OPNET/Riverbed Modeler:
Configuring and Running Simulations

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Lecture № 6

Outline

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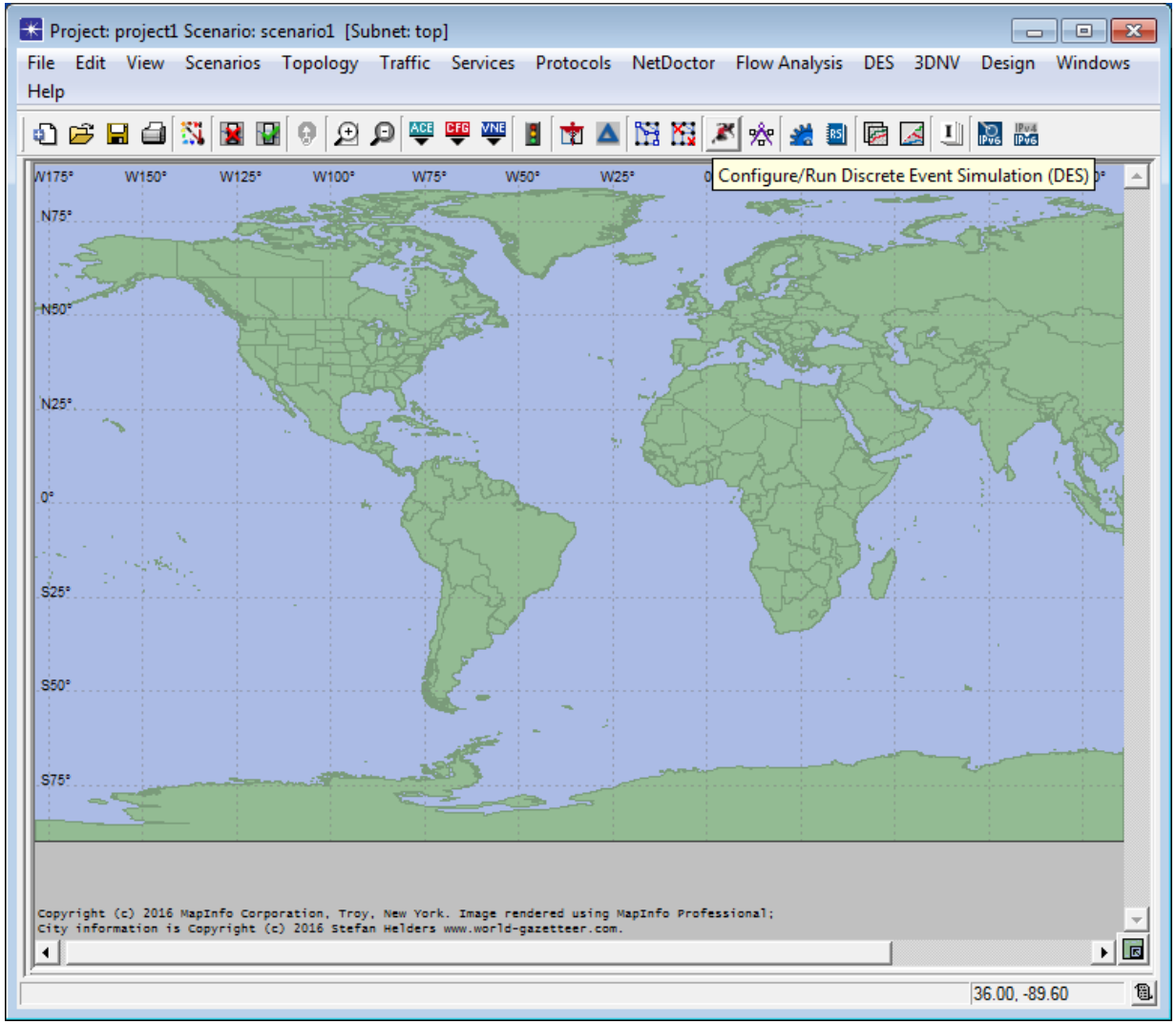
Configuring Simulations

- Before a simulation can be executed, the statistics of interest must be selected and configured
- After the statistics have been selected, there are additional simulation attributes that must be configured
  - E.g., duration, seed, sim efficiency
- In some situations, the simulation execution may be unsuccessful because of the errors in constructing the model or in configuring the simulation
  - Simple debugging may be done using the **discrete event simulation (DES) Log**

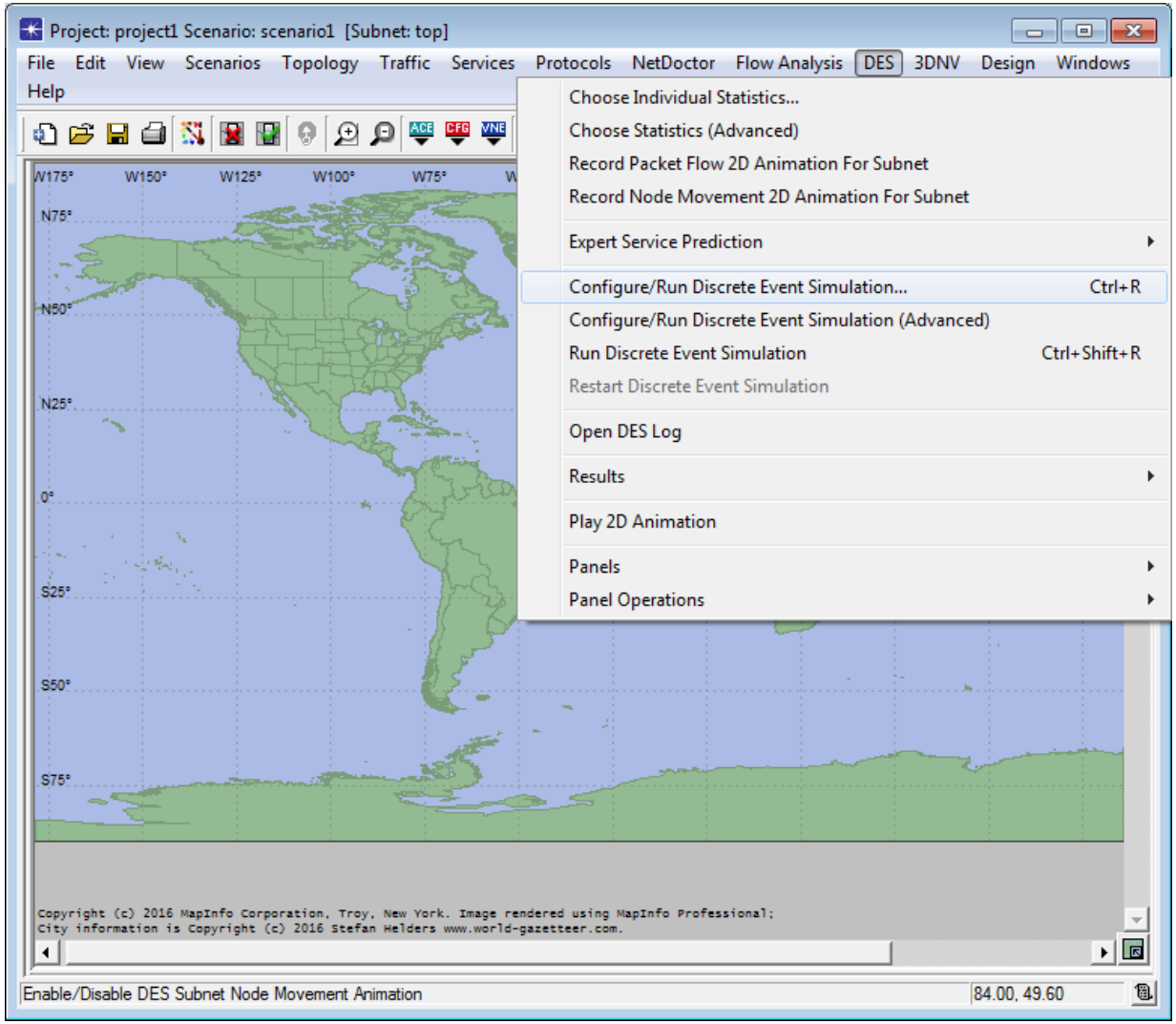
Configuring Simulations (cont'd)

- Configure/Run Discrete Event Simulation (DES)



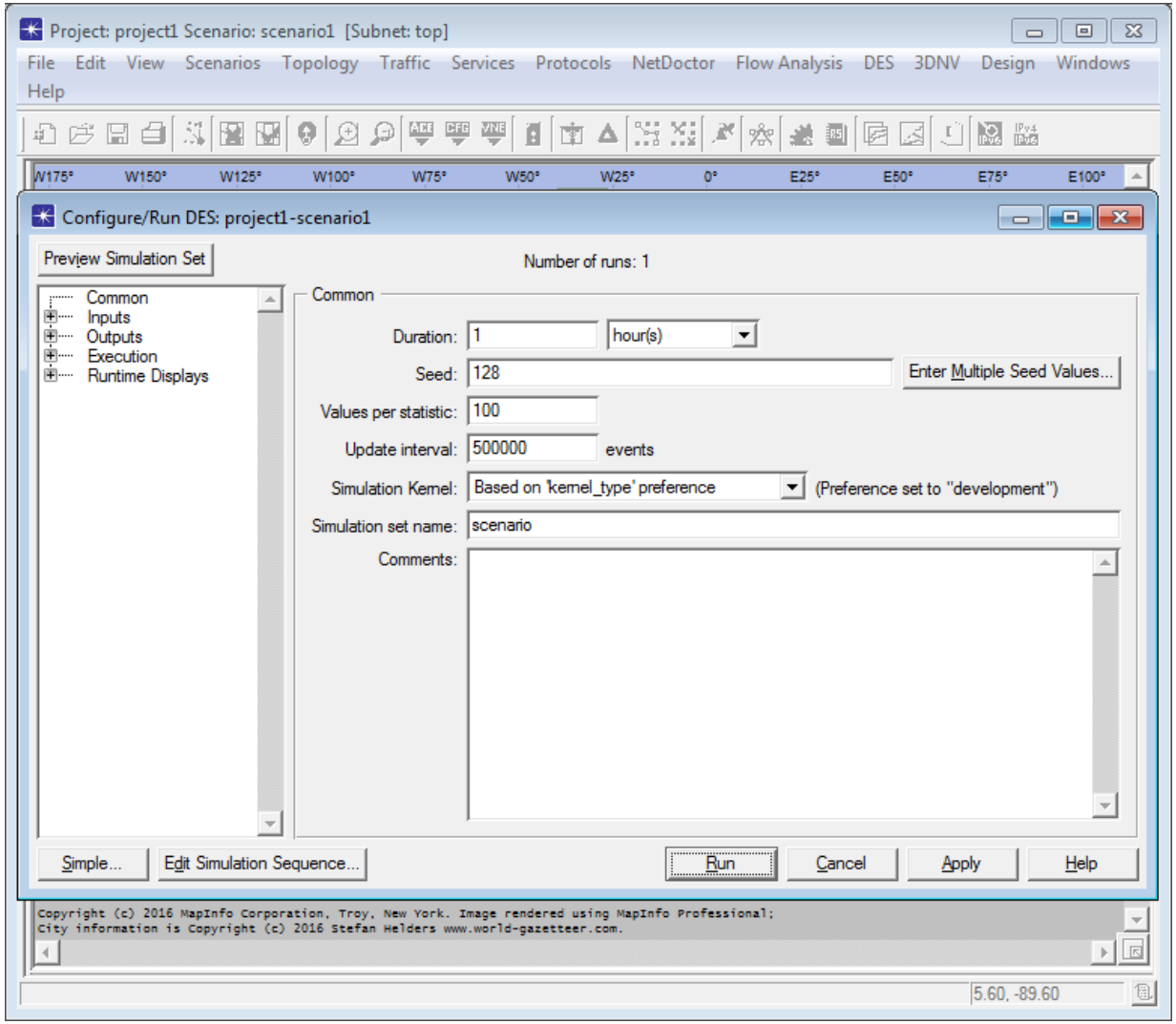
Configuring Simulations (cont'd)

- DES ⇒ Configure/Run Discrete Event Simulation...



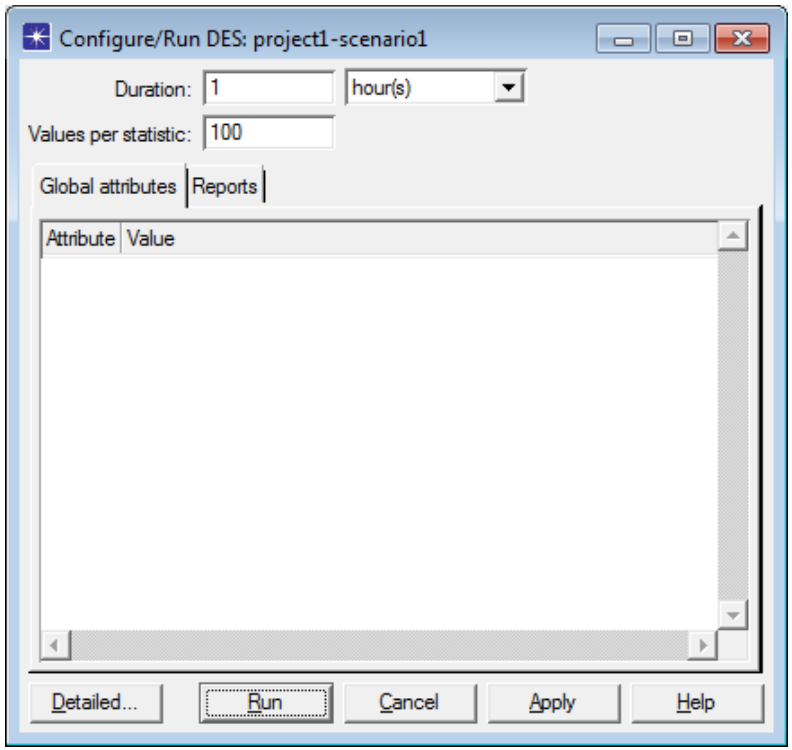
Configuring Simulations (cont'd)

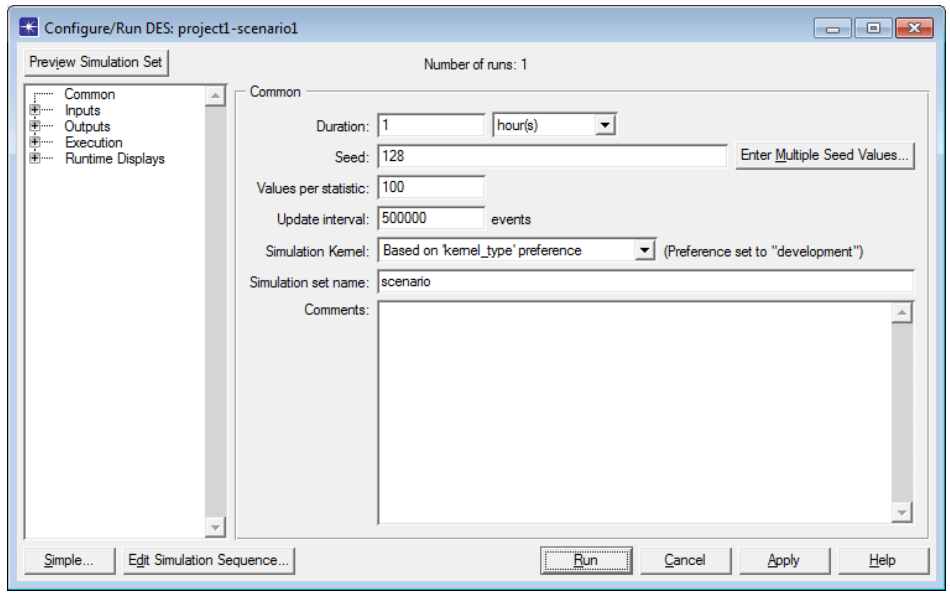
- Configure/Run DES



Configuring Simulations (cont'd)

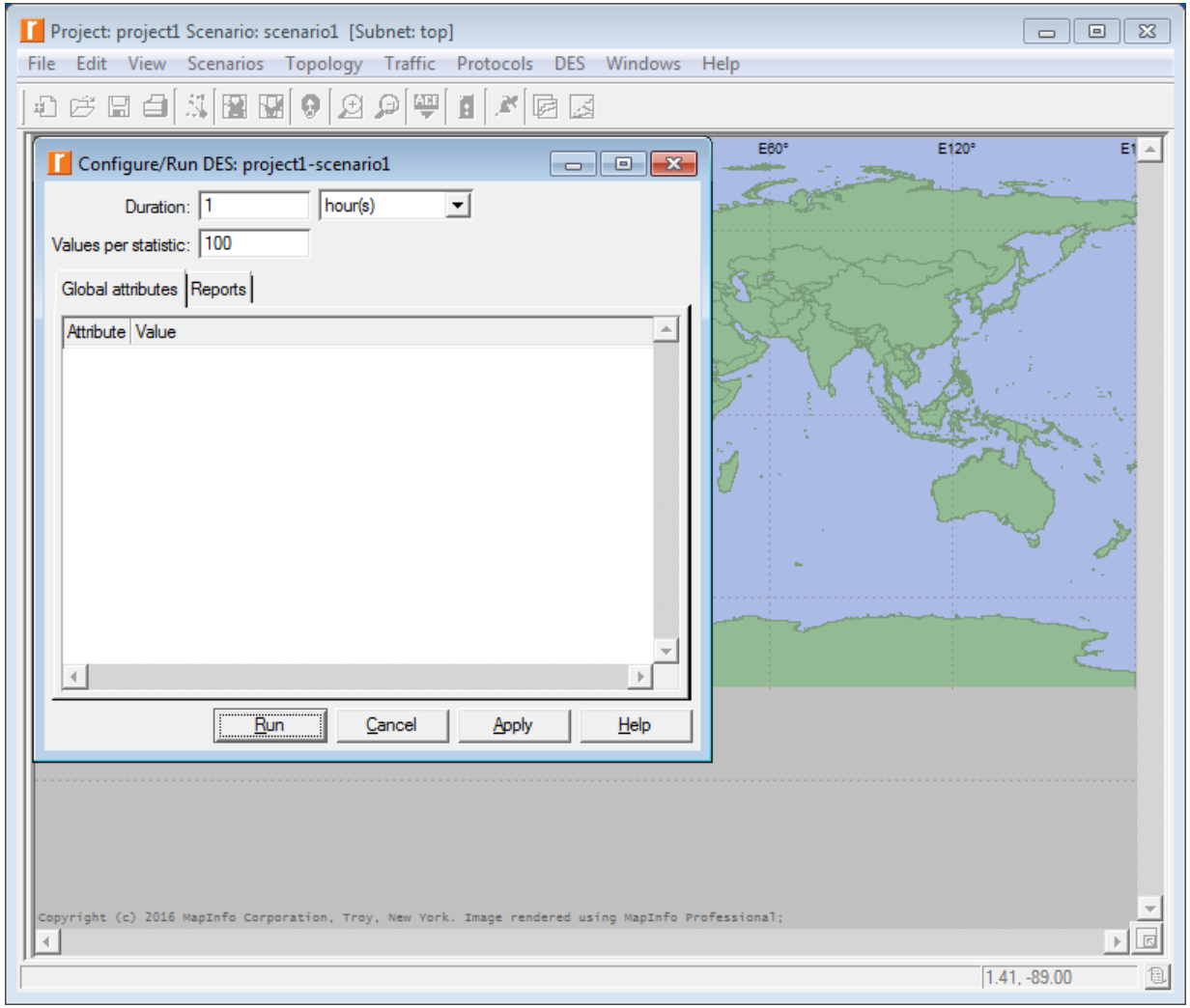
- Configure/Run DES: **Simple...** vs. **Detailed...**
  - Simple mode – allows configuration of only a few key parameters
  - Detailed mode – provides a complete set of configuration controls





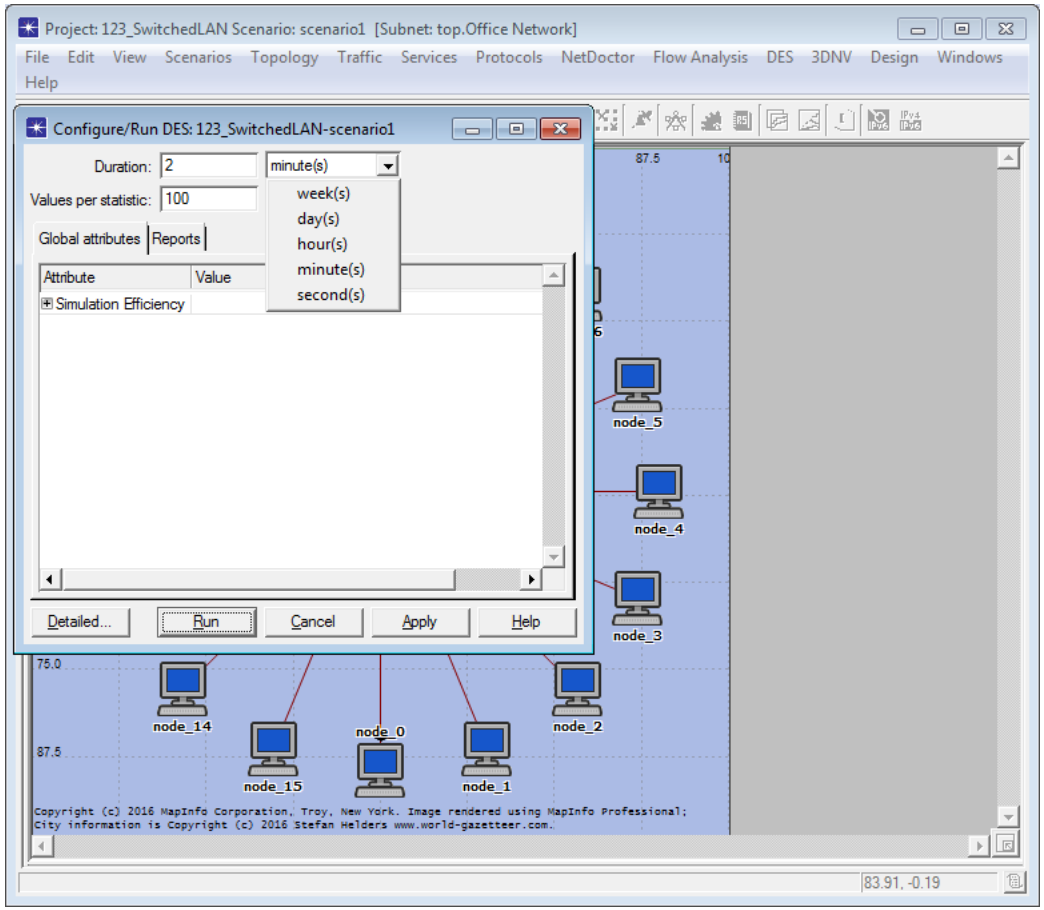
Configuring Simulations (cont'd)

- **Riverbed Modeler Academic Edition**: no Detailed, only Simple ☹



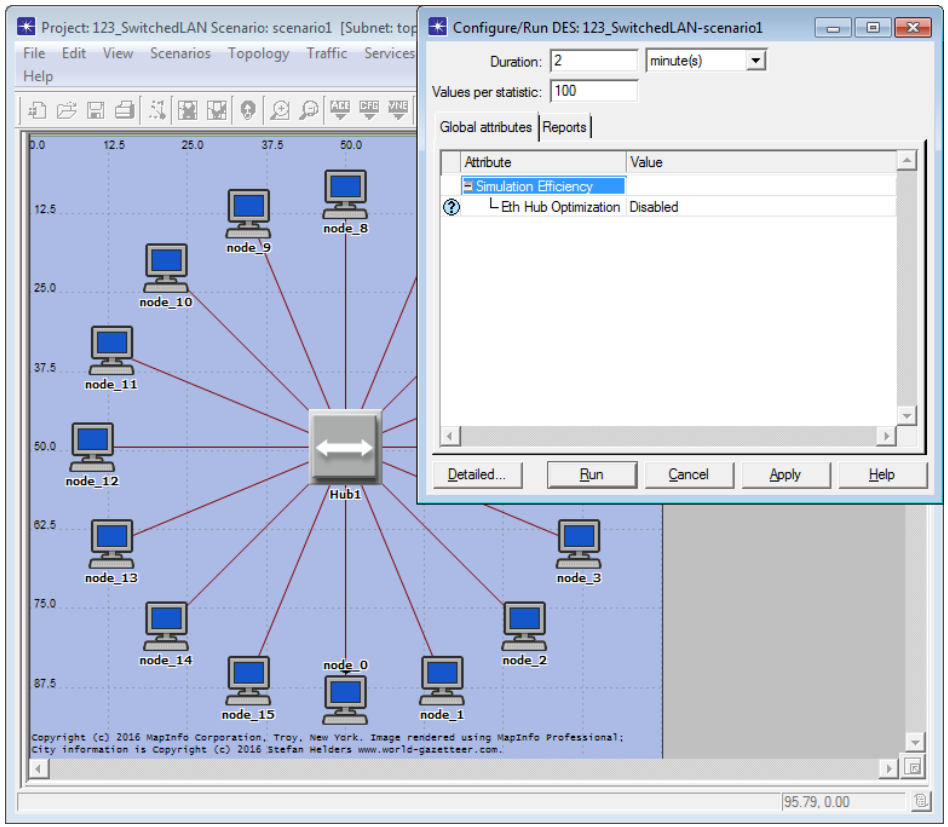
Configuring Simulations (cont'd)

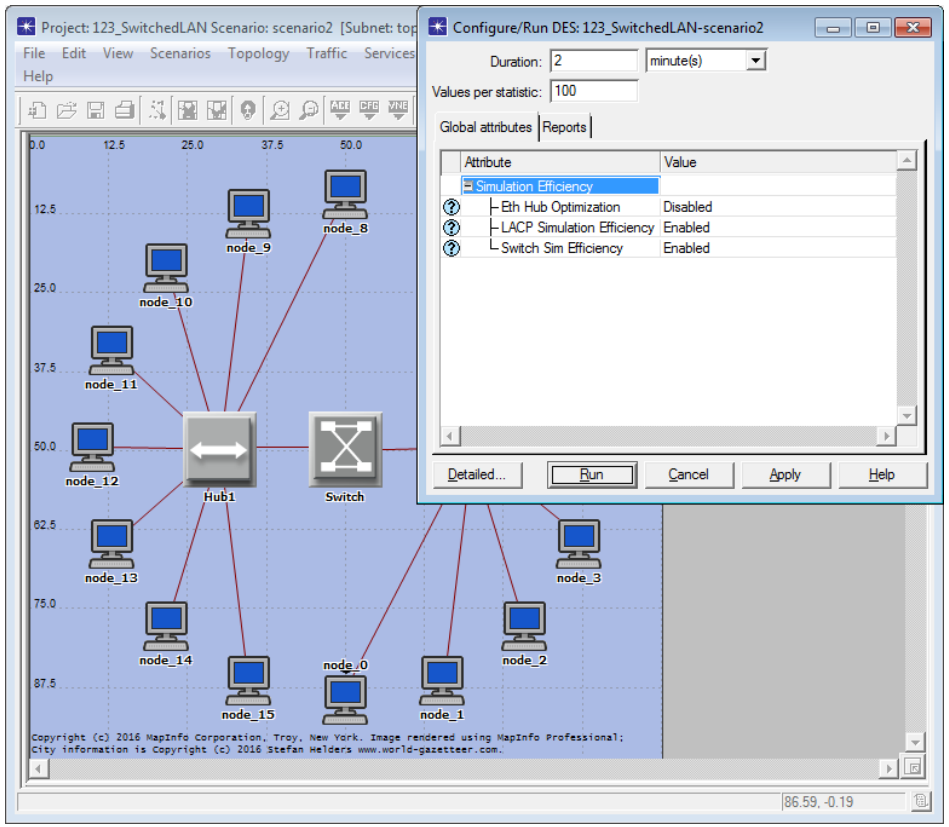
- **Duration** – sets the duration of the simulation
- **Values per statistic** – sets the maximum number of values recorded for each statistic



Configuring Simulations (cont'd)

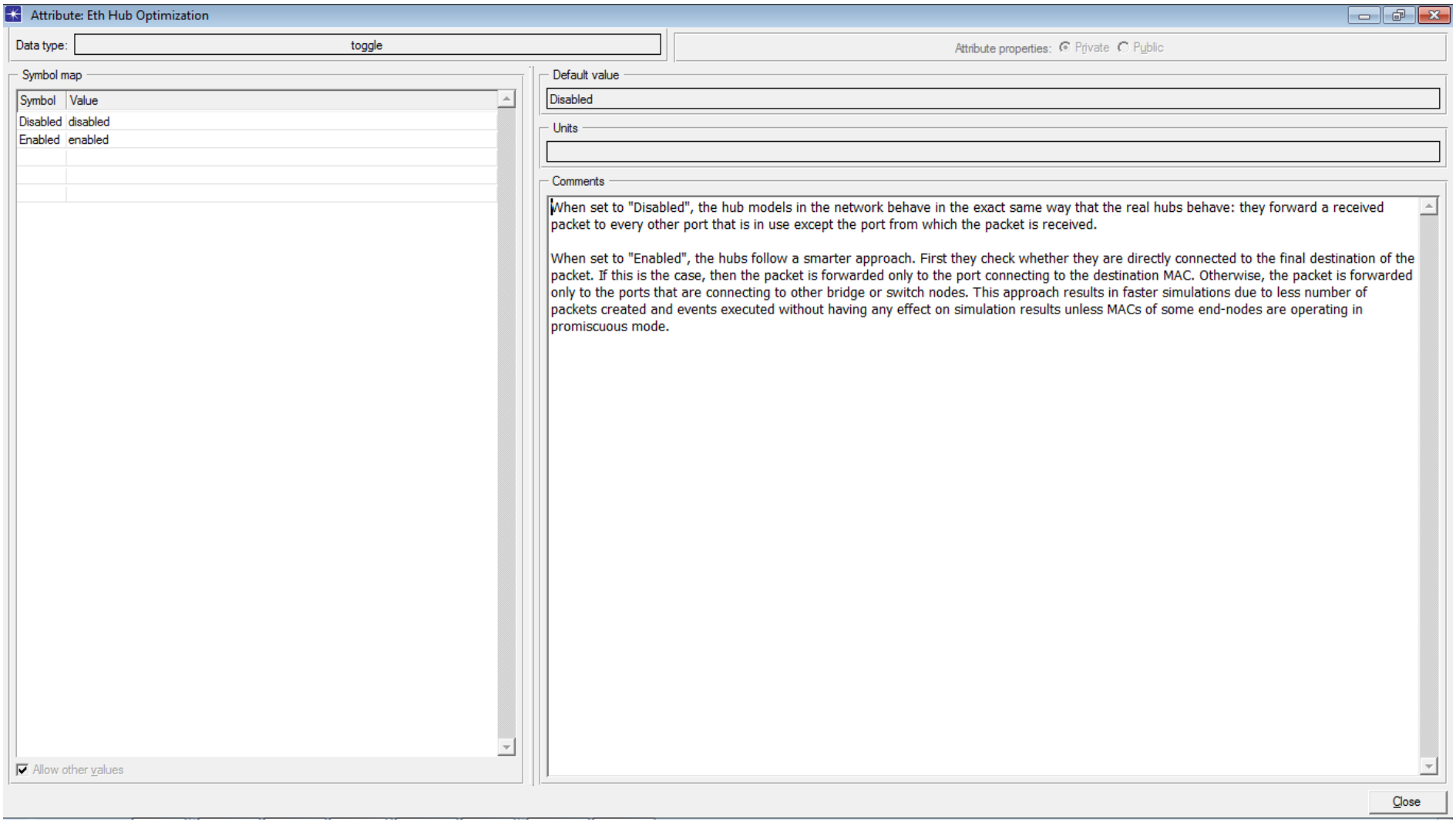
- **Global attributes** – apply to all objects in the simulation study
- **Simulation Efficiency** – specifies whether or not the simulation efficiency (aka 'sim efficiency') mode is used





