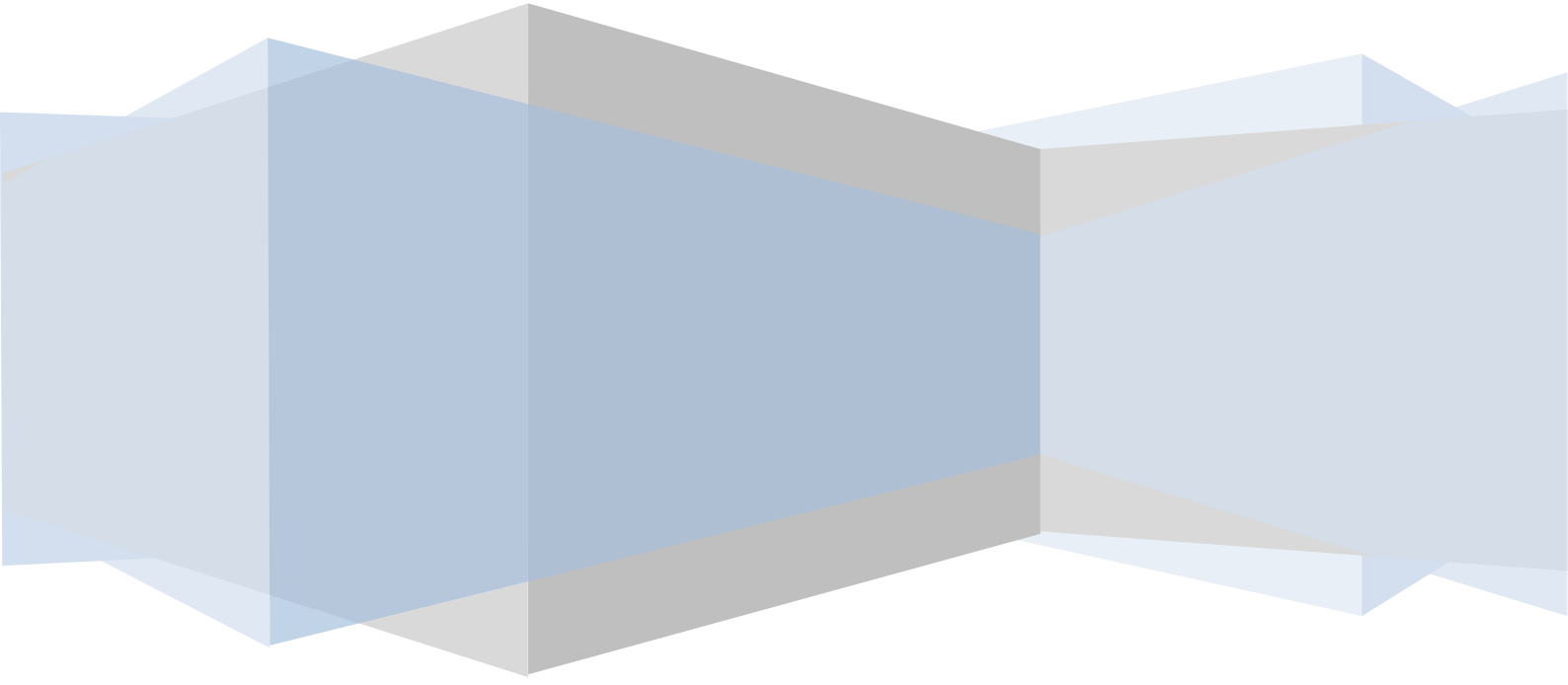
Institute of Computational Intelligence
Częstochowa University of Technology

Ethernet Network with Shared Medium

Foundations of computer networks laboratory



The objective of the exercises

The aim of exercise is to familiarize with working of Ethernet network with shared medium and observation of such network in various configurations of station and its parameters.

The goal will be reached by analysing following cases:

- peer to peer architecture,
- client server architecture.

The influence of stations amount will be also tested.

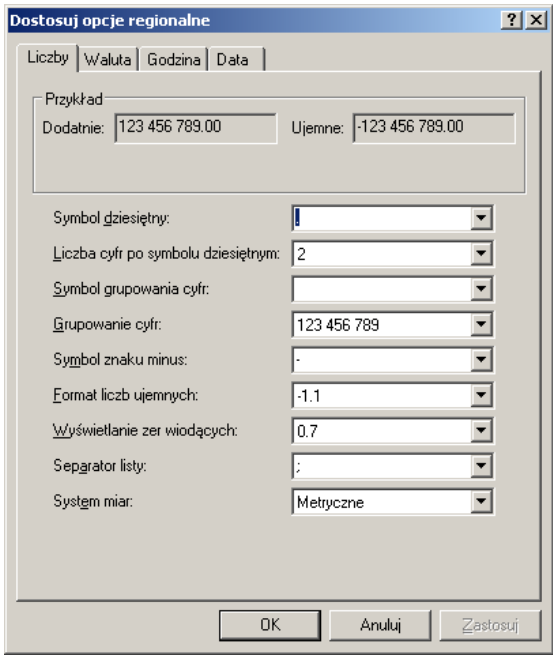
Preparation

1. Run OPNET IT Guru Academic Edition

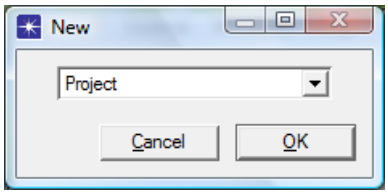
OPNET IT Guru
Academic Edition

IMPORTANT!

