Experiment N0:02 Name: S.M. Wazid Ullah Murad ID:IT-16010

Name of Experiments : TCP Variants

Steps :

1. Create a simple dumbbell topology, two client Node1 and Node2 on the left side of the dumbbell and server nodes Node3 and Node4 on the right side of the dumbbell. Let Node5 and Node6 form the bridge of the dumbbell. Use point to point links.
2. Install a TCP socket instance on Node1 that will connect to Node3.
3. Install a UDP socket instance on Node2 that will connect to Node4.
4. Start the TCP application at time 1s.
5. Start the UDP application at time 20s at rate Rate1 such that it clogs half the dumbbell bridge's link capacity.
6. Increase the UDP application's rate at time 30s to rate Rate2 such that it clogs the whole of the dumbbell bridge's capacity.
7. Use the ns-3 tracing mechanism to record changes in congestion window size of the TCP instance over time. Use gnuplot/matplotlib to visualise plots of cwnd vs time.
8. Mark points of fast recovery and slow start in the graphs.
9. Perform the above experiment for TCP variants Tahoe, Reno and New Reno, all of which are available with ns-3.

Code:

```
#include <fstream>
#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 ("FifthScriptExample");
class MyApp : public Application
{
public:

  MyApp ();
  virtual ~MyApp();
  void Setup (Ptr<Socket> socket, Address address, uint32_t packetSize, uint32_t nPackets,
DataRate dataRate);
```

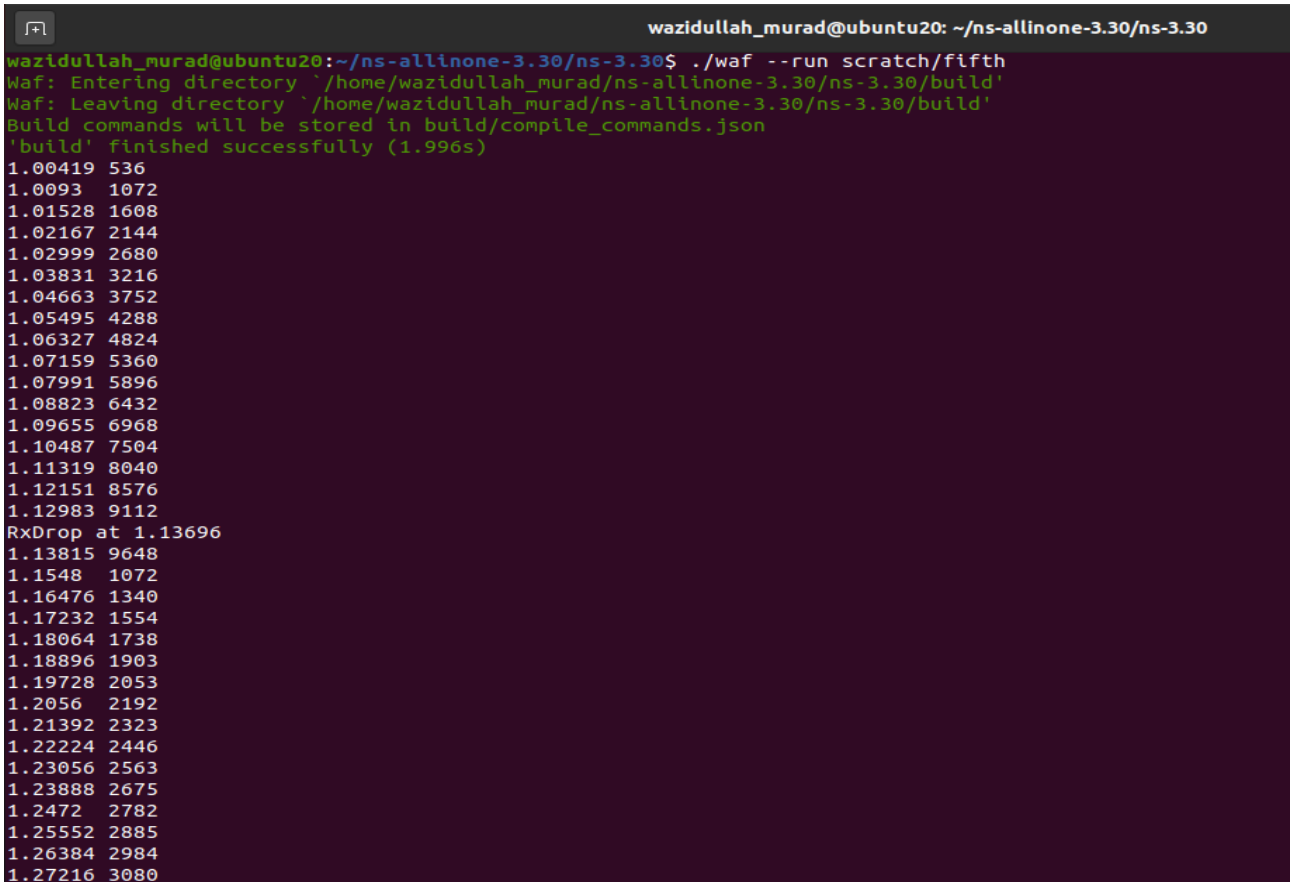
```
private:
  virtual void StartApplication (void);
  virtual void StopApplication (void);
  void ScheduleTx (void);
  void SendPacket (void);
  Ptr<Socket>     m_socket;
  Address         m_peer;
  uint32_t        m_packetSize;
  uint32_t        m_nPackets;
  DataRate        m_dataRate;
  EventId         m_sendEvent;
  bool            m_running;
  uint32_t        m_packetsSent;
};
MyApp::MyApp ()
  : m_socket (0),
    m_peer (),
    m_packetSize (0),
    m_nPackets (0),
    m_dataRate (0),
    m_sendEvent (),
    m_running (false),
    m_packetsSent (0)
{
}
MyApp::~MyApp()
{
  m_socket = 0;
}
void
MyApp::Setup (Ptr<Socket> socket, Address address, uint32_t packetSize, uint32_t nPackets,
DataRate dataRate)
{
  m_socket = socket;
  m_peer = address;
  m_packetSize = packetSize;
  m_nPackets = nPackets;
```