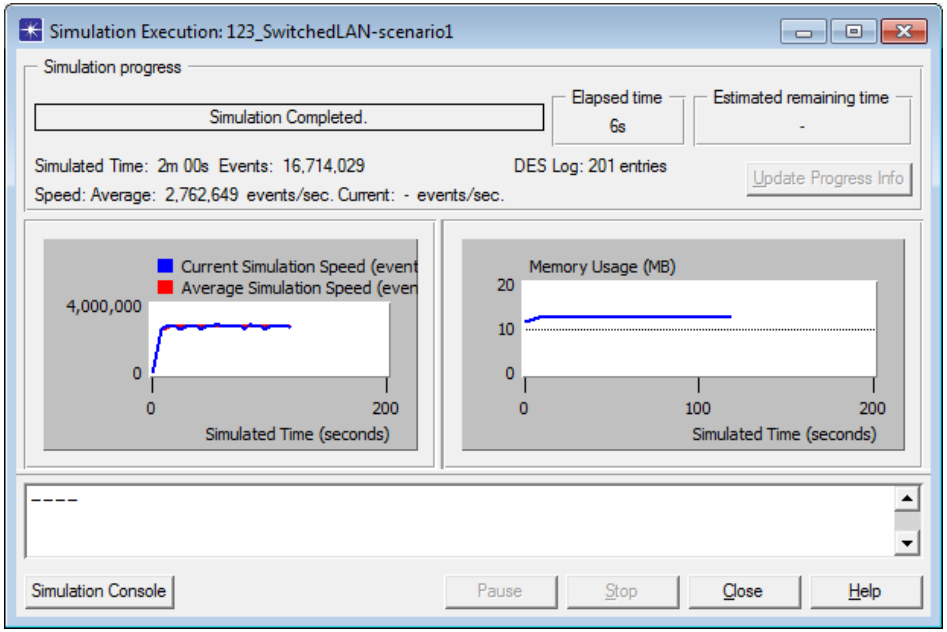
Configuring Simulations (cont'd)

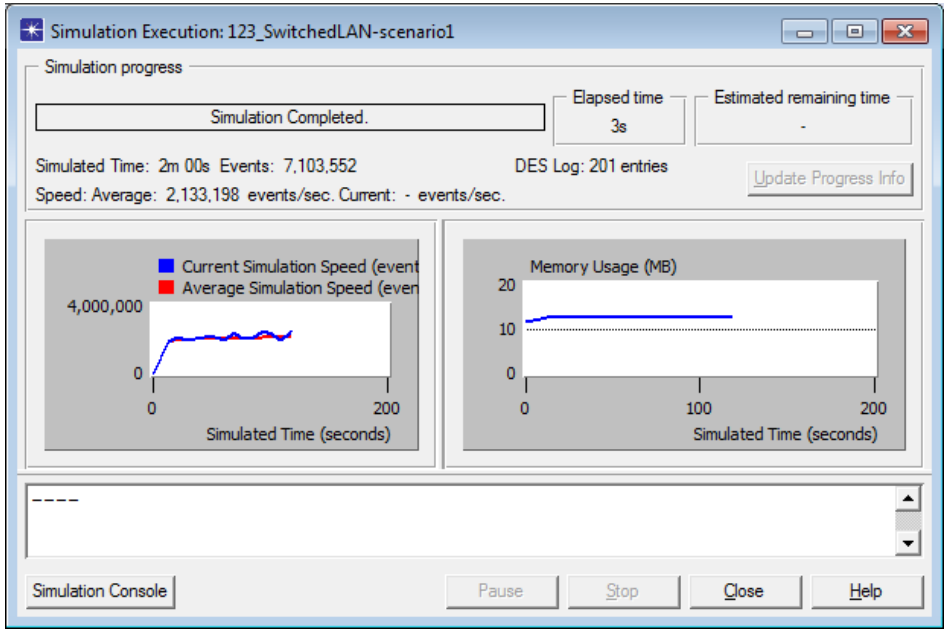
- Eth Hub Optimization



Configuring Simulations (cont'd)

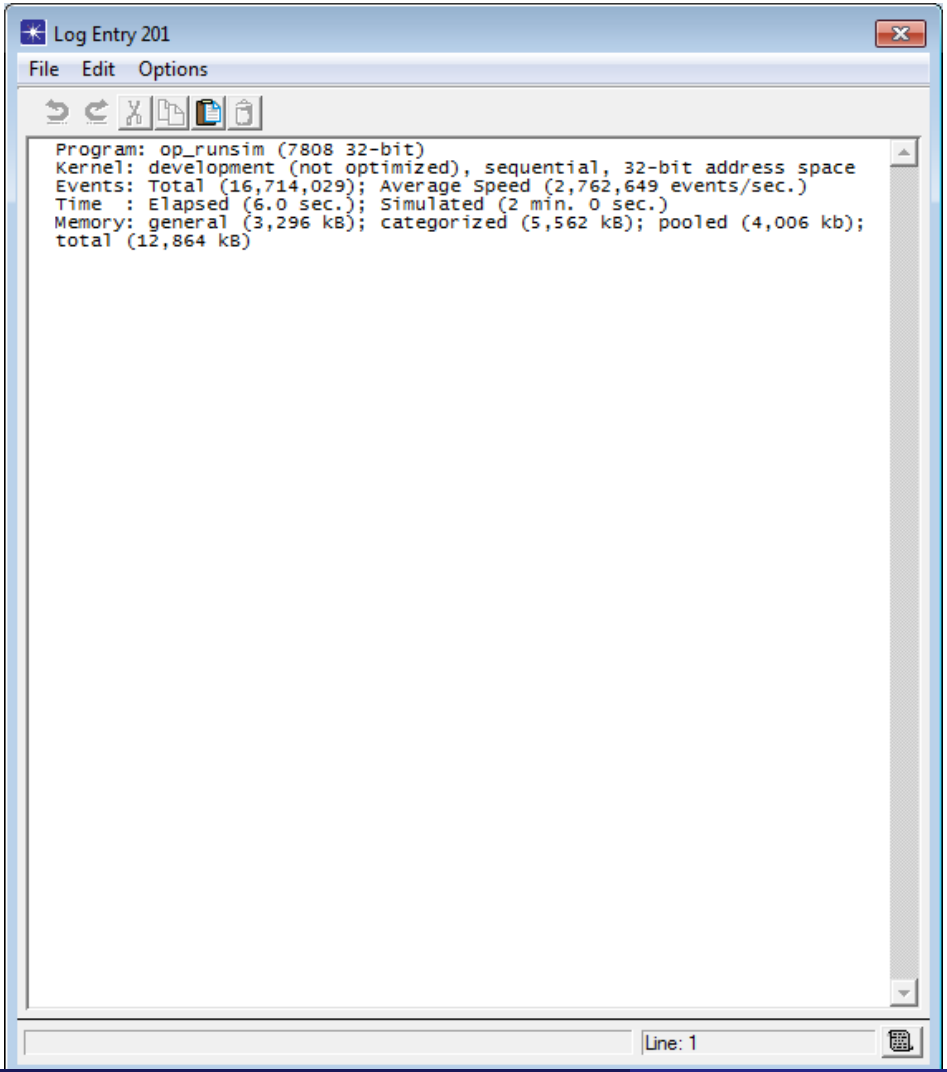
- Eth Hub Optimization: **Disabled** (default) vs. **Enabled**

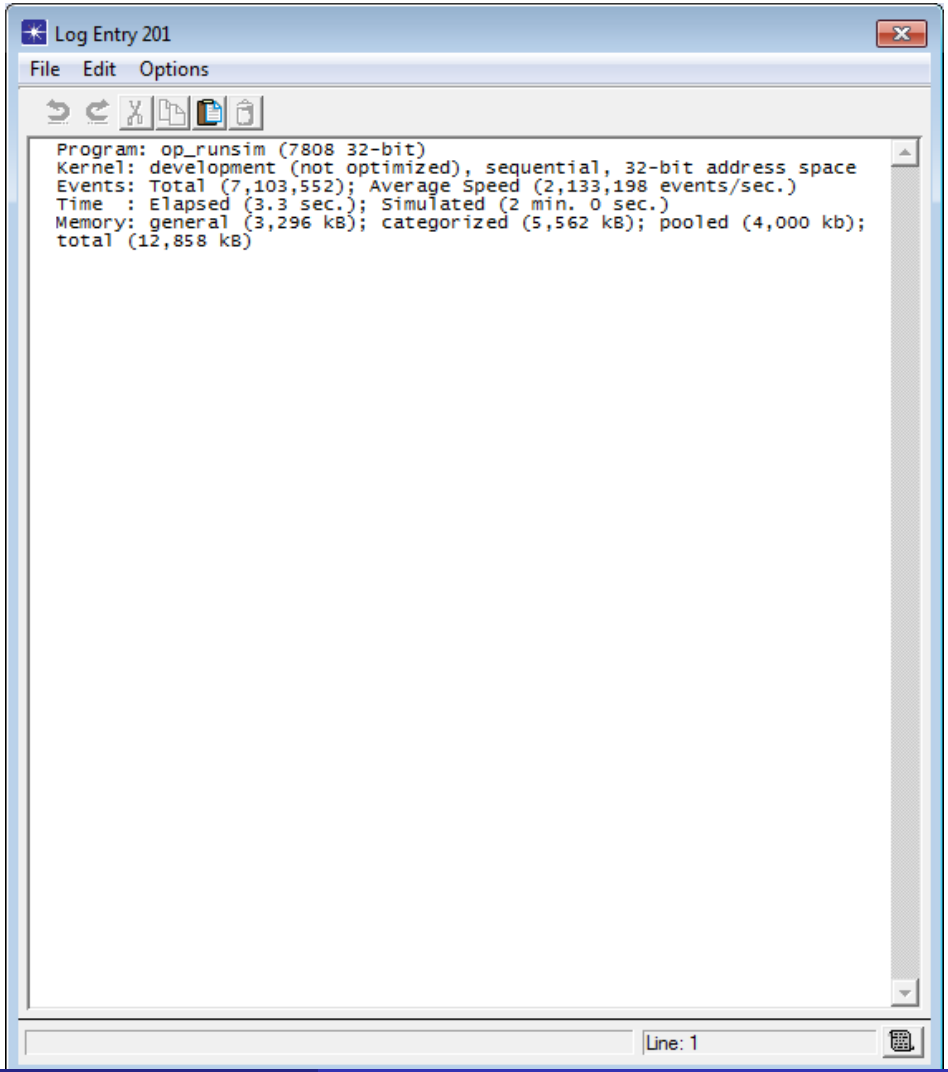




Configuring Simulations (cont'd)

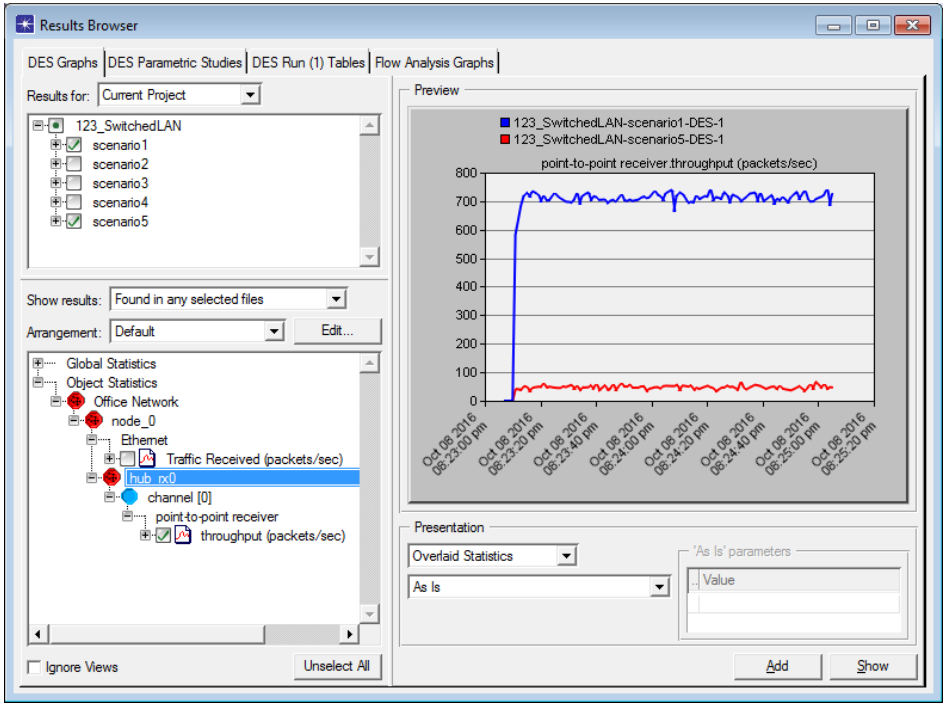
- Eth Hub Optimization: **Disabled** (default) vs. **Enabled**

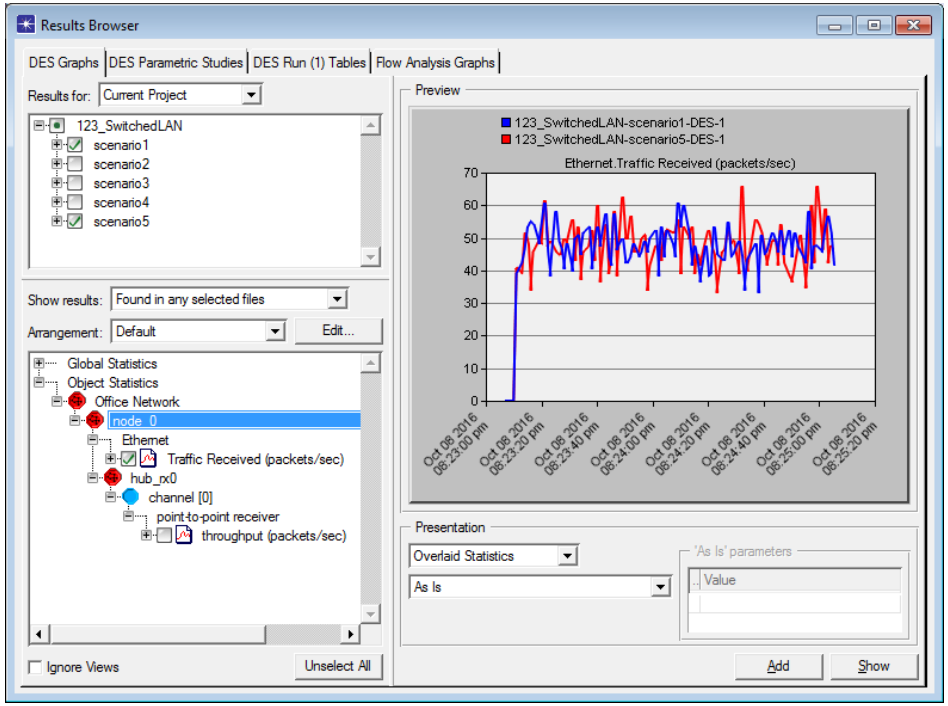




Configuring Simulations (cont'd)

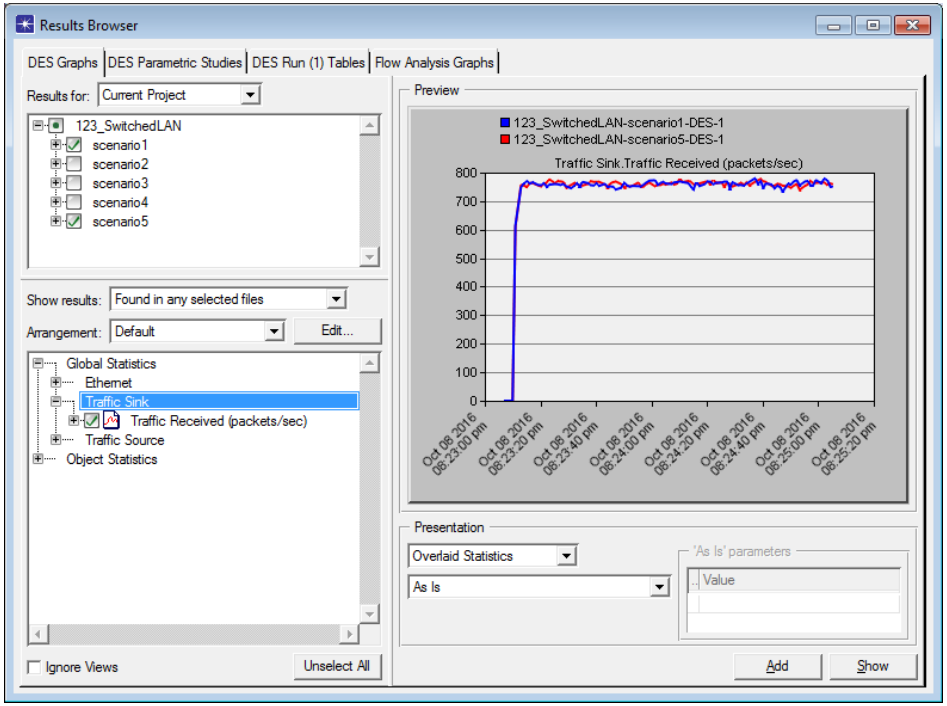
- Eth Hub Optimization: **Disabled** (default) vs. **Enabled**

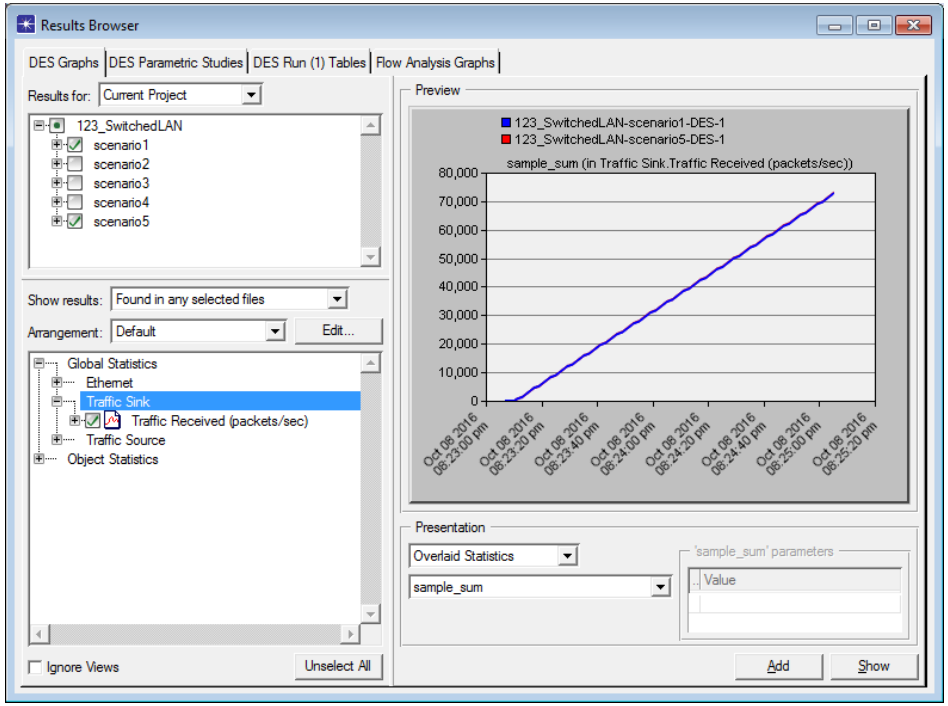




Configuring Simulations (cont'd)

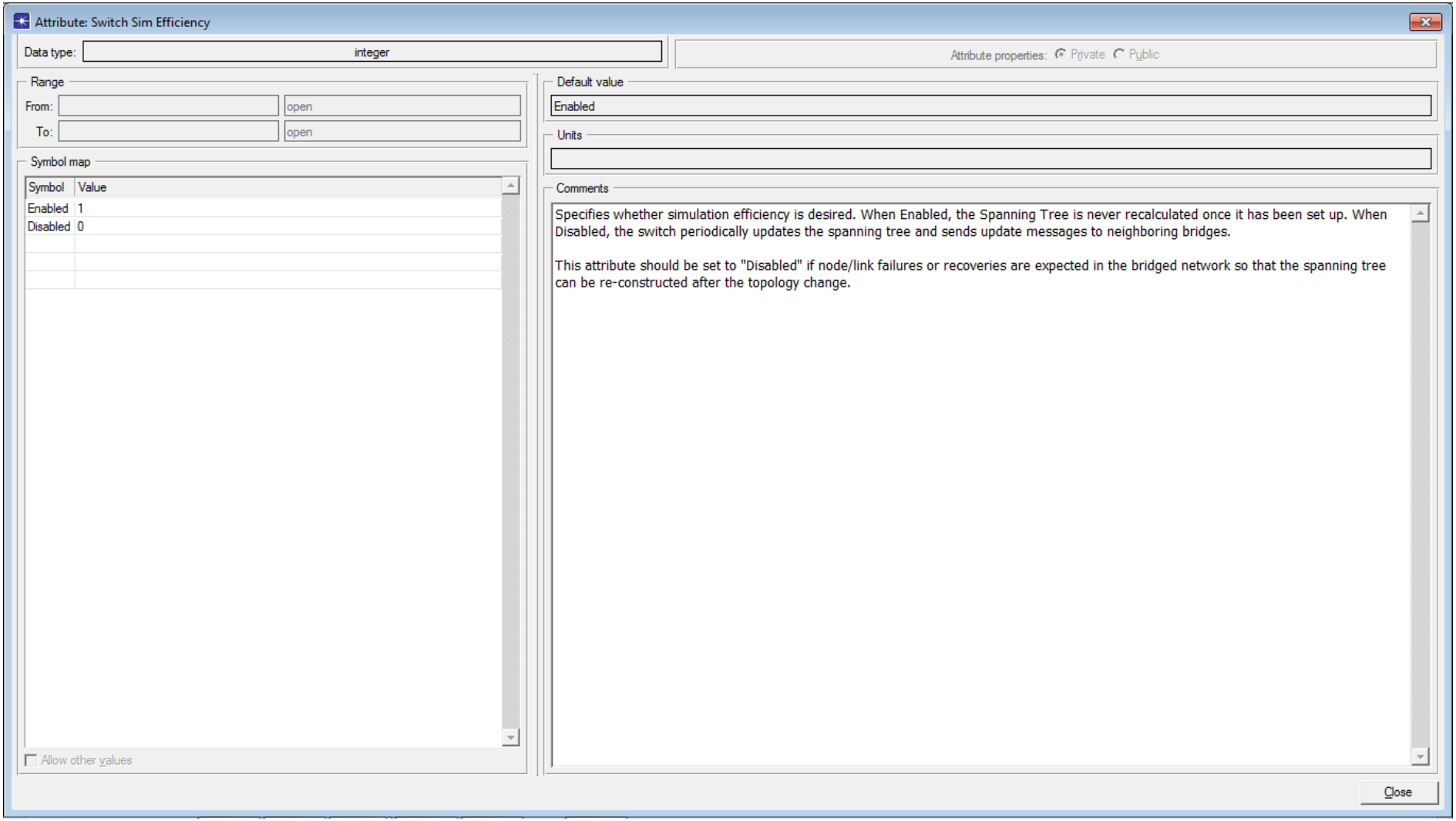
- Eth Hub Optimization: **Disabled** (default) vs. **Enabled**





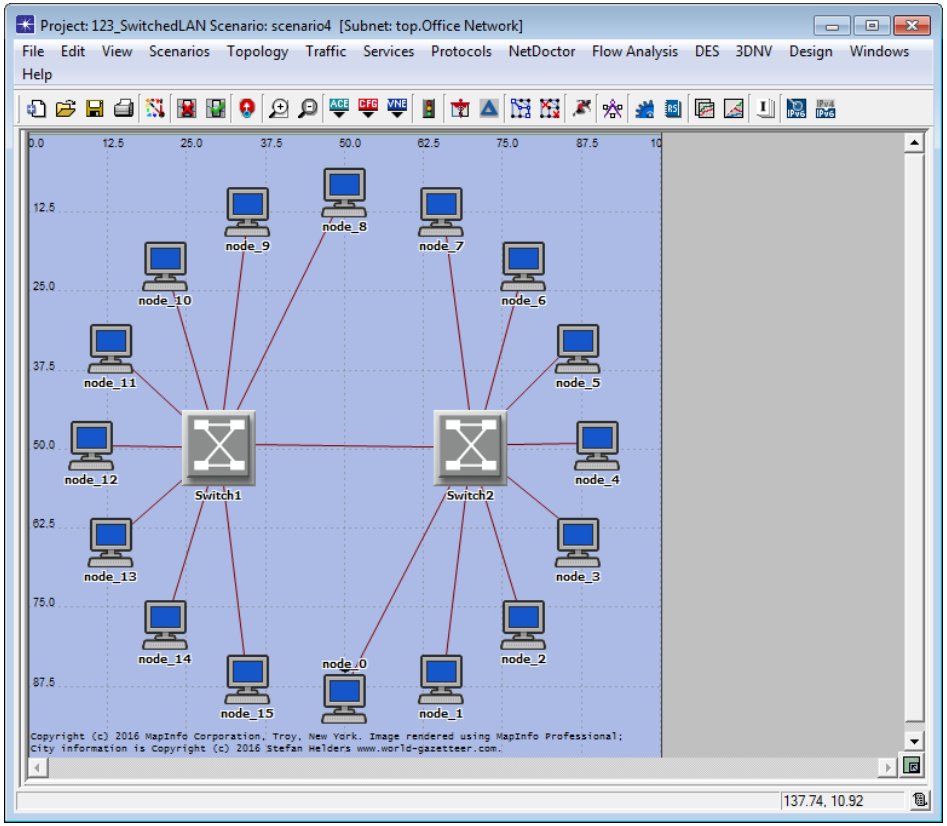
Configuring Simulations (cont'd)

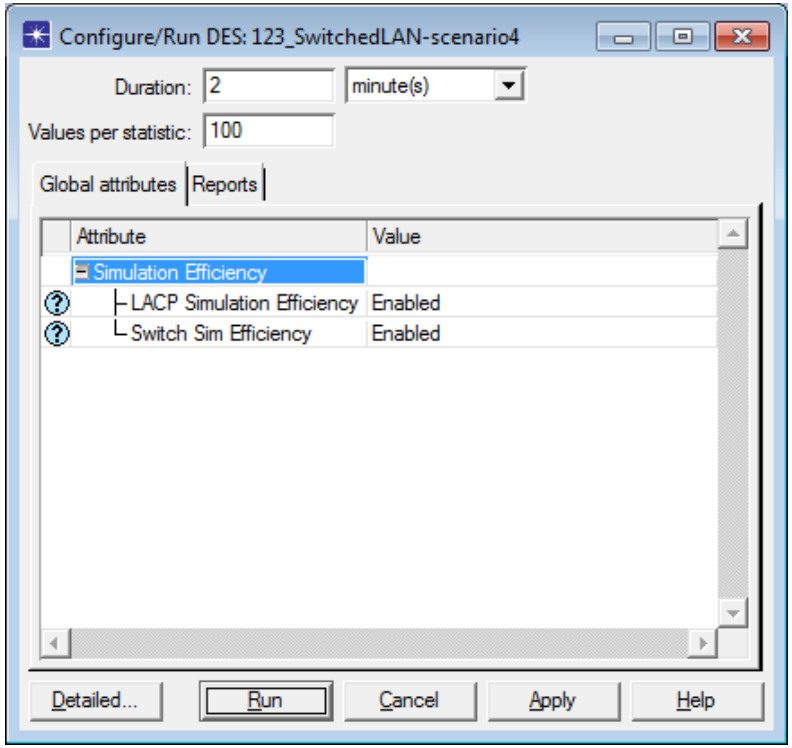
- Switch Sim Efficiency



Configuring Simulations (cont'd)

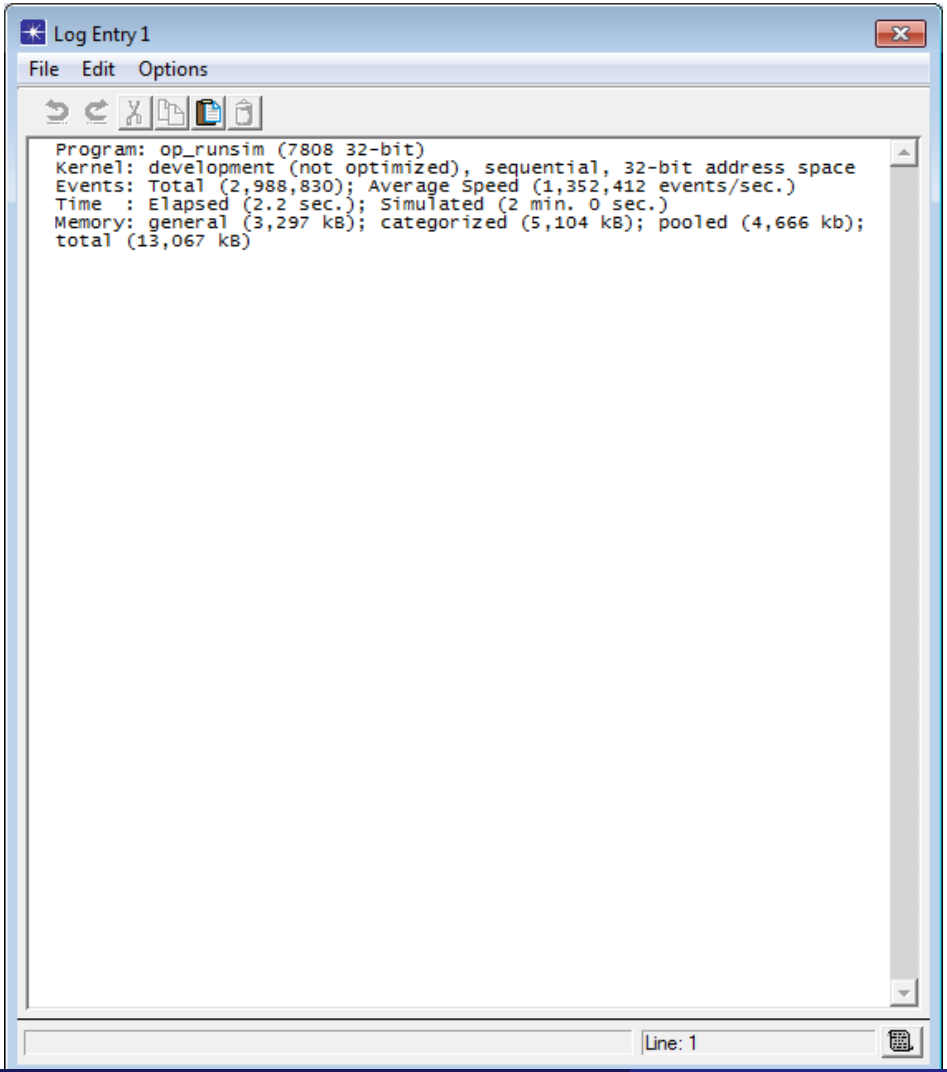
- Switch Sim Efficiency

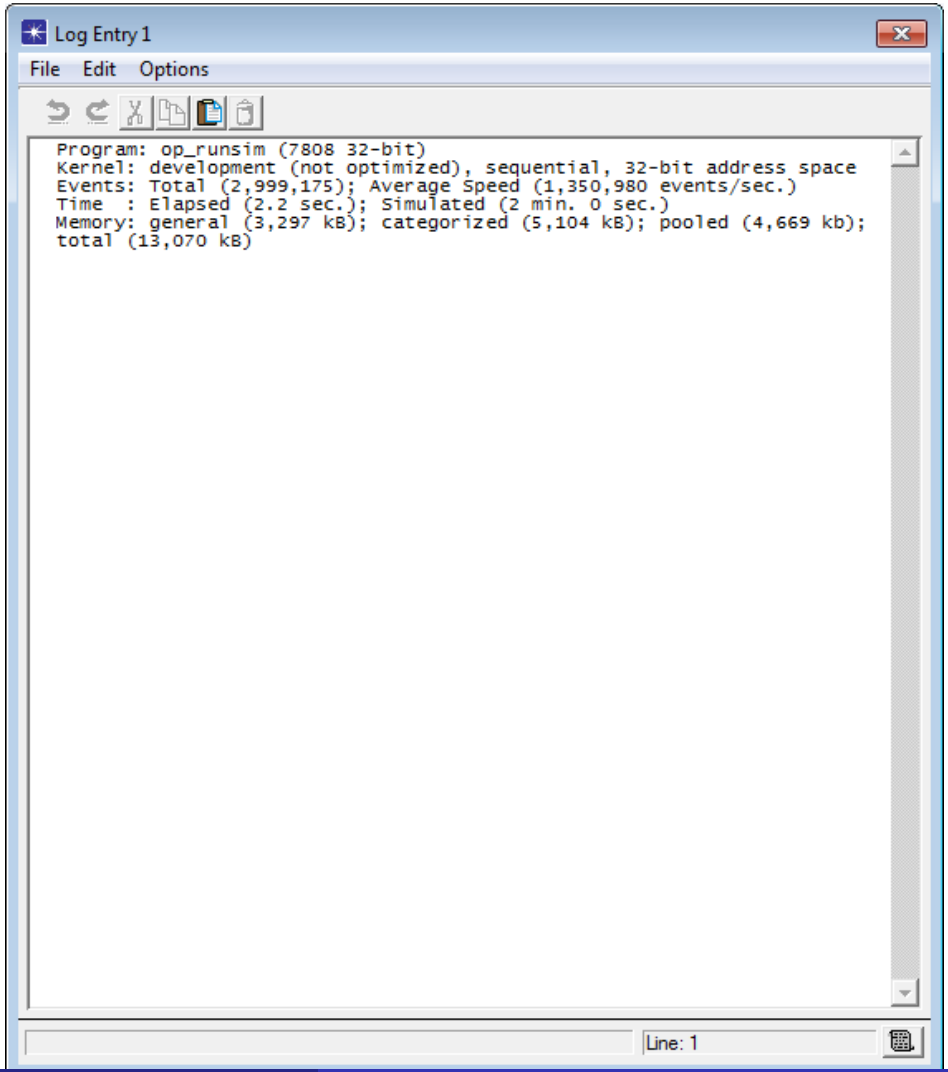




Configuring Simulations (cont'd)