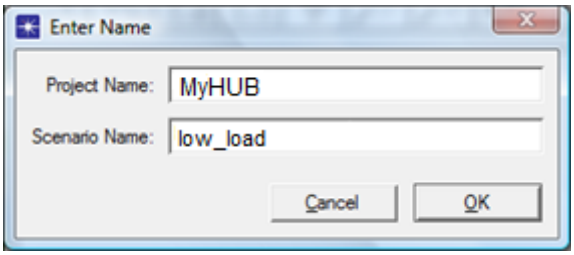
The decimal separator in Regional Setting should be set to dot, not coma. In polish version of MSWindows: Panel Sterowania→Opcje regionalne I językowe→Dostosuj.



2. Create new project by command **New…** in menu **File**. The window **New** will appear. The **Project** option should be selected.

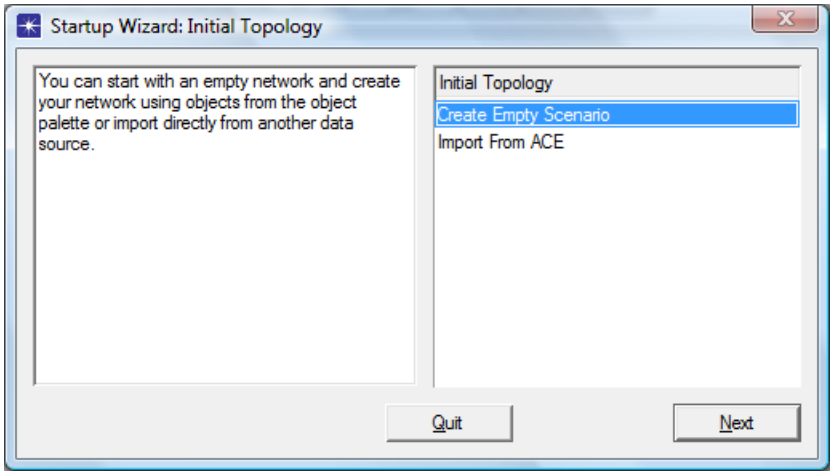


3. Enter the name of new project and first scenario, e.g. as in the following picture

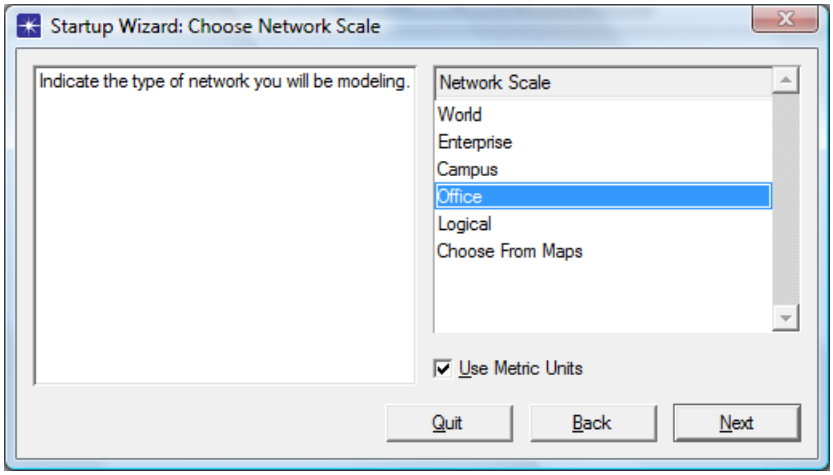


Confirm the choice by button **OK**.

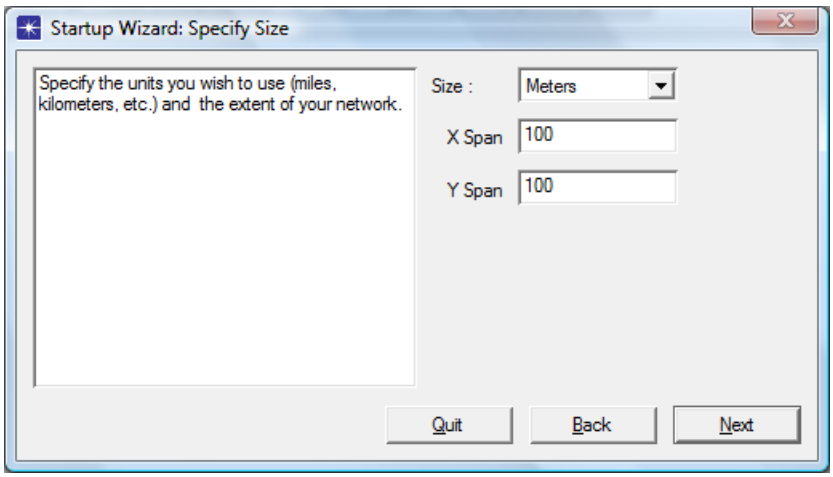
4. In window **Initial Topology** select **Create Empty Scenario** (as in picture) and click **Next**.



