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## **EXPERIMENT – 2**

### **AIM – Installation of NS3**

Following are the basic steps which must be followed for installing NS3

1. Install prerequisite packages
2. Download ns3 codes
3. Build ns3
4. Validate ns3

Prerequisite packages for Linux are as follows:

1. Minimal requirements for Python: gcc g++ python
2. Debugging and GNU Scientific Library (GSL) support: gdbpython-dev
3. valgrind gsl-bin libgsl0-dev libgsl0ldbl Network Simulation Cradle (nsc): flex bison

Reading pcap packet traces: tcpdump

4. Database support for statistics framework: sqlite sqlite3
5. Xml-based version of the config store: libxml2
6. A GTK-based configuration system: libgtk2.0-0
7. Experimental with virtual machines and ns-3: vtun lxc

Detailed steps are as follows:

1. sudo apt-get update / dnf update
2. sudo apt-get upgrade / dnf upgrade
3. Once ubuntu/fedora is installed run following command opening the terminal(ctrl+alt+T) window.
4. To install prerequisites dependency packages- Type the following command in terminal window.

```
sudo apt-get/ dnf install gcc g++ python python-dev mercurial bzip2 gdb valgrind gsl-bin libgsl0-dev
```

```
libgsl0ldbl flex bison tcpdump sqlite sqlite3 libsqlite3-dev libxml2 libxml2-dev libgtk2.0-0 libgtk2.0-
```

```
dev uncrustify doxygen graphviz imagemagick texlive texlive-latex-extra texlive-generic-extra
```

```
texlive-generic-recommended texinfo dia texlive texlive-latex-extra texlive-extra-utils texlive-
```

```
generic-recommended texi2html python-pygraphviz python-kiwi python-pygoocanvas libgoocanvas-
```

```
dev python-pygccxml
```

5.After downloading NS3 on the drive, extract all the files in the NS3 folder, which you have created.

6.Then you can find build.py along with other files in NS3 folder.

Then to build the examples in ns-3 run :

```
./build.py -- enable-examples --enable-tests
```

If the build is successful then it will give output

“Build finished successfully”.

7. Now run the following command on the terminal window,to configure with waf(build tool)

```
./waf -d debug -- enable-examples -- enable-tests configure
```

To build with waf(optional)

```
./waf
```

8.To test everything alright run the following command on the terminal window,

```
./test.py
```

If the tests are ok the installation is done

9.Now after installing ns3 and testing it run some programs first to be ns3 user:

make sure you are in directory where waf script is available then run

## **VIVA Questions**

Q1 What protocols does ns support?

Q2. How should one can start doing something (like implementing a new protocol or trying an experiment)?

Q3. What is waf and its importance in the simulation process?

Q4. How we can test that NS3 has been installed properly?

Q5. Why prerequisite packages are needed before the installation of NS3?

## **EXPERIMENT – 3**

**AIM** – Write a program in NS3 to connect 2 nodes

### **SOURCE 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"

using namespace ns3;

NS_LOG_COMPONENT_DEFINE ("FirstScriptExample");

int
main (int argc, char *argv[])
{
    Time::SetResolution (Time::NS);
    LogComponentEnable ("UdpEchoClientApplication", LOG_LEVEL_INFO);
    LogComponentEnable ("UdpEchoServerApplication", LOG_LEVEL_INFO);

    NodeContainer nodes;
    nodes.Create (2);

    PointToPointHelper pointToPoint;
    pointToPoint.SetDeviceAttribute ("DataRate", StringValue ("10Mbps"));
    pointToPoint.SetChannelAttribute ("Delay", StringValue ("2ms"));

    NetDeviceContainer devices;
    devices = pointToPoint.Install (nodes);

    InternetStackHelper stack;
    stack.Install (nodes);

    Ipv4AddressHelper address;
    address.SetBase ("10.1.1.0", "255.255.255.0");

    Ipv4InterfaceContainer interfaces = address.Assign (devices);

    UdpEchoServerHelper echoServer (9);

