

*7signal Sapphire Carat*

# *Carat User Guide*

*Release 3.1*

## PREFACE

### Document scope

This document is aimed for people that shall manage and configure 7signal Sapphire quality tests on wlan networks. The test pattern configuration and 7signal Sapphire system administration are explained in this document.

This document does not describe how the software is installed and how to handle the monitoring station. This is found in 7signal Sapphire Deployment Guide. To get guidance on how to interpret the measurements, please turn to 7signal Sapphire Loupe User Guide.

### FCC Warning

The radiated output power of the 7signal Sapphire Eye complies with the FCC RF exposure limits. To avoid the possibility of exceeding the FCC radio frequency exposure limits, a distance of at least 20 cm should be kept with the user and the device while operating.

**The FCC ID for 7signal Sapphire Eye is YLF-2010-08-APU2 for IEEE802.11a/b/g**

#### **FCC APPROVAL PENDING ON RELEASE DATE**

**The FCC ID for 7signal Sapphire Eye is YLF-EYE-ABGN-APU3 for IEEE802.11a/b/g/n**

**This device is restricted to indoor-only use in 5150.0-5250.0 MHz and 5470.0 -5725.0 MHz bands**

### Note to the user

Any uninstructed modification to the 7signal products may result in violation of FCC requirements.

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# 1 7signal sapphire – WQA Solution

Welcome to learn about 7signal Sapphire, that provides you a new way to continuously and automatically measure the health and quality of a wireless network from the user's perspective. A commonly used term here is wireless quality assurance, or WQA. Companies and their business processes are becoming increasingly dependent on the performance and service quality of their wireless networks. Thanks to the Sapphire WQA solution, companies can integrate the quality management of wireless networks with their existing IT and communications technology services.

7signal Sapphire uses monitoring stations (Sapphire Eye) to monitor performance and quality in WLAN cells and to monitor the surrounding radio frequency environment. The performance of the customer's network is tested against a test server (Sonar). Interactive tests, monitoring stations, and parameters for automatic measurement are managed with a centralized management tool (Sapphire Carat). The measurement results are reported via a reporting application (Sapphire Loupe).

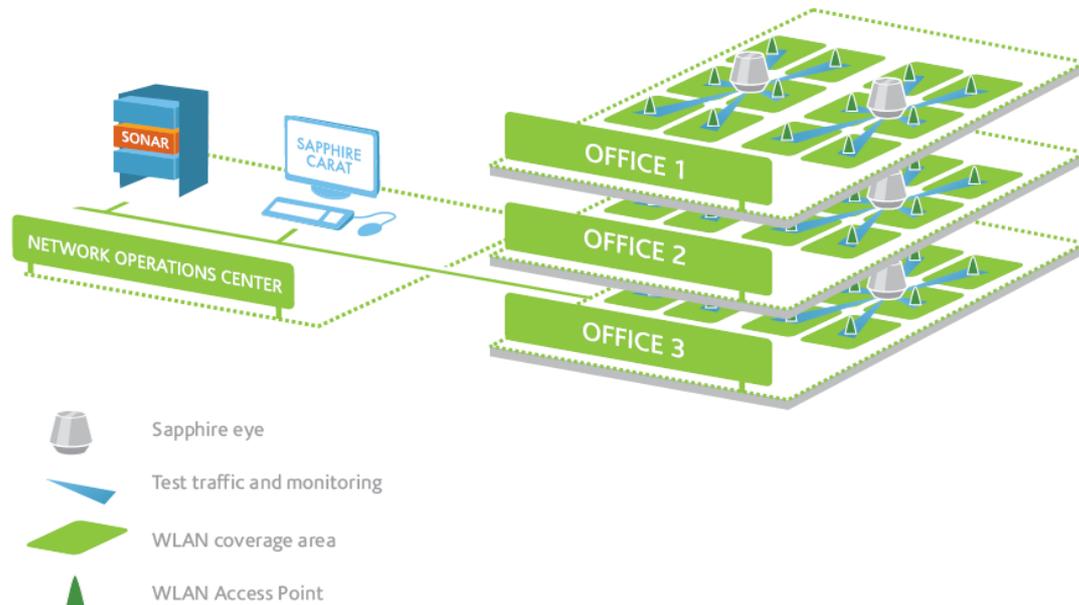
The monitoring station, Sapphire Eye, continuously monitors the selected WLAN channels via passive listening, which does not have an impact on network performance. It can also emulate a client device in the target network and then use the network and the services provided through it. By analyzing the measurement results, the solution can detect network performance and quality-of-service (QoS). The solution can also produce proactive statistics on the predicted user experience of network performance, which enables the company to increase network capacity before the users notice loss of performance.

In user emulation tests, also known as active tests, Eye connects to the test server (Sonar) over the wireless network and uses it like an ordinary production service. The use may include mass file transfers, browser downloads, wireless VoIP calls, or connections to another production server. Sapphire tests the end-user experience by examining the entire data chain from the client to the production service. Active tests can monitor the network even when there are no users in the network. This makes it possible to forecast performance problems and to take corrective actions even before the service level suffers. Active tests show the availability and quality of services offered over the network, and they help administrators to see why some applications with their various demands for network performance do not work as expected in the network or some of its areas. When problems occur, active tests can also aid to locate of the problem area in the network topology, which often includes WLAN, LAN, and WAN elements.

The key benefits of 7signal Sapphire are user emulation, superb coverage, continuous monitoring, and visibility of network health. Competing solutions are often based on monitoring the access point settings. As a result, they do not give any indication of the service quality experienced by the end user. In such limited solutions, the service quality parameters measured are the same as in wired networks. Sapphire, by contrast, produces a comprehensive picture of the radio connection quality, where delay, number of retransmissions, and packet loss are taken into account, in addition to the commonly measured parameters.

## 1.1 System overview

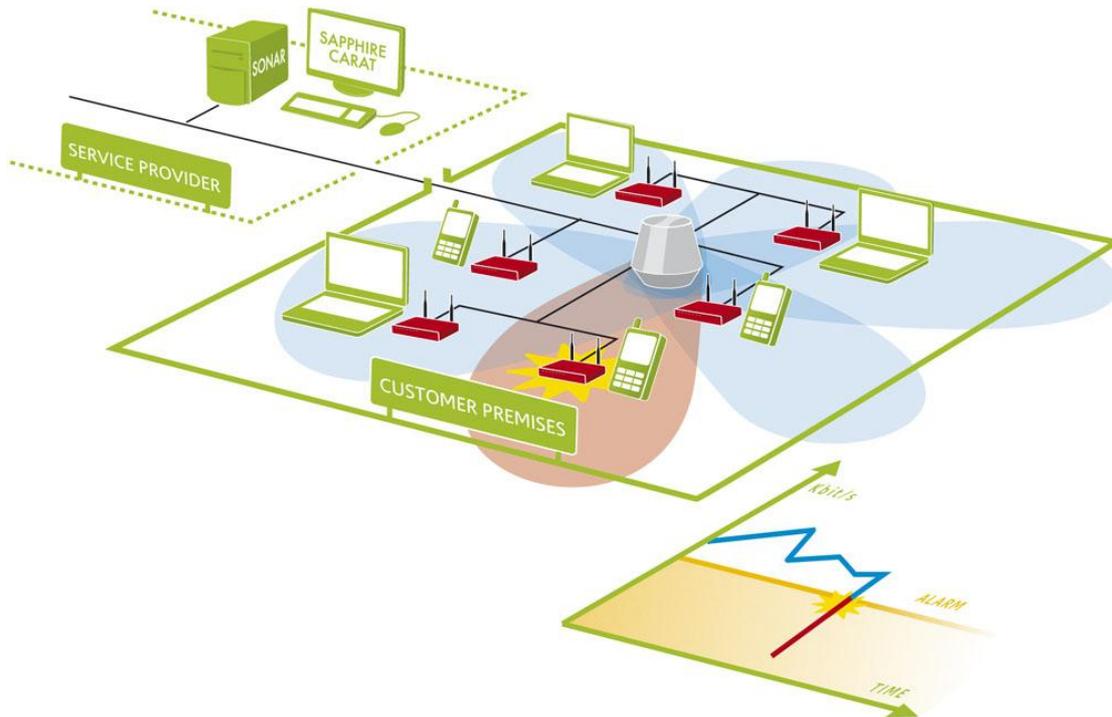
The 7signal Sapphire Quality Monitoring Solution consists of a Sapphire Eye monitoring station, a Sonar test server, the feature-rich Sapphire Carat management software, and Sapphire Loupe for viewing and reporting on results.



The system components are described in chapters 2–6. The remaining chapters describe the management software. The result viewing and reporting tool (Loupe) is described in its own user guide.

## 2 SAPPHIRE EYE

Sapphire Eye is a monitoring station for WLAN environments. Unlike a common access point or client, the Eye monitoring station uses advanced broadband antenna technology, which creates an exceptionally large coverage area. Consequently, one Eye can monitor several access points, or WLAN cells. The typical number of monitored cells is 5–8. Eye is protected against dust and water (conformant to IP55 or IP65 specifications, depending on the model), so it can be installed outdoors also in challenging environments.



In the picture above:

- The monitoring station (Eye) is the grey cone-like object in the center;
- the Carat management interface is on the service provider's premises (top left corner);
- the customer's premises have a wireless network with six access points (center part of the picture, access points in red);
- there is one monitoring station on the customer's premises (the colored lobes depict the station's directional antennas and their range);
- a problem has occurred in an access point in the red lobe;
- the problem can be seen in the monitoring interface or in a report as a falling performance indicator value (lower right corner).

In Sapphire, the management tool Carat and monitoring station Eye work as a client and server, with Eye being the server for Carat. The traffic between the client and server is strongly encrypted and uses 7signal's proprietary management protocol. This makes it possible to manage the monitoring stations from geographically distant locations and over insecure networks.

A monitoring station conducts both passive and active measurements in a WLAN environment. The passive measurements consist of listening to data traffic that uses the IEEE 802.11 protocol and of general analysis of the radio frequency spectrum in the coverage area. Passive measurements have no effect on the functionality or utilization rate of the target network, or the effect is very small (probe request transmissions). During active measurements, Sapphire Eye contacts each monitored access point in turn and uses the network services via the WLAN; i.e., it acts as a client in the network. Using both active and passive measurements, the 7signal WQA solution can monitor the experienced network performance along the entire length of the service chain and locate problems in both WLAN and LAN environments.

## 3 SAPPHIRE CARAT

With the Sapphire Carat management tool, you can manage the Sapphire Eye monitoring stations, run interactive and real-time measurements, configure and manage automatic measurements, and generate reports of the measurement results. The reports shows measurement results in tables and charts.

Sapphire Carat stores the profiles used in the automatic testing of the monitored network, and the network's access rights information. Sapphire Carat can be used interactively to test various areas of the network, or it can be left running in the background for continuous collection of test results.

Key features:

- Status information on the radio network's availability and usability;
- Availability of a production service;
- Overview of data traffic from the client to the production server;
- Packet-level load measurement and traffic analysis in a radio network ;
- Tests at application level;
- Properties, signal levels, and noise levels of the radio frequency environment;
- Statistical analyses, averages, deviations, and distributions;
- Monitoring of data security settings;
- Location of interference;
- Alarms.

## 4 SONAR

The role of the Sonar test server in 7signal Sapphire is to emulate one of the customer's production servers. Sapphire Eye connects to Sonar to measure QoS provided by the network. Measurements are performed both directions (uplink and downlink). Uplink means traffic from end-user device (e.g Eye) towards network (e.g. Sonar). Downlink means traffic from network towards the end-user device.

Single Sonar can serve several monitoring stations which has access through IP networks to Sonar. One Sonar can therefore be used as the test point for several networks.

The 7signal Sapphire WQA solution supports the concurrent use of several Sonar test servers, which means that Sonar can be installed on several servers within a company. Using several Sonars enables the company to detect and locate problems in its network. Sonar can be located in the same network as the access points, in a server room in the same building, or anywhere on the Internet – such as in the centralized identification and authorization center of an international organization.

## 5 SAPPHIRE LOUPE

Sapphire Loupe is the performance and QoS analysis tool in the WQA solution. Loupe cannot be used to control Sapphire's functions and measurements themselves.

Loupe makes the network's key performance indicators (KPIs) available at a glance, or in more detailed form for a given time period. Loupe is browser-based, so authorized persons can use any of the most common browsers to view the results as long as they have an Internet connection. The result summaries can be saved as plain text to comma separated value files (CSV files), or as PDF files, preserving the formatting. The plain-text material can be used in many ways, including import into a spreadsheet.

There is a separate user document for the Sapphire Loupe.

## 6 CARAT USER INTERFACE

The Carat user interface (GUI) is a stand-alone java client. The purpose of the Carat user interface is to configure and manage the Sapphire solution. Several users can access and configure single Carat simultaneously.

### 6.1 Menus

#### 6.1.1 Navigation

The menu contents are dynamic based on context, user access rights and the current license.

Menu	Description	Submenus
File	Log in / log out, lock the session, and close the application.	Lock session Log in Log off Exit
Edit	Enter settings for applications used for viewing the exported result files. Specify the server for outgoing mail.	Configure tools SMTP server
View	Configure and view Sapphire's general settings.	Network topology Alarm
Manage	Manage Sapphire's general settings: <ul style="list-style-type: none"> <li>- alarms</li> <li>- user management</li> <li>- access keys to radio networks</li> <li>- test end point settings</li> <li>- administration of target network client information</li> <li>- settings for automatic reporting</li> <li>- remote management of monitoring station software</li> </ul>	Alarm configuration Users and groups Access Control Network Keys Test end points Alarms <ul style="list-style-type: none"> <li>Email</li> <li>SNMP</li> </ul> Network clients SLA Definitions Automated report configuration Eye software management Change password Test Profiles
Tools	Start and stop the automatic test profile.	Start sequential testing Stop sequential testing Eyes auto test management
Window	Refresh the main window of the user interface.	Refresh
Help	Read user documentation and general information about the system installation.	Release notes Carat User guide Loupe User guide About

## 6.2 Network Topology

The Network topology is a hierarchical tree displaying hierarchy from the Organization to Eyes and Access Points. The user can select from multiple ways to access the network: either via monitoring stations or via the network's service areas. Both methods support network testing, but monitoring stations can only be managed by using their respective icons.

The network hierarchy is displayed as a tree, with an icon representing each item at each node. If the item has functionality, you can bring it into view by right-clicking the icon.

Topology Node	Icon	Description	Submenus
Organization		In the Organization menu, you can add organizations, locations and service areas to the organization that is being created.	Edit View wireless network Add location Add organization Remove organization Bind SLA
Location		From the Location menu, you can set the network's physical location (e.g., country, city, or building). A location is always attached to a higher-level location or organization.	Edit Add Location Add service area Remove location Add Link Group Bind SLA
Service area		A service area is a location where you can install a monitoring station. A service area is determined by the coverage area of the monitoring station, not by the coverage area of the target network. A service area can have a floor plan.	Edit Add Eye Bind wireless network Remove service area Allowed channels Floor plan Bind SLA
Eye		A monitoring station always belongs to a service area.	Edit Remove Eye (De)activate Network scan Client scan Spectrum analysis Noise Monitor Manual tests Bind to test profiles Unbind from test profiles Automated test status Bind SLA
Wireless network		This menu describes the target network, which can be located in one or more service areas. A service area can contain several target networks. This menu is used	Add key Edit Unbind wireless network Allowed channels Bind SLA

		to configure the encryption method used in the network.	
Access Point		In this menu, you can perform tests and set alarm limits for an access point.	<ul style="list-style-type: none"> <li>Access point info</li> <li>Active tests</li> <li>Bind to alarm limit group</li> <li>Unbind to alarm limit group</li> <li>Remove access point</li> <li>Bind SLA</li> </ul>

## 7 STARTING THE CARAT CONFIGURATION

The access rights and user management heavily relies a group-based model. The group is the starting point: every user belongs to one of the groups and the group determines the access rights of any given user. The technical details and management instructions are in the next section.

Any objects in the system – Eyes, Sonars, topology elements such as Organizations and Locations – belong to some administrative group. Objects that do not belong to a certain group are also invisible to the group. This isolation is very low-level in 7signal Sapphire in order to enable safe and secure operations in large setups with numerous and heterogeneous organizations.. 7signal Sapphire supports multiple organizations that are under completely different administration and must remain unaware of each other.

**NOTE:** To fully utilize this feature it is strongly advised that a role called **Solution Administrator** (see the next section on user and group management) is **used only to create other Administrators** (Organization Administrators).

The recommended minimum setup for an operational 7signal Sapphire is to have default admin user for general handling of users and groups and admins of one or more organizations. Any organization needs two users: one for administration and one for configuration network tests etc.

### 7.1 How To Create The Minimum Set Of Users

The system default user is the ‘Solution Administrator’ belonging to Solution Administrator Group. This requires no other action than the initial login and changing the default password to a non-default password.

#### As ‘Solution Administrator’

1. Choose ‘Manage | Users and Groups’ for user account management from the top-menu.
2. Create a new group for the administrators of the organization.  
Use a descriptive name, f ex *NewAdminGroupForOrganizationX*
3. Create a new admin user for the organization.  
Use a descriptive name, f ex *LocalAdministrator1*.
4. Logout

#### As ‘LocalAdministrator1’ created in the previous step

1. Choose ‘Manage | Users and Groups’ for user account management from the top-menu.
2. Create a new group for the configurators of the organization under previously created administrator group.  
Use a descriptive name, f ex *NewConfigGroupForOrganizationX*

3. Create a new configurator user to the Configurator group.  
Use a descriptive name, f ex *LocalConfigurator1*.
4. Continue using Sapphire.

All other configurations related to network topology, test profiles, wlan network keys etc. should be made by the user *LocalConfigurator1* to enable proper operation of the automated object access rights management system.

Some top-level operations for *Solution Administrator* are explained right below

## 7.2 Automated Tests

Top-menu selection “Tools | Start automated tests” affects only those objects that are accessible to the user issuing the command. Stopping works similarly.

Solution Administrator level user starts and stops testing system-wide i.e. all the monitoring stations. Local Administrator may affect the monitoring stations only inside their own administrative boundary i.e. only part of the monitoring stations start/stop. However it is advised to use Configurator level users to manage automated testing.

## 7.3 Access Rights

The access rights is an accessible pane in the “Manage” menu. When one follows the intended way of user and group definition, the contents and actions in the “Access Rights” pane are redundant. The feature remains activated but the use of it is discouraged and thus not instructed in detail.

For sandbox testing and non-warranted try-outs: the left panel contains actual users and groups and related access rights. The right panel contains all objects in 7signal Sapphire. With combinations of right-clicks and drag&drops fine-level adjustment and changes to access rights are possible.

## 8 USER MANAGEMENT

User management in 7signal Sapphire is based on user groups. A user's access rights in the system derive from the user group that the user belongs to. A user may belong to one or more user groups.

In addition to normal user management the Sapphire system supports user group specific view virtualization. The system can be configured so that different user groups have access to different objects that have been created into the system. For instance, one user group may have access to all objects and two subgroups of that group may only have access to a portion of all objects. It is also not necessary for the subgroups to have access to any of the same objects.

User management is also restricted in the same manner as object management. An administrator user only has access to the users created to subgroups in addition to any users belonging to the same administrator group he/she belongs to.

Users belonging to the Sapphire admin group have access to the entire system.

### 8.1 User Groups And Object Permissions

Almost every object created in the Sapphire system includes an access control list (ACL). An object's ACL is mainly determined by the user group of the user that creates the object in question.

Note that objects are also created through automatic testing. For example access points, wireless clients and alarms created this way. Objects created as a result of automatic testing inherit their ACL from the Eye that conducted the test.

The Sapphire system also includes the functionality to transfer access rights of objects from one user group to another.

### 8.2 User Group Hierarchy

The Sapphire system supports two types of user groups: normal user groups and referencing user groups.

A normal user group can be created either as a new root group or as a subgroup to an already existing user group. When new groups are created as subgroups under an existing user group, the existing group inherits access rights to all objects that its subgroups have access rights to. This inheritance rule applies to the whole user group hierarchy meaning that the root user group in a hierarchy gets access rights recursively from all subgroups. Access rights of referencing user groups are not inherited in this way.

A referencing user group can be created for any group except the Solution Administrator group. A referencing user group always has the same access rights as the user group it references. The only difference is that a referencing user group cannot be granted the same access level as the group it references. A common use for a referencing user group is to have it reference for example an organization's configuration group. This way the referencing group's users can view the configuration group's objects, but cannot configure the system.

## 8.3 User Access Levels

The Sapphire system supports three elementary access levels for user groups: Reporter, Configurator and Administrator. Access rights are inherited from lower to higher levels: Reporter users only have their own level's access rights, Configurator users have reporter level rights plus additional rights granted by their configurator level, and Administrator users have all rights.

There are four levels of access rights:

- **Solution Administrator** – system-wide super-user that may be the only user in small set-ups and should be used only for other administrator definitions in large-scale environments
- **Administrator** – full access and management rights 
- **Configurator** – full access rights, no user management rights 
- **Reporter** – access rights to alarms and reports 

## 8.4 User Group And User Management

The Sapphire Carat user management dialog can be accessed from the main menu by selecting "Manage | Users and groups". Only administrator level users can access user group and user management in the Sapphire system.

When the user management dialog is opened, a tree view showing the users and user groups currently existing in the system opens to the left of the dialog.

## 8.5 User Groups

### 8.5.1 Related icons

#### Reporter group



active group



referencing group



inactive group

#### Configurator group



active group



referencing group



inactive group

#### Administrator group



active group



referencing group



inactive group

### 8.5.2 User Group Parameters

- **Name** - The name of the user group
- **Description** - A description of the group
- **Service Role** - Defines access rights for the group's users in the Sapphire system
- **Type** - The group type (normal/referencing)
- **Status** - The group status (active/inactive)

### 8.5.3 Adding User Groups

A new user group can be added into the system in three different ways:

1. As a new root group under which to start creating a new user group hierarchy.
2. As a subgroup to an already existing user group.
3. As a symbolic (referencing) group for an already existing group.

Adding a group can be done by right-clicking on either the "Groups and users" node in case n:o 1 or an existing user group in cases 2 and 3 and selecting "Add instance group" in case n:o 1 and n:o2 or "Add symbolic group" in cases n:o 3 from the pop-up menu.

Steps to create a new group:

1. From the top menu bar select "Manage | Users and Groups" to open a pane on left
2. Right-click the root object named "Users and Groups" or an existing group to get a submenu
3. Select "Add group" to open a pane on right
4. Enter the relevant group information
  - a. user name: login name for the user
  - b. (optional) Description: free-text field for the group description
  - c. Role: group access right level. The field is dynamic, the super-group dictates the default level and available range of valid access level.
  - d. Status: Active or inactive. Only users in an active group may login.
5. Save the group by clicking "Save"

### 8.5.4 Editing User Groups

The user group editing dialog can be accessed by right-clicking the desired user group and selecting "Edit" from the pop-up menu.

An example of editing a user group:

1. Log in as an administrator group user
2. Open the user group and user management dialog by clicking "Manage | Users and Groups" from the top menu bar
3. Select the desired user group for editing by right-clicking on it and choosing "Edit" from the pop-up menu
4. Make the desired changes to the user group's settings
5. Save the changes by clicking on the "Save" button

### 8.5.5 Removing User Groups

A user group can be removed by selecting the group to be removed by right-clicking on it and selecting "Remove Group" from the pop-up menu. The following criteria must be satisfied before a user group can be removed:

1. The group must be empty of users
2. The group must not have any subgroups
3. The group must not own any objects

An example of removing a user group:

1. Log in as an administrator group user
2. Open the user group and user management dialog by clicking "Manage | Users and Groups" from the top menu bar
3. Right-click on a group that satisfies the removal criteria and select "Remove" from the pop-up menu

### 8.5.6 User Group Status

In certain situations it may be desired to inactivate some user group. An inactive user group has no access rights in the system. A user group can be inactivated by right-clicking on the desired group and selecting "Inactivate" from the pop-up menu. An inactive group can be reactivated by right-clicking on the group and selecting "Activate" from the pop-up menu.

An example of changing a group's status:

1. Log in as an administrator group user
2. Open the user group and user management dialog by clicking "Manage | Users and Groups" from the top menu bar

Right-click on the desired group and select "Inactivate" from the pop-up menu

## 8.6 Users

### 8.6.1 Related icons

#### Administrator user



#### Configurator user



#### Reporter user



#### *Parameters*

- User name - User name
- Alias - An alias for the user name, for example the user's real name
- Email Address - User's email address
- Phone - User's phone number
- Organization - The Organization that the user belongs to. Useful for example when a service provider wants to give access rights to clients it manages.
- Status - User's status
- Password/Confirm password: Password/Confirm password

When creating a new user the user name, status and password fields are required, the rest of the parameters are optional.