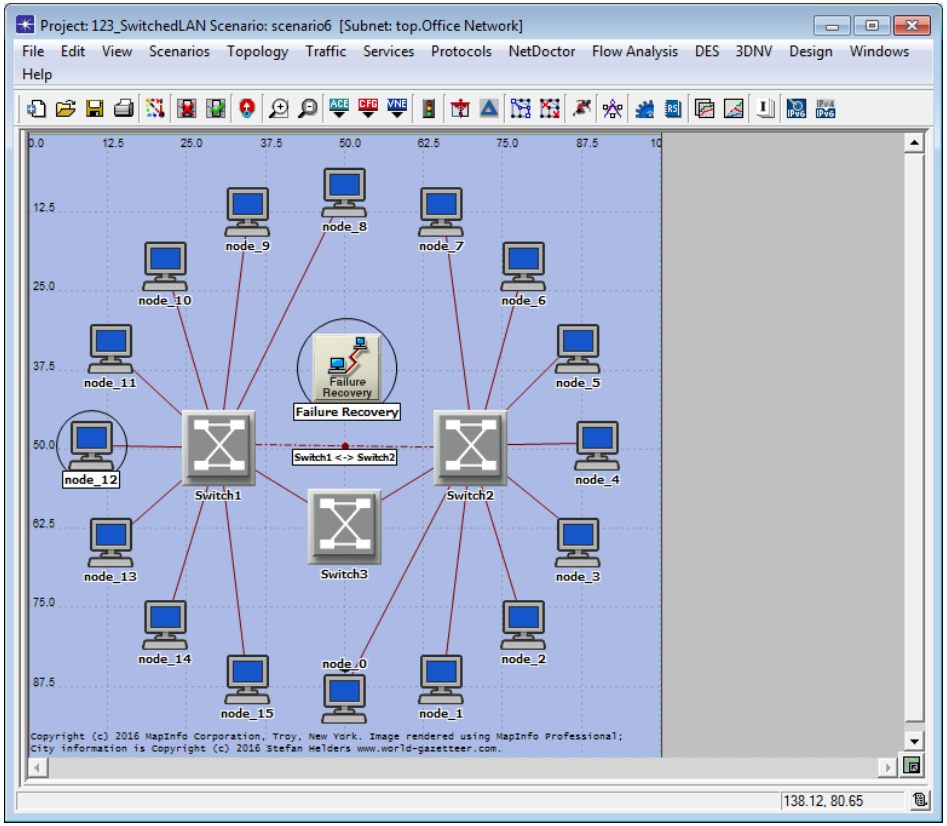
- Switch Sim Efficiency: **Enabled** (default) vs. **Disabled**

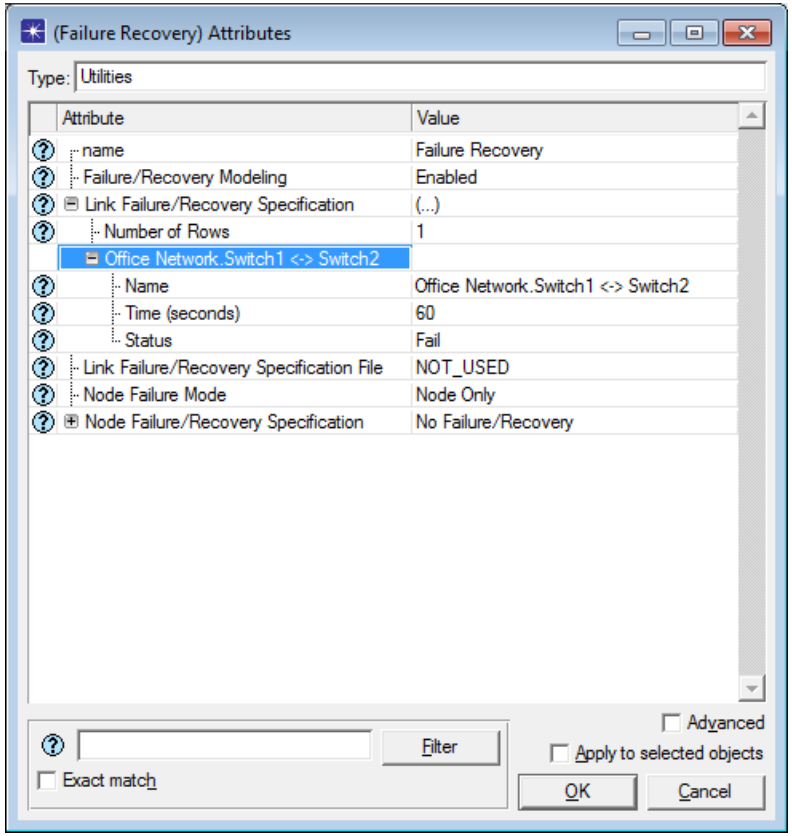




Configuring Simulations (cont'd)

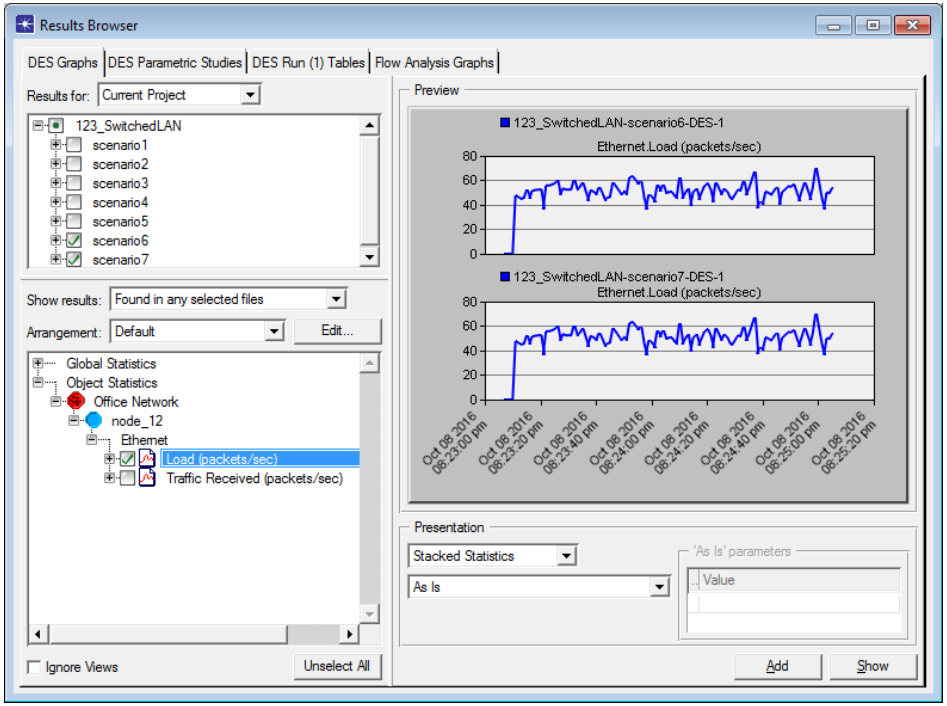
- Let's make it a bit more exciting ☺

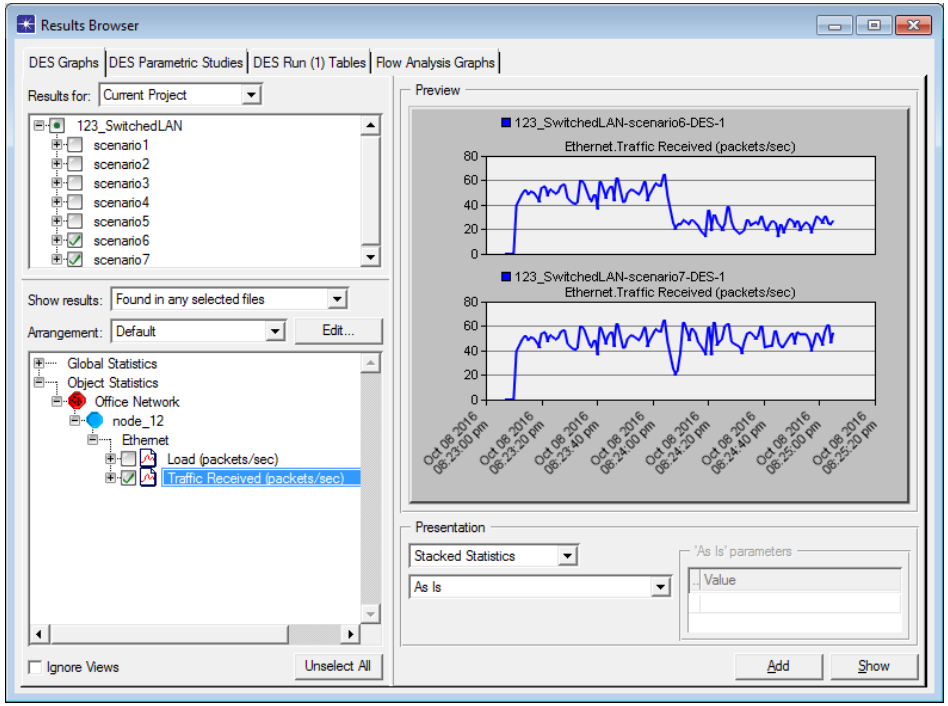




Configuring Simulations (cont'd)

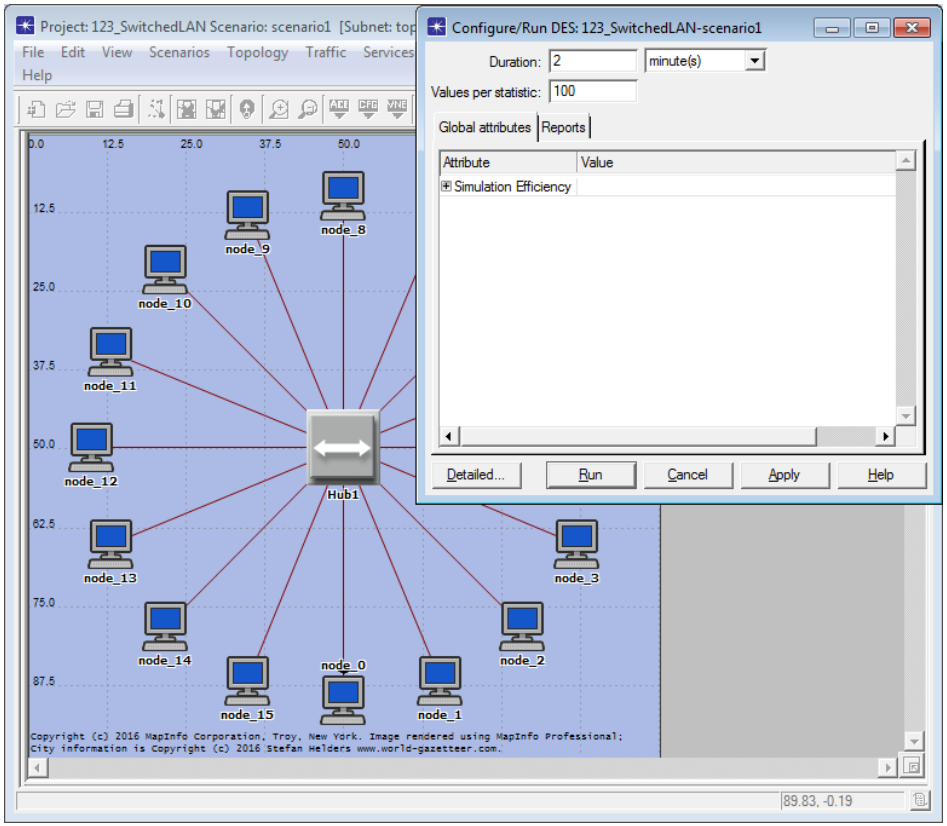
- Switch Sim Efficiency: **Enabled** (default) vs. **Disabled**

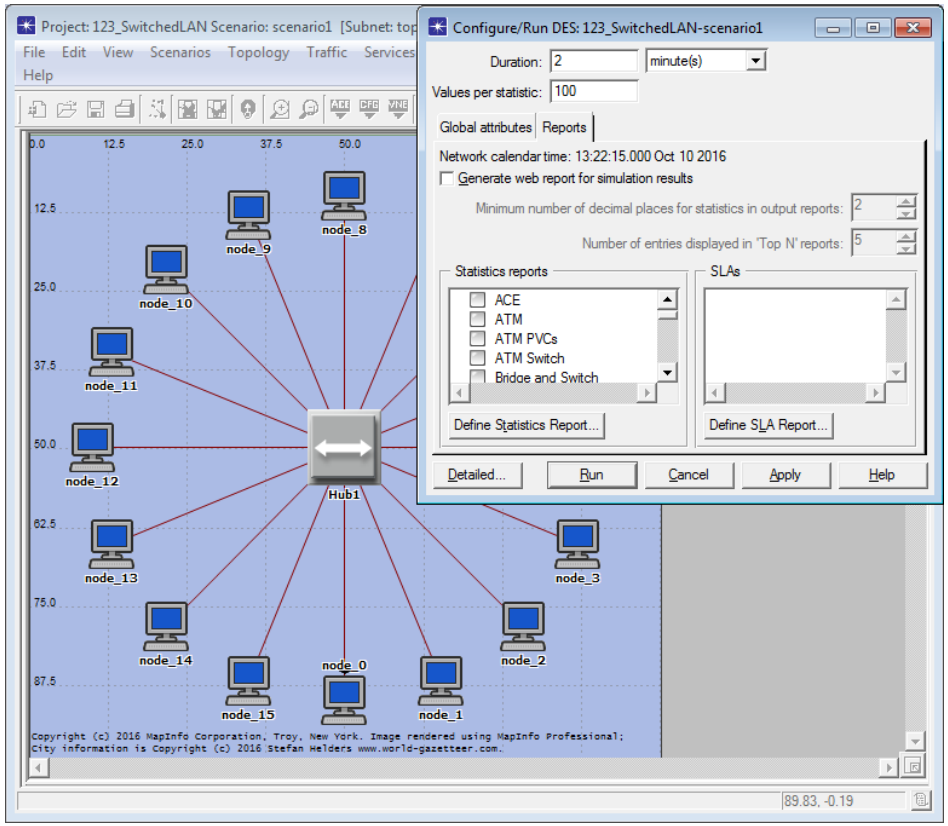




Configuring Simulations (cont'd)

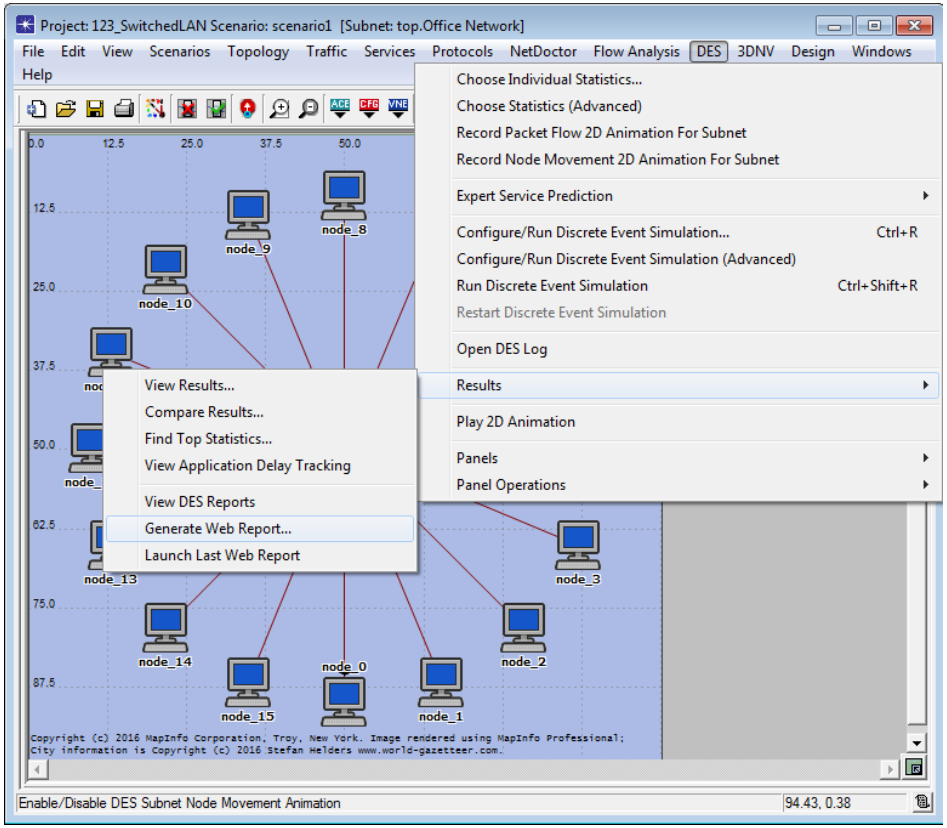
- **Reports** – specifies statistics and **service level agreement (SLA)** reports to be collected during the simulation study

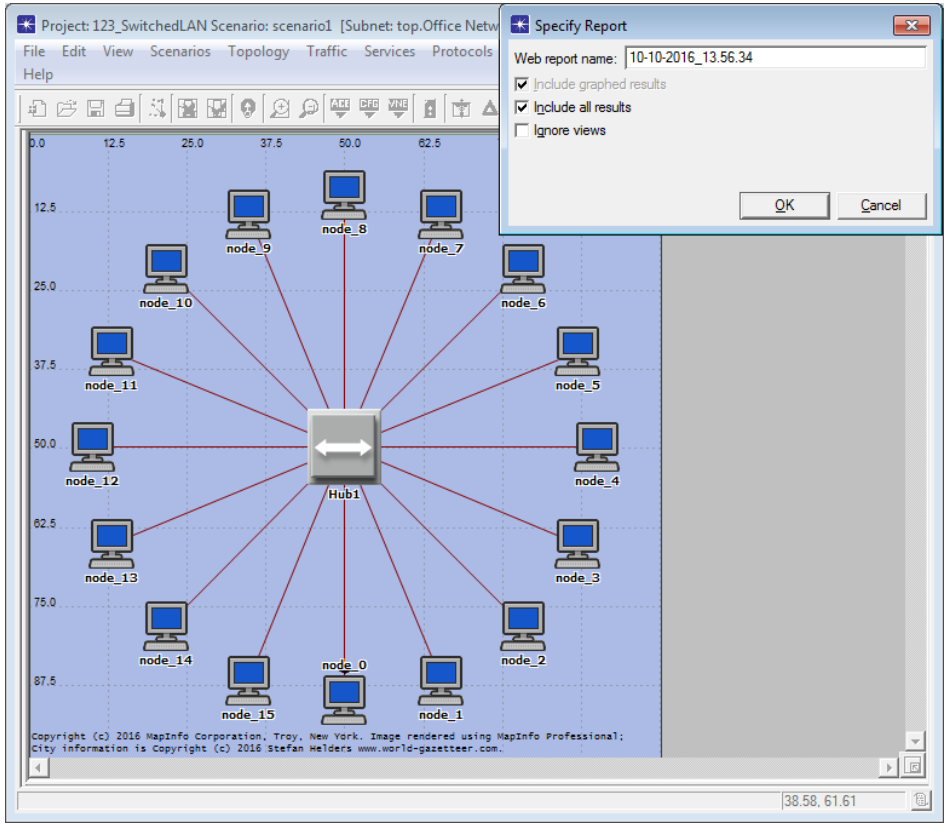




Configuring Simulations (cont'd)

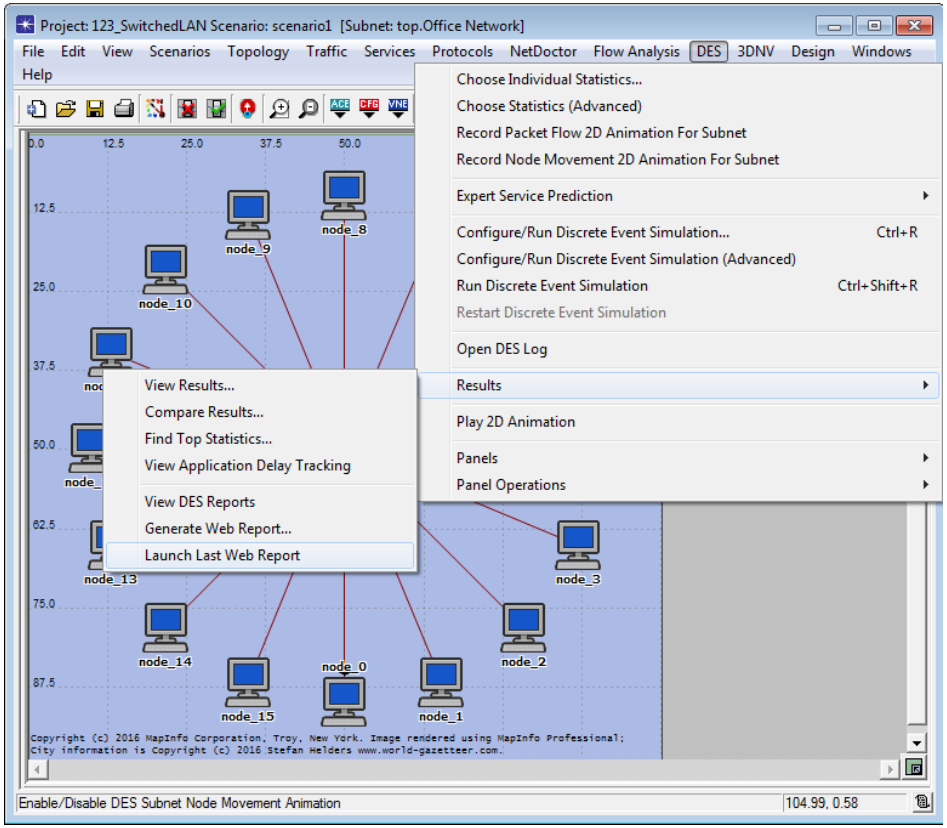
- DES ⇒ Results ⇒ Generate Web Report... ⇒ OK

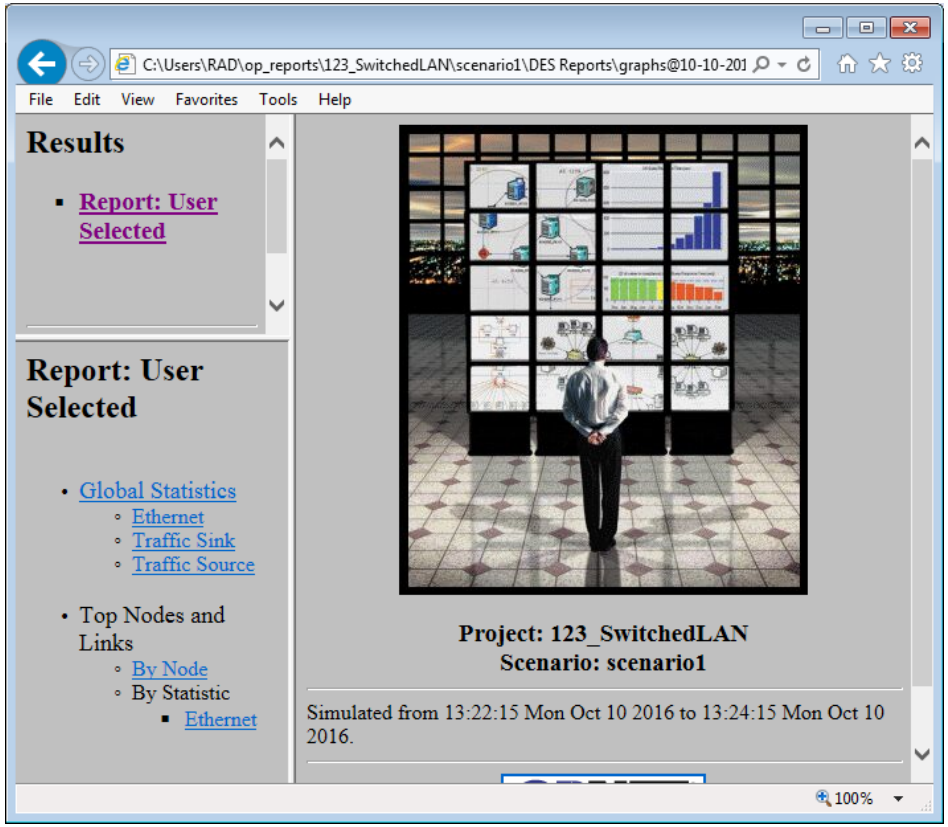




Configuring Simulations (cont'd)

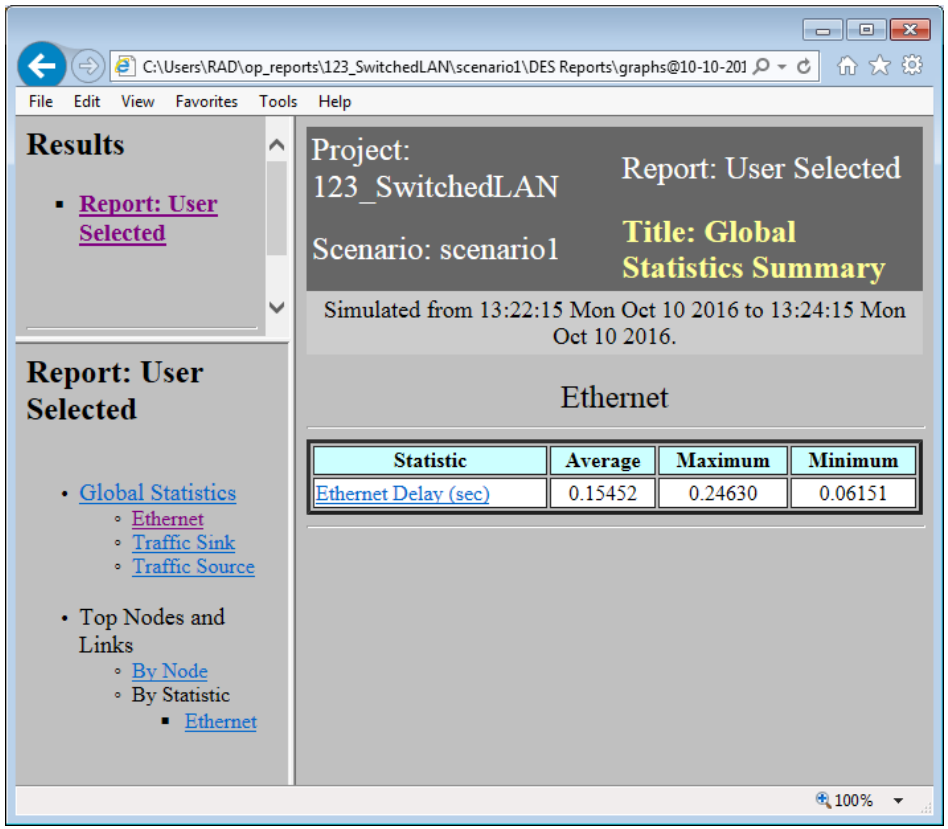
- DES ⇒ Results ⇒ Launch Last Web Report

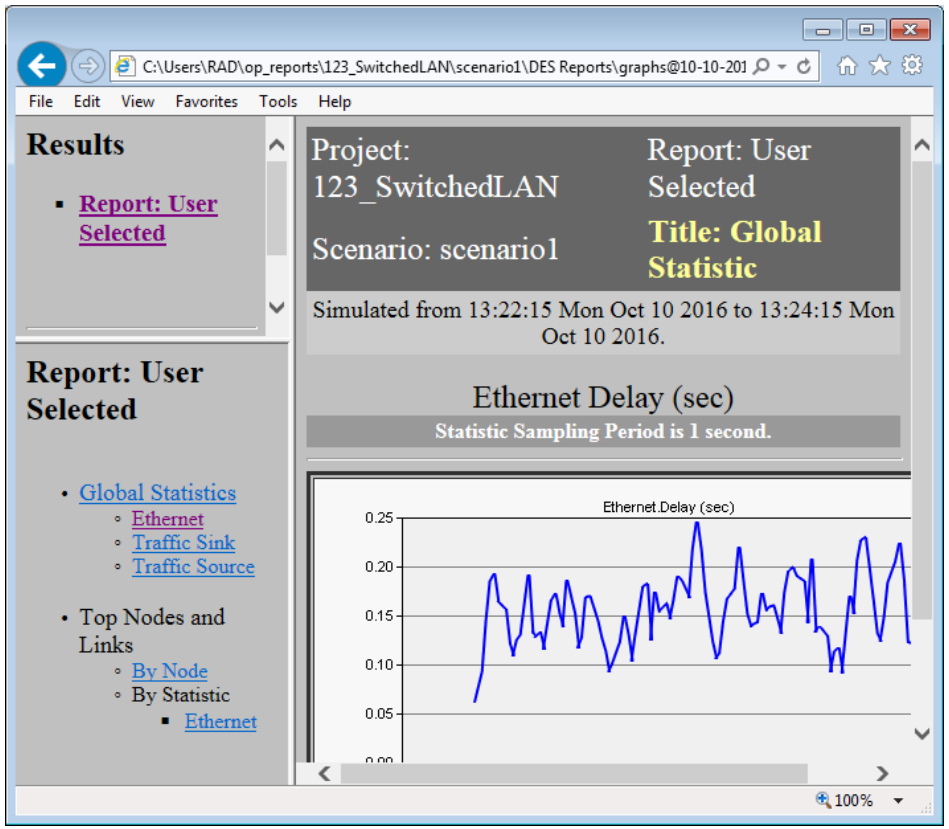




Configuring Simulations (cont'd)

