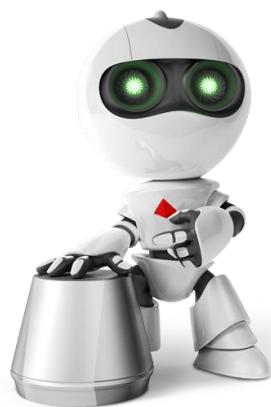


7signal Sapphire

Carat User Guide



Administrativia

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.

NOTE TO THE USER

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

Table of Contents

THE 7signal Sapphire WQA SOLUTION.....	7
<i>System overview.....</i>	<i>8</i>
<i>System components.....</i>	<i>8</i>
SAPPHIRE EYE.....	9
SAPPHIRE CARAT	11
SONAR.....	12
SAPPHIRE LOUPE	13
CARAT MANAGEMENT INTERFACE.....	14
<i>Menus.....</i>	<i>14</i>
ON CONFIGURING OF 7SIGNAL SAPPHIRE CARAT	17
<i>Automated Tests.....</i>	<i>17</i>
<i>Access Rights.....</i>	<i>18</i>
USER MANAGEMENT.....	19
<i>User groups and object permissions.....</i>	<i>19</i>
<i>User group hierarchy.....</i>	<i>19</i>
<i>User access levels.....</i>	<i>20</i>
<i>User group and user management.....</i>	<i>20</i>
<i>User groups.....</i>	<i>20</i>
<i>Users.....</i>	<i>22</i>
WIRELESS NETWORKS AND TARGET NETWORKS.....	25
<i>Addition of networks to be monitored.....</i>	<i>25</i>
<i>Addition of a network location.....</i>	<i>25</i>
<i>Hidden networks.....</i>	<i>26</i>
<i>Removal of a network.....</i>	<i>27</i>
SETTING UP A MONITORING STATION	30
<i>States of Monitoring Stations.....</i>	<i>30</i>
<i>Adding a monitoring station.....</i>	<i>30</i>
<i>Monitoring station settings.....</i>	<i>31</i>
<i>Activation of monitoring station.....</i>	<i>32</i>
<i>Floor plan.....</i>	<i>32</i>
<i>Updates to a management station's software.....</i>	<i>33</i>

CREATION AND USE OF AN ENCRYPTION KEY.....	35
<i>On key types.....</i>	35
<i>On different methods and implementations.....</i>	35
<i>Adding a key.....</i>	36
<i>On certificate-based encryption.....</i>	37
ADDITION OF TEST END-POINT.....	39
<i>Sonar.....</i>	39
<i>Generic test counterparts.....</i>	39
ACCESS POINT INFORMATION	41
LINKS AND LINK GROUPS.....	42
<i>The formation of a link.....</i>	42
<i>Link removal.....</i>	42
<i>Creating a link group.....</i>	43
<i>Removing a link group.....</i>	43
<i>Adding a link to a link group.....</i>	43
<i>Removing a link from a link group.....</i>	43
ALARMS.....	44
<i>Creation of an alarm group.....</i>	44
<i>Binding of alarms to access points.....</i>	45
<i>Alarm messages.....</i>	45
<i>Alarm exporting.....</i>	46
TRAFFIC CLASSES	49
TEST MEASUREMENTS	50
<i>Test profiles.....</i>	50
<i>Contents of a test profile</i>	51
<i>Testing multiple wlan networks in one test profile.....</i>	53
<i>Operations on Templates</i>	53
<i>Operation on Test Element.....</i>	54
<i>Operations on Test Profile Node.....</i>	54
<i>Operations on Test Profile</i>	54
<i>Operations on essid inside a test profile</i>	55
<i>Operations on test profile element inside a test profile.....</i>	55
<i>On test elements.....</i>	56
<i>Modifying test parameters.....</i>	56

<i>Configuring complex test profiles.....</i>	56
<i>Running test profiles.....</i>	57
Passive tests	59
<i>Initial network scan.....</i>	59
<i>“Network Scan” test.....</i>	60
<i>“Client Scan” test.....</i>	61
<i>Spectrum analyzer.....</i>	65
Active Tests	66
<i>“Noise monitor” test.....</i>	66
<i>“Optimal Antenna Selection” test.....</i>	68
<i>Download Tests.....</i>	69
<i>Upload tests.....</i>	70
<i>“Ping test”.....</i>	71
<i>“Traceroute Test”.....</i>	73
<i>“Access point traffic” test</i>	74
<i>“Client Scan”.....</i>	75
<i>“MOS Test”.....</i>	76
<i>“Air Utilization Test”.....</i>	78
<i>“HTTP URL (Intranet) test”.....</i>	79
<i>“Internet Availability Test”.....</i>	80
<i>“SIP Register Test”.....</i>	81
REPORTING.....	83
SERVICE LEVEL AGREEMENT	84
<i>Defining a Service Level Agreement into the system.....</i>	84
<i>Binding SLA groups to network topology elements.....</i>	87
VIEWER SOFTWARE.....	89
EMAIL SERVERS.....	90
DATABASE BACKUP	91
<i>Backup options.....</i>	91
<i>Database logging.....</i>	91
<i>Purging database logs.....</i>	91
<i>Backup method options.....</i>	92
<i>Managing backup levels.....</i>	94
<i>Restoring backups.....</i>	95

NAGIOS SUPPORT	97
<i>Adding Sapphire Host Information To Nagios Server.....</i>	97
<i>Adding Nagios Plug-ins To Sapphire Software.....</i>	98
<i>Verifying Nagios Installation.....</i>	98
<i>Removing Nagios plugins.....</i>	99
CONTACT INFORMATION	100

THE 7signal Sapphire WQA SOLUTION

Welcome to 7signal Sapphire, providing you with 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 business application (Sapphire Loupe). Both tools can forward results either automatically or manually to designated persons in the company, or to third parties, such as technical support or other service provider.

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 impersonate a client device in the target network and then use the network and the services provided through it. By comparing measurement results to a previously saved acceptable environment, the solution can detect interfering transmitters, access points and clients behaving in undesirable ways, and other applications using unregulated frequency bands that can potentially affect network functionality. Among these applications might be motion detectors, microwave ovens, Bluetooth devices, powerful electric motors, radiation devices used for decontamination, and baby monitors. 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.

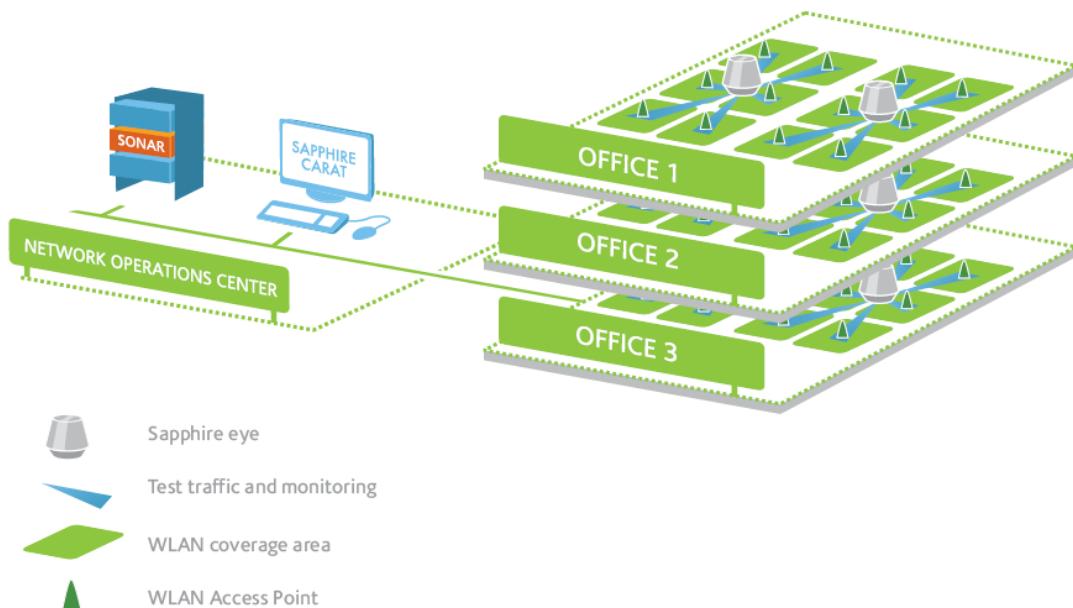
In user emulation tests, also known as active tests, Eye connects to the test server (Sonar) over the wireless network and uses it like an ordinary production service. The use may include mass file transfers, browser downloads, wireless VoIP calls, or connections to another production server. Simply put, 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 in location 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.

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.



