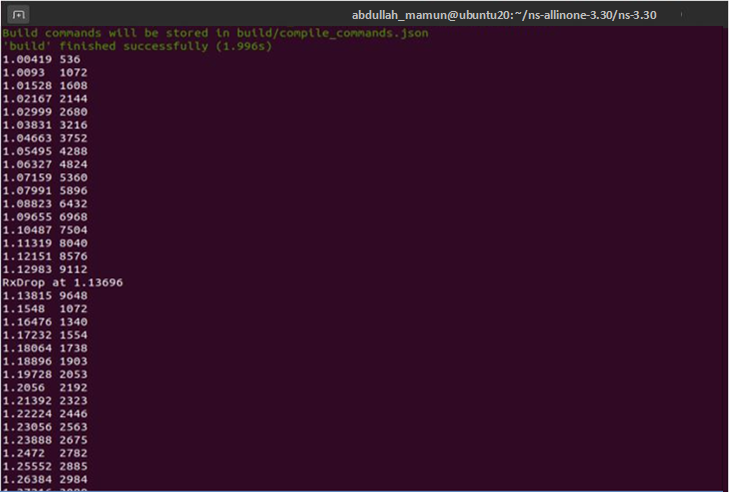
**Experiment N0. : 02**

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**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:**





**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.