Softwave Wireless

# *Prismo*

*Dynamic Simulator*

# Overview

## Prismo Simulator v1.7

Document - Rev B

# Index

# 1 Executive Summary

## 1.1 At a glance

Prismo Simulator is a dynamic network simulator for UMTS networks. A simulator is only a mean to reach higher goals. Prismo Simulator is typically used to perform a variety of studies, such as:

- Performance and Quality of Service (QOS) evaluation, for example to derive maps of throughput for HSDPA,
- Network dimensioning and optimization, to insure all sites are optimally dimensioned in terms of Iub or Channel Elements
- Forecasting the effect of traffic increase, to make appropriate changes before problems occurs
- Evaluate the network plan, initially and after every addition of sites
- Creating guidelines for various technology choice, such as how to manage multiple carriers
- Analyzing the effect of various Radio Resource Management algorithms on the network performance

Prismo Simulator goes beyond the Monte-Carlo static simulation approach, while avoiding the complexity traps of dynamic simulation. It aims to be simple, efficient and easy to configure. As such, the target audience for this tool is the operational radio engineer, not the R&D engineer as is typical for dynamic simulators.

To reach these goals, Prismo Simulator has been developed in close cooperation with a major European operator, and is currently deployed in several countries across Europe.

## 1.2 In more details

Prismo Simulator is not a network planning tool. It connects to existing network planning tools such as Atoll™ by Forsk™ and runs dynamic simulations on pre-planned networks.

Traditional GSM-type planning tools base their cell planning on propagation models and static frequency allocation. In CDMA-type systems, dynamic power allocation replaces static frequency allocation. Dynamic power allocation requires Monte Carlo type simulations or dynamic simulations to study system performance.

Monte Carlo simulations perform, on a static snapshot of the system, a power convergence loop to determine “average” power allocation when the system reaches equilibrium. However, Monte Carlo simulations cannot simulate dynamic changes in the system, e.g., Service Downgrade, Upgrade, Cancellation and other transient behaviors such as Call Admission Control and Load Control procedures. Quality of Service figures for packet-switch service (e.g., mean or percentile user throughput) cannot be measured in Monte Carlo simulations.

Dynamic simulation overcomes these limitations, but are usually unusable on real network with hundreds of sites and thousand of calls. Their focus is the R&D engineer who need to develop

Radio Resource Management algorithms and fine tune their parameters.

Prismo Simulator offers a novel approach to dynamic simulation by using a fast event-driven process, instead of the usual time-sampling process. This approach makes it simpler and more efficient. It provides similar speed and interactivity as static simulation, while bringing the dynamic simulation of service grade changes and other transient behaviors.

Prismo Simulator is very well integrated within Atoll™, and is virtually indistinguishable from a native Atoll module. This advanced integration makes it easy to adapt to the operator work flow.

As a summary, Prismo Simulator main features are:

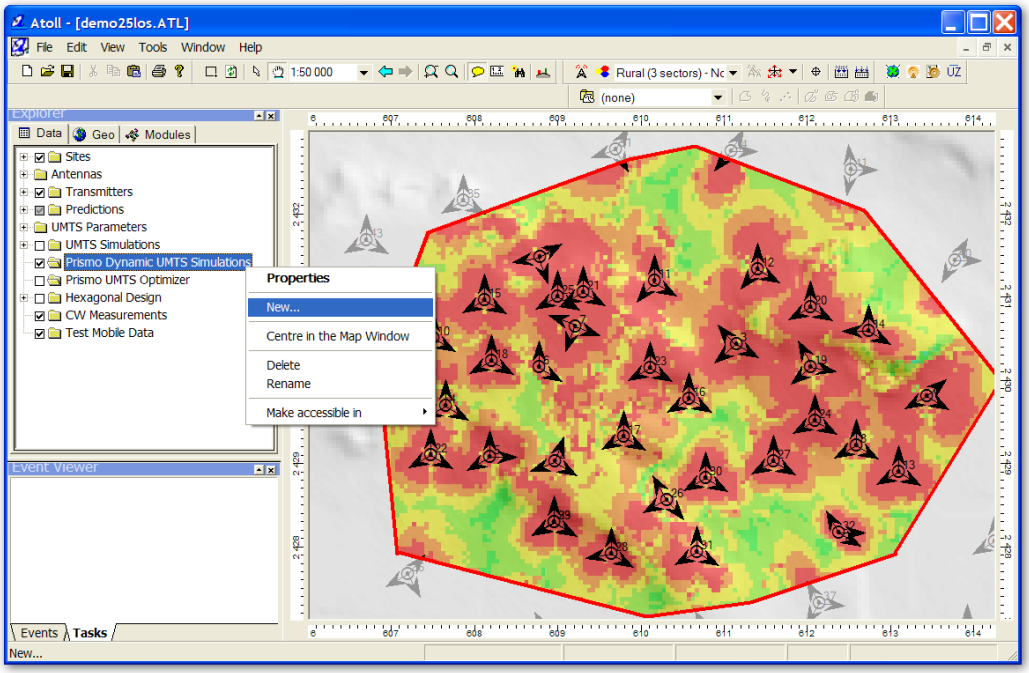
- Native support for UMTS WCDMA R99 and HSDPA.
- Seamless integration with cell planning tool Atoll™. Most of the network configuration is done in Atoll™, as well as the visualization and analysis. Easy to use.
- Simplified event-based dynamic simulation model
- Operator-oriented modeling of services, bearers and terminals.
- Operational engineers are not overwhelmed with unnecessary technical overhead.
- Fast simulation time allows for interactive use
- Easy to extend with new Radio Resource Management (RRM) models.