    ApplicationContainer serverApps = echoServer.Install (nodes.Get (1));
```

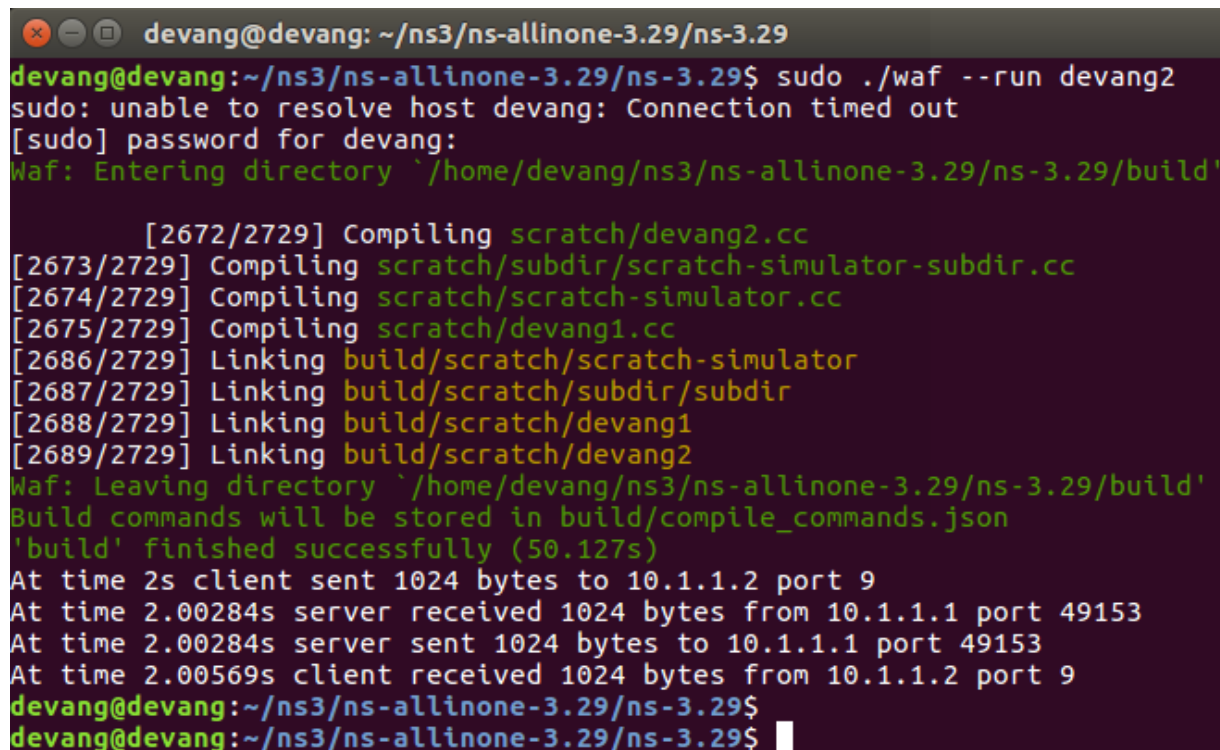
```
serverApps.Start (Seconds (1.0));
serverApps.Stop (Seconds (10.0));

UdpEchoClientHelper echoClient (interfaces.GetAddress (1), 9);
echoClient.SetAttribute ("MaxPackets", UIntegerValue (1));
echoClient.SetAttribute ("Interval", TimeValue (Seconds (1.0)));
echoClient.SetAttribute ("PacketSize", UIntegerValue (1024));

ApplicationContainer clientApps = echoClient.Install (nodes.Get (0));
clientApps.Start (Seconds (2.0));
clientApps.Stop (Seconds (10.0));

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

## OUTPUT –



```
devang@devang: ~/ns3/ns-allinone-3.29/ns-3.29
devang@devang:~/ns3/ns-allinone-3.29/ns-3.29$ sudo ./waf --run devang2
sudo: unable to resolve host devang: Connection timed out
[sudo] password for devang:
Waf: Entering directory `/home/devang/ns3/ns-allinone-3.29/ns-3.29/build'

[2672/2729] Compiling scratch/devang2.cc
[2673/2729] Compiling scratch/subdir/scratch-simulator-subdir.cc
[2674/2729] Compiling scratch/scratch-simulator.cc
[2675/2729] Compiling scratch/devang1.cc
[2686/2729] Linking build/scratch/scratch-simulator
[2687/2729] Linking build/scratch/subdir/subdir
[2688/2729] Linking build/scratch/devang1
[2689/2729] Linking build/scratch/devang2
Waf: Leaving directory `/home/devang/ns3/ns-allinone-3.29/ns-3.29/build'
Build commands will be stored in build/compile_commands.json
'build' finished successfully (50.127s)
At time 2s client sent 1024 bytes to 10.1.1.2 port 9
At time 2.00284s server received 1024 bytes from 10.1.1.1 port 49153
At time 2.00284s server sent 1024 bytes to 10.1.1.1 port 49153
At time 2.00569s client received 1024 bytes from 10.1.1.2 port 9
devang@devang:~/ns3/ns-allinone-3.29/ns-3.29$
devang@devang:~/ns3/ns-allinone-3.29/ns-3.29$
```

## **VIVA Questions**

Q1 which probable protocols can come into play when 2 nodes are connected?