5. In window **Choose Network Scale** select **Office** and click **Next**.

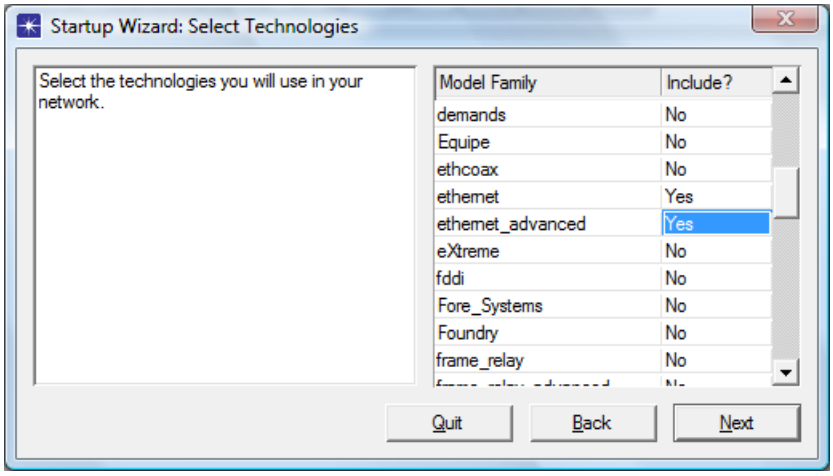


6. In window **Specify Size** leave default parameters.



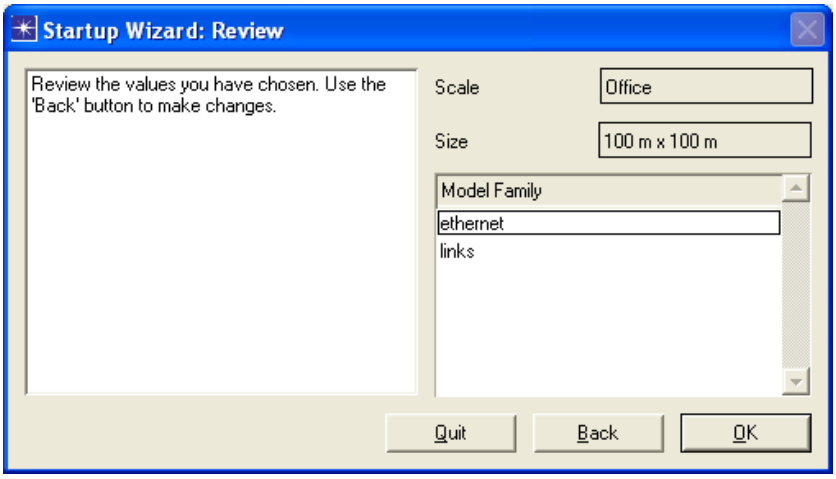
Then click **Next**.

7. In **Select Technologies** windows select and include (set to **Yes**) two technologies: **ethernet** and **links**..



Then click **Next**.

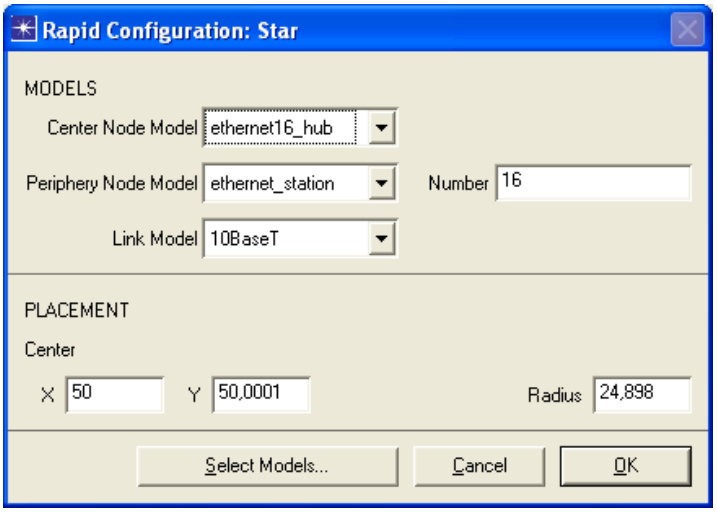
8. In **Review** window confirm the chooses by **OK** button.



Creating the model of network

In this step the model of network of computers connected via hub will be created. This task could be realised in one of two ways – manually and using **Rapid Configuration** wizard. The second way is realised as follow.