# 2 Quick Tour

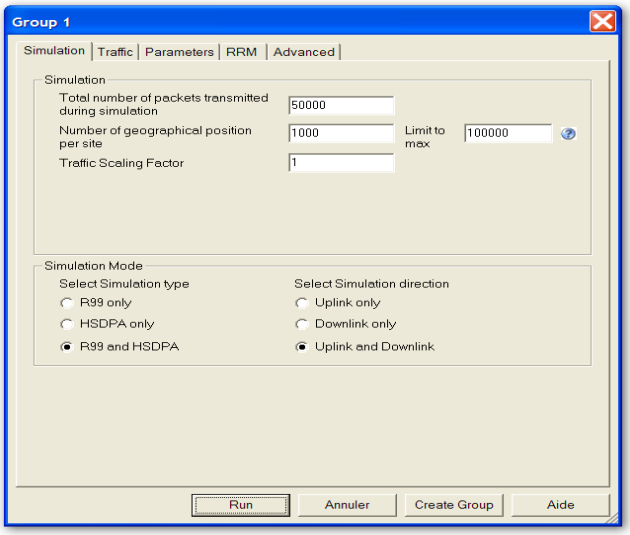
We will do here a quick tour of the simulation process to demonstrate the ease of use of Prismo Simulator and its main output.

## 2.1 Integration within Atoll Explorer

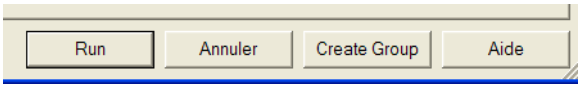
First of all, Prismo Simulator is fully integrated within Atoll within the Data Explorer tab. This is very similar to Atoll Monte Carlo simulator. By using the *New..* option, a new simulation is started.



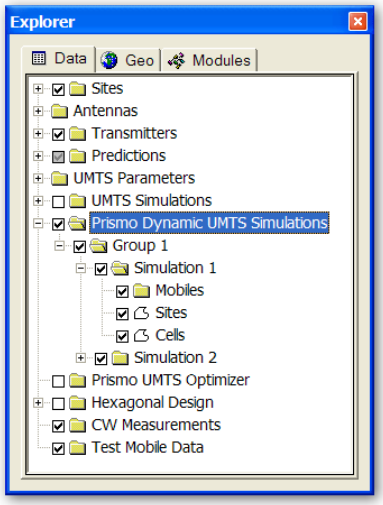

This enter the Setup dialog where the simulation parameters will be entered.



Once all the parameters will be validated, one can launch the simulation.



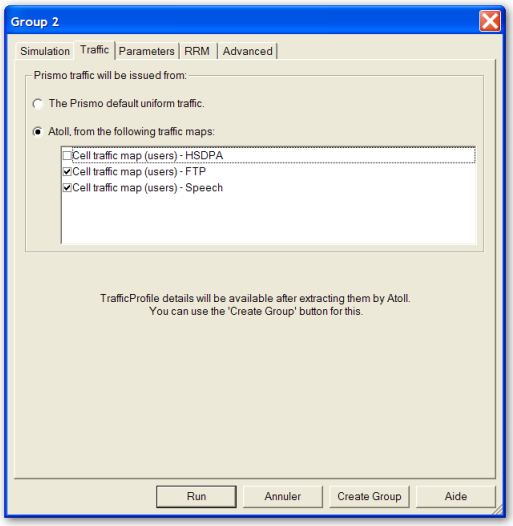

After a simulation run, new nodes are created within Atoll Data Explorer. A *Group* node is used to hold the configuration setup. By double clicking on it, the setup dialog is entered. This allows to come back later and modify some of the parameters for running a new simulation.



