

OpenSimMPLS



Quick user guide

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Introduction

OpenSimMPLS is a MPLS network simulator, written in Java, portable and Multilanguage. It can simulate:

- Single-domain MPLS networks (use only LERs, LSRs, traffic generators and traffic sinks if you want to simulate this kind of networks).
- Single-domain MPLS networks that support Guarantee of Service (GoS) using active techniques (mix LERs, LSRs, active LERs, active LSRs, traffic generators and traffic sinks, as desired, if you want to simulate this kind of networks).

This guide is a little help so you can take your first steps with the simulator quickly. Therefore it is brief and schematic.

Requirements

You need to have installed in your operating system:

- Java 9.

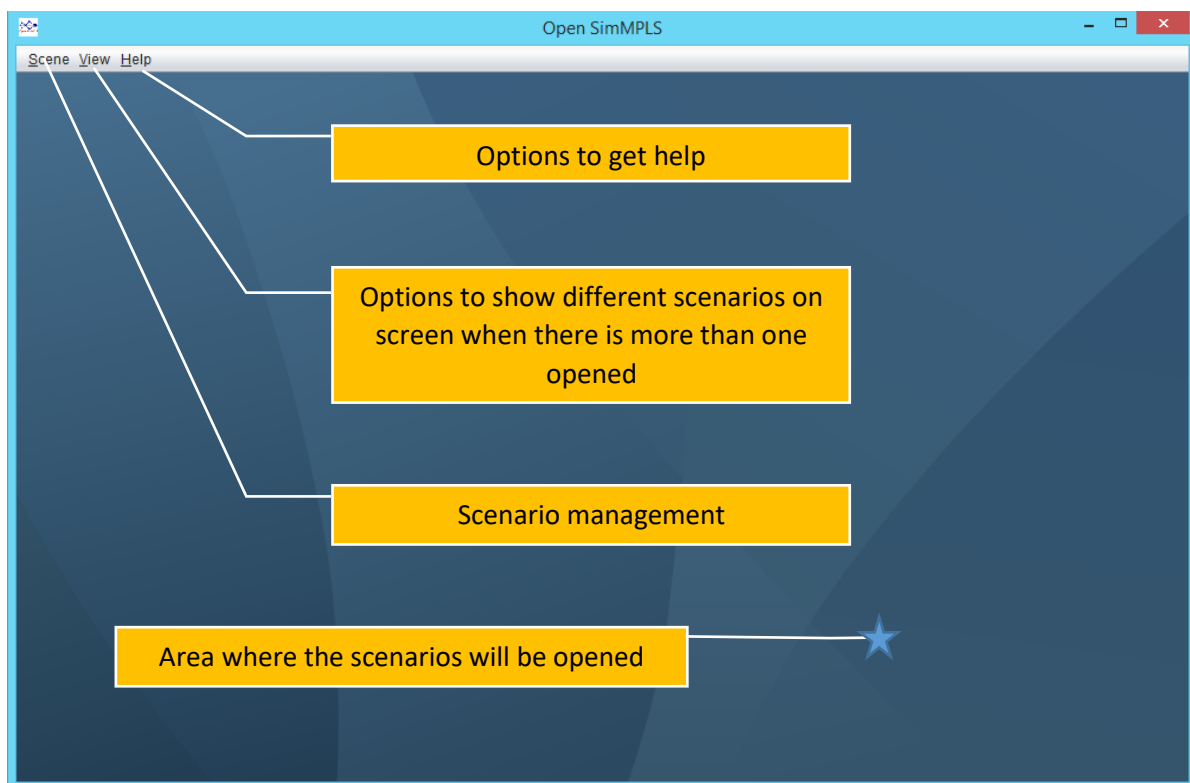
And, of course, have downloaded OpenSimMPLS v2.4, which you can do from the project page that you see in the header of this guide.

Starting OpenSimMPLS v2.4

Once downloaded, run the simulator with the following command:

```
java -jar openSimMPLS-bin-v2.4.jar
```

Main simulator interface

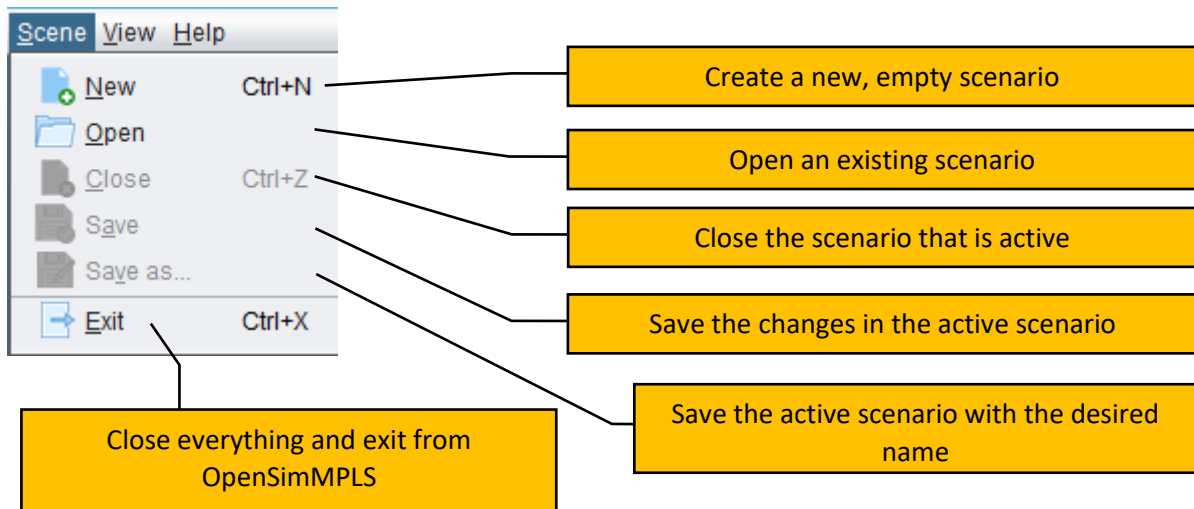


The initial window of the simulator appears only with a menu of options and a large space within which the different scenarios that are being designed or simulated will be displayed.

OpenSimMPLS allows you to keep more than one scenario open or running simultaneously.

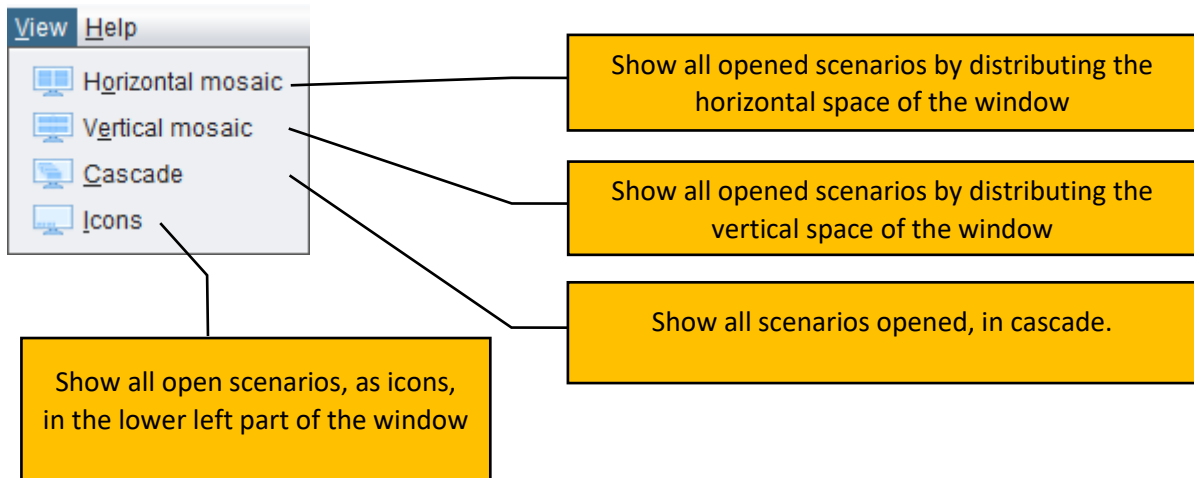
Scenario menu

Some of the options will only be active if there is a scenario opened.

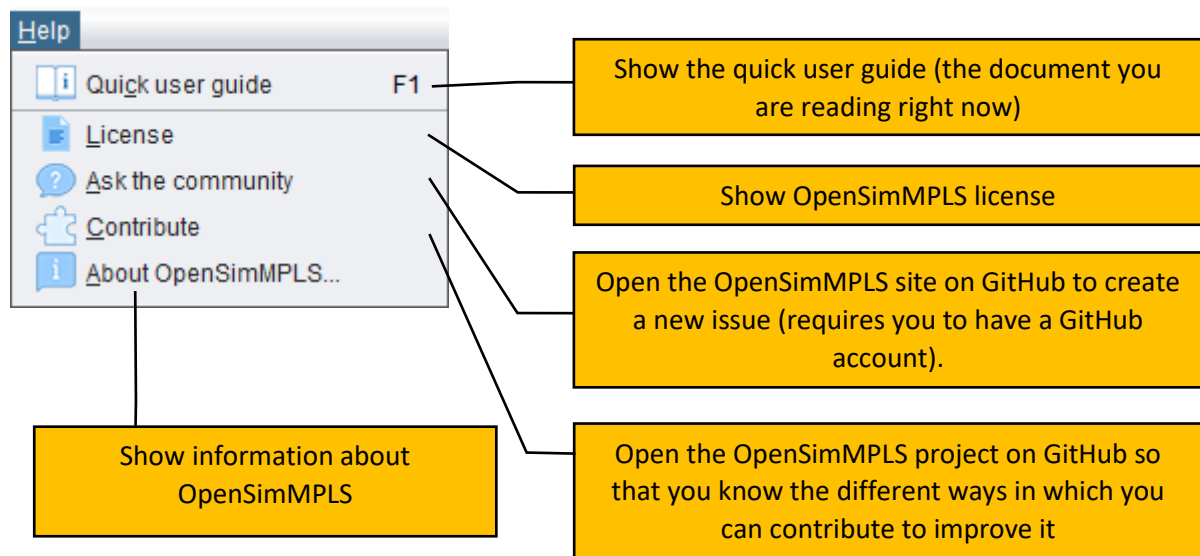


View menu

Some of the options will only be active if there is a scenario opened.

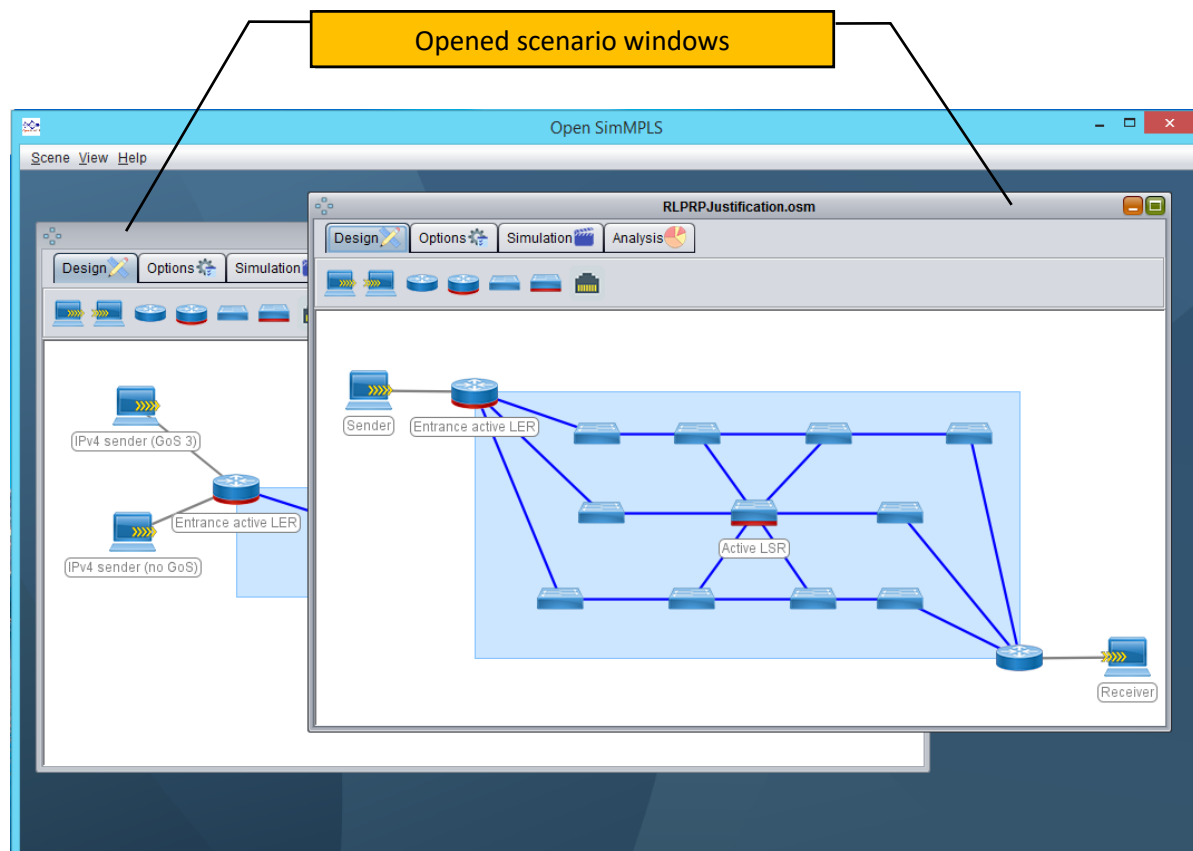


Help menu



Scenario window

Each scenario has its own window within the simulator. This is where all the action happens and where all the OpenSimMPLS functionality is. Each open scenario is independent of the other open scenarios.