### 8.6.2 Adding Users (New)

A new user can be added by right-clicking on the user group that the user is to be added into and selecting "Add user" from the pop-up menu.

Steps to create a new user:

1. From the top menu bar select "Manage | Users and Groups" to open a pane on left
2. Right-click the relevant group to get a submenu
3. Select "Add user" to open a pane on right
4. Enter the relevant user information
  - a. Username: login name for the user
  - b. (optional) Alias: alternative name for the user
  - c. (optional) Email address: contact information for the user
  - d. (optional) Organization: user's organization
  - e. Status: Active or inactive. Only active users may login.
  - f. Password and confirmation: login password
5. Save the user by clicking "Save"

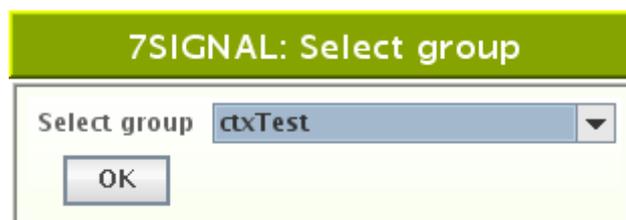
### 8.6.3 Adding Users By Copying

An existing user can be copied to several groups. This enables one single account to be used on numerous organizations while preserving the strict access policy.

Steps to copy a user:

1. Create one more group
2. Select a user from a previously existing group and right-click for the menu
3. Select "Copy user"
4. Select the icon of the new group and right-click for the menu
5. Select "Paste user"

The copied account may now access numerous groups. The login of a user belonging to several groups starts in the typical manner. After successful login a pop-up is shown in order to make selection of the group used for the login. The possible other groups are invisible after the chosen group (context) has been chosen.



### 8.6.4 Editing User Information

A user's information can be edited by right-clicking on the desired user and choosing "Edit" from the pop-up menu. User name and password cannot be changed from here.

An example of editing a user's information:

1. Log in as an administrator group user
2. Open the user group and user management dialog by clicking "Manage | Users and Groups" from the top menu bar
3. Right-click on the desired user and pick "Edit" from the pop-up menu
4. Change the desired parameters

5. Save changes by clicking "Save"

### 8.6.5 Removing Users

A user can be removed by right-clicking on him/her and selecting "Remove" from the pop-up menu.

An example of removing a user:

1. Log in as an administrator group user
2. Open the user group and user management dialog by clicking "Manage | Users and Groups" from the top menu bar
3. Right-click on the desired user and pick "Remove" from the pop-up menu

#### User's status

If for some reason it is desired to deny a certain user from accessing the system, that user can be inactivated by right-clicking on the user and selecting "Inactivate" from the pop-up menu. An inactivated user may be re-activated by right-clicking on him/her and selecting "Activate" from the pop-up menu.

An example of changing a user's status:

1. Log in as an administrator group user
2. Open the user group and user management dialog by clicking "Manage | Users and Groups" from the top menu bar
3. Right-click on the desired user and select "Passivate" or "Activate" from the pop-up menu

### 8.6.6 Changing Password For Users

A user's password can be changed by right-clicking on the user and selecting "Change Password" from the pop-up menu. This will open a new dialog into which the user's new password can be entered.

An example of changing a user's password:

1. Log in as an administrator group user
2. Open the user group and user management dialog by clicking "Manage | Users and Groups" from the top menu bar
3. Right-click on the desired user and select "Change Password" from the pop-up menu
4. Input new password
5. Save new password by clicking the "Save" button

## 9 NETWORK TOPOLOGY CONFIGURATION

Network topology is defined in Carat to reflect geography and organization and help with reporting necessary entities separately. Network topology consists of organizations, locations, service areas, Eyes and managed access points.

### 9.1 Choosing Networks To Be Monitored

#### 9.1.1 Organization

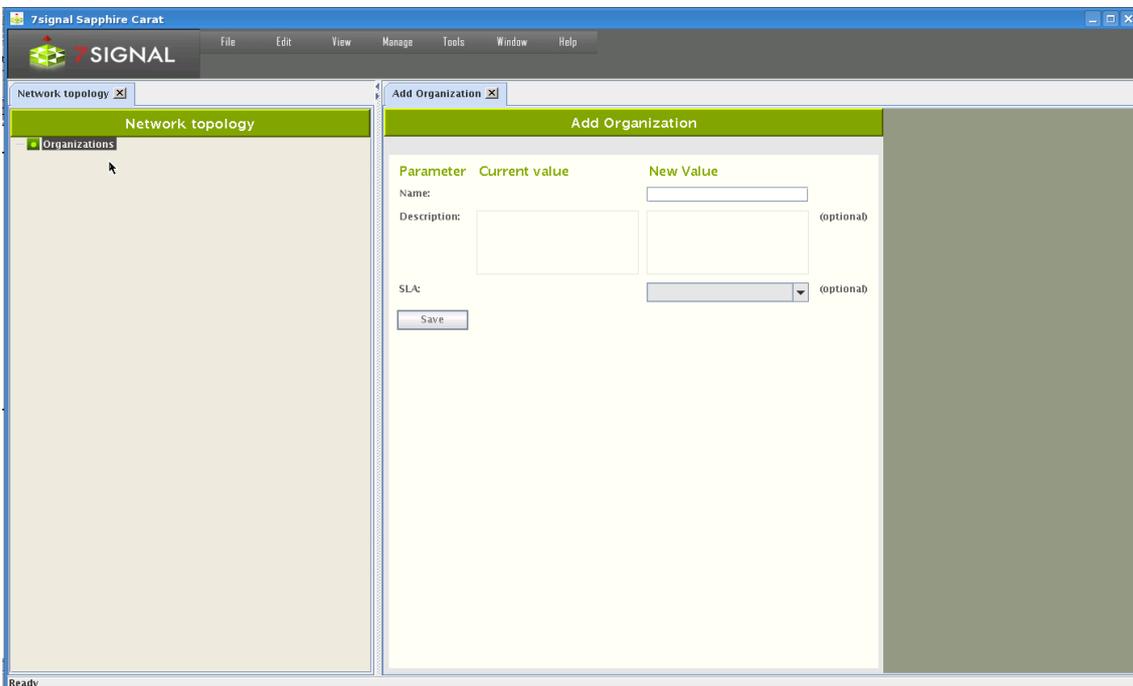
Sapphire can simultaneously manage networks in several independent organizations. A company or other organization can have many separate locations. The networks are displayed in a hierarchical tree starting from the Organization.

A company can have several networks, for different purposes. For example:

- Office network
- Warehouse network
- Guest network

To meet this need, Sapphire can monitor several networks at the same time.

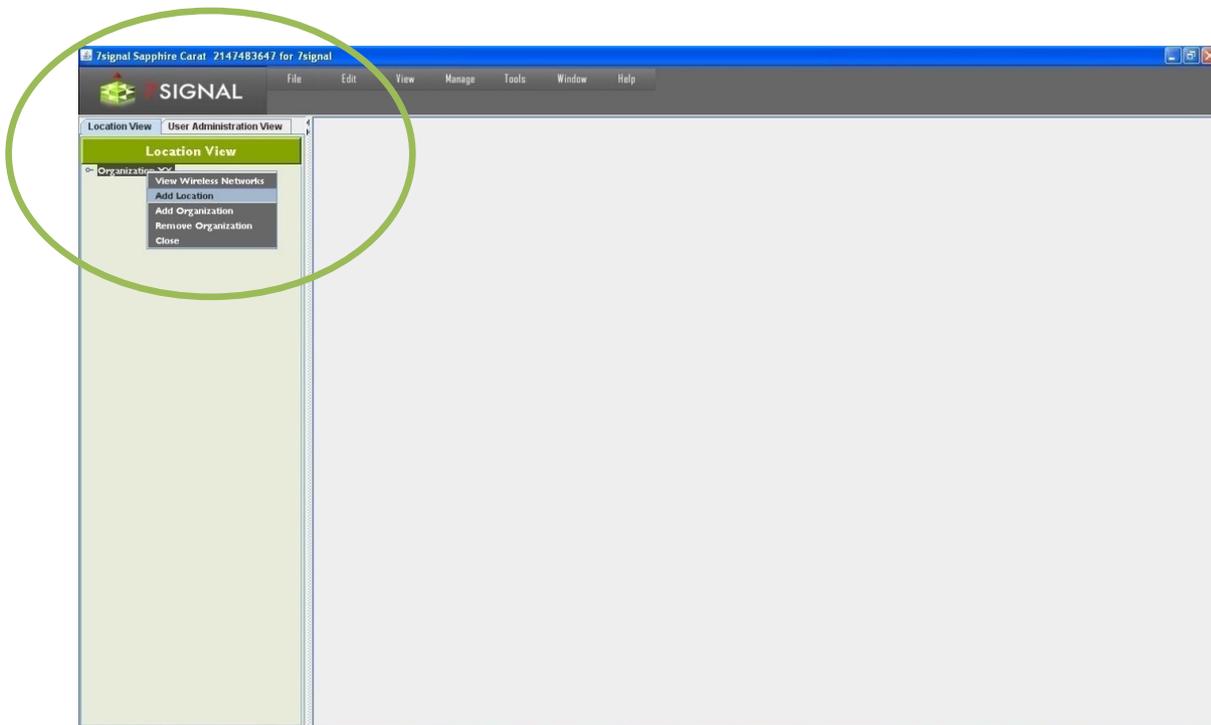
To handle a hierarchy that might grow utterly complex, 7signal uses a tree-structure. Organization is a starting point to create tree structure. User can add one or more organizations depending what is an appropriate structure.



1. Right click Organizations node in tree and select “Add Organization”
2. Enter the organization’s name
3. Save by clicking “Save”
4. The Network topology is automatically displayed after saving

## 9.1.2 Addition Network Locations

Location is used to define the network's location in a precise or descriptive way. A location might be a city, a part of the city, a building, or a single floor in a building, depending on the coverage area of the organization's network. A small organization might have only a single location, an office. On the other hand, a large organization might have several locations, in different cities, or a single overall location, such as "Europe," under which countries and cities etc. are defined.



1. From the top menu bar, select "View | Network topology"
2. Right-click the organization
3. Select "Add location"
4. Enter the location's name
5. Select the location type from the pull-down menu
6. Enter an optional description for the location
7. Click "Save"

You can add as many locations as needed to describe the organization's structure.

After you have added a location, you can add a service area.

1. Right-click a location
2. Select "Add service area"
3. Enter a name for the service area
4. Enter an optional description for the service area
5. Click "Save"

### 9.1.3 Hidden Networks

7signal Sapphire considers a hidden network to be a property of certain Organization. The network scans are based on listening and actively requesting beacon information on the Service Areas. The hidden networks shall not actively transmit beacons nor respond to requests with partial information only. Due to this the various scans - including the initial scan - in 7signal Sapphire do not capture hidden networks. Tests related to traffic analysis shall contain also information on hidden networks but the capture is not used as a technique in scans.

NOTE: Hiding the network SSID should not be used as a security as it does not limit sending the beacons or SSID names in payload frames but leaves only network SSID field blank in beacon signal. Any attacker or publicly available analysis tool can find hidden network as soon as there are any payload packets in the network. Even popular operating systems may present hidden network after a certain period of time. If SSID name is not transmitted, client devices are forced to start probing their access points continuously. This increase significantly radio interface traffic overhead and lowers overall network performance.

To add a hidden network to 7signal Sapphire follow the steps below.

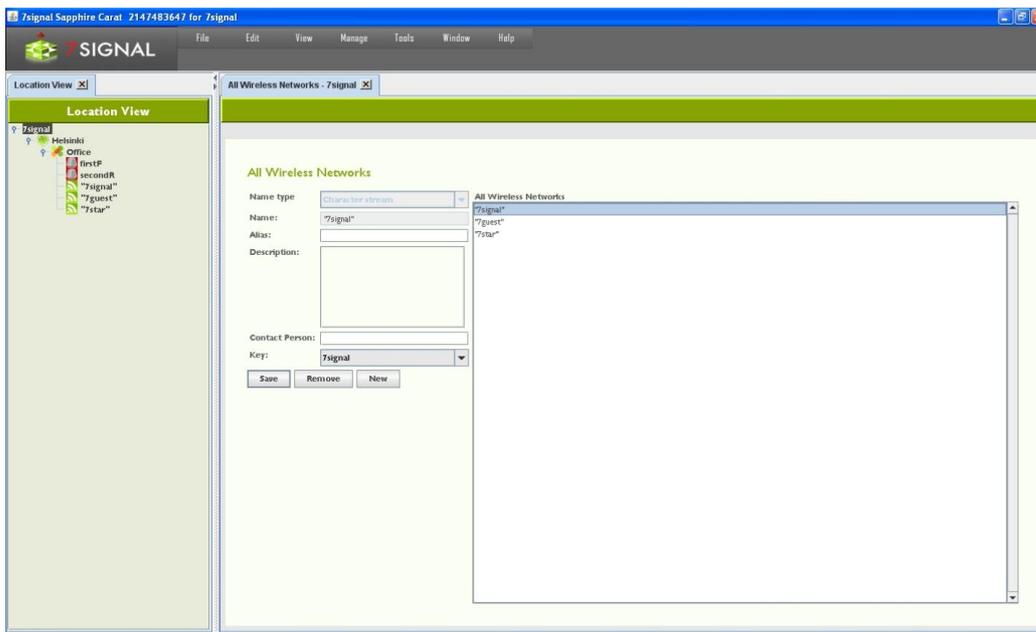
1. locate the Organization with a hidden network from the Topology tree
2. Right-click menu on the Service Area and select "Wireless networks"
3. Enter the relevant data on the hidden network on the pane that opened on the right
  - a. Name type (optional): currently only text strings are supported SSIDs
  - b. Name: the name of the network - not friendly name but SSID
  - c. Description (optional): description on the hidden network
  - d. Contact person (optional): the administrator for the hidden network
  - e. Key: the name of the wlan network access key that has been stored earlier to the system
4. Select "Save" to store the data to the system

The pane "All Wireless Networks" shows all defined networks. By choosing the network it is possible to change the current data. Button "Remove" deletes the network and the related information from the system.

### 9.1.4 Removing Networks

All networks managed by Sapphire are displayed in the Network topology. Networks can be deleted on the organization level. To delete a network from the Network topology:

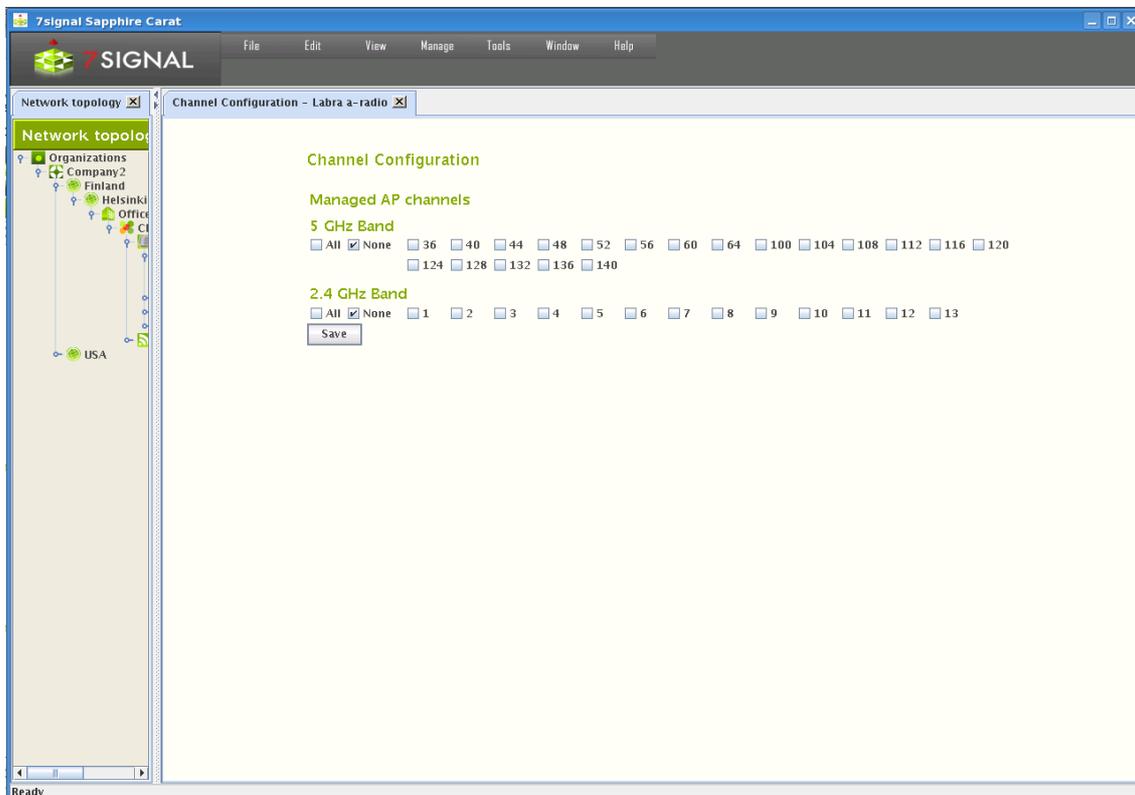
1. From the Network topology, select the organization containing the wireless network you wish to remove
2. Right-click the organization and select "View wireless network" – then the "All Wireless Networks" view is displayed in the right-hand pane
3. Select from the list the network you want to remove
4. Click "Remove"



### 9.1.5 Channel Configuration

In addition to access points, a wireless network can include a controller, which remotely sets RF parameters for a network. In such a case, the transmitting power and channels may change over time, due to operator actions or the controller's own actions.

Sapphire supports controllers via channel configuration so that each managed wireless network or access point can have its own set of allowed channel changes. Changes that stay within the preconfigured channel set do not cause an alarm. A change in a channel outside the preconfigured channel set causes an alarm if that alarm has been activated.



To set up channel configuration, proceed as follows:

1. From the top menu bar, select “View | Network topology”
2. Right-click the item (access point, service area or network) for which you want to set up a channel configuration and select “Channels”
3. Select the allowed channels
4. Select “Save”

7signal Sapphire Enterprise extends this functionality such that all access points or networks within the service area can have their own allowed and forbidden channels. This allows Sapphire to monitor the channel configuration in several networks, and to obtain information on other networks that use channels in unexpected ways. One obvious area of application for channel configuration is office hotels, which have several small wireless networks that can interfere with each other.

Extended channel configuration is a feature in the enterprise edition and requires a license. Each version of Sapphire supports channel configuration in managed networks. To monitor external networks, you need the enterprise license or some other license model that supports channel configuration. Without a suitable license, accessing channel configuration in the user interface does nothing.

## 10 EYE CONFIGURATION

### 10.1 States of Monitoring Stations

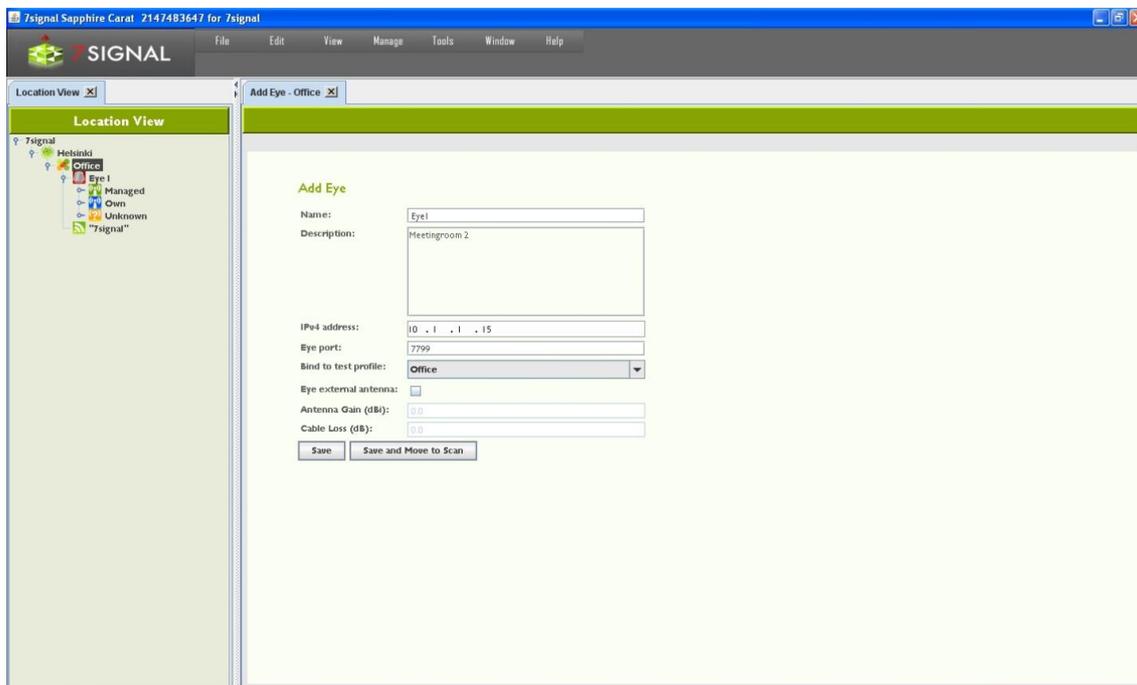
The Eye unit may be in an inactive state. This happens if there is no network connectivity to the monitoring station when a monitoring station is being added to the system. Also, an active monitoring station may be turned inactive. This allows exceeding the number of monitoring stations limited by the license. Only active monitoring stations may run the tests but the topology may contain unlimited number of inactive monitoring stations.

#### Related icons

-  active monitoring station
-  inactive monitoring station

#### 10.1.1 Adding Monitoring Stations

Monitoring stations can be added in the service areas in the Network topology.

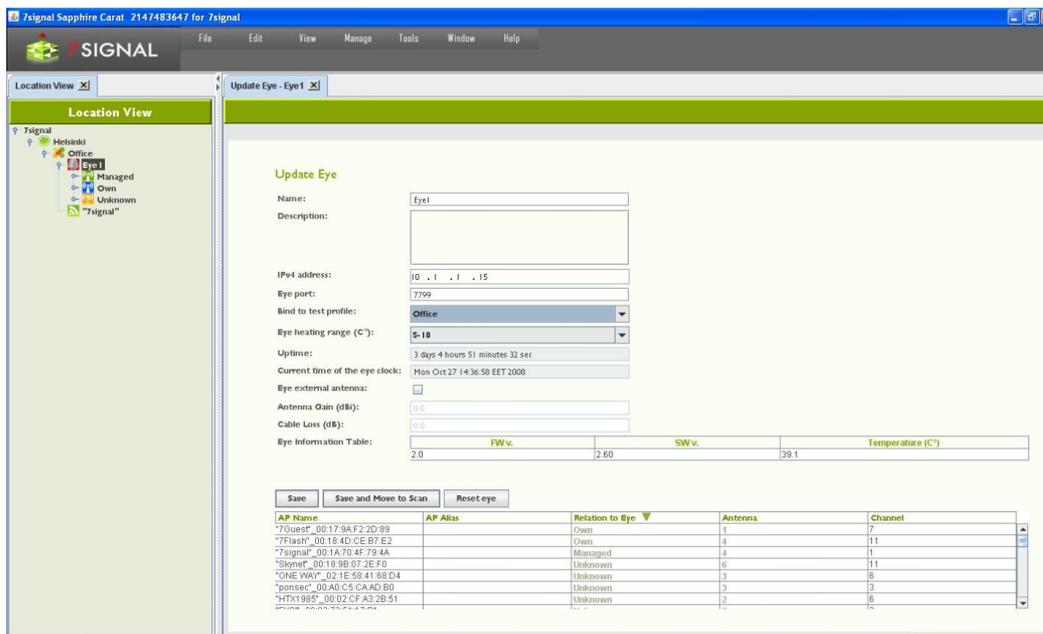


1. In the Network topology, select the service area where you want to set up a monitoring station (Eye)
2. Right-click the service area and select "Add Eye"
3. Enter a name for the Eye
4. Enter the Eye's IP address
5. Enter a description for the Eye (optional)
  - a. for example, its location and mount information
6. If you already know the test profile you want to use, you can select it now (for more information on test profiles, see the section on test profiles in this user guide)
7. Enter the the regional setting. The wlan channels and possibly power options are dependent on this setting so one should always choose the right setting.
8. (optional): if the hardware exists, it is possible to use the 8<sup>th</sup> beam or diversity antenna with the check-box. When selected, one must also provide

- a. Antenna gain
  - b. Cable loss (measured or estimate)
9. Save the monitoring station settings by clicking “Save” or “Save and move to scan”; the latter option opens Scan Networks dialog.