System components

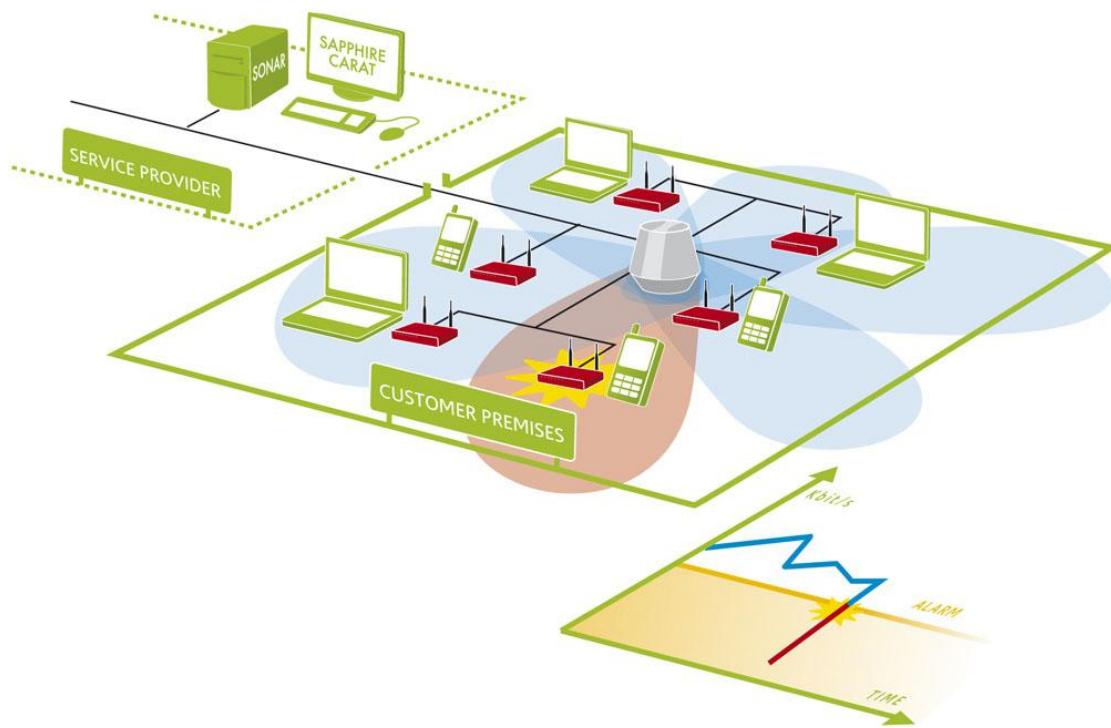
The system components are described in chapters 2–6. The remaining chapters describe the management software. The result viewing and reporting tool (Loupe) is described in its own user guide.

SAPPHIRE EYE

Sapphire Eye is a monitoring station for WLAN environments, serving as the measurement station or monitoring station in the WQA solution. 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 recommended number of monitored cells is 6–10. 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 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 like a user or other 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.



In the picture above

- the 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)

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 contain tables and charts, and they can therefore be immediately used at the customer company, or by third parties such as technical support staff, managers, or service providers.

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

SONAR

The role of the Sonar test server in 7signal Sapphire is to emulate one of the customer's production servers. Sapphire Eye contacts Sonar over the radio network to use some of the services available or to request Sonar to contact Eye, if so specified in the service model. Sonar and Eye thus implement the client–server model during active testing. The roles vary, depending on the test. This symmetry of roles ensures that both directions (uplink and downlink, or A subscriber in phone calls) can be measured. The Eye system's test results are always sent to the management tool Carat, either by Eye itself or by Sonar.

A single Sonar can serve several monitoring stations without being affected by the monitoring station's home network. One Sonar can therefore be used as the test point for several networks.

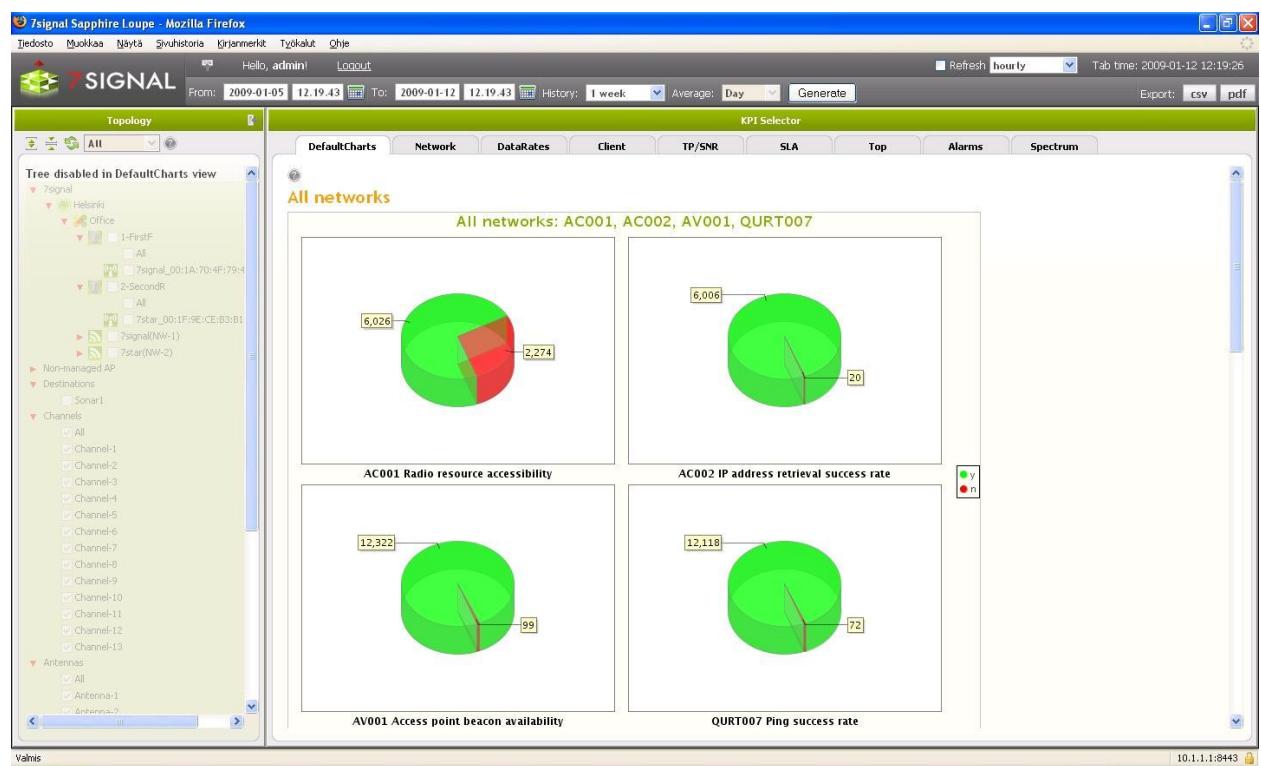
The 7signal Sapphire WQA solution supports the concurrent use of several Sonar test servers, which means that Sonar can be installed on several servers within a company. Using several Sonars enables the company to detect and locate problems in its network. Sonar can be located in the same network as 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.

SAPPHIRE LOUPE

Sapphire Loupe is the measurement tracking tool in the WQA solution. Using Loupe, the persons responsible for business and network can view the saved measurement results, which are obtained in real time. Loupe cannot be used to control Sapphire's functions and measurements themselves; however, the measurement results are available in Loupe in a more precise and detailed form than in Sapphire. Setting access rights for viewing the results is easy with the user management feature.

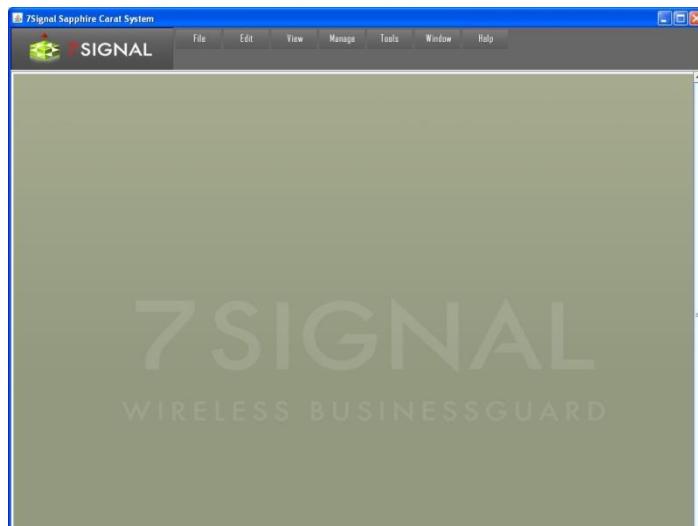
Loupe makes the network's key performance indicators (KPIs) available at a glance, or in more detailed form for a given time period. Loupe is browser-based, so authorized persons can use any of the most common browsers to view the results as long as they have an Internet connection. The result summaries 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.

Loupe is a separate application with its own user guide.



CARAT MANAGEMENT INTERFACE

The management interface home page looks like this:



Menus

Navigation

The menus at the top of the home page function in the same way as in any graphical user interface. The menu bar is used to manage the application, automatic testing and testing profiles, and functions related to the settings of networks being monitored.

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: - alarms - user management - access keys to radio networks - test end point settings - administration of target network client information - settings for automatic reporting	Alarm configuration Users and groups Access Control Network Keys Test end points Alarms Email SNMP

	- remote management of monitoring station software	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

Network topology

The Network topology is a hierarchical tree displaying the monitoring stations and the monitored access points that constitute a network. 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.

Menu	Description	Submenus
Organization	In the Organization menu, you can add 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
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.	Edit Add Eye Bind wireless network Remove service area Allowed channels Floor plan

	A service area can have a floor plan.	
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
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 to configure the encryption method used in the network.	Add key Edit Unbind wireless network Allowed channels
Access Point	In this menu, you can perform tests and set alarm limits for an access point.	Access point info Active tests Bind to alarm limit group Unbind to alarm limit group Remove access point

ON CONFIGURING OF 7SIGNAL SAPPHIRE CARAT

This user manual is mainly intended for ‘random access’ i.e. there is no strict order how to read the manual. However, this section should be read first as its purpose is to ensure proper and scalable operations on the system.

