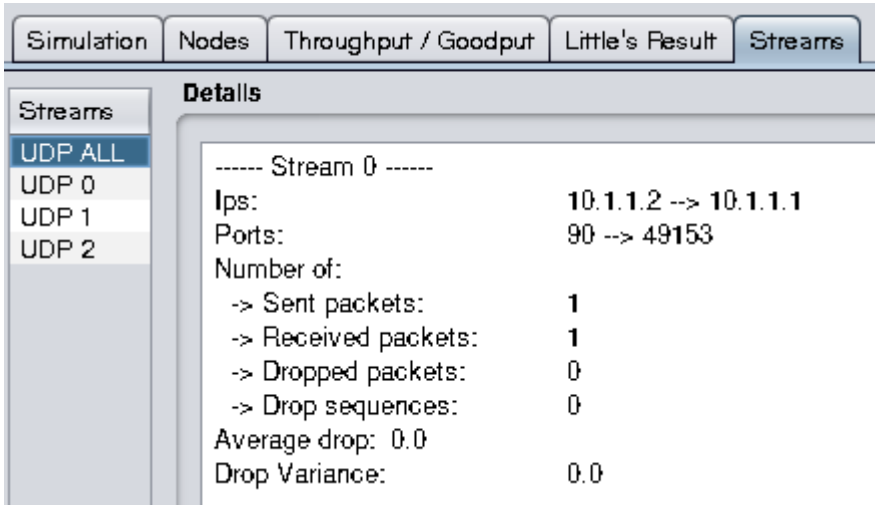

Simulation
Nodes
Throughput / Goodput
Little's Result
Streams
Node
0
1
2
Details
Sent packets: 2
Received packets: 2
Dropped packets: 0
Data sent: 1.0859375 KB
Data received: 2.05859375 KB
Data dropped: 0.0 B
Throughput: 158.7260804649875 B
Goodput: 146.16502373754244 B
Lambda: 0.2854785619873876
EN: 0.0
EW: 0.0
Little's result:
-> EN: 0.0
-> EW*lambda: 0.0
Average length of:
-> Sent packets: 556.0 B
-> Received packets: 1054.0 B

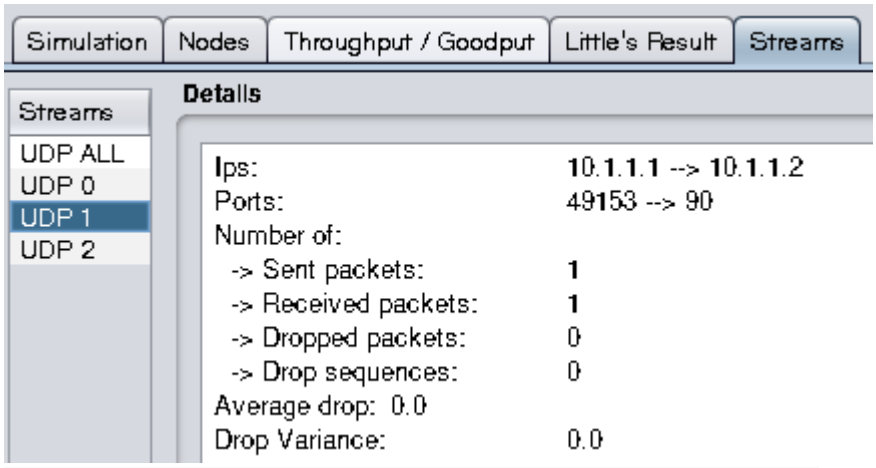


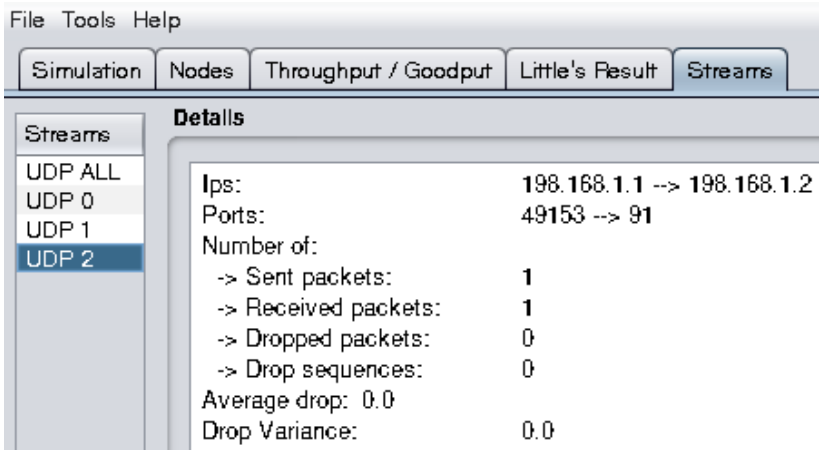
Node	Throughput	Goodput
0	150.44720216735325	146.16502373754244
1	158.7260804649875	146.16502373754244
2	150.44720216735325	146.16502373754244