Q2. What is the difference between UDP and TCP?

Q3. What is a Point to Point Connection? What are its characteristics?

Q4. What will happen if the client starts first then the server?

Q5. What is the difference between IPv4 and IPv6?



## **EXPERIMENT – 4**

**AIM** – Write a program in NS3 to connect 3 nodes

### **SOURCE 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"

using namespace ns3;

NS_LOG_COMPONENT_DEFINE ("3NodeConnection");

int
main (int argc, char *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 ("10Mbps"));
    pointToPoint.SetChannelAttribute ("Delay", StringValue ("5ms"));

    PointToPointHelper pointToPoint1;
    pointToPoint1.SetDeviceAttribute ("DataRate", StringValue ("20Mbps"));
    pointToPoint1.SetChannelAttribute ("Delay", StringValue ("10ms"));

    NetDeviceContainer devices;
    devices = pointToPoint.Install (nodes.Get(0), nodes.Get(1));

    NetDeviceContainer devices1;
    devices1 = pointToPoint1.Install (nodes.Get(2), nodes.Get(1));

    InternetStackHelper stack;
    stack.Install (nodes);

    Ipv4AddressHelper address;
```

```
address.SetBase ("10.1.1.0", "255.255.255.0");

Ipv4AddressHelper address1;
address1.SetBase ("176.0.1.0", "255.255.255.0");

Ipv4InterfaceContainer interfaces = address.Assign (devices);
Ipv4InterfaceContainer interfaces1 = address1.Assign (devices1);

UdpEchoServerHelper echoServer (45);
UdpEchoServerHelper echoServer1 (50);

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

ApplicationContainer serverApps1 = echoServer1.Install (nodes.Get (1));
serverApps1.Start (Seconds (1.0));
serverApps1.Stop (Seconds (10.0));

UdpEchoClientHelper echoClient (interfaces.GetAddress (1), 45);
echoClient.SetAttribute ("MaxPackets", UIntegerValue (1));
echoClient.SetAttribute ("Interval", TimeValue (Seconds (1.0)));
echoClient.SetAttribute ("PacketSize", UIntegerValue (4096));

ApplicationContainer clientApps = echoClient.Install (nodes.Get (0));
clientApps.Start (Seconds (4.0));
clientApps.Stop (Seconds (10.0));

UdpEchoClientHelper echoClient1 (interfaces.GetAddress (1), 50);
echoClient1.SetAttribute ("MaxPackets", UIntegerValue (1));
echoClient1.SetAttribute ("Interval", TimeValue (Seconds (1.0)));
echoClient1.SetAttribute ("PacketSize", UIntegerValue (4096));

ApplicationContainer clientApps1 = echoClient1.Install (nodes.Get (0));
clientApps1.Start (Seconds (5.0));
clientApps1.Stop (Seconds (10.0));

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

**OUTPUT –**

```
devang@devang: ~/ns3/ns-allinone-3.29/ns-3.29
devang@devang:~/ns3/ns-allinone-3.29/ns-3.29$ sudo ./waf --run devang3
sudo: unable to resolve host devang
[sudo] password for devang:
waf: Entering directory `/home/devang/ns3/ns-allinone-3.29/ns-3.29/build'
[2680/2731] Compiling scratch/devang3.cc
[2693/2731] Linking build/scratch/devang3
waf: Leaving directory `/home/devang/ns3/ns-allinone-3.29/ns-3.29/build'
Build commands will be stored in build/compile_commands.json
'build' finished successfully (45.277s)
At time 4s client sent 4096 bytes to 10.1.1.2 port 45
At time 4.00834s server received 4096 bytes from 10.1.1.1 port 49153
At time 4.00834s server sent 4096 bytes to 10.1.1.1 port 49153
At time 4.01667s client received 4096 bytes from 10.1.1.2 port 45
At time 5s client sent 4096 bytes to 10.1.1.2 port 50
At time 5.00834s server received 4096 bytes from 10.1.1.1 port 49154
At time 5.00834s server sent 4096 bytes to 10.1.1.1 port 49154
At time 5.01667s client received 4096 bytes from 10.1.1.2 port 50
devang@devang:~/ns3/ns-allinone-3.29/ns-3.29$
```

## **VIVA Questions**

Q1. What if all the 3 nodes are the part of the same network and each interface is assigned the IP address of the same range?

