

## Lab-Sheet 5

### Dynamic Networks and Creating Output Files for XGraph

For today's lab-session, the goal is to become familiar with Dynamic Networks and be able to create output files for XGraph. Both of which are needed for coursework **Q3-4**.

#### 1. Dynamic Networks

To create a dynamic network. Use the example given at

<https://www.isi.edu/nsnam/ns/tutorial/index.html> under the following section VI. Network dynamics.

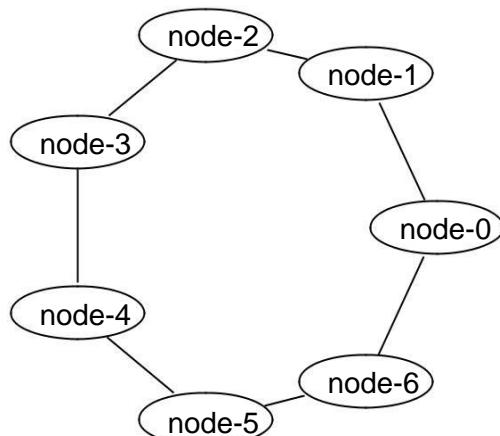
The example shows how you can keep a larger number of nodes in a Tcl array instead of giving each node its own name **For-loop** (*needed for coursework Q2 and Q3*). Also, you will see that the traffic takes the **shortest path** from node 0 to node 3 through nodes 1 and 2, as would be expected. Then, another interesting feature is added. We let the link between node 1 and 2 (which is being used by the traffic) **go down for a second** (*needed for coursework Q2 and Q3*).

You will see that between the seconds 1.0 and 2.0 the link will be down, and all data that is sent from node 0 is lost. The example shows you how to use **dynamic routing** to solve that 'problem' using the **Distance Vector** (DV) routing protocol.

# Tell the simulator to use dynamic routing

```
$ns rtproto DV
```

**Exercise 1.** Create a Dynamic Network and routing algorithm of seven nodes. The links should all have a delay of 10ms, a link-speed of 10Mb, and make use of the DropTail queue. For convenience try using a for-loop to generate the topology. Your network should look something like this:



Now add some UDP communication from node-0 to node-3. The UDP application should generate packets of size 500 at an interval of 2ms. The traffic should start at time-interval 0.5 seconds and stop at 4.5 seconds. Additionally, you should generate a trace file of the communication. *Please see the Hint below at the end of Exercise2*

**Exercise 2.** Extend your network to introduce an intermittent fault, which leads to the link between node-1 and node-2 going down for a few seconds. To do this, you'll need to use the rtmodel\_at function. Here is a basic example on how to use rtmodel\_at:

```
$ns rtmodel_at 1.0    down $nodex $nodey # set link state  
                      # to down at time  
                      # interval 1.0  
  
$ns rtmodel_at 3.0    up $nodex $nodey  # set link state  
                      # to up at time  
                      # interval 3.0
```

The link between node-1 and node-2 should go down at 1.0 seconds and up at 2.0 seconds. What do you observe?

*Hint for Exercise 1 and 2: Just download the given example at the end of the page (You can download the full example here). Download example3.tcl, run it and try to understand what happened during the scenario. Select slow motion in nam (Step: 1.0ms)! Then, change the routing protocol to Link state.*

#Tell the simulator to use dynamic routing

```
$ns rtproto LS
```

Find and try to understand the difference between the two routing protocols

**Remember** You need that for the coursework Q3-4

## 2. Creating Output Files for XGraph

Also, in this Lab you should be familiar with creating output files for network performance measurement (analysis). One part of the ns-allinone package is 'xgraph', a plotting program which can be used to create graphic representations of simulation results.

Use the example given at <https://www.isi.edu/nsnam/ns/tutorial/index.html> under the following section VIII. Creating Output Files for Xgraph.

This example shows you a simple to create output files in your Tcl scripts, which can be used as data sets for xgraph. The example will also show you how to use traffic generators.

**Exercise 3.** Try to understand how to use XGraph to measure a network's performance (e.g. total dropped packets, throughput, sent and received total packets)

*Hint for Exercise 3: Just download the given example at the end of the page (You can download the full example here). Download example4.tcl, run it and try to understand what happened during the scenario. Maybe, you need that for the coursework Q3-4.*

**Note:** Complete the observation/results and discussion sheet for each lab (it is on vision), also keep your Tcl files (labs' scenarios) in a safe place. You need to submit both (results discussion sheet and Tcl files) later on as part of the coursework.

**Remember,** for all the lab sessions the observation and discussion (report) is an individual work which means that MUST be your own work.