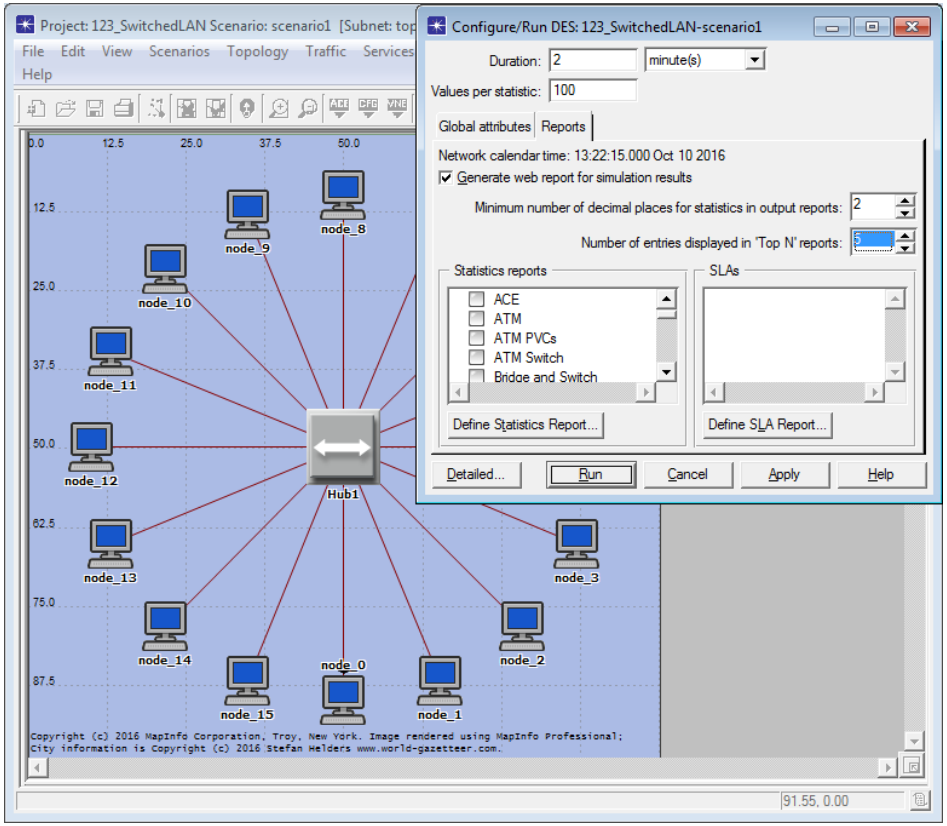
- Web reports are created in **C:/Users/<user name>/op_reports/**

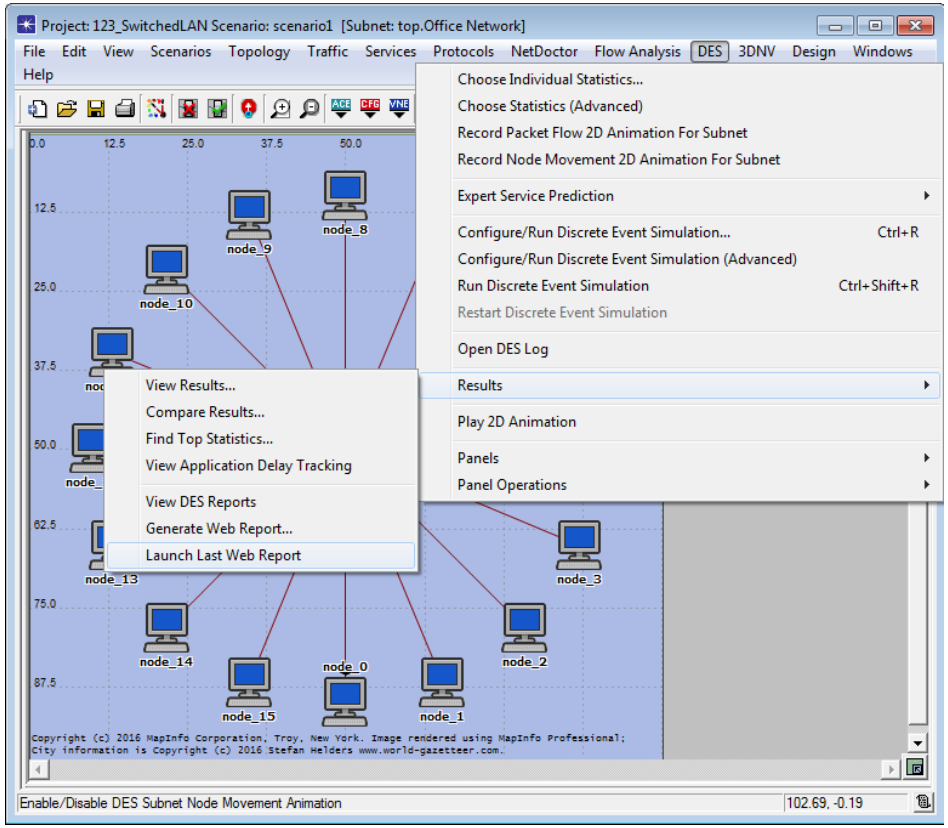




Configuring Simulations (cont'd)

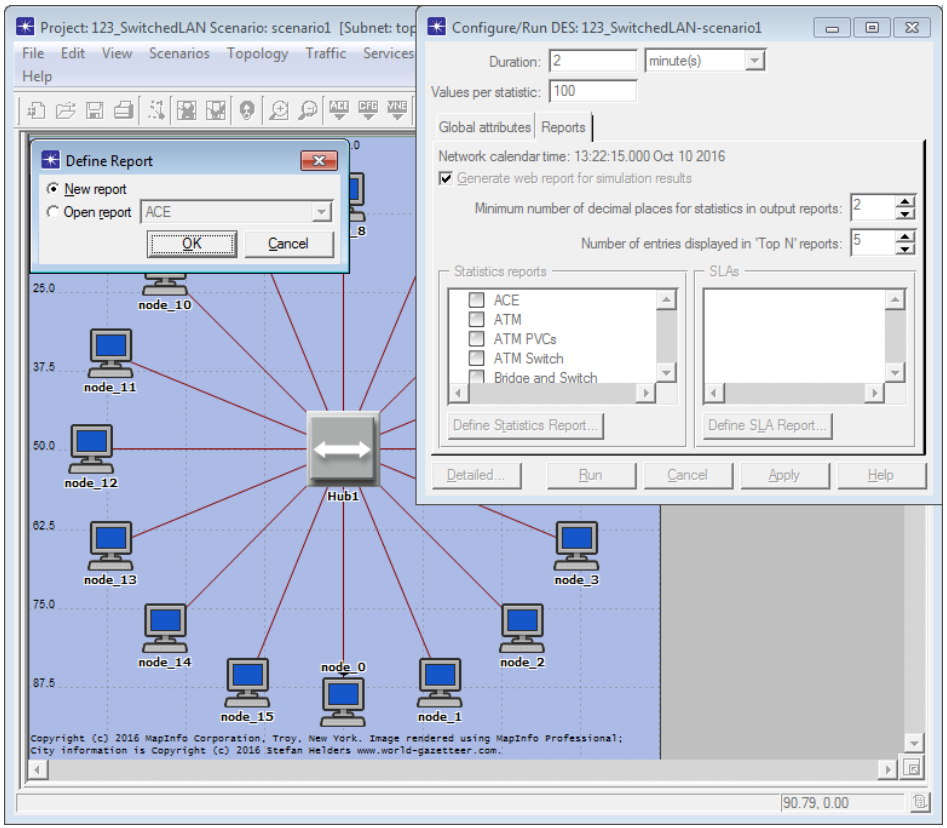
- Web reports can be generated automatically after data collection

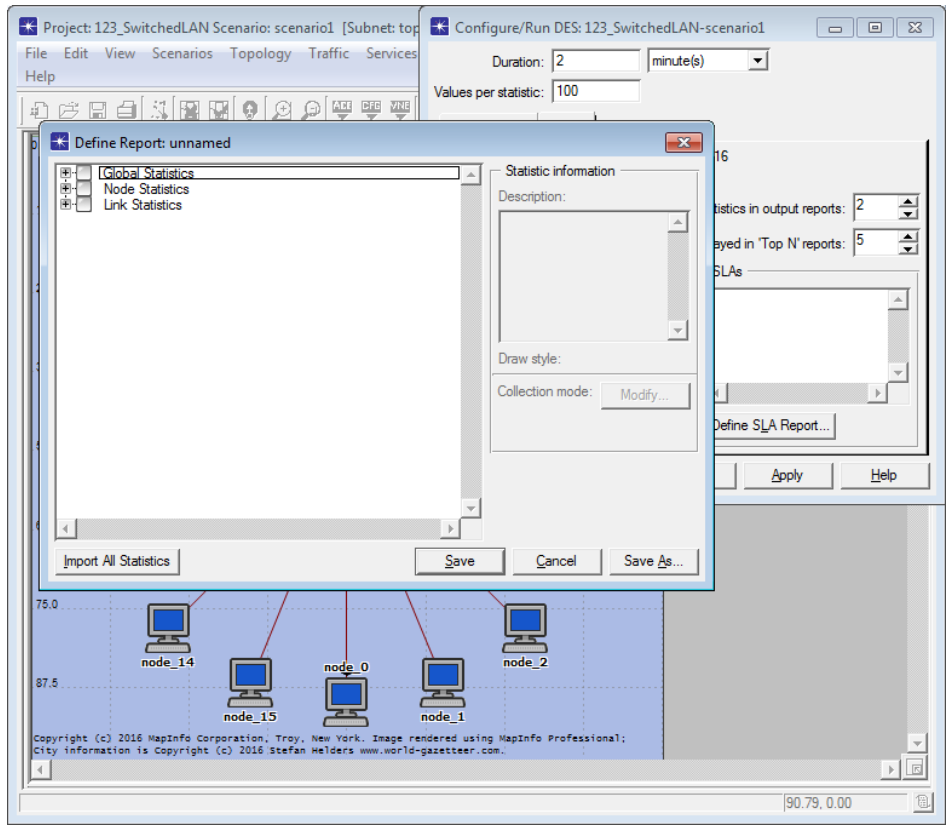




Configuring Simulations (cont'd)

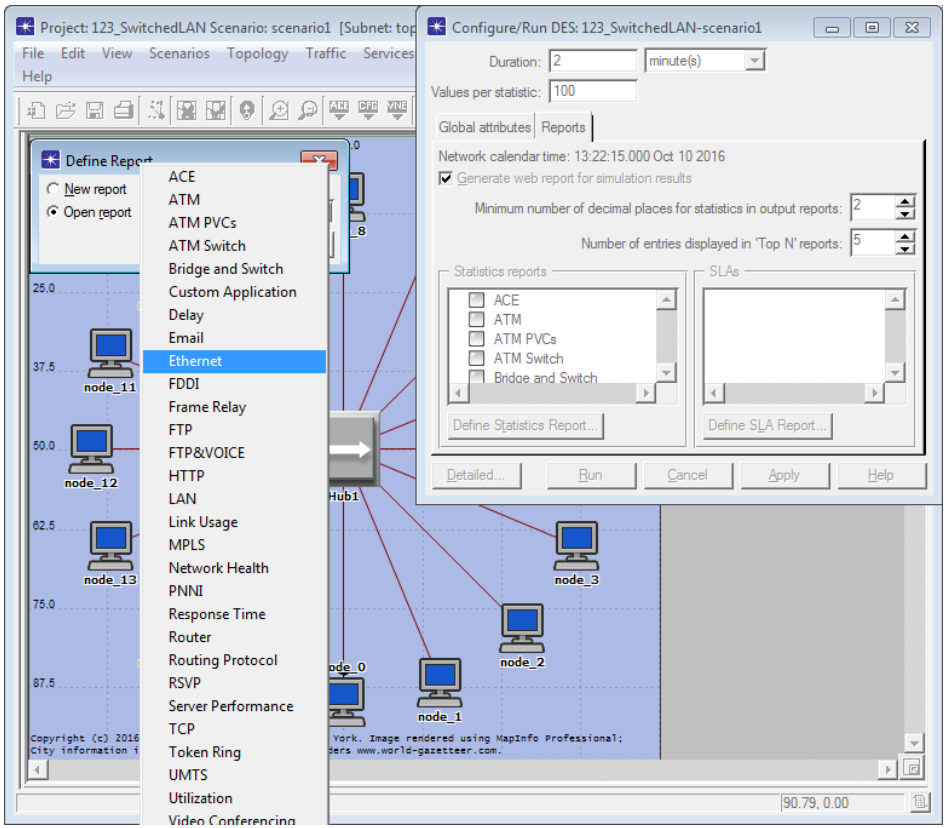
- Define Statistics Report... ⇒ New report ⇒ OK

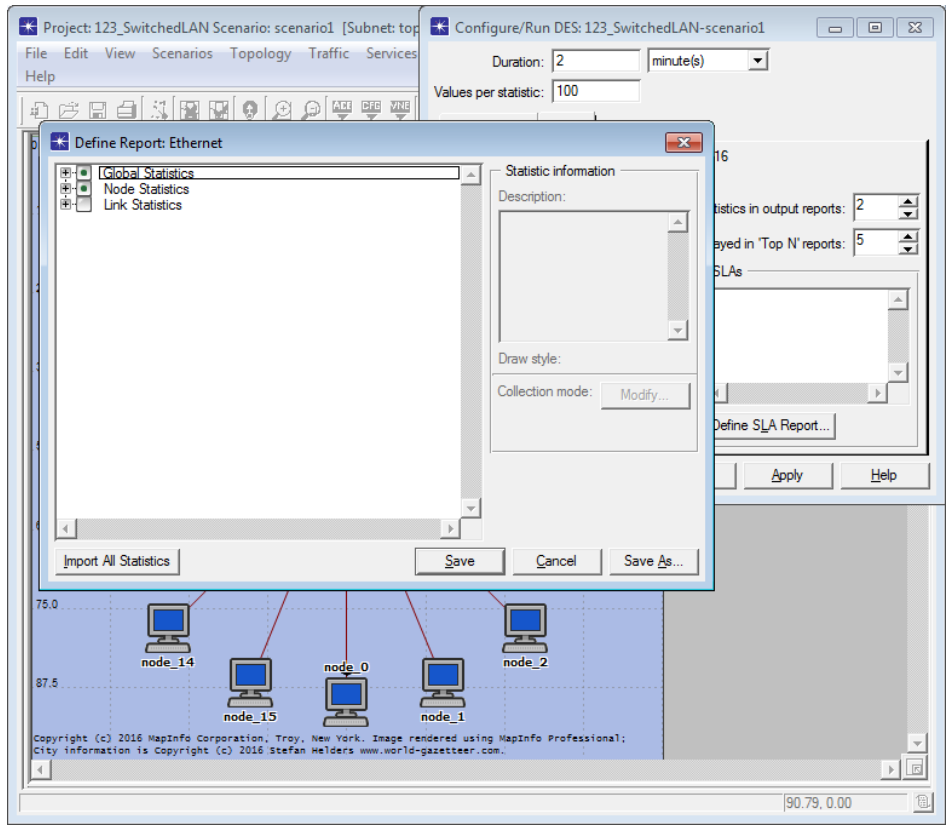




Configuring Simulations (cont'd)

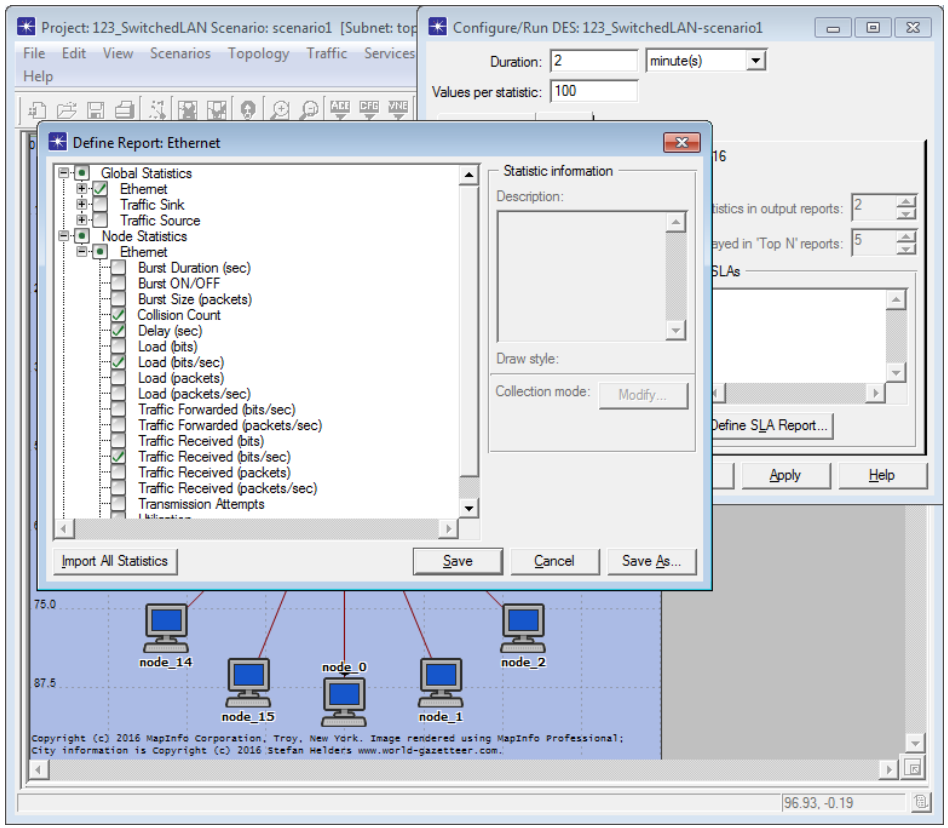
- Define Statistics Report... ⇒ Open report ⇒ bla-bla-bla ⇒ Save

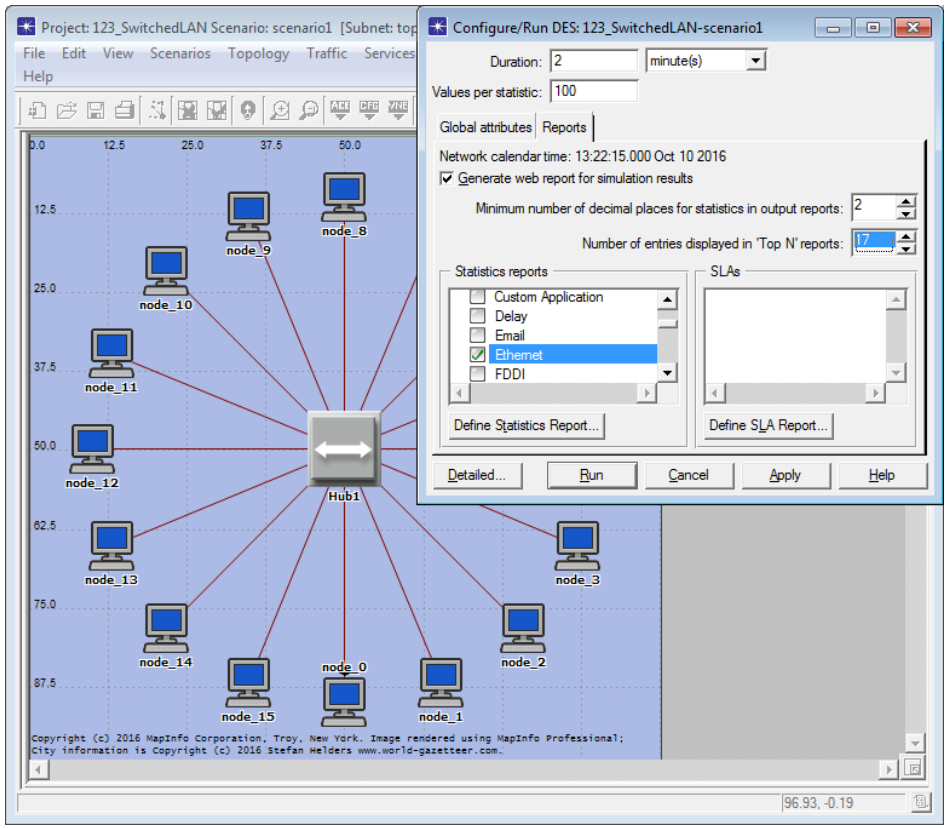




Configuring Simulations (cont'd)

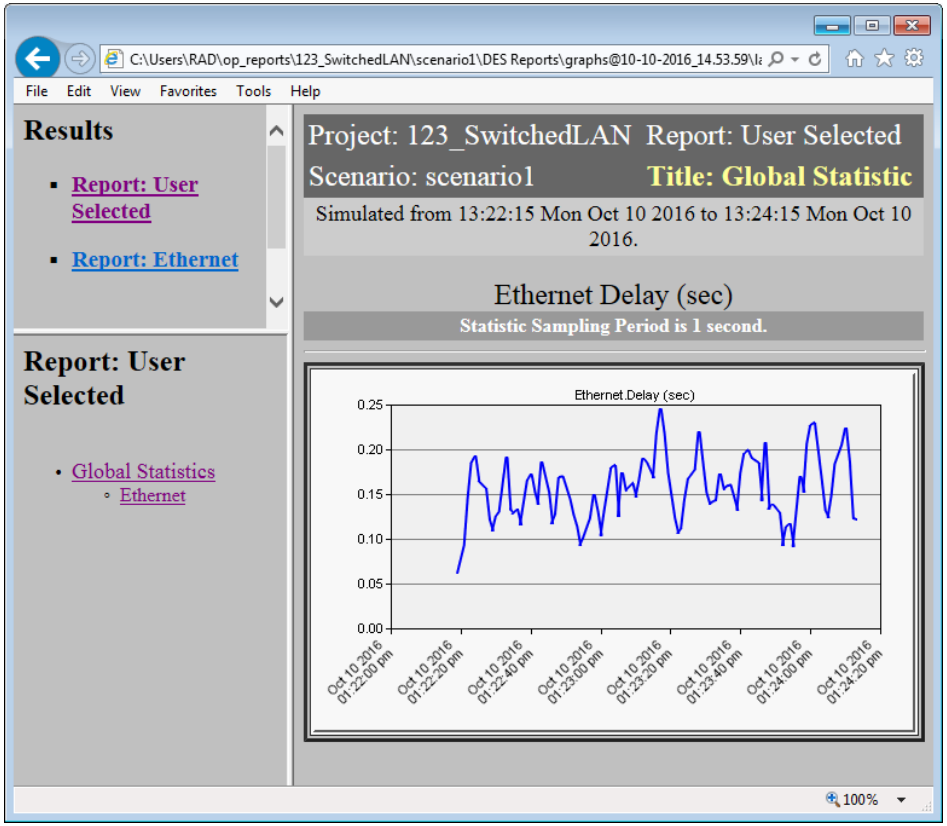
- To collect the statistics specified in a statistics report, you must associate the report with a scenario
  - When a report is defined, it is not associated with any particular project or scenario

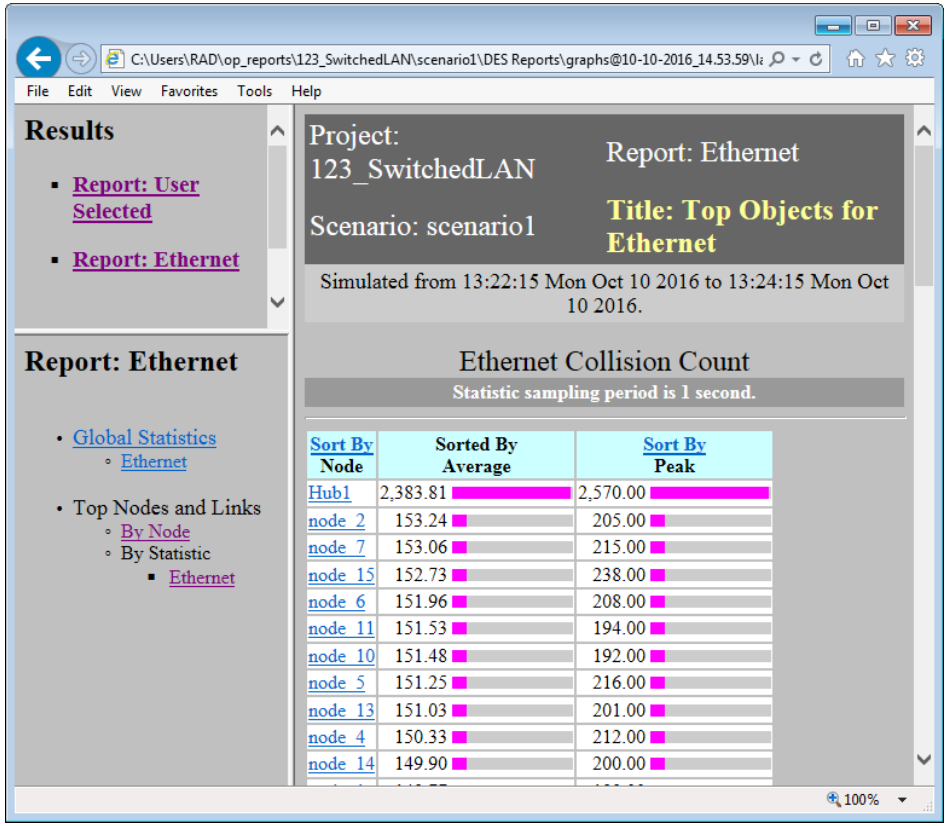




Configuring Simulations (cont'd)

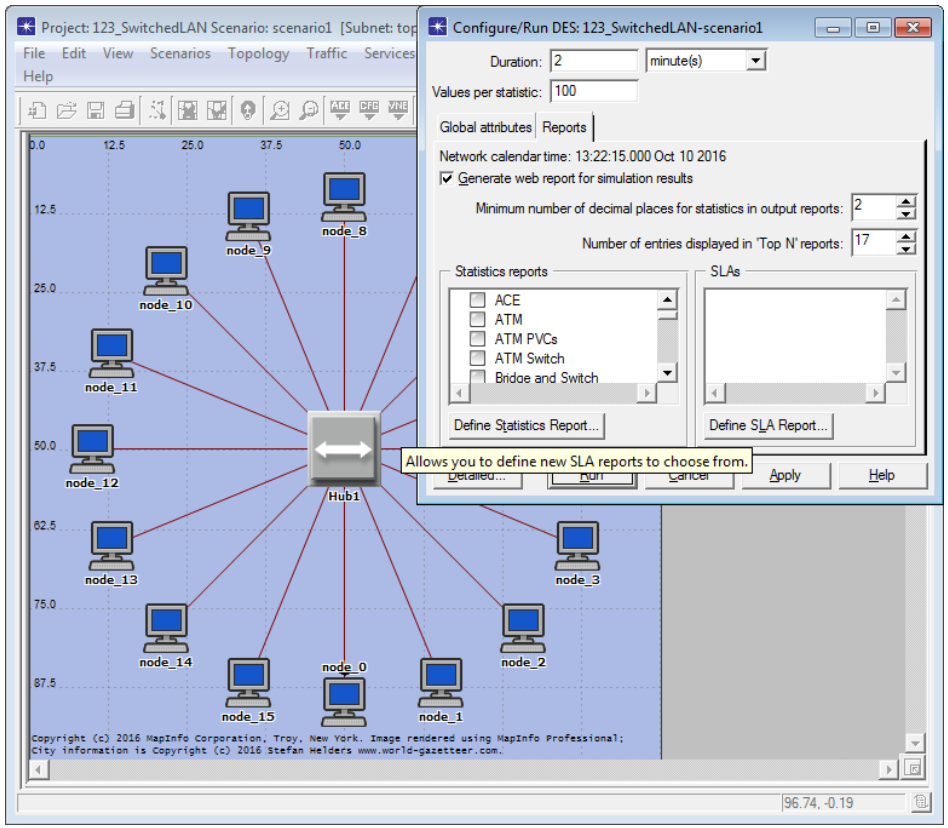
- Reports: **User Selected** vs. **Ethernet** (default)

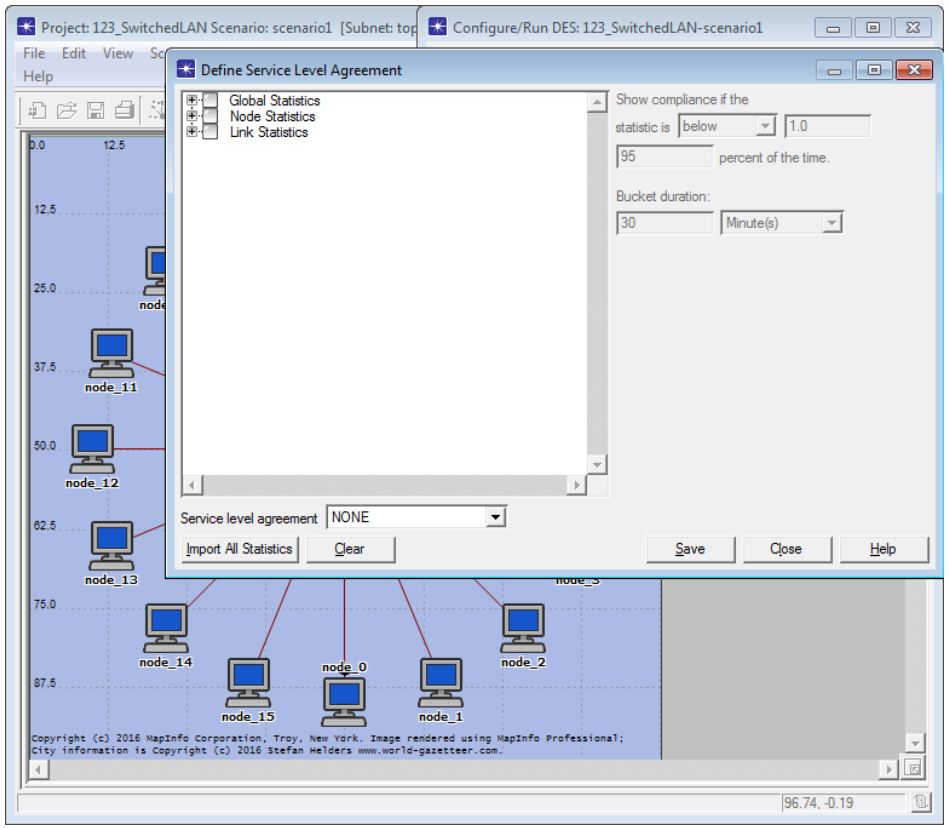




Configuring Simulations (cont'd)

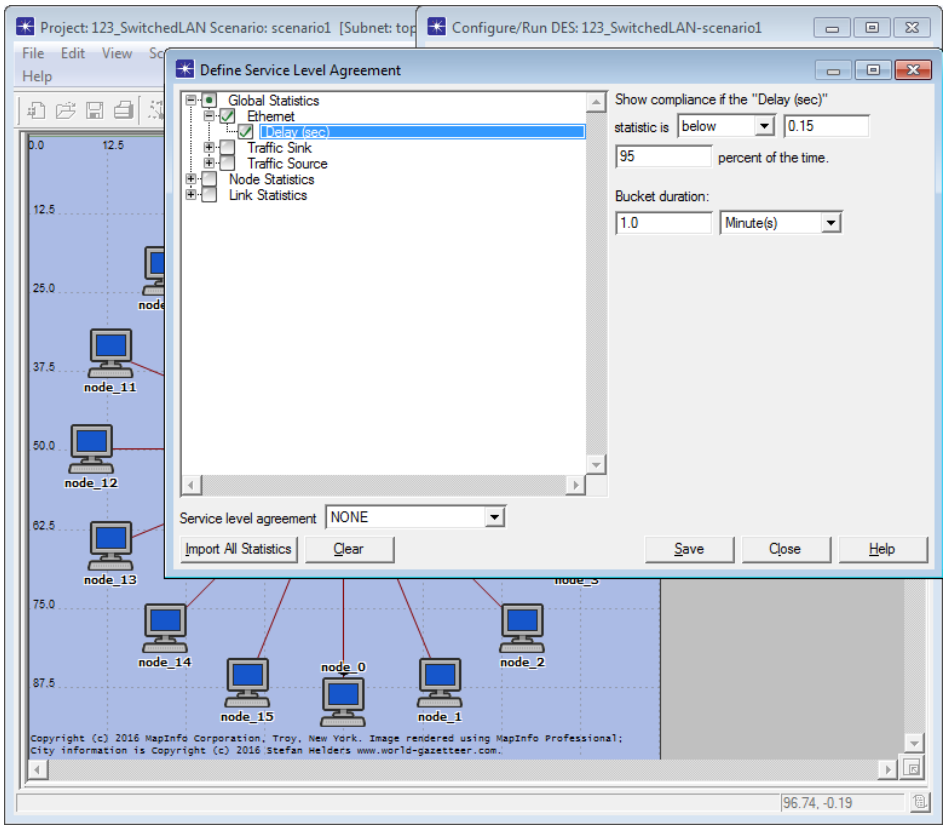
- **SLAs** – define the thresholds that will be applied against the results collected during the simulation study