Q2. What is the port number? What is its significance?

Q3. What is socket address? What is the role of IP address in it?

Q4. How a NS3 program is simulated? Explain various stages.

Q5. What is the difference between IP address and physical address?

## **EXPERIMENT – 5**

**AIM** – Write a program in NS3 to implement star topology.

### **SOURCE 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"

using namespace ns3;

NS_LOG_COMPONENT_DEFINE ("StarNetwork");

int main (int argc, char *argv[])
{
    Time::SetResolution (Time::NS);
    LogComponentEnable ("UdpEchoClientApplication", LOG_LEVEL_INFO);
    LogComponentEnable ("UdpEchoServerApplication", LOG_LEVEL_INFO);

    NodeContainer nodes;
    nodes.Create (5);

    PointToPointHelper pointToPoint1;
    pointToPoint1.SetDeviceAttribute ("DataRate", StringValue ("100Mbps"));
    pointToPoint1.SetChannelAttribute ("Delay", StringValue ("5ms"));

    NetDeviceContainer devices1;
    devices1 = pointToPoint1.Install (nodes.Get(0),nodes.Get(1));

    PointToPointHelper pointToPoint2;
    pointToPoint2.SetDeviceAttribute ("DataRate", StringValue ("15Mbps"));
    pointToPoint2.SetChannelAttribute ("Delay", StringValue ("2ms"));

    PointToPointHelper pointToPoint3;
    pointToPoint1.SetDeviceAttribute ("DataRate", StringValue ("100Mbps"));
    pointToPoint1.SetChannelAttribute ("Delay", StringValue ("2ms"));

    NetDeviceContainer devices2, devices3;
    devices2 = pointToPoint2.Install (nodes.Get(2),nodes.Get(1));
    devices3 = pointToPoint2.Install (nodes.Get(3),nodes.Get(1));
```

```
InternetStackHelper stack;
stack.Install (nodes);

Ipv4AddressHelper address;
address.SetBase ("10.1.1.0", "255.255.255.0");

Ipv4InterfaceContainer interfaces1 = address.Assign (devices1);
Ipv4InterfaceContainer interfaces2 = address.Assign (devices2);
Ipv4InterfaceContainer interfaces3 = address.Assign (devices3);

UdpEchoServerHelper echoServer1 (19);
UdpEchoServerHelper echoServer2 (20);
UdpEchoServerHelper echoServer3 (21);

ApplicationContainer serverApps1 = echoServer1.Install (nodes.Get (1));
serverApps1.Start (Seconds (1.0));
serverApps1.Stop (Seconds (15.0));

ApplicationContainer serverApps2 = echoServer2.Install (nodes.Get (1));
serverApps2.Start (Seconds (1.0));
serverApps2.Stop (Seconds (10.0));

ApplicationContainer serverApps3 = echoServer3.Install (nodes.Get (1));
serverApps3.Start (Seconds (2.0));
serverApps3.Stop (Seconds (8.0));

UdpEchoClientHelper echoClient1 (interfaces1.GetAddress (1), 19);
echoClient1.SetAttribute ("MaxPackets", UIntegerValue (1));
echoClient1.SetAttribute ("Interval", TimeValue (Seconds (1.0)));
echoClient1.SetAttribute ("PacketSize", UIntegerValue (1024));

UdpEchoClientHelper echoClient2 (interfaces2.GetAddress (1), 20);
echoClient2.SetAttribute ("MaxPackets", UIntegerValue (2));
echoClient2.SetAttribute ("Interval", TimeValue (Seconds (2.0)));
echoClient2.SetAttribute ("PacketSize", UIntegerValue (2048));

UdpEchoClientHelper echoClient3 (interfaces3.GetAddress (1), 21);
echoClient2.SetAttribute ("MaxPackets", UIntegerValue (2));
echoClient2.SetAttribute ("Interval", TimeValue (Seconds (2.0)));
echoClient2.SetAttribute ("PacketSize", UIntegerValue (4096));

