



Mawlana Bhashani Science and Technology University

Santosh, Tangail-1902.

Lab Report

Department of Information and Communication Technology

Report No: 02

Report Name: TCP variants.

Course Title: Wireless and Mobile Communication.

Course Code: ICT-4201

Submitted By	Submitted To
Name: Muzahidul Islam. ID: IT-16040 Session: 2015-16 4th Year 2nd Semester Dept. of Information & Communication Technology, MBSTU.	Nazrul Islam, Assistant Professor Dept. of Information & Communication Technology, MBSTU.

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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));
```

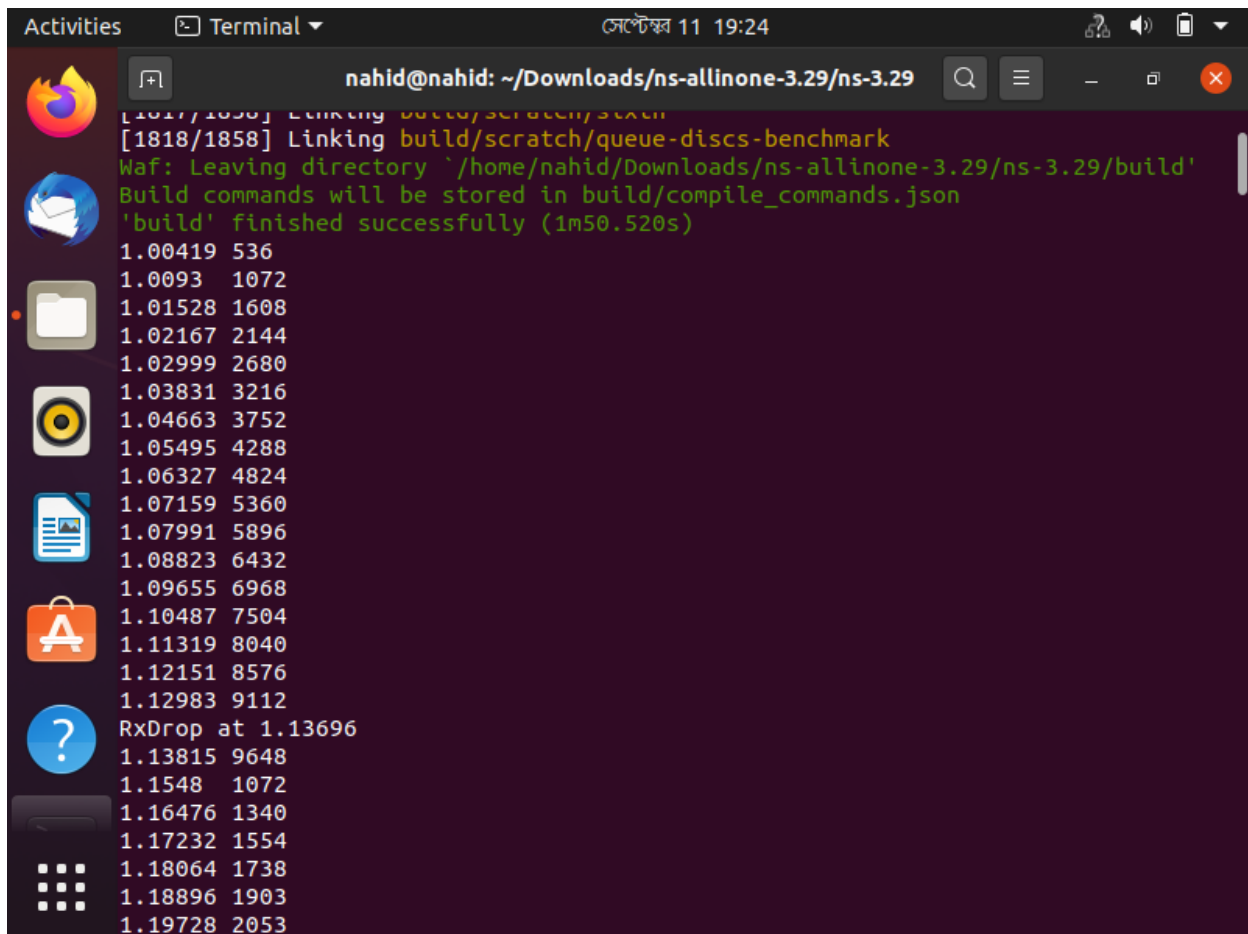
```
Simulator::Run ();
```

```
Simulator::Destroy ();
```

```
return 0;
```

```
}
```

OUTPUT :



```
Activities  Terminal  ১১ ১৯:২৪
nahid@nahid: ~/Downloads/ns-allinone-3.29/ns-3.29
[1817/1858] Linking build/scratch/scratch
[1818/1858] Linking build/scratch/queue-discs-benchmark
Waf: Leaving directory '/home/nahid/Downloads/ns-allinone-3.29/ns-3.29/build'
Build commands will be stored in build/compile_commands.json
'build' finished successfully (1m50.520s)
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
```

Activities Terminal ১১ ১৯:৩১

nahid@nahid: ~/Downloads/ns-allinone-3.29/ns-3.29

```
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
1.28048 3173
1.2888 3263
1.29712 3351
1.30544 3436
1.31376 3519
1.32208 3600
1.3304 3679
1.33872 3757
1.34704 3833
1.35536 3907
1.36368 3980
1.372 4052
1.38032 4122
1.38864 4191
1.39696 4259
RxDrop at 1.4032
1.41072 4326
```