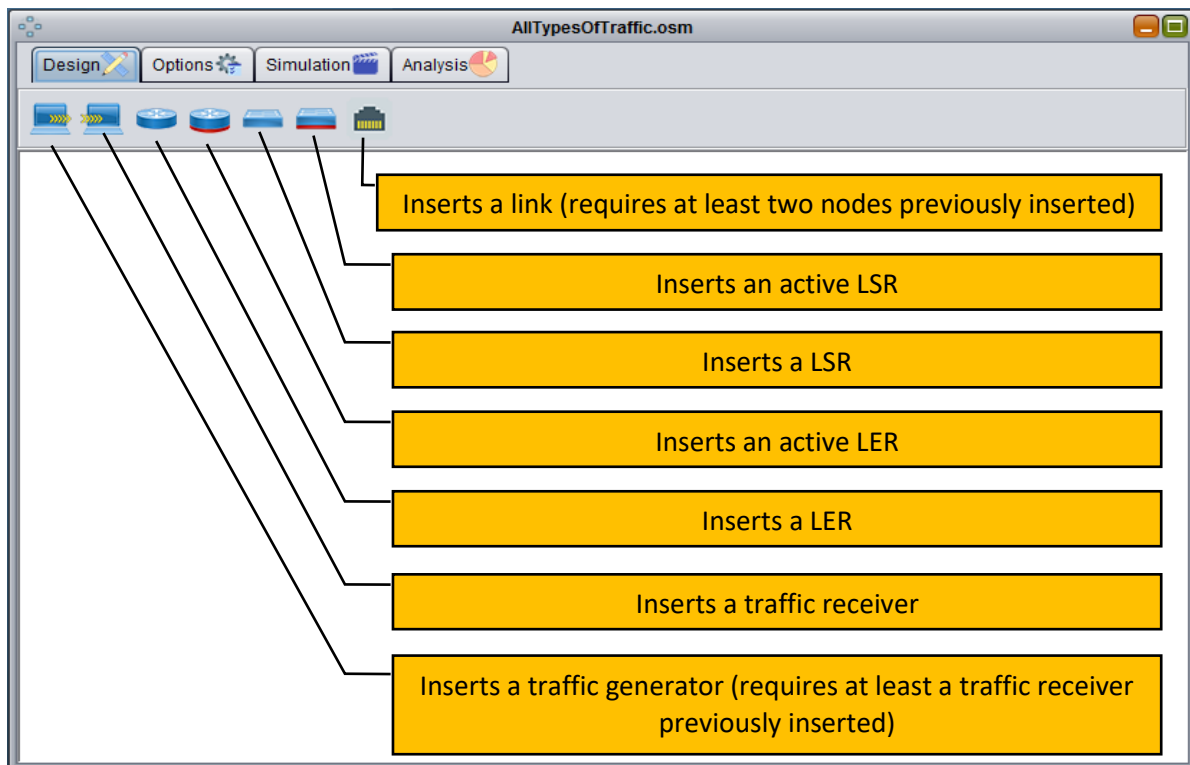


The scenario window has four tabs that will guide you through the simulation process. Follow them in the order in which they appear:

1. **Scenario design.** Configure the topology, the elements, the links and the configuration all of them. It also defines the type of traffic you want to generate and who will receive it.
2. **Options.** Put a title and describe your scenario. In addition, select the duration of the simulation and the grain of it.
3. **Simulation.** Put your scenario to work and interact with the simulation in real time.
4. **Analysis.** Select elements of the topology and see statistical information about them. Observe what has happened throughout the time of the simulation.

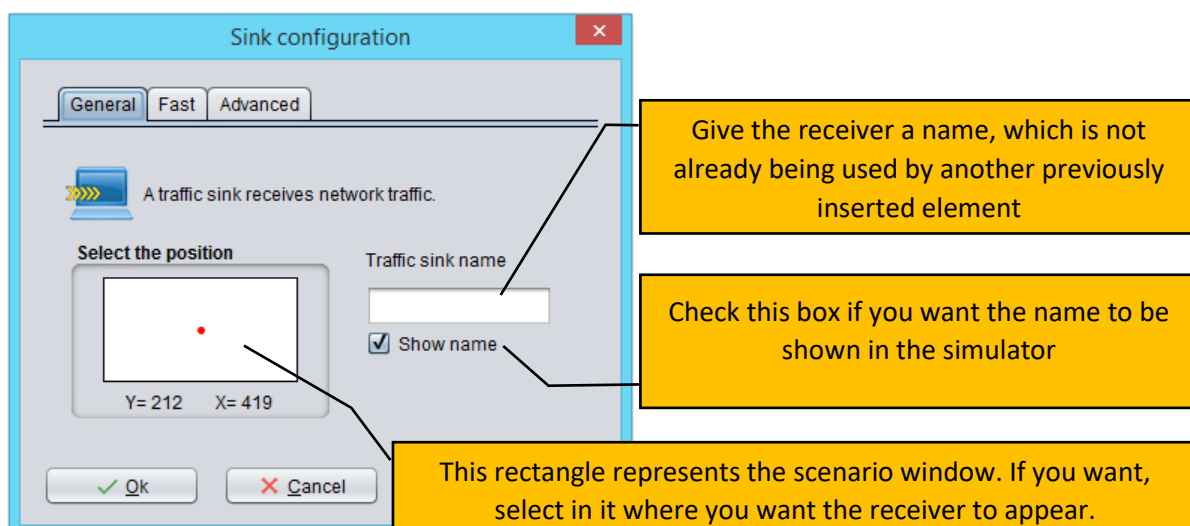
Step 1. Scenario design

To design the scenario, select the Design tab.

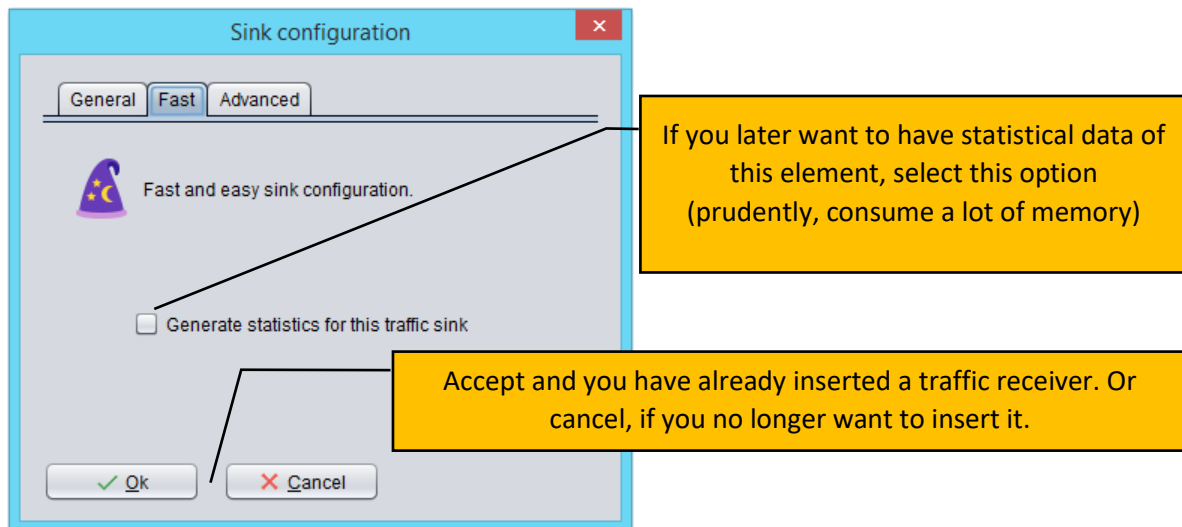


Traffic sinks insertion and configuration

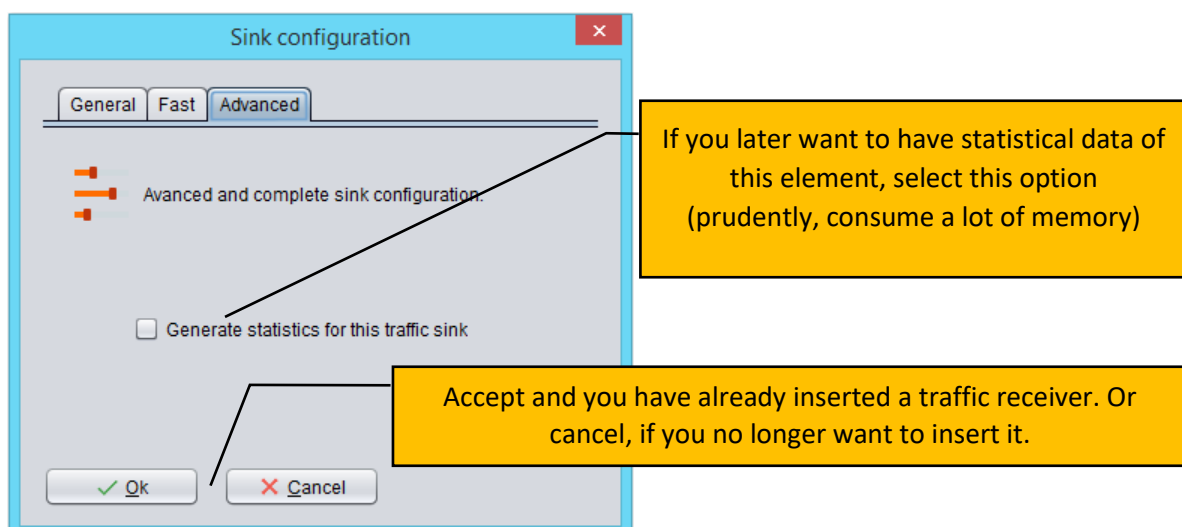
When we insert a traffic receiver, its configuration window appears, with three tabs: general configuration, quick configuration or advanced configuration (to choose).



If you want, you can use the quick settings to have something to try if you're in a hurry. Or if you want to configure all the parameters, use the advanced settings. It does not make sense to use both tabs.

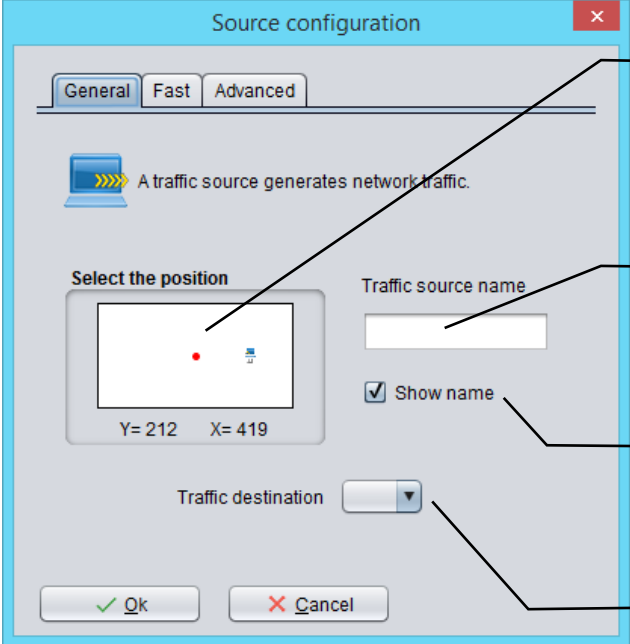


In the case of the traffic receiver, the advanced configuration and quick configuration are the same. There is not much to configure.



Traffic generators insertion and configuration

When we insert a traffic generator, its configuration window appears, with three tabs: general configuration and quick configuration or advanced configuration (to choose).



The 'Source configuration' dialog box is shown with the 'General' tab selected. It features a 'General' tab, a 'Fast' tab, and an 'Advanced' tab. Below the tabs, there is a description: 'A traffic source generates network traffic.' with a yellow arrow icon. A 'Select the position' section contains a small map with a red dot and coordinates 'Y= 212 X= 419'. To the right, there is a 'Traffic source name' text box, a checked 'Show name' checkbox, and a 'Traffic destination' dropdown menu. At the bottom are 'Ok' and 'Cancel' buttons.

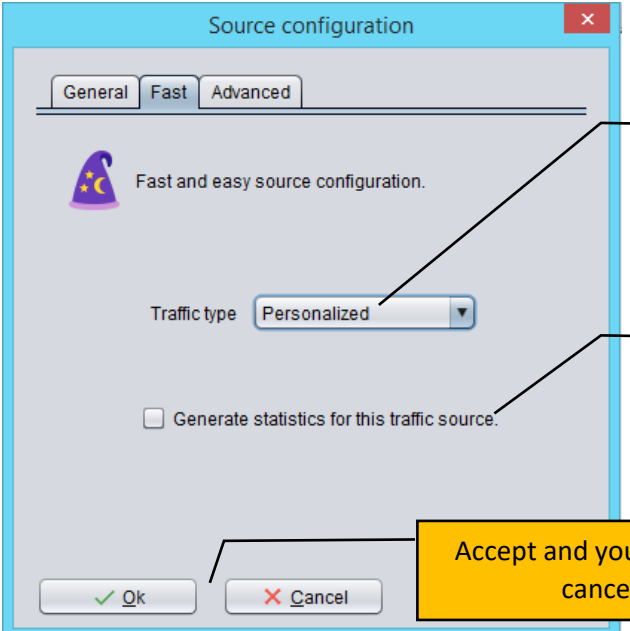
This rectangle represents the scenario window. If you want, select in it where you want the generator to appear.

Give the generator a name which is not already being used by another previously inserted element

Check this box if you want the name to be shown in the simulator

Select, from all the traffic receivers that are already inserted, to which of them the traffic will be directed.

If you want, you can use the quick settings to have something to try if you're in a hurry. Or if you want to configure all the parameters, use the advanced settings. It does not make sense to use both tabs.