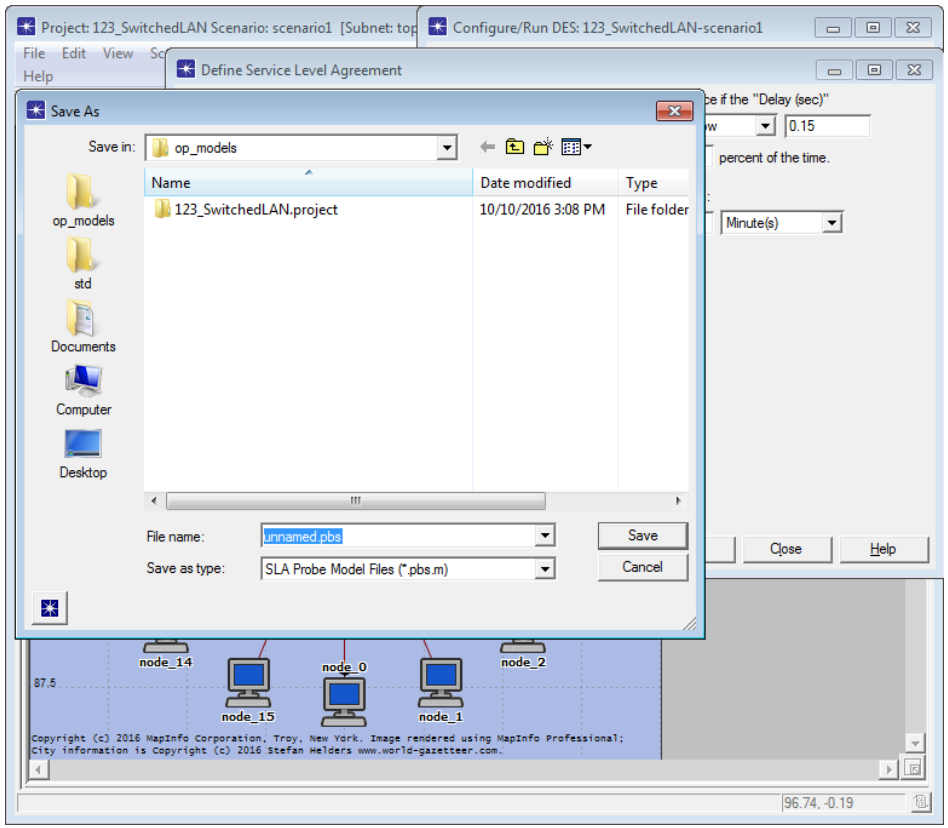




Configuring Simulations (cont'd)

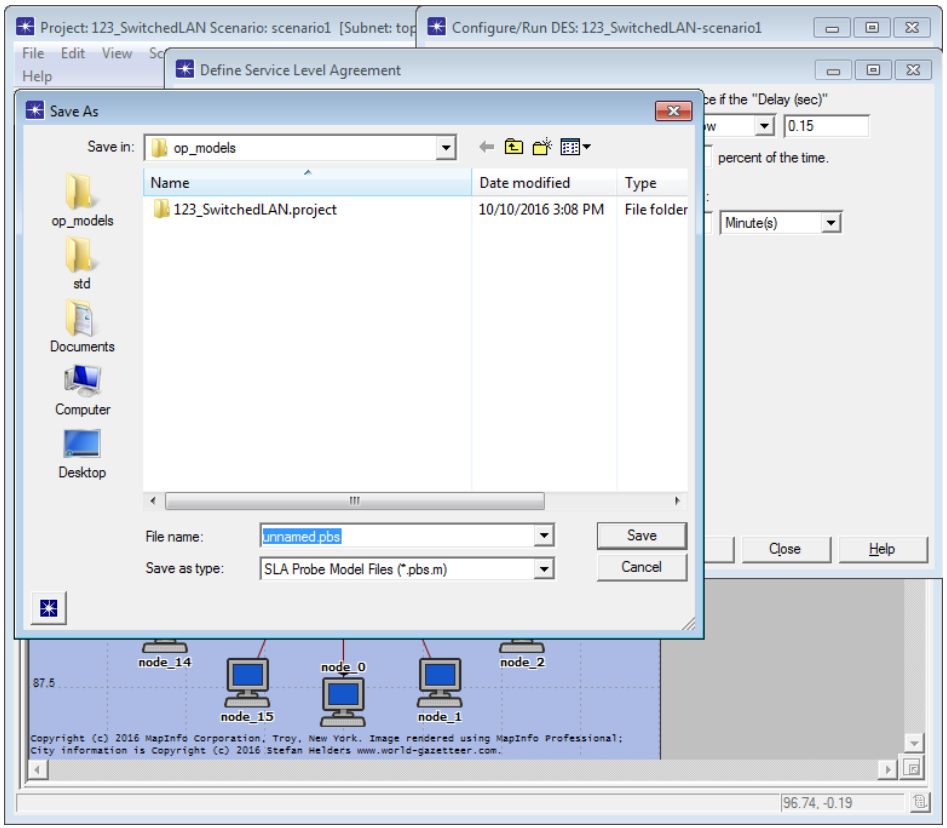
- Define SLA Report... ⇒ bla-bla-bla ⇒ Save

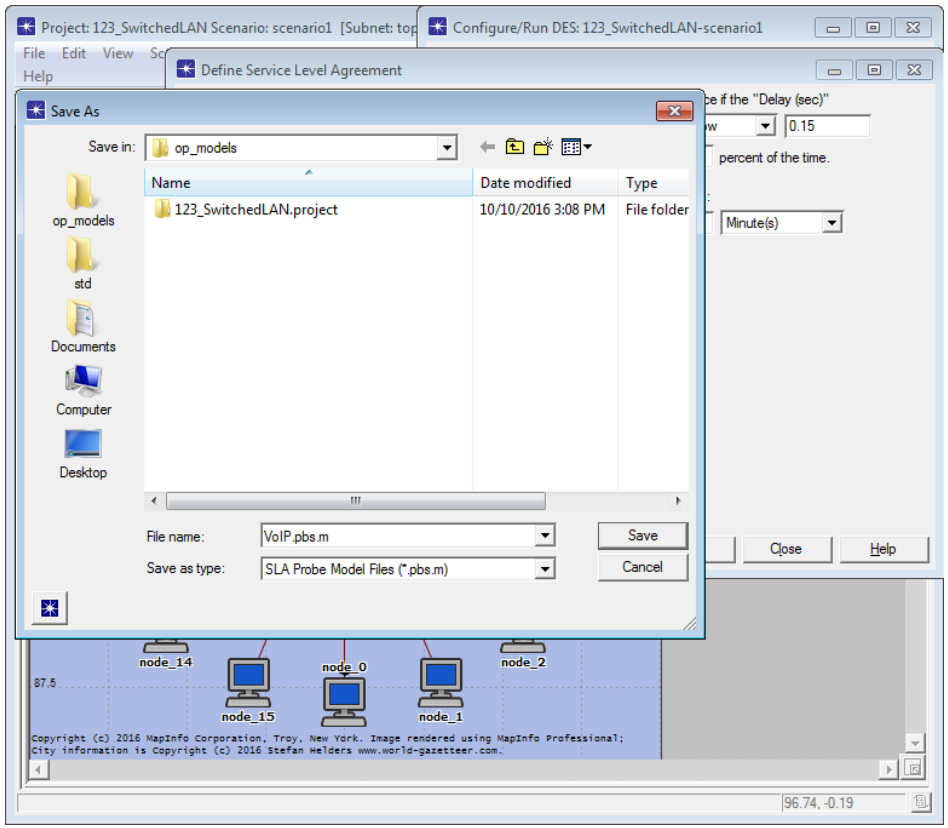




Configuring Simulations (cont'd)

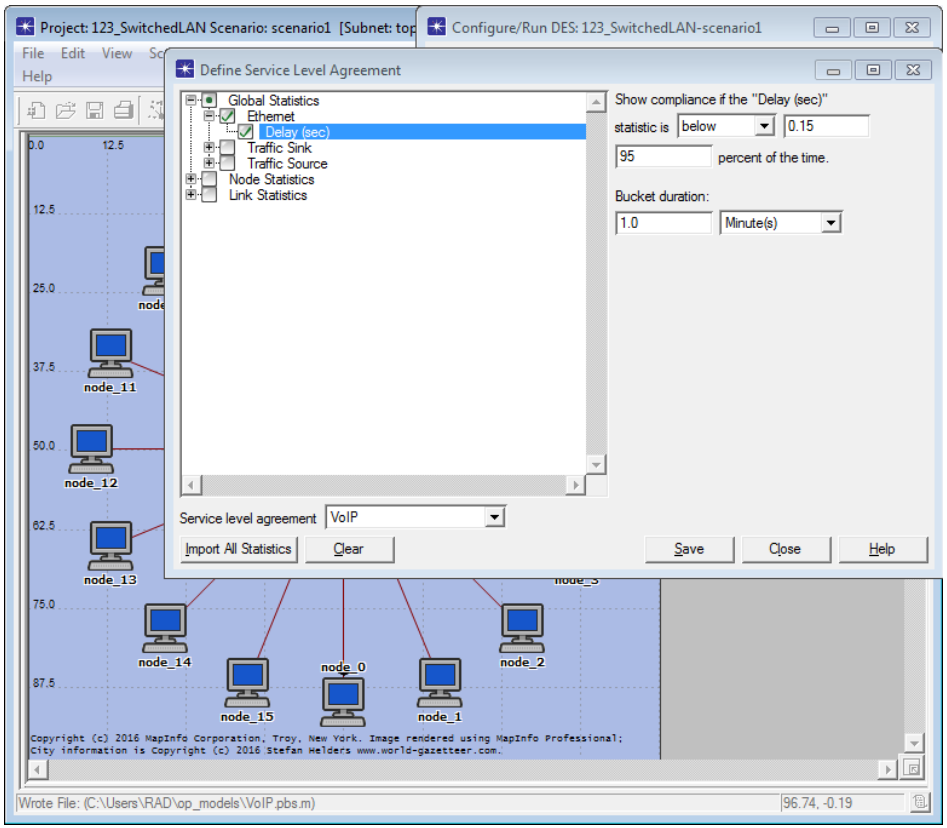
- Save as <**file name**>**.pbs.m**, not just <file name>.pbs

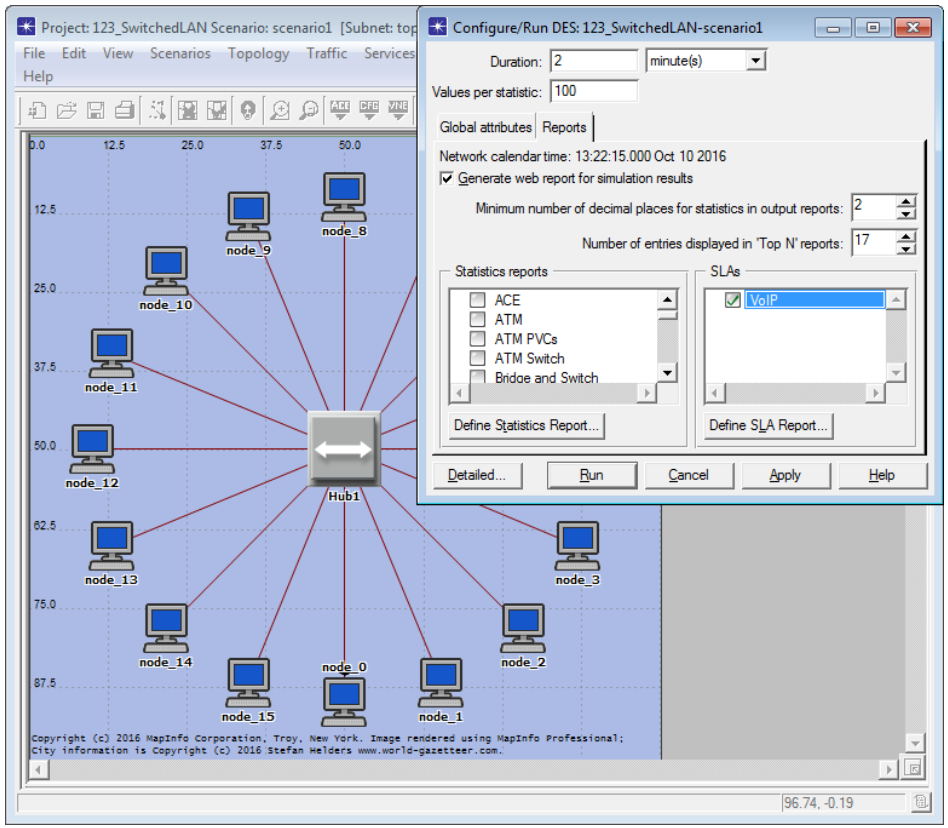




Configuring Simulations (cont'd)

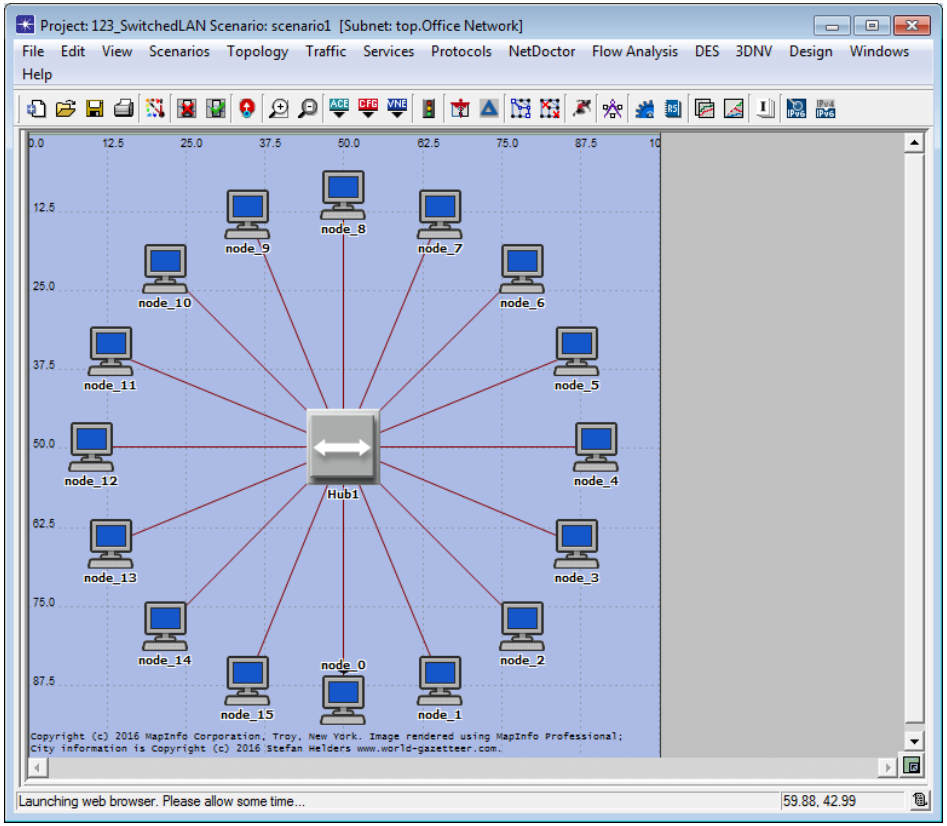
- Done!





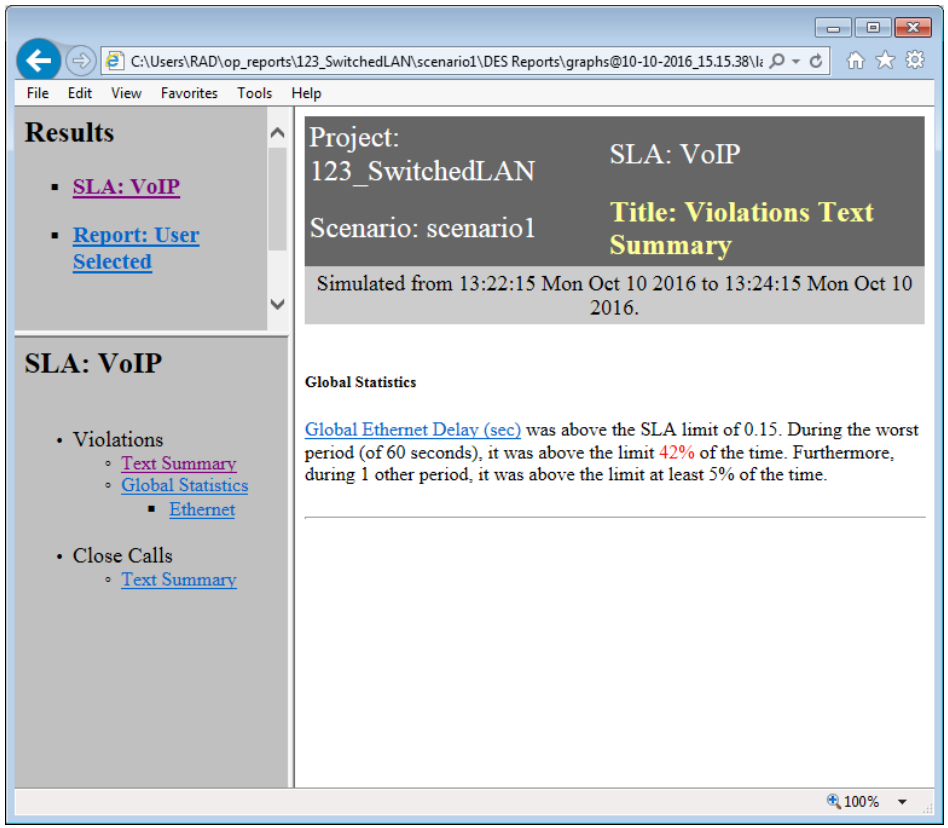
Configuring Simulations (cont'd)

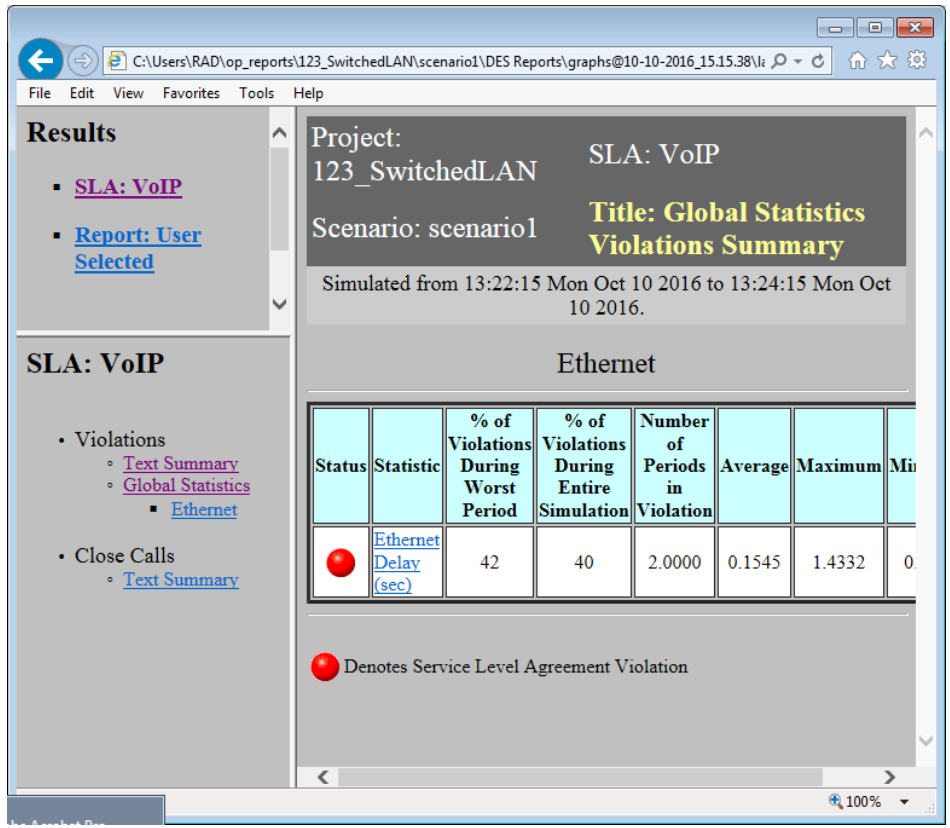
- Let's see... ☺



Configuring Simulations (cont'd)

- SLA violation: Global Ethernet Delay was above the SLA limit of 0.15 seconds for more than 5% of packets in each period

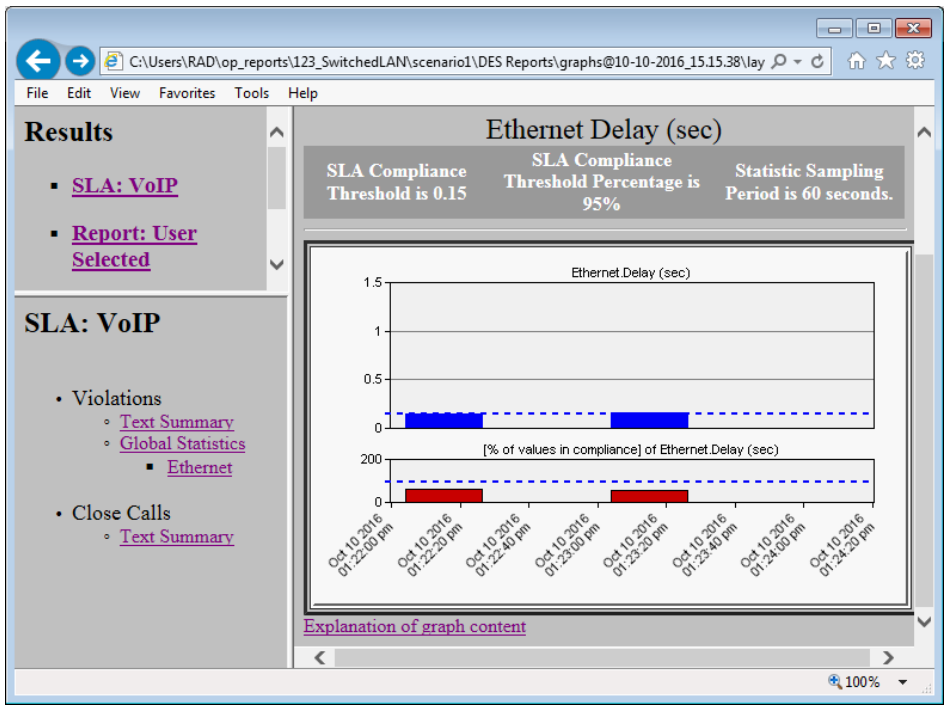


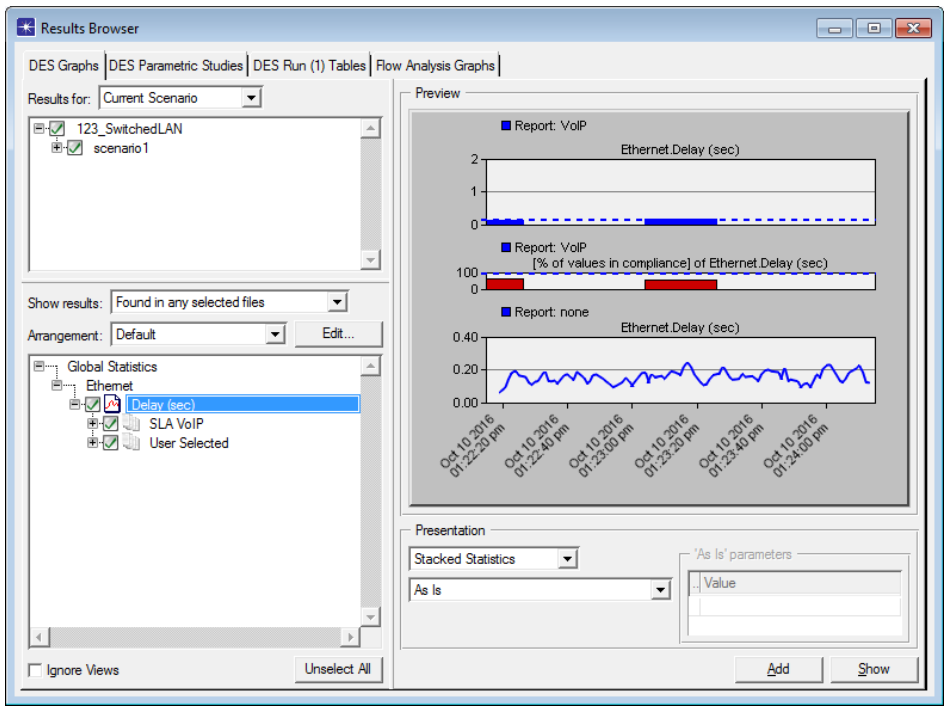


Configuring Simulations (cont'd)

- **Statistic graph** – statistic threshold, sample mean, min/max values, standard deviation, and sample count (total number of values)

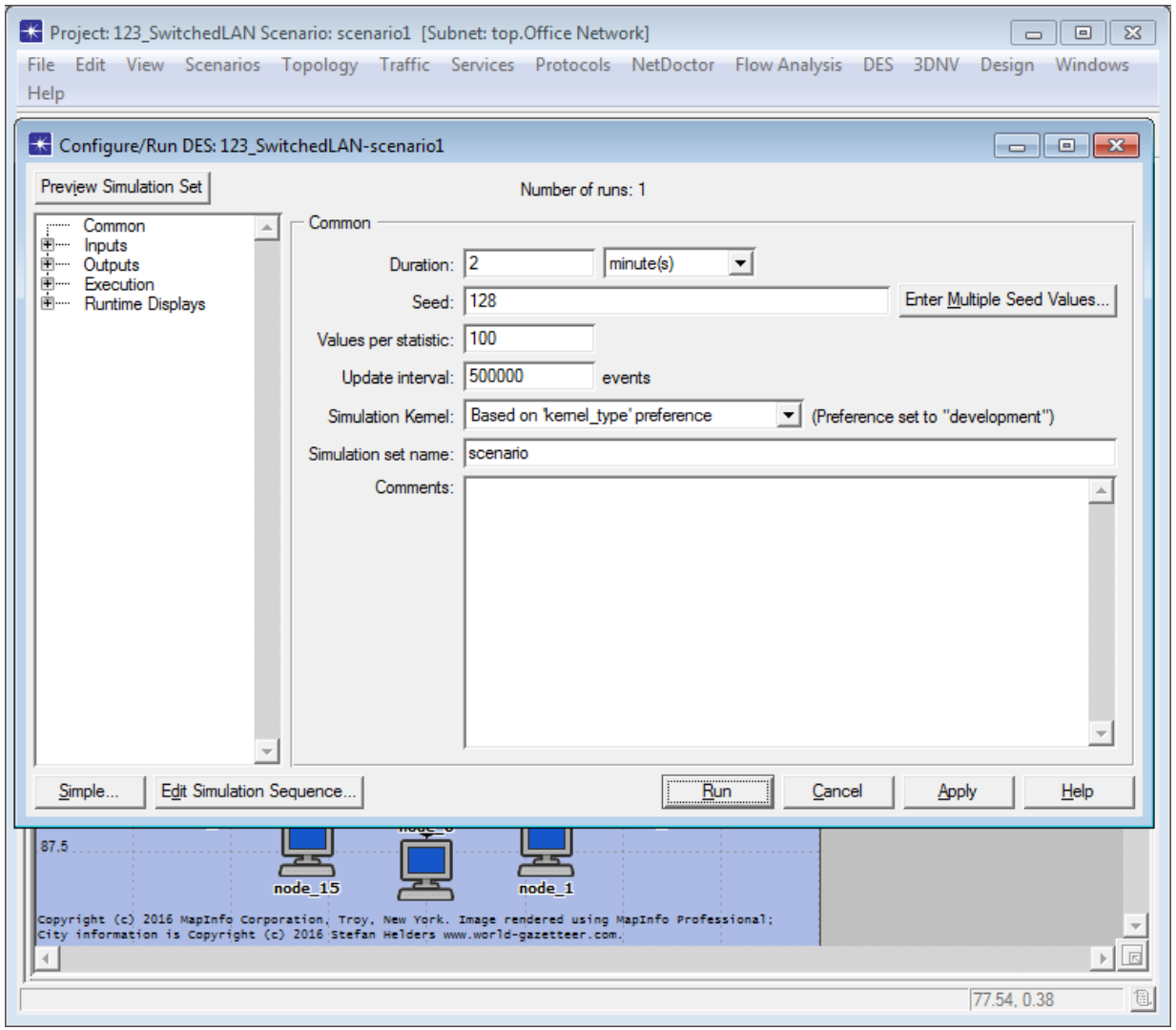
- **Percent compliance graph** – percentage of values in each period that comply with the statistic threshold





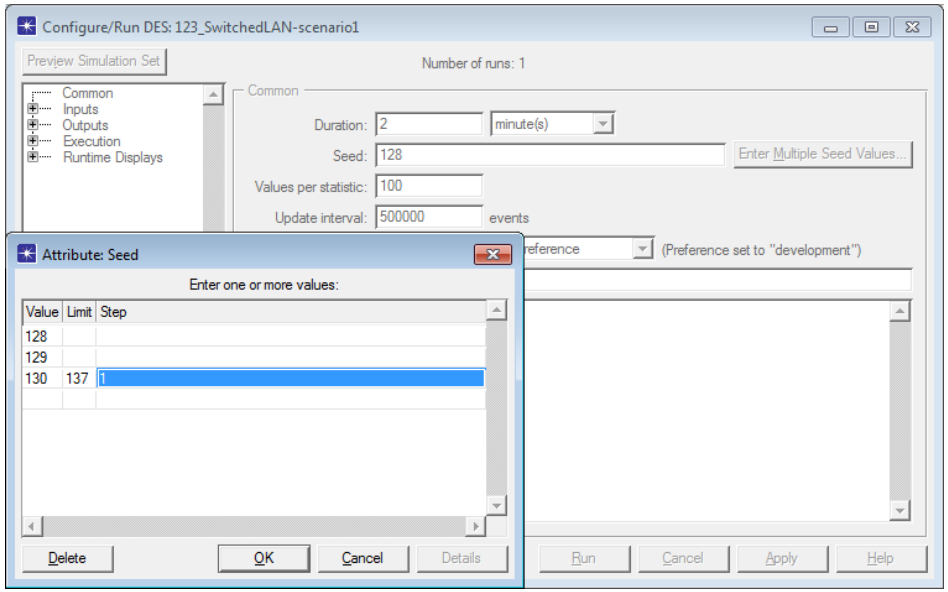
Configuring Simulations (cont'd)

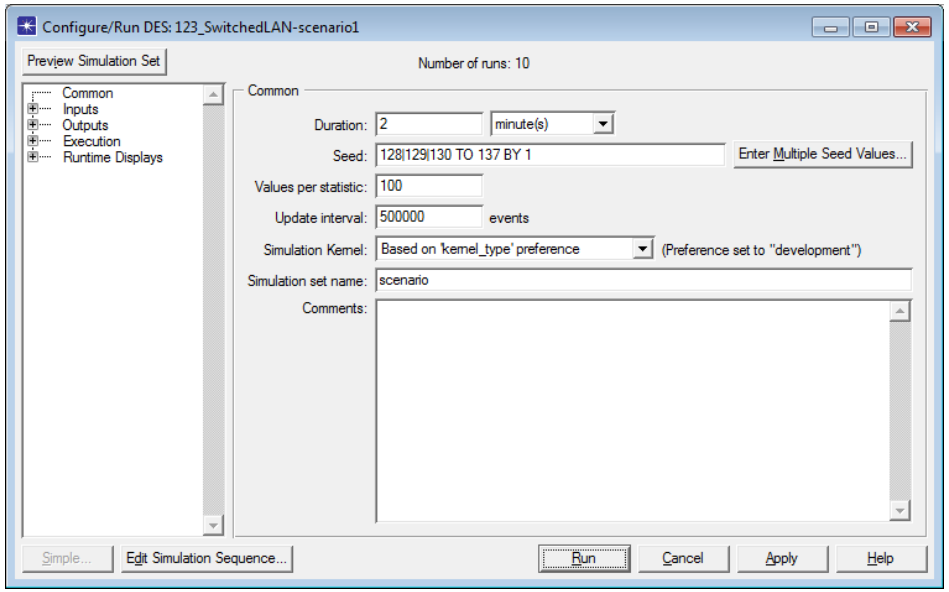
- Detailed mode of Configure/Run DES has multiple pages of controls