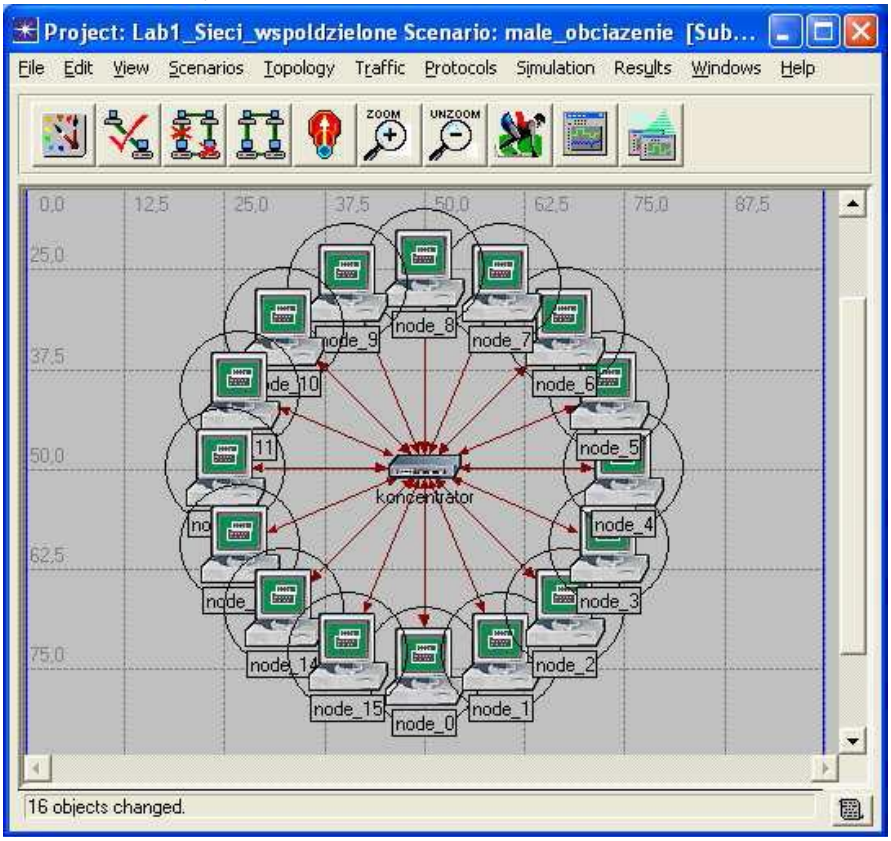
1. The **Object Palette** can be closed. It is not needed in current task.
2. Open **Rapid Configuration** command in **Topology** menu. Then choose **Star** in **Configuration** list and confirm clicking **OK**.
3. Choose **ethernet16_hub** from **Center Node Model** list.
4. Choose **ethernet_station** from **Periphery Node Model** list.
5. Choose **10BaseT** from **Link Model** list.
6. Set number of station **Number** to **16**, then conform all above settings by clocking **OK**.



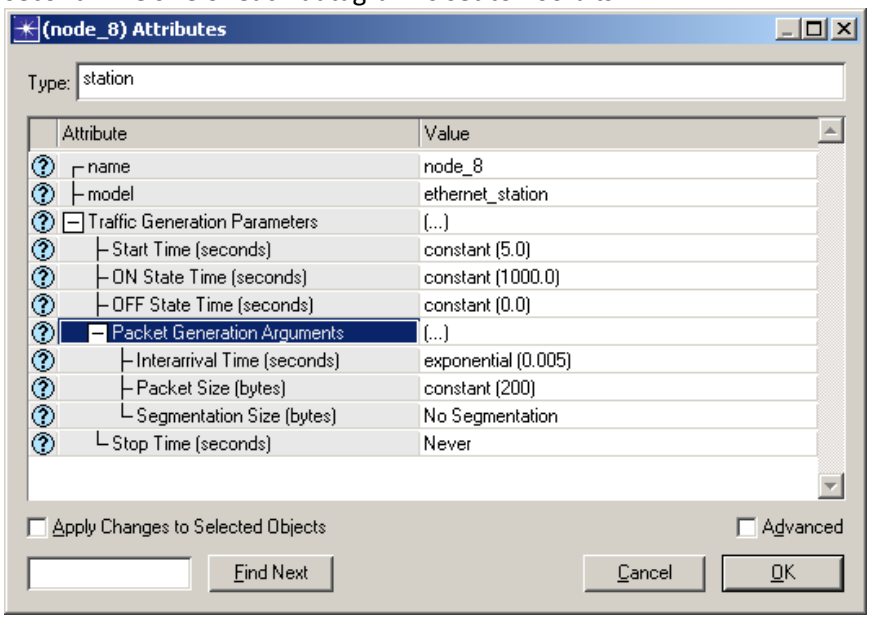
Click using right mouse button the hub and choose command **Set Name**. Set its name and confirm by clicking **OK**.

Setting the station traffic

1. Click on of the station on the scheme and using right mouse button choose **Select Similar Nodes**. As the result, all station will be selected.



2. Use right mouse button clicking one of the station and choose **Edit Attributes** command.
3. Mark **Apply Changes to Selected Objects** option to apply changes to all stations.
4. Expand **Traffic Generation Parameters** and **Packet Generation Arguments** node in the tree of settings.
5. Set **ON State Time** to **constant(1000)** and **OFF State Time** to **constant(0)**. It set permanent transmission from all stations.
6. Set **Interarrival Time (seconds)** to **exponential(0.005)** and **Packet Size (bytes)** to **constant(200)**. It will cause that each station will be sending one datagram for per millisecond. The size of each datagram is set to 200 bits.