### 10.1.2 Monitoring Station Settings

1. Activate the monitoring station by right-clicking on it in the Network topology
2. Select “Edit”
  - a. This opens the settings window in the right pane
3. The settings window allows you to view and edit the following information about the monitoring station:
  - a. Name
  - b. Description
  - c. IPv4 address
  - d. TCP port for management traffic
  - e. Test profile
  - f. Settings for the Eye’s heating resistor
  - g. Monitoring station’s uptime
  - h. Monitoring station’s current time
  - i. External antenna enabled or disabled
    - i. gain of the external antenna
    - ii. cable loss
  - j. Software versions and temperature of the monitoring station (in a table)
  - k. Information about the access points within the monitoring station’s range
4. You can also check the information you have entered for the access points:
  - a. Access point ID (AP ID)
  - b. Access point name (AP name)
  - c. The role of the access point with relation to this Eye (AP relation to Eye)
5. Click “Save” to save any changes you have made



### 10.1.3 Activating Monitoring Stations

By default, the monitoring station is in active state. This is flagged with the green background color in the Network topology. An inactive monitoring station would have orange background color.

It is possible to deactivate the monitoring station. This feature is mainly targeted for temporary installations. An inactive monitoring station exists in the system and its measurements are accessible as usual. Only an active monitoring station may produce measurements and run manual tests. The state management enables consistent user view on Network topology and measurements.

The use case is to have temporary measurements in numerous locations and to have the possibility to return to one location and continue with identical monitoring station setup to keep the measurements comparable. After activating monitoring station, it is recommended that it would be treated as new if it will be used for monitoring.

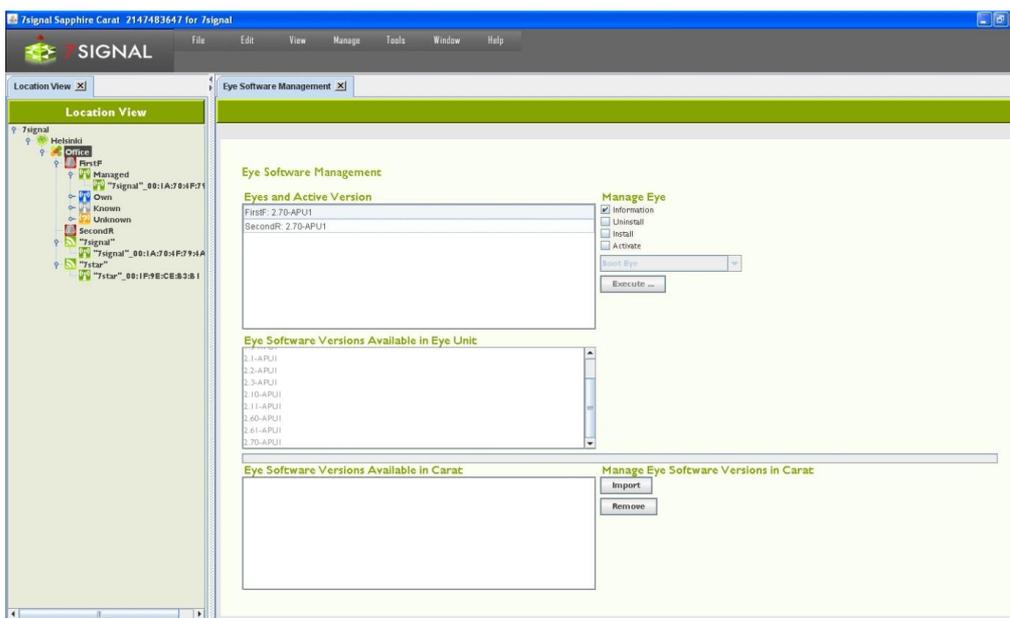
### 10.1.4 Updating Monitoring Station Software

The software versions of the monitoring stations are managed via Carat. In the “Eye software management” view, you can manage Eye software via the Carat server’s file system. Software imported into Carat is visible in a list. Only solution admin has access to software management.

The center portion of the view lists the software versions of an individual monitoring station when the monitoring station is activated. At the same time, you can also perform operations that are available in the top part of the pane.

Operations:

- **Information** displays the software versions in the activated Eye
- **Uninstall** uninstalls the software version
- **Install** adds a software version from the Carat server
- **Activate** activates the software uploaded to the monitoring station
- 



To start using a new software version:

1. From the top menu bar, select “Manage | Eye software management”

2. At the bottom right, under “Manage Eye software version in Carat,” select “Import”
3. Browse to the desired monitoring station software version in the Carat server file system and select “Open”; the software is displayed in the “Eye Software Versions Available in Carat” list
4. Click on the software version you want to install
5. At the top right, under “Manage Eye,” check the “Install” checkbox
6. Select “Execute”

## 10.2 Initial network scan

When the Eye has been installed or needs to be reconfigured, you must run a network scan. There are various preconfigured scanning durations. When an Eye has been installed for the first time, it is recommended that you run the longest scan, titled “Initial scan.” The purpose of the initial scan is to scan the monitoring station’s radio frequency environment very thoroughly and to detect the access points suitable for monitoring.

Network scan type	Description	Estimated duration (all antennas and channels) for channels 1-11 <b>excl. 5 GHz</b>
Initial	First deployment	15–20 min
Slow	Thorough	7–9 min
Regular	Normal	3–4 min
Fast	Quick	less than 1 min

The scan results are presented in a table. An initial scan should be run whenever substantial physical changes have been made in the environment being monitored (for example, new or removed walls), or if the Eye’s location has been changed.

The table contains the following information about the WLAN access points detected:

- Network name (ESSID)
- Encryption methods supported by the access point
- MAC address of the access point
- Channel
- Management status (if not known, denoted as “Unknown”)
- Antenna that hears the access point best
- Access point signal strength
- Noise level

The access points in the service area must have a management status. Setting a management status means that the access point’s existence is acknowledged. Unacknowledged access points prompt issuing of an alarm if such an alarm has been configured. The management statuses are as follows:

- **Managed:** Monitored by this monitoring station
  - The recommendation for signal strength is >-65 dBm
- **Own:** Own access point managed by another monitoring station
- **Known:** An access point that is an accepted part of the radio frequency environment (for example, a neighboring network)
  - If possible, ensure the access point operates properly and can be accepted
- **Unknown:** An access point without a monitoring status
  - In practice, this status should exist only during network scans in new service areas; it should not exist in normal use

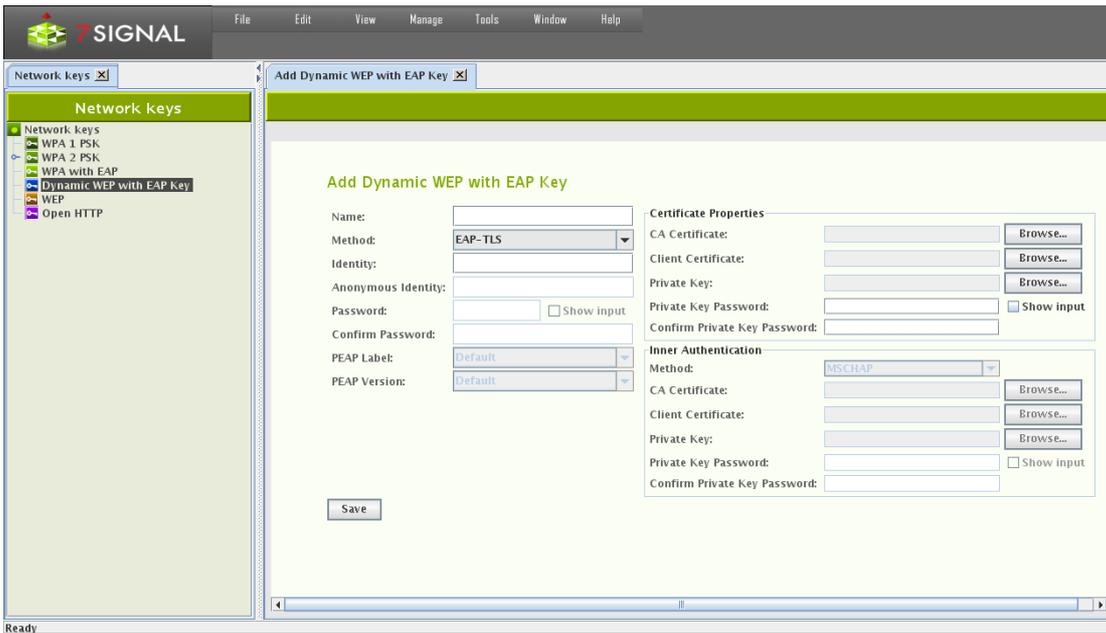
The changes are saved in Sapphire Carat's database and the installed monitoring station. The test is described in more detail below, under the "Network Scan" description.

# 11 CREATION AND USE OF ENCRYPTION KEYS

## Related icons

-  wpa2 encryption
-  wpa 1 encryption
-  ieee encryption
-  wpa eap encryption
-  wep encryption
-  http encryption

Before accessing secured wlan, an encryption key for that network should be created.



## 11.1 Supported Encryption Types

Key type	Authentication method	Inner authentication
WPA 1 PSK		
WPA 2 PSK		
WPA with EAP	EAP_TLS	
	EAP_PEAP	GTC MD5 MSCHAPV2 OTP TLS
	EAP_TTLS	MSCHAP MSCHAPV2 PAP CHAP EAP-MSCHAPV2 EAP-TLS EAP-GTC EAP-OTP EAP-MD5
	EAP_PSK	
	EAP_FAST	
	LEAP	
	EAP_MSCHAP_V2	
	Dynamic WEP with EAP	EAP_TLS
EAP_PEAP		GTC MD5 MSCHAPV2 OTP TLS
EAP_TTLS		MSCHAP MSCHAPV2 PAP CHAP EAP-MSCHAPV2 EAP-TLS EAP-GTC EAP-OTP EAP-MD5
LEAP		
EAP_MSCHAP_V2		
WEP	WEP 104 Hex WEP 104 Asc WEP 40 Hex WEP 40 Asc	
Open HTTP		

## 11.2 Adding Encryption Keys (PSK)

### 11.2.1 Passphrase and pre-shared key

Pre-shared key authentication is sometimes called passphrase authentication. Standard configuration interfaces allow user to type passphrase (that is converted to PSK) and proprietary interfaces can allow direct entry of PSK.

WPA and WPA2 are both vulnerable to brute force attacks if you use weak PSK.

The user may enter either a PSK or a passphrase when creating WPA1/2 PSK.

### 11.2.2 Adding

Add a key by following the instructions below:

1. From the top menu bar, select “Manage | Network Keys” – the available key types and existing keys are displayed in a hierarchical structure in the left pane
2. Right-click the key type you want to create and select “Add key”
3. Enter a name for the key
4. Enter the data required by the key type
  - a. There are significant differences in the data required for different key types
  - b. When “Show input” is checked, the user interface displays the passwords in plain-text.
5. Save the key by clicking “Save”



After a key has been created, it should be attached to a wireless network.

1. From the top menu bar, select “View | Network topology”
2. In the Network topology, select the network to which you want to add the encryption key and right-click
3. Select “Add Key”
4. Select a suitable encryption key for the network from the pull-down menu
5. Click “Save”

## 11.3 On Certificate-Based Encryption

There are input fields for the “CA certificate” and “Client certificate”. It is recommended that both certificates are added. If one certificate file contains all the information, it should be used in both of the input fields.

The certificate container is expected to be accessible by the Carat GUI client in the local or shared file system of the host machine. Accepted formats are the following:

- CA certificate – PEM, DER, PKCS12 (aka PFX)

- Private key – PKCS12 (aka PFX)

As a corollary, a single PKCS12 formatted file that contains the CA certificate as well as the private key, can be used in both of the cases.

If conversions are required to achieve these formats, please consult Your Certificate Authority. In Linux and Unix environments OpenSSL is commonplace tool and can handle the conversions required.

TIP: Microsoft environments have certificate files with file extension CER. The file content format typically is DER. To turn DER files into PEM, please use the command below:  
**openssl x509 -informat DER -in <yours>.cer -outformat PEM -out <target>.pem**

Windows environments have extension “PFX” to mark a typical certificate container file type. This format is exactly PKCS12 format that typically has “p12” extension in Linux/Unix world. 7signal Sapphire does not care about the extension but the internal format of the file.

## 11.4 Multiple Keys Per Eye

There is no limitation to number of keys per Eye or per Wireless Network. If there is only one key bound to Wireless Network, that key shall be used every time this particular SSID is associated with. On top of that, each Eye unit may be bound with eye specific key (right-click on Eye in the topology).

The rationale is to support environments where the actual key dictates both access to the access point in general and also the access level to the network services beyond the access point.

### 11.4.1 Microsoft PKI Infrastructure

One commonplace certificate-based environment is implemented by Microsoft. Typically any appliance shall have their own account (“machine-account”). It would very challenging to make the linux-based Eye to serve Windows infrastructure with the proper certificate. An applicable option is to create one user-account to be used by all Eye units.

When a user-account is in place, the authentication may be defined as follows:

**Add WPA EAP Key**

<p>Name: <input type="text"/></p> <p>WPA Version: <input type="text" value="WPA 1 PSK"/></p> <p>EAP Method: <input type="text" value="EAP_MSCHAP_V2"/> <input type="checkbox"/> Allow any</p> <p>Pre-shared Key: <input type="text"/> <input type="checkbox"/> Show input</p> <p>Confirm Pre-shared Key: <input type="text"/></p> <p>Identity: <input type="text" value="local_ID"/></p> <p>Anonymous Identity: <input type="text"/></p> <p>Password: <input type="text" value="secret123"/> <input checked="" type="checkbox"/> Show input</p> <p>Confirm Password: <input type="text" value="secret123"/></p> <p>PEAP Label: <input type="text" value="Default"/></p> <p>PEAP Version: <input type="text" value="Default"/></p> <p>NAT: <input type="text"/></p> <p>PAC File: <input type="text"/> <input type="button" value="Browse..."/></p> <p><input type="button" value="Save"/></p>	<p><b>Certificate Properties</b></p> <p>CA Certificate: <input type="text"/> <input type="button" value="Browse..."/></p> <p>Client Certificate: <input type="text"/> <input type="button" value="Browse..."/></p> <p>Private Key: <input type="text"/> <input type="button" value="Browse..."/></p> <p>Private Key Password: <input type="text"/> <input type="checkbox"/> Show input</p> <p>Confirm Private Key Password: <input type="text"/></p> <p><b>Inner Authentication</b></p> <p>Method: <input type="text" value="MSCHAP"/></p> <p>CA Certificate: <input type="text"/> <input type="button" value="Browse..."/></p> <p>Client Certificate: <input type="text"/> <input type="button" value="Browse..."/></p> <p>Private Key: <input type="text"/> <input type="button" value="Browse..."/></p> <p>Private Key Password: <input type="text"/> <input type="checkbox"/> Show input</p> <p>Confirm Private Key Password: <input type="text"/></p>
--	--

1. Select “Dynamic WEP with EAP key” to get the dialog above
2. Select WPA key type, either 1 or 2, according the local environment
3. EAP method must be set to “EAP\_MSCHAP\_V2”
4. Fill in the account user name to the field “Identity”
5. Enter and confirm the account password.
6. Enter Windows infrastructure CA certificate.
7. One may enter the same certificate as “Client Certificate” as well.

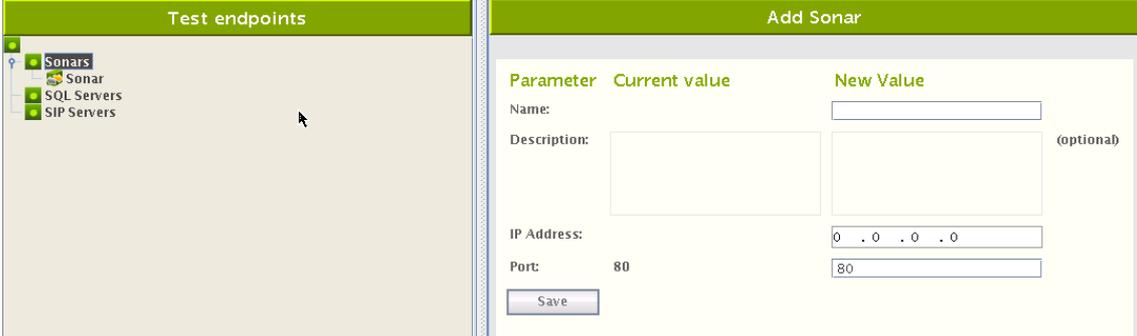
The Eye is now properly authenticated in Windows PKI environment.

## 12 TEST END-POINTS

### 12.1 Sonar

Sonar is 7signal specific server that handles typical network requests i.e. it emulates numerous servers in the network.

Sonar (icon ) is the server needed for executing elementary tests. There can be several Sonar servers configured. Each test can be configured to use any of the configured Sonars. Configuring Sonar servers makes it easy to define the parameters for the automatic measurements.



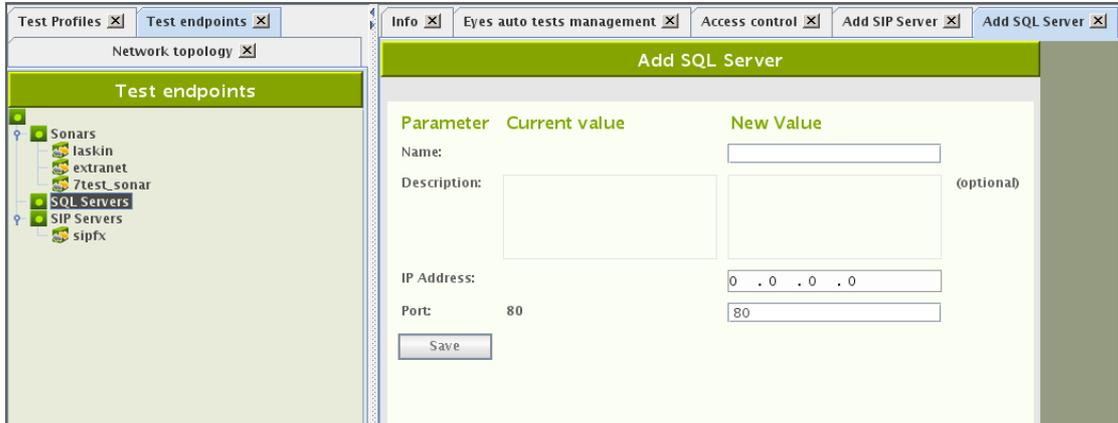
Parameter	Current value	New Value
Name:		<input type="text"/>
Description:	<input type="text"/>	<input type="text"/> (optional)
IP Address:	0 . 0 . 0 . 0	<input type="text"/>
Port:	80	<input type="text"/>

Save

1. From the top menu bar, select “Manage | Test endpoints”
2. Select “Add Sonar” from Sonars tree node after right clicking it.
3. Enter a name for the Sonar instance (*Note: The name should be descriptive, especially when one is using several Sonars*)
4. Enter a description for the Sonar (optional)
5. Enter the IP address and TCP port (*Note: At this stage, Carat does not verify that the Sonar actually exists, so ensure that the Sonar exists before you begin testing*)
6. Click “Save”

### 12.2 Generic Test Counterparts

It is possible to run tests towards actual network servers such as SIP servers or database hosts.



Parameter	Current value	New Value
Name:		<input type="text"/>
Description:	<input type="text"/>	<input type="text"/> (optional)
IP Address:	0 . 0 . 0 . 0	<input type="text"/>
Port:	80	<input type="text"/>

Save

Test endpoint definition requires information on networking level but does not require anything application specific. For example, an SQL server is considered only from connectivity

point of view while the actual access credentials and test queries are defined per test. Therefore the endpoint definition is a simple procedure and is similar to all supported test endpoints.

## 13 ACCESS POINT INFORMATION

### Related icons

-  unknown access point (unwanted state)
-  known access point (in the coverage area but outside administrative domain)
-  own access point (in administrative domain)
-  managed access point (target to a monitoring station, in administrative domain)

The access point information can be displayed by right-clicking the access point in the Network topology and selecting “Access Point Info.” The information includes the following:

- Access point name
- Alias
- Description
- The managing Eye (i.e., the Eye that performs the tests)
- Related Eyes
- ESSID
- Access point type
- The antenna used by the Eye to monitor the access point
- Network
- MAC address
- Alarm limit
- SLA Group
- Encryption
- Beacon Interval
- Country Code
- Environment
- Capabilities
- Channel and channel change history
- legacy bitrates and changes in those
- 802.11n MCS Indexes
- 802.11n HT Capabilities
- 802.11n secondary Channel
- 802.11n Control Channel
- 802.11n HT Parameters
- WMM Category: Best Effort
- WMM Category: Background
- WMM Category: Video
- WMM Category: Voice

### 13.1 Replacing Access Points

7signal Sapphire saves all access points it has noticed. The changes in the hardware may be due removal of existing hardware or because of extensions of the current network. These cases are handled by inactivation of the removed access points or scanning and saving the new ones.

The hardware replacements require a different approach. The new equipment shall have new MAC addresses and this causes a discontinuity in the measurements as it is considered a new access point in the target network. If this is not the intention and the new equipment should totally replace an access point that was previously in Managed more, 7signal Sapphire must be informed.

To retain the measurement history with a new hardware:

1. Scan the network to get hold of the new access point hardware
2. Right-click on the access point that has been replaced to summon the edit dialog
3. Locate the replace panel and choose from the drop-down list the new access point that shall assume the role of the replaced access point.

The intended use of this feature is to help with replacing identical hardware. If the hardware is not identical, the results may be many-fold. SLAs and alarm thresholds should be checked, for example.

There is also possibility to enable automatic access point change logic in carat server. This can be done configuring Wireless Network to allow automatic changes.

1. Open Edit Wireless Network by right clicking network in tree and selecting "Edit"
2. Enable "Allow automatic BSSID changes"
3. Save Wireless Network Configuration.

## 14 LINKS AND LINK GROUPS

In 7signal Sapphire a link denotes an end to end connection between an Eye monitoring station and a Sonar server. Link consists of a monitoring station, an access point and a Sonar server. In the Network topology links are positioned below the managed access points. 7signal Sapphire forms the links automatically when it detects an established end to end connection.

### Related icons



link



link group

A link group is a grouping of links defined by a user. A user can create a link in a Location in the Network topology. The main purpose of a link group is to give users the ability to easily bind one SLA group to multiple links with similar expected level of service.

Links and link groups enable the versatile binding of SLA groups formed from service level agreements to end to end connections. For example an SLA group bound to an organization is applied to all topology elements within that organization. However, this can be overridden by binding different SLA groups to specific links or link groups, in which case their compliance with the service level agreement is determined by measuring against the KPIs defined in their own SLA group, instead of the SLA group bound to the organization.

### 14.1 Forming Links

7signal Sapphire Carat forms a link automatically once a test profile with a Sonar definition is bound to a monitoring station.

For example when a test profile containing active tests to two Sonars ("Sonar1" and "Sonar2") is bound to a monitoring station ("Eye1") with two managed access points ("AP1" and "AP2") 7signal Sapphire carat forms the following links:

1. Eye1 - AP1 - Sonar1
2. Eye1 - AP1 - Sonar2
3. Eye1 - AP2 - Sonar1
4. Eye1 - AP2 - Sonar2

### 14.2 Removing Links

7signal Sapphire Carat automatically removes a link if one of its components (the monitoring station, access point or Sonar) is removed. Because links are formed automatically it may be in certain rare situations necessary for the user to remove links one deems unnecessary.

Remove a link as follows:

1. Click on "View | Network topology" from the top menu bar
2. Right-click on the link to be removed from the tree hierarchy
3. Choose "Remove link" from the pop-up menu
4. Confirm link removal

## 14.3 Creating Link Groups

Create a link group as follows:

1. Click on "View | Network topology" from the top menu bar
2. Right-click on the desired Location into which the link group is to be added
3. Choose "Add Link Group" from the pop-up menu. A dialog for adding a link group is opened to the right.
4. Name the link group
5. Define the SLA group to be bound to the link group (optional)
6. Click "Save"

## 14.4 Removing Link Groups

Remove a link group as follows:

1. Click on "View | Network topology" from the top menu bar
2. Right-click on the link group to be removed from the tree hierarchy
3. Choose "Remove" from the pop-up menu
4. Confirm link group removal

## 14.5 Adding Link To Group

Add a link to a link group as follows:

1. Click on "View | Network topology" from the top menu bar
2. Drag the link to the desired link group

## 14.6 Removing Links From Group

Remove a link from a link group as follows:

1. Click on "View | Network topology" from the top menu bar
2. Right-click on the link (under a link group) to be removed from the tree hierarchy
3. Choose "Remove link" from the pop-up menu
4. Confirm link removal

## 15 ALARMS

### Related icons

	alarm configuration		alarm configuration group
	critical alarm		network error
	informational message		warning message

The system alarms are initiated by significant changes in the monitored network's status or topology. It is possible to send the alarms to an SNMP system. Please see the instructions later in this document.