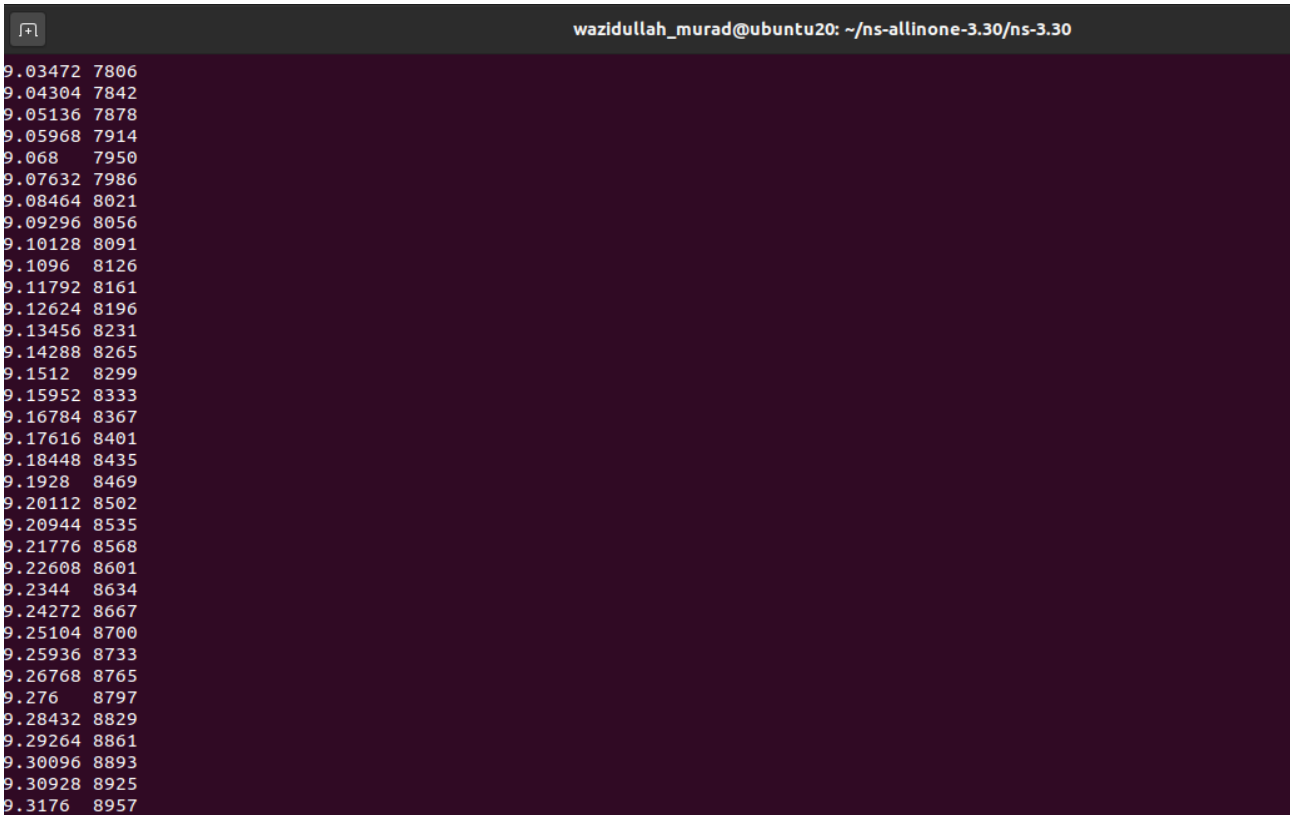
```
  m_dataRate = dataRate;
}
void
MyApp::StartApplication (void)
{
  m_running = true;
  m_packetsSent = 0;
  m_socket->Bind ();
  m_socket->Connect (m_peer);
  SendPacket ();
}
void
MyApp::StopApplication (void)
{
  m_running = false;

  if (m_sendEvent.IsRunning ())
    {
      Simulator::Cancel (m_sendEvent);
    }

  if (m_socket)
    {
      m_socket->Close ();
    }
}
void
MyApp::SendPacket (void)
{
  Ptr<Packet> packet = Create<Packet> (m_packetSize);
  m_socket->Send (packet);

  if (++m_packetsSent < m_nPackets)
    {
      ScheduleTx ();
    }
}
```

```
void
MyApp::ScheduleTx (void)
{
  if (m_running)
    {
      Time tNext (Seconds (m_packetSize * 8 / static_cast<double> (m_dataRate.GetBitRate ())));
      m_sendEvent = Simulator::Schedule (tNext, &MyApp::SendPacket, this);
    }
}
static void
CwndChange (uint32_t oldCwnd, uint32_t newCwnd)
{
  NS_LOG_UNCOND (Simulator::Now ().GetSeconds () << "\t" << newCwnd);
}

static void
RxDrop (Ptr<const Packet> p)
{
  NS_LOG_UNCOND ("RxDrop at " << Simulator::Now ().GetSeconds ());
}
int
main (int argc, char *argv[])
{
  CommandLine cmd;
  cmd.Parse (argc, argv);
  NodeContainer nodes;
  nodes.Create (2);
  PointToPointHelper pointToPoint;
  pointToPoint.SetDeviceAttribute ("DataRate", StringValue ("5Mbps"));
  pointToPoint.SetChannelAttribute ("Delay", StringValue ("2ms"));
  NetDeviceContainer devices;