ApplicationContainer clientApps1 = echoClient1.Install (nodes.Get (0));
clientApps1.Start (Seconds (2.0));
clientApps1.Stop (Seconds (10.0));
ApplicationContainer clientApps2 = echoClient2.Install (nodes.Get (2));
```

```
clientApps2.Start (Seconds (4.0));
clientApps2.Stop (Seconds (10.0));
```

```
ApplicationContainer clientApps3 = echoClient3.Install (nodes.Get (3)); clientApps3.Start
(Seconds (6.0));
clientApps3.Stop (Seconds (10.0));
```

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

```
}
```

## OUTPUT –

```
devang@devang: ~/ns3/ns-allinone-3.29/ns-3.29
devang@devang:~/ns3/ns-allinone-3.29/ns-3.29$ sudo ./waf --run devang4
sudo: unable to resolve host devang
[sudo] password for devang:
Waf: Entering directory '/home/devang/ns3/ns-allinone-3.29/ns-3.29/build'
[2680/2733] Compiling scratch/devang4.cc
[2681/2733] Compiling scratch/devang3.cc
[2692/2733] Linking build/scratch/devang3
[2694/2733] Linking build/scratch/devang4
Waf: Leaving directory '/home/devang/ns3/ns-allinone-3.29/ns-3.29/build'
Build commands will be stored in build/compile_commands.json
'build' finished successfully (47.564s)
At time 2s client sent 1024 bytes to 10.1.1.2 port 19
At time 2.00508s server received 1024 bytes from 10.1.1.1 port 49153
At time 2.00508s server sent 1024 bytes to 10.1.1.1 port 49153
At time 4s client sent 4096 bytes to 10.1.1.4 port 20
At time 4.00422s server received 4096 bytes from 10.1.1.3 port 49153
At time 4.00422s server sent 4096 bytes to 10.1.1.3 port 49153
At time 6s client sent 4096 bytes to 10.1.1.4 port 20
At time 6s client sent 100 bytes to 10.1.1.6 port 21
At time 6.00207s server received 100 bytes from 10.1.1.5 port 49153
At time 6.00207s server sent 100 bytes to 10.1.1.5 port 49153
At time 6.00414s client received 100 bytes from 10.1.1.6 port 21
At time 6.00422s server received 4096 bytes from 10.1.1.3 port 49153
At time 6.00422s server sent 4096 bytes to 10.1.1.3 port 49153
At time 7s client sent 100 bytes to 10.1.1.6 port 21
At time 7.00207s server received 100 bytes from 10.1.1.5 port 49153
At time 7.00207s server sent 100 bytes to 10.1.1.5 port 49153
At time 7.00414s client received 100 bytes from 10.1.1.6 port 21
At time 8s client sent 100 bytes to 10.1.1.6 port 21
At time 9s client sent 100 bytes to 10.1.1.6 port 21
```

## **VIVA Questions**

Q1 What is network topology?

Q2. What is the difference between Star and Bus topology?

Q3. What is role of socket address in networking?

Q4. Why server is started before the client in a NS3 program?

Q5. What is the role of command line arguments in a NS3 program?



## **EXPERIMENT-6**

**AIM:** Using Free Open Source Software tools ns3, design and implement a bus topology using CSMA.

### **SOURCE CODE:**

```
#include "ns3/core-module.h"
#include "ns3/network-module.h"
#include "ns3/csma-module.h"
#include "ns3/internet-module.h"
#include "ns3/point-to-point-module.h"
#include "ns3/applications-module.h"
#include "ns3/ipv4-global-routing-helper.h"

using namespace ns3;

NS_LOG_COMPONENT_DEFINE ("BusTopology");

int
main (int argc, char *argv[])
{
    bool verbose = true;
    uint32_t nCsma = 3;

    CommandLine cmd;
    cmd.AddValue ("nCsma", "Number of \"extra\" CSMA nodes/devices", nCsma);
    cmd.AddValue ("verbose", "Tell echo applications to log if true", verbose);

    cmd.Parse (argc,argv);

    if (verbose)
    {
        LogComponentEnable ("UdpEchoClientApplication", LOG_LEVEL_INFO);
        LogComponentEnable ("UdpEchoServerApplication", LOG_LEVEL_INFO);
    }

    nCsma = nCsma == 0 ? 1 : nCsma;

    NodeContainer p2pNodes;
    p2pNodes.Create (2);