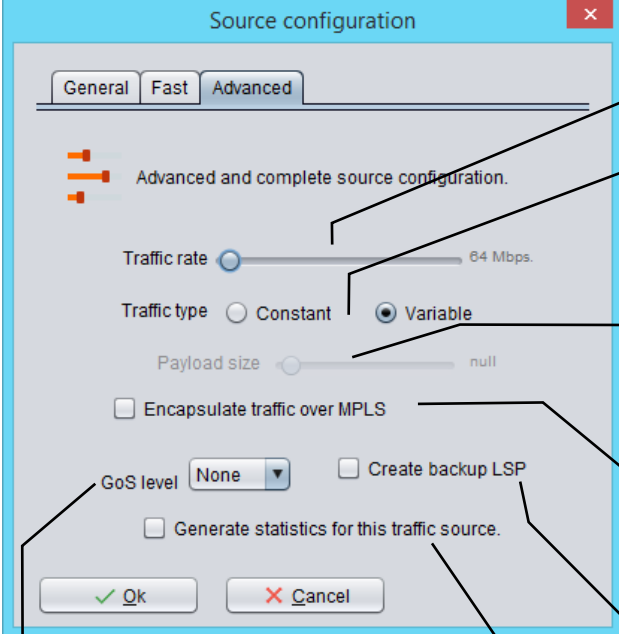
The 'Source configuration' dialog box is shown with the 'Fast' tab selected. It features a 'General' tab, a 'Fast' tab, and an 'Advanced' tab. Below the tabs, there is a description: 'Fast and easy source configuration.' with a purple wizard icon. A 'Traffic type' dropdown menu is set to 'Personalized'. Below it is a checkbox labeled 'Generate statistics for this traffic source.' At the bottom are 'Ok' and 'Cancel' buttons.

Select what type of traffic, predefined, you want the generator to generate. This will configure everything necessary.

If you later want to have statistical data of this element, select this option (prudently, consume a lot of memory)

Accept and you have already inserted a traffic receiver. Or cancel, if you no longer want to insert it.

In the case of the traffic receiver, the advanced configuration allows defining all aspects of the traffic that you want to generate.



The 'Source configuration' dialog box has three tabs: 'General', 'Fast', and 'Advanced'. The 'Advanced' tab is selected. It contains the following options:

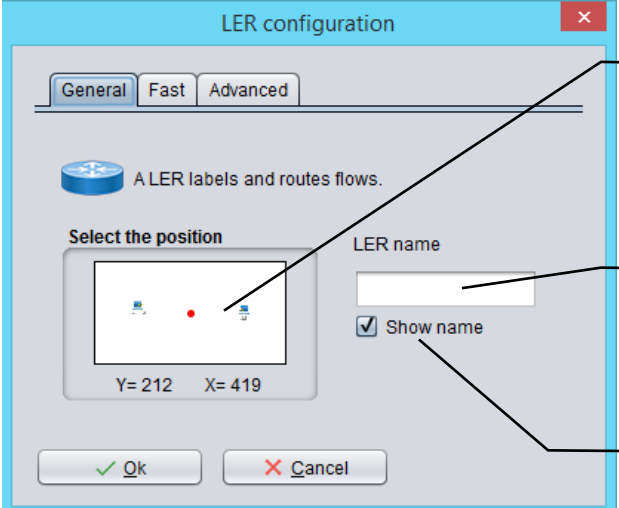
- Traffic rate:** A slider set to 64 Mbps.
- Traffic type:** Radio buttons for 'Constant' and 'Variable' (selected).
- Payload size:** A slider set to 'null'.
- Encapsulate traffic over MPLS:** An unchecked checkbox.
- GoS level:** A dropdown menu set to 'None'.
- Create backup LSP:** An unchecked checkbox.
- Generate statistics for this traffic source:** An unchecked checkbox.

Annotations point to the following elements:

- Traffic rate slider:** Choose the number of megabits per second you want to generate.
- Traffic type radio buttons:** You can generate constant traffic (with the size you choose) or variable (following statistics from the Abilene Network).
- Payload size slider:** For constant traffic, select the size of the payload of the packets, in octets.
- Encapsulate traffic over MPLS checkbox:** By default it will generate IPv4 traffic. Check this box if you want to generate MPLS traffic.
- Create backup LSP checkbox:** You can request that an additional backup LSP be pre-established for traffic by checking this box.
- GoS level dropdown:** Select the level of Service Guarantee (GoS) you want for traffic. Higher level for more important traffic.
- Generate statistics for this traffic source checkbox:** If you later want to have statistical data of this element, select this option (prudently, consume a lot of memory).

LERs insertion and configuration

When we insert an LER, its configuration window appears, with three tabs: general configuration and quick configuration or advanced configuration (to choose).



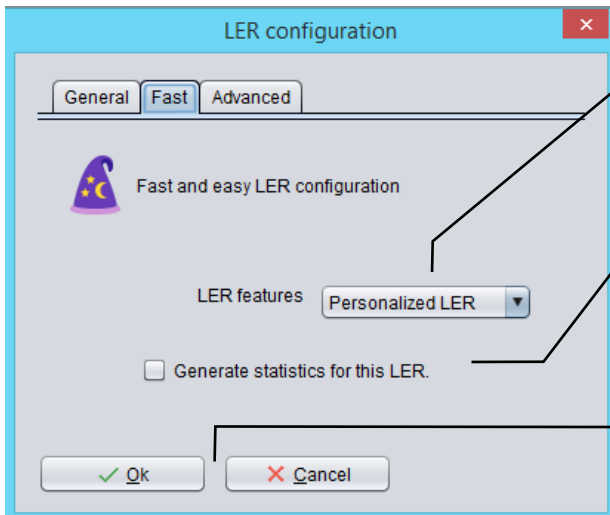
The 'LER configuration' dialog box has three tabs: 'General', 'Fast', and 'Advanced'. The 'General' tab is selected. It contains the following options:

- Select the position:** A diagram showing a network topology with a red dot indicating the LER position. Coordinates Y=212 and X=419 are shown.
- LER name:** A text input field.
- Show name:** A checked checkbox.

Annotations point to the following elements:

- Select the position diagram:** This rectangle represents the scenario window. If you want, select in it where you want the LER to appear.
- LER name input field:** Give the LER a name which is not already being used by another previously inserted element.
- Show name checkbox:** Check this box if you want the name to be shown in the simulator.

If you want, you can use the quick settings to have something to try if you're in a hurry. Or if you want to configure all the parameters, use the advanced settings. It does not make sense to use both tabs.

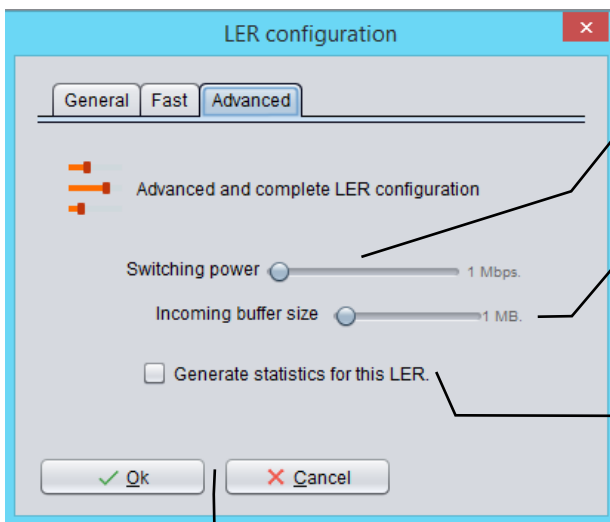


Select what type of LER, predefined. This will configure everything necessary.

If you later want to have statistical data of this element, select this option (prudently, consume a lot of memory)

Accept and you have already inserted an LER. Or cancel, if you no longer want to insert it.

In the case of the LER, the advanced configuration allows defining all aspects of the hardware required.



Choose the number of megabits per second that the LER can process

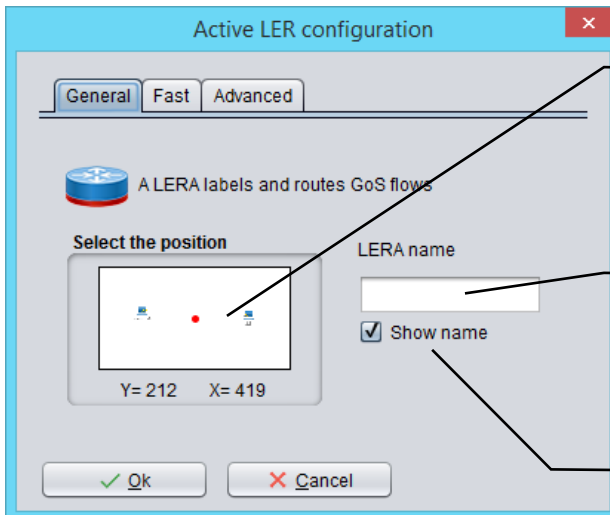
Choose the size of the input buffer of the LER, in Megabytes

If you later want to have statistical data of this element, select this option (prudently, consume a lot of memory)

Accept and you have already inserted an LER. Or cancel, if you no longer want to insert it.

Active LERs insertion and configuration

When we insert an active LER, its configuration window appears, with three tabs: general configuration and quick configuration or advanced configuration (to choose).

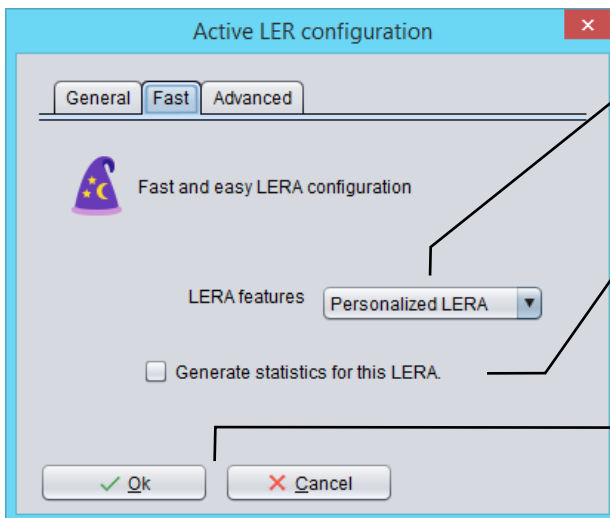


This rectangle represents the scenario window. If you want, select in it where you want the active LER to appear.

Give the active LER a name which is not already being used by another previously inserted element

Check this box if you want the name to be shown in the simulator

If you want, you can use the quick settings to have something to try if you're in a hurry. Or if you want to configure all the parameters, use the advanced settings. It does not make sense to use both tabs.

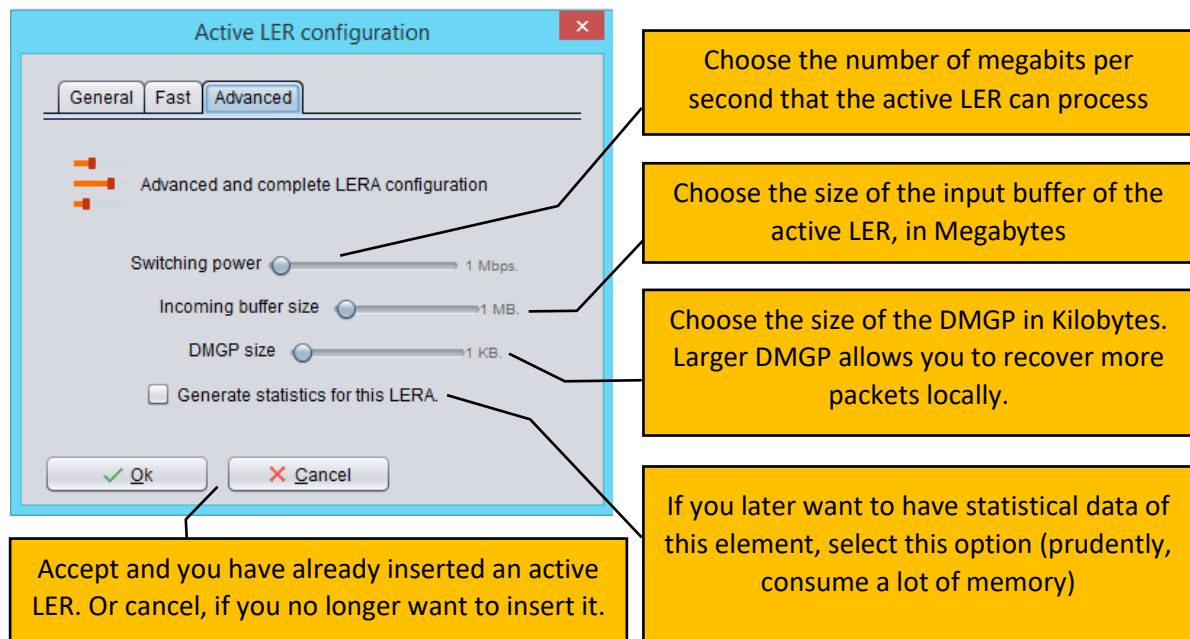


Select what type of LER is active, predefined. This will configure everything

If you later want to have statistical data of this element, select this option (prudently, consume a lot of memory)

Accept and you have already inserted an active LER. Or cancel, if you no longer want to insert it.

In the case of the active LER, the advanced configuration allows defining all the necessary hardware aspects.



