Introduction to NS-3

COMPUTER
NETWORKING

MOHAMED KASSEM

What is NS-3?

- Discrete event network simulator
- Open Source
- Collection of C++ libraries, not a program
- Support under Linux, FreeBSD and Cygwin

Installing NS-3

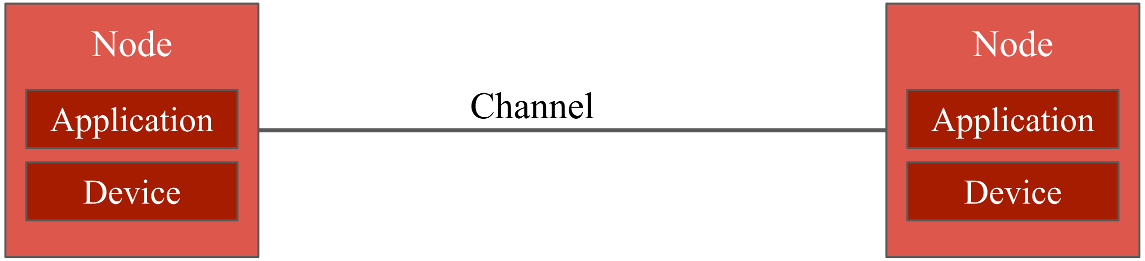
Recommended install workflow:

```
-> mkdir workspace
-> cd workspace
-> wget http://www.nsnam.org/release/ns-allinone-3.26.tar.bz2
-> tar xjf ns-allinone-3.26.tar.bz2
-> cd ns-allinone-3.26/
-> ./build.py
```

Tutorial: https://www.nsnam.org/docs/release/3.26/tutorial/ns-3-tutorial.pdf

Key Terms and Abstractions

- Node - the hardware (eg. router, PC, phone)
- Network device (ND) - transmits and receives over the channel
- Channel - transmission medium between NDs (eg. WiFi, ethernet)
- Application - creates or receives data sent between nodes
- Helper - NS-3 construct used to quickly configure and create the above



Walkthrough of Example Script

Sections of the code to cover :

- Node Creation
- Channel Configuration
- WiFi Settings
- Mobility and positioning
- Application Configuration
- Running the Simulation
- Flow Monitor

Walkthrough of Example Script (cont)

```
NodeContainer wifiStaNodes;
wifiStaNodes.Create (1);
NodeContainer wifiApNode;
wifiApNode.Create(1);
```

- Node Container
  - Holds groups of nodes
  - Offer functions for node creation and adding existing nodes or containers to the group

- Separate containers for AP and Stations for ease of application/device installation

Walkthrough of Example Script (cont)

```
YansWifiChannelHelper channel;
channel.SetPropagationDelay ("ns3::ConstantSpeedPropagationDelayModel");
channel.AddPropagationLoss("ns3::LogDistancePropagationLossModel");
if(rayleigh){
      wifiChannel.AddPropagationLoss("ns3::NakagamiPropagationLossModel",
                                    "m0", DoubleValue(1.0),
                                     "m1", DoubleValue(1.0),
                                     "m2", DoubleValue(1.0));
}
```

- Helper not the actual channel
- Physical attributes
  - Propagation loss and delay
  - Fading (Nakagami with equal m values is equivalent to Rayleigh)

Walkthrough of Example Script (cont)

```
WifiHelper wifi = WifiHelper::Default ();
wifi.SetStandard(ns3::WIFI_PHY_STANDARD_80211g);
wifi.SetRemoteStationManager ("ns3::AarfWifiManager");
NetDeviceContainer apDevices;
apDevices = wifi.Install (phy, mac, wifiApNode);
```

- WiFi Helper
  - Creates the Net Devices mentioned earlier
  - Using for setting standards and station manager
  - Sets MAC and PHY information for nodes

Walkthrough of Example Script (cont)

```
MobilityHelper mobility;
mobility.SetPositionAllocator ("ns3::GridPositionAllocator",
                               "MinX", DoubleValue (0.0),
                               "MinY", DoubleValue (0.0),
                               "DeltaX", DoubleValue (5.0),
                               "DeltaY", DoubleValue (10.0),
                               "GridWidth", UintegerValue (3),
                               "LayoutType", StringValue ("RowFirst"));
mobility.SetMobilityModel ("ns3::ConstantPositionMobilityModel");
mobility.Install (wifiApNode);
```

- Used to Position Nodes
- Can be used to specify movement of nodes

Walkthrough of Example Script (cont)

```
OnOffHelper onoff ("ns3::UdpSocketFactory", Address ());
std::string dataRate = "20Mib/s";
onoff.SetConstantRate(dataRate, (uint32_t)1024);
remoteAddress (InetSocketAddress (apAddress.GetAddress (0), 8000));
onoff.SetAttribute ("Remote", remoteAddress);
ApplicationContainer apps = onoff.Install (wifiStaNodes.Get (0));
UniformRandomVariable var;
apps.Start(var.GetValue(0, 0.1));
apps.Stop (Seconds (10.0));
PacketSinkHelper sink("ns3::UdpSocketFactory",
      InetSocketAddress (apAddress.GetAddress (0), 8000));
apps.Add(sink.Install(wifiApNode.Get(0)));
```

- Applications send (onoff) or receive (sink) packets

Walkthrough of Example Script (cont)

```
flowmon = flowmonHelper.InstallAll();

//Simulator configuration and run commands see next slide
flowmon->CheckForLostPackets ();
Ptr<Ipv4FlowClassifier> classifier = DynamicCast<Ipv4FlowClassifier> (flowmonHelper.GetClassifier ());
std::map<FlowId, FlowMonitor::FlowStats> stats = flowmon->GetFlowStats ();
for (std::map<FlowId, FlowMonitor::FlowStats>::const_iterator iter = stats.begin (); iter != stats.end (); ++iter){
	Ipv4FlowClassifier::FiveTuple t = classifier->FindFlow (iter->first);
	if (t.sourceAddress == Ipv4Address("10.1.1.1") && t.destinationAddress == Ipv4Address("10.1.1.2")){
		NS_LOG_UNCOND("Throughput in Kib/s over the run time: "
			<< iter->second.rxBytes * 8.0 / (10 * 1024)
			<< std::endl);
	}
}
```

- Monitors all data flows between nodes
- Iterate through statistics to find nodes of interest by IP

Walkthrough of Example Script (cont)

```
Simulator::Stop (Seconds (10.0));
Simulator::Run ();
Simulator::Destroy ();
```

- Schedule the stop time for the simulator
- Run the simulation
- Clean up afterwards

Running the Script

1. Copy Files to :
```
ns-allinone-3.26/ns-3.26/scratch
```
2. From the ns-3.26 directory build the simulation with
```
./waf
```
3. Run the simulation using waf (remember to remove the .cc from the filename)
   a. If no command line arguments are required
```
./waf --run scratch/scriptname
```
4. If command line arguments are required
```
./waf --run “scratch/scriptname --argument=value”
```

Questions?

Please e-mail:

Mohamed Kassem <M.M.M.Kassem@sms.ed.ac.uk>