

COE 444
LAN (Local Area Networks)
Presented by Hakim ADICHE

FIRST OPNET FROM SCRATCH

OBJECTIVES:

1. Continue introduce students to network simulation using OPNET.
2. Create a simple network model.
3. Collect statistics on network performance through the use of OPNET tools.
4. Analyze statistics and draw conclusions on network performance.

REFERENCES:

1. OPNET Online Documentation.

EQUIPMENT AND SOFTWARE:

1. Network Laboratory 22/347-A
1. OPNET Version 8.0

INTRODUCTION:

OPNET was the first commercial networking software based on modeling and simulation technology developed in 1987. There are other simulation software in the market; however, the OPNET is the leader in this niche market. OPNET is located in Washington D.C. The OPNET users include MIT, UI, NASA, AT&T, BOEING, Hughes, Hewlett Packard, CISCO, Qualcomm, Loral, and Intelsat to name a few. There are three versions of OPNET software which are marketed by the company. OPNET Modeler is one of these three and will be used for this course. OPNET network simulation is becoming an industry standard and used for both military and commercial enterprises. The simulation tool is design for highly technical use. However, in this course we shall use the tool as a rudimentary introduction tool for the WAN topics. This course is not intended to teach all the complexities of simulation setup and manipulation.

OBJECTIVE:

Create a simple multiple switch based Ethernet network with a switch, a server and group of 20 clients and observe the result of the simulation run. Note, this lab uses components of LAN. The extension of the LAN will be performed in the subsequent labs to extend the LAN into WAN implementation. You must keep a copy of the simulation in your U: drive (or zip drive). The files to be created will result in 10's of megabytes of data. You cannot save the model on the floppy.

Your task is to create the following model. The node numbers need not be as shown. You will be creating a 20 workstation based network which shares resource from the server (in this model it is

node_21). The network type is Ethernet 10 BaseT. We will use default settings on most of the objects shown. The details about the individual setting and its implication will be explored in the future labs.

Make sure you capture frequent screenshots to support your lab write up. This lab is not intended to be used for deep analysis of the network operation. Your main task is to get comfortable with the network model set up and general operations within the OPNET.