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. This 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.

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 (so called local Administrators) that in turn should not do much more than create a set of configurators, at least one and as many as deemed necessary.

The recommended minimum setup for an operational 7signal Sapphire is

Users and Groups

- Solution Administrator Group (default initial user)
 - Solution Administrator (default initial user)
- NewAdminGroupForOrganizationX (created by Solution Administrator)
 - LocalAdministrator1 (created by Solution Administrator)
 - NewConfGroup (created by LocalAdministrator1)
 - LocalConfigurator1 (created by LocalAdministrator1)

Now, 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.

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, even here it is advised to use Configurator level users to manage automated testing locally.

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.

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 only belong to one user group at a time.

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 by him-/herself 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.

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.

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.

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 preconfigured 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 

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 right of the dialog.

User groups

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
---	--------------	---	-------------------	---	----------------

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)

Adding a user group

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 or "Add symbolic group" in cases 2 and 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"

Editing a user group

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

Removing a user group

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

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 re-activated 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
3. Right-click on the desired group and select "Inactivate" from the pop-up menu

Users

Related icons

Administrator user

	active		inactive
--	--------	--	----------

Configurator user

	active		inactive
--	--------	--	----------

Reporter user

	active		inactive
--	--------	--	----------

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.

Adding a user (new user)

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"

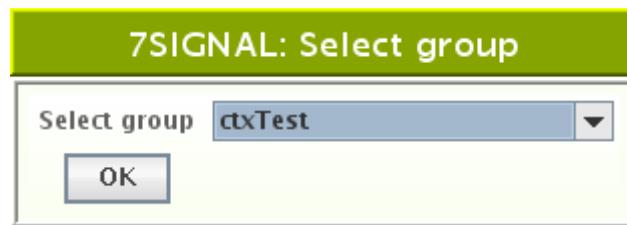
Adding a user (copy user)

An existing user maybe 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 copied user starts in the typical manner and after successful login adds a pop-up in order to make selection of the group used in the login. The possible other groups are invisible after the chosen group (or context) has been chosen.



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"

Removing a user

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

Changing a user's password

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

WIRELESS NETWORKS AND TARGET NETWORKS

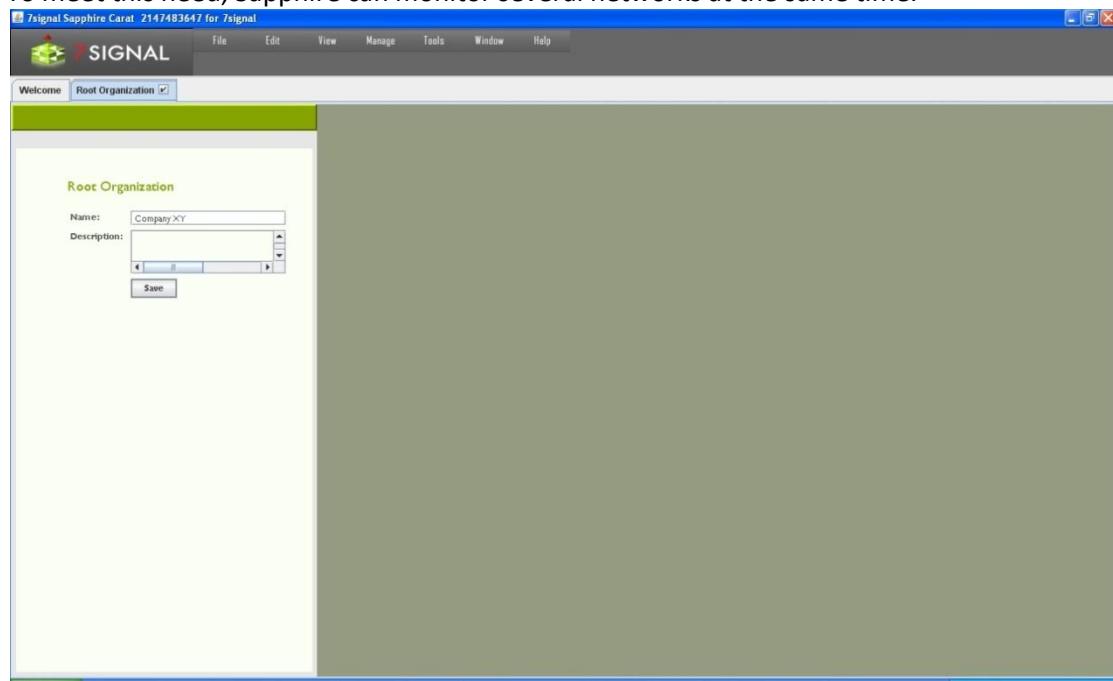
Addition of networks to be monitored

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, where the top node is a root organization that binds the various organizations conceptually together.

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

- Office network
- Warehouse network
- Visitor network

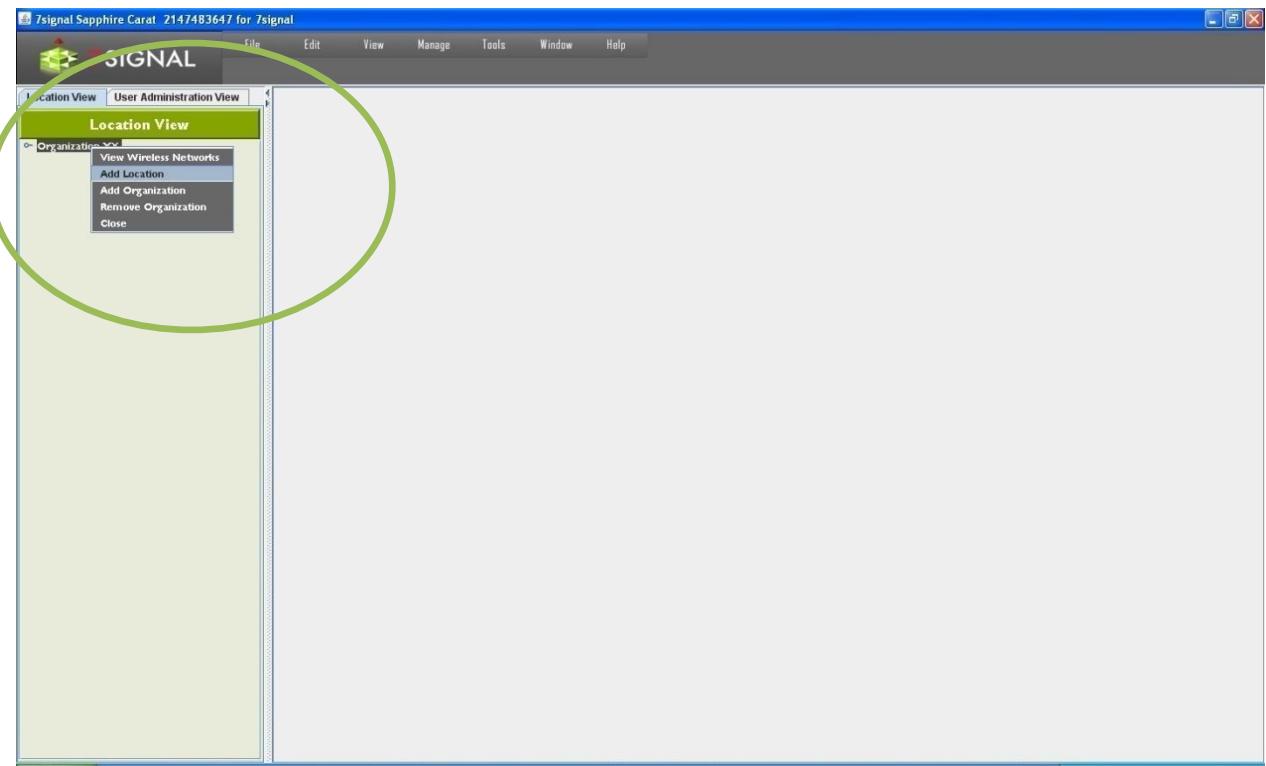
To meet this need, Sapphire can monitor several networks at the same time.



1. From the top menu bar, select “View | Root Organization”
2. Enter the root organization’s name
3. Save by clicking “Save”
4. The Network topology is automatically displayed after saving

Addition of a network location

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”

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 is very limited a security measure as limits only beacons sent by an access point but not the payload traffic. Any attacker or typical analysis tool shall 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.