Configuring Simulations (cont'd)

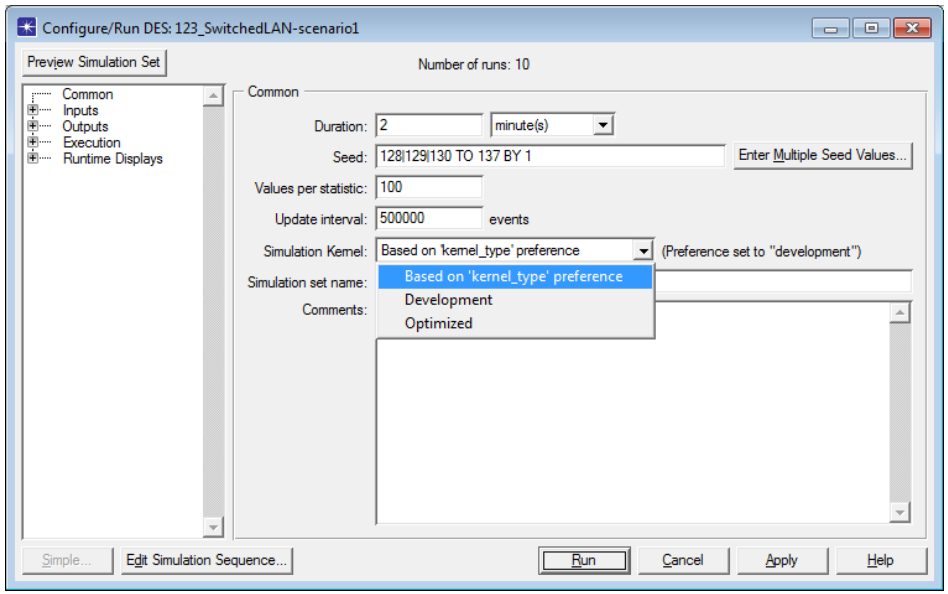
- **Common** – allows specification of commonly used parameters
- **Seed** – the seed value for the random number generator
- **Enter Multiple Seed Values...** – allows you to specify multiple seeds
  - Varying the random number seed across a family of simulations helps ensure statistical validity

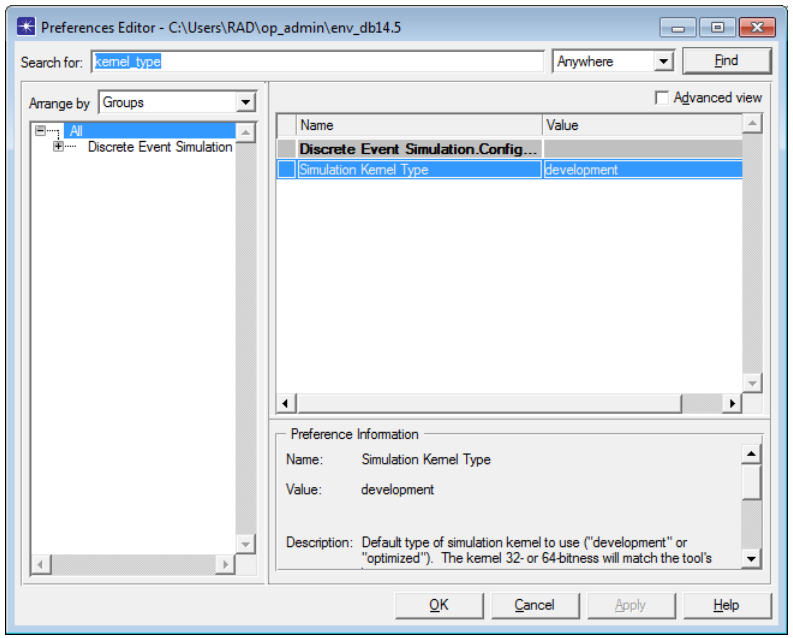




Configuring Simulations (cont'd)

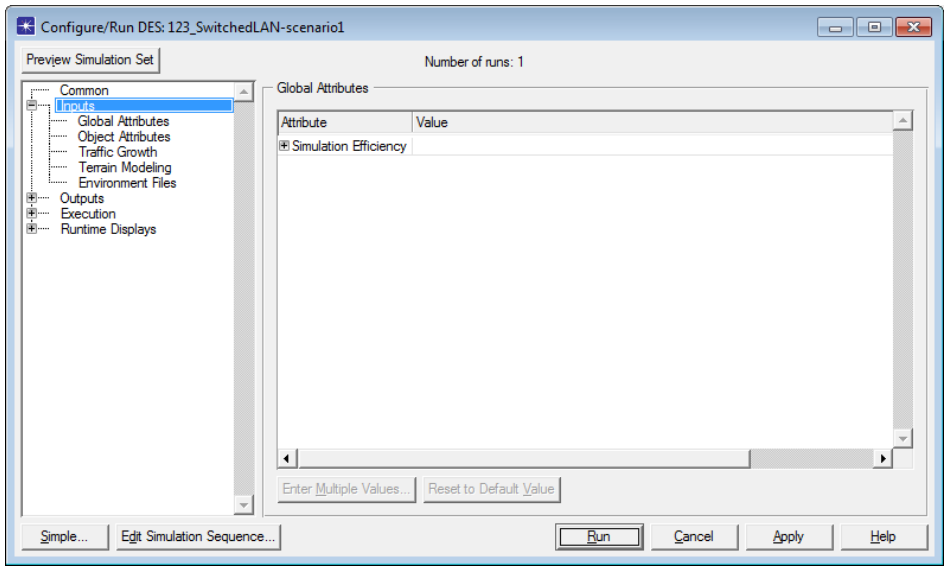
- **Update interval** – determines the frequency with which simulation progress reports are displayed in the simulation console
- **Simulation Kernel** – specifies the type of simulation kernel
  - **Development** – allows close monitoring and debugging of the simulation
  - **Optimized** – optimizes the code for fast execution

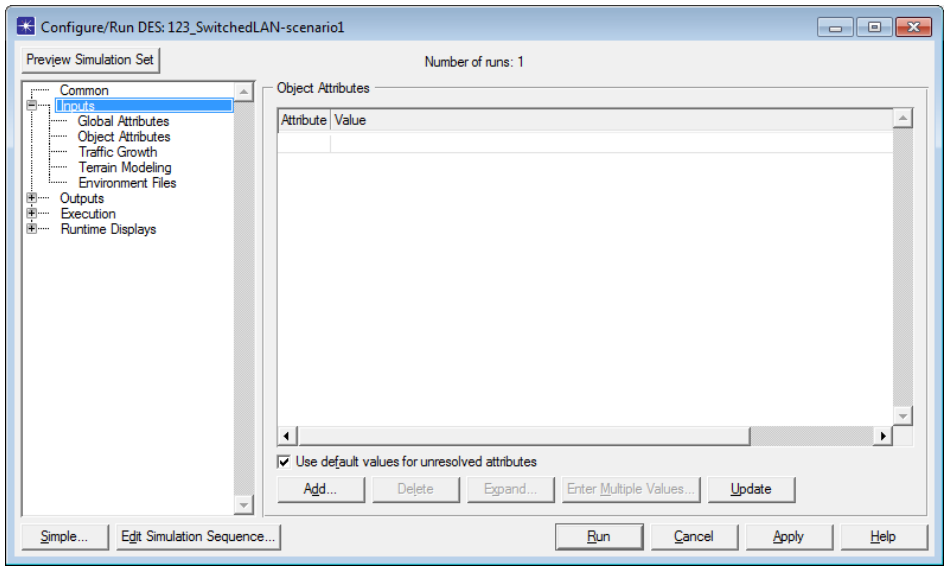




Configuring Simulations (cont'd)

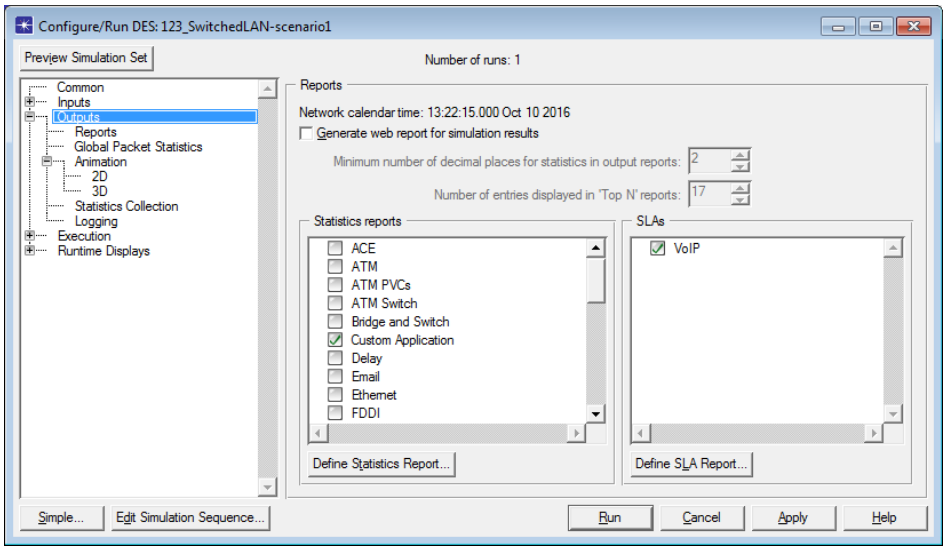
- **Inputs** – contains several subcategories that can be used to specify configuration items such as global attributes, promoted object attributes, traffic growth, terrain modeling, and environment files

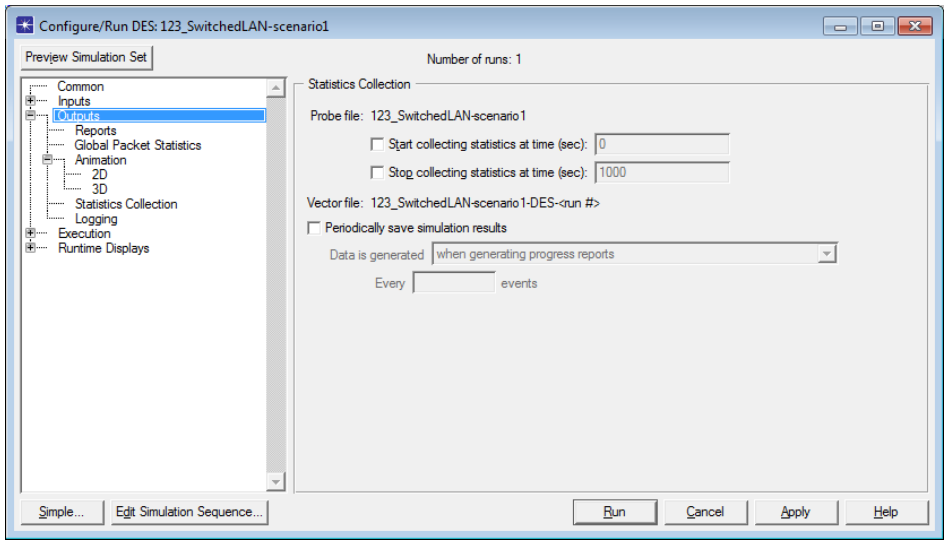




Configuring Simulations (cont'd)

- **Outputs** – contains several subcategories that allow configuring reports to be created upon simulation completion, the time period for collecting simulation statistics, simulation log data collection, animation, etc.

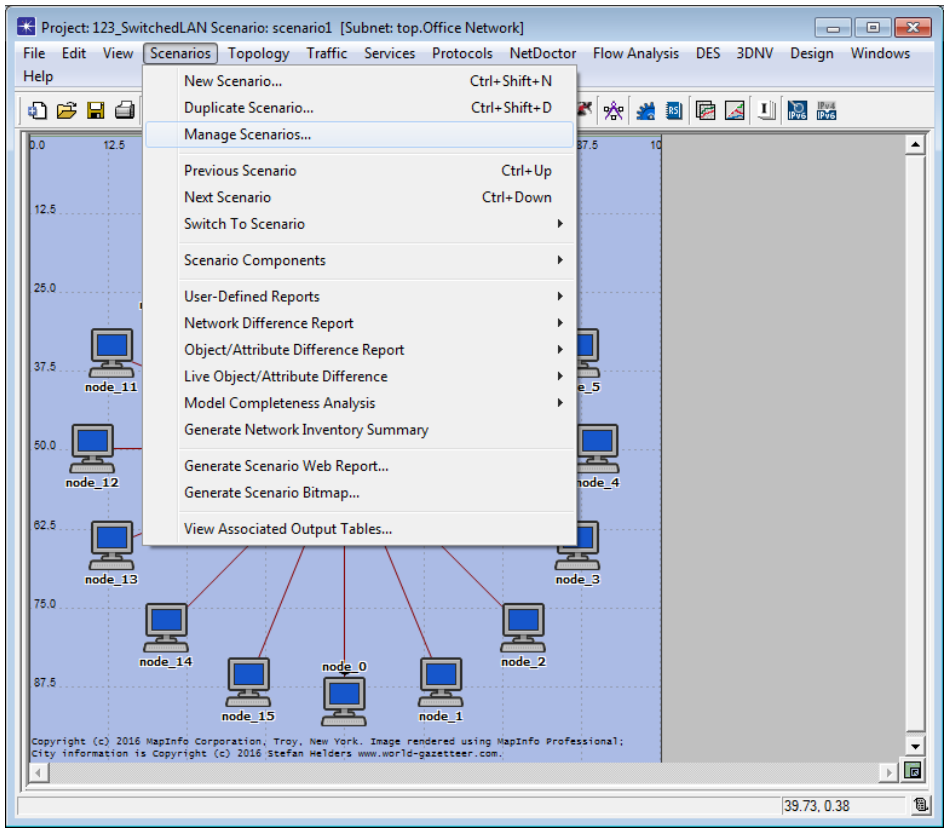


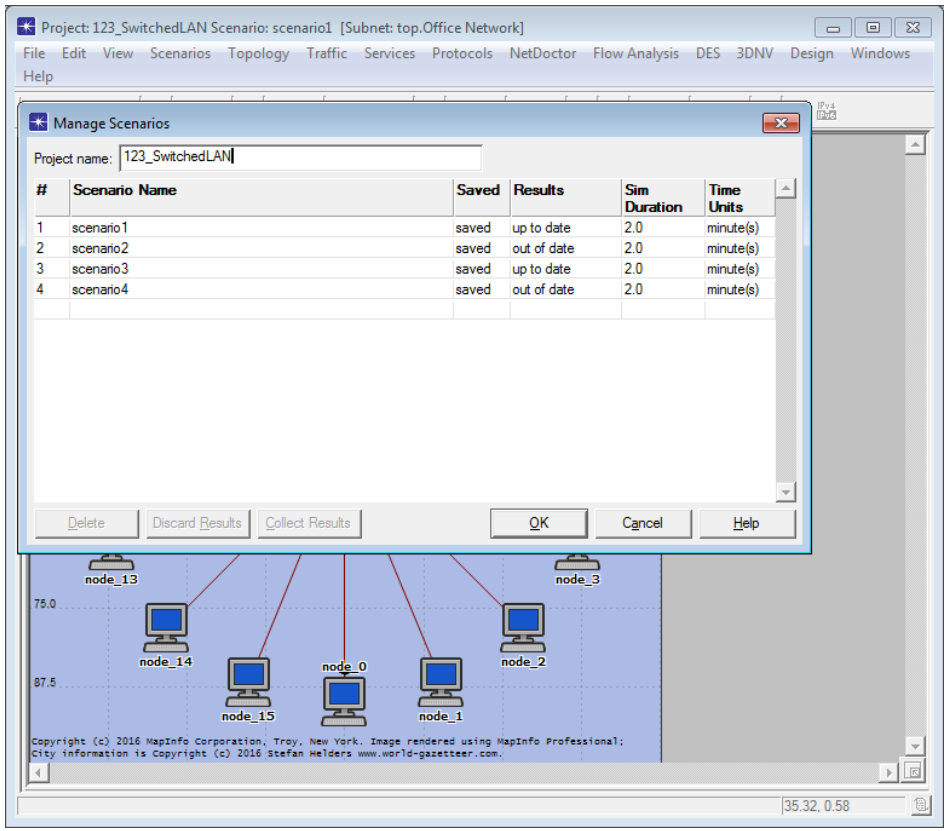


Outline

Manage Scenarios

- **Manage Scenarios** – organizes all scenarios within the project in the form of a table
- Scenarios ⇒ Manage Scenarios...

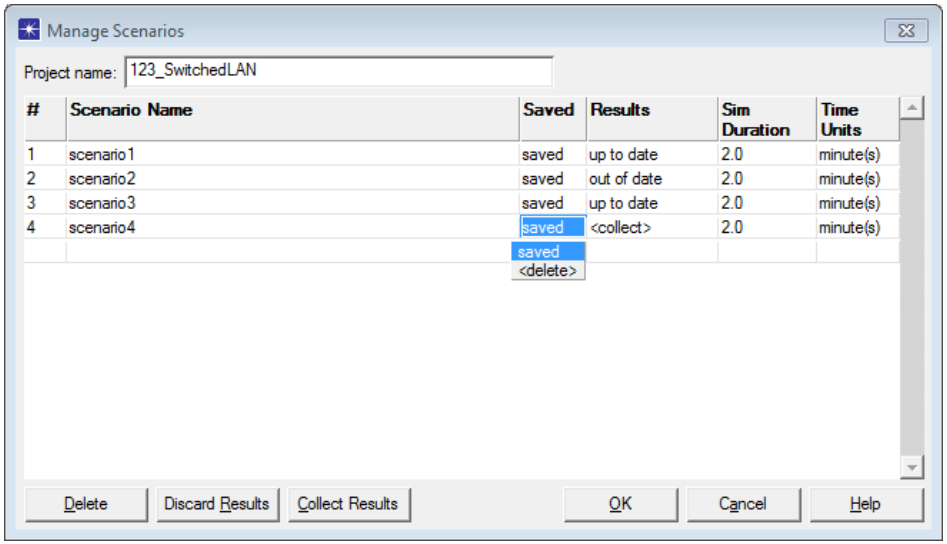


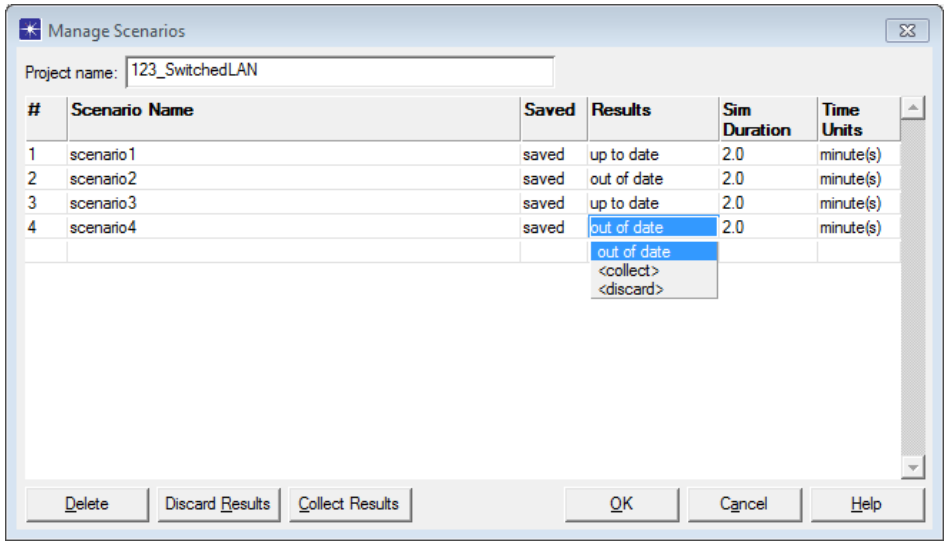


Manage Scenarios (cont'd)

- **OK** – saves all the changes, plus all scenarios marked to <collect> or <recollect> the results will automatically begin executing in the order of their scenario numbers

- **Cancel** – discards all the changes and closes the window

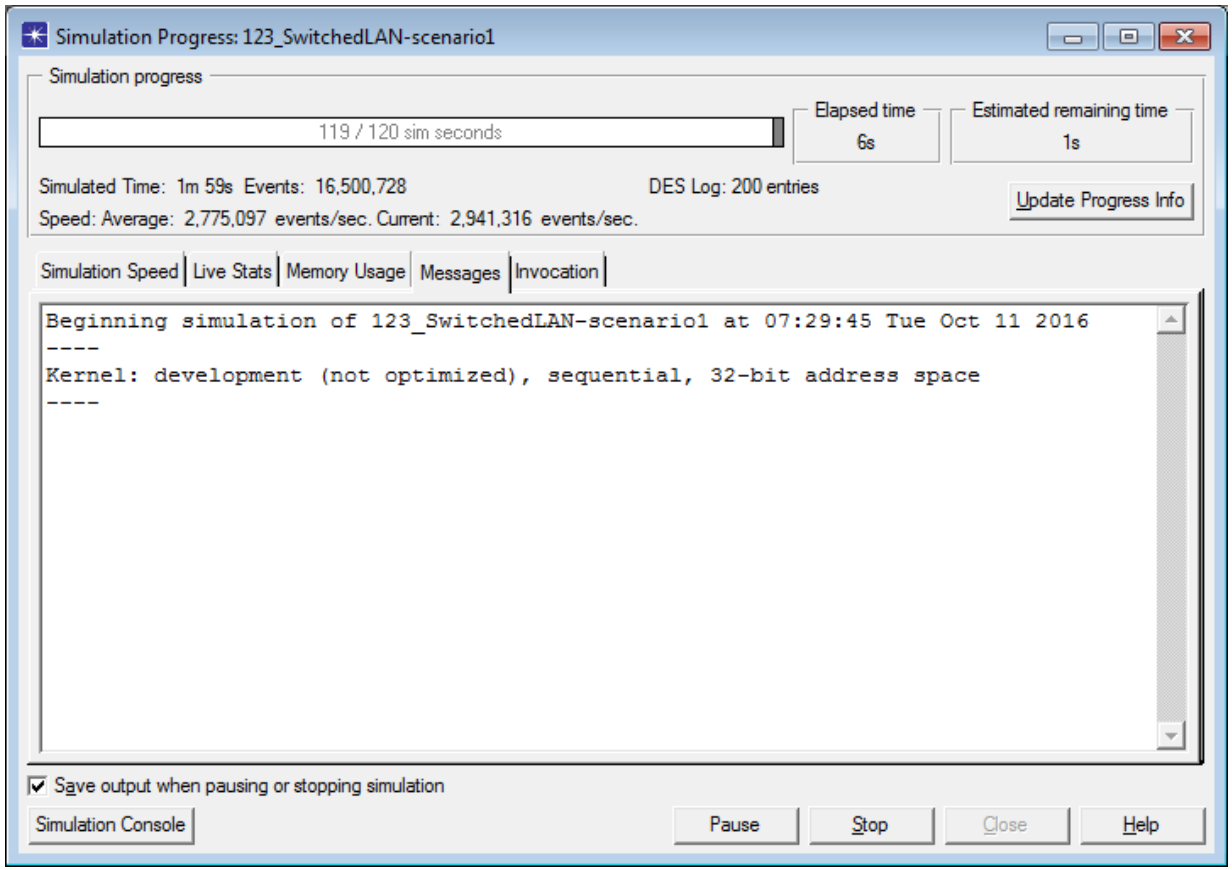




Outline

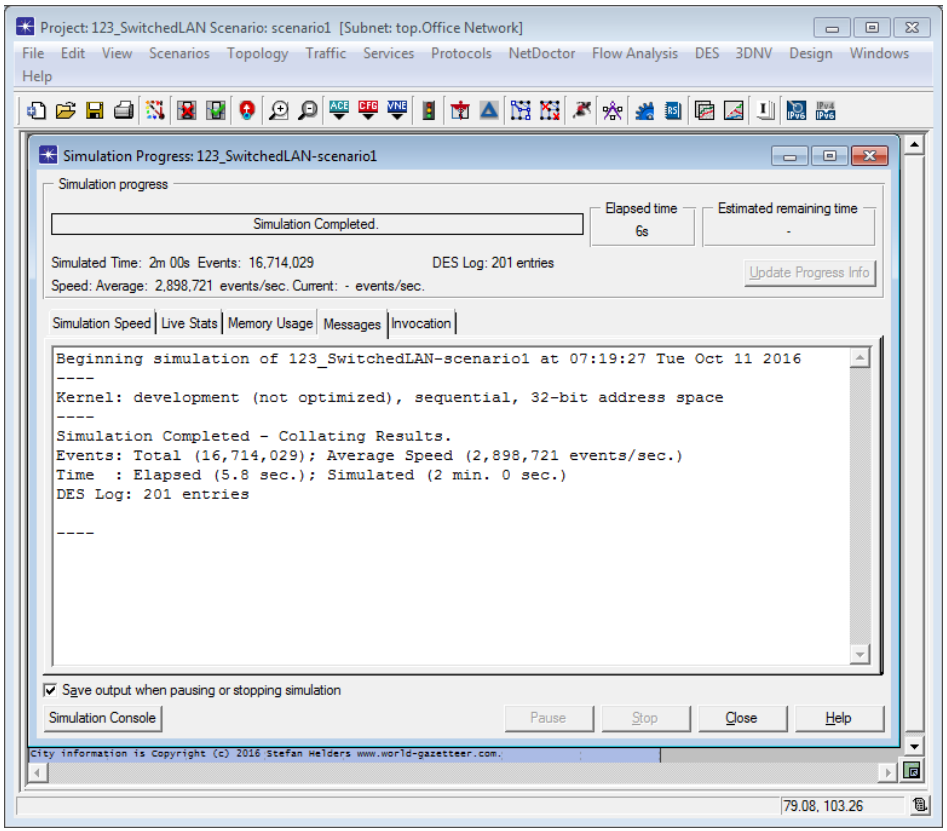
Running Simulations

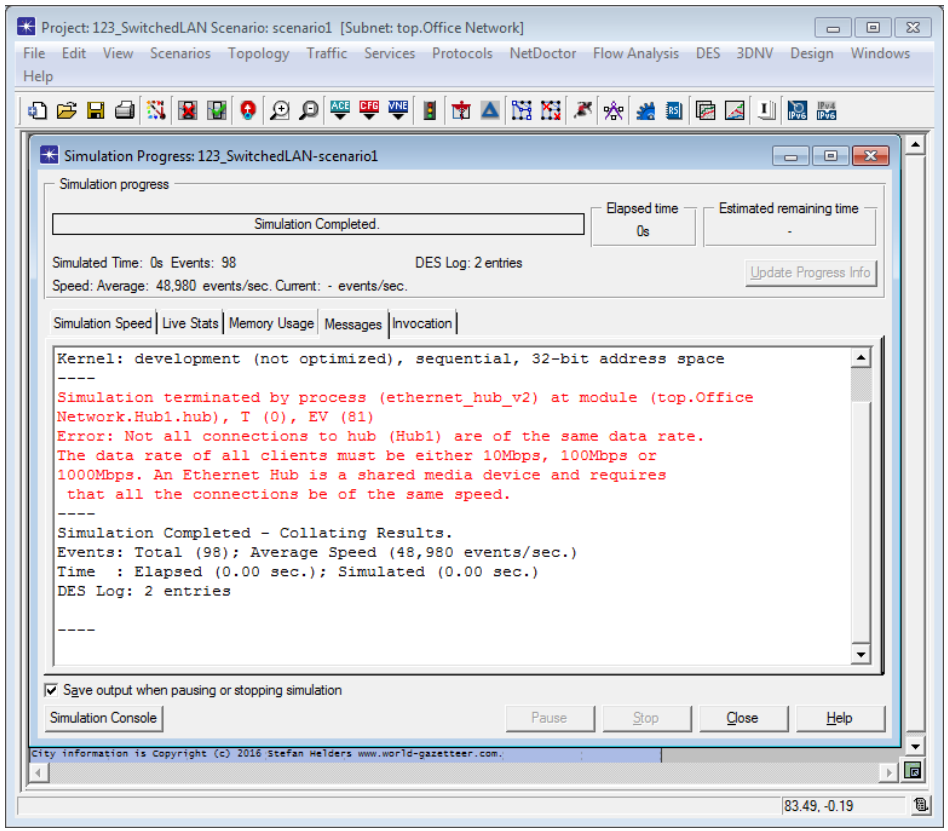
- **Pause** – suspends simulation execution
- **Resume** – resumes simulation execution
- **Stop** – terminates simulation execution, resulting in only partial simulation results being collected



Running Simulations (cont'd)

- Once the simulation completes, the simulation progress pane will display the message 'Simulation Completed' and will have the 'Close' button enabled