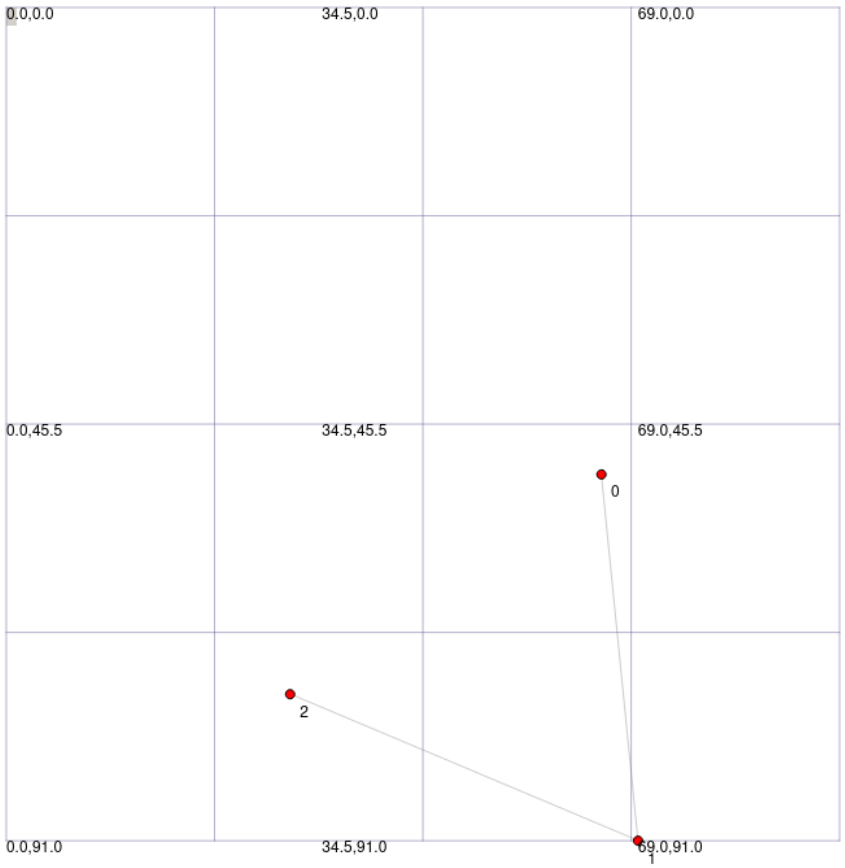


Node	Lambda	E[W]	E[N]	E[W] * Lambda
0	0.1427392809936938	0.0	0.0	0.0
1	0.2854785619873876	0.0	0.0	0.0
2	0.1427392809936938	0.0	0.0	0.0




Simulation
Nodes
Throughput / Goodput
Little's Result
Streams
Streams
UDP ALL
UDP 0
UDP 1
UDP 2
Details
Ips: 10.1.1.1 --> 10.1.1.2
Ports: 49153 --> 90
Number of:
-> Sent packets: 1
-> Received packets: 1
-> Dropped packets: 0
-> Drop sequences: 0
Average drop: 0.0
Drop Variance: 0.0


File Tools Help
Simulation
Nodes
Throughput / Goodput
Little's Result
Streams
Streams
UDP ALL
UDP 0
UDP 1
UDP 2
Details
Ips: 198.168.1.1 --> 198.168.1.2
Ports: 49153 --> 91
Number of:
-> Sent packets: 1
-> Received packets: 1
-> Dropped packets: 0
-> Drop sequences: 0
Average drop: 0.0
Drop Variance: 0.0


0.0,0.0
34.5,0.0
69.0,0.0
0.0,45.5
34.5,45.5
69.0,45.5
0.0,91.0
34.5,91.0
69.0,91.0
0
1
2