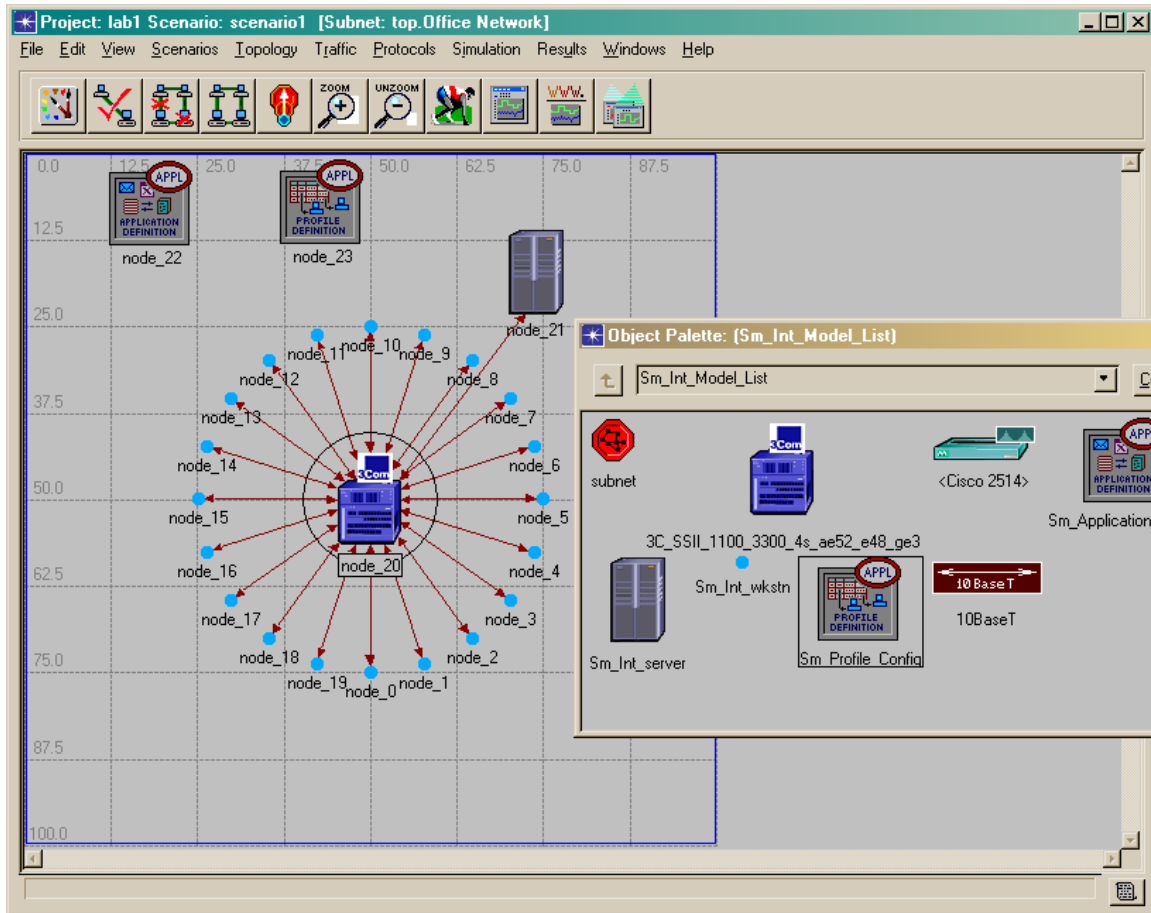


Figure 1. Lab 2 model to be built

PROCEDURE:

1. Create a Project and Scenario: Launch OPNET Modeler by simply using the **Start** button on the windows interface, clicking **Programs** → **OPNET Modeler 9.0** → **OPNET Modeler**. Double-click on OPNET Modeler to launch the simulation software. You should have the screen picture below (figure 2.) if you executed these steps correctly. If not, simply close out the other windows and try again.