The screenshot shows the 'Active LER configuration' dialog box with three tabs: 'General', 'Fast', and 'Advanced'. The 'Advanced' tab is selected. It contains the following elements:

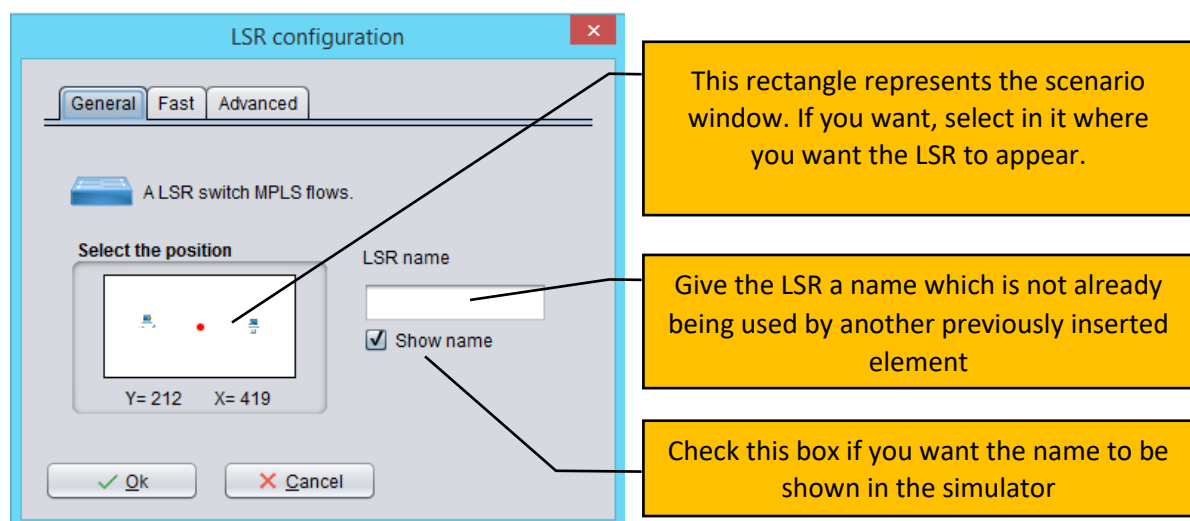
- Switching power:** A slider set to 1 Mbps.
- Incoming buffer size:** A slider set to 1 MB.
- DMGP size:** A slider set to 1 KB.
- Generate statistics for this LERA:** An unchecked checkbox.
- Buttons:** 'Ok' and 'Cancel' buttons at the bottom.

Annotations (yellow boxes) point to these elements:

- Choose the number of megabits per second that the active LER can process (points to Switching power).
- Choose the size of the input buffer of the active LER, in Megabytes (points to Incoming buffer size).
- Choose the size of the DMGP in Kilobytes. Larger DMGP allows you to recover more packets locally. (points to DMGP size).
- If you later want to have statistical data of this element, select this option (prudently, consume a lot of memory) (points to Generate statistics for this LERA).
- Accept and you have already inserted an active LER. Or cancel, if you no longer want to insert it. (points to the 'Ok' button).

LSRs insertion and configuration

When we insert an LSR, its configuration window appears, with three tabs: general configuration and quick configuration or advanced configuration (to choose).



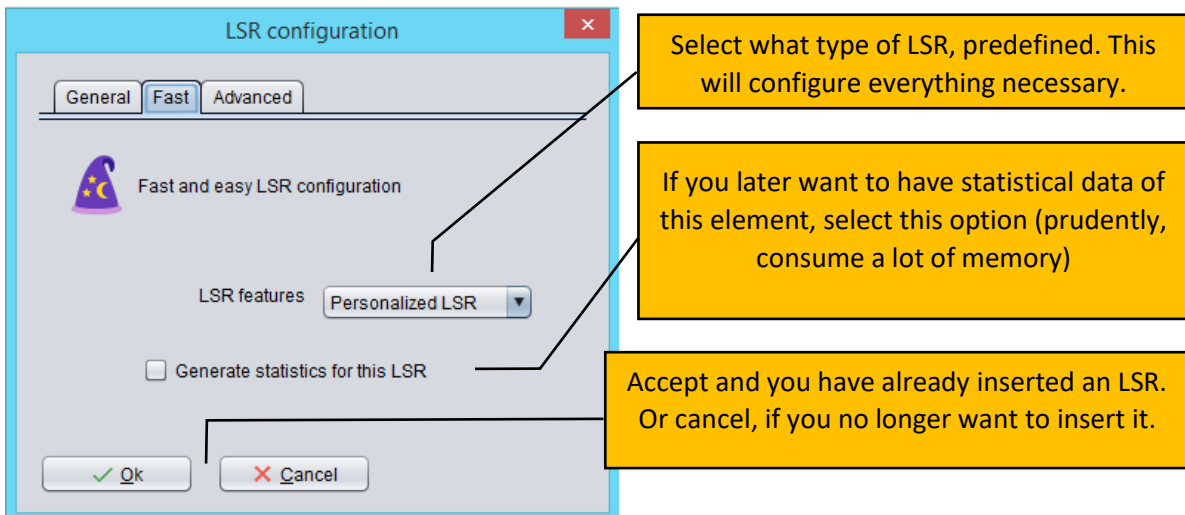
The screenshot shows the 'LSR configuration' dialog box with three tabs: 'General', 'Fast', and 'Advanced'. The 'General' tab is selected. It contains the following elements:

- Scenario window:** A rectangle representing the scenario window where the LSR will appear.
- LSR name:** A text input field.
- Show name:** A checked checkbox.
- Buttons:** 'Ok' and 'Cancel' buttons at the bottom.

Annotations (yellow boxes) point to these elements:

- This rectangle represents the scenario window. If you want, select in it where you want the LSR to appear. (points to the scenario window).
- Give the LSR a name which is not already being used by another previously inserted element (points to the LSR name input field).
- Check this box if you want the name to be shown in the simulator (points to the 'Show name' checkbox).

If you want, you can use the quick settings to have something to try if you're in a hurry. Or if you want to configure all the parameters, use the advanced settings. It does not make sense to use both tabs.



LSR configuration

General Fast Advanced

Fast and easy LSR configuration

LSR features Personalized LSR

☐ Generate statistics for this LSR

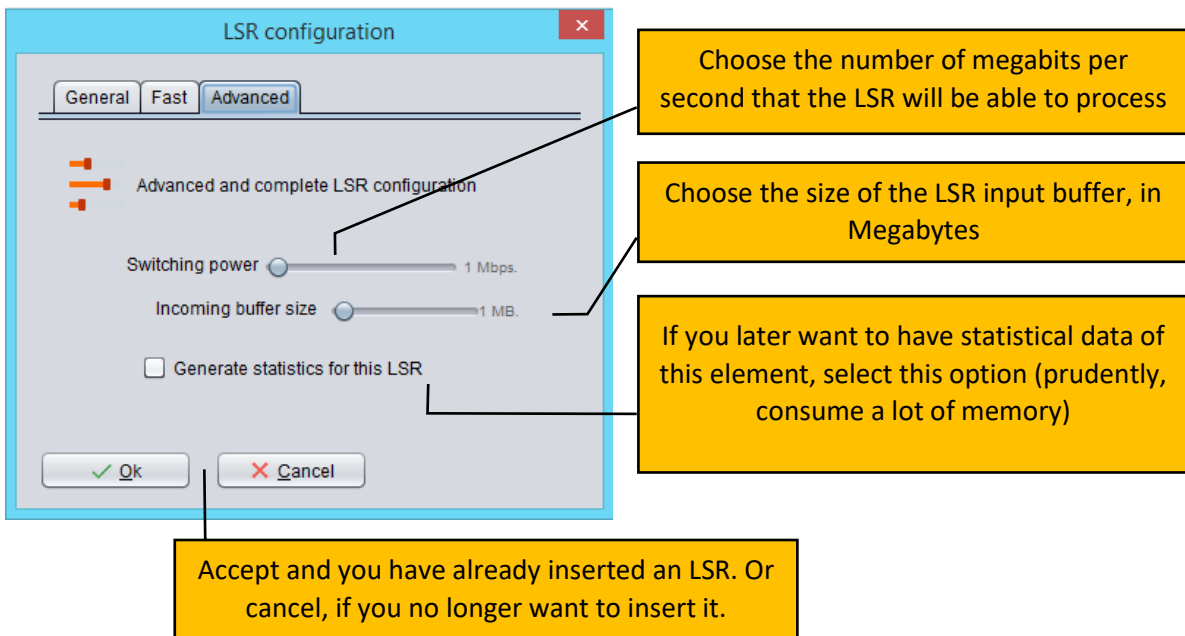
Ok Cancel

Select what type of LSR, predefined. This will configure everything necessary.

If you later want to have statistical data of this element, select this option (prudently, consume a lot of memory)

Accept and you have already inserted an LSR. Or cancel, if you no longer want to insert it.

In the case of the LSR, the advanced configuration allows defining all aspects of the hardware required.



LSR configuration

General Fast Advanced

Advanced and complete LSR configuration

Switching power 1 Mbps

Incoming buffer size 1 MB

☐ Generate statistics for this LSR

Ok Cancel

Choose the number of megabits per second that the LSR will be able to process

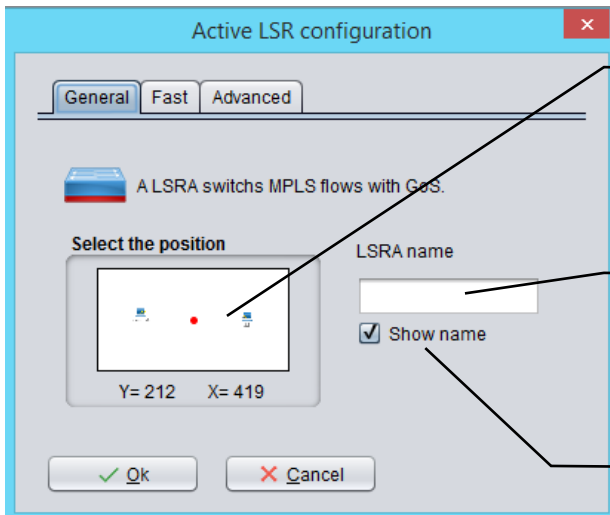
Choose the size of the LSR input buffer, in Megabytes

If you later want to have statistical data of this element, select this option (prudently, consume a lot of memory)

Accept and you have already inserted an LSR. Or cancel, if you no longer want to insert it.

Active LSRs insertion and configuration

When we insert an active LSR, its configuration window appears, with three tabs: general configuration and quick configuration or advanced configuration (to choose).

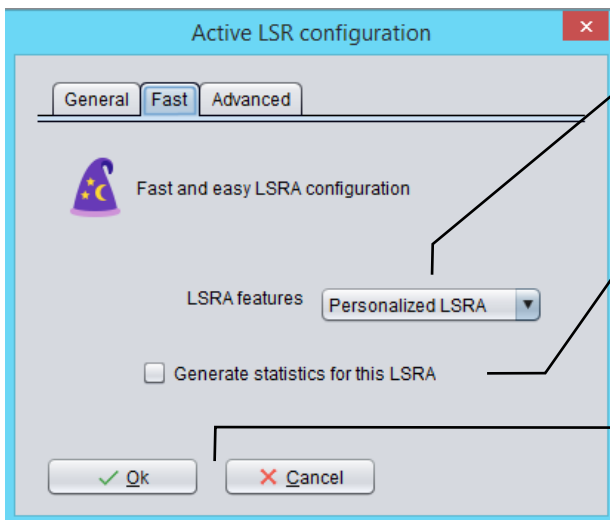


This rectangle represents the scenario window. If you want, select in it where you want the active LSR to appear.

Give the active LSR a name which is not already being used by another previously inserted element

Check this box if you want the name to be shown in the simulator

If you want, you can use the quick settings to have something to try if you're in a hurry. Or if you want to configure all the parameters, use the advanced settings. It does not make sense to use both tabs.

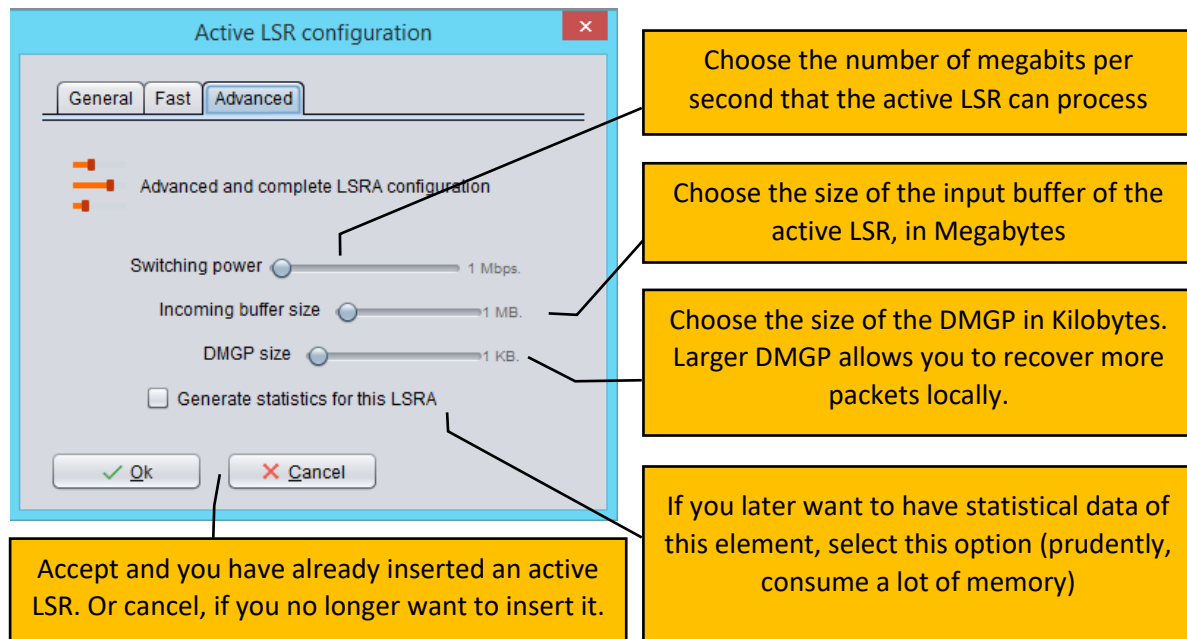


Select which type of LSR is active, predefined. This will configure everything

If you later want to have statistical data of this element, select this option (prudently, consume a lot of memory)

Accept and you have already inserted an active LSR. Or cancel, if you no longer want to insert it.