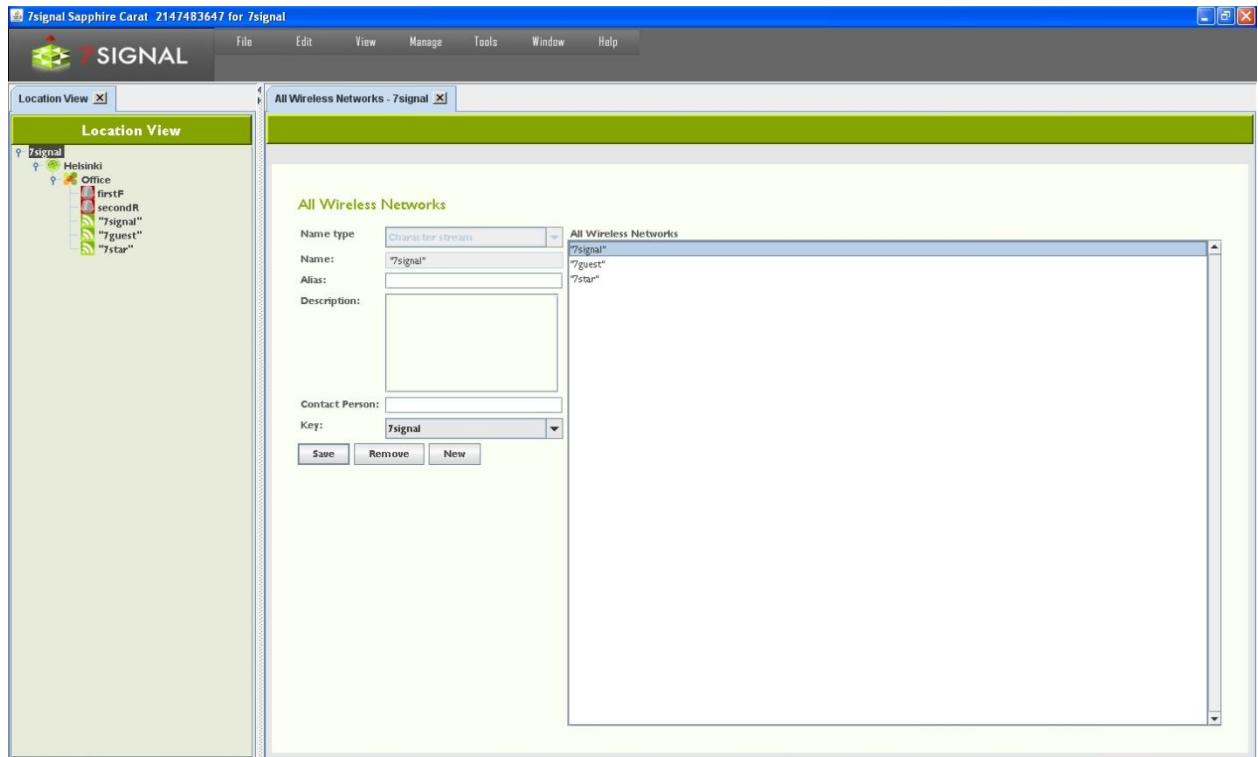
To add a hidden network to 7signal Sapphire follow the steps below.

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.

Removal of a network

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, right-click the network and select:

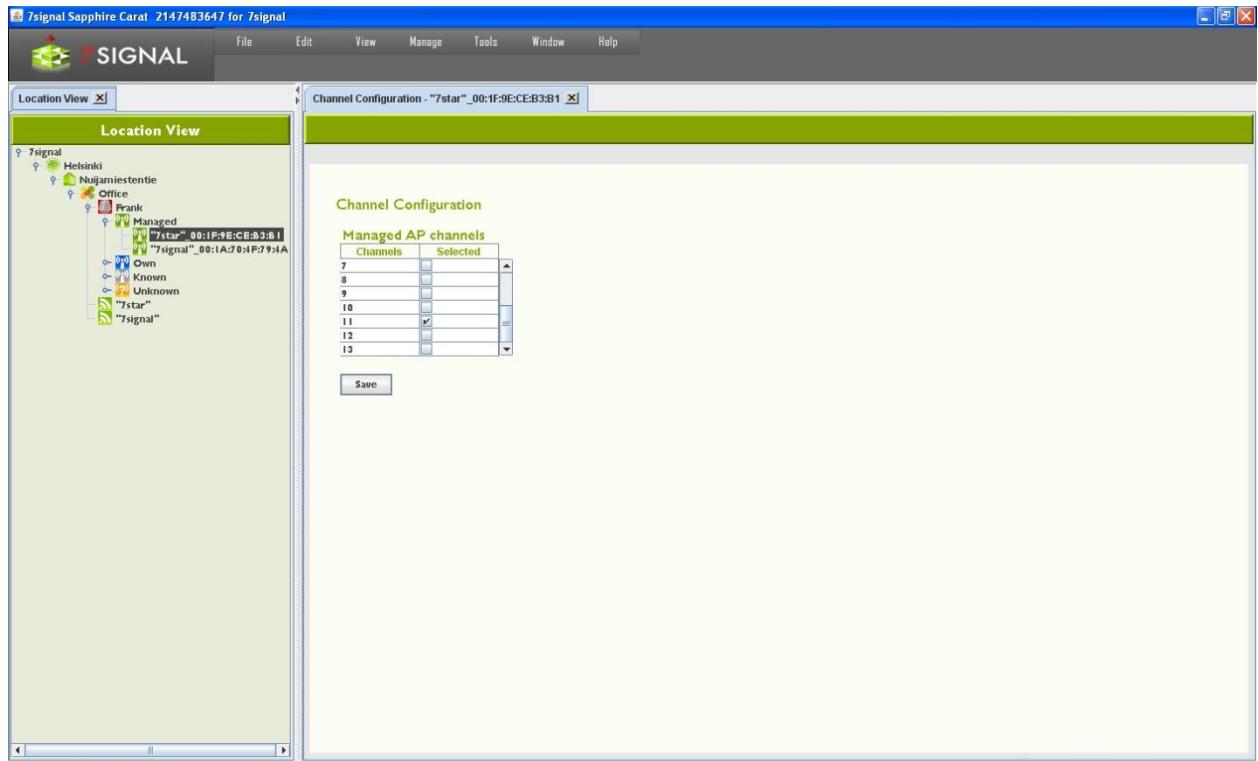


1. From the Network topology, select the organization containing the wireless network you wish to remove
2. Right-click the organization and select “View wireless network” – then the “All Wireless Networks” view is displayed in the right-hand pane
3. Select from the list the network you want to remove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

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 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.

SETTING UP A MONITORING STATION

Related icons

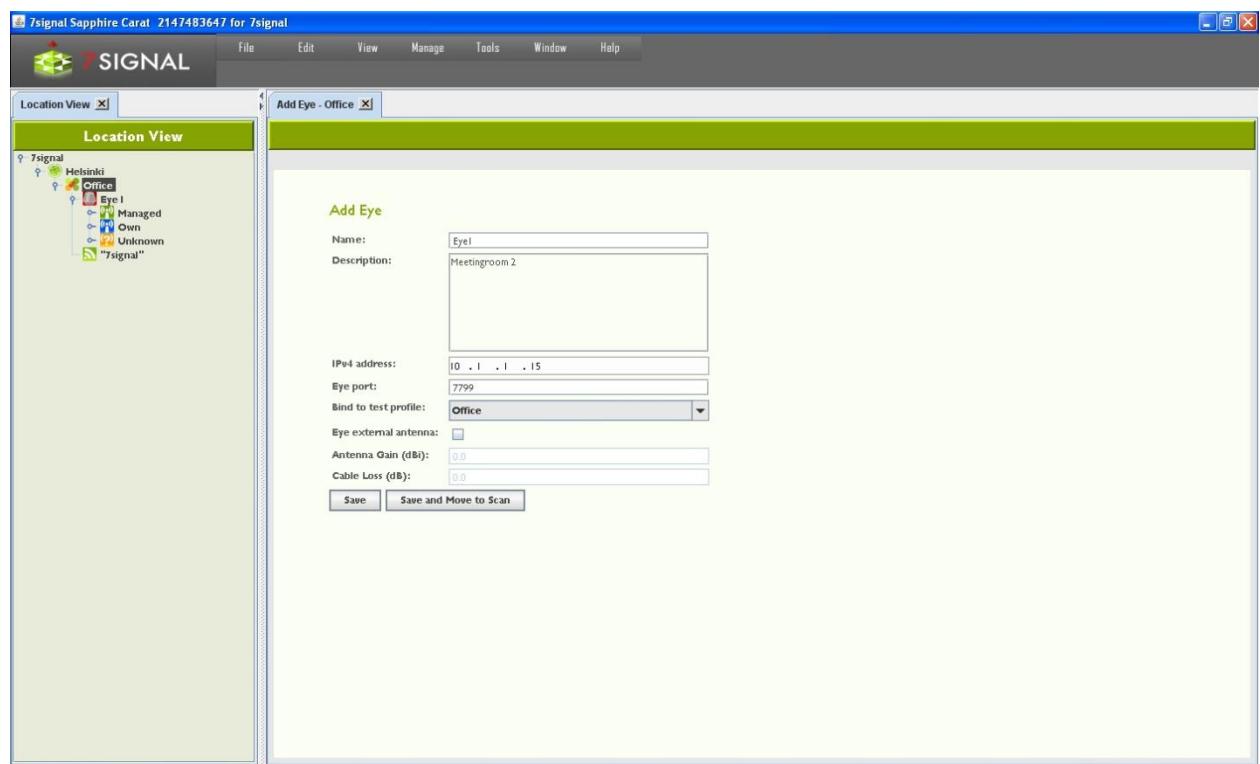
-  active monitoring station
-  inactive monitoring station

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.