Alarms are used through alarm groups to which the desired alarms can be assigned. There is a preconfigured alarm group, Global Alarms, which is active by default. The alarms will then be issued by any access point in the network. The Global Alarms group includes the following alarms:

- Managed Access Point Down
- Offending Channel Changes of Managed Domain
- Offending Channel Changes of External Domain

### 15.1 Creating Alarm Groups

You can extend the Global Alarms group or create new alarm groups. It is recommended that you create new groups. To create a group, proceed as follows:

1. From the top menu bar, select "Manage | Alarm configuration"
2. Select "Alarm Groups" and right-click it
3. Select "Add Alarm Group"
4. Enter a name for the alarm group
5. Select the alarms by dragging them from "Alarm Templates" to the alarm group pane
6. When you have added all the alarms you want, select "Save"

Modification of alarms in a group

The table below lists the alarms. Some of them have parameters that can be modified. To modify the parameters of an alarm, proceed as follows:

1. Select the alarm to be modified in the alarm group
2. Right-click and select "Edit"
3. Modify the parameter value
4. Select "Update"

Menu	Description	Modifiable?
Managed Access Point Not Responding	The alarm is activated when a managed access point does not respond. This is a critical alarm.	No
Channel Interference	The alarm is activated when a new access point with a strong signal is detected on a managed channel. This is a warning alarm.	Yes
Managed Access Point Security Settings Changed	The alarm is activated when the security settings of a managed access point are changed. This is a critical alarm.	No

Managed Access Point Channel Violation	The alarm is activated when a managed access point starts to use a restricted channel. This is a warning alarm.	No
Non-Managed Access Point Channel Violation	The alarm is activated when an external access point starts to use a restricted channel. This is a warning alarm.	No
Unknown Access Point Detected	The alarm is activated when an unknown access point is detected. This is a warning alarm.	Yes
End to end latency time exceeded.	The alarm is activated when the average round-trip time in a ping test exceeds the set limit. This is a warning alarm.	Yes
End-to-End Connection Loss	The alarm is activated when ping tests fail. This is a critical alarm.	Yes
Retransmission Rate Exceeded	The alarm is activated when the retransmission rate exceeds the set limit. This is a critical alarm.	Yes
DCHP Server Unreachable	The alarm is activated on DHCP timeout. This is a critical alarm.	Yes
Access Point MAC Change.	Alarm is activate when BSSID's mac changes.	No
Attach Success Rate	Alarm is activated when Attach Success Rate falls under configured value.	Yes
DHCP Server Success Rate	Alarm is activated when DHCP success Rate falls under configured value.	Yes
Beacon Availability	Alarm is activated when beacons are not detected under configured value.	yes
FTP Download Throughput	Alarm is activated when throughput is lower than configured value.	Yes
FTP Upload Throughput	Alarm is activated when throughput is lower than configured value.	Yes
VoIP MOS, listen quality	Alarm is activated when listening quality drops under configured value.	Yes
VoIP MOS, Talk quality	Alarm is activated when Talk quality drops under configured value.	Yes
Ping Success Rate	Alarm is activated when Ping success rate drops under configured value.	Yes
FTP Success Rate	Alarm is activated when FTP success rate drops under configured value.	Yes
VoIP Success Rate	Alarm is activated when VoIP test success rate drops under configured value.	Yes
Internet Availability	Alarm is activated when Internet availability is lost.	No

## 15.2 Binding Alarm Groups To Access Points

Alarms can be configured on a per-access-point basis by binding an alarm group to an access point. Only an existing group can be bound to an access point.

1. In the Network topology, right-click the access point to which you want to bind the alarms

2. Select “Bind to alarm limit group”
3. From the pull-down menu, select the alarm group you want to use for this access point

Or

1. Open Service Alarm Binder Dialog by right clicking Service Area Node and selecting “Bind Alarms”
2. Select Alarm Limit Group from the Combo Box
3. Select Access Points for the binding
4. Save

## 15.3 Alarm Messages

To view the alarms issued, select “View | Alarms” from the top menu bar. You can indicate whether you want to see all alarms or only alarms that are currently active. You can also select how the alarms are listed.

**Alarms**

All Alarms     Warnings  
 Active Alarms     Messages  
 Group by Severity  
 Normal Listing

On time	Access Point	Severity	Eye	Ack time	Off Time	Alarm	Context
2/24/10 3:30 AM	YFIGUEST_00:19	warning	test	?		Offending Chann	
2/24/10 3:30 AM	YFIPRIVATE_00:	warning	test	?		Offending Chann	
2/25/10 10:46 A	YFIPRIVATE_00:	warning	test	?		Offending Chann	
2/25/10 10:46 A	YFIGUEST_00:15	warning	test	?		Offending Chann	

You can acknowledge an alarm by clicking the symbol under “Ack time”. The symbol will be replaced by the current time of the Carat server, and the alarm is acknowledged. The alarms are turned off when the cause of the alarm is no longer present.

## 15.4 Alarm Forwarding

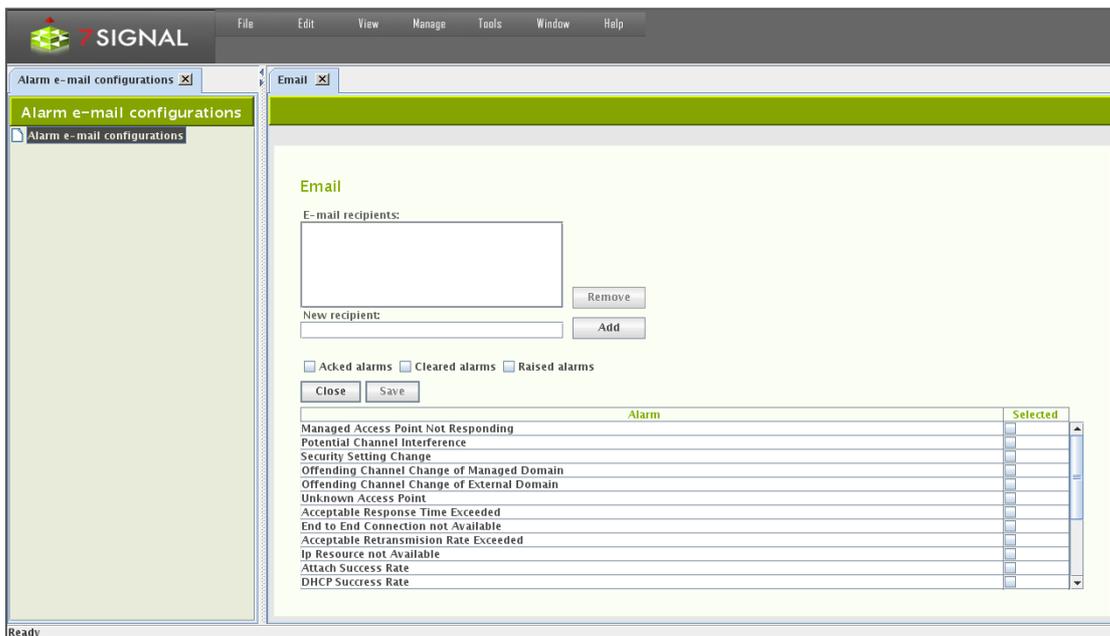
There are two methods that alarms may be brought to attention of external systems: email forwarding and SNMP.

### 15.4.1 Email Forwarding

Alarms are sent as plain-text emails with standard formatting easy to be parsed with typical text-processing tools.

**NOTE:** Email may be used only for relaying the alarms to the other messaging system that convert emails to f ex SMS and messenger formats. 7signal products do not directly provide such integration.

Email forwarding requires an SMTP server to be defined. There may be numerous recipients that shall receive the alarms.



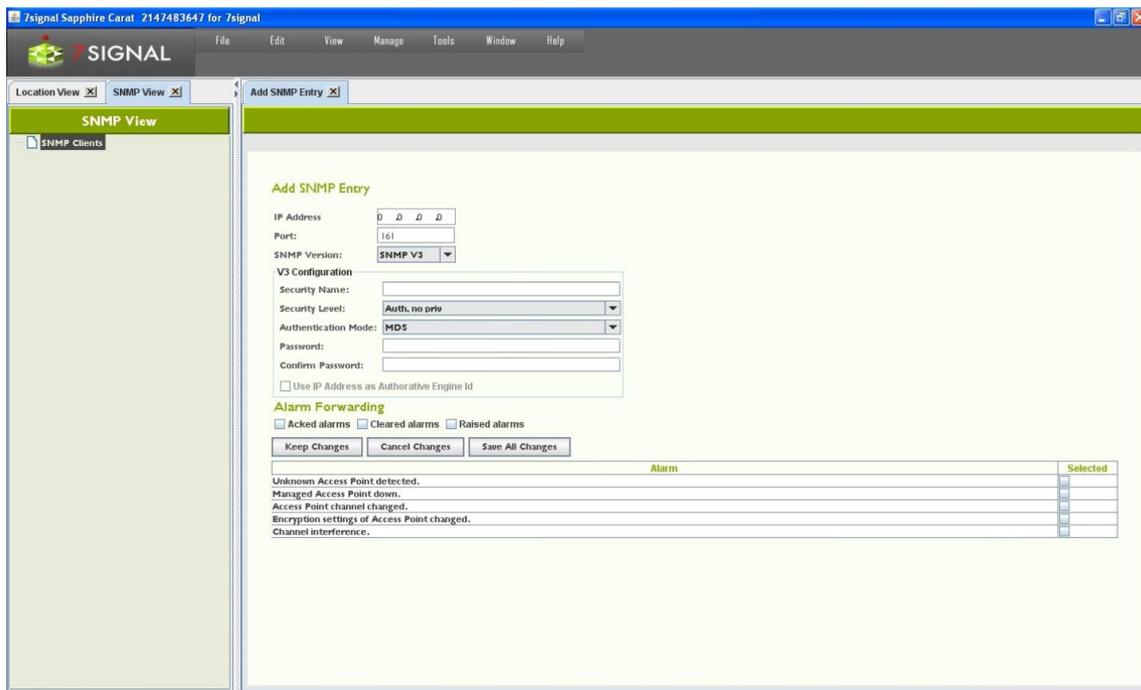
1. From the top menu bar, select “Manage | Alarms | Email”
2. Enter target email address to “New recipient” field
3. Select “Add” to register the email address as a recipient. It shall appear in the box named “Email recipients”
  - a. Incorrectly added or not any more relevant recipients may be removed by activating the recipient in the box and then selecting “Remove”
4. Choose the types of alarm event that shall be forwarded by ticking the check-boxes.
  - a. Types are: raised, aked, offed.
5. Choose the set of alarms to be forwarded by ticking the check-boxes on the alarm table.
6. Select “Save” to make the selection permanent and stored.
7. Select “Close” to close the pane.

## 15.4.2 SNMP

Some alarms in Sapphire Carat can be forwarded as SNMP notifications to a receiving server.

1. From the top menu bar, select “Manage | Alarms | SNMP”
2. Enter the IP address of the receiving server
3. Enter the UDP port to use
4. Select the SNMP version (v2c/v3) to be used for the message format
5. If you select v3, you must also:
  - a. Enter a security name
  - b. Select the security level (authentication / no authentication)
  - c. If you select authentication, configure its settings:
    - i. Select an encryption method (MD5/SHA)
    - ii. Enter a password
    - iii. Re-enter the password
6. Select the alarms you want to forward
7. Select the events you want to forward:
  - a. Alarms issued
  - b. Acknowledged alarms
  - c. Alarms that have been turned off
8. Select “Update”

9. Click Save all Changes.



## 16 TRAFFIC CLASSES

The IEEE 802.11e standard defines eight traffic classes. Most mission-critical access points support this standard. Traffic classes are becoming more and more important, especially on account of wireless VoIP.

7signal Sapphire Enterprise supports the 802.11e standard. Active tests can be configured to have a traffic class. All Sapphire versions support assignment of traffic classes, but if the Sapphire license does not include traffic classes, Sapphire will treat the traffic as ordinary traffic (Non-QoS, best-effort). Traffic classes are taken into account in only those networks whose access points support this feature. A request for a traffic class does not guarantee that it is granted. When viewing measurement reports, you might see that several traffic classes have been used. The class granted will never exceed that requested.

The following table describes the traffic classes for the parameters of active tests:

Category	Selected
BestEffort(0)	<input checked="" type="checkbox"/>
Background(1)	<input type="checkbox"/>
Background(2)	<input type="checkbox"/>
BestEffort(3)	<input type="checkbox"/>
Video(4)	<input type="checkbox"/>
Video(5)	<input type="checkbox"/>
Voice(6)	<input type="checkbox"/>

The standard defines eight traffic classes, which are grouped into four named classes (background, best-effort, video, and voice). In practice, most telecommunications devices support four named classes. This is seen in Sapphire as well, where Eye supports four classes, and the user interface shows eight. Only supported classes are selectable in the user interface.

## 17 AUTOMATED TEST CONFIGURATION

The tests are grouped into passive listening tests and active tests in the radio network. There are two ways to run tests in Sapphire Carat: user-initiated tests to locate a fault and automated tests for continuous monitoring and collecting of measurement results.

You can run the tests from a hierarchical tree. Test menus are accessible by right-clicking a monitoring station or an access point. You can also run tests from the floor plan.

### 17.1 Test Profiles

#### Related icons



test profile element



test profile



test profile template

A test profile is a series of tests that can be run continuously either on a per-access-point basis or in monitor mode, thus listening all 802.11 traffic. Sapphire contains preconfigured profiles intended for typical business environments.

To set up test profiles, select “Manage | Test Profiles” to display the Test Profiles view. The existing templates, test elements and actual profiles are displayed on the left in the management tree in descending order, respectively.

The screenshot shows the 7signal software interface. The main window is titled "Test Profile - VoIP-Duplicate". On the left, there is a "Test Profiles" management tree with categories: Templates (Passive, Warehouse, Office, Lightweight, VoIP, Hospital, Spectrum and Noise, Surveillance), Elements (Access point traffic, Http, FTP upload, VoIP MOS, Ping, FTP download, Spectrum analysis, Network scan, Managed AP scan, Surveillance, Noise monitor), and Test profiles. The main area displays the configuration for a "Test Profile". It includes a "Name" field, a "Bound Tests" list containing: VoIP MOS, VoIP MOS, Network scan, Ping, Access point traffic, VoIP MOS, VoIP MOS, Managed AP scan, FTP download, Noise monitor, FTP upload, and Spectrum analysis. Below the list are buttons for "Keep Changes", "Cancel Changes", and "Save All Changes". At the bottom, there is a "Common Values" table.

Parameter	New Value
SonarId	Sonar not used
IPAddress	0.0.0.0
LocalIPAddress	0.0.0.0
LocalIPNetMask	0.0.0.0
UseDHCP	1
GatewayAddress	0.0.0.0

- **Templates** are a collection of pre-configured test profiles aimed at various business purposes. They are not to be used as runnable test profiles but as a source, reference and model for the user creating the runnable test profiles.
- **Elements** are individual tests that may be inserted to test profiles.

- **Test profile** is a collection of test elements that may be executed. The user is supposed to copy either templates or elements to a test profile. There may be numerous profiles for different purposes. A test profile is always bound to a monitoring station.

## 17.2 Contents Of A Test Profile

The purpose of the network dictates which tests should be used to get the best picture of its functionality. As a result, there are several preconfigured test profiles, where the order and frequency of tests is different and so are test parameters, such as the number of megabytes downloaded and uploaded. The test profile names reflect the business environment in which they are thought to be most useful.

Below is a sample profile that could be used for a monitoring station.

Test	Test parameters
RTT ping	32 B x 10
Download	2 MB x 2
Scan managed	350 ms/channel
Download	2 MB x 2
Access point traffic	60 s
Noise monitor	350 ms/channel
Scan	350 ms/channel
Http	500 kB
MOS	VoIP parameters

When the profile is running, each test is run in its turn, followed by the next test. After the last test is run, the test profile starts from the beginning. The table shows the most important test parameters, but the tests also have other configurable parameters.

Below are descriptions of the preconfigured profiles - Templates - in Sapphire. You can copy a template and save it under a different name. You can then freely modify the parameters in the original profile and the copy. By copying test profiles, you can easily create a customized profile for each monitoring station.

### 17.2.1 Passive

“Passive” template contains five passive tests and no active tests. In passive tests, the monitoring station does not attach to an access point; it just listens to radio traffic for the specified time. When using a passive profile, you do not need to configure encryption settings or authentication for the radio network.

Note: A passive profile has an extremely small effect on the monitored network. The only effect is that Sapphire sends probe requests to access points.

### 17.2.2 Warehouse

The “Warehouse” template serves the needs of logistics services where the amount of data transferred is not large but the data traffic is continuous. Network availability and uptime are

vital. The network clients are mostly known or even preconfigured. This profile can be used in all environments that have similar circumstances.

### 17.2.3 Office

The “Office” template is intended for office use wherein the clients are mostly laptops running office applications. An office WLAN must have superb usability and a robust data transfer capacity. This profile can be used in all environments with similar circumstances.

### 17.2.4 Lightweight

The “Lightweight” profile is intended for environments that do not have several concurrent users and that have a narrowband link to a central server (<512 kbit/s). This profile emphasizes WLAN availability. Another emphasis is on a fast testing cycle, where each test takes only a short time.

### 17.2.5 VoIP

The “VoIP” template is intended for environments where the wireless clients are mostly VoIP devices. A wireless VoIP network must have extremely high-quality radio connections. The MOS test indicates packet losses and jitter in the network, among other things.

### 17.2.6 Hospital

“Hospital” resembles the “Office” template. However, the “Hospital” template produces more results that describe the status of the wireless clients. The profile is a general purpose one that emphasizes wireless clients.

### 17.2.7 Spectrum and Noise

This template is limited in test elements: there are no active test at all. It is targeted for environments that have severe interference conditions. This can be considered as a trouble-shooting template that is activated if the normal course of testing does not provide enough information on the source of the interference.

### 17.2.8 Surveillance

The “Surveillance” is a limited template with one test only that specializes in surveillance. The point is to capture traffic in any channel in any direction. The rationale is environments where there should be no radio traffic at all or only for white-listed devices.

### 17.2.9 TripleSSID

Mainly example how to configure test profiles that access numerous wlan networks in a single profile. This is the case one Eye unit is supposed to monitor multiple wlangs concurrently. The next chapter has more details on this.

## 17.3 Testing multiple wlan networks in one test profile

One monitoring station may test multiple access points that provide multiple wlan networks. In the context of test profiles wlan networks are referred as ESSIDs (essid later in the text).

Testing on multiple essid's is achieved by either copying and editing individual test element in a profile or copying a complete template to pasted to an existing profile.

Whenever it is possible to define an essid to a test element there may be exactly one essid per element or no essid at all. The latter means that the test in question shall be executed against all access points managed by the monitoring station. The former limits the access points to ones that have the essid and are managed by the monitoring station.

## 17.4 Operations on Templates

Templates are for copying and editing. There are two different supported methods for that, "Duplicate" to make a fresh copy of the sample profile and "Copy as essid" that adds the template profile to an existing test profile.

### 17.4.1 Duplicate

1. Select "Manage | Test Profiles" to open the management tree on the left.
2. Choose the appropriate template and right-click for the submenu.
3. Select "Duplicate" to open the Test Profile pane.
4. Give a name to the new Test Profile.
5. Bound Tests window is for informative purposes here only. Editing if desired is available later.
6. In "Common Values" one may enter test parameters that apply to every test in the profile.
7. Saving options
  - a. Select "Cancel Changes" to undo changes.
  - b. Select "Keep Changes" to save the intermediate work.
  - c. Select "Save All Changes" to finalize the work on this pane.

### 17.4.2 Copy as essid

The pre-requisite here is to have existing test profiles that shall be the target for pasting all elements in the template. This is one form of cut&paste operation.

1. Select "Manage | Test Profiles" to open the management tree on the left
2. Choose the appropriate template and right-click for the submenu
3. Select "Copy as essid" (no visible results)
4. Right-click on Test Profile icon and select "Insert essid" to open essid pane on the right
5. Insert an existing essid name
6. Optionally, insert other common parameters in the table "Common Values"
7. Select "Save All Changes" to insert the test elements in the template to the test profile as individual essid. All tests under the essid contain the same parameters, such as Sonar etc.

## 17.5 Operation on Test Element

### 17.5.1 Copy element

The pre-requisite here is to have existing test profiles that shall be the target for pasting this test element. This is one form of cut&paste operation.

1. Select "Manage | Test Profiles" to open the management tree on the left

2. Choose one of the test elements and right-click
3. Select “Copy element” (no visible results)
4. Paste the element by choosing “Paste testprofile element” available on the right-click
  - a. If the target is a Test Profile icon, the element shall be the last one in that profile
  - b. If the target is an essid inside a test profile, the element shall be the last one for that essid.
5. Repeat step 2-4 until the test profile is according the expectations.

## 17.6 Operations on Test Profile Node

### Save All Changes

Any change in the sub-tree shall be made persistent.

### Add empty Test Profile

A new test profile object to the tree shall be inserted. The only input required is the name of the profile.

## 17.7 Operations on Test Profile

### Edit

Open a pane with “Common Values” and “Name” field ready for editing. “Bound Tests” remains read-only, the elements are managed in the tree.

### Duplicate

Create identical test profile with a new name. It is possible to change top-level parameters on the same pane. This option enables easy creation of test profiles with similar test elements to another link.

### Copy as essid

Copies the contents of a test profile to be pasted to another profile as essid object.

### Remove

Removes the object.

### Bound Eyes

Shows the monitoring stations that are using this profile.

### Paste test profile element

Paste previously copied test profile element as the last element in the profile.

## Save

Make the changes in the sub-objects persistent.

## Insert ESSID

Paste previously copied essid into this profile as the last element.

## Insert New ESSID

Create a new empty essid into this profile as the last element.

# 17.8 Operations on essid inside a test profile

## Edit

Open a pane with “Common Values” and “Name” field ready for editing.

## Copy

Enable pasting of the object.

## Paste test profile element

Paste previously copied test profile element as the last element in the profile.

## Remove

Deletes the object.

# 17.9 On test elements

Each test has default parameters, which can be used as is or modified as needed. To obtain the best results and find the best measurement methods for a target network, plan and configure the tests to suit the network.

A test profile must be configured for each monitoring station separately. The same profile can be used in several monitoring stations.

## 17.9.1 Modifying test parameters

If you wish to modify individual tests, see the instructions below. For each test, do the following:

1. Select the test from the profile and right-click the test
2. Select “Edit”
3. If desired, set the test duration (in seconds)
  - a. The test duration does not affect the running of the test; however, if the test type is temporarily removed from the test set, the time specified is spent in sleep mode, depending on the configuration
4. For some tests, such as RTT ping, you may also do the following:
  - a. Select the interval, or the pause between pings
  - b. Select Sonar

- c. Select an access point
- d. Select an IP address
- e. Select the number of bytes to be downloaded/uploaded
- f. Select the number of repetitions
- g. Select the client's IP address policy:
  - i. DHCP in use (1)
  - ii. Static address (0) – enter address data
5. Select "Keep changes"
6. Select "Save all changes"

### 17.9.2 Use case: Multiple SSID testing

There are two ways to achieve testing on multiple networks on one single monitoring station. The first is based on element copying (the previous paragraph) and the other is using copies of essid objects.