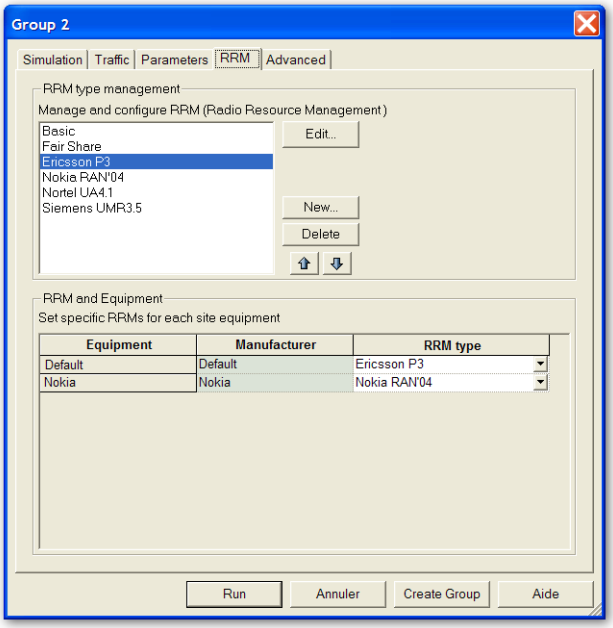

A *Simulation* node is used to hold the optimization results. By double clicking on it, the result dialog is shown for that optimization. Under the *Simulation* node, we have access to a *Mobile* node to show and display the results for each mobile, as well as *Sites* and *Cells* node to display the related results.

## 2.2 Parameters Setup

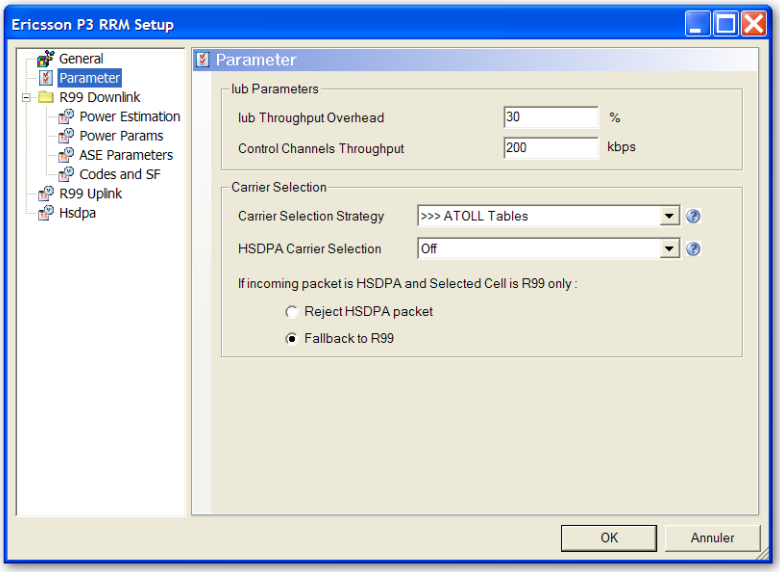
In order to run a simulation, it is best to select a number of traffic maps to be used. The simulator supports all traffic methods from Atoll. By using Atoll traffic maps, all settings related to traffic load as well as service, mobility and terminal usage are derived directly without further setup.



It is possible to setup more advanced parameters such as the Radio Resource Management (RRM) settings. Each site equipment is associated with a RRM module.

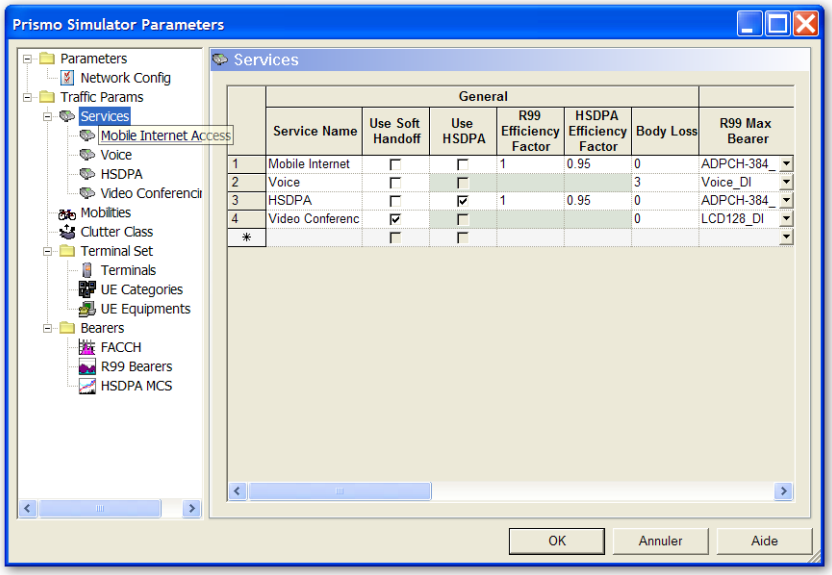



New RRM modules can be defined, and their parameters tuned to replicate the network configuration.




All parameters related to Service, Mobility, Terminal, Clutter parameters, etc. are directly extracted from Atoll, and usually no extra setup is required. This insure coherent simulation against other Atoll tool such as the Monte-Carlo static simulator.

Prismo provides however the possibility to display these parameters in its own interface, as well as making local modification if wanted.