Adding a monitoring station

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

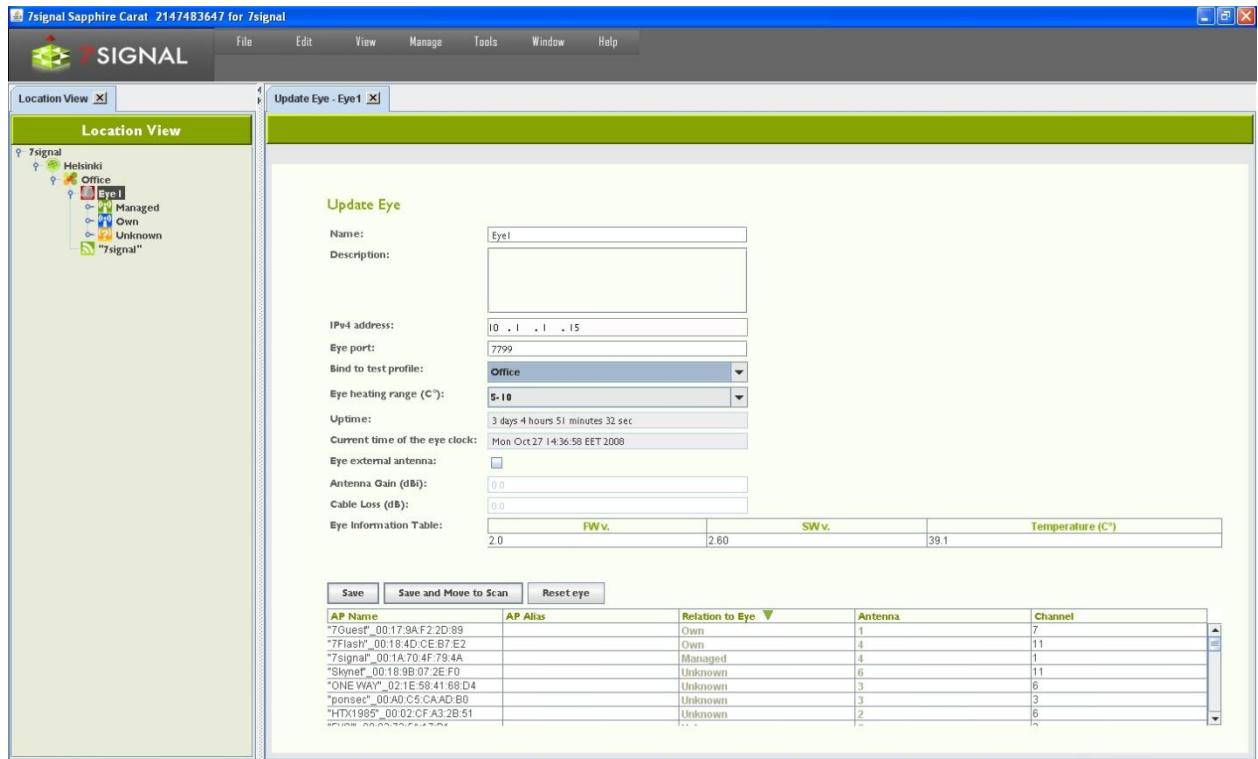


1. In the Network topology, select the service area where you want to set up a monitoring station (Eye)
2. Right-click the service area and select “Add Eye”
3. Enter a name for the Eye
4. Enter the Eye’s IP address
5. Enter a description for the Eye (optional)
 - a. for example, its location and mount 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 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 8th 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 places the added Eye in network scan mode

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



Activation of monitoring station

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. Naturally an activated monitoring station must have a scan to become operational again.

Floor plan

The floor plan helps you to manage networks and the physical location of devices. The floor plan accepts all formats supported by Java 2 SE.

To add a floor plan, proceed as follows:

1. From the top menu bar, select “View | Network topology” to display the management hierarchy in the right pane

2. Right-click the service area where you want to add a floor plan
3. In the menu that opens, select “Floor plan”
4. Right-click in the right pane and select “Load new floor plan image”
5. Browse to the floor plan file in the Carat server file system and select “Open”

To add devices to the floor plan, do the following:

1. Right-click on the floor plan and select “Eye” or “Access point” from the menu
2. Drag the selected icon to the appropriate position in the floor plan
 - a. *Note: Before an Eye can be added to a floor plan, it must be added to the Eye view*
3. Right-click the floor plan area and select “Save”

To view and edit a saved floor plan, select the service area from the Network topology and right-click “Floor Plan.” Right-clicking a floor plan displays a menu containing editing functions. *Note: To refresh the view, right-click the floor plan and select “Refresh.”*

Tests from the floor plan

You can run interactive tests for the monitoring stations also from the floor plan.

1. Right-click a monitoring station in the floor plan and select “Active Tests”
2. Select the test you want to run
3. A test window opens on top of the floor plan

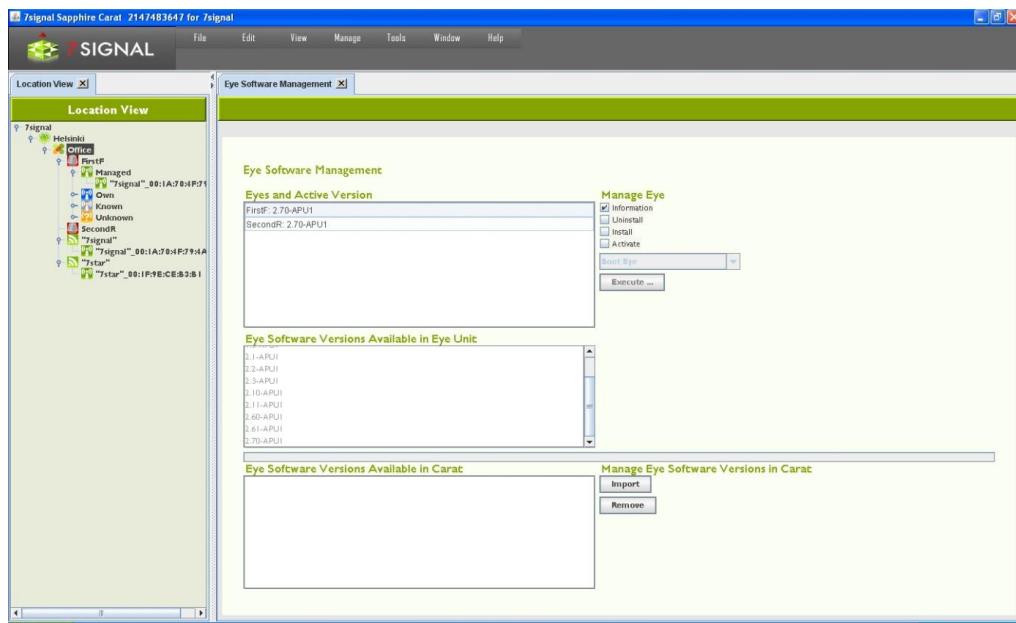
Updates to a management station's software

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.

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:

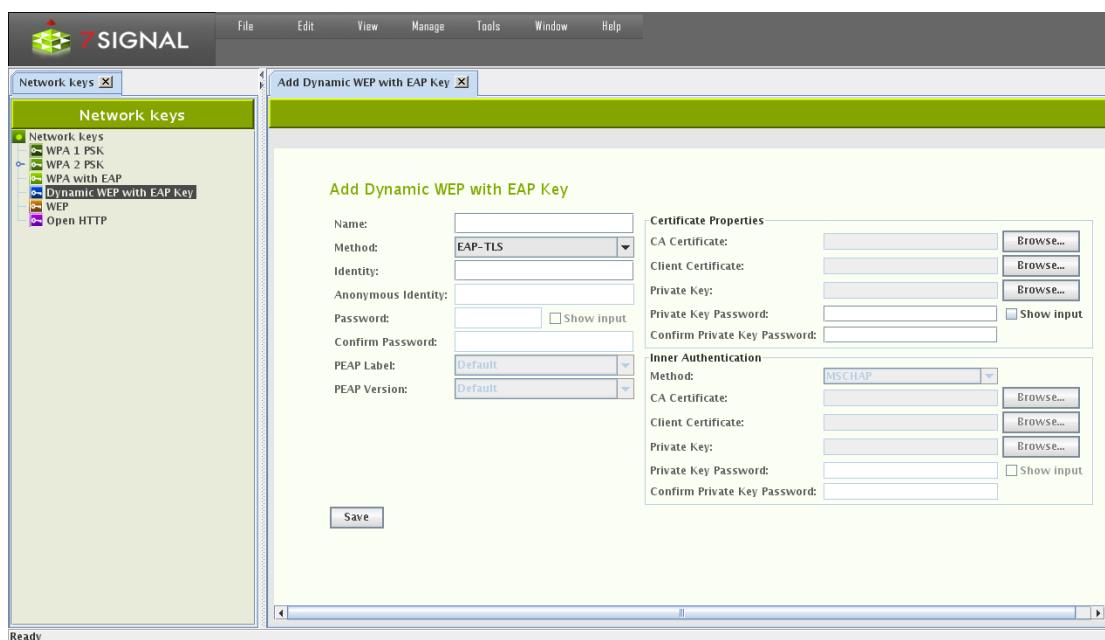
1. From the top menu bar, select “Manage | Eye software management”
2. At the bottom right, under “Manage Eye software version in Carat,” select “Import”
3. Browse to the desired monitoring station software version in the Carat server file system and select “Open”; the software is displayed in the “Eye 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”

CREATION AND USE OF AN ENCRYPTION KEY

Related icons



Before you start monitoring, you must create an encryption key. You can have several keys, for different networks. Check the latest supported key set from the release notes.



On key types

WEP	Insecure, should not be used in critical networks
WPA1 / TSN	Early security method, outdated, recommended not be used
WPA2 / RSN	Truly secure method
WPA with EAP	a.k.a. WPA-Enterprise. Early EAP enhanced WPA that is supported but somewhat outdated.
Dynamic WEP with EAP key	Modern and possibly secure. Actual security level is based on implementation. Couraged to be used.
Open HTTP	Needs tailoring per vendor and per software version because of versatility of HTTP protocol and implementation.

