Computer Networks
@CS.NYCU

Lab. 2: Network Simulator with Ns-3

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Agenda

- Objectives
- Background
- Tasks
- Submission
- Grading Policy
- References

Objectives

In this lab, we are going to write a C++ program which can generate a network topology and flows via *NS-3*

1. Learn how to download and install NS-3
2. Learn how to create a network topology and generate flows in **NS-3**

Background

- NS-3:
  - Discrete-event network simulator for Internet systems
  - Designed for research and educational use
  - Free, open-source software, licensed under the GNU GPLv2 license
  - Maintained by a worldwide community
  - Used to evaluate the performance of a network protocol design

Tasks

1. Environment Setup
2. Trace Example Code
3. Create New Topology
4. Create New Flows
5. Report

Task 1. Environment Setup

- Step1. Join the **GitHub Classroom Lab2**
  - GitHub Classroom Lab2
- Step2. Install Oracle VM VirtualBox (Same as Lab1)
  - Oracle VM VirtualBox - Downloads

Task 1. Environment Setup (cont.)

- Step3. Download TA's ova file and import it into your Oracle VM VirtualBox (Same as Lab1)
  - Lab1.ova
  - Password: cn2023
  - How To Use OVA Files with VirtualBox (alphr.com)

- Step4. Download required files from GitHub

```
$ git clone https://github.com/NYCU-CN2023/Lab2-<GITHUB_ID>.git
```

Task 1. Environment Setup (cont.)

- Step5. Get and set repository for global options

```
$ cd Lab2-<GITHUB_ID>
$ git config --global user.name "<NAME>"
$ git config --global user.email "<EMAIL>"
```

- Step6. Install NS-3
  - NS-3 install note

Task 2. Trace Example Code

- Run the example code

```
$ cd ns-3-dev/
$ ./ns3 run first
```

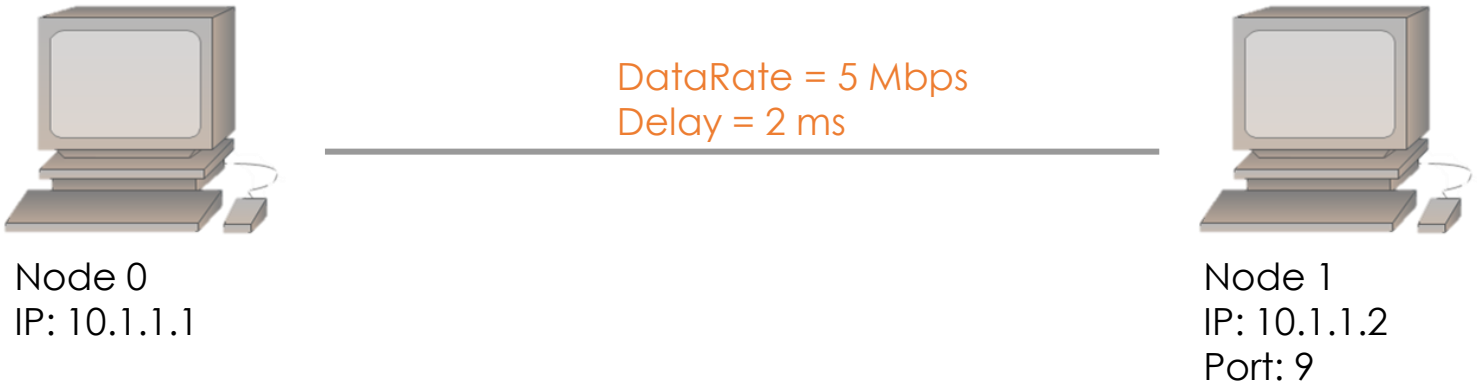
- Result

```
At time +2s client sent 1024 bytes to 10.1.1.2 port 9
At time +2.00369s server received 1024 bytes from 10.1.1.1 port 49153
At time +2.00369s server sent 1024 bytes to 10.1.1.1 port 49153
At time +2.00737s client received 1024 bytes from 10.1.1.2 port 9
```

- Example code path
  - `ns-3-dev/examples/tutorial/first.cc`

Task 2. Trace Example Code (Cont.)