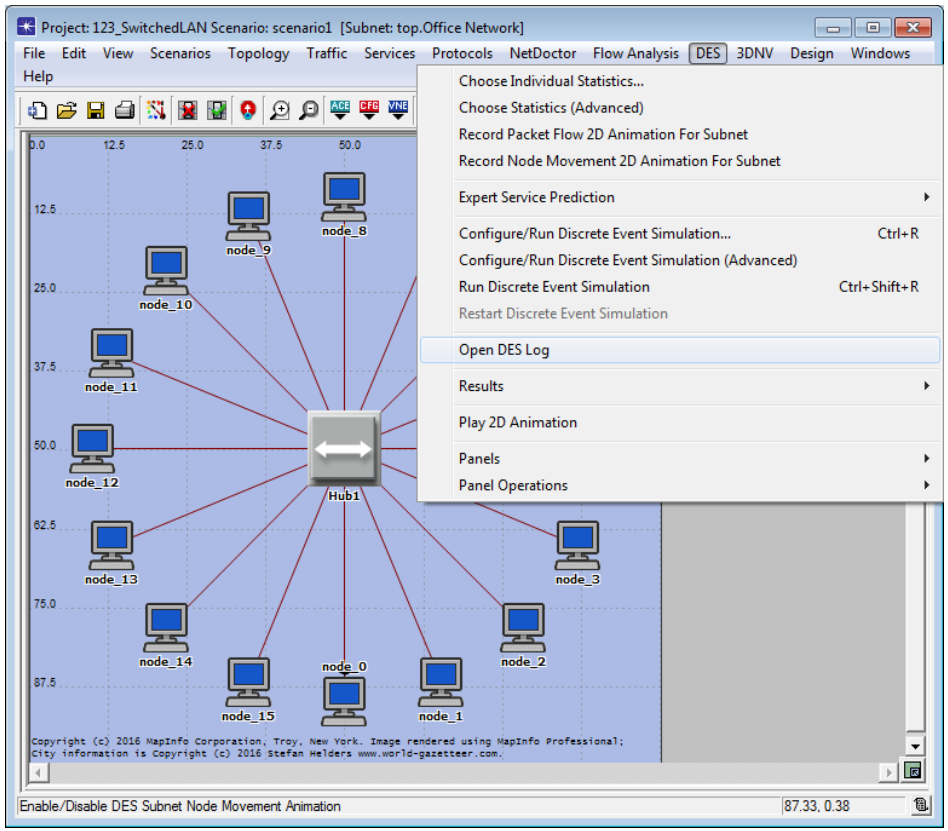


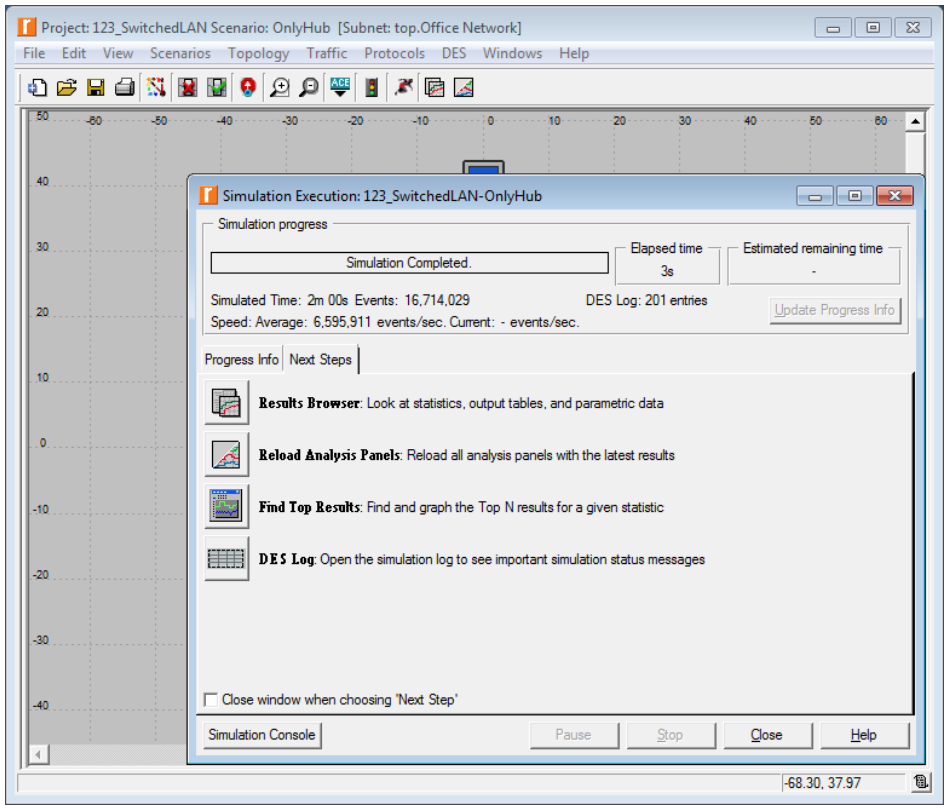


Outline

DES Log

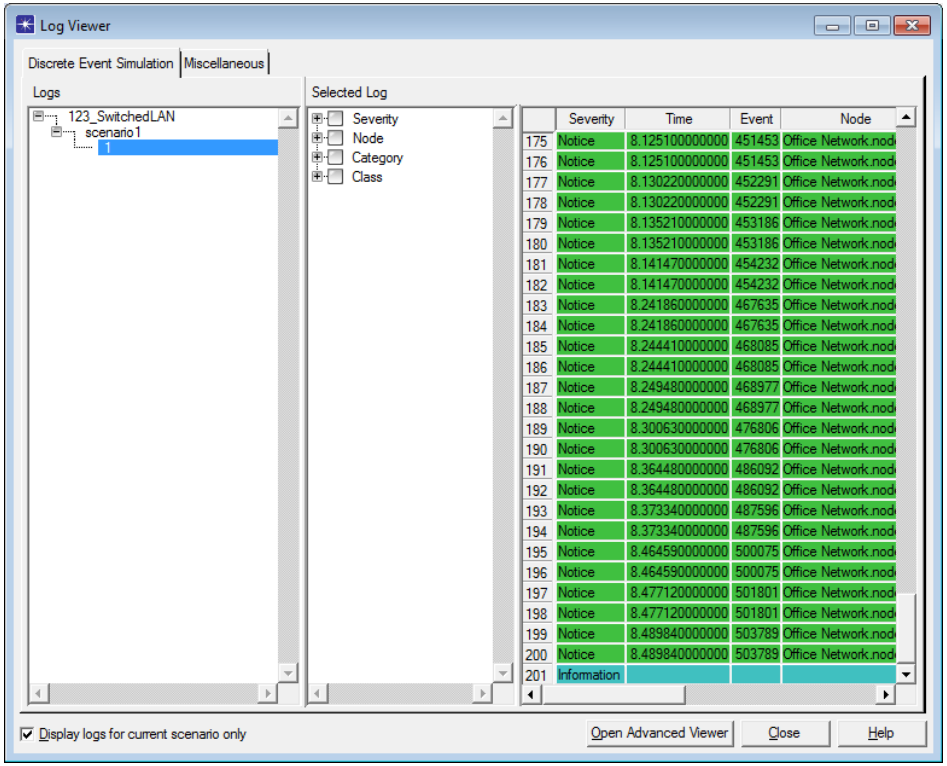
- **DES Log** – records all important events that occur during the simulation study
- DES ⇒ Open DES Log

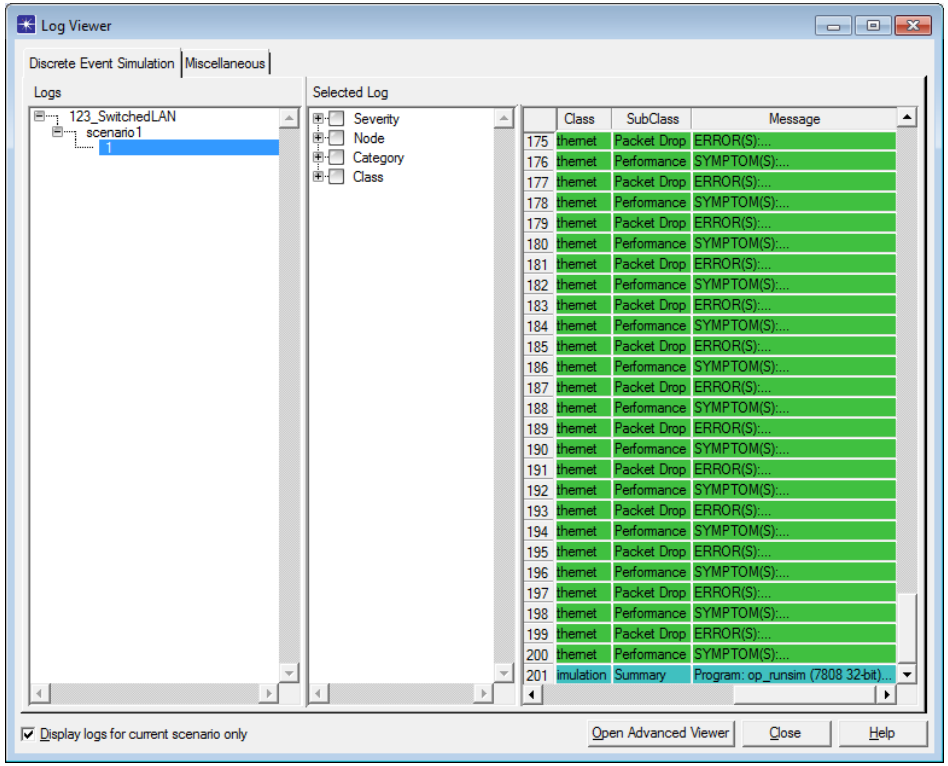




DES Log (cont'd)

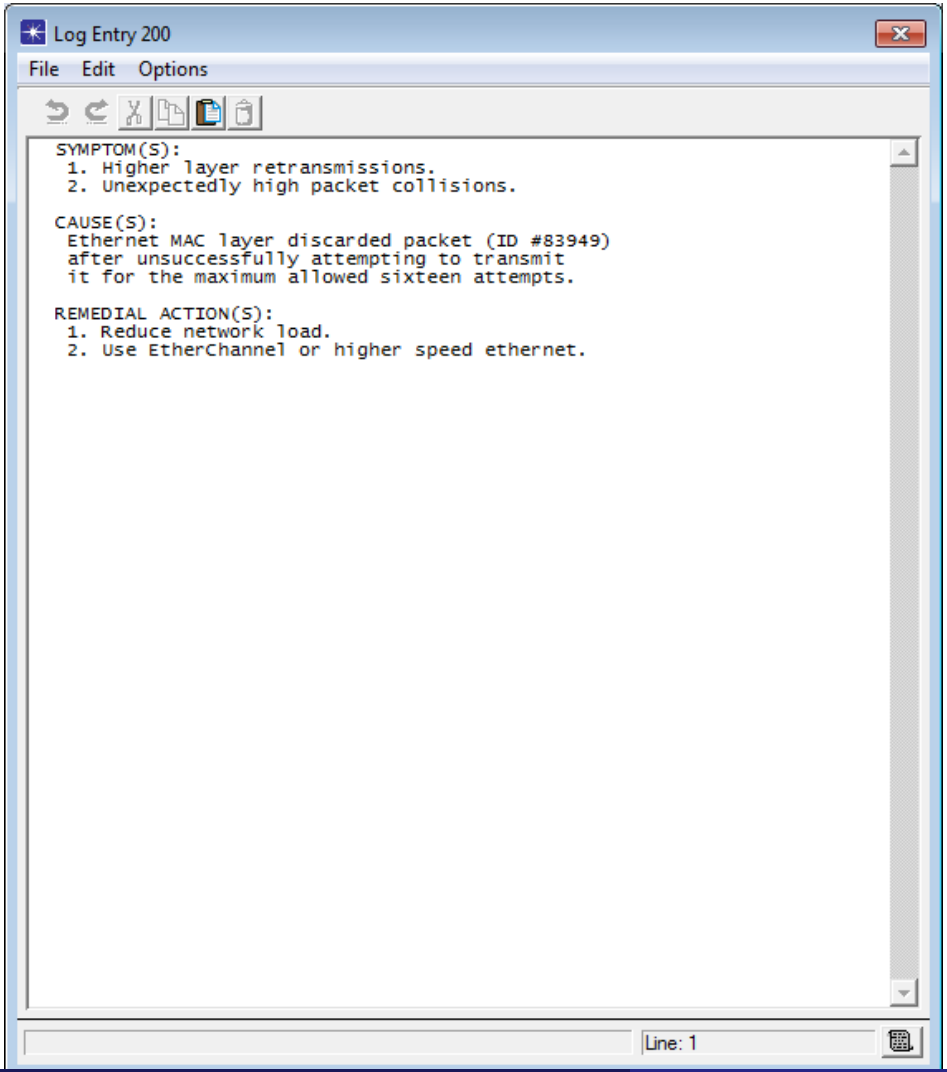
- Log Viewer ⇒ Scroll to the right for an explanation message

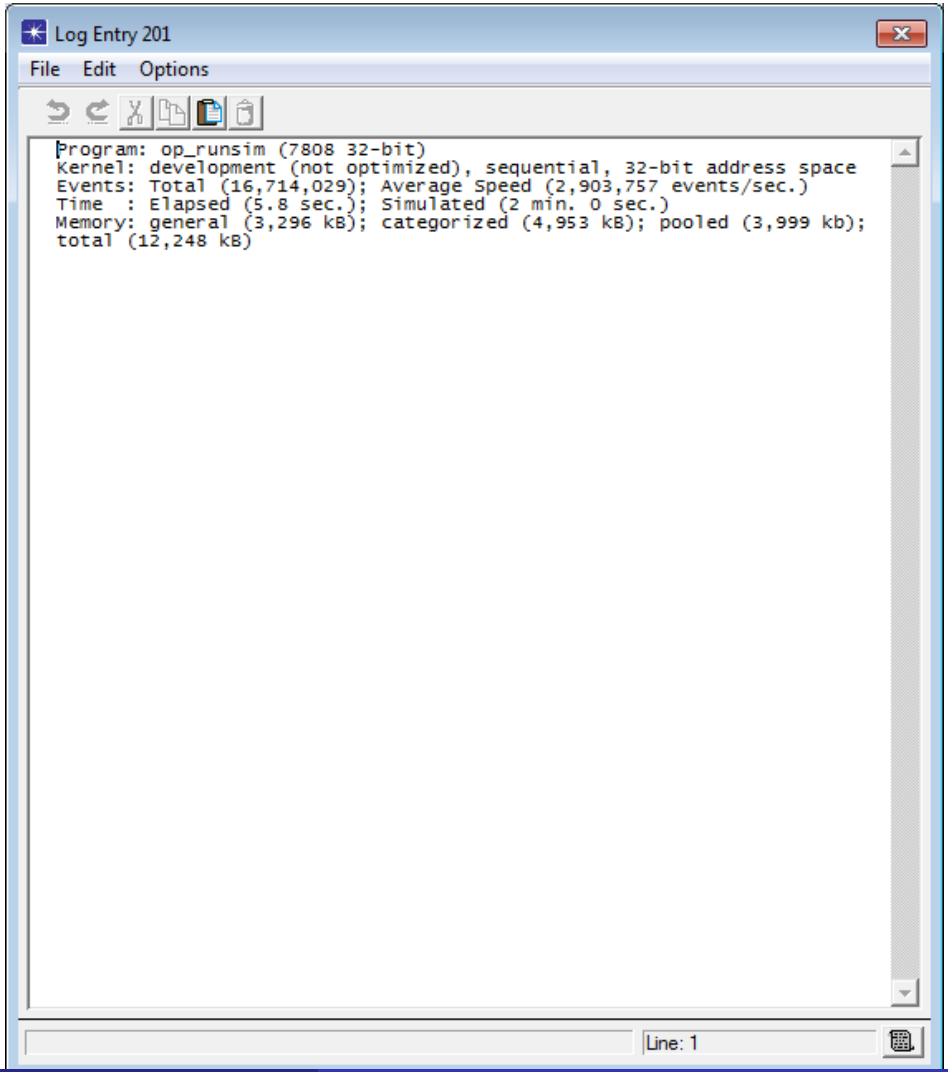




DES Log (cont'd)

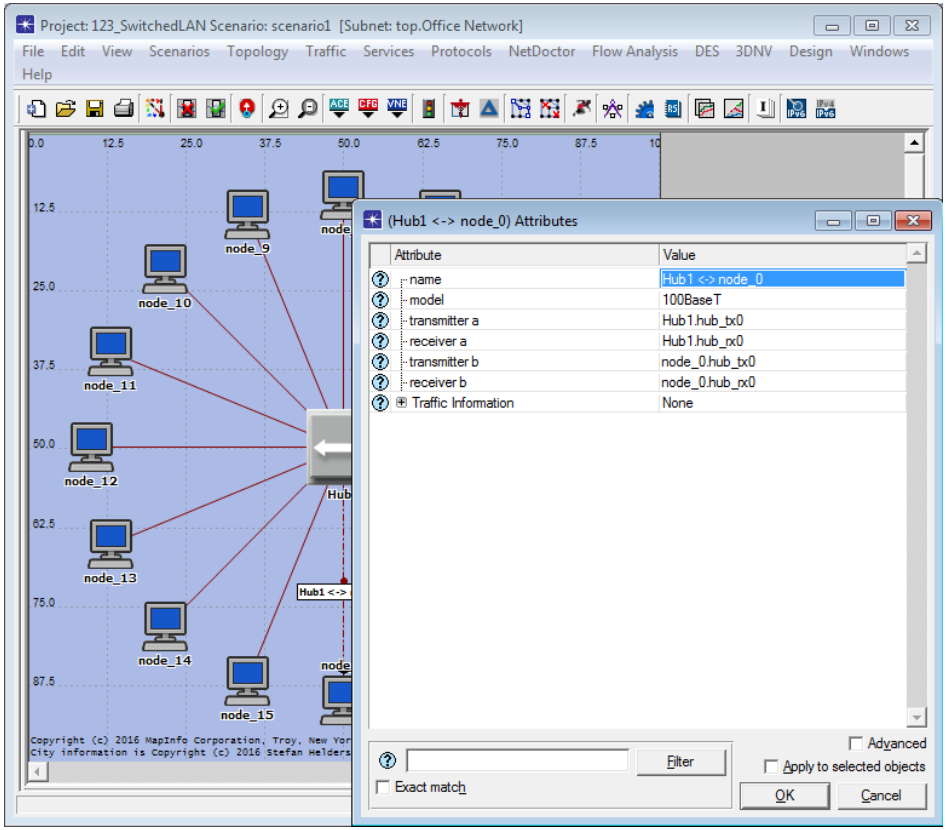
- Each simulation run results in at least one DES Log message generated

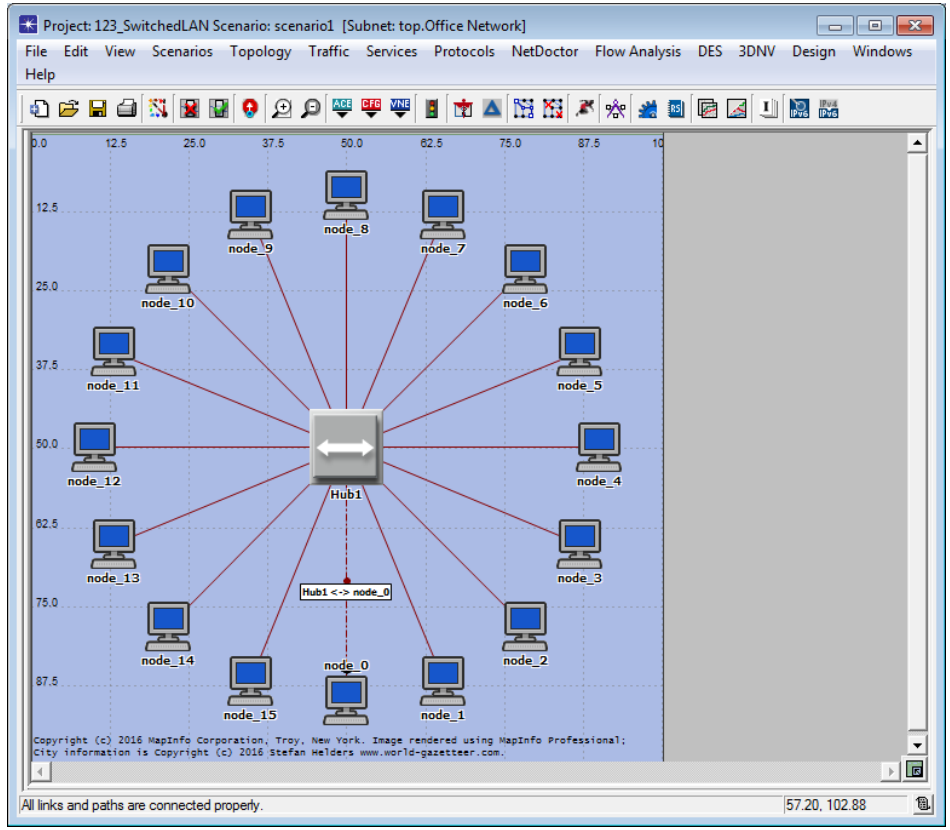




DES Log (cont'd)

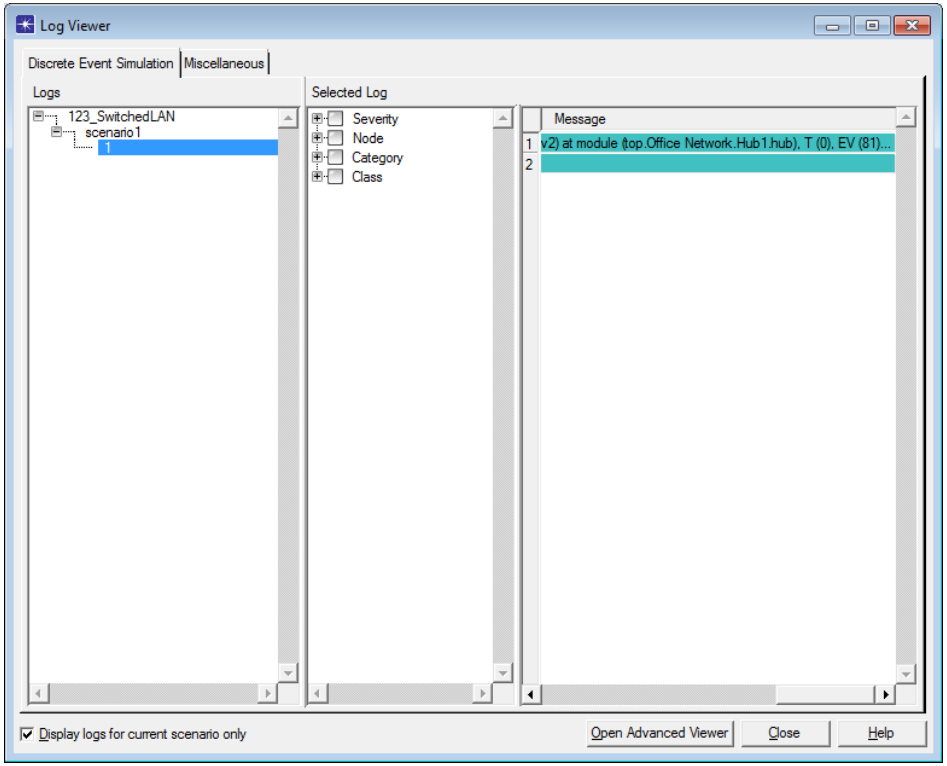
- 'All links and paths are connected properly.' Oh really? ☺

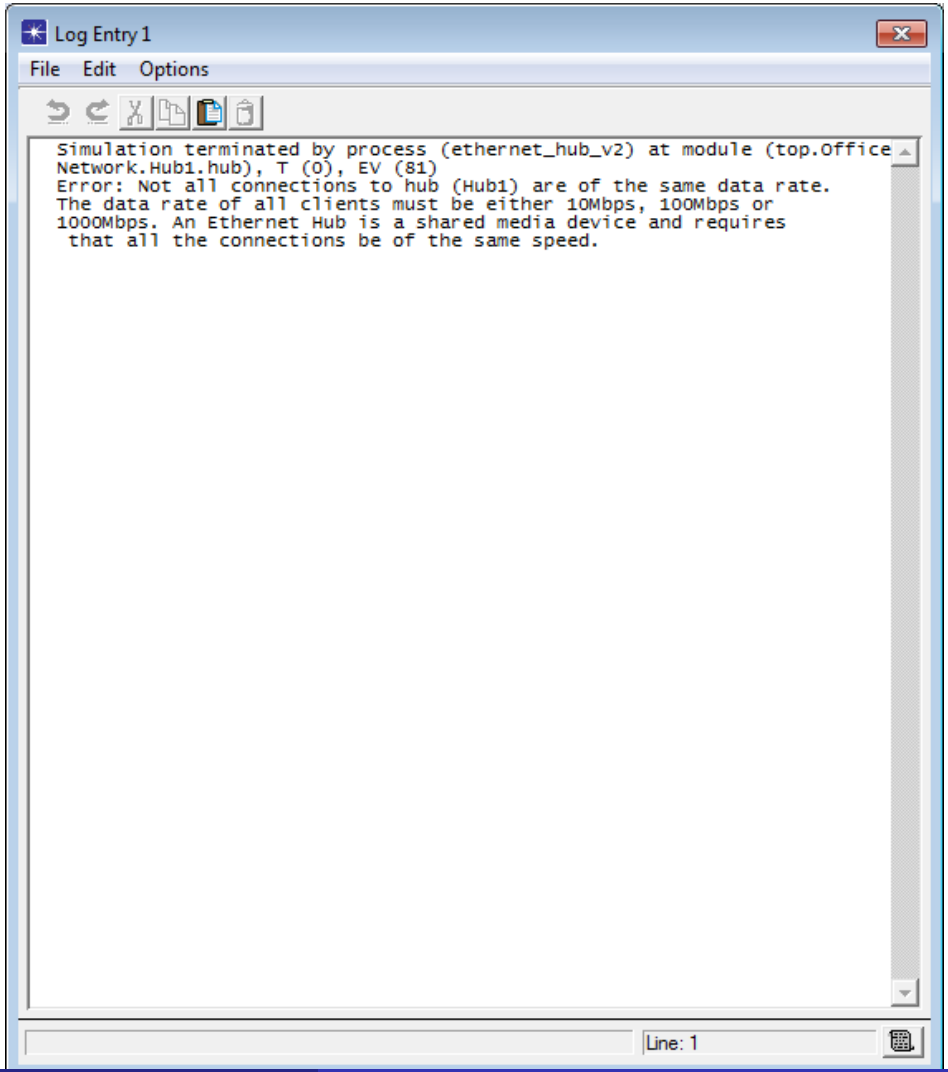




DES Log (cont'd)

- Let's see... ☺





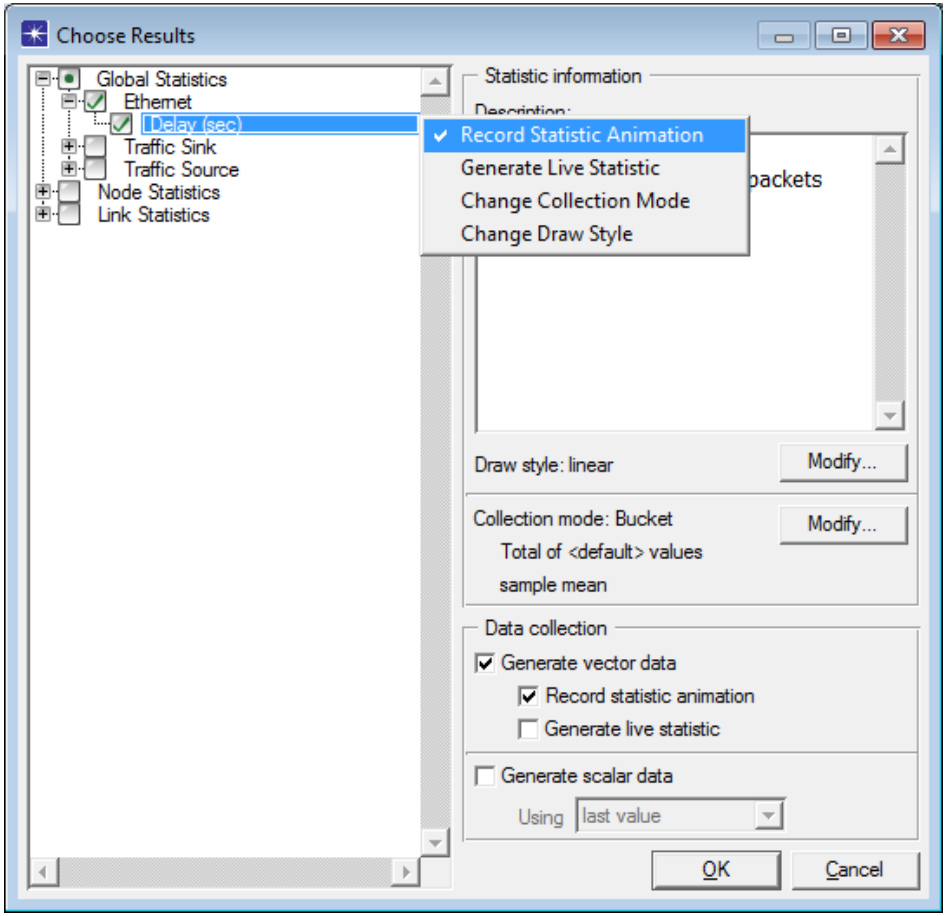
Outline

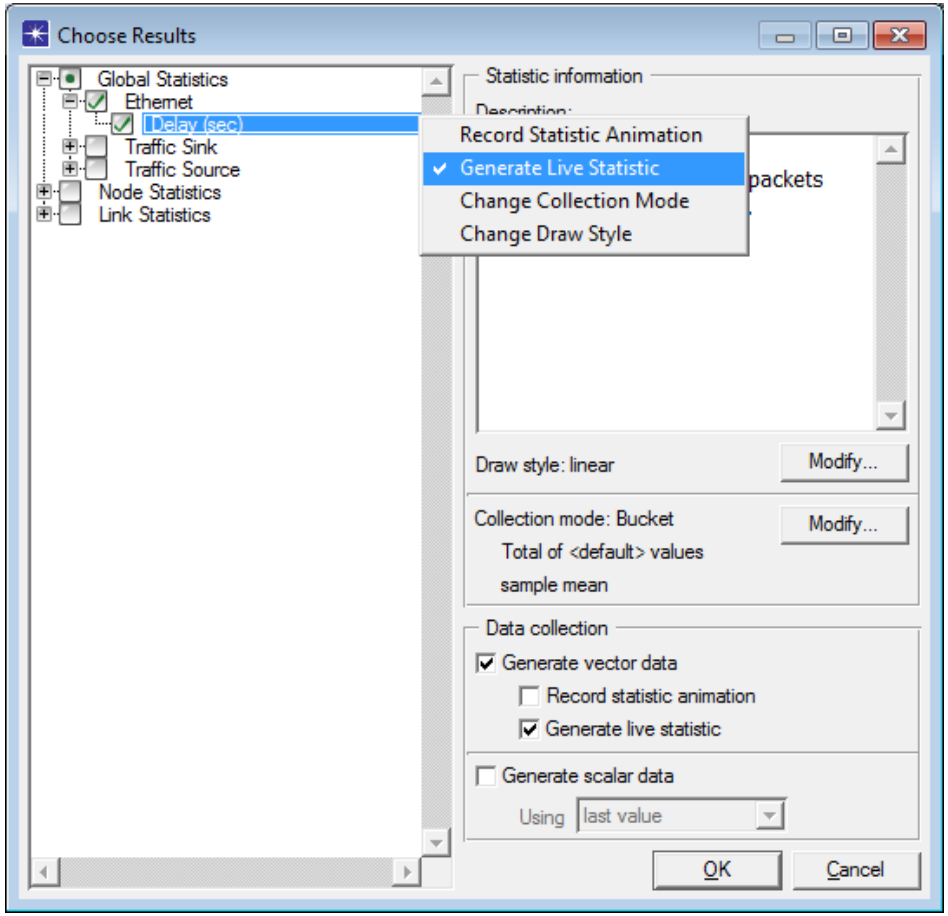
Animation

- 3 types of animation:
  - **Statistic Animation** – shows a graph illustrating the value of a given statistic
  - **Packet Flow Animation** – shows the network as it is represented in the scenario, with packets traversing the links
  - **Node Animation** – shows how nodes operate or move during a simulation study

Animation (cont'd)

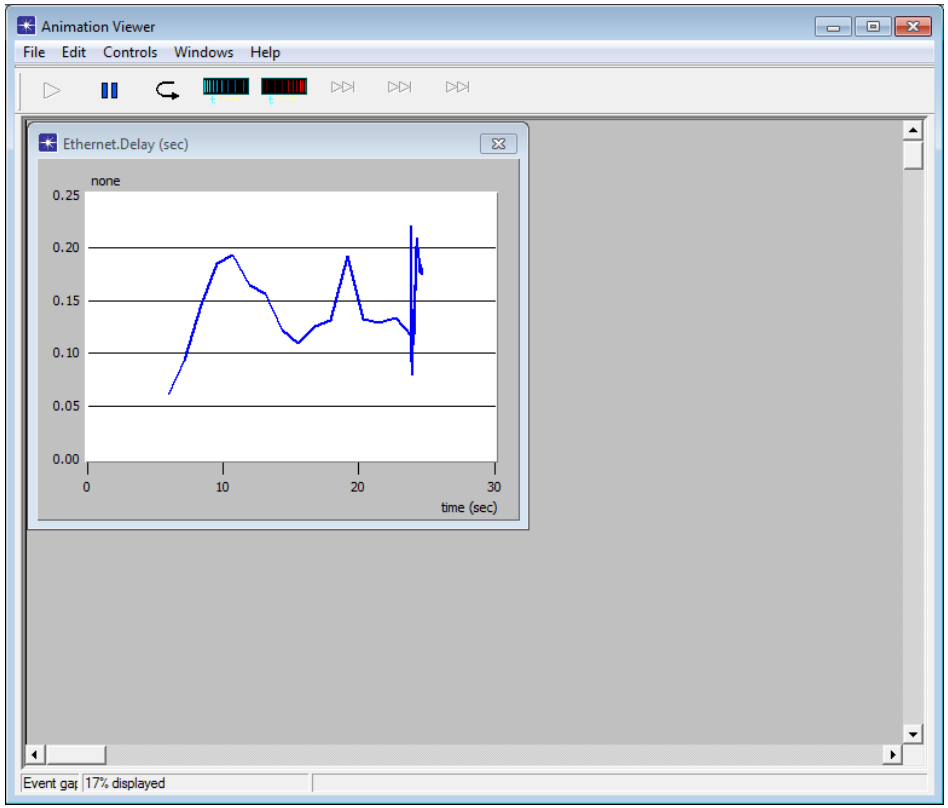
1. **Record Statistic Animation** vs. **Generate Live Statistic**