On different methods and implementations

7signal Sapphire should support all possible encryption methods and this requires generic approach to encryption issues. A concise presentation of the wlan encryption can be found from the link http://tldp.org/HOWTO/html_single/8021X-HOWTO/.

Various vendor-specific simplify PKI infrastructure into client and server certificates and username/password accounts. Unfortunately setting up the wlan encryption requires understanding beyond the use of the vendor-specific PKI implementation.

In case Carat does not directly support the encryption method used by the other wlan clients (as Eyes emulate wlan clients), typically an alternative option may be used. If the authentication server remains the same, most probably the other method would be successful, too.

TIP 1: Microsoft environments tend to use combination of 802.1X and username/password. This falls into category:
Key type: Dynamic WEP with EAP key
Method: EAP-PEAP
Inner authentication: MSCHAPV2

TIP 2: In Cisco PKI infrastructure the a setting similar to the one above would be:
Key type: Dynamic WEP with EAP key
Method: EAP-PEAP
Inner authentication: GTC

Adding a key

Add a key by following the instructions below:

1. From the top menu bar, select “Manage | 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 “Create 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 can 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 “Edit”
4. Enter a contact person
5. Select a suitable encryption key for the network from the pull-down menu
6. Click “Save”

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. However, it is not mandatory to use certificate files if the certificate or encryption system if the implementation is based on username/password.

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:

- 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 following command:

```
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.

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

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

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.

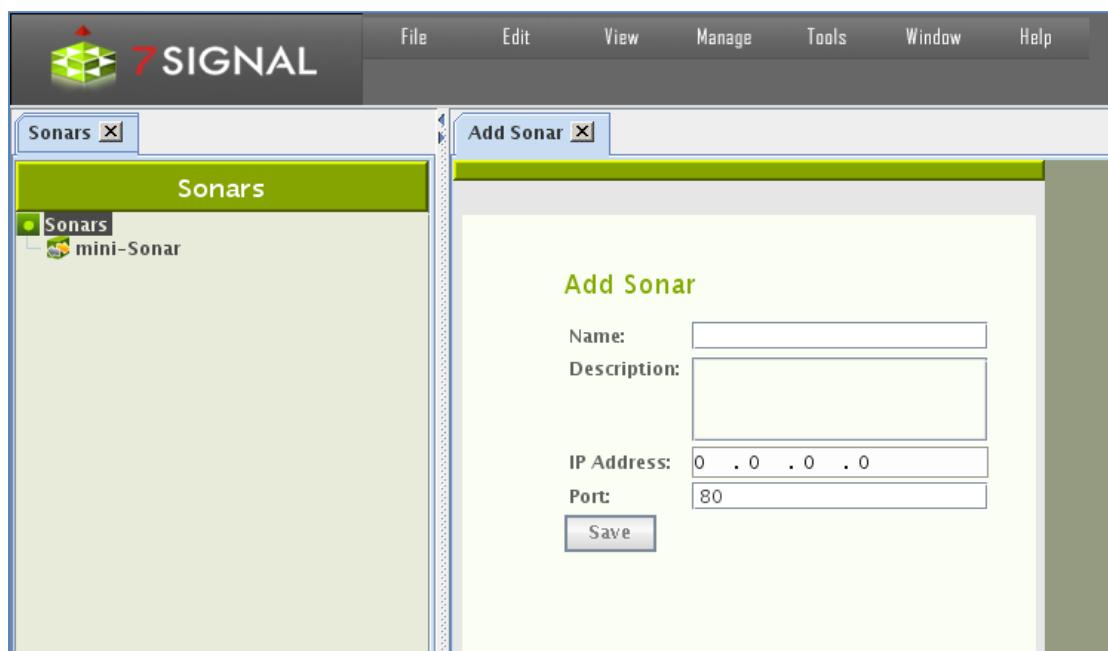
The Eye is now properly authenticated in Windows PKI environment.

ADDITION OF TEST END-POINT

Sonar

Sonar is 7signal specific server that handles typical network requests i.e. it emulates numerous servers in the network. While the network traffic generated is always identical to the emulated service, the service cannot be extremely complex or dynamic in nature.

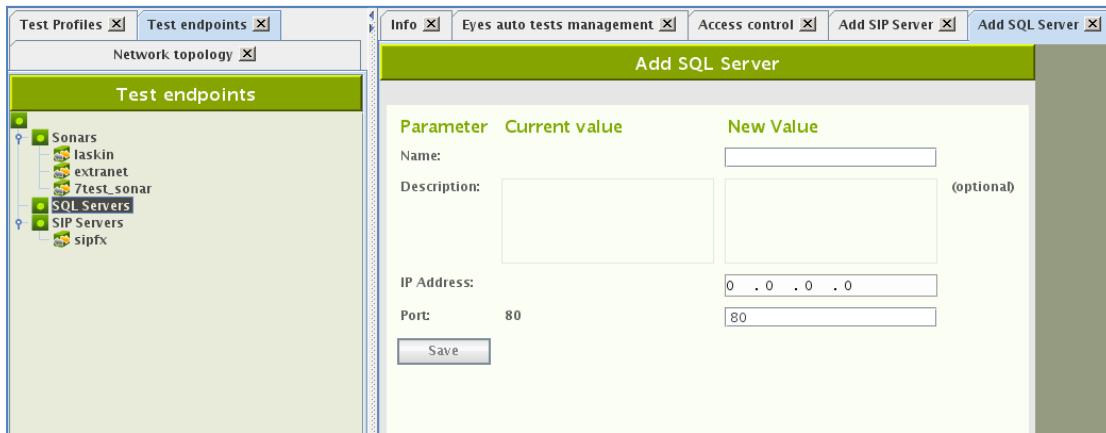
Sonar (icon ) is the server needed for executing elementary tests. There can be several Sonar servers configured. Each test can be configured to use any of the configured Sonars. Configuring Sonar servers makes it easy to define the parameters for the automatic measurements.



1. From the top menu bar, select “Manage | Sonar view”
2. Select “Add Sonar”
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 or DNS name 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”

Generic test counterparts

It is possible to run tests towards actual network servers.



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.

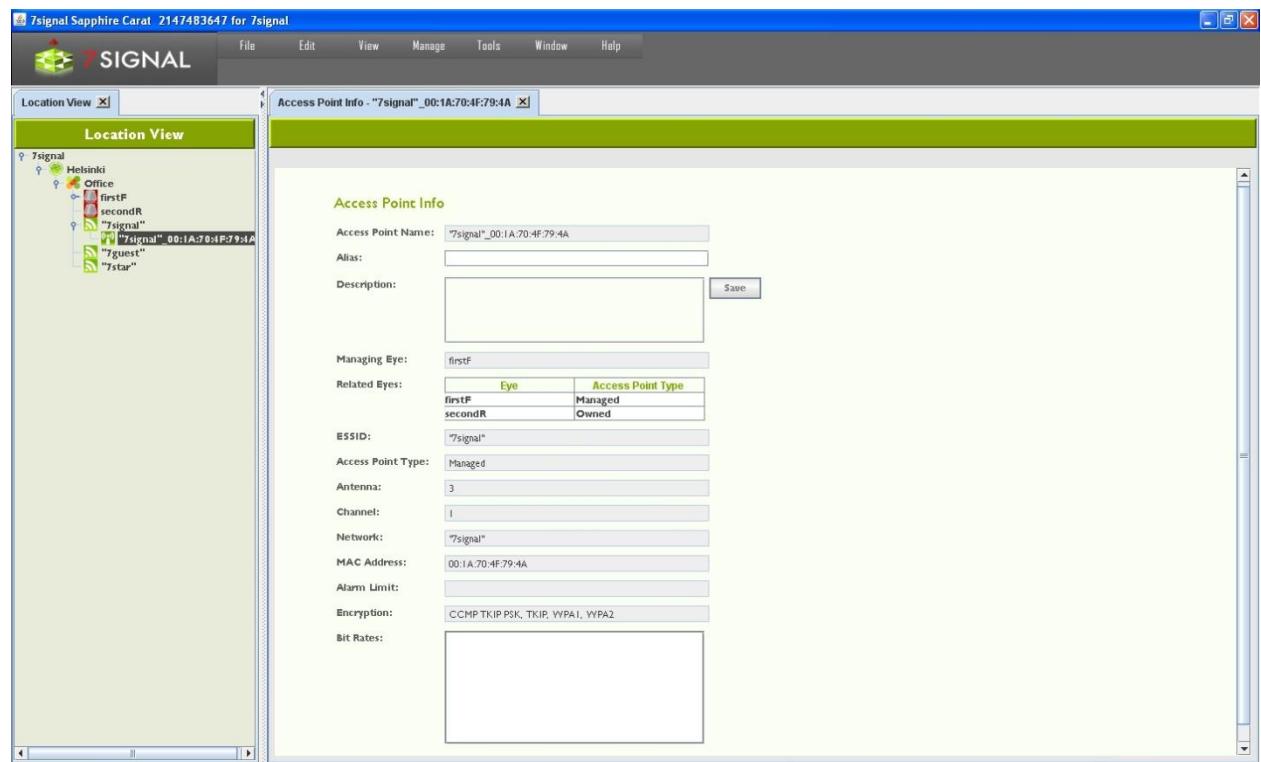
ACCESS POINT INFORMATION

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
- The managing Eye (i.e., the Eye that performs the tests)
- Network name
- Access point type
- The antenna used by the Eye to monitor the access point
- Channel
- MAC address
- Alarm limit
- Encryption
- bits/s values for the supported codecs



LINKS AND LINK GROUPS

In 7signal Sapphire a link denotes an end to end connection between an Eye monitoring station and a Sonar server. Thus a link can be said to consist of a monitoring station, an access point and a Sonar server. In the Network topology links are positioned beneath 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.

The formation of a link

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

Link removal

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

Creating a link group

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"

Removing a link group

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

Adding a link to a link 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

Removing a link from a link 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

ALARMS

Related icons



alarm configuration



critical alarm



informational message



alarm configuration group



network error



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 can be bound to a network by binding it to one of its access points. 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

Creation of an alarm group

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 Limit Group” and right-click it
3. Select “Add alarm limit group”
4. Enter a name for the alarm group
5. Select the alarms by dragging them from “metadata” 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
Potential 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
Offending Channel Change of Managed Domain	The alarm is activated when a managed access point starts to use a restricted channel. This is a warning alarm.	No
Offending Channel Change of External Domain	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
Acceptable Response 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 Availability Loss	The alarm is activated when ping tests fail. This is a critical alarm.	Yes
Acceptable Retransmission Rate Exceeded	The alarm is activated when the retransmission rate exceeds the set limit. This is a critical alarm.	Yes
IP Resource Availability	The alarm is activated on DHCP timeout. This is a critical alarm.	Yes

Binding of alarms 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

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									
<input type="checkbox"/> All Alarms <input type="checkbox"/> Warnings		<input checked="" type="checkbox"/> Active Alarms <input type="checkbox"/> Messages		<input type="checkbox"/> Group by Severity <input checked="" type="checkbox"/> Normal Listing					
<input type="button" value="Save Settings"/>		<input type="button" value="Columns"/>							
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 in the same way.

Alarm exporting

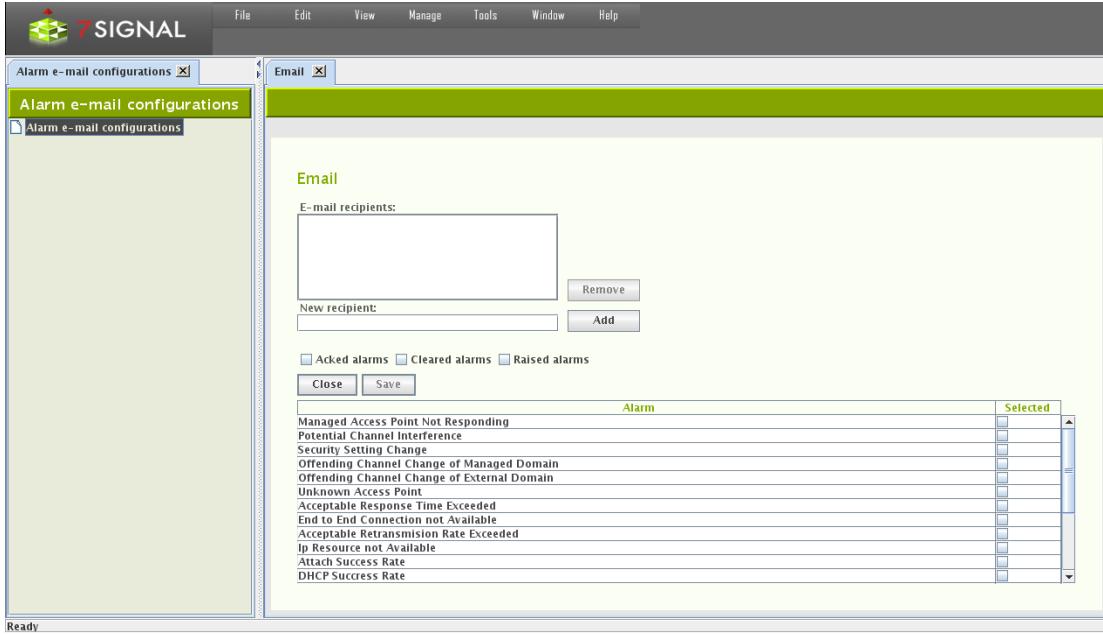
There are two methods that alarms may be brought to attention of external systems: email forwarding and SNMP.

Alarms and 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



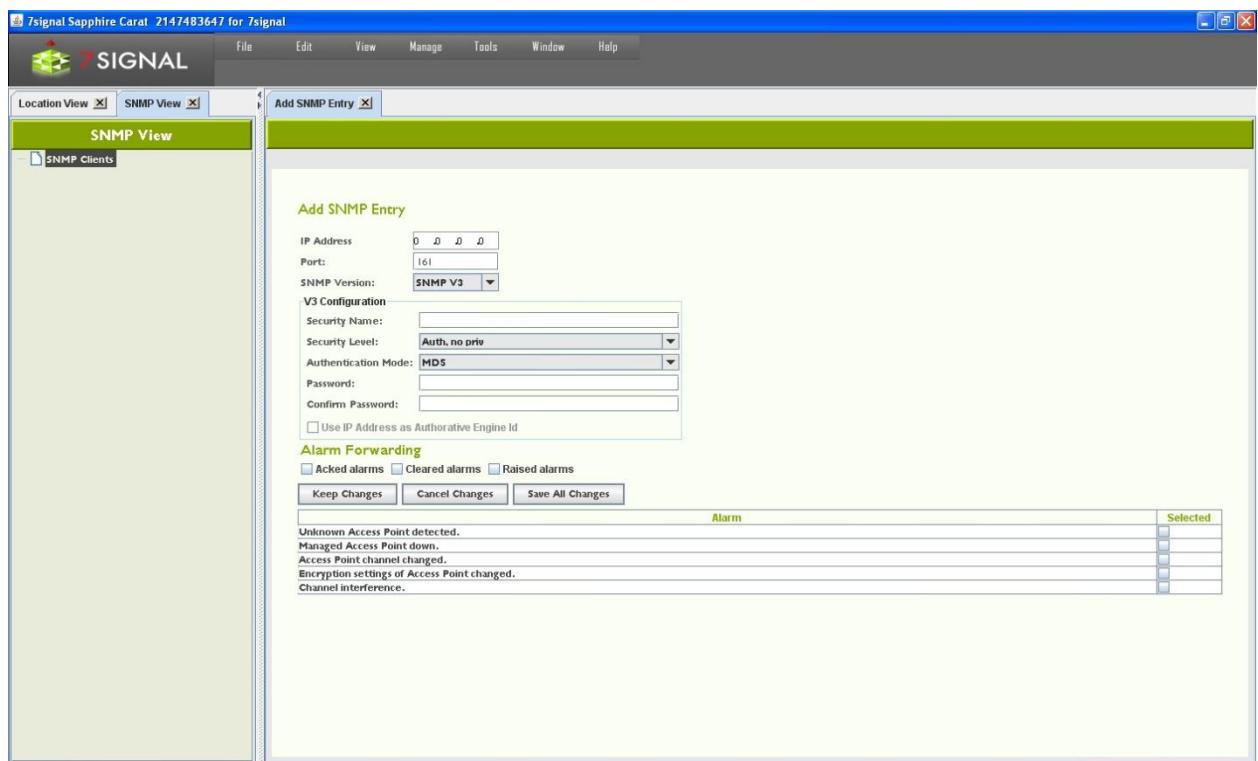
1. From the top menu bar, select “Manage | Alarms | Email”
2. Enter target email address to “New recipient” field
3. Select “Add” to register the email address as a recipient. It shall appear in the box named “Email recipients”
 - a. Incorrectly added or not any more relevant recipients may be removed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

Alarms and 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 or DNS name 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. Right-click "SNMP clients" in the Network topology and select "Save"



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.

Note: The ping test is an active test, but, on account of its nature, assigning a traffic class to it is not sensible.

Note: Best-effort (0) refers to unclassified traffic that does not conform to the IEEE 802.11e standard.

TEST MEASUREMENTS