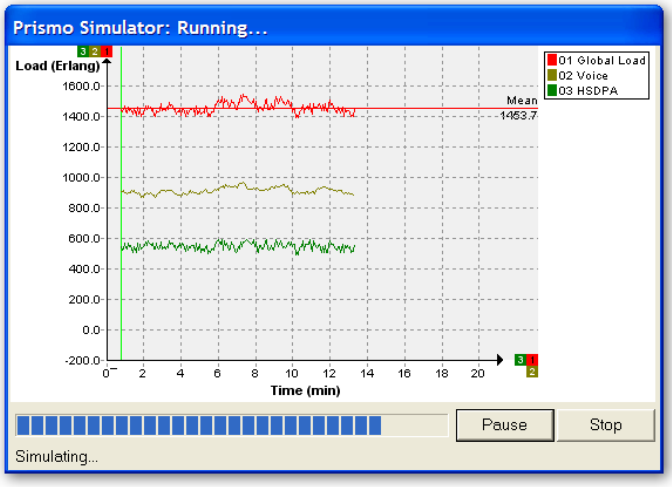



The setup is finished. We can see here the ease of use of setting up a simulation on a network:

- Simply define once for all the Service/Terminal/Bearer/etc.. in the Atoll template project. This can be reused across projects
- Select the Traffic maps to be used for a simulation
- Launch the simulation

## 2.3 Running the simulation

While running, the simulation shows to the user the instantaneous load seen by various services:

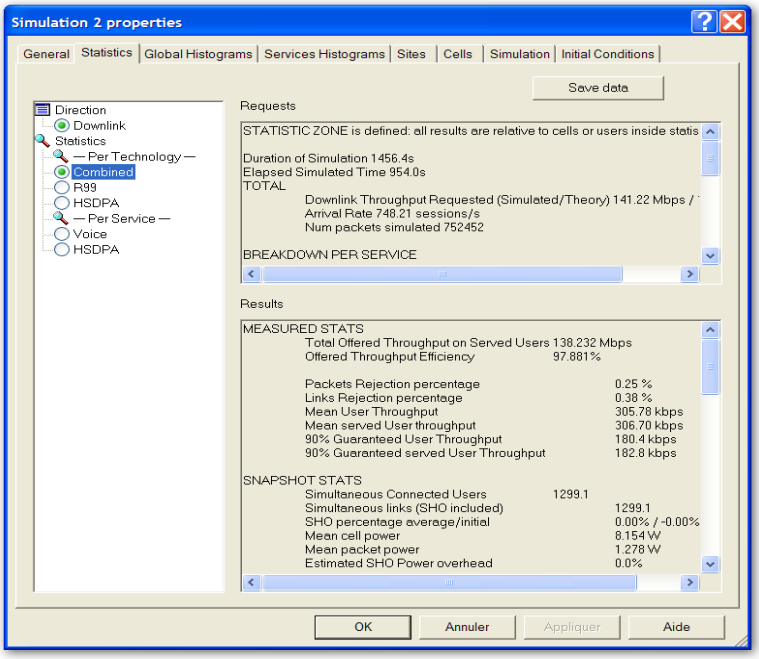



During the simulation run, Atoll is not locked, and can still be used for performing any other tasks.
A simulation run is fast. As an example, an 30km2 area with 100 Tx, with 500.000 sessions simulated (average load of 1500 erlang) takes less than 20 mn to simulate on a regular desktop computer.

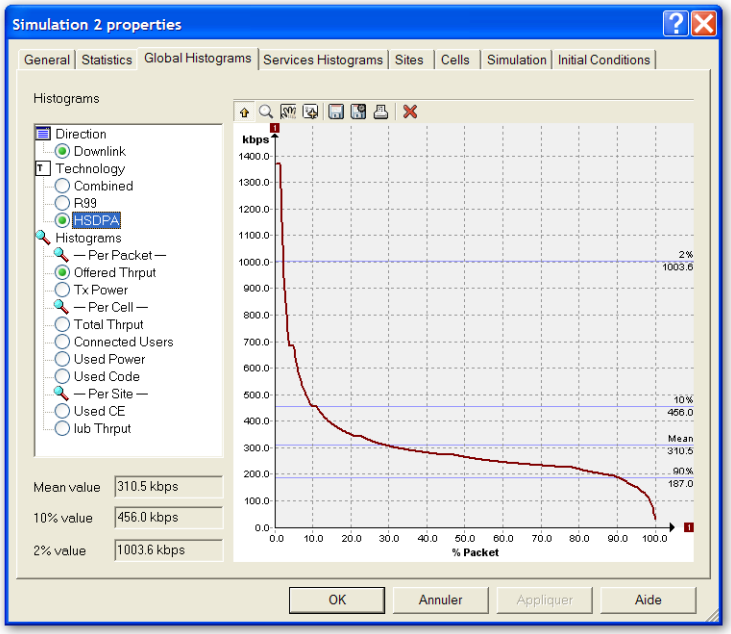
## 2.4 Simulation results

The *Results* dialog is accessed by double clicking on a *Simulation* node. It contains multiple tabs showing the various results available.