In the case of the active LSR, the advanced configuration allows defining all the necessary hardware aspects.



The screenshot shows the 'Active LSR configuration' dialog box with three tabs: 'General', 'Fast', and 'Advanced'. The 'Advanced' tab is selected. It contains the following settings:

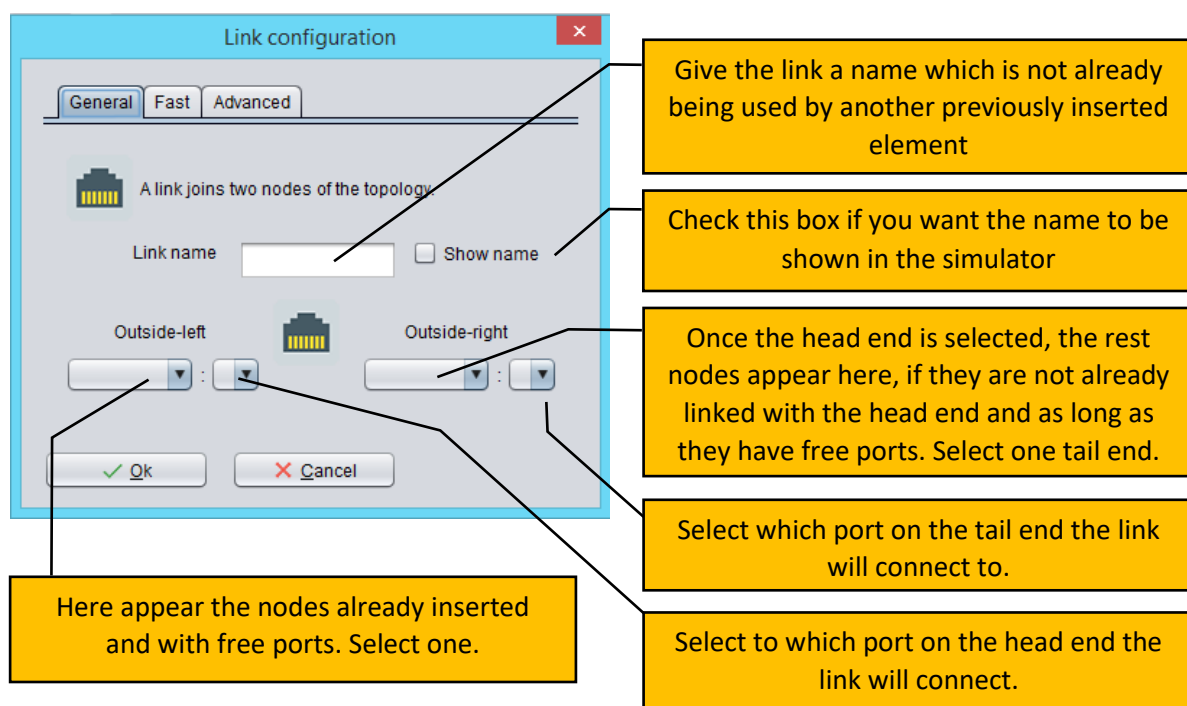
- Switching power:** A slider set to 1 Mbps.
- Incoming buffer size:** A slider set to 1 MB.
- DMGP size:** A slider set to 1 KB.
- Generate statistics for this LSRA:** An unchecked checkbox.
- Buttons:** 'Ok' and 'Cancel' buttons at the bottom.

Annotations point to the following elements:

- Switching power:** Choose the number of megabits per second that the active LSR can process.
- Incoming buffer size:** Choose the size of the input buffer of the active LSR, in Megabytes.
- DMGP size:** Choose the size of the DMGP in Kilobytes. Larger DMGP allows you to recover more packets locally.
- Generate statistics for this LSRA:** If you later want to have statistical data of this element, select this option (prudently, consume a lot of memory).
- Ok button:** Accept and you have already inserted an active LSR. Or cancel, if you no longer want to insert it.

Links insertion and configuration

When we insert a link, its configuration window appears, with three tabs: general configuration and quick configuration or advanced configuration (to choose).



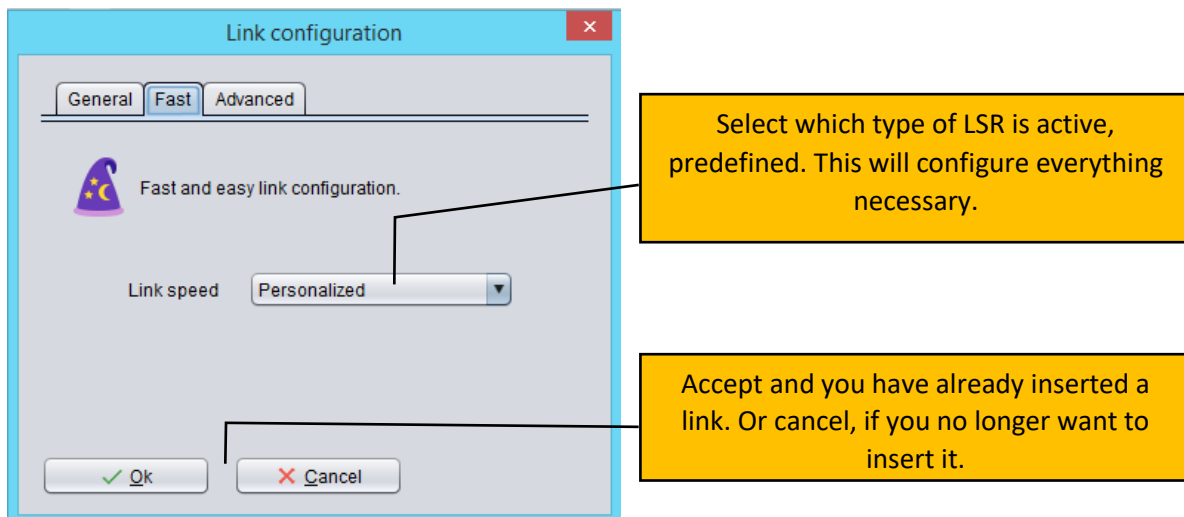
The screenshot shows the 'Link configuration' dialog box with three tabs: 'General', 'Fast', and 'Advanced'. The 'General' tab is selected. It contains the following settings:

- Link name:** A text input field.
- Show name:** An unchecked checkbox.
- Outside-left:** A dropdown menu.
- Outside-right:** A dropdown menu.
- Buttons:** 'Ok' and 'Cancel' buttons at the bottom.

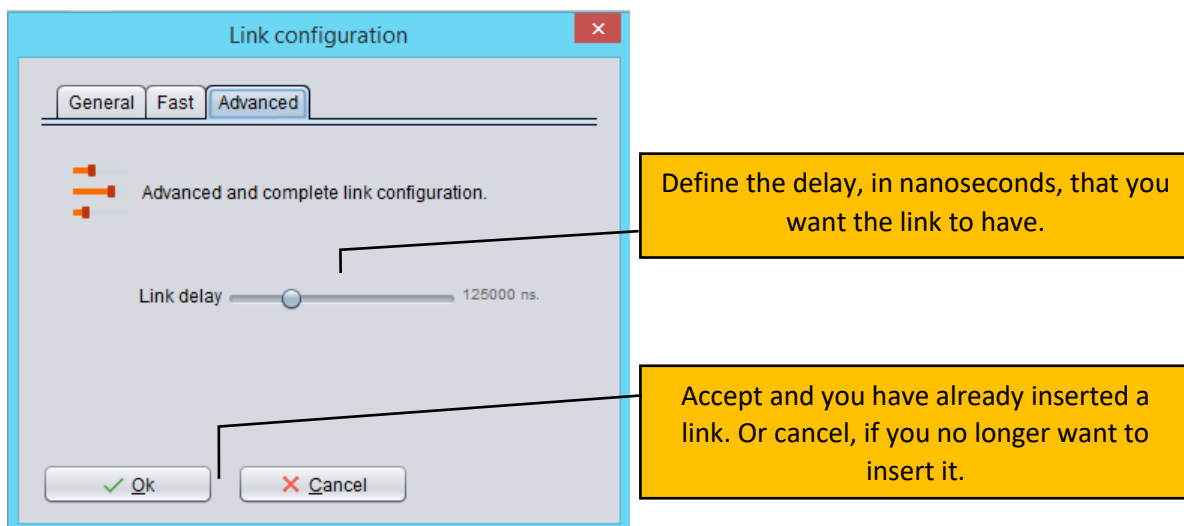
Annotations point to the following elements:

- Link name:** Give the link a name which is not already being used by another previously inserted element.
- Show name:** Check this box if you want the name to be shown in the simulator.
- Outside-left:** Here appear the nodes already inserted and with free ports. Select one.
- Outside-right:** Once the head end is selected, the rest nodes appear here, if they are not already linked with the head end and as long as they have free ports. Select one tail end.
- Outside-right (Port selection):** Select which port on the tail end the link will connect to.
- Outside-left (Port selection):** Select to which port on the head end the link will connect.

If you want, you can use the quick settings to have something to try if you're in a hurry. Or if you want to configure all the parameters, use the advanced settings. It does not make sense to use both tabs.

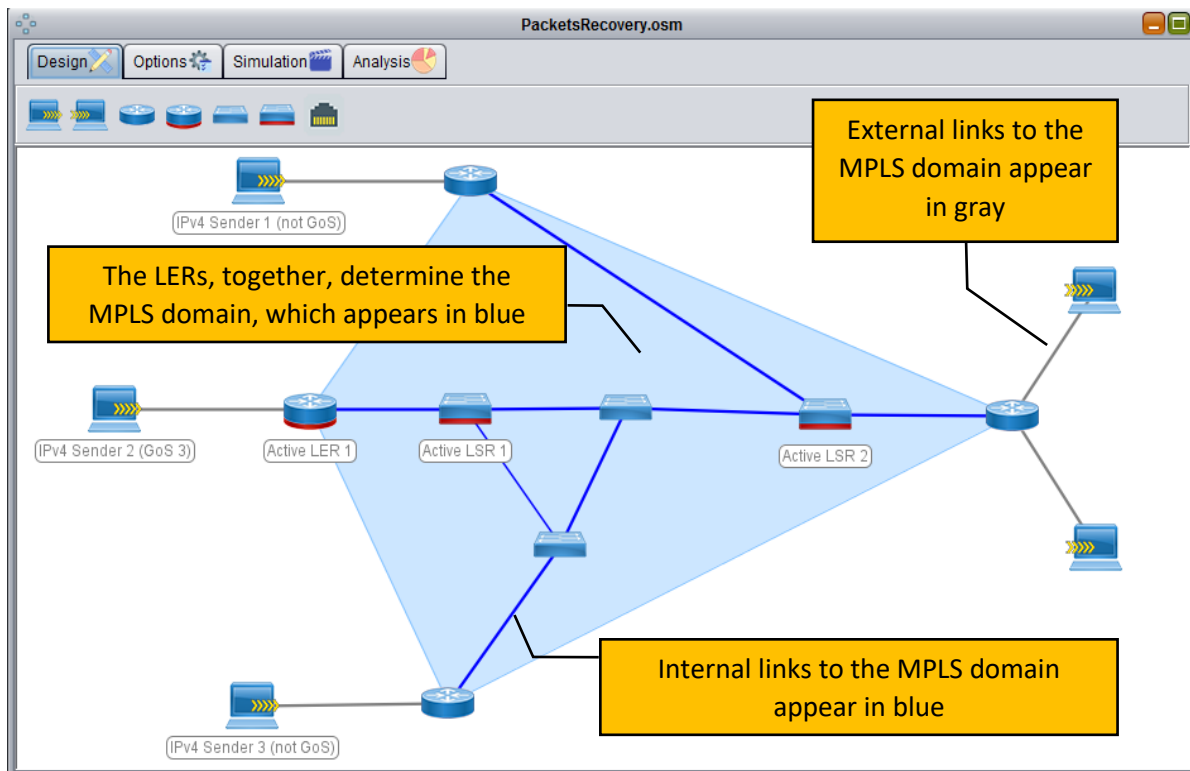


In the case of the active LSR, the advanced configuration allows defining all the necessary hardware aspects.



