This lab manual is intended to make the student assume the minimum knowledge to understand the utility of a simulation tool such as OPENT, and why nowadays the profile of simulator engineer begins to be requested in big international companies. The students have to implement the scenarios proposed by Raymond R. Panko in the book “Business Data Networks & Telecommunications – Fourth Edition”, which is available in “OPNET University Program” web:

http://www.opnet.com/services/university/itg_panko.html

The scenarios that the students have to implement are:

1. Evaluating Internet Connection Choices for a small Home PC Network.
2. Evaluating LAN Configuration in a Multistored Office Building.

In the first exercise, the scenario has been previously built for the students. It consists on a family’s home PC network with three PCs connected to the Internet. The aim of this scenario is to make series of simulations with different conditions on the network in order to see how performance differs. For each scenario, the download speed will be set in the simulation. The figure below shows the simulated network.

The application configured in this scenario is web browsing and different profiles are applied to the workstations.

In the first scenario, the WAN link is configured as a 20 kbps dial-up line and the simulation is run for a time period of eight hours, which represents a day. The results obtained for the point-to-point link utilization in both directions are shown in the graphic below. The graphic on the right shows the page response time for PC2 Researcher.
A second scenario is configured with a fast modem connection at 40 kbps. The student will notice that the link utilization is reduced by half and that page response time also decreases. A third implementation is done with a cable modem or DSL line at 512 kbps. In these conditions, the link utilization goes down to 4% and the response time continues decreasing.

Finally, the DSL line is replaced for a residential T1 connection. The students are requested to make a comparison with all the scenarios implemented. The conclusion they should take is that response time and link utilization are not affected when they change the link connection from a DSL line to a T1 line.

When concluding this exercise, the student should be able to analyze the link utilization and take some conclusions about which connection is more suitable in each case. Furthermore, they are invited to implement some advanced scenarios to study in depth how to simulate networks and study their response with OPNET.

In the second exercise, which is “Evaluating LAN Configuration in a Multistored Office Building”, the scenario has also been previously built for the students. The objective is to study the application performance of two different network architectures: Daisy Chain and Collapsed Backbone Network. More specifically, this lab shows the application latency introduced by connecting building switches in different ways.
The students should implement three different scenarios with different switched topologies that represent the network of a building with ten floors, each having many users connected to a 10Base-T workgroup switch. The configured applications are Oracle, file, print and email servers, and different profiles are assigned to the workstations.

In the first scenario, the switches on each floor are daisy chained to the core switch in the basement.

In a one hour simulation, the results obtained are shown in the figure below. This graphic represents the applications response time for 95 users in floor 10, 50 users in floor 5 and 70 users in floor 1. Students can see that this daisy chain approach introduces high application latency to users on the highest floor. This latency is reduced when the floor is closer to the servers.

As the latency is too high for users in upper floors, in the second scenario the servers are placed in an intermediate floor, the fifth one. With this configuration, as it can be expected, the application response time goes down for users on floor 5 and floor 10, but increases for users on floor 1. For this reason, the company decides to change the Daisy Chain topology to a Collapsed
Backbone network in order to achieve the same applications performance for users. The third scenario implements the following architecture.

As in the first exercise, a comparison of the three scenarios is required again. The student has to realize that when a collapsed backbone is used (this means that the core switch in the basement is linked directly to the workgroup switch on each floor), application response becomes the same for all the users in any floor.

With the graphics shown above, the student is asked to prepare a brief report giving his/her conclusions and to give a recommendation for what the company should do.

When concluding this lab manual, the students have to be able to implement any network in order to test it and evaluate different design decisions before they implement the scenario physically.