  devices = pointToPoint.Install (nodes);
  Ptr<RateErrorModel> em = CreateObject<RateErrorModel> ();
  em->SetAttribute ("ErrorRate", DoubleValue (0.00001));
  devices.Get (1)->SetAttribute ("ReceiveErrorModel", PointerValue (em));
  InternetStackHelper stack;
  stack.Install (nodes);
```

```
  Ipv4AddressHelper address;
  address.SetBase ("10.1.1.0", "255.255.255.252");
  Ipv4InterfaceContainer interfaces = address.Assign (devices);
  uint16_t sinkPort = 8080;
  Address sinkAddress (InetSocketAddress (interfaces.GetAddress (1), sinkPort));
  PacketSinkHelper packetSinkHelper ("ns3::TcpSocketFactory", InetSocketAddress
(Ipv4Address::GetAny (), sinkPort));
  ApplicationContainer sinkApps = packetSinkHelper.Install (nodes.Get (1));
  sinkApps.Start (Seconds (0.));
  sinkApps.Stop (Seconds (20.));
  Ptr<Socket> ns3TcpSocket = Socket::CreateSocket (nodes.Get (0),
TcpSocketFactory::GetTypeId ());
  ns3TcpSocket->TraceConnectWithoutContext ("CongestionWindow", MakeCallback
(&CwndChange));
  Ptr<MyApp> app = CreateObject<MyApp> ();
  app->Setup (ns3TcpSocket, sinkAddress, 1040, 1000, DataRate ("1Mbps"));
  nodes.Get (0)->AddApplication (app);
  app->SetStartTime (Seconds (1.));
  app->SetStopTime (Seconds (20.));
  devices.Get (1)->TraceConnectWithoutContext ("PhyRxDrop", MakeCallback (&RxDrop));
  Simulator::Stop (Seconds (20));
  Simulator::Run ();
  Simulator::Destroy ();
  return 0;
}
```