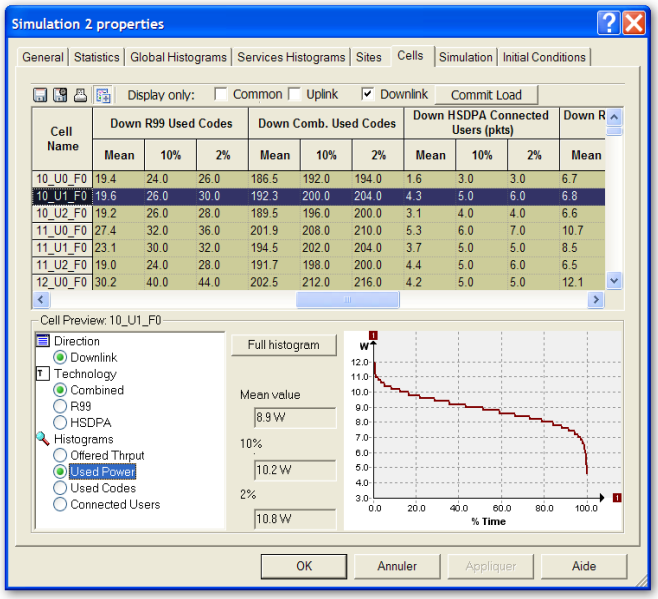
The *Statistics* tab provides a synthesized view of the simulation statistics, per technology and per service. Example of data are Packet Rejection ratio and their reason, average offered throughput, etc...




The *Global Histograms* and *Service Histograms* tabs shows various histograms giving an overall view of the system performance.

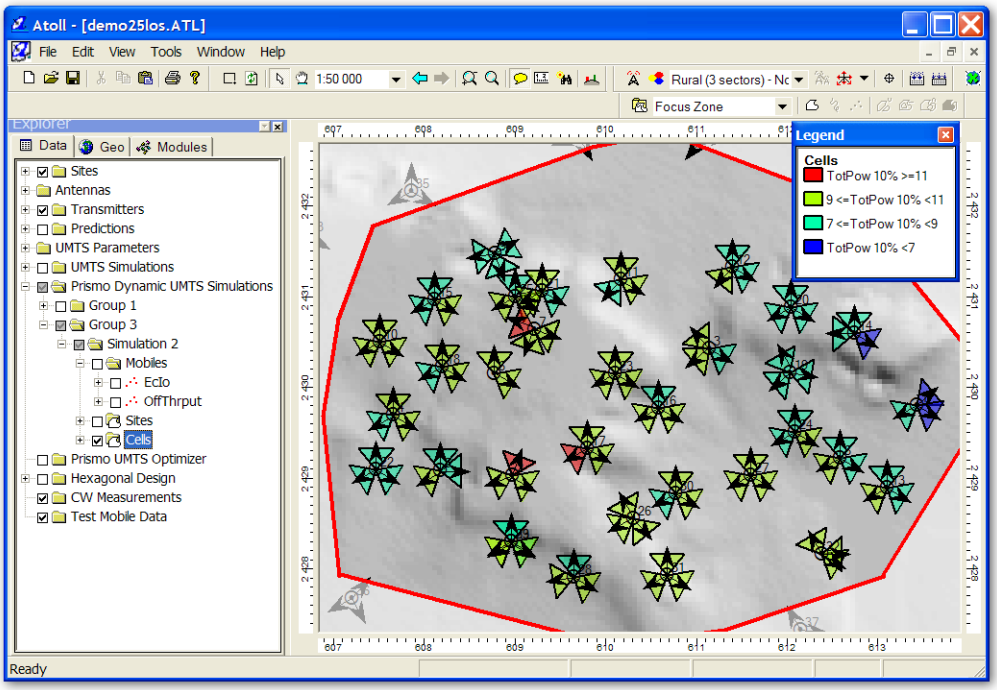


The *Cells* and *Sites* tab provides statistical results on a per cell/site basis. All results are presented on a grid fashion allowing sorting, column hiding, export, etc. Histograms are provided for resource usage such as power, codes, channel elements or Iub. These figures are typically used in the resources dimensioning process.