    NodeContainer csmaNodes;
    csmaNodes.Add (p2pNodes.Get (1));
    csmaNodes.Create (nCsma);

    PointToPointHelper pointToPoint;
    pointToPoint.SetDeviceAttribute ("DataRate", StringValue ("5Mbps"));
```

```
pointToPoint.SetChannelAttribute ("Delay", StringValue ("2ms"));

NetDeviceContainer p2pDevices;
p2pDevices = pointToPoint.Install (p2pNodes);

CsmaHelper csma;
csma.SetChannelAttribute ("DataRate", StringValue ("100Mbps"));
csma.SetChannelAttribute ("Delay", TimeValue (NanoSeconds (6560)));

NetDeviceContainer csmaDevices;
csmaDevices = csma.Install (csmaNodes);

InternetStackHelper stack;
stack.Install (p2pNodes.Get (0));
stack.Install (csmaNodes);

Ipv4AddressHelper address;
address.SetBase ("10.1.1.0", "255.255.255.0");
Ipv4InterfaceContainer p2pInterfaces;
p2pInterfaces = address.Assign (p2pDevices);

address.SetBase ("10.1.2.0", "255.255.255.0");
Ipv4InterfaceContainer csmaInterfaces;
csmaInterfaces = address.Assign (csmaDevices);

UdpEchoServerHelper echoServer (9);

ApplicationContainer serverApps = echoServer.Install (csmaNodes.Get (nCsma));
serverApps.Start (Seconds (1.0));
serverApps.Stop (Seconds (10.0));

UdpEchoClientHelper echoClient (csmaInterfaces.GetAddress (nCsma), 9);
echoClient.SetAttribute ("MaxPackets", UintegerValue (1));
echoClient.SetAttribute ("Interval", TimeValue (Seconds (1.0)));
echoClient.SetAttribute ("PacketSize", UintegerValue (1024));

ApplicationContainer clientApps = echoClient.Install (p2pNodes.Get (0));
clientApps.Start (Seconds (2.0));
clientApps.Stop (Seconds (10.0));

Ipv4GlobalRoutingHelper::PopulateRoutingTables ();

pointToPoint.EnablePcapAll ("second");
csma.EnablePcap ("second", csmaDevices.Get (1), true);

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

## OUTPUT

```
devang@devang: ~/ns3/ns-allinone-3.29/ns-3.29
devang@devang:~/ns3/ns-allinone-3.29/ns-3.29$ ./waf --run Bus
Waf: Entering directory `/home/devang/ns3/ns-allinone-3.29/ns-3.29/build'
[2679/2737] Linking build/scratch/scratch-simulator
[2681/2737] Linking build/scratch/devang1
[2682/2737] Compiling scratch/Bus.cc
[2684/2737] Linking build/scratch/devang4
[2696/2737] Linking build/scratch/devang3
[2697/2737] Linking build/scratch/Bus
Waf: Leaving directory `/home/devang/ns3/ns-allinone-3.29/ns-3.29/build'
Build commands will be stored in build/compile_commands.json
'build' finished successfully (9.134s)
At time 2s client sent 1024 bytes to 10.1.2.4 port 9
At time 2.0078s server received 1024 bytes from 10.1.1.1 port 49153
At time 2.0078s server sent 1024 bytes to 10.1.1.1 port 49153
At time 2.01761s client received 1024 bytes from 10.1.2.4 port 9
devang@devang:~/ns3/ns-allinone-3.29/ns-3.29$
```

## **VIVA Questions**

Q1 What is the difference between CSMA/CA and CSMA/CD protocol?

Q2 Explain the flowchart of CSMA protocol?

Q3. Explain the persistence strategy and the types of persistence strategies?

Q4. Which persistence strategy is the best and why?

Q5. What is the difference between Star and Bus topology?

## **EXPERIMENT-7**

**AIM-** Design and Implement Hybrid topology connecting multiple routers and nodes.

### **SOURCE 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"

using namespace ns3;

NS_LOG_COMPONENT_DEFINE ("Hybrid");

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

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

    NodeContainer host, router, host1;
    host.Create (2);
    router.Create (4);

    NodeContainer subnet1;
    subnet1.Add (host.Get (0));
    subnet1.Add (router.Get (0));

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

    NetDeviceContainer subnet1Devices;
    subnet1Devices = pointToPoint.Install (subnet1);

    subnet1Devices = pointToPoint.Install (subnet1);

    InternetStackHelper stack;
```

```

stack.Install (router);
stack.Install (host);

