LAB1 - Introduction to ns-3

CS169: Mobile Wireless Networks - Winter 2018

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TA Information

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Lab Logistics

- There will be six lab classes and may be exercises for you to practice
- After the sixth lab, you do not have to attend
- Homework will be posted with explicit due dates and times (the same for two lab sections)
- There will be one final project. I will post more information online and will let you know

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What is ns-3?

- A discrete-event network simulator, targeted primarily for research and educational use
- ns-3 is free and publicly available for use
- ns-3 is written entirely with C++ while Python user code wrappers are available.
- We will focus on how to use ns-3 to simulate simple IP networks and WiFi channels

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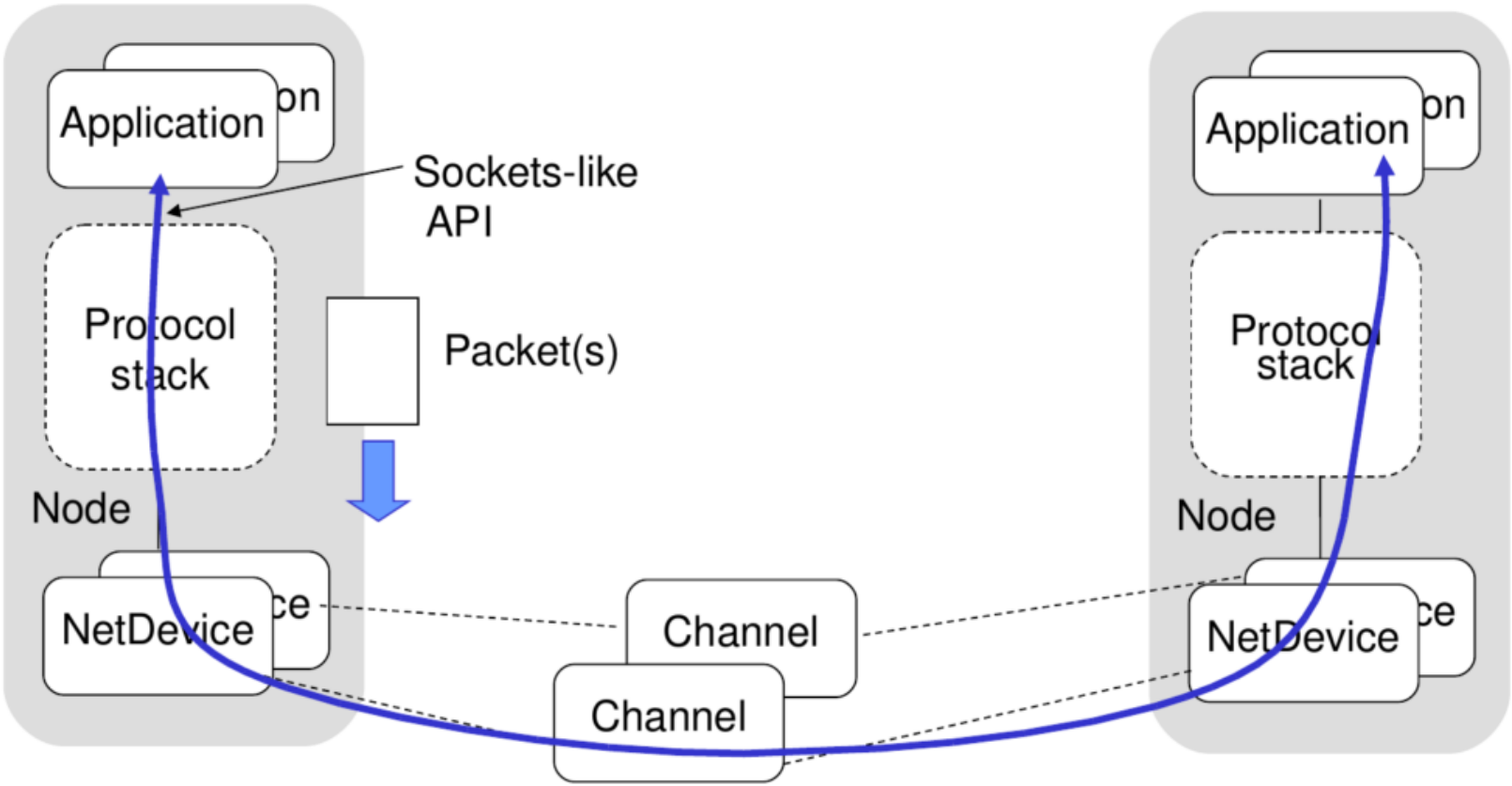
Architecture



Architecture

- Just like TCP/IP stacks
- Applications running in a node use Protocol Stack (TCP, UDP, IP, etc)
- Protocol Stack sends packets to NetDevices (or Network interfaces / adapters)
- Each NetDevice interfaces with each Channel (WiFi, LTE, etc.)