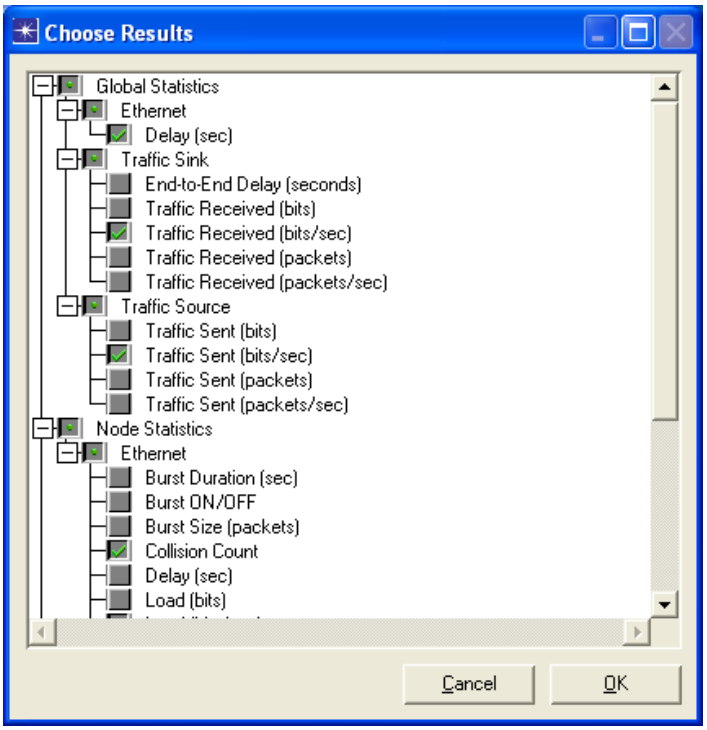
The average traffic generated by single station can be calculated using the formula:

$$AAT = SD \times SP$$

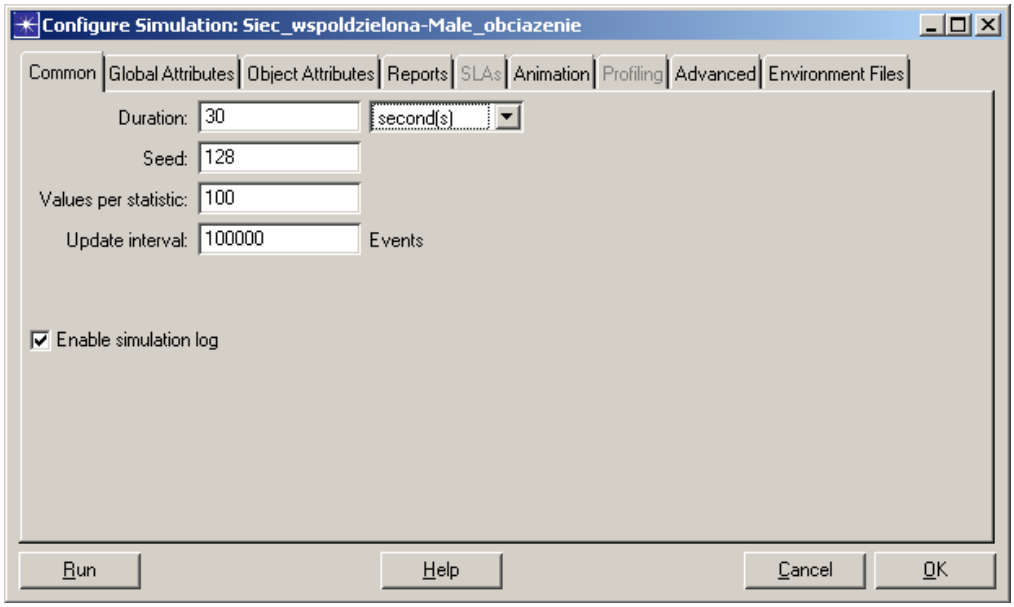
where
AAT – average amount of traffic [bites per second]
SD – size of datagram [bits]
SP – speed of traffic [datagrams per second]

Configuration of simulation

1. Open **Choose Individual Statistics…** in **Simulation** menu.
2. Expand **Global Statistics** node and then **Ethernet** node and mark **Delay (sec)** option.
3. Expand **Traffic Sink** node and mark **Traffic Received (bits/sec)** option.
4. Expand **Node Statistics**, then **Ethernet** and mark following options: **Collision Count**, **Load (bits/sec)**, **Traffic Forwarded (bits/sec)**, **Traffic Received (bits/sec)**, and **Utilization**.
5. Click **OK**.



6. Open **Configure Discrete Event Simulation...** in **Simulation** menu.
7. Open **Common** tab and change **Duration** option to **40** and the unit to **second(s)**.
8. Conform changes clocking **OK**.