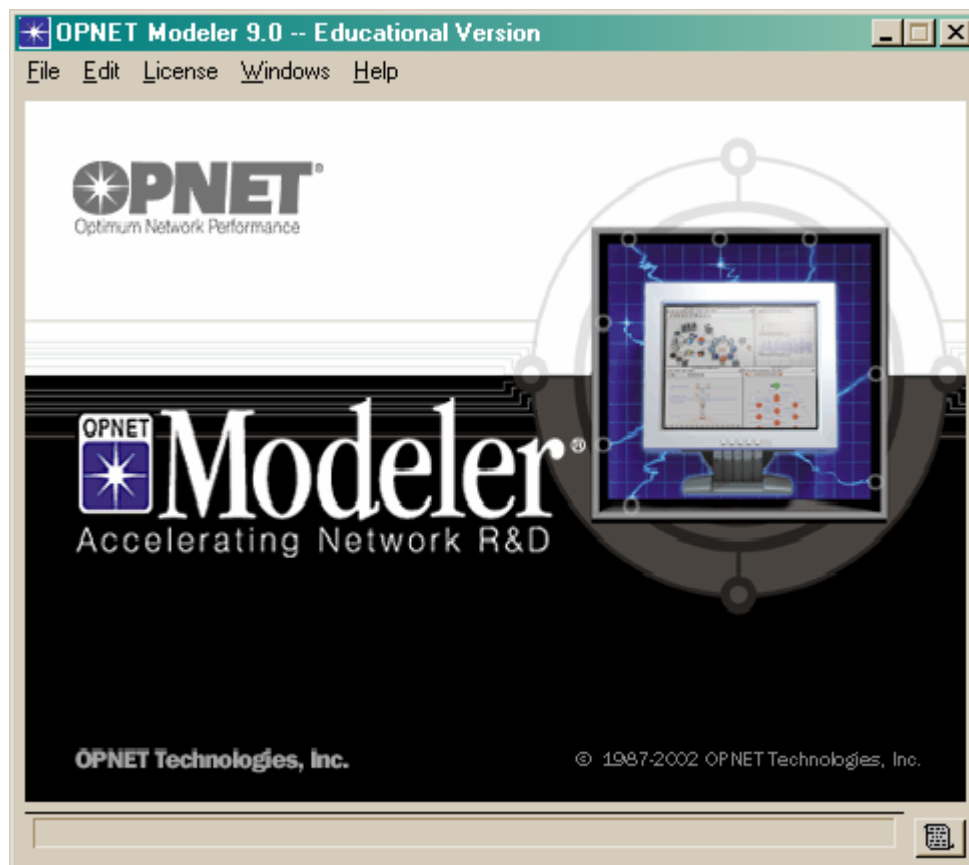


Figure 2. OPNET Modeler Main Menu

2. From the **File** menu, choose **New**, and then select **Project** and **OK**
3. Name your **project** *lastname_net1* & **scenario** *lab1*, and then click next
2. Build the first_floor network using Startup Wizard: The end state is to establish a 10baseT LAN with thirty users and one server. This is initiated through the use of the **Startup Wizard** function. From the main menu, select **Network** and then **Startup Wizard**. Make the following entries for the next successive entries and press next.

Initial Topology:	Empty
Choose Network Scale:	Office
Specify Size:	100ft X 100ft (default setting)
Select Grid Properties:	12.5ft (default setting)

5. Select Technologies: As depicted in figure 3, using window slide bar, move down to **Sm_Int_Model_List** and toggle to **yes**. This will provide the simulation tools to model a small internet which is sufficient for this simple scenario. However, future labs will require various selections to provide the node and link models required to model network behavior. Take the time to observe and note some of the other selections which are intuitive. After making the technology selection, press **next** and confirm your selections by pressing **OK** in the Review window.

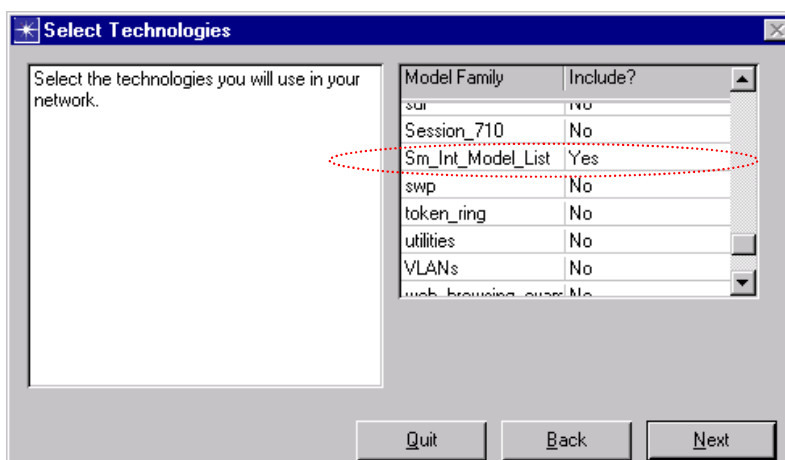


Figure 3. Technology Selection

6. Examine the project workspace: As a result of the Startup Wizard entries, a project workspace and scenario have been created as depicted in Figure 4. The *object palette* is created as a result of technology selections and depicts real world network objects which are “clicked and dragged” into the workspace to construct simulations. There are two primary types of objects; *nodes* and *links*. *Nodes* are communication devices that can transmit and receive information. *Link* objects are which represent the communication medium which connects the *nodes* together. Figure 4 annotates a **10BaseT** link object and a small internet server (**Sm_Int_server**) *node* object. Figure 4 also depicts the **12.5m x 12.5m** grid which provides a visual reference for distance and within the **100m x 100m** workspace defined by the initial **Startup Wizard** entries.