Using copies of elements may be burdensome at the configuration time but gives control over the test order. By copying one single element (test type) to be sequentially tested on different wlangs produces the following sample profile:

1. FTP on Wlan1
2. FTP on Wlan2
3. FTP on Wlan3
4. Spectrum
5. MOS on Wlan1
6. MOS on Wlan2
7. MOS on Wlan3
8. Scan

The other approach is the create a simple test sequence as essid and then duplicate the essid object and make the duplicates to point to different wlangs. The resulting sample test profile would be similar to the following:

1. FTP on Wlan1
2. MOS on Wlan1
3. Spectrum
4. FTP on Wlan2
5. MOS on Wlan2
6. Scan
7. FTP on Wlan3
8. MOS on Wlan3

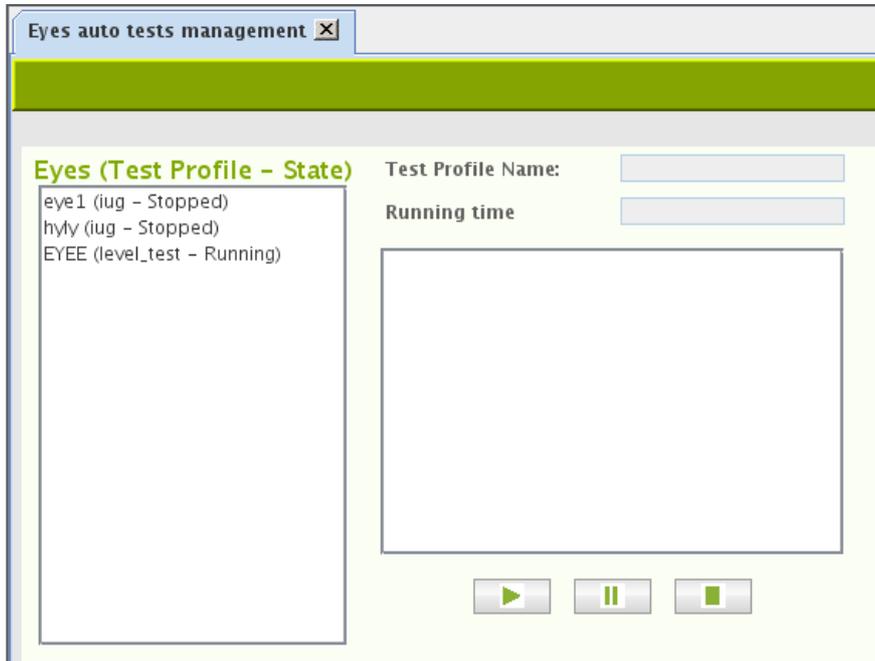
Please observe that in the latter approach the measurements on a single wlan network shall be sparser temporally. While individual tests shall happen on roughly the same time interval, the distribution of the samples per network differs a great deal on these two approaches.

When planning the test cycles, one should bear in mind:

- The more tests there are in the sequence, the bigger the difference in sample distribution.
- The more networks, the less samples for individual networks.

## 17.10 Running test profiles

Select “Tools | Eye auto tests management” to see current status of Eye units.



The Eyes of the user context are enlisted in the box on the right. The Eye name, the test profile name and the state of the test profile run are indicated.

By selecting one of the Eyes brings additional information such as the run time and test profile content on the left.

Buttons:

Play – runs the chosen test profile on the active Eye

Pause – temporarily stop or resume running the test profile on the active Eye

Stop – Stop running the profile on the active Eye

## 18 MANUAL TESTS

Manual tests can run simultaneously with automated testing. Sapphire will perform ongoing automated test first and then run user defined manual test. Automated test will continue after manual test has been finished.

Manual test results will not be saved to database.

### 18.1 “Network Scan” test

The network scan test can also be used as a separate test outside initial deployment. The deployment is described in the previous section of this guide.

To scan the network, do the following:

1. In the Network topology, select the Eye you want to use for scanning the network
2. Right-click and select “Network Scan”; a test window is displayed in the right pane
3. Select the test duration from the pull-down menu
4. If you want to view information about each antenna, select “Show RX level”
  - a. If this checkbox is selected, the results window has a separate line for each antenna, which might make the window’s content more difficult to read
  - b. The system selects the best antenna automatically in any case
  - c. The system offers an active test for verification of the antenna selection
5. Select the scan directions – i.e., directional antennas
6. Select the channels to scan
7. Select “Scan”
8. The results are displayed in a table

**Wireless Network Scan**

Scan Interval: **Fast scan** Show detailed results:

**Antennas**  
 All  None  1  2  3  4  5  6  7

**A Channels**  
 All  None  36  40  44  48  52  56  60  
 120  124  128  132  136  140

**B/G Channels**  
 All  None  1  2  3  4  5  6  7

**Scan** **Save** **Columns** **Export**

ESSID	Encryption	MAC	Channel	Manage	Eye
"7signal"	CCMP, CCMP PSK,...	00:15:05:00:00:00	F0 140	Unknown	
"YFIGUEST"		00:15:05:00:00:00	DE 56	Unknown	
"YFIPRIVA..."	Encrypted	00:15:05:00:00:00	DF 56	Unknown	
"YFIPRIVA..."	Encrypted	00:15:05:00:00:00	AF 44	Unknown	
"YFIGUEST"		00:15:05:00:00:00	AE 44	Unknown	
"7rd"	CCMP TKIP PSK, T...	00:15:05:00:00:00	10 13	Unknown	

MAC hidden

After the network scan, you can verify the suitability of the selected antenna by running the antenna selection test.

The information in the table can be edited. Remember to save the changes.

- “Manage”: The management status: the status of a monitoring station can be changed
- “Sel Ant”: Selected antenna – you can change the antenna used by the Eye to monitor the access point
  - We recommend that you compare the signal levels received very thoroughly
  - We recommend that you perform the antenna selection test if anything is even slightly unclear

Options for processing the results:

- “Save” saves the information in the table to the Carat system.
- “Columns” select the visible columns; the table might be easier to read if you hide unnecessary columns
- “Export” exports a text file to the local file system – you can enter the location in the dialog that appears after you click “Export” – which is a handy feature for comparison of results obtained at different times

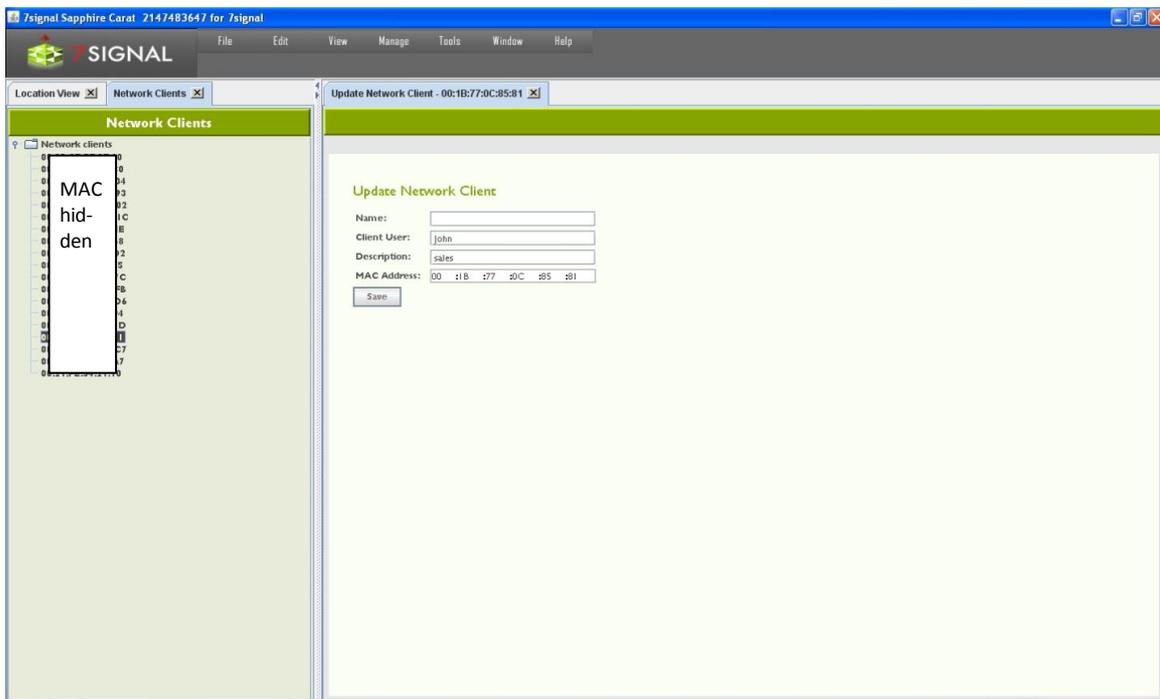
## 18.2 “Client scan” test

You can scan for preconfigured clients by their MAC address.

1. In the Network topology, select the Eye you want to use for scanning the network
2. Right-click and select “Active Tests | Client Scan”
3. Enter the scan duration under “Scan interval”
4. Select the scan directions – i.e., antenna lobes
5. Select the channels to scan
6. Select “Scan”
7. The results are displayed in a table:
  - a. The MAC address of the scanned devices that transmitted during the test
  - b. The noise level and signal strength, by antenna



3. Right-click and select “Edit”
4. Edit the information
5. Select “Save”



### 18.2.1 Addition of a new client

1. From the top menu bar, select “Manage | Network clients”
2. In the hierarchical tree in the left pane, right-click the topmost element, titled “Network clients”
3. Select “Add network client”
4. Enter a friendly name for the client
5. Enter a user’s name, if known
6. Enter a description (optional)
7. Enter the client’s MAC address
8. Click “Save”

To add several clients at once, select “Import network clients” in step 3. This option imports a text file from the Carat server’s file system. The file format is as follows:

field	MAC	Name	User	Description
<b>explanation</b>	MAC address, required	Client name, (optional)	Client user if known (optional)	Client description (optional)
<b>example</b>	complete	A:B:C:D,pda,Pda User,personal digital assistant		
	description omitted	A:B:C:D,officeLaptop,J.D.,		
	partial	A:B:C:D,barCodeReader, ,		

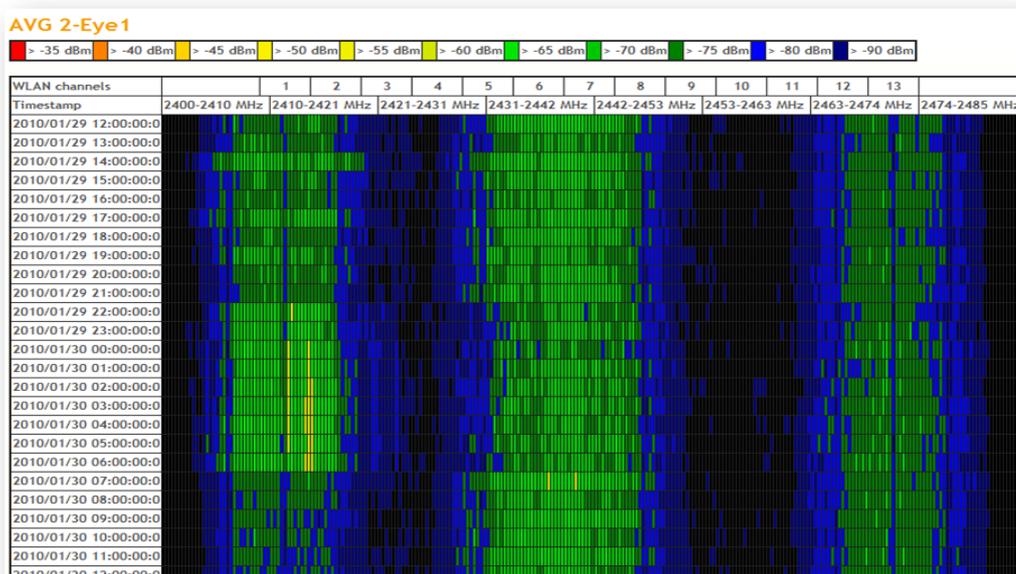
The “Export network clients” function creates a corresponding file in the Carat server’s file system.

## 18.3 Spectrum Analyzer

The monitoring station supports frequency-sweep-based radio spectrum analysis. The frequency status is displayed as a colored map.

1. In the Network topology, select the Eye that will run the test
2. Right-click and select "Spectrum Analysis"
3. Select a suitable sweep method from the pull-down menu
4. Select the presentation mode from the pull-down menu
  - a. Off-line: one-time draw
  - b. On-line: regularly updated image
5. Select the test duration from the pull-down menu
6. Select the antennas to be used in the test by selecting their respective checkboxes
7. Select "Scan"

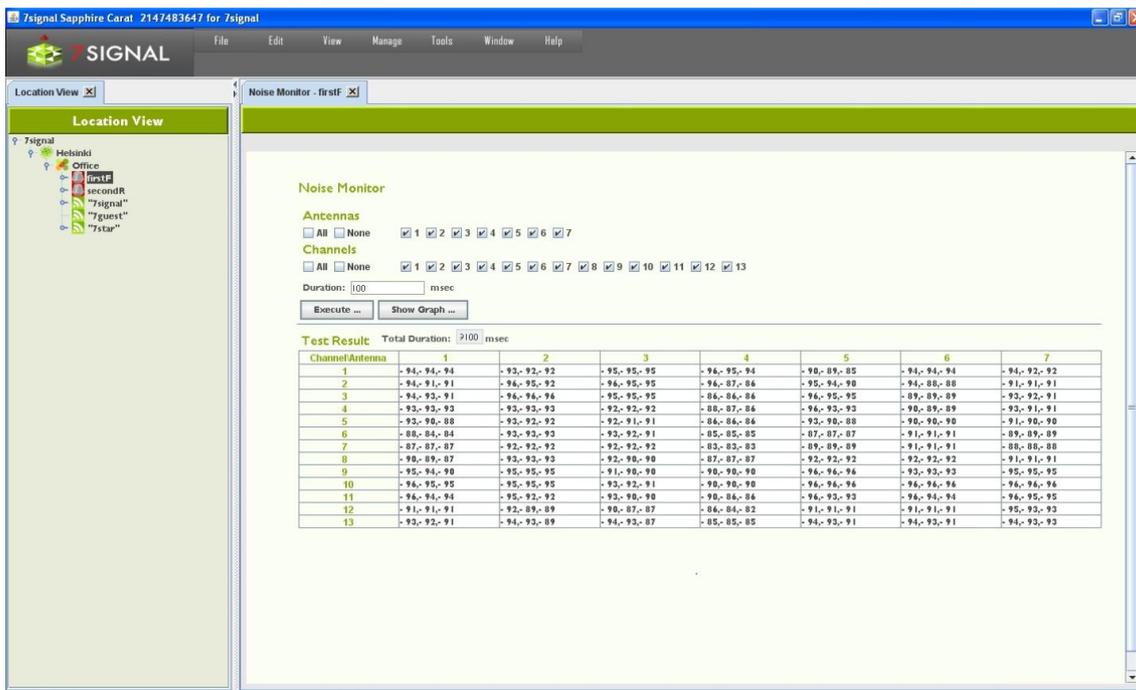
For the results See the figure below:



## 18.4 "Noise monitor" test

You can measure the noise levels surrounding the monitoring station.

1. In the Network topology, select the Eye that will run the test
2. Right-click and select "Noise Monitor"
3. Select the scan directions – i.e., directional antennas
4. Select the channels to scan
5. Select "Execute"
6. The results are displayed in a table as seen below
7. To view the results in a graphical view, click "Show graph"

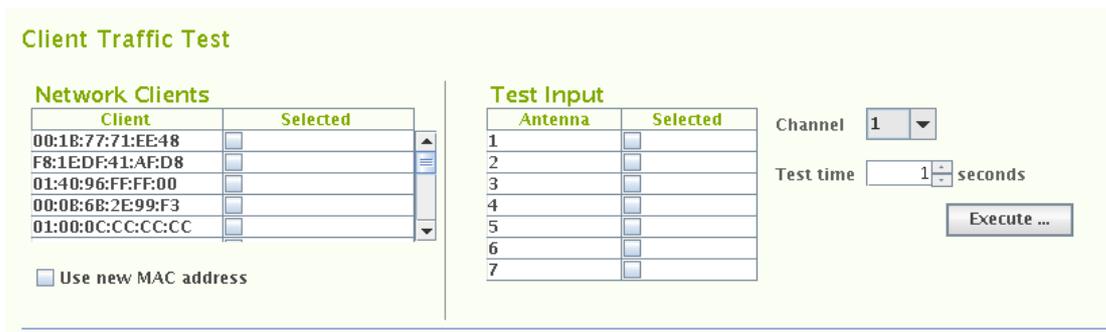


## 18.5 “Client Traffic Test”

This test listens to radio traffic in the Sapphire Eye’s coverage area and gathers information on wlan clients that are active i.e. exchange traffic with access points in the proximity.

The result contains all the clients that were active during the test. Please note that both channels and antennas work in an exclusive manner, only one antenna and only one channel are active at the time. In other words: it is impossible to capture all the traffic during the test execution.

Depending on the test purpose, it might be worthwhile to define the interesting MAC addresses beforehand, possibly giving a friendly-name, too. If such definition exists, the friendly-name is shown in the result tables instead of text-formatted MAC addresses.



To run the test:

1. In the Network topology, select the Eye that will run the test
2. Right-click and select “Manual tests | Client Traffic Test”
3. Select the antennas to be used in the test
4. Select the channel to be used in the test
5. Select the listening time from the drop-down menu, the division is similar to the network scan
6. Select “Execute”

The results are displayed in two tables as seen below. The tables are active and the column names support sort-orders.

The table “Client Scan Results” shows individual clients and their antenna sectors. By activating a row on this table, more detailed information on the client is displayed on the table named “Client Results” below.

## 18.6 “Air Utilization” test

To capture spectrum heavy-users and misconfigurations – such as extensive use of legacy codecs - in the wlan network, air utilization test should be run. This test is not part of the test profiles as it is lengthy troubleshoot test. Special attention to the test parameters is required as the maximum runtime is easily very high. One should check the “aggregate time” box for an estimate.

**Air utilization test**

**Antennas**  
 All  None  1  2  3  4  5  6  7

**Channel widths**  
 20 MHz  HT20 MHz  HT40- MHz  HT40+ MHz

**5 GHz Band**  
 All  None  36  40  44  48  52  56  60  64  100  104  108  112  116  120  
 124  128  132  136  140

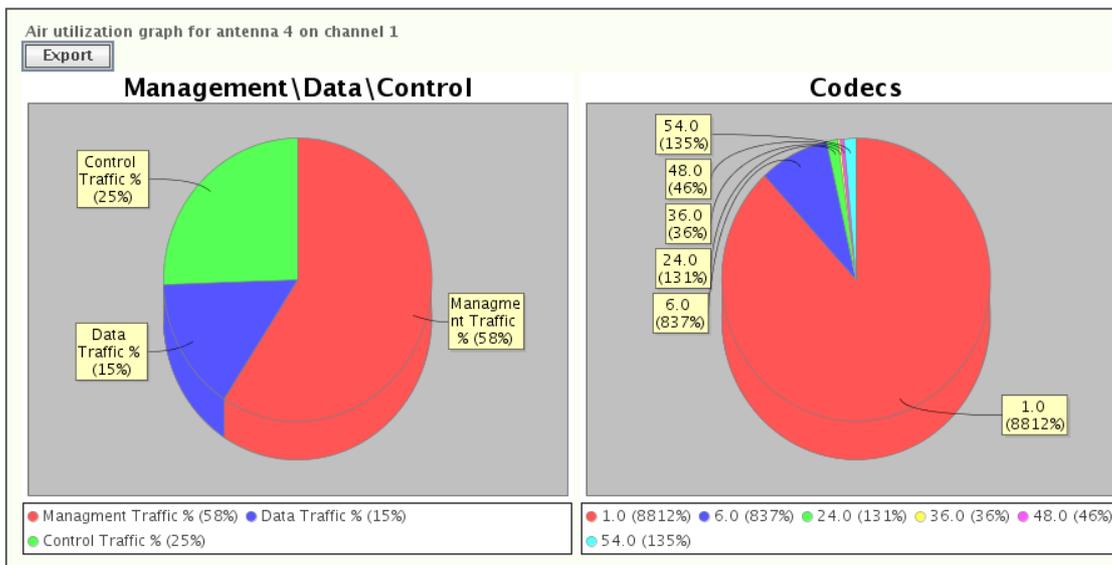
**2.4 GHz Band**  
 All  None  1  2  3  4  5  6  7  8  9  10  11  12  13

Listen time  (sec)  (aggregate time)

To run the test:

1. Select antennas, at least one must be selected.
2. Select the desired channels with the check-boxes.
3. Select the channel widths for the test(802.11n feature)
4. Select the time – in seconds – to listen to each selected channel on each selected antenna.

The results are shown in a table that has each antenna/channel combination as one row. One will get simple table result by activating each row with the mouse. There shall be more detailed result if “Show graph” is selected for the activated row:

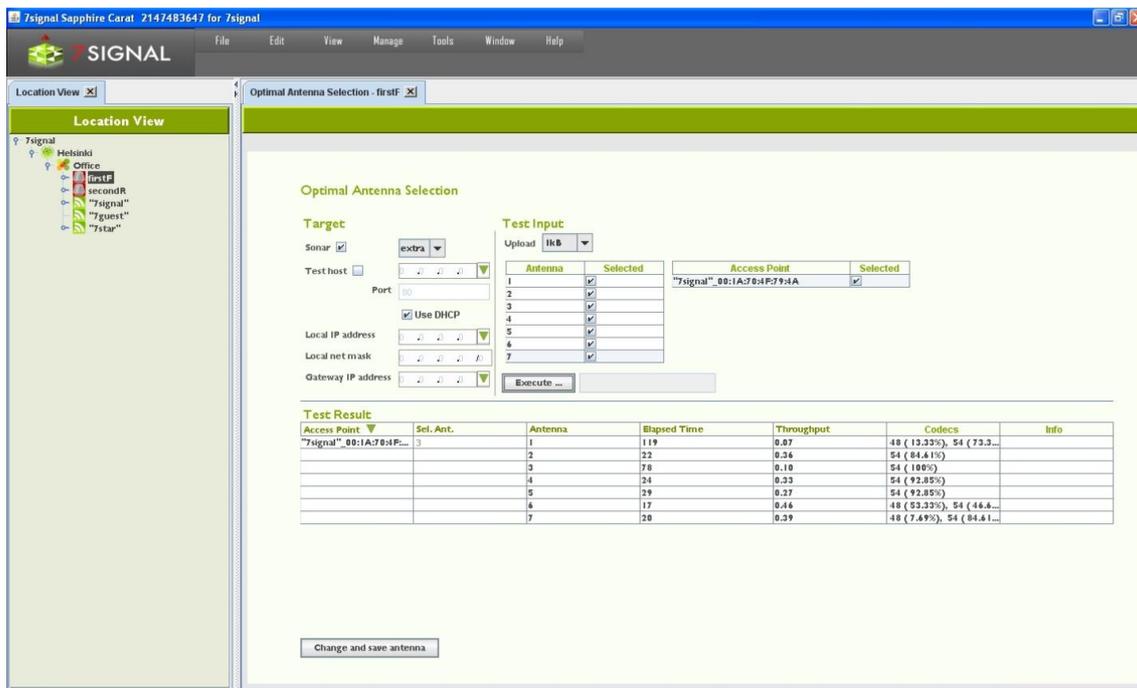


Antenna/channel row is presented in a pie-chart form that show frame type distribution on the left and codec distribution on the right.

## 18.7 “Optimal Antenna Selection” test

The antenna test is used to verify the suitability of the selected antenna. Because of reflections, the network scan can show similar results for different antennas. However, during transmission of data to an access point, the differences between antennas become significant. This test is worth running if more than one antenna shows similar results.

1. In the Network topology, select the Eye that will run the test
2. Right-click and select “Active Tests | Optimal Antenna Selection”
3. Select the Sonar against which you want to run the test, or type another IP address
4. Select an access point
5. Select the Eye’s IP address (DHCP or static)
  - a. If static, enter the (1) local IP address, (2) local netmask, and (3) gateway
6. Set up the test options:
  - a. Select the amount of data transferred at one time
  - b. Select the antennas to be used in the test
7. Select “Execute”
8. The results are displayed in a table as seen below
9. If an antenna gives better results than the currently used antenna, select the better antenna for monitoring

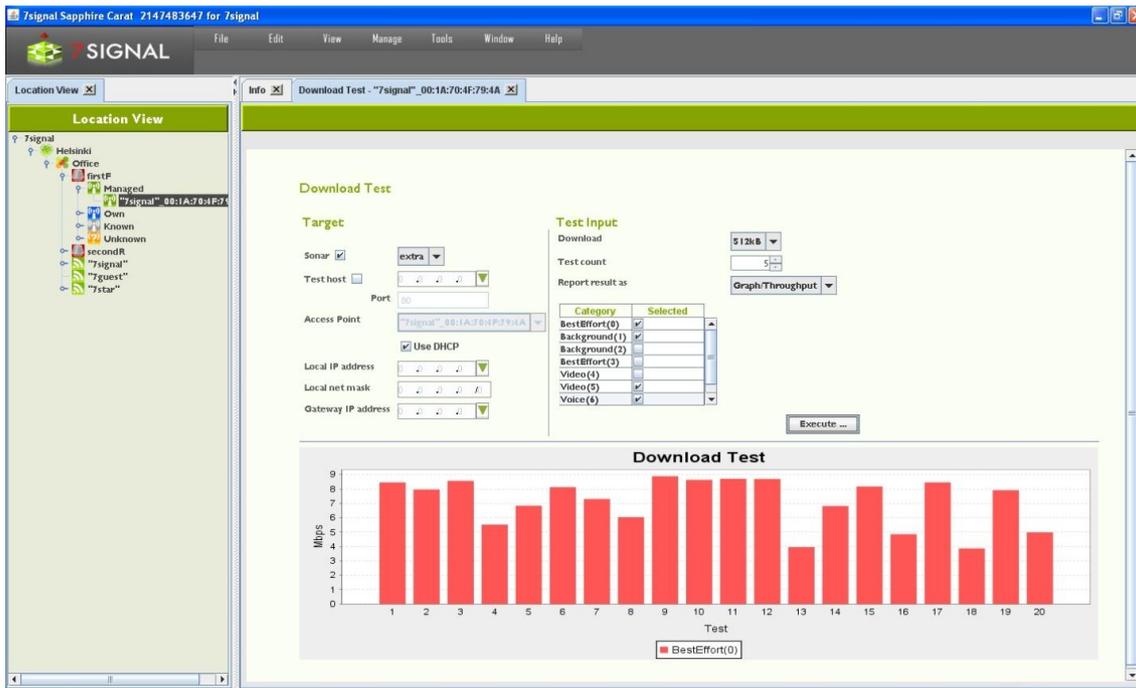


## 18.8 Download Tests

This test gives an indication of an access point's FTP or UDP downlink capacity.