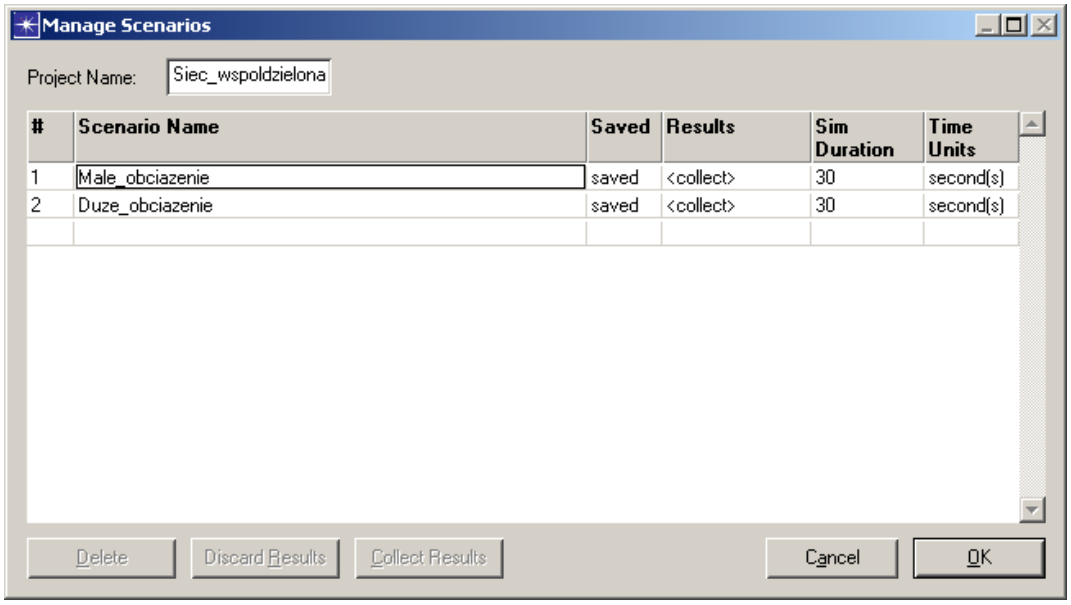
Multiplication of scenario

The defined above scenario will be duplicated to define the another one with higher load. To do it:

1. Open **Duplicate Scenario…** from **Scenario** menu and set the name of new scenario to **high_load**.
2. Confirm clicking **OK**.
3. Click on of the station on the scheme in new scenario and using right mouse button choose **Select Similar Nodes**. As the result, all station will be selected.
4. Use right mouse button clicking one of the station and choose **Edit Attributes** command.
5. Mark **Apply Changes to Selected Objects** option to apply changes to all stations.
6. Expand **Traffic Generation Parameters** and **Packet Generation Arguments** node in the tree of settings.
7. Set **Interarrival Time (seconds)** to **exponential(0.001)** and **Packet Size (bytes)** to **constant(200)**.

Start-up of simulation

1. Open **Manage Scenarios…** command from **Scenarios** menu.
2. For both scenarios set **Results** as **collect** and **recollect**.

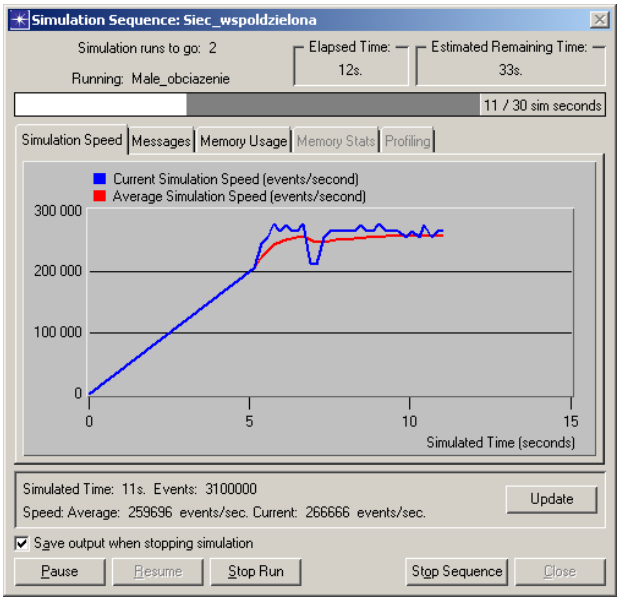


3. Click **OK** button to run both simulations. The second will be executing after the first one.
4. Click **Close** button when both simulations will finished.