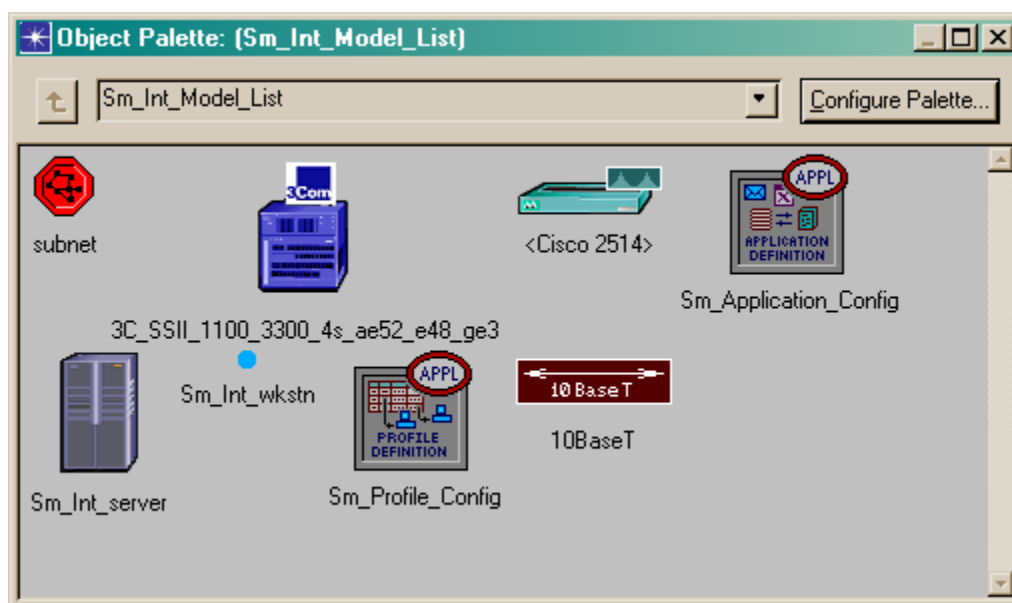


Figure 4. Project Object Pallet

7. Create the network in the workspace: The fastest way to create a new local area network (LAN) network topology is by using the **Rapid Configuration** feature. Close out the *Object Palette* window. Go to the main menu and select **Network** and then **Rapid Configuration**. Specify **star** configuration and press **OK** for initial *Rapid Configuration* window. The following selections are made in the *Rapid Configuration: Star* window as depicted in Figure 5; *Center Node Model* → **3C_SSII_1100_3300_4s_ae52_e48_ge3** (3Com Router/Ethernet Hub), *Periphery Node Model* →

Sm_Int_wkstn, *Link Model* → **10BaseT** (communication medium with hub), *Number* = **20** (number of workstations), *Placement Center X* = **50** (ft) and *Y* = **50** (ft), *Radius* = **20** (ft). Press **OK** and OPNET will implement the first_floor LAN configuration in workspace as depicted in Figure 1.

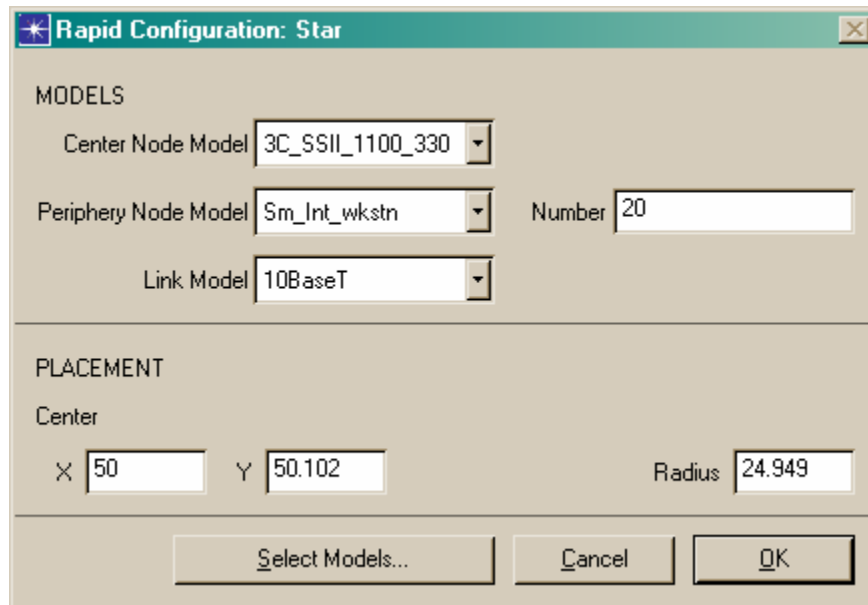


Figure 5. Rapid Configuration: Star

8. Add server to the LAN network model: Open up the *Object Palette* by pressing the **paintbrush icon** from the main menu. With a single right click of your mouse, scroll down to **Sm_Int_server** (see Figure 4) and select this node object. Slide the cursor over to the workspace near the *Lab1* and position as shown in Figure 1 with a left click of the mouse. Right click your mouse to deselect this *node object*. Note: additional left clicks of the mouse would have added additional servers. Following the deselection, a second left click with the mouse is used to “degroup” all objects which have been added to the network model. Unintended objects can be eliminated by using a left click select on the node object and pressing Cut from the main menu. **The delete button will not work in this situation! To delete an object first select the object and use the key sequence control-x.**

