LAB2 - More about ns-3

CS169: Mobile Wireless Networks - Winter 2018

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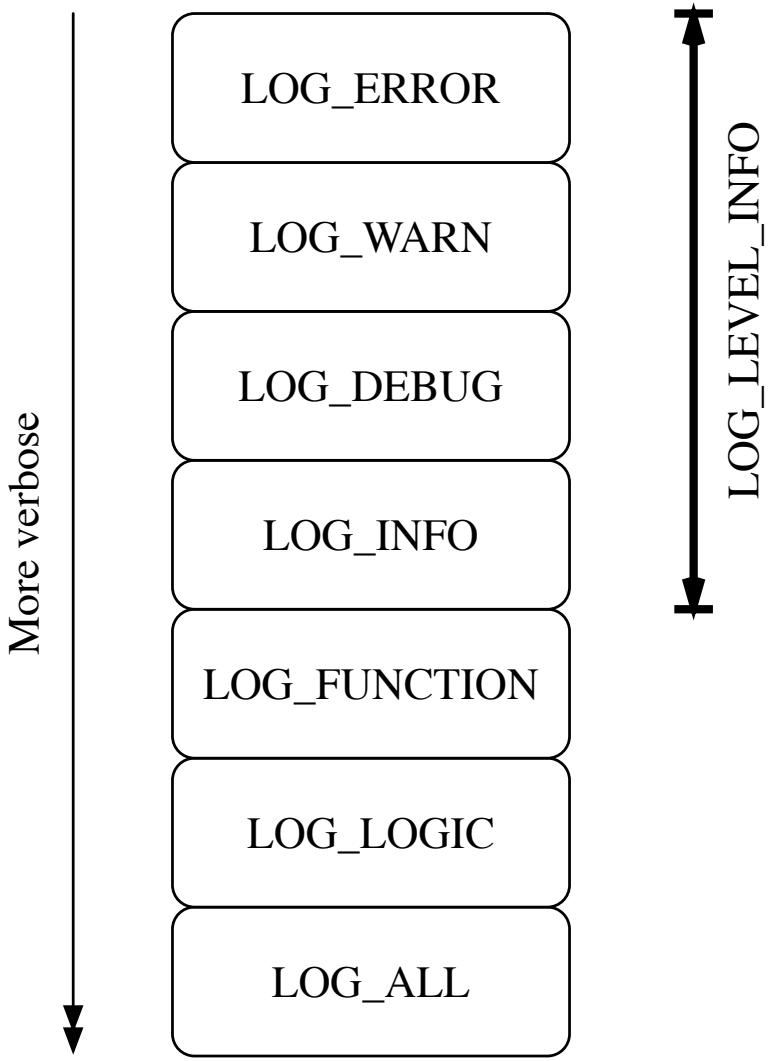
NS-3 Logging

- Go to working directory
- `$ cd /extra/CSUserName/cs169lab/ns-allinone-3.25/ns-3.25`
- `$ cp examples/tutorial/first.cc scratch/myfirst.cc`
- `$ ./waf`
- `$ ./waf --run scratch/myfirst`
- Observe the logs... What cause them?
- *LogComponentEnable("UdpEchoClientApplication", LOG_LEVEL_INFO);*

Log Verbosity Levels



Log more, see more

- `$ export NS_LOG=UdpEchoClientApplication=level_all`
- `$ export 'NS_LOG=UdpEchoClientApplication=level_all | prefix_func'`
- `$ export 'NS_LOG=UdpEchoClientApplication=level_all|prefix_func : UdpEchoServerApplication=level_all|prefix_func'`
- `$ export 'NS_LOG=UdpEchoClientApplication=level_all|prefix_func|prefix_time: UdpEchoServerApplication=level_all|prefix_func|prefix_time'`

Log-all-application Masking

```
export 'NS_LOG=*=level_all|prefix_func|prefix_time'
```

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Adding your own logs

- `$ vim scratch/myfirst.cc`
- *NS_LOG_COMPONENT_DEFINE ("FirstScriptExample");*
- *NS_LOG_INFO("Creating Topology");*
  NodeContainer nodes;
  nodes.Create (2);
- `$ ./waf`
- Clear `NS_LOG` variables
- `$ export NS_LOG=`
- Running...
- `$ ./waf --run scratch/myfirst`
- Do you see the log?

Seeing your own logs

- `$ export NS_LOG=FirstScriptExample=info`
- `$ ./waf --run scratch/myfirst`
- `$ export NS_LOG=FirstScriptExample=level_info`
- `$ ./waf --run scratch/myfirst`

Command Line Arguments

- When we wanted to alter attribute values, ...
- *PointToPointHelper pointToPoint;*
  pointToPoint.SetDeviceAttribute ("DataRate", StringValue ("5Mbps"));
  pointToPoint.SetChannelAttribute ("Delay", StringValue ("2ms"));
- Now, we want to pass these as command line arguments, then go to **myfirst.cc** and declare the command line parser
- *CommandLine cmd;*
  cmd.Parse (argc, argv);

Looking for help...