Ipv4AddressHelper address1, address2, address3, address4, address5, address6;;
Address1.SetBase ("10.1.1.0", "255.255.255.0");
Ipv4InterfaceContainer subnet1Interfaces;
subnet1Interfaces = address1.Assign (subnet1Devices);

echoClient.SetAttribute ("MaxPackets", UIntegerValue (3));
echoClient.SetAttribute ("Interval", TimeValue (Seconds (1.0)));
echoClient.SetAttribute ("PacketSize", UIntegerValue (1024));
ApplicationContainer clientApps = echoClient.Install (subnet1.Get (0));

serverApps.Start (Seconds (1.0));
serverApps.Stop (Seconds (10.0));
clientApps.Start (Seconds (1.0));
clientApps.Stop (Seconds (10.0));

Ipv4GlobalRoutingHelper::PopulateRoutingTables ();

Simulator::Run ();
Simulator::Destroy ();

```

## **OUTPUT :**

```

[root@mta-192-180-1-231 ns-3.24.1]# ./waf --run scratch/pragati2
Waf: Entering directory `/home/mait/Downloads/ns-allinone-3.24.1/ns-3.24.1/bui
Waf: Leaving directory `/home/mait/Downloads/ns-allinone-3.24.1/ns-3.24.1/bui
Build commands will be stored in build/compile_commands.json
'build' finished successfully (0.631s)
At time 1s client sent 1024 bytes to 10.1.5.2 port 9
At time 1.01475s server received 1024 bytes from 10.1.1.1 port 49153
At time 1.01475s server sent 1024 bytes to 10.1.1.1 port 49153
At time 1.02949s client received 1024 bytes from 10.1.5.2 port 9
At time 2s client sent 1024 bytes to 10.1.5.2 port 9
At time 2.01475s server received 1024 bytes from 10.1.1.1 port 49153
At time 2.01475s server sent 1024 bytes to 10.1.1.1 port 49153
At time 2.02949s client received 1024 bytes from 10.1.5.2 port 9
At time 3s client sent 1024 bytes to 10.1.5.2 port 9
At time 3.01475s server received 1024 bytes from 10.1.1.1 port 49153
At time 3.01475s server sent 1024 bytes to 10.1.1.1 port 49153
At time 3.02949s client received 1024 bytes from 10.1.5.2 port 9
[root@mta-192-180-1-231 ns-3.24.1]# █

```

## **VIVA Questions**

Q1 What is the difference between amplifier and repeater?

Q2 What is hub and how it is different from router?

Q3. What is the role of animation in NS3 simulator?

Q4. Explain difference between TCP/IP protocol suite and OSI model?

Q5. How communication can be set between nodes of a ring network?

## **EXPERIMENT-8**

**AIM:** To Install and configure NetAnim.

**STEPS:**

**Installing NetAnim**

**URL:**

<http://www.nsnam.org/wiki/index.php/NetAnim>

*1. Install Mercurial:*

```
$apt-get/dnf install mercurial
```

*2. Install QT4 development package:*

```
$apt-get/dnf install qt4-dev-tools
```

*3. Use Synaptic alternatively to install above mentioned packages.*

**4. Download NetAnim: hg clone <http://code.nsnam.org/netanim>**

**5. Build NetAnim:**

```
$cd netanim-3.xxx
$make clean
$make / qmake-qt?
$NetAnim. Pro
$make
```

Compiling code with NetAnim

Make the following changes to the code, in order to view the animation on NetAnim.

```
#include " ..."

#include "ns3/netanim-module.h" //1 Include. . .

int main ( int argc , char *argv [ ] )

{ std :: string animFile = "somename. xml"; //2 Name of f i l e for animation

    ...

