Indian Institute of Technology, Bhilai

CSL351: Computer Networks

Assignment - 5 (NS-3 Introduction)

Full Marks: 20 *Deadline: 15-02-2026*

Submission Instructions:

1) Answer all the questions.
2) Deliverables in a .zip:
    a) Submission Guidelines: For each part, create a separate folder. Upload all the folders and Assignment Report in .zip.
    b) Readable Report **[3 Marks for report quality]** enumerating steps followed with screenshots for each of the important steps.
        i) Link to download the collected Pcap trace and mention the command/tool used.
        ii) Put the screenshots in the report for better clarity
        iii) Your report should have screenshots of your final results necessarily and you are expected to explain in the report which function was used or which line of code set the data rate or a TCP flow or a UDP flow or how did you fetch the address of a particular node, so everything needs to be carefully explained in your report.
        iv) Explain everything that has been asked in your report and highlight the important parts, and attach each and every codefile, script or anything which you used to complete the tasks.
    c) For all the experiments, write the inferences that you have observed.
3) Follow the instructions carefully given in the question.
4) You can use latex/word to make the pdf.
5) The naming of the zip file should strictly follow the given format: <Roll_No>_<Name>_<Assignment No>. If your name is Alex, your roll number is B23CS055, then the filename should be: B23CS055_Alex_05.zip
6) **Any plagiarism case will be considered unethical practice, and appropriate action will be taken against them.**

Objectives:

1. **Getting familiar in NS-3:**
    a. Gain hands-on experience in setting up network simulations using the ns-3 simulator.
    b. Understand how to create custom network topologies and configure various network elements.
2. **Understand Traffic Flow Configuration:**

a. Learn to establish and analyze UDP traffic flows across different network setups.
b. Explore the impact of link latency, data rates, and other parameters on network performance.

3. **Analyze Network Performance Metrics:**
   a. Measure key metrics using Wireshark.
4. **Automate Simulations:**
   a. Develop scripts to automate simulation tasks, such as data collection and processing.
5. **Familiarize with Visualization Tools:**
   a. Use NetAnim to visually represent and analyze network topologies and traffic flows.
   b. Capture and interpret pcap traces to understand packet-level communication.
6. **Report and Document Findings:**
   a. Document the steps followed, code implementation, and observations comprehensively.
   b. Include screenshots, flow graphs, and scripts to support results and inferences.

PART 1: Getting Familiar with NS-3 [17 Points]

Using lab_1.cc as a reference, achieve the following tasks:

1. Create a simple topology of two nodes (Node1, Node2) separated by a point-to-point link. **[2 Points]**
2. Set up a UdpClient on one Node1 and a UdpServer on Node2. Let it be of a fixed data rate. **[2 Points]**
   [Note: You have to use udp-client-server-helper. You can not use udp-echo-helper]
3. Start the client application to send data to the server, and measure end-to-end throughput whilst varying the latency of the link and fill up the following table: **[8 Points]**

Bandwidth	Latency	Maximum Number of Packets	Interval	Packet Size	End-to-End Throughput	Number of packets transmitted
5 Kbps	15 milliseconds	100	1 second	1024		
5 Kbps	10 milliseconds	50	100 milliseconds	512		
5 Kbps	5 milliseconds	Unlimited	10 milliseconds	1024		
5 Mbps	15 milliseconds	150	10 seconds	2048		
5 Mbps	10 milliseconds	50	5 seconds	256		
5 Mbps	5 milliseconds	10	1 millisecond	256		
5 Gbps	15 milliseconds	Unlimited	1 millisecond	1024		
5 Gbps	20 milliseconds	5	2 seconds	256		
5 Gbps	5 milliseconds	100	5 milliseconds	512		

[Note: Set the ending time of the simulation to 1 minute]

4. Now add another client application to Node1 and a server instance to Node2 with **udp-echo-server-helper**. What do you need to configure to ensure that there is no conflict? **[1 Mark]**

5. Repeat the procedure with extra client and server application instances. Show **screenshots of the pcap traces** that indicate that delivery is made to the appropriate server instance, and submit the drive link of the pcap files. **[2 Marks]**

   [Note: You have to use bandwidth = 5Mbps , latency = 2 milliseconds , number of packets for transmission = unlimited, sending interval = 10 milliseconds and packet size= 1024 bytes, simulation time = 30 seconds for this step]
6. Show the topology diagram using NetAnim and submit the .xml file used to generate the topology. **[1 Mark]**
7. Use the pcap traces to generate an I/O graph using Wireshark for both nodes' interfaces. **[1 Mark]**

** **ns-3 version should be >=3.44**

** **Reference File Paths:**

- ns-allinone-3.44/ns-3.44/examples/tutorial/first.cc

Check Web sources for more information.