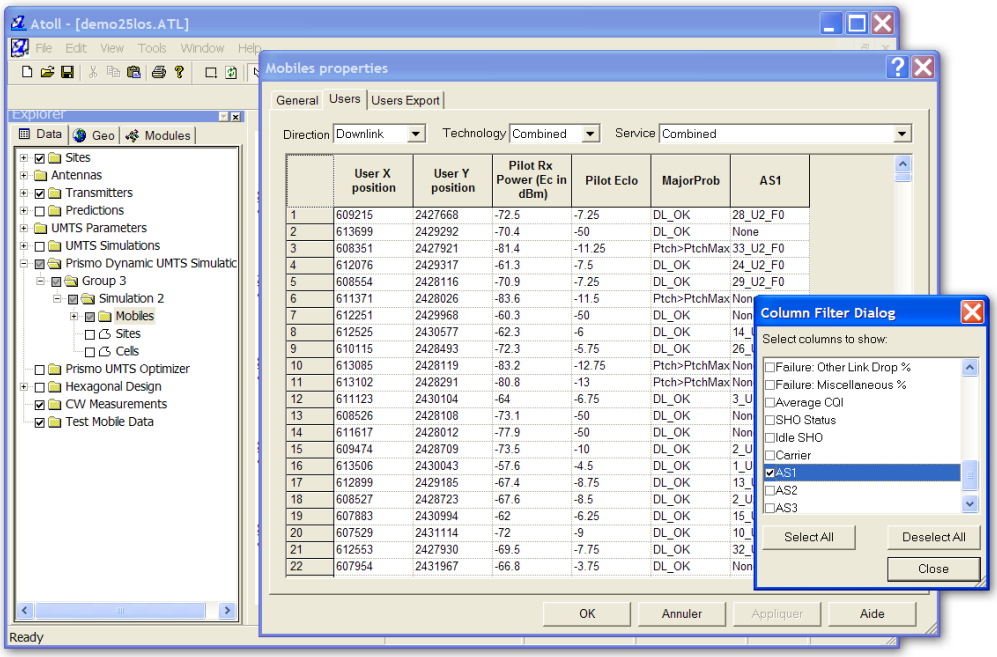



Committing cell power load back into Atoll is provided, which allows to recompute EcIo prediction maps directly in Atoll based on average cell load.

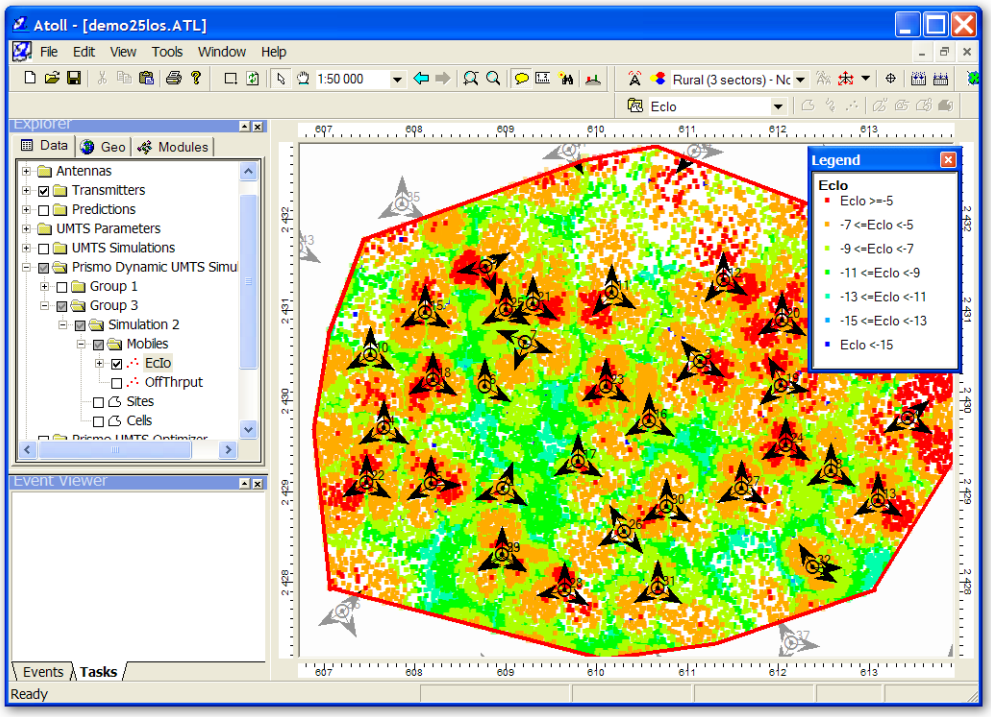
These Cell/Site statistics can also be displayed directly on Atoll for quick visualization and analysis.



Directly from Atoll explorer, it is also possible to display *Mobile* statistics in a grid fashion, suitable for export.




Any of the *Mobile* statistics can also be directly displayed in Atoll with a few clicks. Export to raster BIL files is also possible.