Design finishing

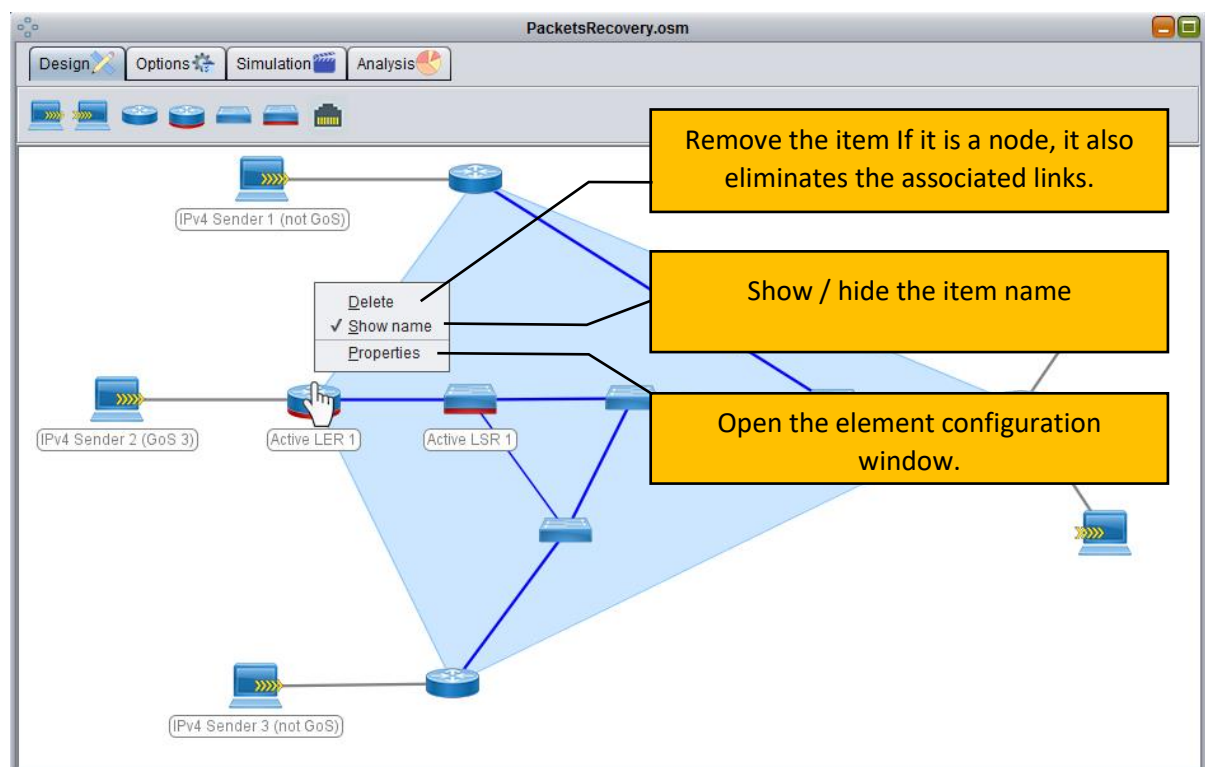
Repeat the process of inserting elements as many times as necessary until you have designed the desired topology. The following figure shows an example of how a completely designed scenario would look.



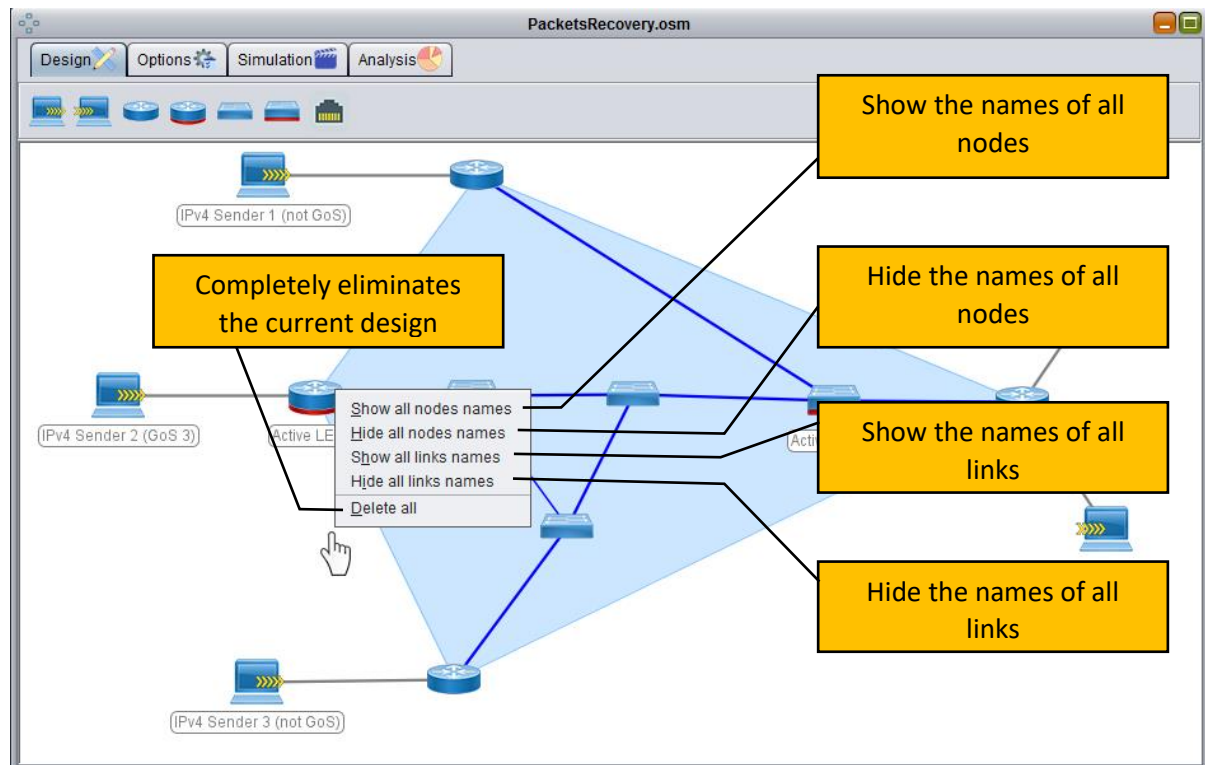
Design editing

At any time, the design can be edited: change the settings, delete inserted elements, and so on. For example:

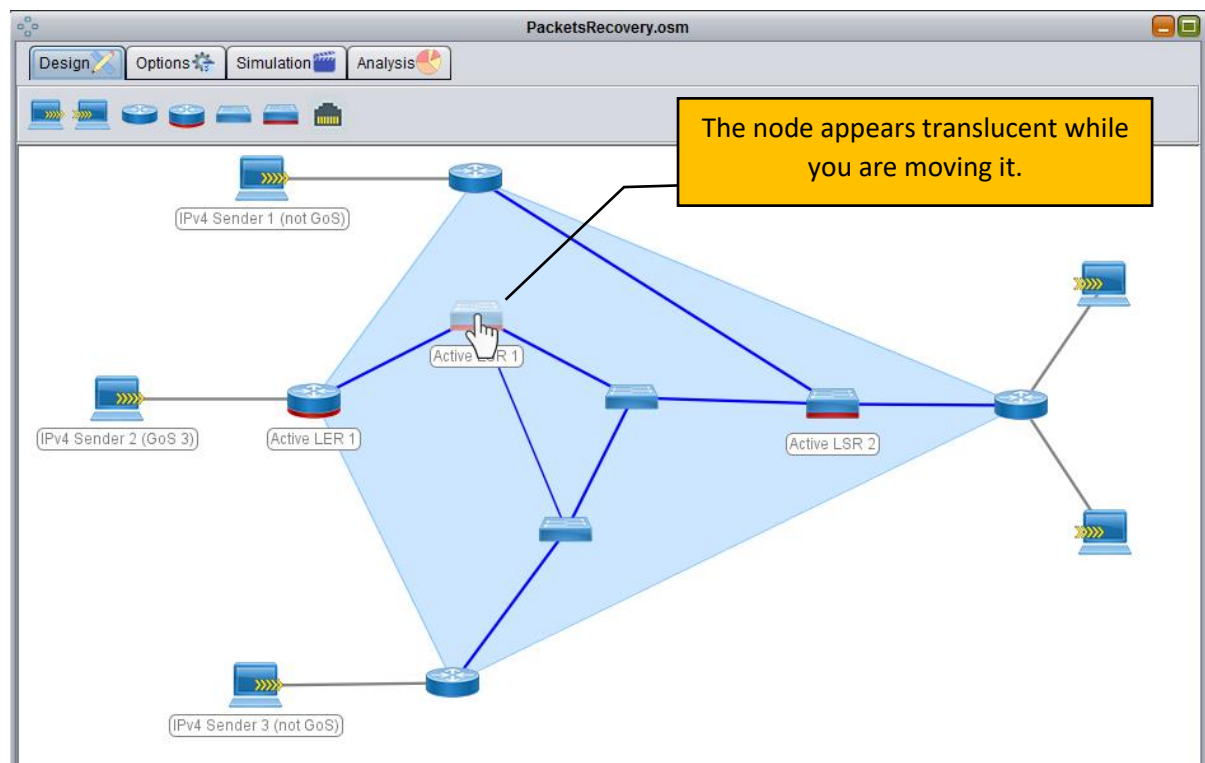
- A right click on an element (node or link) shows options on that element.



- A right click on the background of the design space shows global options on the design.

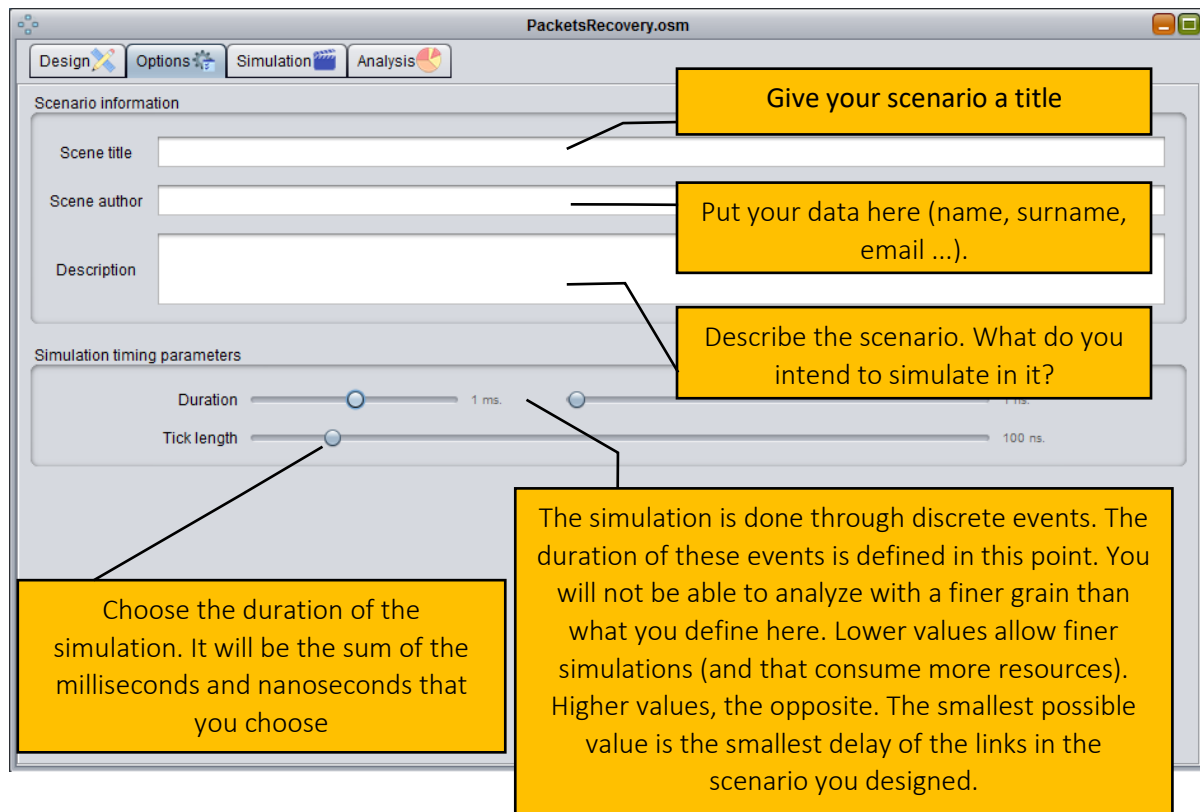


- You can drag the nodes with the main mouse button to place them where you want.



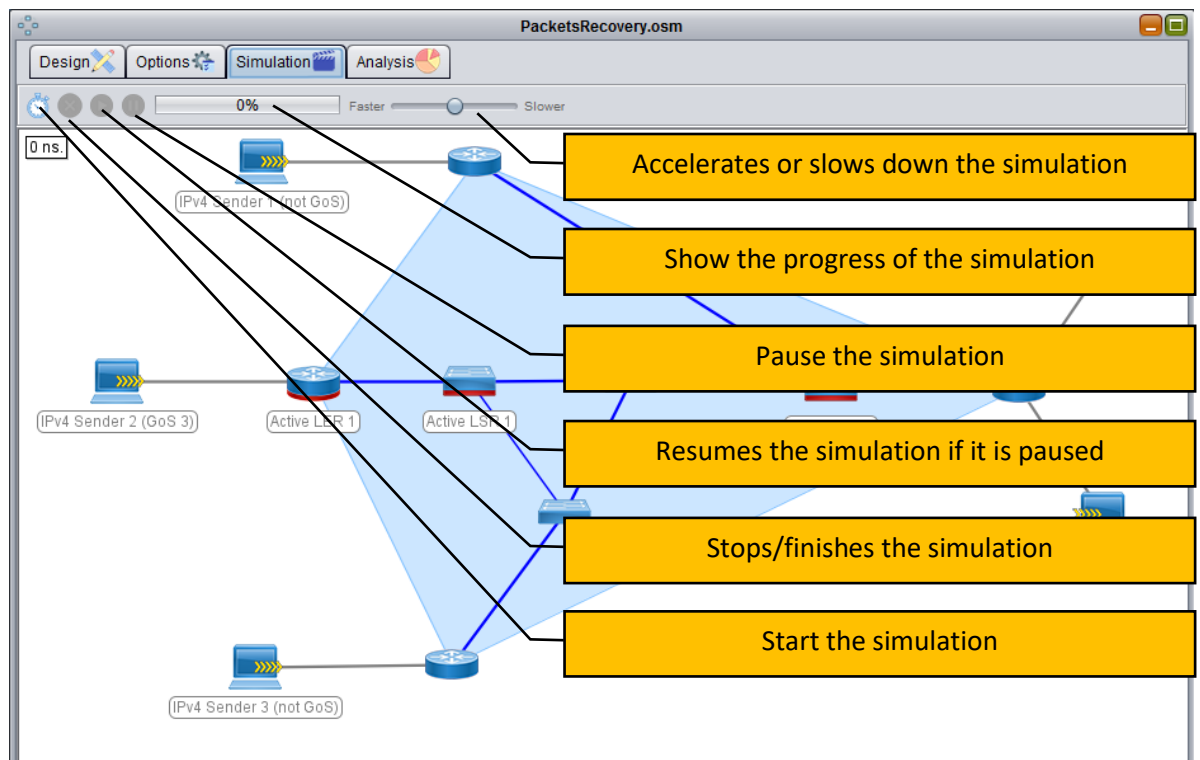
Step 2. Scenario information and timing parameters

To define the duration and basic data of the scenario, select the "Options" tab. In this tab you can define several aspects such as, for example, data about the scenario (author, title, description) or the duration of the simulation and its granularity.



