# Network Simulators

This package includes a set of five educational network simulators designed to demonstrate various network technologies, which would otherwise be difficult to do using the commercial software and hardware. The simulators can be used to support tutorial and practical sessions as part of a LAN Networking module at an undergraduate level.

The package includes the following five simulators:

## 1. Network Simulator

This simulator demonstrates the use of three popular network protocols at the Transport Layer (OSI layer 4), which are used to detect/correct data packet errors and provide flow control. The three protocols are:

- Stop-And-Wait
- Go-Back-N
- Selective-Repeat

To start the simulation, select one of the protocols from the drop-down list. You may also select parameters such as the number of packets, the number of retries and the timeout value. Click on the **START** button to start the simulation. Click on the **SUSPEND** button to temporarily suspend the currently active simulation. Click on the **RESET** button to reset the simulator. While the data and the acknowledgement packets are in transition, use the left button on a packet to "destroy" it or use the right button to "corrupt" it. This will demonstrate the error detection and correction mechanisms employed by the protocols.

## 2. CSMA Simulator

This simulator demonstrates the "Carrier Sense Multiple Access" (CSMA) technology at the Physical Layer (OSI layer 1) used to control the access to a common transmission medium (e.g. Ethernet bus topology) by multiple communications devices. This technology is

often implemented in "Network Interface Card" (NIC) electronics. The following techniques can be investigated:

- No CSMA control
- CSMA with Collision Avoidance (CSMA/CA)
- CSMA with Collision Detection (CSMA/CD)

To start the simulation, click on one or more of the **SEND** buttons next to each of the PC nodes. You may also select the target nodes' numbers in the corresponding drop-down lists. Use a radio-button to select the required access mode (none, collision avoidance or collision detection). Use the **PAUSE** button to temporarily suspend the current activity. Use the **RESUME** button (same as the **PAUSE** button) to resume the suspended activity. Use the **RESET** button to reset the simulator. Each node displays the following information during the simulations: collisions detected by that node, retries made by that node and the current "random back-off" time (i.e. delay time after which a new retry will be made) by that node.

## 3. Token Ring Simulator

This simulator investigates the Token Ring topology. The simulator demonstrates the use of a token in enabling contention-free multiple access to a common Ethernet transmission medium at the Physical Layer (OSI layer 1). The simulator supports multiple tokens used by some token ring networks.

Start the simulator by clicking on one of the **Token** buttons. You can send packets from one node to the other nodes by clicking on the **Send** button. Normally only one token will be allowed to go round the nodes. You can check the "Allow multiple tokens" check box in order to be able to "kick off" multiple tokens around the ring. Use the **RESET** button to reset the simulator and the **PAUSE**/**RESUME** button to temporarily suspend the simulation or resume the suspended simulation.

**4. Hub-Switch Simulator**

This simulator demonstrates the way the data packets are handled by LAN network hubs at the Physical Layer (OSI layer 1) and switches at the Link Layer (OSI layer 2). It can be used to show the operational differences between the two main network connectivity components. The Hub simulation demonstrates the packet-broadcasting feature where all attached nodes receive the same packets. The Switch simulation demonstrates the use of a "switch table" in filtering the data packets so that only the target node attached to the switch is sent the packet, i.e. all other nodes do not get a copy as well unlike the hub. One feature of the switch table is that it maintains the Time-To-Live (TTL) value, which defines the time for which an entry will be kept in the table.

Start the simulation either by sending a packet from the Router node to a selected node attached to the hub/switch or by sending a packet from a PC node to another PC node on the hub/switch. You can also use the radio buttons to select either the hub simulation or the switch simulation. In switch simulation, use the **SHOW TABLE…** button to show the switch table. You should see the table showing entries of those PC nodes as they are sent packets and as they reply to these packets. Note the Time-To-Live (TTL) function.

**5. Router Simulator**

This simulator demonstrates the functionality of routers at the Network Layer (OSI layer 3). It provides five routers, each of which is connected to its neighbours only (i.e. two neighbouring routers). The simulator provides the following features designed to help investigate the behaviour of routers:

- Periodic automatic polling of neighbouring routers
- Manual polling of neighbouring routers
- Pinging of specified routers (only if a valid entry is in the router table)
- Auto updating whenever a connection's status changes (e.g. whenever a connection is broken or is re-connected)
- Time-to-live (TTL) of router table information

- Burst test (i.e. all routers ping their neighbours at the same time - can be repeated many times causing saturation of network with multiple packets)

To use the simulator simply click on the **RESUME** button (not needed for the Burst Test). You may select any of the options provided by the three checkboxes. Click on the **SUSPEND** button (same as the **RESUME** button) to temporarily suspend the current activity. Use the **RESET** button to reset the simulator. **The INFO…** buttons on each of the routers display the router tables. The **POLL** buttons send ping packets to the routers' neighbours. The **PING** buttons ping only the selected routers (the router tables must have all the relevant entries to enable this function). Use the drop-down lists against each connection to force "Connected" or "Broken" status ("Noisy" is not used) for the relevant connection.

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October 2011