9. Establish 10BaseT connection between LAN and Server: Open up the *Object Palette* by pressing the **paintbrush icon** from the main menu. With a single right click of your mouse, scroll down to **10BaseT** (see Figure 4) and select this node object. Position the cursor over the *3Com hub* and left click. Slide the cursor over to the server object and left click. If done correctly, a 10BaseT link will exist between the server and the 3Com hub as depicted in Figure 1.

10. Specify application traffic that will exist on the network: Using the object palette, place the **Sm_Application_Config** object in the palette and drag into the workspace as shown in Figure 1. Right Click to turn off object creation. Also place the **Sm_Profile_Config** object into the workspace as shown in Figure 1. The purpose of both of these objects is to model to application traffic for this scenario. For the purposes of this scenario, each default user profile will attempt **Data Access (Light)** with the single server to measure performance.

11. Close out object palette and save project file: Close out the object palette window since the *Lab 2 LAN* is complete. Select **File** → **Save** to save your project file.

Select statistics for collection: In OPNET, as in C++, there are statistics with varying scope. In general there are two types; global statistics for the entire network and object statistics which can be collected from each individual node and link. Let's set network data to be recorded during the simulation. There is no default report selected. You must select the report to be collected.

a. Selecting the individual server Ethernet Load Statistic: Place your pointer over the server in the workspace and right click. As shown in Figure 6, select Choose **Individual Statistics** from the servers object pop-up menu. The **Choose Results Dialog Box** hierarchically organizes the statistics you may collect. To collect the **Ethernet Load** on the server, expand the Ethernet Branch and select **Load (bits/sec)** to activate collection for this statistic. Click **OK** to dismiss the dialog box. This statistic is the throughput in bits transmitted per second transmitted by the server. In effect we are simulating the effective throughput required to support 20 workstations connected through 10baseT using a switch.