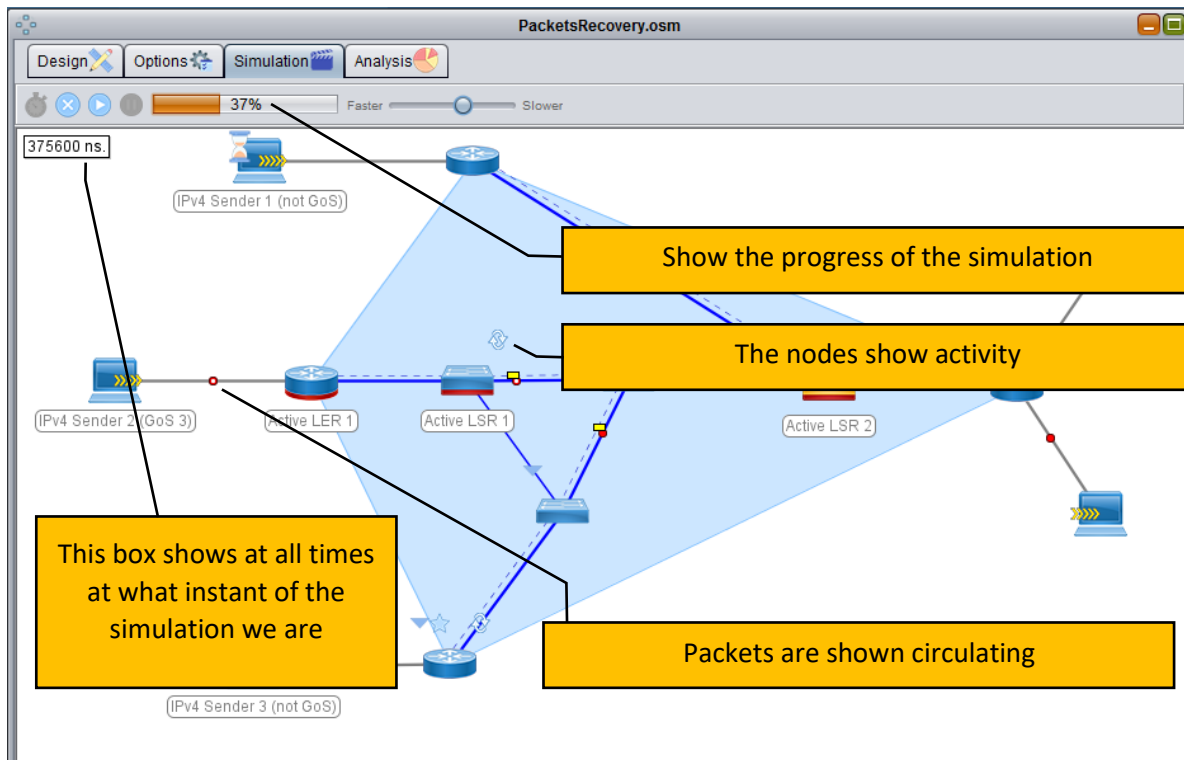
Step 3. Simulation execution

When everything is configured in the "Design" and "Options" tabs, it is usual to go to the "Simulation" tab, where the designed scenario can be put into operation.



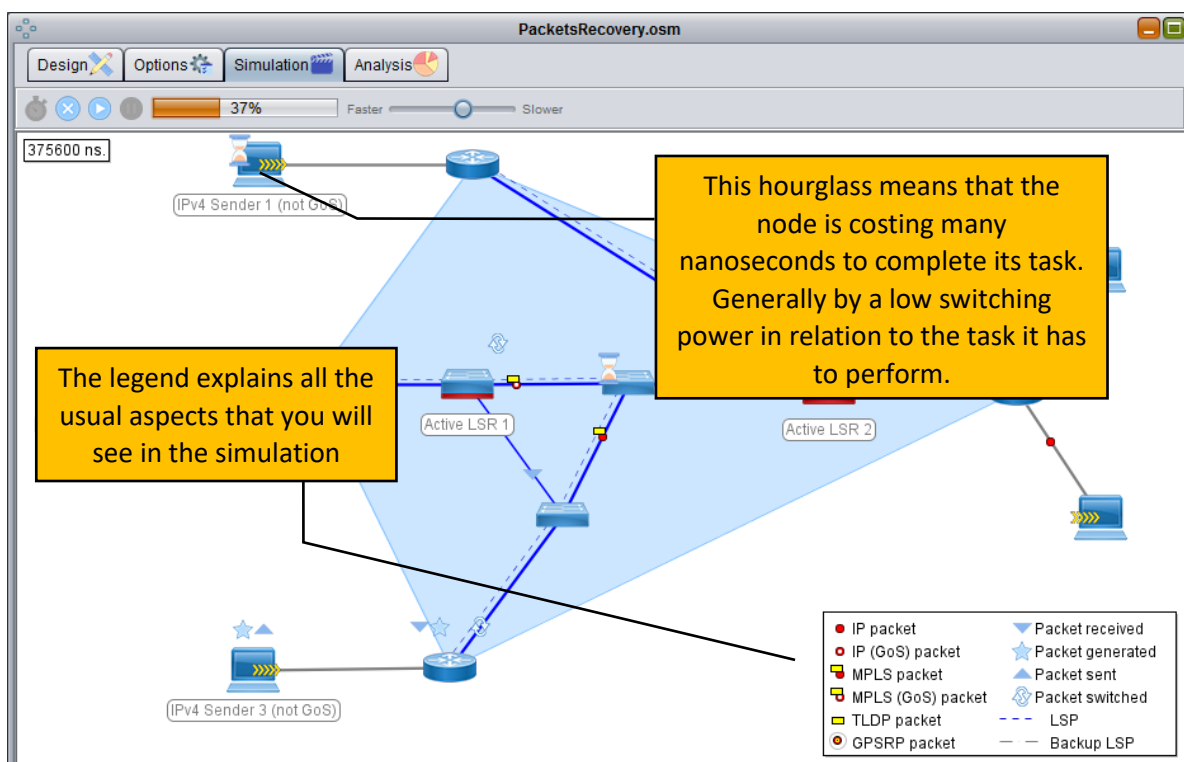
Start simulation

When the simulation starts, all the elements of the scenario begin to work in unison with the parameters that have been configured for them.



Understanding the simulation

You can see a legend that explains all the symbols that you can see in the simulation. To make this legend appear, you must click with the main mouse button in the background of the simulation panel (click again to hide it).

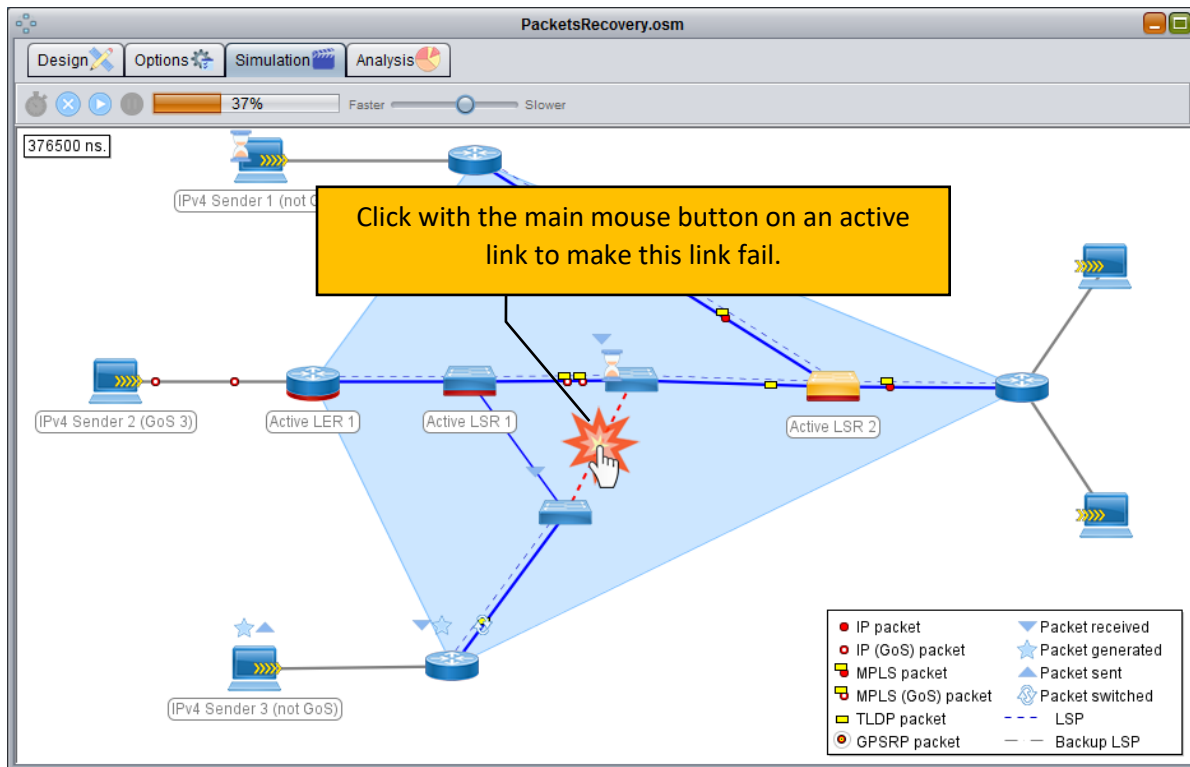


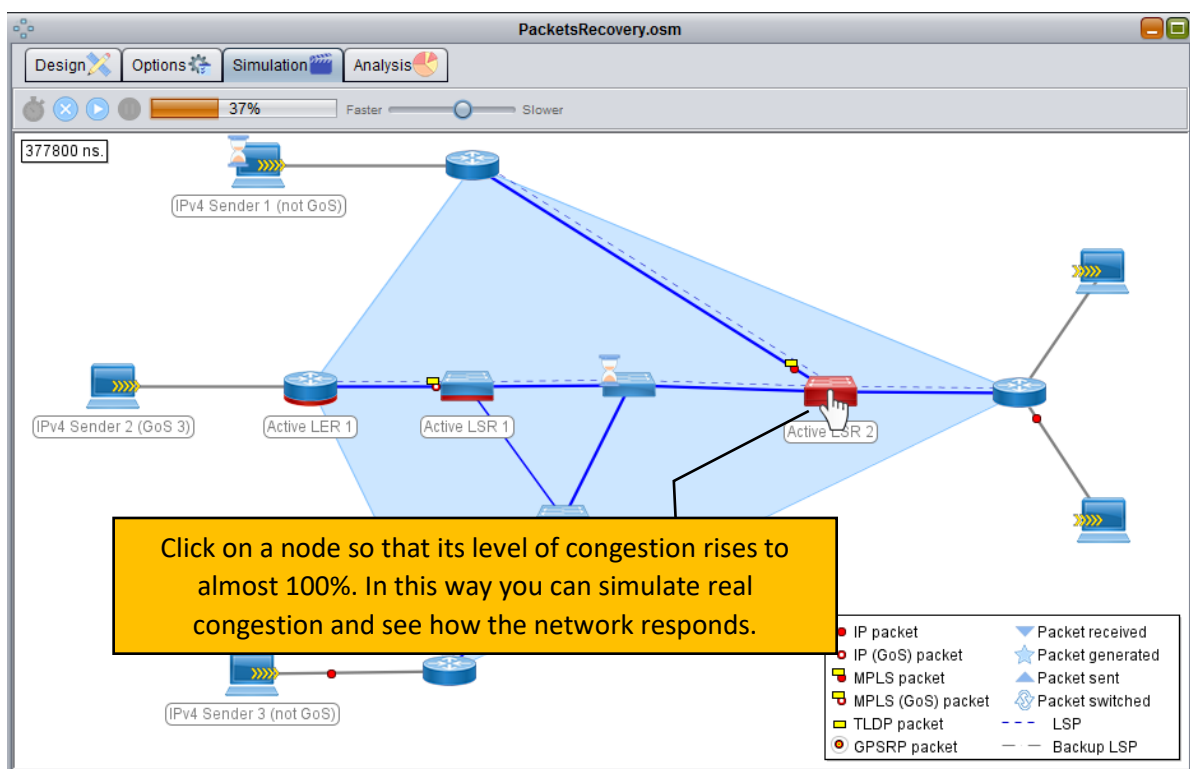
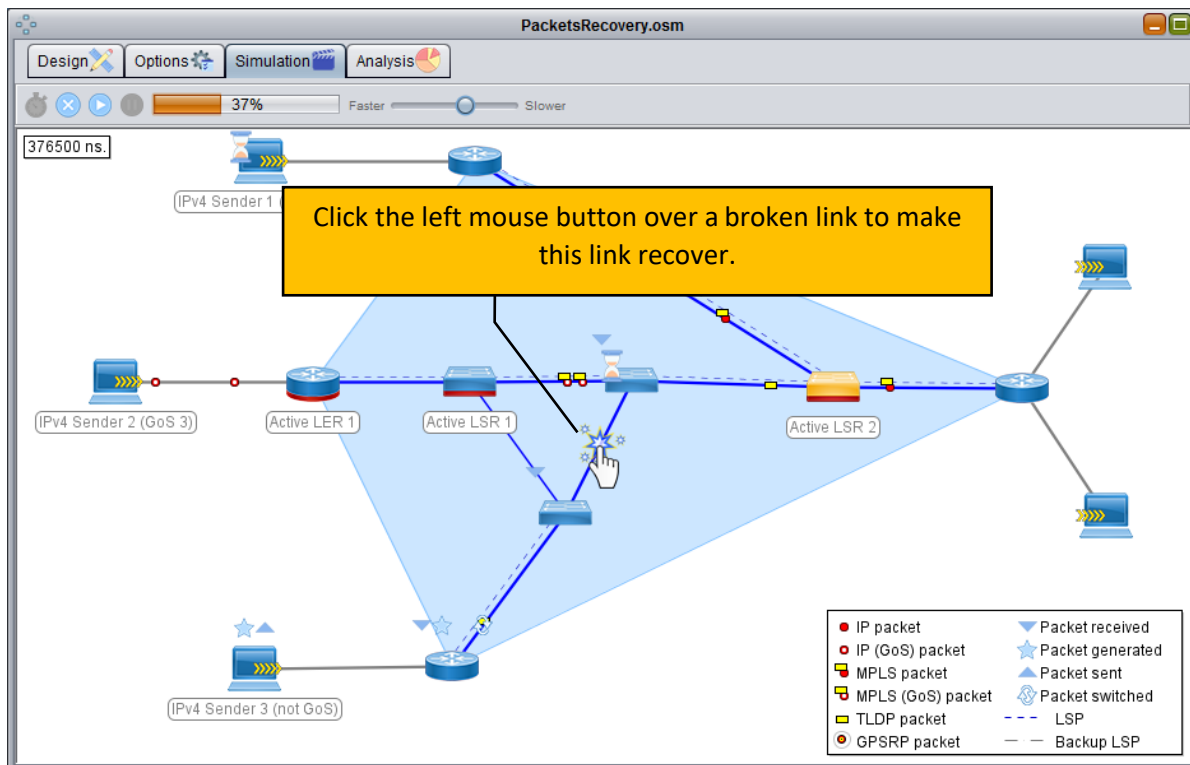
Interacting with the simulation