- `$ ./waf --run "scratch/myfirst --PrintHelp"`
- Print attributes
- `$ ./waf --run "scratch/myfirst --PrintAttributes=ns3::PointToPointNetDevice"`
- Remove these two lines from the script
- *pointToPoint.SetDeviceAttribute ("DataRate", StringValue ("5Mbps"));*
  pointToPoint.SetChannelAttribute ("Delay", StringValue ("2ms"));
- Set attributes
- `$ ./waf --run "scratch/myfirst --ns3::PointToPointNetDevice::DataRate=5Mbps"`

Do not forget

Double quotes when passing arguments

Exercise I

- Insert more LOG_INFO for *FirstScriptExample*
- Ex. Creating Topology, Assigning IP Addresses, Creating echoServer
- What is the default channel delay value?
- Set channel delay to 4 ms using CLA
- Set max packets to 4 using CLA
- Set data rate, channel delay, and max packets at the same run using CLA

Hints!

```
$ ./waf --run "scratch/myfirst --PrintGroup=PointToPoint"
$ ./waf --run "scratch/myfirst
--ns3::UdpEchoClient::MaxPackets=4"
```

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Using your own values

- Just before *cmd.Parse (argc, argv);* add
  uint32_t nPackets = 1;
  cmd.AddValue("nPackets", "Number of packets to echo", nPackets);
- Type
  echoClient.SetAttribute ("MaxPackets", UintegerValue (nPackets));
- `$ ./waf --run "scratch/myfirst --nPackets=4"`

Good to know

Using your own values, you do not have to know ns3 Group and Argument names (ex. ns3::UdpEchoClient::MaxPackets) but knowing some of them allows you to get the default values used by ns3.

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Tracing Systems

- How can you look at IP headers by using LOG?
- Tracing Systems are extended logging systems that provide users with more customizations.
- Trace source $\rightarrow$ trace sink
- ASCII Tracing: Add the following two lines before *Simulator::Run*
- *AsciiTraceHelper ascii;*
  pointToPoint.EnableAsciiAll (ascii.CreateFileStream ("myfirst.tr"));
- Run the script again
- Open *myfirst.tr*

ASCII Trace I

Figure: ASCII Trace Event Locator

- `+`: An enqueue operation occurred on the device queue;
- `-`: A dequeue operation occurred on the device queue;
- `d`: A packet was dropped, typically because the queue was full;
- `r`: A packet was received by the net device.

Figure: ASCII Trace Event I

```
1  +
2  2
3  /NodeList/0/DeviceList/0/$ns3::PointToPointNetDevice/TxQueue/Enqueue
4  ns3::PppHeader (
5    Point-to-Point Protocol: IP (0x0021))
6    ns3::Ipv4Header (
7      tos 0x0 ttl 64 id 0 protocol 17 offset 0 flags [none]
8      length: 1052 10.1.1.1 > 10.1.1.2)
9      ns3::UdpHeader (
10       length: 1032 49153 > 9)
11       Payload (size=1024)
```

ASCII Trace II

Figure: ASCII Trace Event Locator

- `+`: An enqueue operation occurred on the device queue;
- `-`: A dequeue operation occurred on the device queue;
- `d`: A packet was dropped, typically because the queue was full;
- `r`: A packet was received by the net device.

Figure: ASCII Trace Event II

```
1  r
2  2.25732
3  /NodeList/1/DeviceList/0/$ns3::PointToPointNetDevice/MacRx
4    ns3::Ipv4Header (
5      tos 0x0 ttl 64 id 0 protocol 17 offset 0 flags [none]
6      length: 1052 10.1.1.1 > 10.1.1.2)
7      ns3::UdpHeader (
8        length: 1032 49153 > 9)
9        Payload (size=1024)
```

Pcap Tracing

- Add this line of code before *Simulator::Run*
- *pointToPoint.EnablePcapAll ("myfirst");*
- *myfirst* will be the prefix of the real file names: *myfirst-0-0.pcap* and *myfirst-1-0.pcap*

Exercise

Find a computer with Wireshark installed (www.wireshark.org) and remote access to your lab machine (tango or delta) and secure copy (scp) *myfirst-0-0.pcap* and *myfirst-1-0.pcap* from tango or delta to your Wireshark-installed computer. Finally, open pcap files using Wireshark and look around the TCP/IP headers and packet sizes (total packet length vs. data length)

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Questions?