# 3 Typical Usage

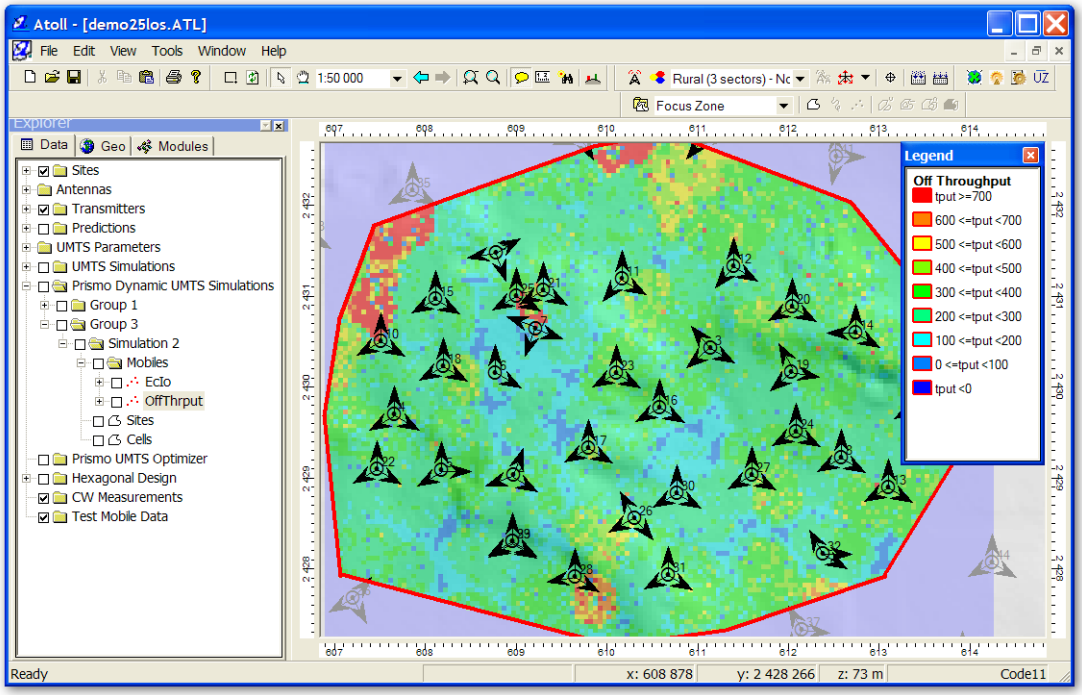
Here are described some of the typical usage of Prismo Simulator.

## 3.1 QOS maps

It is often useful to produce maps of provided QOS (quality of service). They can be used:

- for marketing purposes,
- to identify weak areas in the network

One common example of such QOS map is the offered throughput on HSDPA services.
In HSDPA, offered throughput depends on the signal quality, but also on the number of concurrent users sharing the HSDPA channels and the scheduler algorithm. Prismo Simulator models the various possible schedulers and reproduces the traffic as measured in the real network.




Other type of QOS map can be plotted such as:

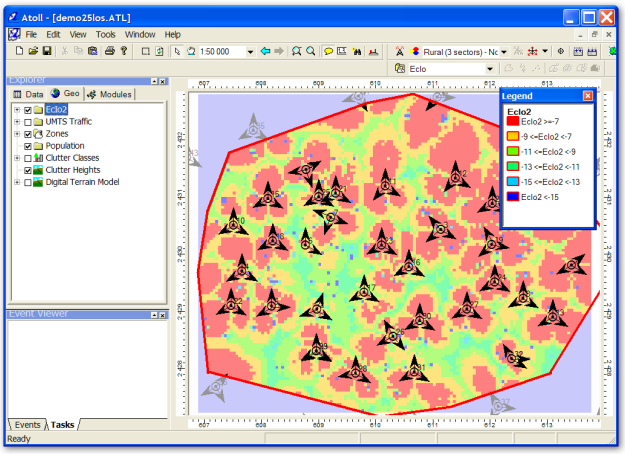
- Map of CQI in HSDPA, showing thus maximum achievable throughput
- Map of Call Failure ratio, and their precise failure reason
- etc.

## 3.2 Simulated EcIo maps

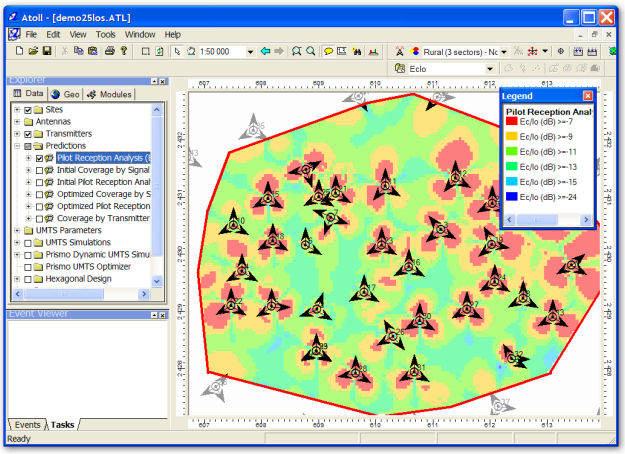
Map of EcIo is a traditional figure used by radio engineers for planning the UMTS network. It measures in a simple way the network signal quality and interference level. Such maps depend strongly on the power load on each cells.
Traditionally one uses fixed dedicated value for these power loading, thus leading to suboptimal EcIo map. In addition aggregated maps on multiple carrier is not possible.

