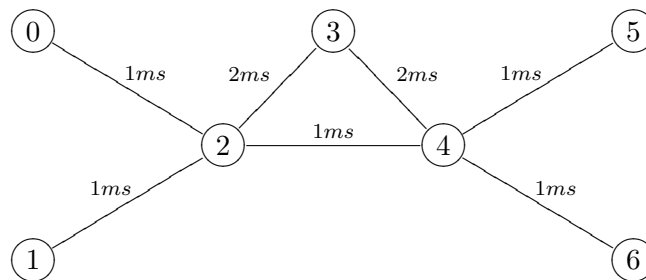


Network Traffic Analysis

1 Network Traffic Data

In this project, you will analyze simulated network traffic to determine throughput, delay, and packet send times.

The topology for the network is shown below, where each node is designated by a number 0–6.



All of the links have a bandwidth of 1Mbps. The links from node 2 to 3 and node 3 to 4 have a delay of 2ms; all other links have a delay of 1ms.

After an initial sequence of route discovery packets, two TCP connections are set up:

- At time 0.4 seconds a TCP connection from node 0 to node 6 starts.
- At time 0.75 seconds a TCP connection from node 1 to node 5 starts.

All of the TCP connections have a packet size of 1000 bytes.

The network simulation data can be found in the file `net.sim` available on the course web page. This file contains a sequence of events that occur during the two TCP sessions described above. Each line of the file corresponds to one event, and the events themselves are in the following format:

```
<type> <time> <from> <to> <prot> <size> <flags> <flow id> <src> <dest> <seq> <id>
```

Each of these fields is described in Figure 1.

2 Programming

Write software that collects information from the network simulation data and creates the following graphs for both of the TCP sessions present in the network.

1. Independent variable (x-axis): seconds. Dependent variable (y-axis): throughput in Kbps, measured for each 100ms interval at the source of the TCP stream.
2. Independent variable (x-axis): seconds. Dependent variable (y-axis): TCP packet sequence number transmitted by the source.
3. Independent variable (x-axis): seconds. Dependent variable (y-axis): Average delay between source and destination of delivered packets, measured for each 100ms interval. (Start measuring as the first packet of the TCP stream is sent.)

<type>	r receive at <to> node + enqueue - dequeue d dropped packet
<time>	measured in seconds
<from>	sending node of the packet
<to>	receiving node of the packet
<prot>	tcp indicates TCP data packet ack indicates TCP ack rtProtoDV indicates IPv6 routing protocol
<size>	size of the packet in bytes
<flags>	A indicates a Congestion Window Reduce flag (others are not used in this project)
<flow id>	used by IPv6
<src>	source address in the format <node>.<port>
<dest>	destination address in the format <node>.<port>
<seq>	packet sequence number
<id>	unique packet identifier (used by the simulator)

Figure 1: Event field descriptions

You should write your programs in Java or Perl. The output of the programs should be suitable for graphing by the Unix utilities `xgraph` or `gnuplot`, or Excel. Use one of these programs to plot the statistics you collect. Your programs should be clearly documented and easy to understand.

3 What to turn in

Each group should turn in the following items.

1. A hardcopy project report containing the names of the students in your group. In addition to the items specified below, include a one- or two-sentence description of each group member's contributions to the project and an estimate of the number of hours each member contributed. This project report should be signed by all of the members of your group.

Your group will receive a single grade for the project. The information about individual contributions will be used at the end of the semester to determine borderline grade cases.
2. Hardcopies of the six graphs described above (each of the three graphs for each TCP flow). These graphs should be clearly labeled and appropriately titled. It may also be instructive to plot both of the throughput flows simultaneously on one graph.
3. A hardcopy description of the features of these graphs. Describe the graphs using appropriate networking terminology, focusing particularly on identifiable characteristics of the protocols being used. Also give a description of the overall behavior of this network, indicating interesting events (such as when the TCP streams start or stop) and their impact on the network traffic.
4. An *electronic* submission of your source code. This should be single, compressed directory in `.tar.gz` or `.zip` format. The directory should contain a file called `README` that describes the contents of the directory and any special instructions needed to run your programs (i.e. describe

any command-line arguments). The `README` should also include a list of your group members. The compressed directory should be e-mailed to the TA. Please *do not* turn in a hard copy of your source code.