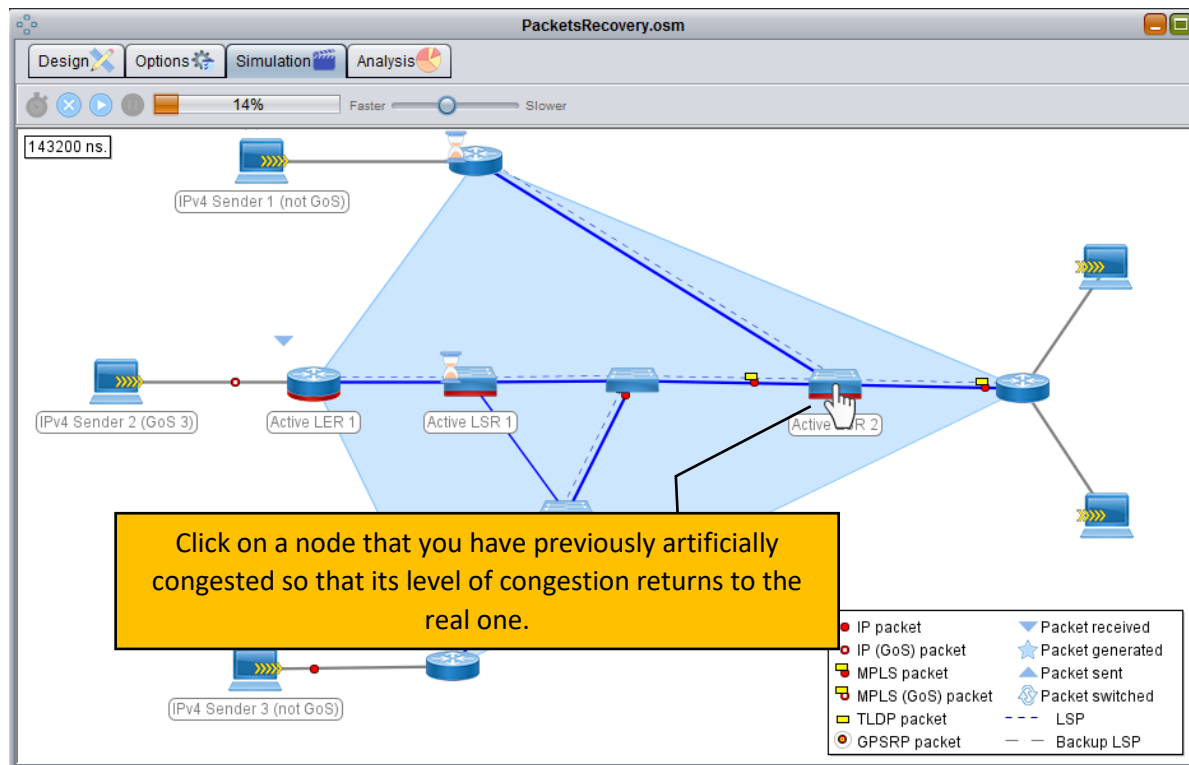
You can interact with the simulation in two ways:

- Manually causing congestion in a node.
- Making a link fail.

The simulation will adjust to the disasters you cause. This way you can analyze what happens in situations that could happen in reality.







Step 4. Analyzing the simulation

After finishing the simulation (or while it is running) you can go to the "Analysis" tab to see the statistics of those elements that you have configured to generate them.

Selection of the element to analyze

Select an element to show its statistics

- Active LER 1
- Active LSR 1
- Active LSR 2

Recovering packet via GPSRP

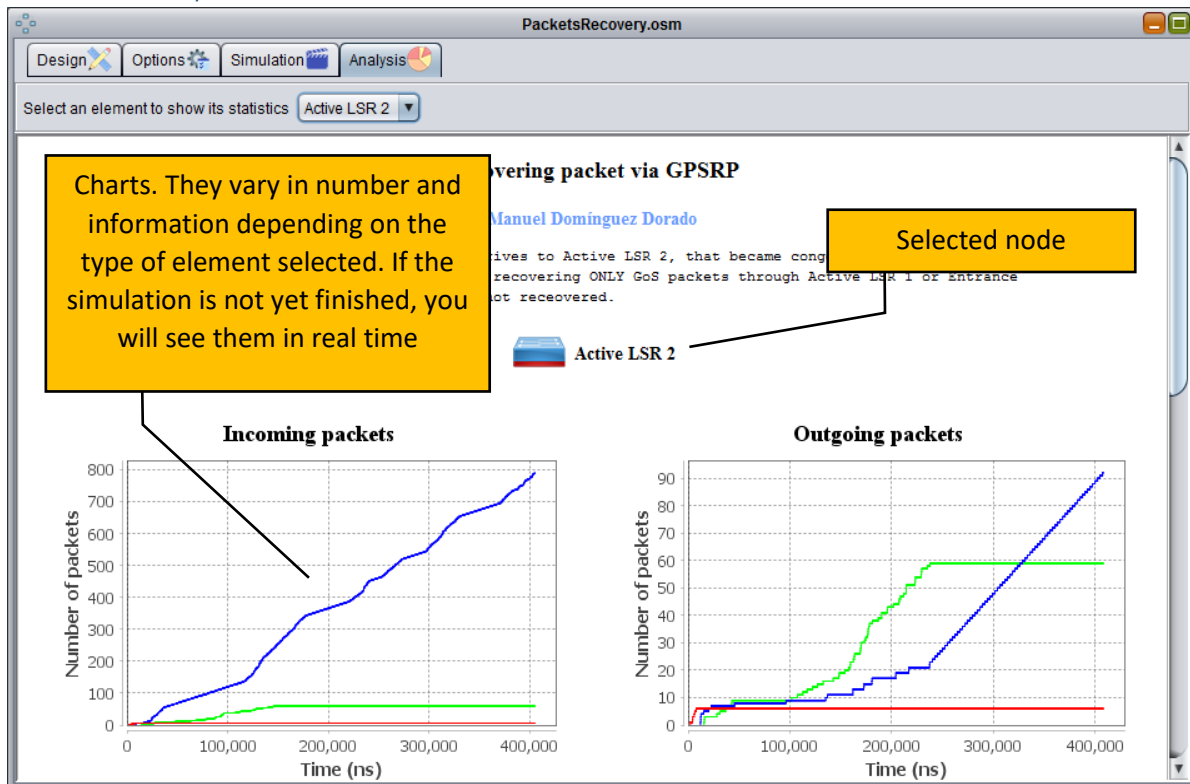
Manuel Domínguez Dorado

Three IPv4 flows (one is GoS tagged) arrives to Active LSR 2, that became congested and start discarding packets. This LER will start recovering ONLY GoS packets through Active LSR 1 or Entrance active LER. The rest of the traffic is not recovered.

Select from this drop-down the element of your scenario that you want to analyze. If you did not configure an item to generate statistics in the "Design" tab, it will not appear here

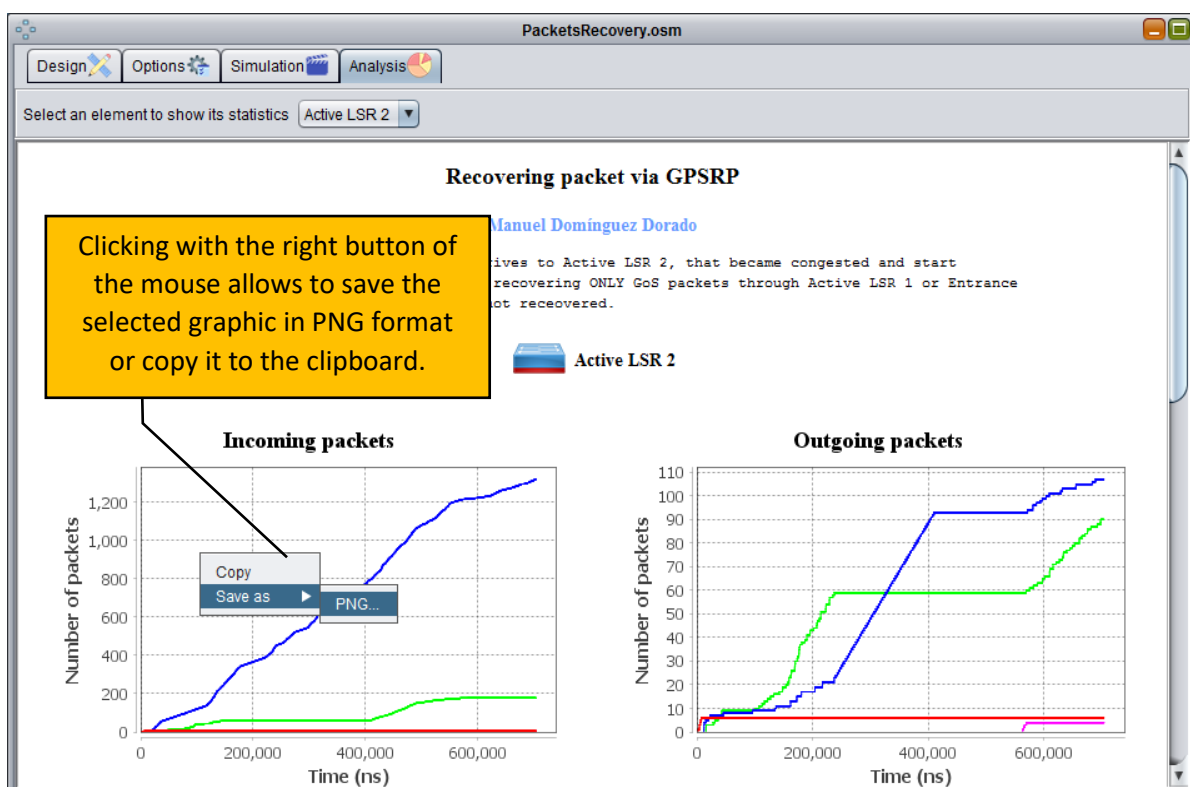
The information about the scenario that you configured in the "Options" tab

Statistical analysis



Exporting charts

The graphics can be exported in PNG format to illustrate your work, practices ... in short, to reuse them where you see fit. You can also copy them to the clipboard and paste them directly elsewhere.



Contribute

OpenSimMPLS is open source software. It is used by professionals and universities around the world (in more than 130 countries). It is a simulator in operation since 2004. Its maintenance is expensive in terms of time so, if you can contribute to its evolution/use, my family will thank you. There are many ways to collaborate.

Teachers

As a teacher, you use this simulator in your practices regarding communication networks. You can contribute a lot:

- Contribute the **teaching units** you use, to teachers from other parts of the world. It is not necessary to provide the solutions, but the statements, the scenarios you use and the purpose of the practical session.
- **Encourage your students to contribute**, instilling in them from the beginning in class a collaborative culture and respect for the work of others. Not only will they learn more about MPLS networks, but they will learn to work with repositories of software versions, pull requests and collaborate on software development projects.

Students

The students are very active. You are the people who directly use the simulator and, therefore, those who most discover their shortcomings. You can contribute a lot:

- **Contribute the scenarios that you develop** in your class practices.
- Contribute with **source code to repair bugs** or add new functionality.
- **Translate the simulator into other languages**. It is currently translated into Spanish and English, but any other language will be welcome. Together with them, Chinese and Arabic would allow practically anyone to understand it.
- **Build community**. Go to the OpenSimMPLS repository on GitHub: detect bugs, file issues for them, help answering questions from other users of the simulator, and so on.

Researchers

Most researchers use OpenSimMPLS as the basis to develop your own techniques. You can contribute a lot in this regard:

- **Source code of algorithms or novel techniques** for the simulator. If it's already done, why not bring it?

Professionals/developers

Professionals who use this simulator, get an economic benefit. I do not need financial resources, but time. **If your company uses this simulator, ask it to sponsor a few hours of your dedication to improve it.** It is the best way for you to have a simulator that is not obsolete.

Thanks for, at least, thinking about it ☺