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Download ns-3

- `$ cd /extra/CSUserName`
- `$ mkdir cs169lab && cd cs169lab`
- `$ wget http://www.nsnam.org/release/ns-allinone-3.25.tar.bz2`
- `$ tar -xvf ns-allinone-3.25.tar.bz2`
- `$ cd ns-allinone-3.25`

Addtional commands for remote access

- `$ ssh CSUserName@bolt.cs.ucr.edu`
- `$ ssh wch133-xx`
- where xx is the machine number you are using

Build ns-3

- `$ ./build.py --enable-examples --enable-tests`
- `$ cd ns-3.25`
- `$ ./test.py`
- `$ ./waf --run examples/tutorial/hello-simulator`
- If you see Hello Simulator, congratulations! You have environments ready for running ns-3.

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Running the first script

- `$ ./waf --run examples/tutorial/first`
- `$ vim examples/tutorial/first.cc`

Script headers

- Add module header files

```
#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"
```

- Namespace

```
using namespace ns3;
```

- Create log components

```
NS_LOG_COMPONENT_DEFINE ("FirstScriptExample");
```

More headers

- Set time resolution

```
Time::SetResolution (Time::NS);
```

- Enable log components and set log levels

```
LogComponentEnable ("UdpEchoClientApplication",
LOG_LEVEL_INFO);
LogComponentEnable ("UdpEchoServerApplication",
LOG_LEVEL_INFO);
```

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Creating topology

- Create nodes

```
NodeContainer nodes;
nodes.Create (2);
```

- Create Channel

```
PointToPointHelper pointToPoint;
pointToPoint.SetDeviceAttribute ("DataRate",
StringValue ("5Mbps"));
pointToPoint.SetChannelAttribute ("Delay", StringValue
("2ms"));
```

- Create NetDevice and bind them to Channel

```
NetDeviceContainer devices;
devices = pointToPoint.Install (nodes);
```

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Protocol Stack

- Create InternetStack

```
InternetStackHelper stack;
stack.Install (nodes);
```

- Set IP network address

```
Ipv4AddressHelper address;
address.SetBase ("10.1.1.0", "255.255.255.0");
```

- Assign IP to NetDevice

```
Ipv4InterfaceContainer interfaces = address.Assign
(devices);
```

Building UDP Echo Server

- Create echo server
  ```
  UdpEchoServerHelper echoServer (9);
  ```
- Install echo server to node 1, mark it application, and set start and stop time
  ```
  ApplicationContainer serverApps = echoServer.Install
  (nodes.Get (1));
  serverApps.Start (Seconds (1.0));
  serverApps.Stop (Seconds (10.0));
  ```

Building UDP Echo Client

- Create echo client and set its attributes

```
UdpEchoClientHelper echoClient (interfaces.GetAddress
(1), 9);
echoClient.SetAttribute ("MaxPackets", UintegerValue
(1));
echoClient.SetAttribute ("Interval", TimeValue (Seconds
(1.0)));
echoClient.SetAttribute ("PacketSize", UintegerValue
(1024));
```

- Install echo client to node 0, mark it application, and set start and stop time

```
ApplicationContainer clientApps = echoClient.Install
(nodes.Get (0));
clientApps.Start (Seconds (2.0));
clientApps.Stop (Seconds (10.0));
```

Run simulator

- Run, destroy, return

```
Simulator::Run ();
Simulator::Destroy ();
return 0;
```

Exercises

- Increase packet sizes 4K, 16K, 64K
- Have the client send the packets every one second for 4 packets
- Double data link rate
- Double data link delay
- Increase the number of echo clients to 2, 3, 4, 5 and have them send packets to the server

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...What we have learned?

1. TA Information
2. Lab Logistics
3. What is ns-3?
4. ns-3 Installation
5. Running the first ns-3 script
6. Exercises

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Next Lab...

- Logging modules
- Command line arguments
- Tracing systems
- Pcap tracing

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