Output:


wazidullah_murad@ubuntu20: ~/ns-allinone-3.30/ns-3.30
wazidullah_murad@ubuntu20:~/ns-allinone-3.30/ns-3.30$ ./waf --run scratch/fifth
Waf: Entering directory `/home/wazidullah_murad/ns-allinone-3.30/ns-3.30/build'
Waf: Leaving directory `/home/wazidullah_murad/ns-allinone-3.30/ns-3.30/build'
Build commands will be stored in build/compile_commands.json
'build' finished successfully (1.996s)
1.00419 536
1.0093 1072
1.01528 1608
1.02167 2144
1.02999 2680
1.03831 3216
1.04663 3752
1.05495 4288
1.06327 4824
1.07159 5360
1.07991 5896
1.08823 6432
1.09655 6968
1.10487 7504
1.11319 8040
1.12151 8576
1.12983 9112
RxDrop at 1.13696
1.13815 9648
1.1548 1072
1.16476 1340
1.17232 1554
1.18064 1738
1.18896 1903
1.19728 2053
1.2056 2192
1.21392 2323
1.22224 2446
1.23056 2563
1.23888 2675
1.2472 2782
1.25552 2885
1.26384 2984
1.27216 3080


wazidullah_murad@ubuntu20: ~/ns-allinone-3.30/ns-3.30
9.03472 7806
9.04304 7842
9.05136 7878
9.05968 7914
9.068 7950
9.07632 7986
9.08464 8021
9.09296 8056
9.10128 8091
9.1096 8126
9.11792 8161
9.12624 8196
9.13456 8231
9.14288 8265
9.1512 8299
9.15952 8333
9.16784 8367
9.17616 8401
9.18448 8435
9.1928 8469
9.20112 8502
9.20944 8535
9.21776 8568
9.22608 8601
9.2344 8634
9.24272 8667
9.25104 8700
9.25936 8733
9.26768 8765
9.276 8797
9.28432 8829
9.29264 8861
9.30096 8893
9.30928 8925
9.3176 8957

Conclusion:

from the lab we've learnt how to create dumbbell topology, the process of installing TCP & UDP instance & got used to these.We've used the ns-3 tracing mechanism to record changes in congestion window size of the TCP instance over time & used gnuplot/matplotlib to visualise plots of cwnd vs time.