1. In the Network topology, select the Eye that will run the test
2. Right-click and select "Manual tests"
3. From the submenu select either "FTP Download Test" or "UDP Download Test"
4. Specify whether you want to run the test against a Sonar or another target
5. Select the Sonar against which you want to run the test, or type another IP address
6. Select an access point
7. Select the Eye's IP address (DHCP or static)
  - a. If static, enter the (1) local IP address, (2) local netmask, and (3) gateway
8. Set up the test options
  - a. Select the amount of data transferred at one time
  - b. (UDP only): Packet size to be used (small = 256, medium = 1024, large = 32768 bytes)
  - c. (UDP only): Sender (Sonar) port. Default 0 means that system shall allocate used ports. User-given port overrides this setting. Please observe possible firewall settings.
  - d. (UDP only): Receiver (Eye) port. Default 0 means that system will allocate used ports. User-given port overrides this setting. Please observe possible firewall settings.
  - e. Select the display format for the results
  - f. Select how many times the test is to be run
9. Select "Execute"
10. The results are displayed in a table as shown below

You can change the table type even after the test is executed.



## 18.9 Upload Tests

This test gives an indication of an access point's FTP uplink capacity.

1. In the Network topology, select the Eye that will run the test
2. Right-click and select "Manual tests"
3. From the submenu select either "FTP Upload Test" or "UDP Upload Test"
4. Configure the test target in the target area:
  - a. Select the Sonar against which you want to run the test, or type another IP address
  - b. Select an access point from the pull-down menu
  - c. Select the Eye's IP address (DHCP or static)
    - i. If static, enter the (1) local IP address, (2) local netmask, and (3) gateway
5. Set up the test options:
  - a. Select the amount of data from the pull-down menu
  - b. (UDP only): Packet size to be used (small = 256, medium = 1024, large = 32768 bytes)
  - c. (UDP only): Sender (Eye) port. Default 0 means that system will allocate ports .User-given port overrides this setting. Please observe possible firewall settings.
  - d. (UDP only): Receiver (Sonar) port. Default 0 means that system shall allocate used ports. User-given port overrides this setting. Please observe possible firewall settings.
  - e. Specify how many times the test is to be run
  - f. Select the display format for the results from the pull-down menus
  - g. Select the traffic classes to use (licensed products only)
6. Select "Execute"

The results are displayed in a table as seen below.

You can change the table type even after the test is executed.

Test	Time (ms)	Throughput (Mbps)	Percent from practical max	Traffic category
1	504	7.94	32.66	BestEffort(0)
2	473	8.16	34.80	BestEffort(0)
3	928	4.25	17.89	BestEffort(0)
4	886	4.51	18.58	BestEffort(0)
5	875	4.57	18.81	BestEffort(0)
6	925	4.32	17.80	BestEffort(0)
7	899	4.45	18.21	BestEffort(0)
8	845	8.99	36.99	BestEffort(0)
9	447	8.95	36.82	BestEffort(0)
10	3479	1.15	4.73	BestEffort(0)

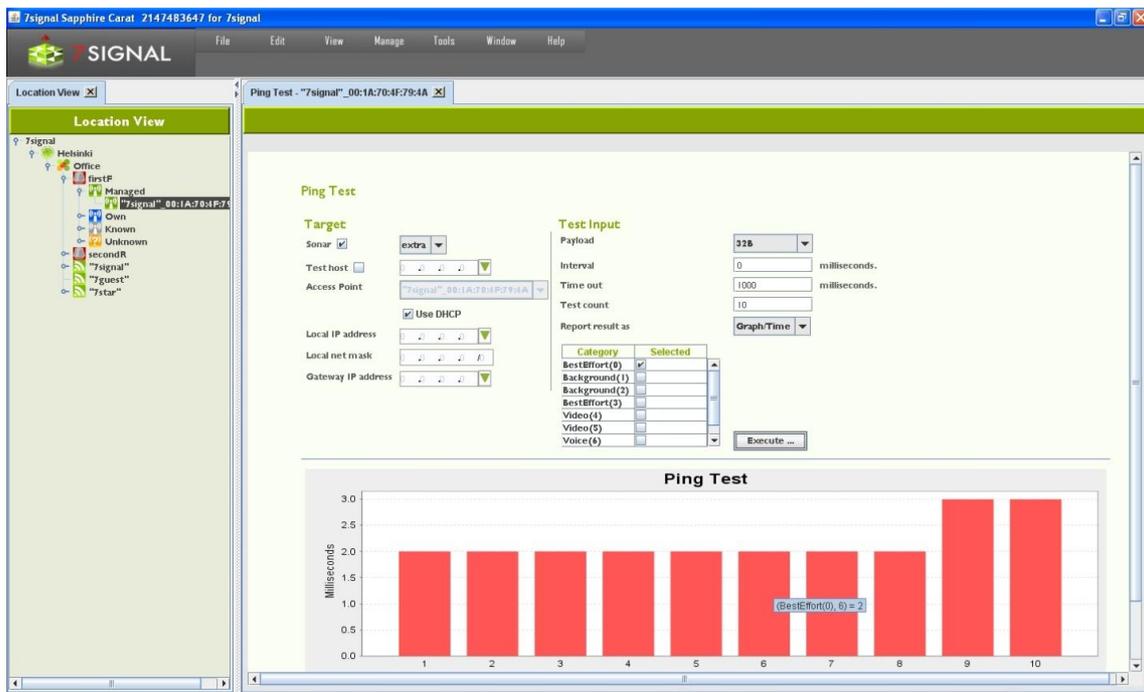
## 18.10 “Ping” test

A ping test tests the accessibility of a device, the number of packets sent and received, and latency time.

1. In the Network topology, select the Eye that will run the test
2. Right-click and select “Manual tests | Ping test”
3. Define the test target in the target area:
  - a. Select the Sonar against which you want to run the test, or type another IP address
  - b. Select an access point from the pull-down menu
  - c. Select the Eye’s IP address (DHCP or static)
    - i. If static, enter the (1) local IP address, (2) local netmask, and (3) gateway
4. Set up the test options:
  - a. Select the size for the ping packet
  - b. Select the waiting time between ping tests (in milliseconds)
  - c. Select the waiting time (in seconds) before termination of a test that does not progress
  - d. Specify how many pings will be send.
  - e. Select the display format for the results from the pull-down menus
5. Select the traffic classes to use (licensed products only) – *note that it is not recommended to use traffic classes in a ping test*
6. Select “Execute”

The results are displayed in a report as seen below.

You can change the table type even after the test is executed.



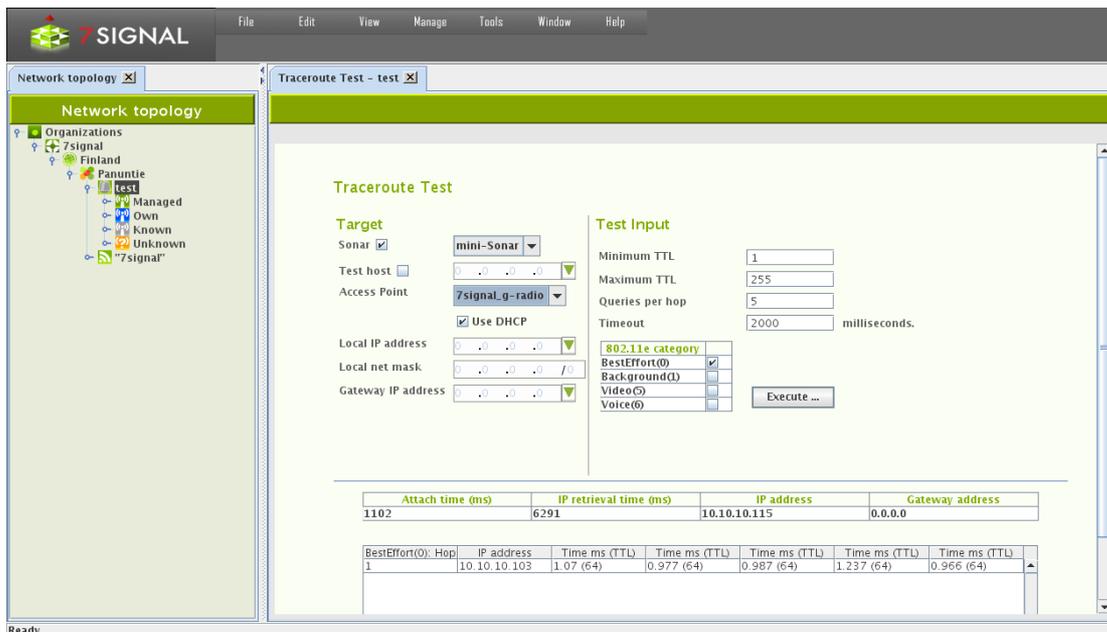
## 18.11 Traceroute Test

This test helps one perform network troubleshooting and identify routing problems or firewalls that may be blocking access to a host.

1. In the Network topology, select the Eye that will run the test
2. Right-click and select "Manual tests | Traceroute Test"
3. Define the test target in the target area:
  - a. Select the Sonar against which you want to run the test, or type another IP address
  - b. Select an access point from the pull-down menu
  - c. Select the Eye's IP address (DHCP or static)
    - i. If static, enter the (1) local IP address, (2) local netmask, and (3) gateway
4. Set up the test options:
  - a. Minimum TTL: minimum number of devices/hops to try
  - b. Maximum TTL: maximum number of devices/hops to try
  - c. Queries per hop: how many times a device/hop is tried
  - d. Timeout: how long to wait before giving up on a device/hop
5. Select the traffic classes to use (licensed products only)
6. Select "Execute"

The results are displayed in a report as seen below.

*Note: You can change the report type even after the test is executed*

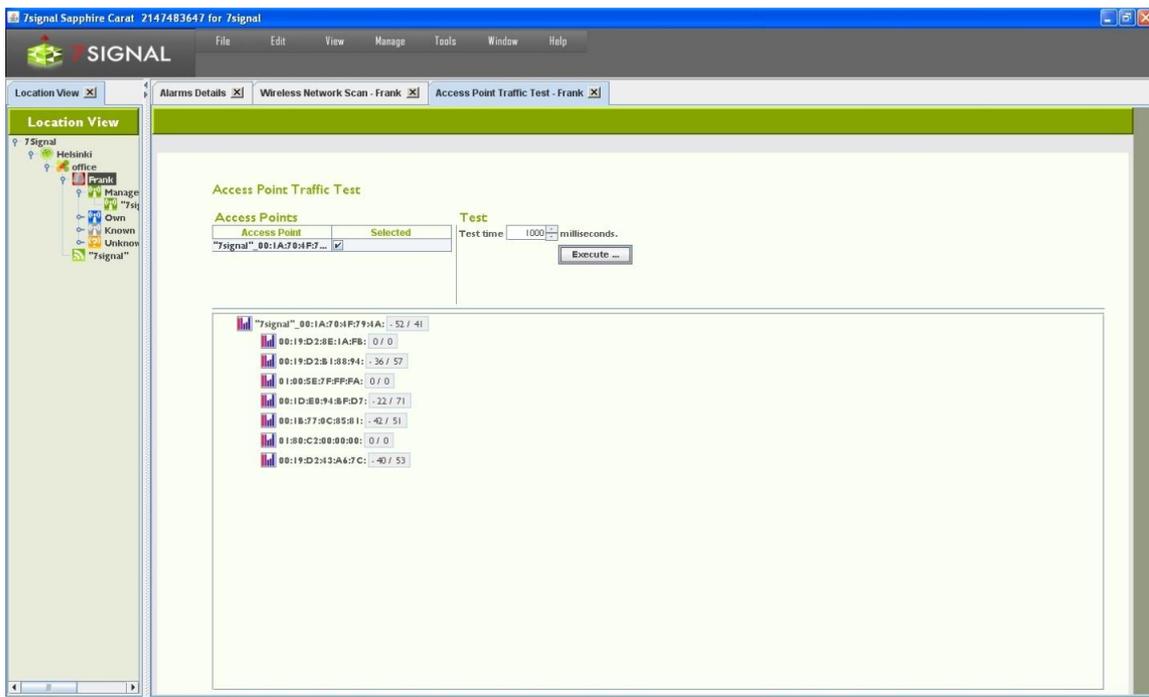


## 18.12 “Access point traffic” test

This test listens to radio traffic in the Sapphire Eye’s coverage area and gathers many kinds of information.

1. In the Network topology, select the Eye that will run the test
2. Right-click and select “Manual tests | Access Point Traffic Test”  
*Note: This test is among the active tests since it requires you to select a target access point*
3. Select the target access points from the table
4. Select the listening time (in milliseconds)
5. Select “Execute”

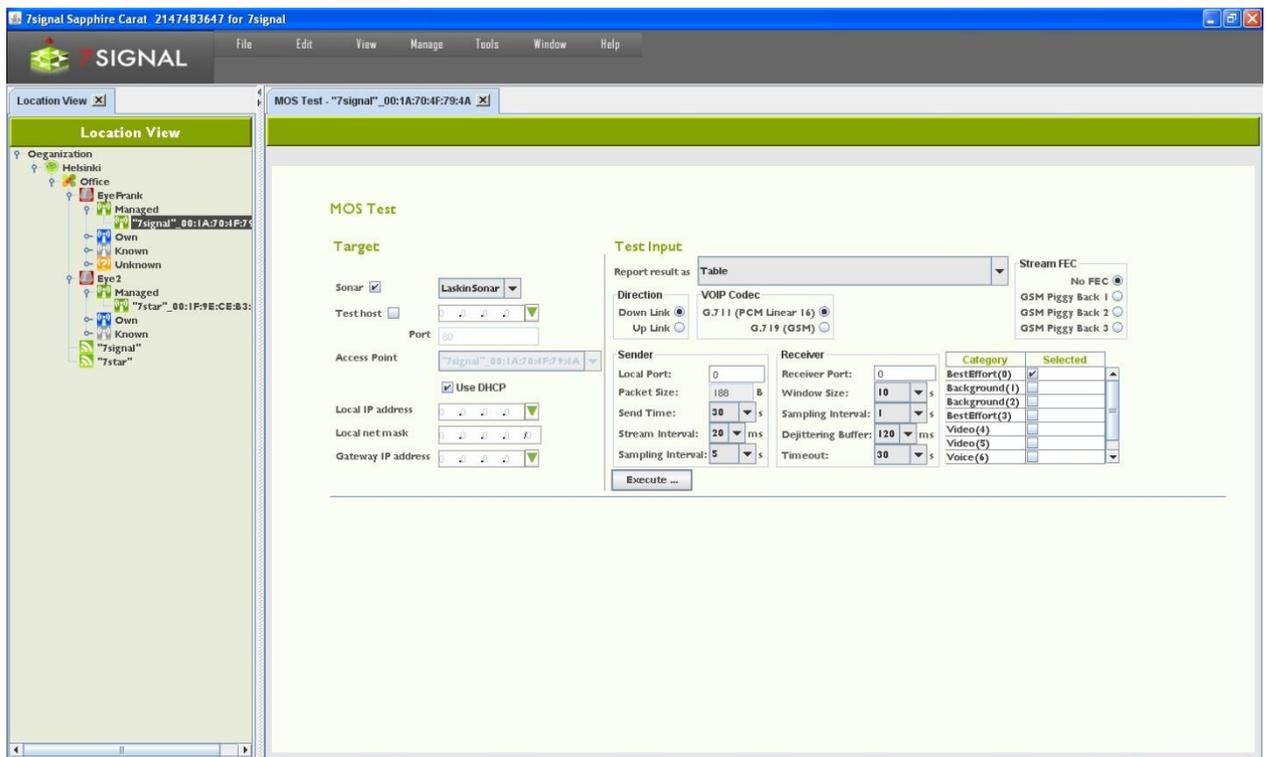
The results are displayed in a table as seen below – the tree view in the table shows the access point as the root node, and the heard clients under it; for more information, move the mouse cursor over the individual items in the tree or, to display even more details and a graphical view, click an item in the tree.



## 18.13 “MOS test”

This test creates a VoIP call between Sapphire Eye and Sonar. Both uplink and downlink call quality can be measured.

1. In the Network topology, select the Eye that will run the test
2. Right-click and select “Manual tests | Http test”
3. Define the test target in the target area:
  - a. Select the Sonar against which you want to run the test
  - b. Select an access point from the pull-down menu
  - c. Select the Eye’s IP address (DHCP or static)
    - i. If static, enter the (1) local IP address, (2) local netmask, and (3) gateway
4. Configure the test data (see separate instructions)
5. Select “Execute”

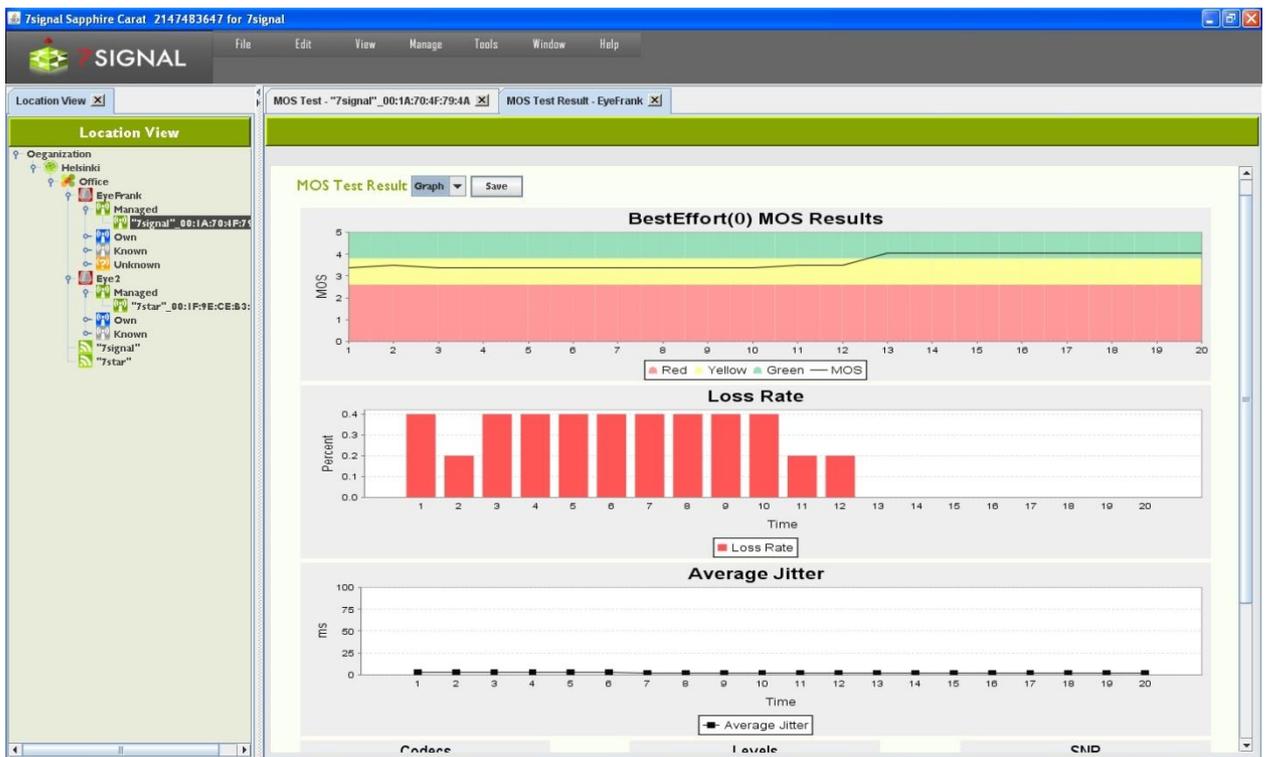


### 18.13.1 MOS test parameters

1. Select the initial display format for the results (Table/Graph)
2. Select the direction of the test (Downlink/Uplink)
3. Select the codec to be used in the test (VoIP Codec):
  - a. G.711 PCM Linear 16 = 64 kbit/s
  - b. G.729 GSM data = 8 kbit/s
4. Select an optional error correction method (Stream FEC)
5. Configure sender information:
  - a. Enter a port for the MOS test (Local port)
  - b. Enter the test duration in seconds (Send time)
  - c. Enter the packet interval in milliseconds (Stream interval)
  - d. Enter the packet size in bytes (Packet size)
  - e. Enter the sampling window size in seconds (Sampling interval)
6. Configure the receiver information:
  - a. Enter a port for the MOS test (Receiver port)
  - b. Enter the receiving window size in seconds (Window size)
  - c. Enter the sampling interval in seconds (Sampling Interval)
  - d. Enter the size of the dejittering buffer (Dejittering Buffer)
  - e. Enter the connection timeout in milliseconds (Timeout)
7. Enter the traffic class (licensed feature only)
8. Select "Execute"
9. The results are displayed in a new window in the selected format

### 18.13.2 MOS Test Result

Sample result set:



Elements of the results image:

- **MOS result:** The distribution of MOS values related to test duration. The color coding indicates quality.
- **Loss Rate:** Packet loss as a function of test duration.
- **Average Jitter:** Variation in delay as a function of test duration.
- **Codec:** The distribution of codecs used during the test. If only one result is visible, the codec was not changed during the test.
- **Levels:** Signal and noise levels during the test, averaged over the duration of the test.
- **SNR:** Signal/noise ratio during the test, averaged over the duration of the test.

Test result	
5	Excellent
4	Good
3	Fair
2	Poor
1	Bad

In practice, the supported codec's can reach MOS scores that are slightly above 4.

## 18.14 "HTTP URL test"

This test is used for "downloading" actual WWW-pages.

To run the Intranet test:

1. Select an access point from the pull-down menu
2. Select the Eye's IP address (DHCP or static)
  - a. If static, enter the (1) local IP address, (2) local netmask, and (3) gateway
3. Choose URL from the box
  - a. To add a URL
    - i. Write a well-formed and proper address to the input box
    - ii. Select "Add URL"
  - b. To remove a URL
    - i. Activate the URL to be removed with a right-click
    - ii. Select "Remove URL"
4. Select Execute.

The result marks whether the download was successful (protocol errors or not), the download time and the downloaded byte count.

## 18.15 "Internet AvailabilityTest"

This is an infrastructure test that reflects how well a wlan client (Eye) is able to utilize the Internet. The test includes the following steps:

- radio link setup
- wlan authentication
- DHCP service
- Gateway pinging
- DNS server checks
- DNS name resolves

If the Eye passes all the phases of the test, it is justified to assume that the internet use is in general fully functional.

**Internet Availability Test**

**Target**

Access Point:

Use DHCP

Local IP address:

Local net mask:

Gateway IP address:

**DNS Servers**

Primary:

Secondary:

Tertiary:

**DNS Resolve Names**

First:

Second:

Third:

---

**General Results**

Used IP	Attach time	Retrieval time	Router Addr...
0.0.0.0	0	0	?

**DNS Servers Results**

DNS Server Address	Availability
89.18.234.2	Unavailable
89.18.235.2	Unavailable

**DNS Names Resolve Results**

DNS Name	Resolve Status	Resolve elapsed ti...	Aliases	Ip addresses
	"Try again" status	0		

To run the Internet availability test:

1. Select an access point from the pull-down menu
2. Select IP address
  - a. Use DHCP of the wlan network by checking the box
    - i. DHCP result shall affect other test parameters as the actual servers shall be dictated by the result and the reliability is expected.
  - b. Use of static IP address configuration
    - i. enter the (1) local IP address, (2) local netmask, and (3) gateway
    - ii. Enter primary DNS server
    - iii. Enter secondary DNS server (optional)
    - iv. Enter tertiary DNS server (optional)
  - c. Enter 1st network name to be resolved
  - d. Enter 2nd network name to be resolved (optional)
  - e. Enter 3rd network name to be resolved (optional)
3. Select "Execute"

The result-set is three-fold:

1. General results: IP address obtained, attach time, dhcp retrieval time and gateway address.
2. Status of DNS servers
3. Results of the name resolving.