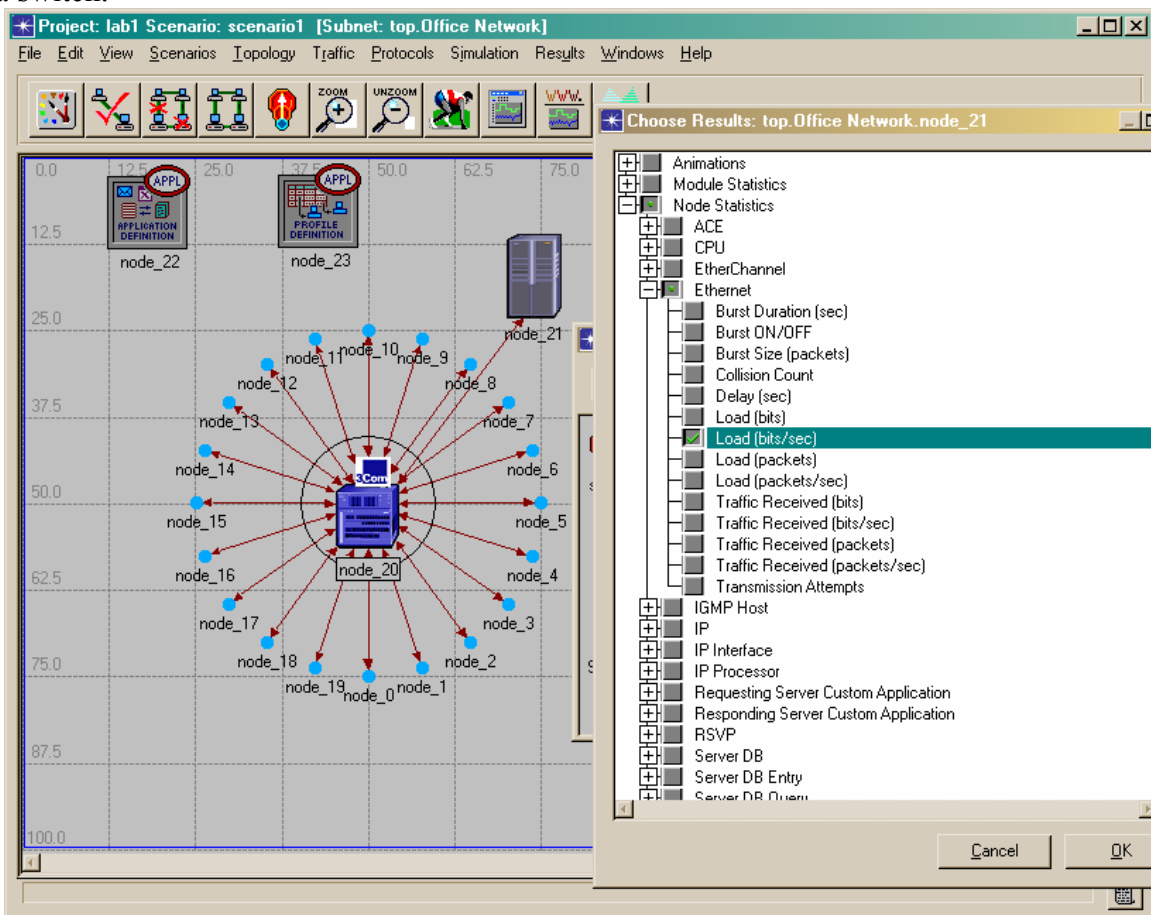


Figure 6. Server Individual Statistic Selection

b. Selecting Global Ethernet Delay: Global statistics are used to collect information on the network as a whole. For example, you can find out the delay for the entire network by collecting the Global Delay statistic. Right Click in the project workspace and select Choose Individual Statistics (or access via File Menu: **Simulation** → **Choose Individual Statistics**). Again, the **Choose Results** dialog box hierarchically organizes the statistics you may collect. Under Node Statistics, expand the Ethernet branch and select Delay (sec) to turn on collection. Click **OK** to dismiss the dialog box, Choose Save from the **File Menu** to save your project scenario!

12. **Input Configure Simulation parameters:** Now that the network has been designed and the statistics for collection have been specified, you can execute the OPNET simulation. Choose **Configure Simulation** from the **Main Menu; Simulation → Configure Simulation**. As shown in Figure 7, enter or verify (most default settings) the following parameters in the **Configure Simulation** dialog box; **Duration = 0.5 hours**, **Values Per Statistic = 100**, and **Seed = last four of SSN**. Once you have finished, close the **Configure Simulation** dialog box and save your project workspace. This extra step will lock in the changes to the simulation parameters. Re-open the **Configure Simulation** window and press **Run** to execute the simulation. An **Simulation Sequence** window will appear on the screen and notify you when the simulation has been completed. Press **Close** when simulation has completed or notify instructor if program aborts due to errors.

