

IT: 16038

Experiment N0:02

Name of Experiments : TCP Variants

Objective :

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.

Source 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");
```

```
//
```

```
=====
```

```
//
```

```
//      node 0          node 1
```

```
//  +-----+  +-----+
```

```
//  | ns-3 TCP |  | ns-3 TCP |
```

```
//  +-----+  +-----+
```

```
//  | 10.1.1.1 |  | 10.1.1.2 |
```

```
//  +-----+  +-----+
```

```
//  | point-to-point |  | point-to-point |
```

```
//  +-----+  +-----+
```

```
//      |          |
```

```
//      +-----+
```

```
//      5 Mbps, 2 ms
```

```
//
```

```
//
```

```
// We want to look at changes in the ns-3 TCP congestion window. We need
```

```
// to crank up a flow and hook the CongestionWindow attribute on the socket
```

```
// of the sender. Normally one would use an on-off application to generate a
```

```
// flow, but this has a couple of problems. First, the socket of the on-off
```

```
// application is not created until Application Start time, so we wouldn't be
```

```
// able to hook the socket (now) at configuration time. Second, even if we
```

```
// could arrange a call after start time, the socket is not public so we
```

```
// couldn't get at it.
```

```
//
```

```
// So, we can cook up a simple version of the on-off application that does what
```

```
// we want. On the plus side we don't need all of the complexity of the on-off
```

```
// application. On the minus side, we don't have a helper, so we have to get
```

```
// a little more involved in the details, but this is trivial.
```

```
//
```

```
// So first, we create a socket and do the trace connect on it; then we pass
```

```
// this socket into the constructor of our simple application which we then
```

```
// install in the source node.
```

```
//
```

```
=====
```

```
//
```

```
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));
```

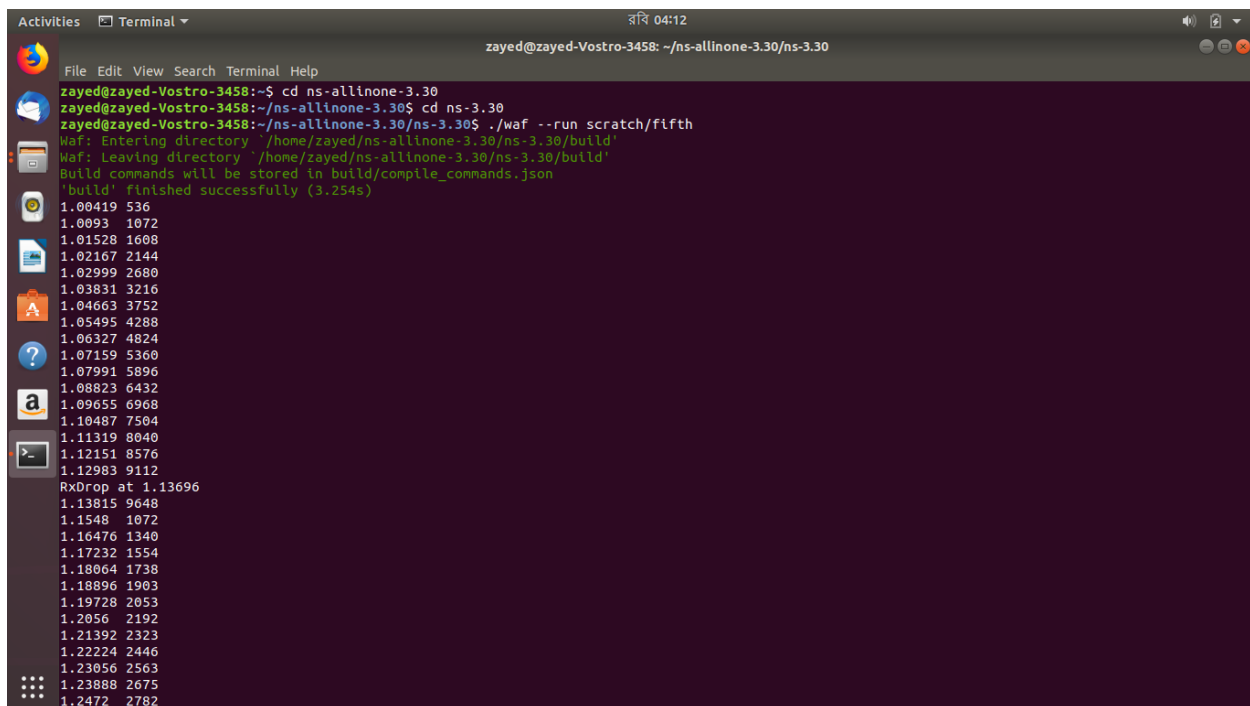
Simulator::Run ();

Simulator::Destroy ();

return 0;

}

OUTPUT :



```
zayed@zayed-Vostro-3458:~$ cd ns-allinone-3.30
zayed@zayed-Vostro-3458:~/ns-allinone-3.30$ cd ns-3.30
zayed@zayed-Vostro-3458:~/ns-allinone-3.30/ns-3.30$ ./waf --run scratch/flfth
Waf: Entering directory '/home/zayed/ns-allinone-3.30/ns-3.30/build'
Waf: Leaving directory '/home/zayed/ns-allinone-3.30/ns-3.30/build'
Build commands will be stored in build/compile_commands.json
'build' finished successfully (3.254s)
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
```

```
File Edit View Search Terminal Help
2.49431 8502
2.50263 8535
2.51095 8568
2.51927 8601
2.52759 8634
RxDrop at 2.53382
2.53682 8667
RxDrop at 2.54304
2.55258 1072
2.57267 1340
2.57865 1554
2.58583 1738
2.59415 1903
2.60247 2053
RxDrop at 2.6087
2.6117 2192
2.62002 1072
2.63003 1340
2.63664 1554
2.64496 1738
2.65328 1903
2.6616 2053
2.66992 2192
2.67824 2323
2.68656 2446
2.69488 2563
2.7032 2675
2.71152 2782
2.71984 2885
2.72816 2984
2.73648 3080
2.7448 3173
2.75312 3263
2.76144 3351
2.76976 3436
2.77808 3519
2.7864 3600
2.79472 3679
```

```
Activities Terminal 04:15
zayed@zayed-Vostro-3458: ~/ns-allinone-3.30/ns-3.30
File Edit View Search Terminal Help
5.83228 1340
5.83984 1554
5.84816 1738
5.85648 1903
5.8648 2053
5.87312 2192
5.88144 2323
5.88976 2446
5.89808 2563
5.9064 2675
5.91472 2782
5.92304 2885
5.93136 2984
5.93968 3080
5.948 3173
5.95632 3263
5.96464 3351
5.97296 3436
5.98128 3519
5.9896 3600
5.99792 3679
6.00624 3757
6.01456 3833
6.02288 3907
6.0312 3980
6.03952 4052
6.04784 4122
6.05616 4191
6.06448 4259
6.0728 4326
6.08112 4392
6.08944 4457
6.09776 4521
6.10608 4584
6.1144 4646
6.12272 4707
6.13104 4768
6.13936 4828
```