Prismo Simulator allows to take into consideration the traffic coming from measurement on the real network, replicates it on the simulated environment, and then produce relevant EcIo maps using the simulated power load on each cell. These maps are thus derived directly from the simulated connections.

Producing aggregated maps on multiple carrier is also possible with this method.



*Simulated EcIo*
*(exported map in raster BIL)*

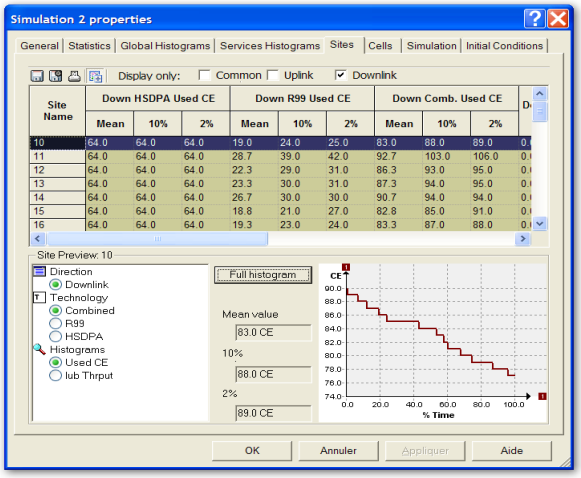


*Atoll EcIo Map*
*(using average cell load from simulation)*

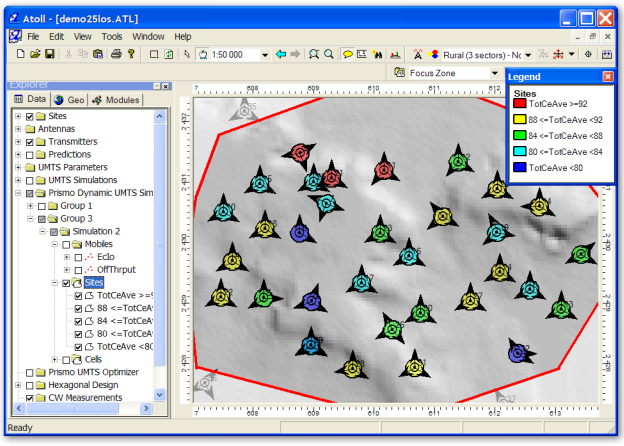
## 3.3 Dimensioning of Cell/Site resources

Sites have limited resources, such as cell power, channel elements and Iub capacity. Prismo captures the statistics and distribution of these resource usage on a per cell and per site basis. It also keeps statistics on any call failure due to limitation of these resources.

Using these data, one can derive the correct dimensioning to be used, reduce capital cost and improve quality.




*Histogram view of CE usage per site*



*Graphical view of CE usage per site*

## 3.4 Continuous planning

Prismo Simulator allows to lock the simulation on the traffic measured in live network. In some way this performs a calibration to the real network.

By increasing the traffic load according to marketing expectation, maps of future QOS are created.
This helps forecast the network quality, and identify areas of weakness before the changes actually take place. Any appropriate action can then be planned *ahead of time*.
Prismo Simulator thus complements *reactive* optimization techniques based on post-processing of drive test or KPI measurement.

To accommodate these traffic changes, it is often necessary to add new sites and plan again the network. Many design choice are left open when performing these network upgrades, such as site location, antennas azimuth, modification to existing sites, etc..
Prismo Simulator also complements existing methodologies based on manual planning or ACP (Automatic Cell Planning) tools. It allows to quickly validate the new network setup before implementation.

## 3.5 Design study and guidelines

Prismo Simulator can be used to run studies for comparing various network design options. It provides a quick and easy way to test various scenarios, derive statistical results and QOS maps, and find out the best rules which can be applied in a systematic way.
These studies can then lead to guidelines for network deployment.

Examples of such studies are:

- how to deploy HSDPA on multiple carrier networks: should HSDPA be enabled on a dedicated carrier, or is it better to share a carrier for both HSDPA and R99 traffic
- what is the best strategy in deploying bi-layer micro/macro with 2 or more carriers.
- what values to use on key open parameters
- etc..

## 3.6 Analyzing RRM strategies

Prismo Simulator implements various vendor RRM modules. New modules can be added to the simulator as of customer request.

The simulator can be used for:

- comparing various vendor RRM strategies, and evaluate their effect on overall network quality
- understanding the effect of the main parameters of the RRM algorithms, and possibly tuning them
- etc..

## 3.7 Providing input to link level simulations

For R&D engineers, Prismo Simulator can be setup to output detailed statistics of mobile signal and interference data for each interfering cell. These data can be used as input of link level simulation for performing detailed analysis of receiver algorithms and performance.
As an example, such studies have been performed to evaluate beamforming performance in real network configuration.