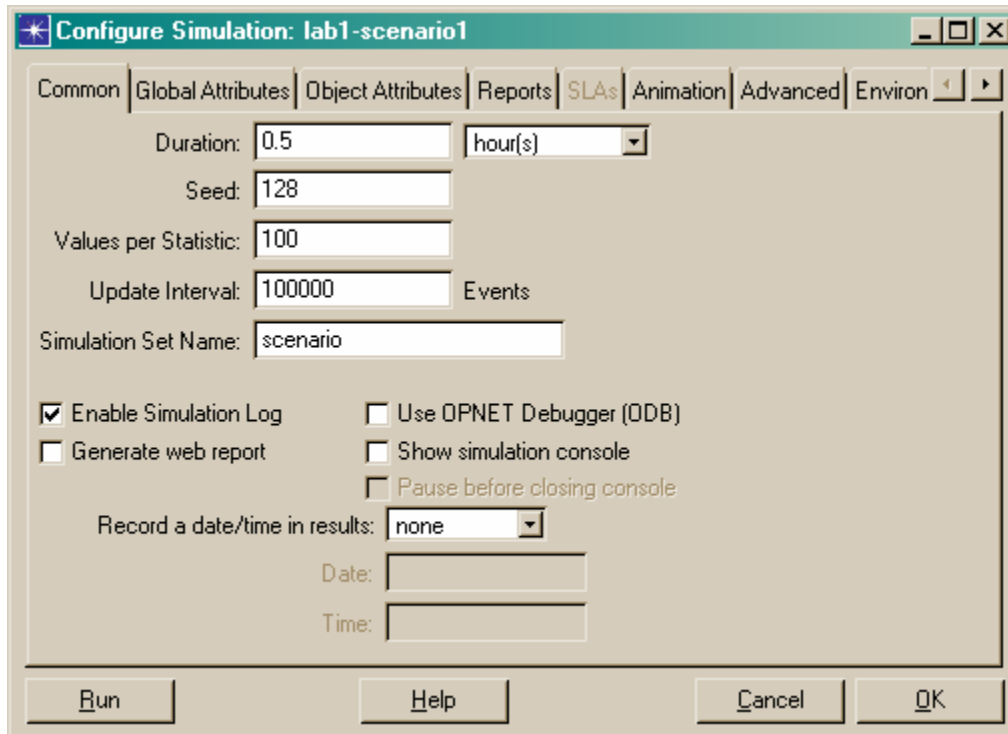


Figure 7. Configure Simulation Parameters

13. **Select View Results of server Ethernet Load:** To view the statistics you have collected, you can either use the object or workspace pop-up menu. To view the server **Ethernet Load** for the simulation, right click on the server node and choose **View Results** from the servers object pop-up menu. Expand the **Ethernet** branch and select **Load (bits/sec)**. Click **Show** to view results. You can capture your results and copy to Microsoft Word by pressing **ctrl-alt-print scrn** and pasting into PowerPoint slide. Then copy the PowerPoint slide into a word document to publish results. By placing your cursor over the maximum point and pressing the left click button, a dialog box will appear with the X and Y coordinates to record accurate measurement vice visual readings. The graph you simulation result will vary.

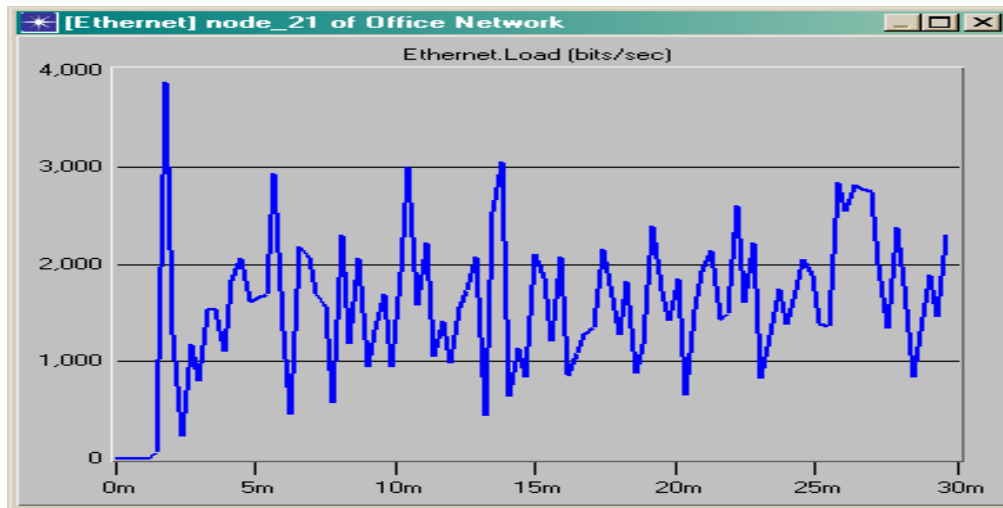


Figure 8.

- Record the peak **Load (bits/sec)** _____.

15. Select **View Results** of global Ethernet Delay: To view the global Ethernet Delay from the simulation, right-click in the project workspace and choose **View Results** from the pop-up menu. Expand the **Ethernet** branch and select Delay (sec). Click **Show** to view the results. Use Microsoft Word to capture the lab results and record the maximum value below using the method explain in Step 14.

- Record the peak Ethernet **Delay(sec)** _____.

SUBMISSION REQUIREMENTS:

- Publish a Word Document which includes the following information:
 - Graph of Server Load (bits/sec)
 - Graph of Global Ethernet Delay (sec)
 - Server Load (bits/sec) Peak Value
 - Global Ethernet Delay (sec) Peak Value for first_floor scenario
 - Screenshot of the model.

Note: we shall build the lab #3 upon this lab. Please make sure that your simulation runs properly.