- Network topology in **first.cc**

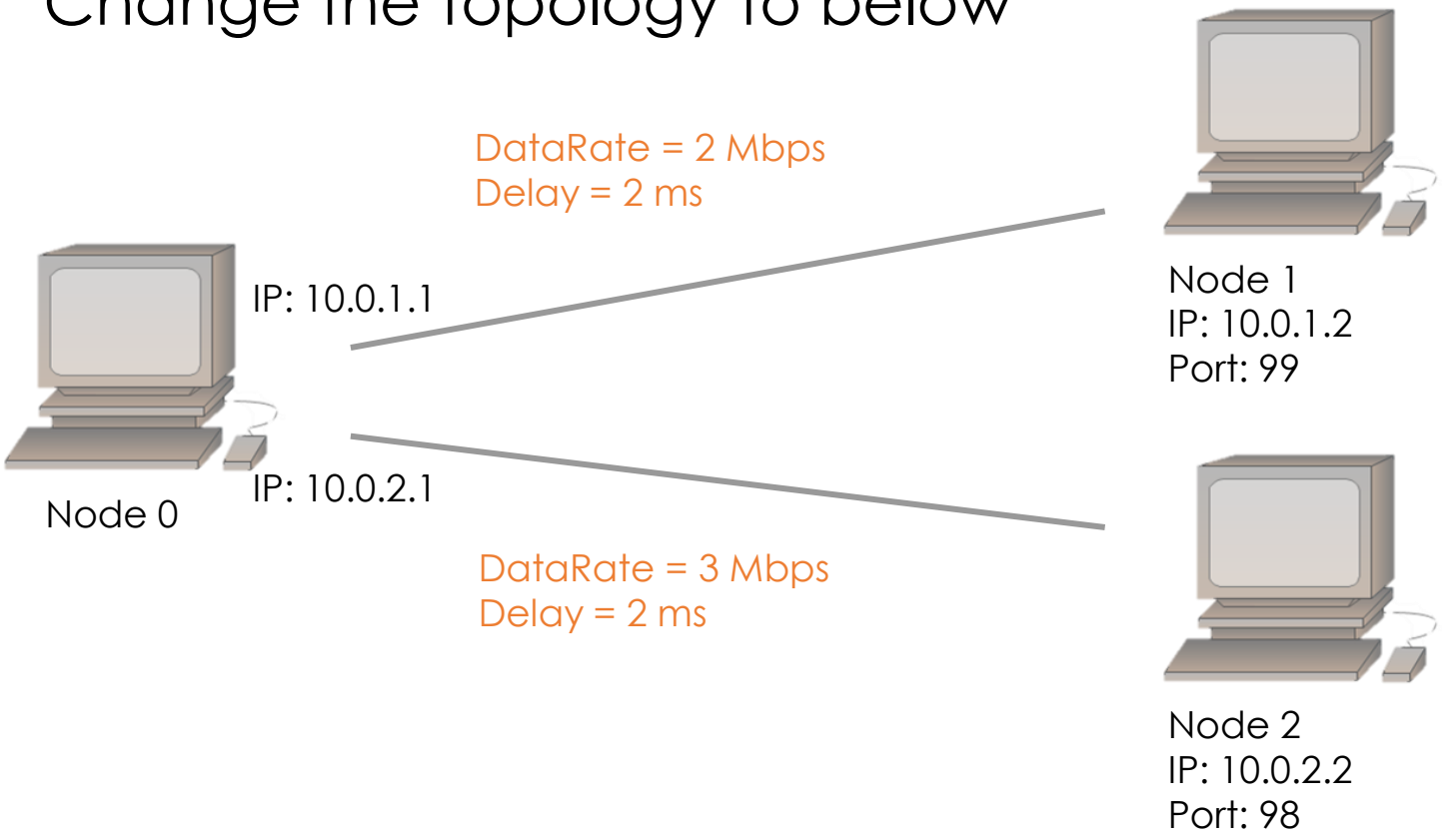


Task 2. Trace Example Code (Cont.)

- Follow the Ns-3 tutorial to trace first.cc
- It will guide you to a detailed understanding of the functionality of each part of the code
- Teach you build your script in **scratch/**

Task 3. Create a New Topology

- Duplicate **first.cc** to **scratch/** called **StudentID.cc**
- Change the topology to below