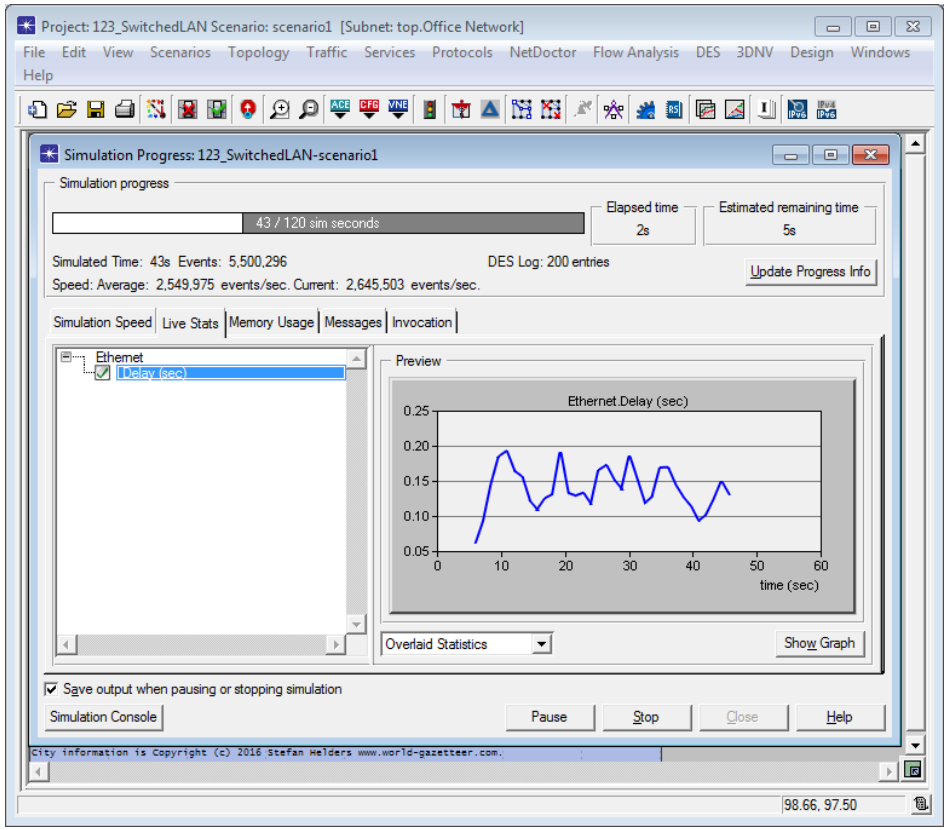




Animation (cont'd)

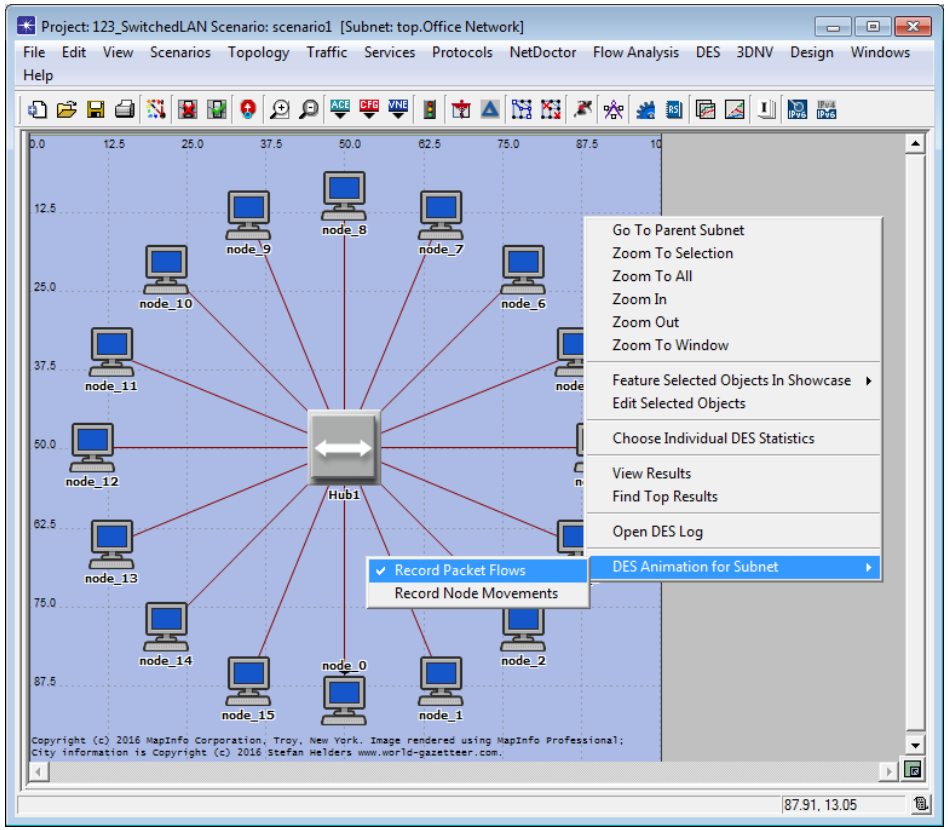
1. **Record Statistic Animation** vs. **Generate Live Statistic**
   - DES ⇒ Play 2D Animation
   - DES ⇒ Configure/Run Discrete Event Simulation... ⇒ Run ⇒ ⇒ Live Stats

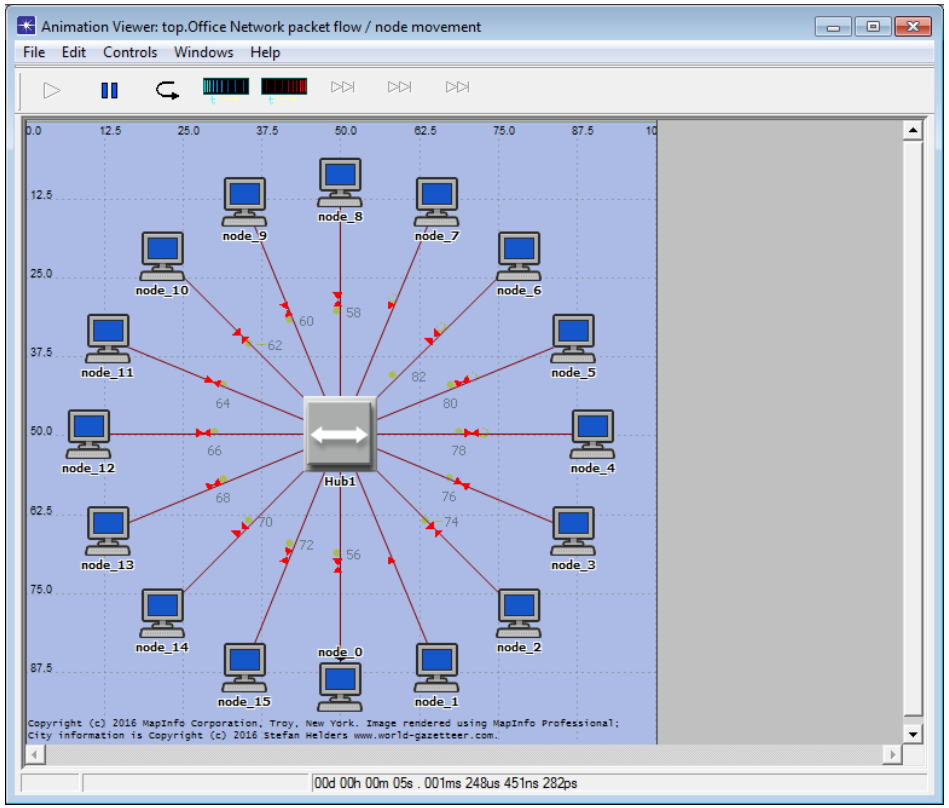




Animation (cont'd)

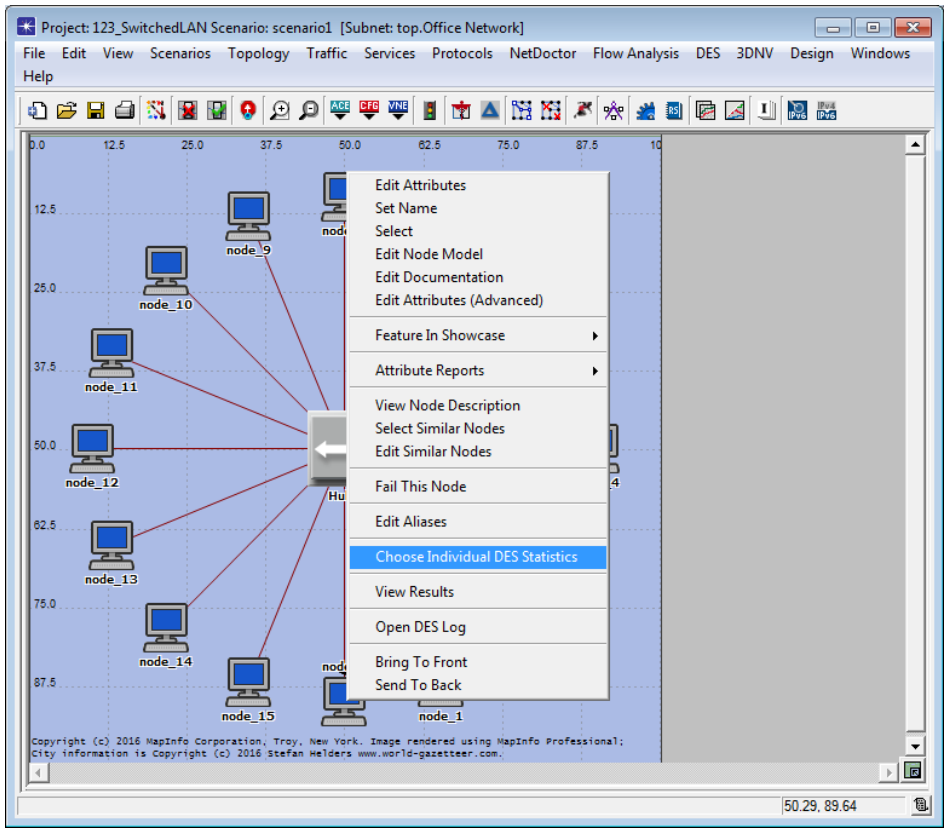
2. Packet Flow Animation
   - DES Animation for Subnet ⇒ Record Packet Flows
   - DES ⇒ Configure/Run Discrete Event Simulation... ⇒ Run
   - DES ⇒ Play 2D Animation

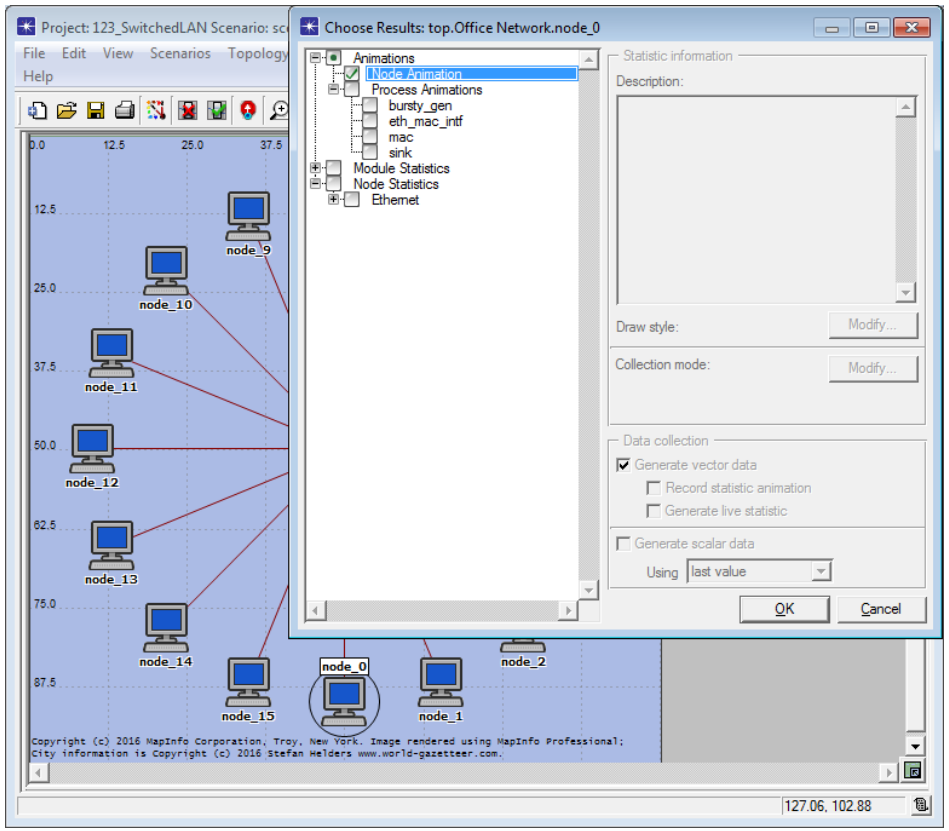




Animation (cont'd)

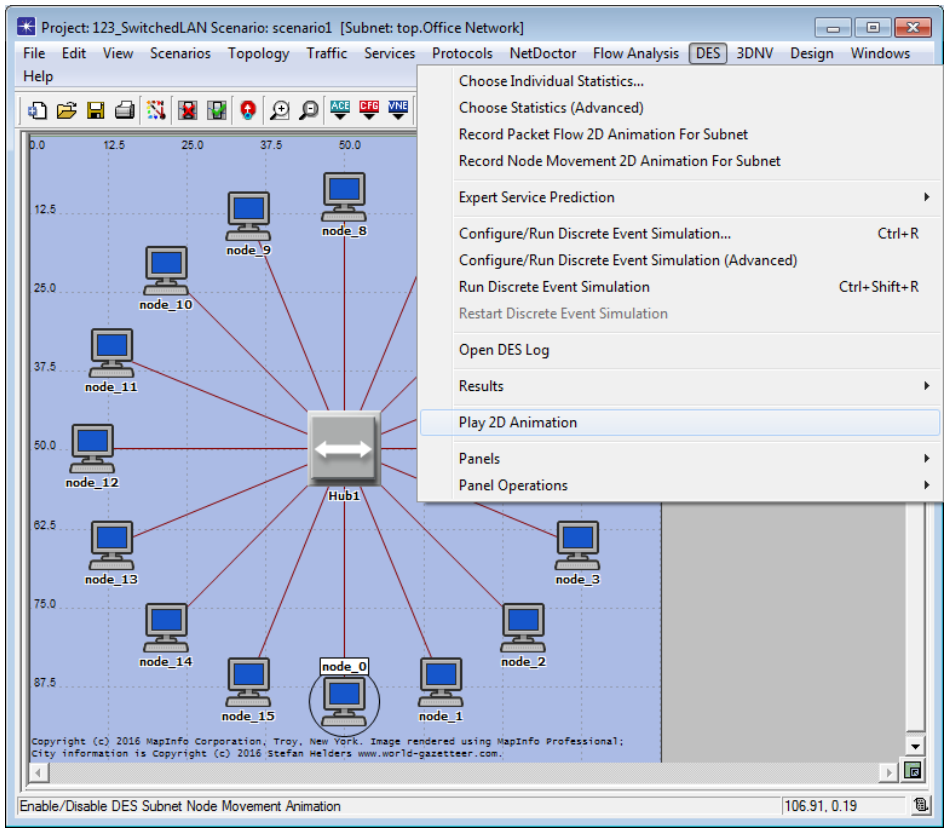
3. Node Animation
   - Choose Individual DES Statistics ⇒ Animations ⇒ Node Animation ⇒ ⇒ OK

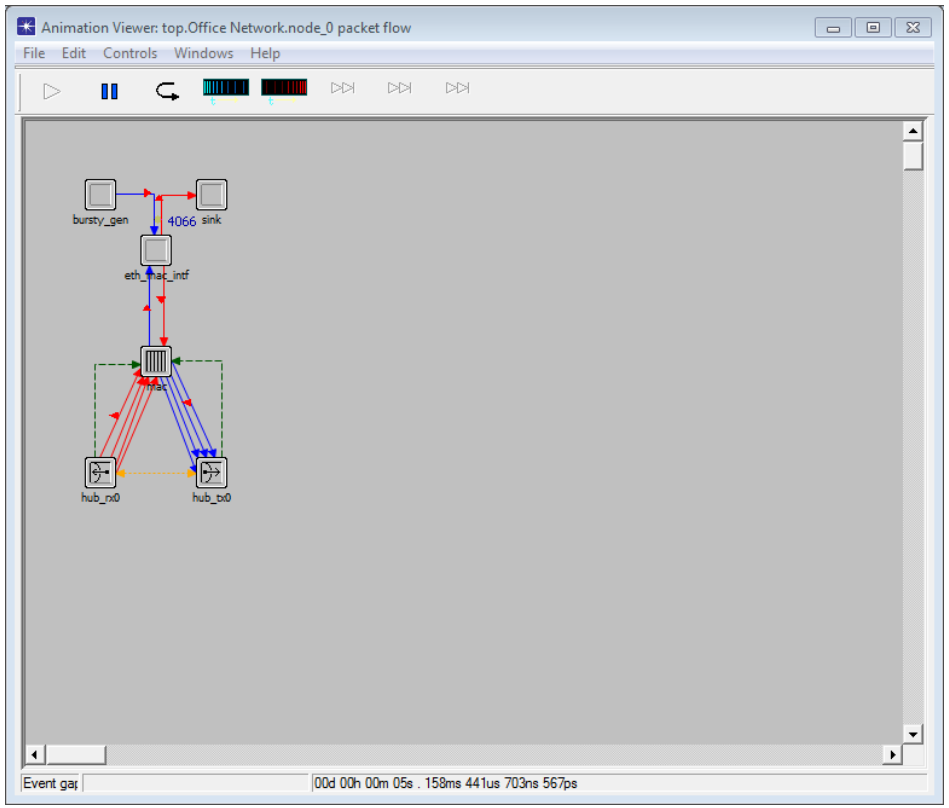




Animation (cont'd)

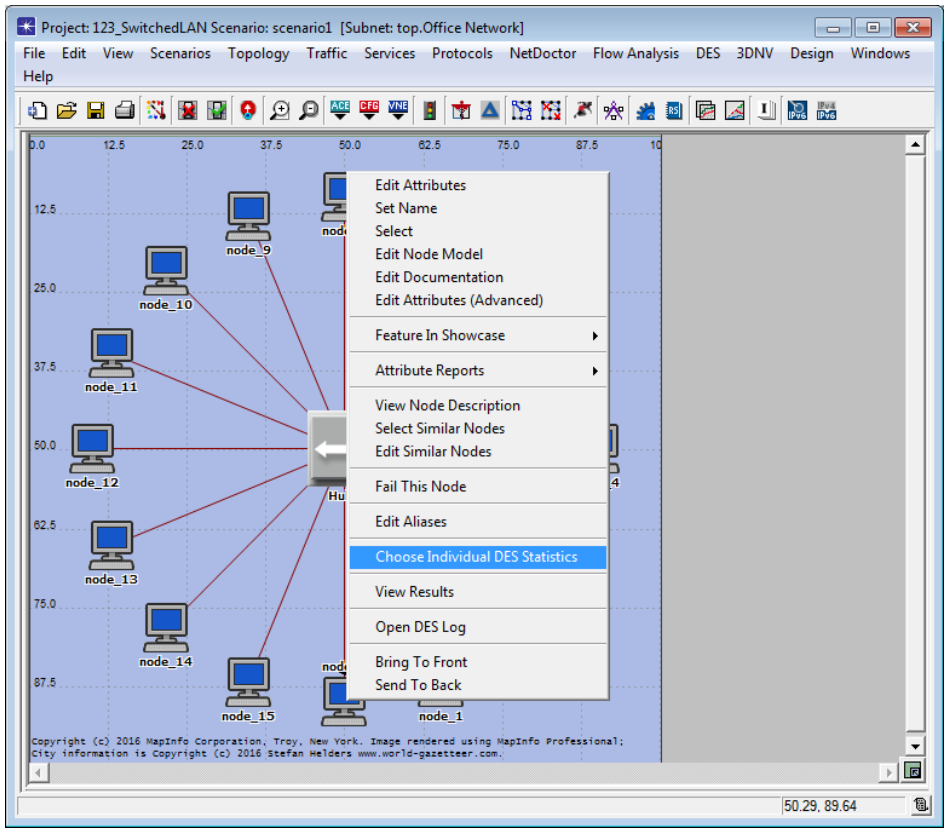
3. Node Animation
   - DES ⇒ Configure/Run Discrete Event Simulation... ⇒ Run
   - DES ⇒ Play 2D Animation

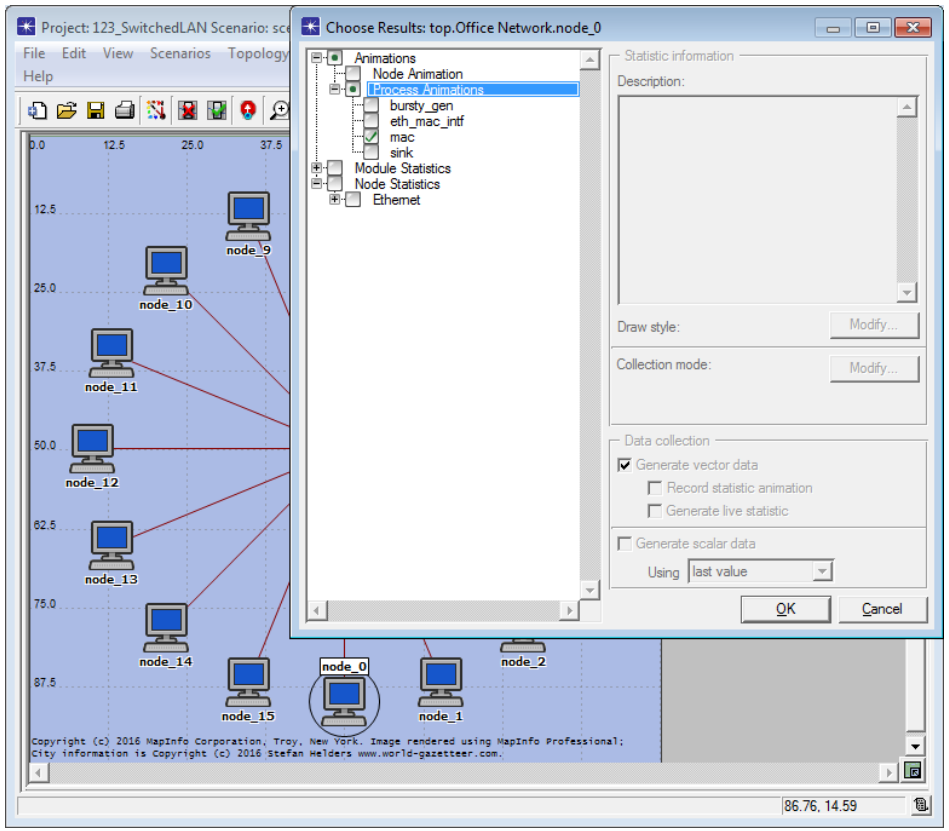




Animation (cont'd)

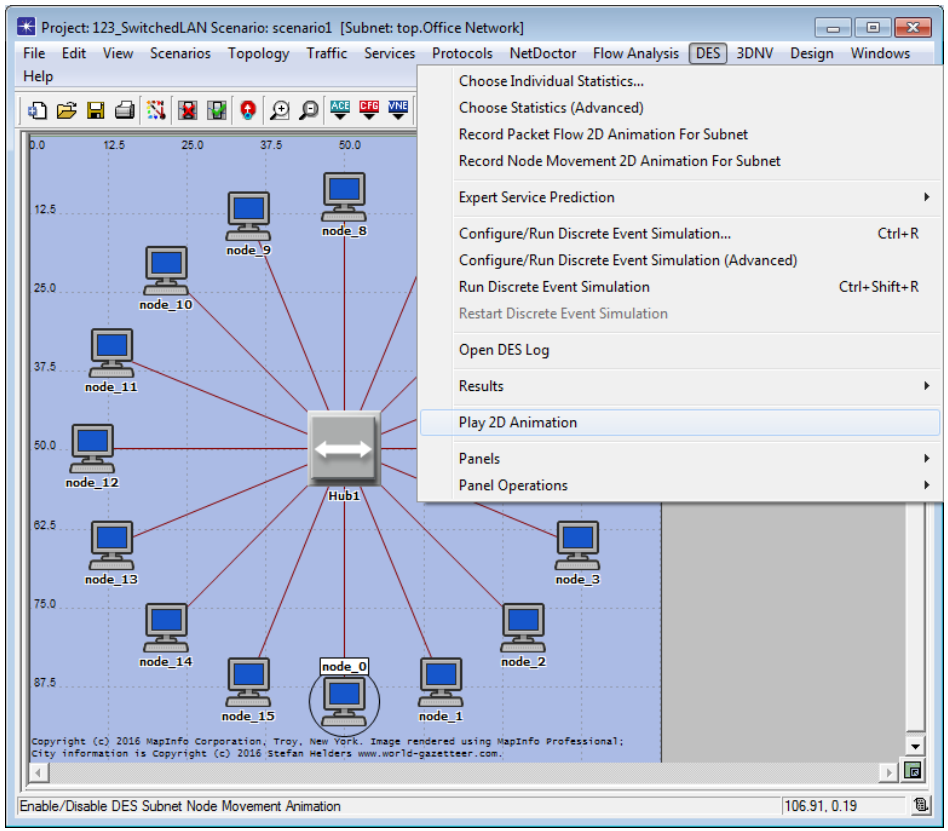
3. Node/Process Animation
   - Choose Individual DES Statistics ⇒ Animations ⇒ ⇒ Process Animation ⇒ bla-bla-bla⇒ OK

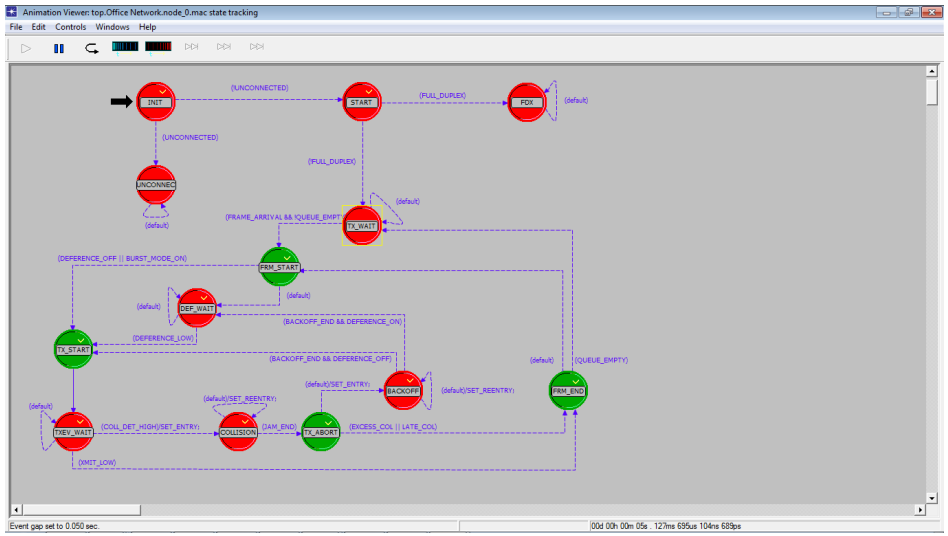




Animation (cont'd)

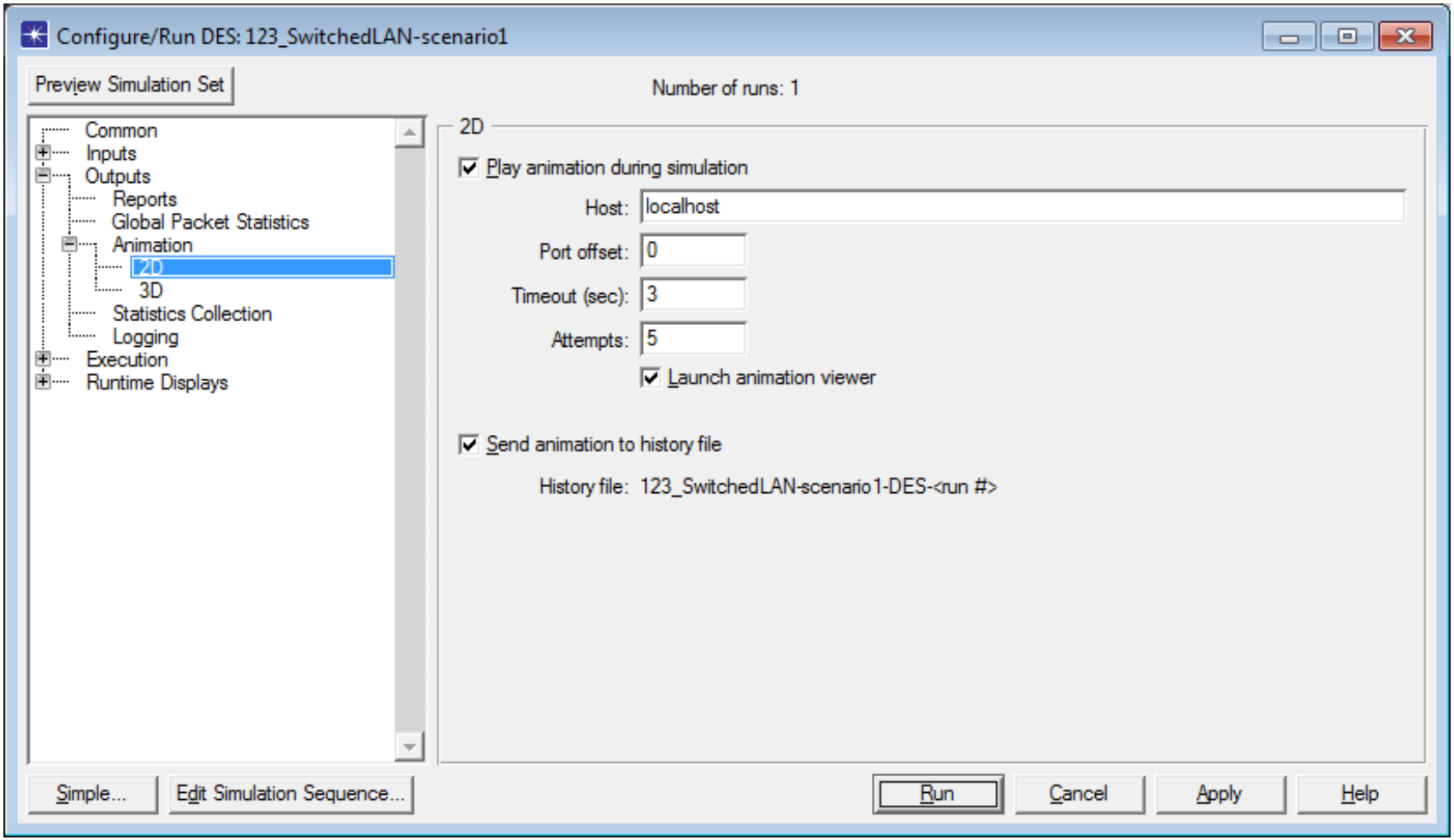
3. Node/Process Animation
   - DES ⇒ Configure/Run Discrete Event Simulation... ⇒ Run
   - DES ⇒ Play 2D Animation





Animation (cont'd)

- DES ⇒ Configure/Run Discrete Event Simulation... ⇒ Outputs ⇒ ⇒ Animation ⇒ 2D ⇒ Play animation during simulation



Animation (cont'd)

- **Riverbed Modeler Academic Edition**: no Animation Viewer ☹
  - 123_SwitchedLAN-OnlyHub-DES-1.ah : $\sim$ 161 MB