    AnimationInterface anim ( animFile ); //3 Animation interface
    Simulator :: Run ();
    Simulator :: Destroy ();
    return 0;
```

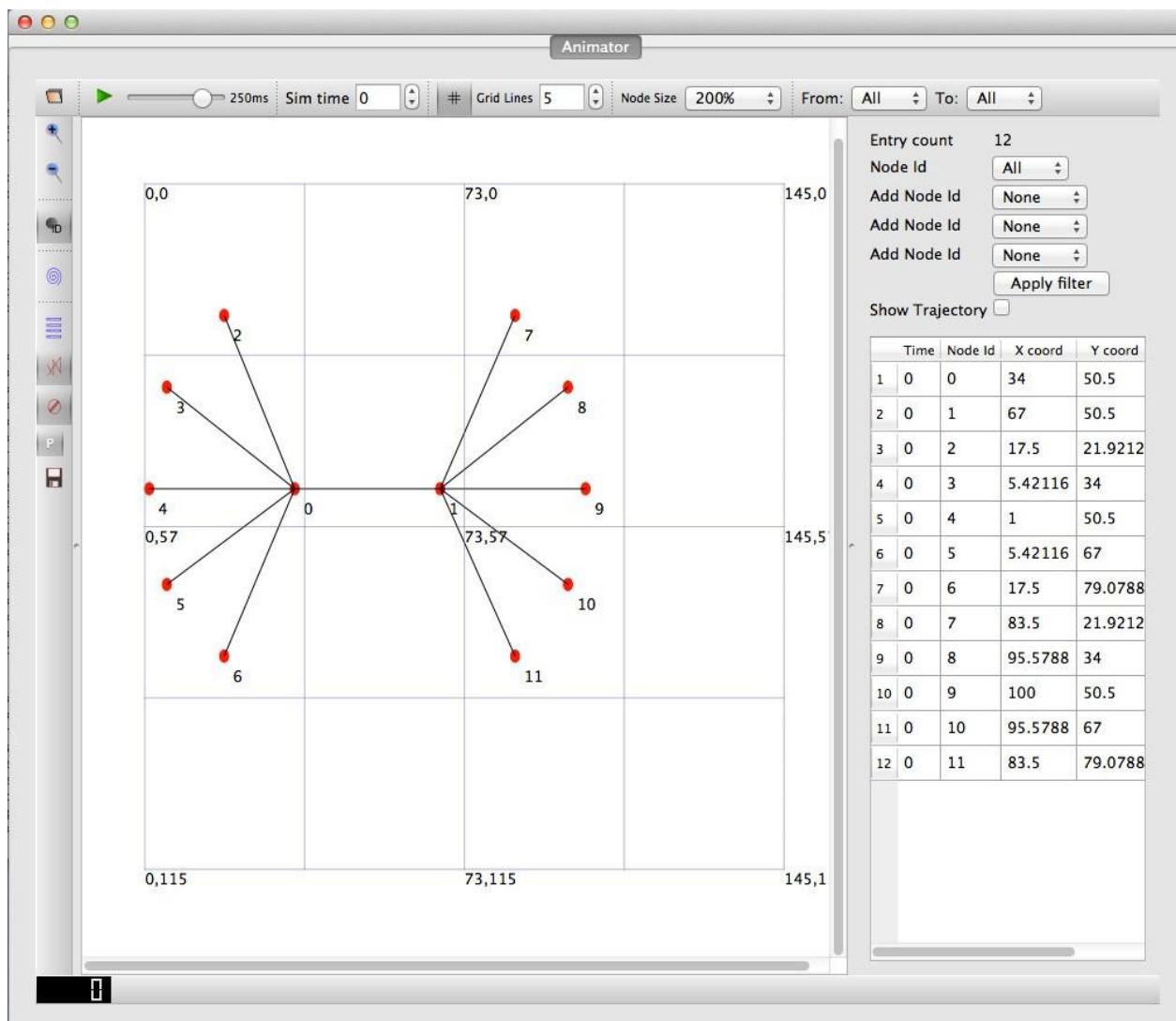


To run the code:

1. Move the waf , waf.bat , wscript and wutils.py les in to the scratch folder (~/.ns-allinone-3.24/ns-3.24/scratch/).
2. Move the example code to the scratch folder and make the changes required for NetAnim, as shown above.
3. Now cd to the scratch folder (cd ~/.ns-allinone-3.24/ns-3.24/scratch/).
4. Run the code using the command:  
`./ waf --run <filename>`

**To visualize on NetAnim:**

1. cd to the netanim folder (\$cd ~/.netanim/).
2. Run Netanim:  
`./NetAnim`
3. Include the .xml file generated in the ns-3.24 folder (~/.ns-allinone-3.17/ns3.24/).

**OUTPUT****NetAnim GUI**

## **VIVA Questions**

Q1 What is the role of NetAnim in NS3 simulator?

Q2 What is the role of scratch folder in NS3 program simulation?

Q3. What is the role of animation in NS3 simulator?

Q4. Explain TCP/IP protocol suite?

Q5. What is the hybrid network?