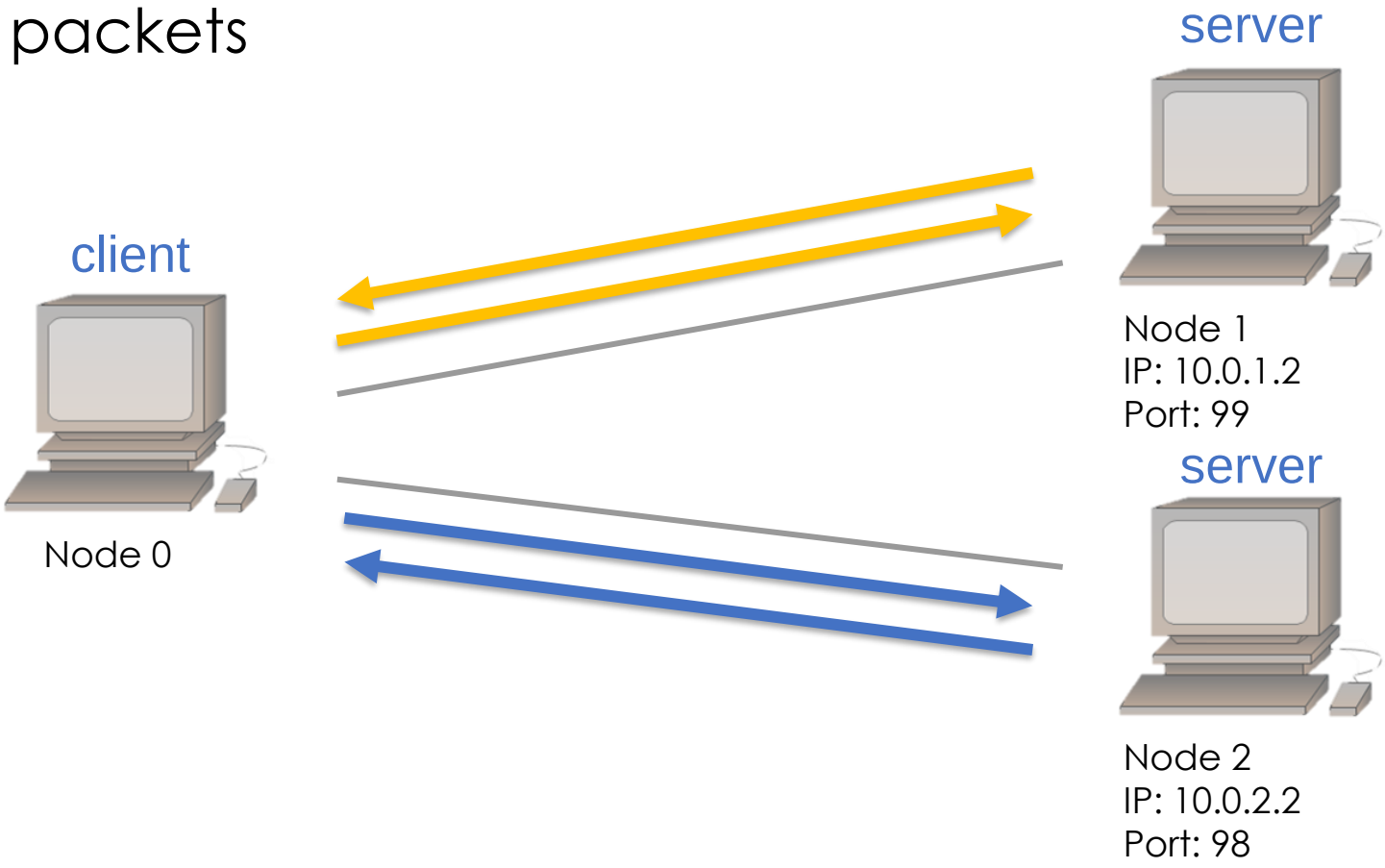


Task 4. Create New Flows

- The example **first.cc** includes only one client and one server, sending one UDP packets

Task 4. Create New Flows (Cont.)

- **StudentID.cc** should include one client and two servers, with each of two flows sending four UDP packets



Task 4. Create New Flows (Cont.)

- Example output:

```
At time +2s client sent 1024 bytes to 10.0.1.2 port 99
At time +2s client sent 1024 bytes to 10.0.2.2 port 98
At time +2.00481s server received 1024 bytes from 10.0.2.1 port 49154
At time +2.00481s server sent 1024 bytes to 10.0.2.1 port 49154
At time +2.00622s server received 1024 bytes from 10.0.1.1 port 49153
At time +2.00622s server sent 1024 bytes to 10.0.1.1 port 49153
At time +2.00962s client received 1024 bytes from 10.0.2.2 port 98
At time +2.01243s client received 1024 bytes from 10.0.1.2 port 99
```

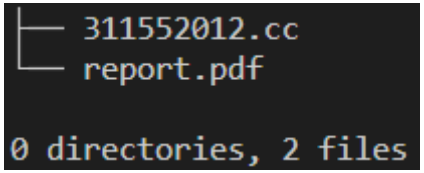
- The correct output will have 32 lines logs, 2 lines per packet

Task 5. Report

- A report in PDF format, contains:
  - Describe each step and how to run your program
  - Answer the following question in short:
    - What is the different between network simulation and emulation?
    - Generally, in NS-3, if you don't change the code, the output will be always the same every time you run, even if you set some probabilistic parameter like error rate, why?
    - Following the previous question, how to deal with this problem?
  - Bonus
    - What have you learned from this lab?
    - What difficulty have you met in this lab?

Submission

- **You should write your report in English**
- push StudentID.cc and report to your GitHub repository (NYCU-CN2023/Lab2-<GITHUB_ID>)
- Make sure the filename of each file is correct
- File Structure:



Notice: No need to submit to E3

Grading Policy

- Deadline – **2024.01.06 23:59**
- Grade
  - code correctness - 40%
  - Report - 60%
- Late Policy
  - (Your score) * 0.8^D, where D is the number of days over due
- Cheating Policy
  - Academic integrity: Homework must be your own – cheaters share the score
  - Both the cheaters and the students who aided the cheater equally share the score

Q&A

- If you have any question about Lab2:
  1. Post the question in Lab2 channel
  2. DM TAs for reservation (EC635)

     nycu-nc2023@googlegroups.com

     (Office hour: PM2:00 ~ PM4:00 Mon.)

References

- **NS-3**
  - ns-3 Tutorial