Results analysing

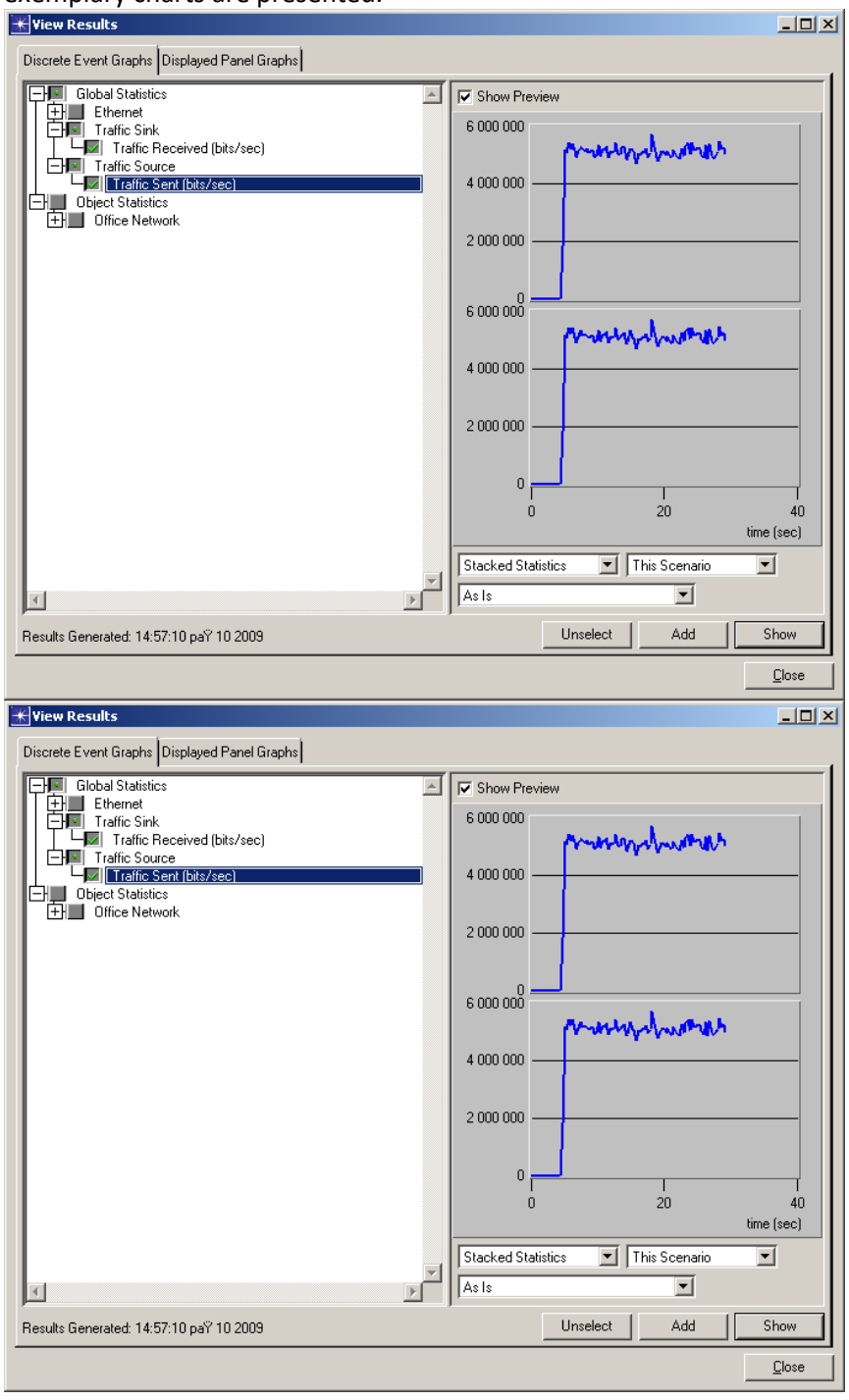
1. Open menu **Scenarios** and choose **Switch to Scenario...**.
2. Choose first scenario.
3. Open menu **Results** and choose **View Results...**.
4. Expand node **Global Statistics**, and then **Traffic Source**.
5. Select **Traffic Sent (bits/sec)** option.
6. Expand **Traffic Sink** node.
7. Select **Traffic Received (bits/sec)** oprion.
8. Shown on the charts you will notice that when a small load on the shape of the graph representing the number of bits received is virtually the same as the graph of the number of bits sent.
9. To hide preview unmark options **Traffic Sent (bits/sec)** and **Traffic Received (bits/sec)**.
10. Close preview clicking **Close** button.