## 18.16 "SIP Register Test"

It is possible to run SIP REGISTER test in both unauthorized and authorized mode.

**SIP Registration Test**

**Target**

SIP Server  sipfx

Test host  0 .0 .0 .0

Port 5060

Access Point "7test".00:18:F8:71:21:23

Use DHCP

Local IP address 0 .0 .0 .0

Local net mask 0 .0 .0 .0 /0

Gateway IP address 0 .0 .0 .0

**SIP Specific parameters**

Name:  (required)

Password:   (Show)

Local Bind URI

Proxy URI

Registrar URI

Stun Address 0 .0 .0 .0

**802.11e category**

BestEffort(0)

Background(1)

Video(5)

Voice(6)

To run the SIP test:

1. Select the SIP server to register to
  - a. From the pull-down menu
    - i. SIP end-point has to be defined as a test end-point to be selectable
  - b. Arbitrary IP address
    - i. Enter IP address and the port
2. Select an access point
3. Select the Eye's IP address (DHCP or static)
  - a. If static, enter the (1) local IP address, (2) local netmask, and (3) gateway
4. Enter the SIP protocol specific parameters
  - a. Name is mandatory
  - b. If alone, the test is run as un-authorized
5. Select the wlan traffic category
6. Select "Execute"

**Common SIP Registration test results**

Attach Time 1450

IP Retrieval Time 2278

Retrieved IP address of the eye 7 .7 .7 .120

Gateway Address 0 .0 .0 .0

Traffic Class	Register status	Register time	Authentication s...	Authentication t...	Unregister status	Unregister time
BestEffort(0)	503 (ServiceUnav...	32	Not Applicable	0	Not Applicable	0

The test result is two-fold: test setup information and SIP specific.

Test setup information contains:

- attach time
- dhcp retrieval time
- Eye IP address used in wlan interface
- The gateway

SIP results contain:

- used IEEE802.11e traffic category
- SIP server response for REGISTER: SIP protocol code
- Register time, milliseconds
- Authentication information (optional)
- SIP server response for UNREGISTER: SIP protocol code

- Unregister time, milliseconds

## 19 SERVICE LEVEL AGREEMENT

Service Level Agreement (SLA) groups a number of KPIs and their expected target values. In a nutshell, typically a KPI has a scalar value while SLA is combination of numerous KPI values and statistical rules that result in a higher-level view on the quality of the network.

The ultimate goal is to bind together a contractual agreement and actual measurements, the expression of the desired or required level of the service and the proven real-life phenomena. As such, the SLA is a communication medium between the service provider and the customer.

The SLA outcome is percentage value and based on user-defined thresholds it is divided into values green, yellow and red according the three-basket principle. This means that the end-user experience on the wlan network might remain adequate but the resulting SLA value is clearly in the red basket.

### Related icons



SLA template



SLA KPI definition



SLA group



KPI definition

### 19.1 Defining a Service Level Agreement into the system

A network service provider can make Service Level Agreements (SLA) with their customers, defining the level of service provided to the customer. 7signal Sapphire enables users to monitor the fulfillment of the various performance level guarantees defined in the SLA.

The user may freely choose the performance indicators to be monitored in the service level agreement, in effect forming out of them an SLA group.

### 19.2 Defining SLA Key Performance Indicators (KPI)

In 7signal Sapphire an SLA group is formed out of a set of Key Performance Indicators corresponding to the SLA. The SLA group is bound to a topology element in the monitored network.

An SLA group consists of several KPIs which define the boundary values used in monitoring the fulfillment of the service level agreement.

In the 7signal Sapphire system the boundary values can be set separately for each KPI contained in the SLA group. Each KPI defines a certain type of boundary value and percentage values for how many measurement samples may fall outside the defined boundary values without causing the service level agreement to be considered unfulfilled. The type of the KPI determines whether measurement samples with values over or under the boundary value are desired.

Three color coding is used for service levels in the KPIs: green, yellow and red. The percentage boundaries are defined for green and yellow levels of service.

To attain the green level of service the percentage of measurement samples that fulfill the boundary value criteria set in the KPI (that is, are over or under the set boundary value, depending on the type of KPI) must be at least as high as the percentage boundary value set for the green level in the KPI. If there are too many measurement samples that do not fulfill the boundary value criteria, the service level falls to yellow. The yellow level functions likewise: if it is not attained, the service level falls to red.

## 19.3 Example: Upload throughput KPI

The table below explains how an SLA value is calculated based on target KPI, it's measurement and statistical analysis.

Boundary value	above 5,5 Mbit/s	The threshold value for KPI.
Green level	99,0%	At least 99,0% of measured samples must attain an upload throughput of at least 5,5Mbit/s in order to attain the green level for the KPI in question.
Yellow level	95,0%	If the percentage of measured samples that satisfy the boundary value criteria falls between 95,0% and 98,99% the yellow level is attained.
Red level	below 95,0%	If the percentage falls below 95,0% the service level can be considered unfulfilled.

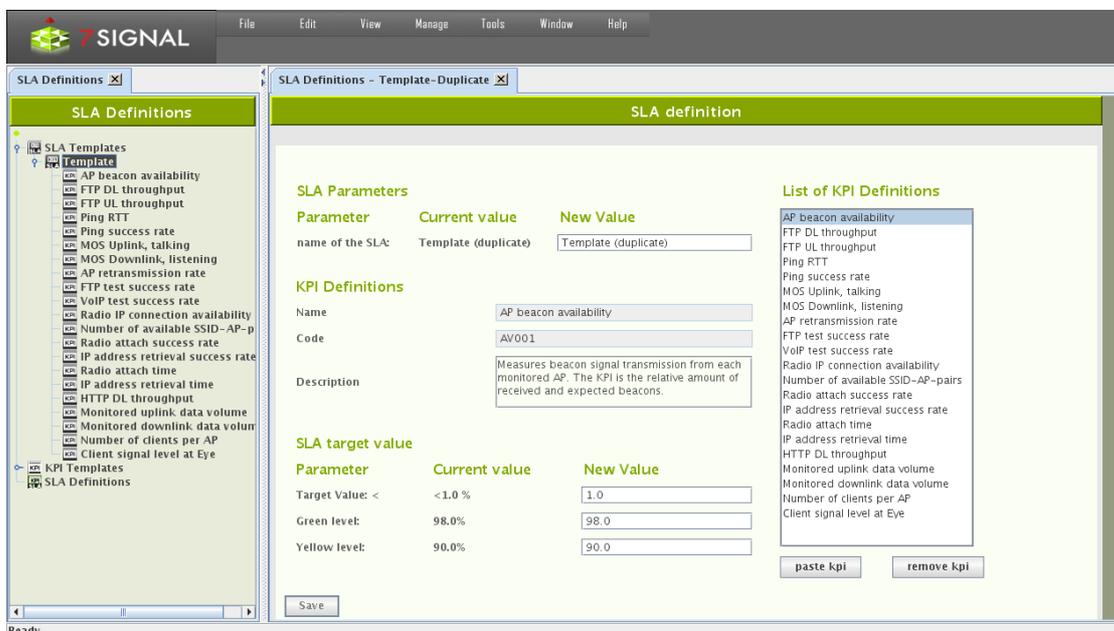
## 19.4 Creating an SLA group

An SLA group can be created in one of two ways:

1. By copying an SLA template
2. By creating an empty SLA group and adding to it the desired Key Performance Indicators

When the desired set of KPIs has been added to the SLA group the KPI boundary values can be set to match the service levels outlined in the actual Service Level Agreement contract.

### 19.4.1 Creating an SLA group from a template



Create the SLA group as follows:

1. Click on "Manage | SLA definitions" from the top menu bar
2. Open Templates node.
3. Right-click on the desired SLA template

4. Choose "Duplicate" from the pop-up menu. An SLA group editing dialog opens to the right (pictured above)
5. Name the SLA group
6. Remove unnecessary KPIs from the "KPI definitions" list by using the "Remove KPI" button
7. Add wanted KPI's which are not within the template. See next chapter how to do this.
8. If it's desired to change the boundary values of KPIs, choose the desired KPI from the "KPI definitions" list. The KPI's name, description and boundary values according to service level agreement are updated into the editing dialog.
9. Edit the boundary values to your liking.
10. Repeat from step 7. until every boundary value is as desired.
11. Click "Save"

### 19.4.2 Creating an SLA group from scratch

The dialog pane is identical to the case of duplicated template. Naturally the contents of the pane are empty, but the look and the process is identical.

Create the SLA group as follows:

1. Click on "Manage | SLA definitions" from the top menu bar
2. Right-click on "SLA groups" from the tree hierarchy
3. Choose "Add SLA group" from pop-up menu. An SLA group editing dialog opens to the right.
4. Name the SLA group
5. Choose "KPI definitions" from the tree hierarchy. Available KPIs are opened into the tree.
6. Right-click on the desired KPI
7. Choose "Copy" from the pop-up menu
8. Click "Paste KPI" from the SLA group editing dialog
9. Choose the KPI in the SLA group editing dialog ("KPI definitions"). The KPI's name, description and boundary values according to service level agreement are updated into the editing dialog.
10. If necessary, edit the boundary values.
11. Repeat from step 6. onwards until all desired KPIs have been added to the SLA group.
12. Click "Save"

### 19.4.3 Binding an SLA group to a Link

Bind an SLA group to a link as follows:

1. Click on "View | Network topology" from the top menu bar
2. Right-click on the link that you want to bind an SLA group to from the tree hierarchy
3. Choose "Set SLA group" from the pop-up menu
4. Choose the desired SLA group from the menu that opens

or alternatively

1. Click on "View | Network topology" from the top menu bar
2. Right-click on the link that you want to bind an SLA group to from the tree hierarchy
3. Select "Edit" from the pop-up menu. A link editing dialog opens to the right
4. Choose the desired SLA group from the drop-down menu
5. Click "Save"

### 19.4.4 Binding an SLA group to a link group

Bind an SLA group to a link group as follows:

1. Click on "View | Network topology" from the top menu bar
2. Right-click on the link group that you want to bind an SLA group to from the tree hierarchy
3. Choose "Set SLA group" from the pop-up menu
4. Choose the desired SLA group from the menu that opens

or alternatively

1. Click on "View | Network topology" from the top menu bar
2. Right-click on the link group that you want to bind an SLA group to from the tree hierarchy
3. Select "Edit" from the pop-up menu. A link group editing dialog opens to the right
4. Choose the desired SLA group from the drop-down menu
5. Click "Save"

### 19.4.5 Binding an SLA Group to other Entities

SLA Group can be bound to any entity within the Topology Tree. This can be done as follows

1. Right click the topology element and select "Bind SLA"
2. Select the SLA from the given list.

### 19.4.6 SLA propagation hierarchy

There is a propagation hierarchy how SLA Groups are propagated from different levels within the topology hierarchy. This means that for example if SLA Group is only bound to Top level organization, it is propagated to each element under the organization. Following is a order of propagation from left to right for the rightmost element. Element right always overrides propagation from the left.

- Organization > Location > Service Area > Access Point > Link Group > Link
- Organization > Location > Link Group
- Organization > Location > Service Area > Eye
- Organization > Wireless Network
- Organization > Location > Service Area > Access Point
- Organization > Location > Service Area
- Organization > Location
- Organization

## 20 CONTINUOUS AND AUTOMATED REPORTING

Loupe is an interactive tool for studying network phenomena of interest and for in-depth investigation of problems. Reports in standard, easy-to-interpret formats are available to support routine monitoring.

By using the report view in Carat, the user can configure reports from elements that are familiar from Loupe. In addition to the user-selected indicators, a report configured here contains the time of compilation and delivery and a list of the delivery addresses. At the specified time, Carat generates the report and delivers it to the recipients, specified as either e-mail addresses or directories in the Carat server file system. A report can include KPIs, service level views, and alarms, referred to below as report items.

Note: Configuring the mail server settings found under “Edit | SMTP server” enables the use of email in reporting.

### 20.1 Subscription for a new report

1. Select “Manage | Automated report configuration”
2. Select “New” to create a new subscription and open a report template
  - a. Use “Edit” for editing a subscription
  - b. The “Delete” option allows you to delete a subscription
  - c. When you select a report name, the description of this existing report is displayed

The screenshot shows the 'Report Properties Configuration' dialog box. It has the following fields and controls:

- Name:** specimen
- Description:** (empty)
- Brand Image:** (empty)
- Report rendering quality:** Medium
- Brand image location:** Upper left
- Items in the report:** alarms
- Recurrence:**  Every week  Every month
- When to send:** 1st of every month
- Send time:** 00:00
- Buttons:** Add, Edit, Delete, Generate preview, Generate and send now
- Report delivery settings:**
  - Media type: Email
  - Destination email: sms\_gateway@my.operator.com
  - Buttons: Add, Remove
- Destinations:** sms\_gateway@my.operator.com
- Bottom Buttons:** Save, Cancel

In the “Report Properties Configuration” area:

3. Enter a name for the subscription
4. Enter a description for the subscription (optional)
5. Select an report image (optional)
6. Choose the location for the image on the page  
The image will be repeated on each page of the report. It might represent, for example, a company or a target network.
7. Select the resolution (quality) to be used for the report graphics, mainly relevant to charting.

In the “Report items” area:

8. Configure the items to be included in the report by selecting “Add”
  - a. this starts content-dependent workflows, instructions below
9. Specify the send time
  - a. recurrence is weekly or monthly
    - i. Field “When to send” is dynamic and let’s one choose either numerous week days or a day in month
  - b. send time has 30 minutes resolution in a drop-down menu
10. “Generate preview” creates a report and opens it in a viewer tool
11. “Generate and send now” are available for subscriptions that have been saved.

In the “Report destination settings” area:

12. Choose the delivery format (**Media type**) of the PDF report
  - a. **Email**
  - b. save to **File** system
    - i. an absolute path gives the location in the Carat server file system
    - ii. relative paths are relative to the Carat startup directory (default: /opt/7signal/Carat/7signal)
13. Add one or more formats in the “Destinations” field by clicking “New”
14. Save the subscription by clicking “Save”

## 20.2 Adding Report Items

There are four report item types. A report item is an individual piece of information – SLA compliance, a KPI chart, SLA table or a set of alarms – that is part of the report. A report is a series of report items.

Configuration of automated reports  Automated report configuration  Add report item

**Report item**

Report item type:  SLA Compliance  
 Kpi  
 Sla  
 Alarm

Name:

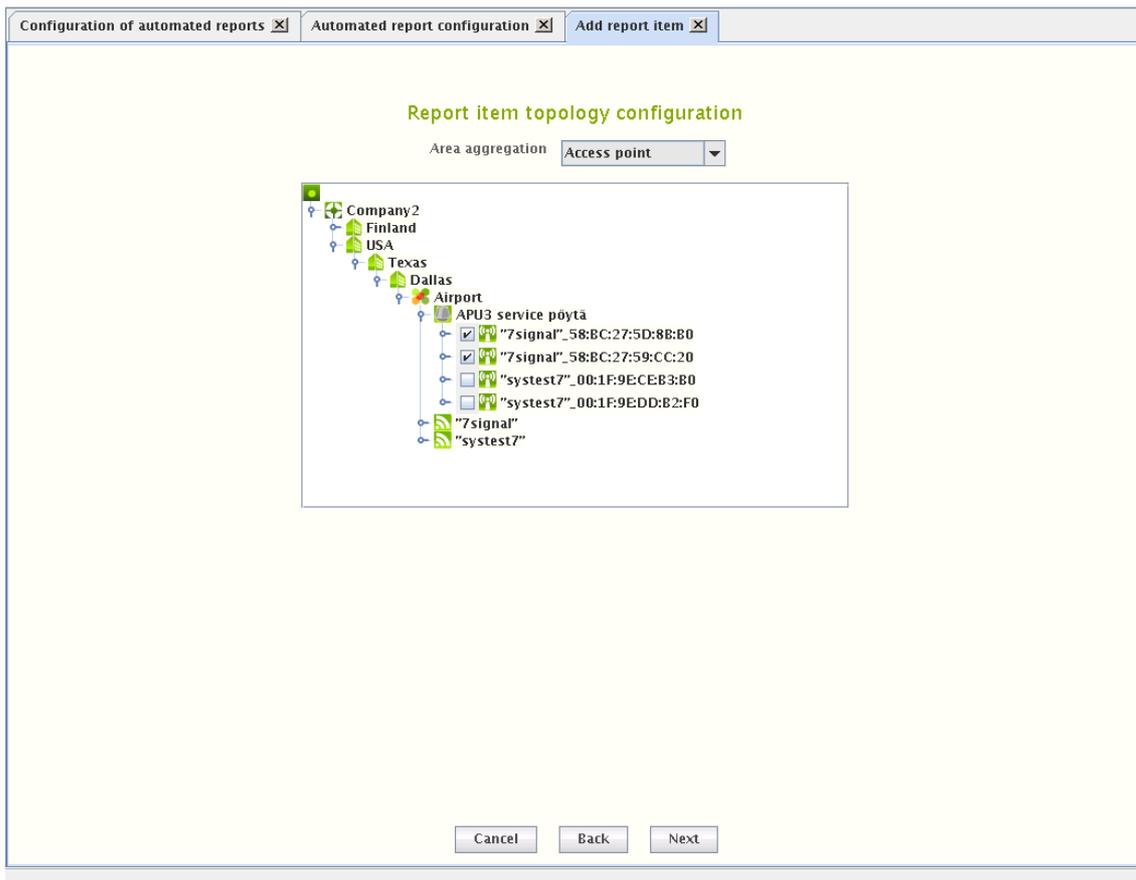
Description:

Cancel Back Next

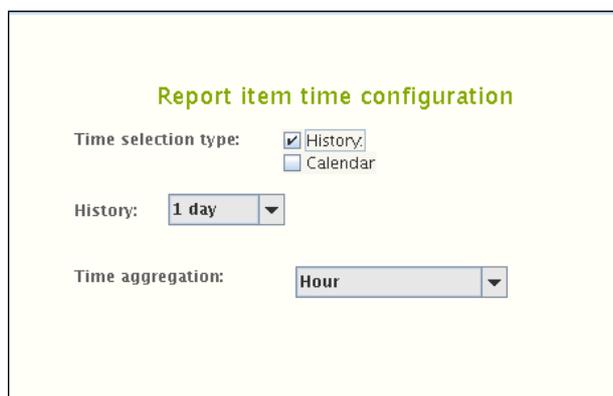
To add a report item:

1. Choose the content type
2. Give a name to the report item
  - a. a descriptive name is good especially if the item content groups together numerous pieces of information
3. Optionally write a description of the report item
4. Select “Next”

### 20.2.1 Adding SLA compliance report item



1. Select the method of aggregation in **Area aggregation**
2. From the hierarchical tree presented, select the corresponding elements depending on the selected area aggregation.
3. Click “Next” to continue to “Report item time configuration”

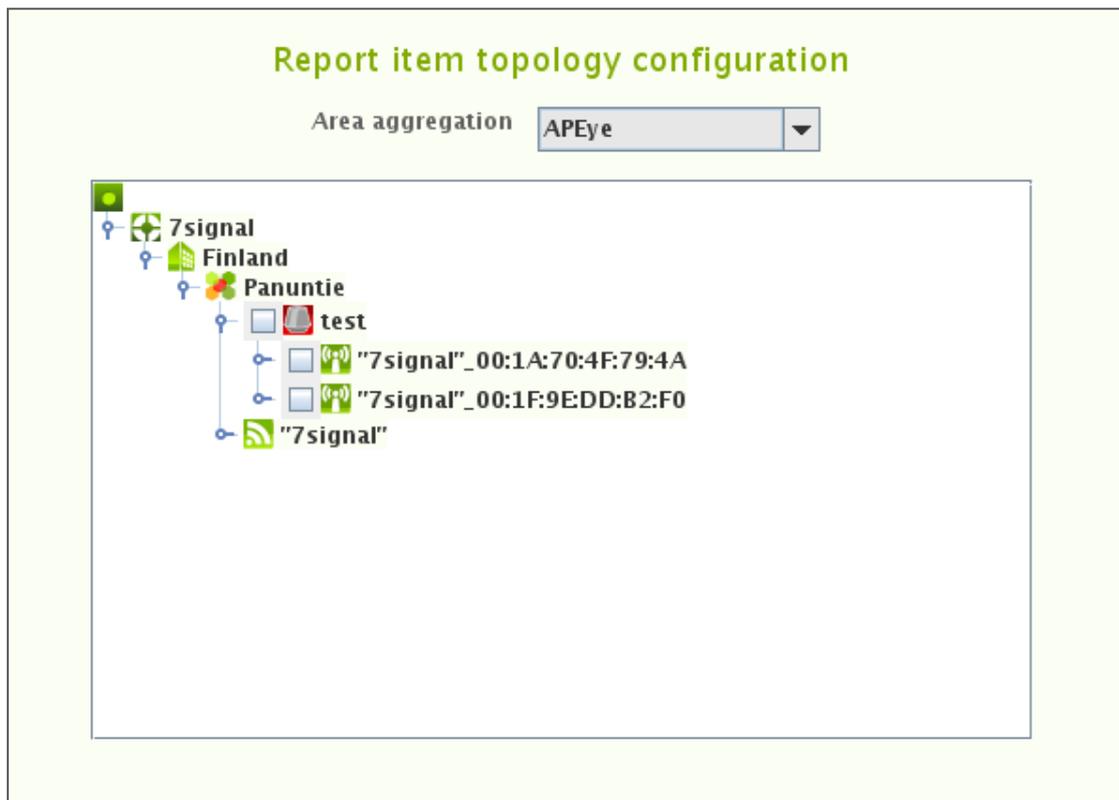


4. Select the time interval for the report
  - a. **History** uses pre-defined intervals from the generation time backwards
  - b. **Calendar** (in the picture above) allows free interval definition
5. Time aggregation defines the averaging period for the report item
6. Click “Finish” to return to first subscription page

## 20.2.2 Adding KPI report item

The screenshot shows the 'KPI report item configuration' dialog box. It features three tabs at the top: 'Configuration of automated reports', 'Automated report configuration', and 'Add report item'. The 'Add report item' tab is selected. The main content area is titled 'KPI report item configuration' and is divided into two panes: 'Selected KPIs' (currently empty) and 'Available KPIs' (containing a list of KPIs such as 'Radio attach success rate', 'IP address retrieval success rate', 'Radio attach time', 'IP address retrieval time', 'AP beacon availability', 'Radio IP connection availability', 'Number of available SSID-AP-pairs', 'Beacon availability in managed AP scan', and 'Access point beacon availability in global AP'). Below the panes, there are three dropdown menus: 'Chart type' (set to 'Line'), 'Chart content' (set to 'Single KPI chart'), and 'Presentation type' (set to 'Chart'). At the bottom of the dialog are three buttons: 'Cancel', 'Back', and 'Next'.