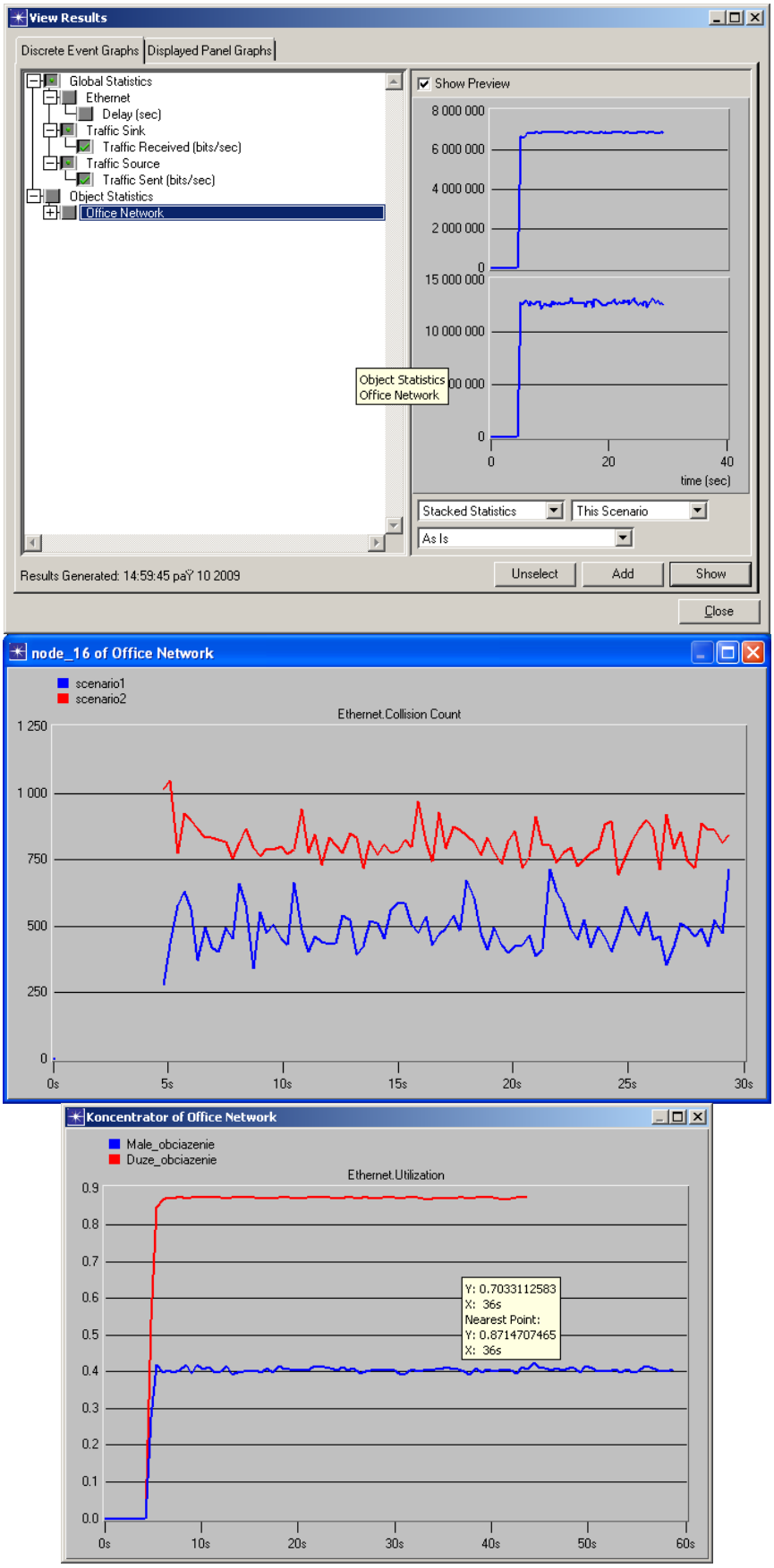
Repeat above for second scenario.

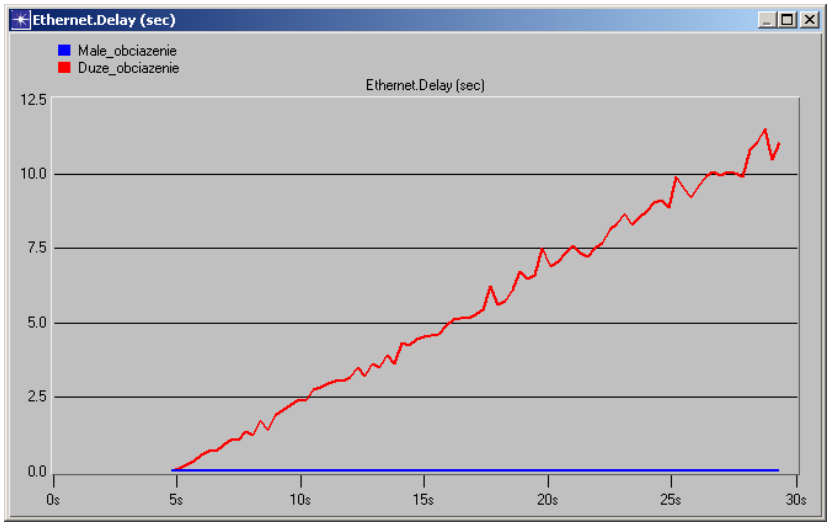


1. To compare results of simulations choose **Compare Results…** command in **Results** menu.
2. Expand nodes **Object Statistics**, **Office Network** and **node_0**, and select **Load (bits/sec)**. See the charts.
3. Click **Show** to see more details.
4. Close window and confirm by clicking **Delete**.
5. Click again **Load (bits/sec)**. to turn active chart off.
6. Expand the node with name of Hub and mark **Collision Count** option to see appriopriate chart.
7. Click **Show** to see more details.
8. See also other statistics – **Utilisation**, **Delay (sec)**. the last one is available in group **Ethernet** in **Global Statistics** menu.

Below some exemplary charts are presented.




View Results
Discrete Event Graphs
Displayed Panel Graphs
Global Statistics
Ethernet
Delay (sec)
Traffic Sink
Traffic Received (bits/sec)
Traffic Source
Traffic Sent (bits/sec)
Object Statistics
Office Network
Show Preview
8 000 000
6 000 000
4 000 000
2 000 000
0
15 000 000
10 000 000
0
0
20
40
time (sec)
Object Statistics
Office Network
Stacked Statistics
This Scenario
As Is
Results Generated: 14:59:45 paŸ 10 2009
Unselect
Add
Show
Close
node_16 of Office Network
scenario1
scenario2
Ethernet.Collision Count
1 250
1 000
750
500
250
0
0s
5s
10s
15s
20s
25s
30s
Koncentrator of Office Network
Male_obciazenie
Duze_obciazenie
Ethernet.Utilization
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Y: 0.7033112583
X: 36s
Nearest Point:
Y: 0.8714707465
X: 36s
0s
10s
20s
30s
40s
50s
60s



The report

Students work in pairs or alone. The report should include the results obtained during exercises and conclusions.