7. Select the desired KPI by left-clicking it in the right-hand pane
8. Right-click and select “Add KPI” in the submenu
9. Repeat steps 2–3 until all desired KPIs are in the left pane
10. Select the **Chart type**
11. Select the method for displaying the measurement series in **Chart content**
12. Select the display method
  - a. Data **Table**, Aggregation **Chart**
13. Click “Next” to continue to “Report item topology configuration”



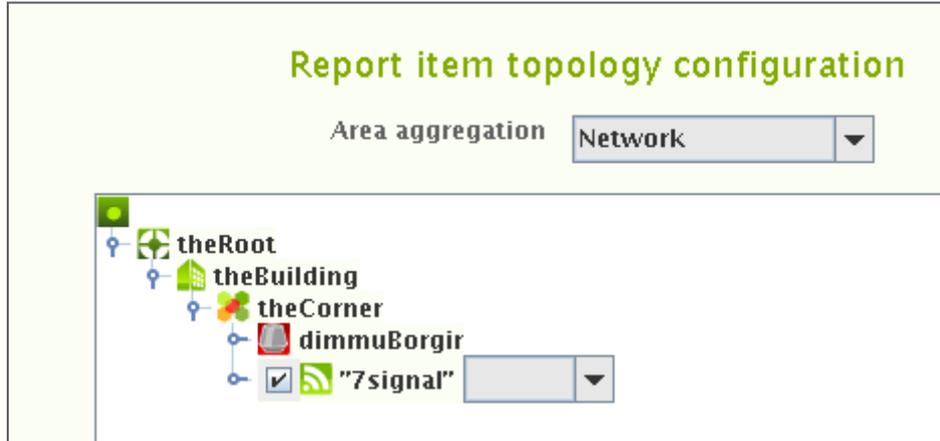
14. Select the method of aggregation in **Area aggregation**
15. From the hierarchical tree presented, select the corresponding elements depending on the selected area aggregation.
16. Click "Next" to continue to "Report item time configuration"



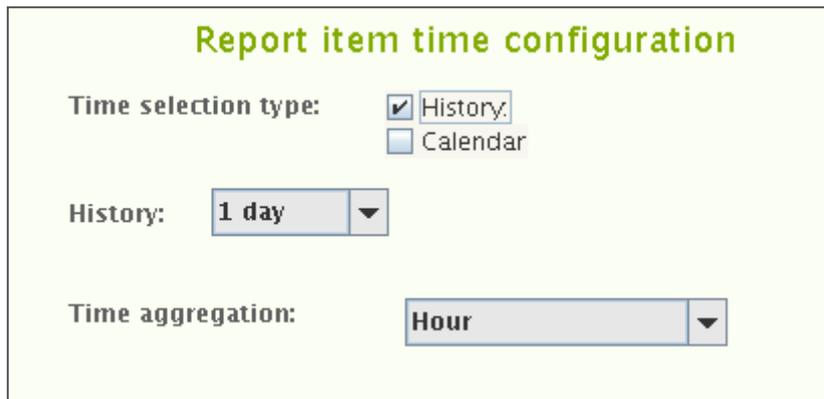
17. Select the time interval for the report
  - a. **History** uses pre-defined intervals from the generation time backwards
  - b. **Calendar** (in the picture above) allows free interval definition
18. Time aggregation defines the averaging period for the report item
19. Click "Finish" to return to first subscription page

### 20.2.3 Adding SLA report item

1. Choose the appropriate aggregation in the drop-down box.

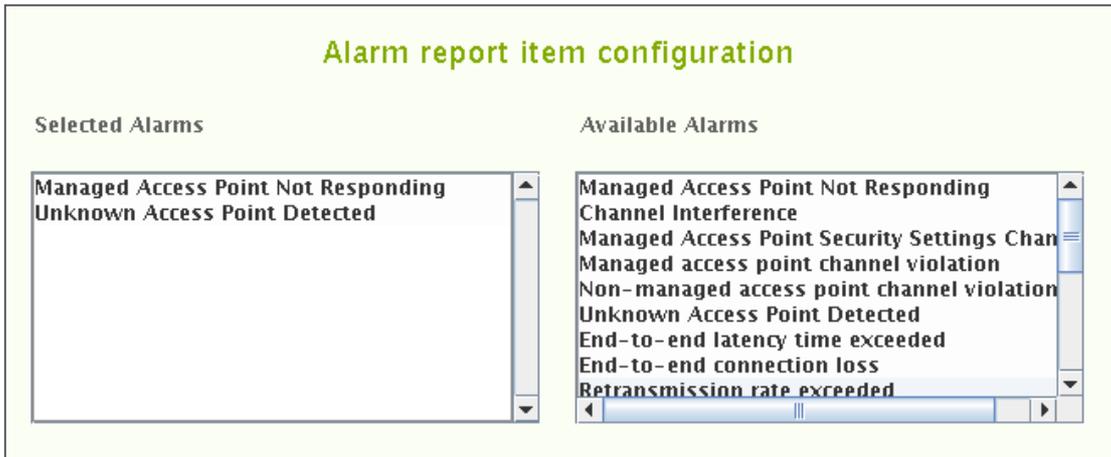


2. Select the elements in the topology tree
3. Select the SLA group to be applied. Available SLA groups are in a drop-down menu on the right of the topology element name.
4. Repeat steps 2-3 until all desired elements are bound to SLA groups.
5. Click "Next" to continue to "Report item time configuration"



6. Select the time interval for the report
  - a. **History** (in the picture above) uses pre-defined intervals from the generation time backwards
  - b. **Calendar** allows free interval definition
7. Time aggregation defines the averaging period for the report item
8. Click "Finish" to return to first subscription page

## 20.2.4 Adding alarm report item

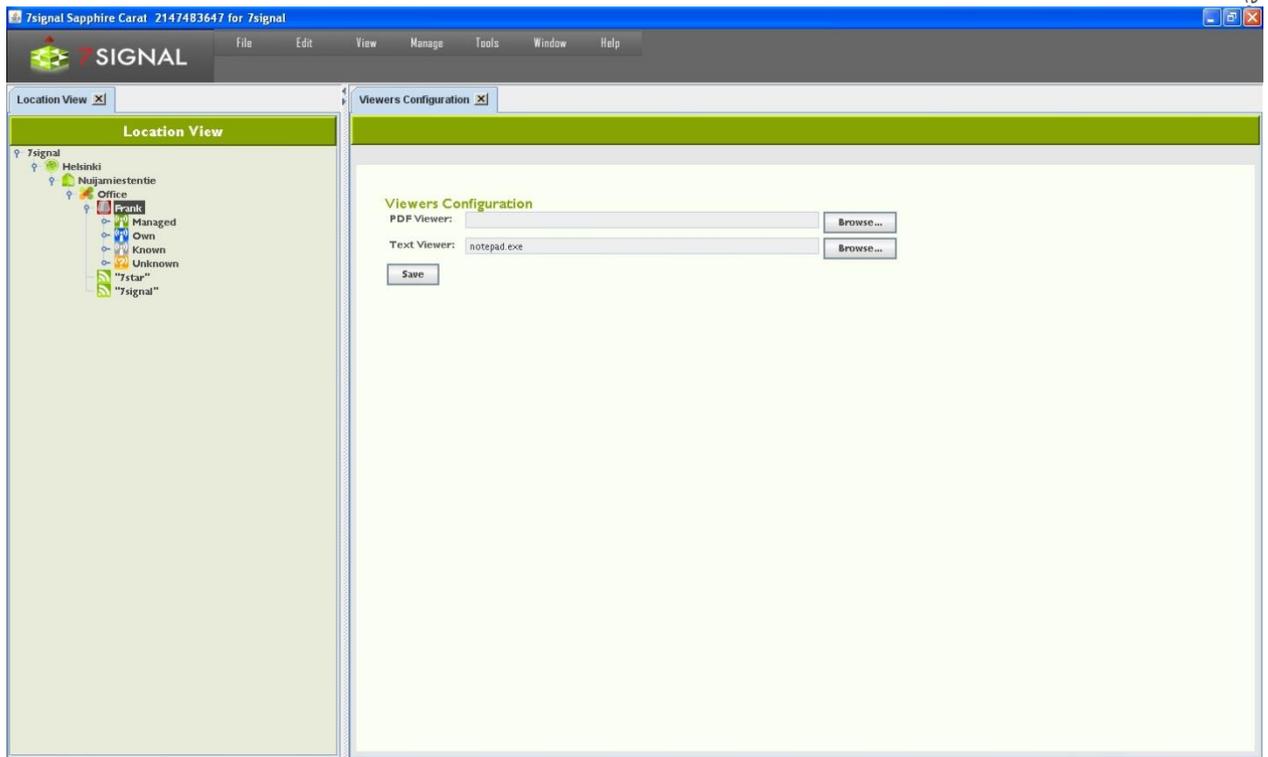


1. Select the desired alarm by left-clicking it in the right-hand pane
2. Right-click the alarm and select "Add alarm" in the submenu
  - a. One may remind oneself about the alarm by selecting "Description"
3. Repeat steps 2–3 until all of the desired alarms are in the left pane
4. Select "Next" to continue to "Report item topology configuration"
5. Select the method of aggregation in **Area aggregation**
6. From the hierarchical tree presented, select the access points or networks to be included in the report by ticking the check-boxes
7. Select "Next" to continue to "Report item time configuration"
8. Select the time interval for the report
  - a. **History** uses pre-defined intervals from the generation time backwards
  - b. **Calendar** allows free interval definition
9. Time aggregation defines the averaging period for the report item
10. Click finish to return

## 21 VIEWER SOFTWARE

Test result information and other results can be transferred outside Carat in spreadsheet format and as raw or delimited text and pdfs. You can select the applications you want to use to process these files in Carat.

1. From the top menu bar, select “Edit | Configure viewers”
2. The installed applications are displayed on the right
3. To change the applications, click “Browse”
4. Locate the application in the Carat server file system and select “Open”
5. Click “Save”

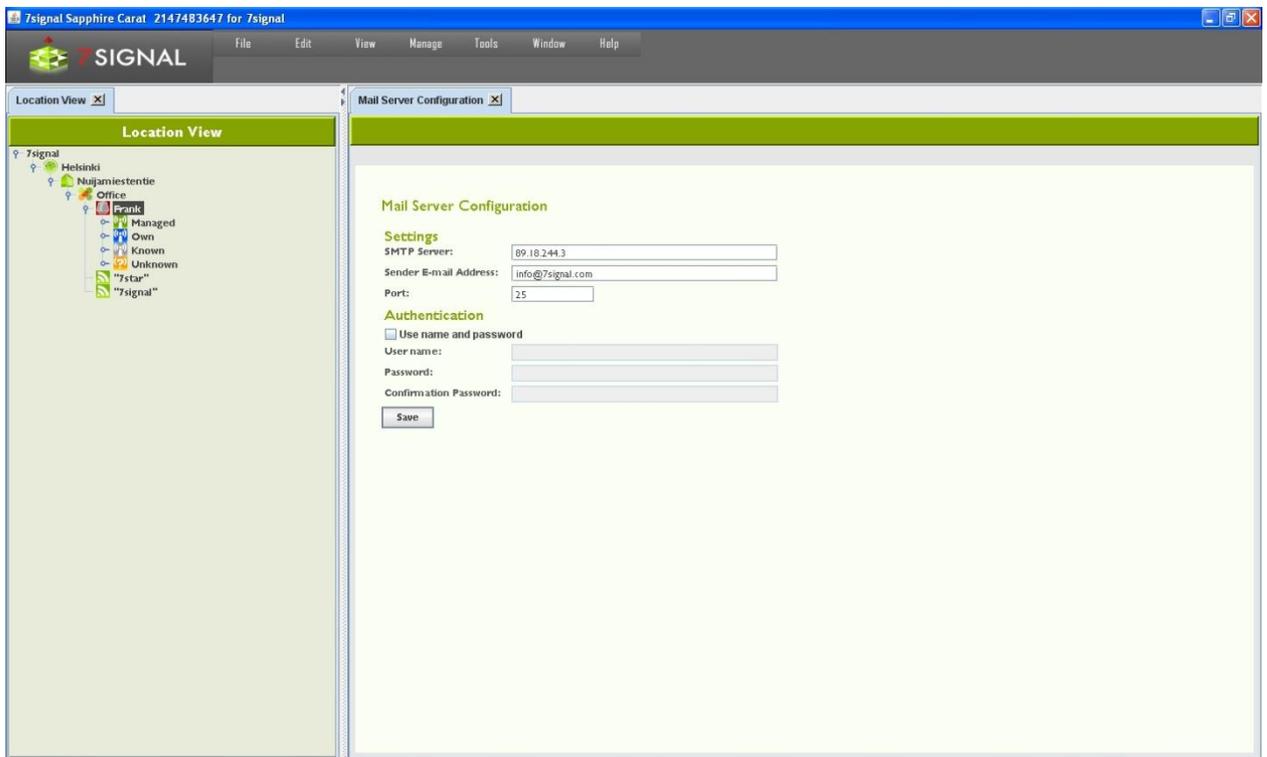


## 22 EMAIL SERVERS

When one configures an email server (icon ) , one can send reports and alarms to email addresses. This setting is only for the SMTP server, the email account information is given in each of the features using the SMTP server.

There should be only one SMTP per organization. Solution Administrator has visibility to all SMTP servers but local Administrators and Configurators may add only one SMTP server.

1. From the top menu bar, select “Edit | Mail server configuration”
2. Enter the SMTP server’s address
3. Enter the recipient’s e-mail address
4. Enter the SMTP port to use
5. Enter a username and password, if required by the SMTP server
6. Click “Save”



## 23 DATABASE BACKUP

It is possible to backup databases in 7signal Sapphire. Given a proper backup, the system state may be recovered completely in case of system crash. There are two remarkably different alternatives and an option not to backup the database. The default in 7signal Sapphire is no backup. While this option is known to be non-optimal for any production environment, it is chosen as default to force every organization to define their own backup policy.

### 23.1 Backup options

The backup process will use /tmp directory by default and take a lot of disk space. The directory can be changed with 7db-utility.

Example:

```
# 7db backup workdir set /largefilesys
```

#### 23.1.1 Automated backup with server downtime

Backup with downtime is a circadian backup based on Unix cron that pauses the measurements by stopping the Carat server and closing the underlying database connections. In quiescent mode a full backup of the database is made and stored to the desired location in the Carat server file system. The user is responsible for managing the backup files, moving and purging and so on. This type of logging is later referred as offline backup.

Example:

```
# 7db backup set daily 03:00 /mnt/backups
```

#### 23.1.2 Automated backup without server downtime

Online backup is a circadian backup based on Unix cron that keeps 7signal Sapphire in production while creating the backups.

Database logging method should be archival logging.

Example:

```
# 7db backup set daily 03:00 /mnt/backups
```

#### 23.1.3 Manual backup

##### Circular logging

Sapphire processes will be stopped during backup process and automatically restarted after backup has been created.

Example:

```
# 7db backup now /mnt/backups offline
```

### Archival logging

Sapphire processes will not be stopped during backup process.

Example:

```
# 7db backup now /mnt/backups online
```

## 23.2 Database logging

In short, the logs of a database system are the most precious. It is justified to say that the logs are the database as they are written first and the tables are updated after that.

IBM DB2 provides alternative logging methods that affect the backup options. So called 'circular logging' method keeps the size of the logs very predictable. The other option used in 7signal Sapphire is so called 'infinite archive logging'. This is very flexible a logging method provided that there is a special file system available. Practically the file system must not fill up ever.

The default logging method in 7signal Sapphire is 'circular logging'.

### 23.2.1 Purging database logs

#### Circular logging

There is no need for purging in case of circular logging. The default logging method in 7signal Sapphire is 'circular logging'.

#### Infinite archice logging

There is one secure way of purging the log files in the infinite archive directory. Offline backup has to be done and this comes with price of the 7signal Sapphire halt. Offline backup provides one single and unique point-in-time to be restored later. Once the offline backup exists, the log files in the infinite archive directory become obsolete and may be removed.

The other option comes with no warranty whatsoever. The option is to keep 7signal Sapphire running and to delete log files in the infinite archive directory. To understand what files are likely to be unused, the active log files has to be followed to see the time to fill up a single log file and then deduce what infinite archive files might be available for deleting . If one chooses this option, setting the safety margins reasonably high is advisable.

In case there is both a system crash and a log file has been deleted too early, the recovery shall never be able to finish. In this case, the only consistent system stage is available at offline backup time.

The automated reporting lessens the impact of possible data loss if used in detail and frequently. However, possibility to measurement drill-in analysis is lost as well as any change in the network topology and other management information.

The infinite archival logging is provided in order to support online backups (see below) but it should also be seen as a method to make system run longer automatically without user interruption. However, the system has to be maintained and administered. It is outside of the scope of this document to fit 7signal Sapphire to IT processes of all organizations but offline backups with planned system halts are highly recommended.

## 23.3 Backup method options

### 23.3.1 Default state (not recommended)

Essentially the 7signal Sapphire system default state is not a backup system at all but it is based on the underlying database management system's robustness, fault tolerance and basic level recovery options. In case of a permanent disk failure the data is lost. By installing the databases on RAID disks lessens the risk further.

On default state the 7signal Sapphire relies on the database management system (IBM DB2) logging. The assumptions are that the management information (Eye, access point and target network) changes are not continuous but rather sporadic. The measurements are continuous but losing few of the most recent samples is a risk that can be tolerated. Typical starting point for analysis is one week of measurements and in case of sudden system down one would lose the data until the system is fixed. And in case of system down it is expected that all the efforts shall be there to bring 7signal Sapphire and other systems online again. There shall be no special snapshots where to start operations again. It is possible to resume a state before the interrupt, possibly the system is operational with no special effort at all.

Offline backups are possible but require user actions both to shutdown 7signal Sapphire and do the actual backup.

Handicaps of the default method:

- no precise and secure backup (system state) to return to by default
- backup process is completely manual
- backup process requires downtime

Method strengths:

- least planning
- least resource consuming

### 23.3.2 First degree of backup: offline backup

Most importantly this method gives fully recoverable snapshots at the desired intervals. The disk space requirement is an issue but not extremely serious as the frequency is totally user-managed and the file size growth is easy to check (with the tools provided by the operating system, not by 7signal). The downside is the downtime as the 7signal Sapphire must be halted for the time of the backup, hence it is called offline backup. Typically this would be rather minutes than tens of minutes. Naturally all the measurements are stopped for that time.

Offline backup 1st degree is available in every install and run scenario of 7signal Sapphire. One can start offline backup with a tool or have it run by the system in a circadian manner.

Method handicaps:

- backup process requires downtime

Method strengths:

- simple to recover
- recovered system state is thoroughly consistent

**TIP:** offline backup is suitable for environments that require automated backup but do not have special backup policy hardware nor other extensive resources.

### 23.3.3 2nd degree of backup: online backup

The requirement for the online backup is that infinite archive logging is enabled.

When online backup is operational, the most significant benefit is the ability to run circadian backups online i.e. 7signal Sapphire remains operational and continues testing while creating the backup. As opposed to offline backup, the system is online all the time producing measurements.

The first and the most important assumption is that there is a storage device available that in practice is a so-called endless device. 7signal cannot and shall not guarantee any checks on the device but it is assumed to be available all the time and have the capacity for massive data transfers. The user is responsible for the storage capacity.

**NOTE:** backups are not done incrementally in any case. This means that over time the needed to dump the database increases but more importantly the disk space requirement increases continuously.

**NOTE:** use of backup systems require planning and administration i.e continuous effort from the administrator. This area is outside of 7signal scope, 7signal encourages clear planning on the issue.

During installation there shall be various destination folders inquired by the install script. The folders are for logs, for backup files etc. As complex as online backup may sound, the setting of the online backup is easy. To maintain and keep it available and functional requires IT support that is beyond the scope of 7signal guidance.

Behind the scenes the technology relies completely on IBM DB2 backup system and 7signal provides interface that covers and automates IBM interface to support 7signal databases.

**TIP:** there are environments that require separate hardware for backups. If possible, 7signal Sapphire should be integrated (on file system level) to these.

TIP: with frequent and detailed automated reports the loss of measurement data becomes less drastic as the needed information may be found in the reports.

### 23.3.4 Changing log settings

Install time gives the option to set all the backup related settings including log setup.

To change the settings while the system is installed and in production later, please use the tool **7db** and the **logsetup** sub-command. Complete guide to 7db tool is in the appendix of Deployment Guide.

### 23.3.5 Managing backup levels

By default the system is in default state, no automated backups at all. Any change to that state would require more resources and administration that should be planned separately.

In case one has changed the default settings – either by giving such install parameters or issuing the needed commands after the installation - the following operations return the initial state:

- 1) stop circadian backups
- 2) set logging to circular mode

This implies that the default state means circular logging without circadian backups.

### 23.3.6 File system settings for the database

There are three elements that require – optimally separate – disk space:

1. databases
  - a. measurement database
  - b. management database
  - c. security database
2. database logs
3. database backups

Naturally the backups must be stored separately from the logs and the databases, otherwise the value of the backups reduces significantly. The databases and the related logs are expected to be accessible easily from the hosting server but it is encouraged to use separate physical file systems for these two.

NOTE: log files and databases residing in the same physical disk mean duplicate disk operation efforts on the same device. It is good design to separate logs and actual databases to different physical storage devices.

### 23.3.7 Changing backup settings

Install time gives the option to set all the backup related settings.

To change the settings while the system is installed and in production later, please use the tool **7db** and the **backup** sub-command. Complete guide to 7db tool is in the appendix of Deployment Guide.

Below there are example commands to give the reader an overview:

```
# 7db backup remove
# 7db backup set weekly Wed 00:30 /mnt/backups /mnt/backups
# 7db backup set daily 03:00 /mnt/backups
# 7db backup set directory /mnt/newbackups
# 7db backup set weekly Sun 01:30
# 7db backup set type online
# 7db backup now /mnt/backups online
```

## 23.4 Restoring backups

Backups are located in the user-defined directory. Backup files contain timestamp in the name, also the operating system timestamp exists.

**NOTE:** the user must be aware which backup file should be used. Therefore it is essential to understand the backup system and the related files.

Based on this information one must choose which backup to restore.

Restore command is

```
# 7db backup restore <absolute-file-path>
```

**NOTE:** while issuing restore command when using online backup, it might be necessary for the system to retrieve files from the infinite archive directory when the restore command is issued. The access time is affected by the physical device. If the system cannot access the files, restore shall not happen. The most recent offline backup is the alternative point of recovery.

## 24 NAGIOS SUPPORT

7signal Sapphire supports Nagios, a commonplace open license tool for IT infrastructure monitoring.

In this case Sapphire is the object of monitoring, not the monitor itself. Therefore we assume the general concepts and usage of Nagios to be well-known to the user. If this is not the case, one may start exploring the topic from the Nagios web pages (<http://www.nagios.org>). Also, a recent Nagios release package is included in the delivery media of the 7signal Solution in Sonar disk and the folder named "Non-7signal Software"

### 24.1 Adding Sapphire Host Information To Nagios Server

The prerequisite is that Nagios is installed and running on the host machine. In order to monitor a remote Carat server do the following steps (as a root user):

1. Modify `commands.cfg` file (default location: `/etc/nagios/object/commands.cfg`)  
Add:

```
define command {
    command_name check_nrpe
    command_line $USER1$/check_nrpe -H $HOSTADDRESS$ -c $ARG1$
}
```

2. Create configuration file for remote machine running the Carat server to Nagios objects directory (default location: `/etc/nagios/objects`)

File extension is `cfg`, otherwise the naming is free. You may use or modify the following:

```
carat-host-xyz.cfg
7signal_wqa_carat_1.cfg etc.
```

Content of the file:

```
define host {
    use linux-server
    host_name <host-name-of-the-monitored-server>
    alias <alias-of-the-monitored-server>
    address <IP address of the monitored server>
}
define service {
    use local-service
    host_name <host-name-of-the-monitored-server>
    service_description 7signal Sapphire Carat
    check_command check_nrpe!check_carat_server
}
```

3. Add host configuration file (the previous step) to `nagios.cfg` file (default location: `/etc/nagios/nagios.cfg`):

```
cfg_file=/etc/nagios/objects/carat-host-xyz.cfg
```

4. Restart Nagios server  
`service nagios restart`

## 24.2 Adding Nagios Plug-ins To Sapphire Software

The prerequisite is that client-side tools of Nagios have been installed on the host running 7signal Sapphire software. The protocol being used is NRPE. There is no SSH support concurrently.

### 24.2.1 Install NRPE daemon

Use online install with yum:

```
# yum install nrpe
```

### 24.2.2 Install toolset 'Nagios plugins'

Use online install with yum:

```
# yum install nagios-plugins-nrpe
```

**NOTE:** the following installers shall open port tcp/5666 for Nagios traffic in the firewall settings. Install Sapphire plugin

There folders named Nagios\_support on both Carat and Sonar delivery disks. They contain the following files

```
7signal-Nagios-plugin-<version-info>-for-Carat-installer.bin
7signal-Nagios-plugin-<version-info>-for-Loupe-installer.bin
7signal-Nagios-plugin-<version-info>-for-Sonar-installer.bin
```

The files are executable and totally self-contained. By running each of the file makes the respective Sapphire Nagios plugin available. The process includes configuration file creation, updates and firewall settings.

Silent install mode (option -s) uses 7signal defaults for all parameters. If this option is not used, all parameters are inquired interactively with the default setting visible.

By default, the plugin installations end up in `/opt/7signal/nagios` folder. However, the installation makes the plugins available and after this the process and operations are completely transparent to the Carat user.

## 24.3 Verifying Nagios Installation

Complete and operational install is achieved if Nagios GUI shows

```
check_carat_server
check_sonar_server
check_loupe_server
```

as options for monitoring for the hosts running 7signal Sapphire software.

## 24.4 Removing Nagios plugins

The installation directory contains `uninstall_nagios.sh` that removes Sapphire related plugin files. The NRPE daemon stays untouched and its configuration is cleaned only for Sapphire plugins thus NRPE and other Nagios operations remain untouched.