The tests are grouped into passive listening tests and active switched 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.

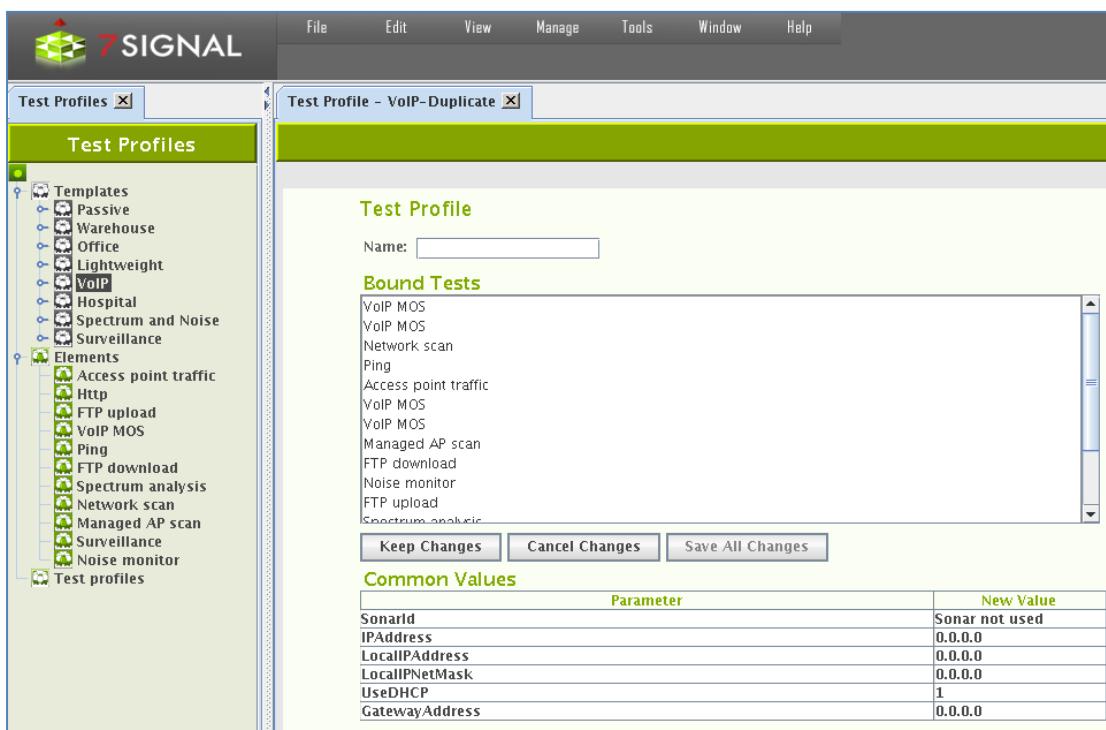
Test profiles

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.



- **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.

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.

Passive

“Passive” template contains four passive tests and no switched 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.

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.

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.

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.

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.

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.

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 troubleshooting template that is activated if the normal course of testing does not provide enough information on the source of the interference.

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.

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 wlans concurrently. The next chapter has more details on this.

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.

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.

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.

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.

Operation on Test Element

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.

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.

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.

Automated Tests

No current functionality.

Automated Tests for Eyes

No current functionality.

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.

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.

Operations on test profile element inside a test profile

Edit

Edit the parameters of the test.

Save

Make active changes persistent.

Copy Element

Enables pasting of the object.

Remove Element

Deletes the object.

Insert Element Before

Paste the element on clipboard as element as a predecessor to this one.

Insert Element After

Paste the element on clipboard as element as a successor to this one.

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.

Modifying test parameters

If you wish to modify individual tests, see the instructions below. However, the tests will work perfectly well even without modification. 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. Select a test
5. Select a test type (*parameter is visible*)
6. 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
7. Select “Keep changes”
8. Select “Save all changes”

Configuring complex test profiles

Free editing makes it possible to create profiles for any imaginable purpose. One might want to create fine-grain testing for a particular wlan network or it might want to test multiple wlan networks in one profile.

Use case: fine-tuning existing profile

Use “Copy Element” and “Insert Element After” or “Insert Element Before” to multiply one single test. Change parameters in each duplicate to achieve the desired effect. This could be changing the ping packet size, changing the amount of data to be transferred or changing

the MOS test parameters. Such extreme-values and range tests produce detailed information on the network behavior.

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 wlans 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 to create a simple test sequence as essid and then duplicate the essid object and make the duplicates to point to different wlans. 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

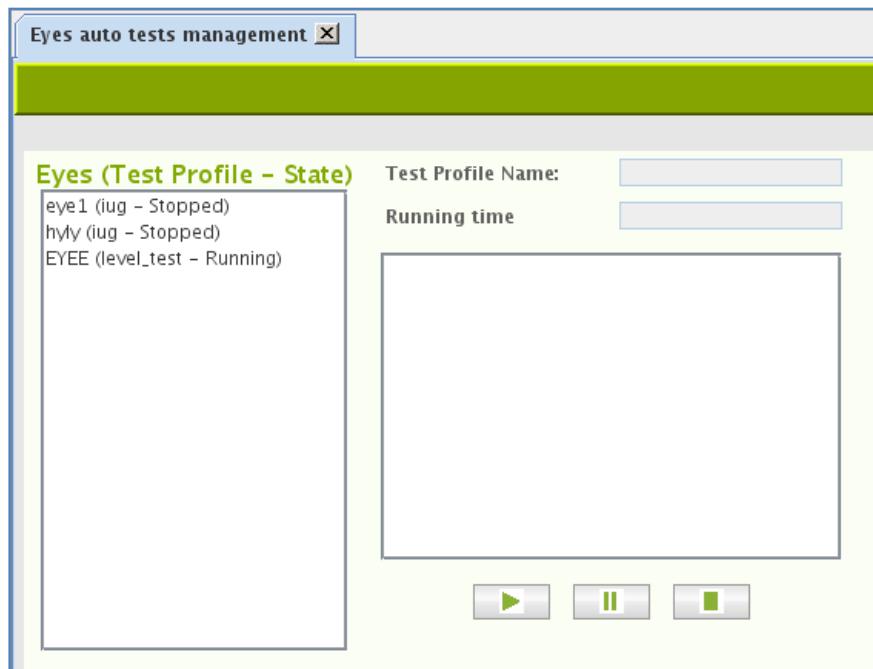
Please observe that in the latter approach the measurements on a single wlan network shall be sparser temporally. While individual tests shall happen on roughly the same time interval, the distribution of the samples per network differs a great deal on these two approaches.

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

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

Passive tests

Initial network scan

When the Eye has been installed or needs to be reset, 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)
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.

"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., antenna lobes
6. Select the channels to scan
7. Select "Scan"
8. The results are displayed in a table

The screenshot shows the "Wireless Network Scan" dialog box. At the top, there is a dropdown for "Scan Interval" set to "Fast scan" and a checkbox for "Show detailed results". Below this are three sections for selecting antennas, channels, and B/G channels, each with checkboxes for "All" or "None" and individual channel/antenna numbers. At the bottom are "Scan", "Save", "Columns", and "Export" buttons. A large table below displays network scan results with columns for ESSID, Encryption, MAC, Channel, and Manage. The table includes entries for networks like "7signal", "YFIGUEST", and "7rd", along with their respective details and channel numbers.

ESSID	Encryption	MAC	Channel	Manage
"7signal"	CCMP, CCMP PSK, ...	00:1A:2B:3C:4D:5E	140	Unknown
"YFIGUEST"		00:1A:2B:3C:4D:5E	56	Unknown
"YFIPRIV..."	Encrypted	00:1A:2B:3C:4D:5F	56	Unknown
"YFIPRIV..."	Encrypted	00:1A:2B:3C:4D:5F	44	Unknown
"YFIGUEST"		00:1A:2B:3C:4D:5E	44	Unknown
"7rd"	CCMP TKIP PSK, T...	00:1A:2B:3C:4D:50	13	Unknown

NOTE: 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

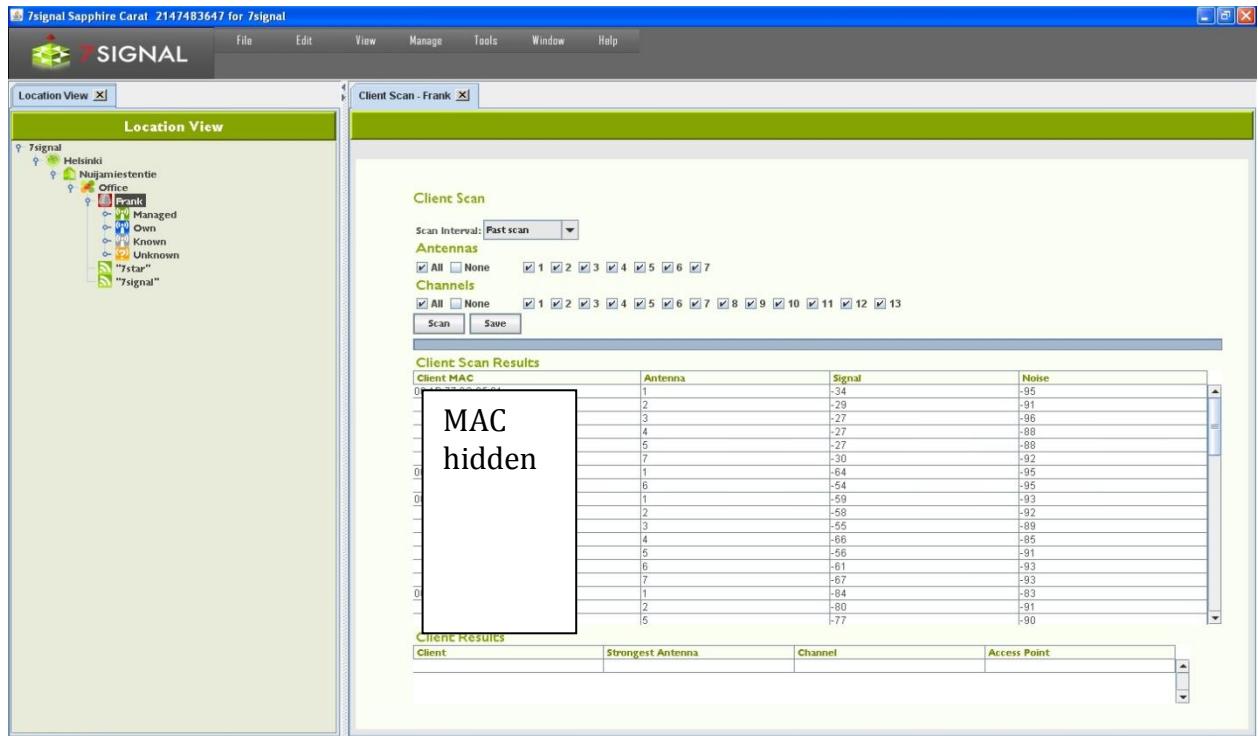
Options for processing the results:

- “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 Carat 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

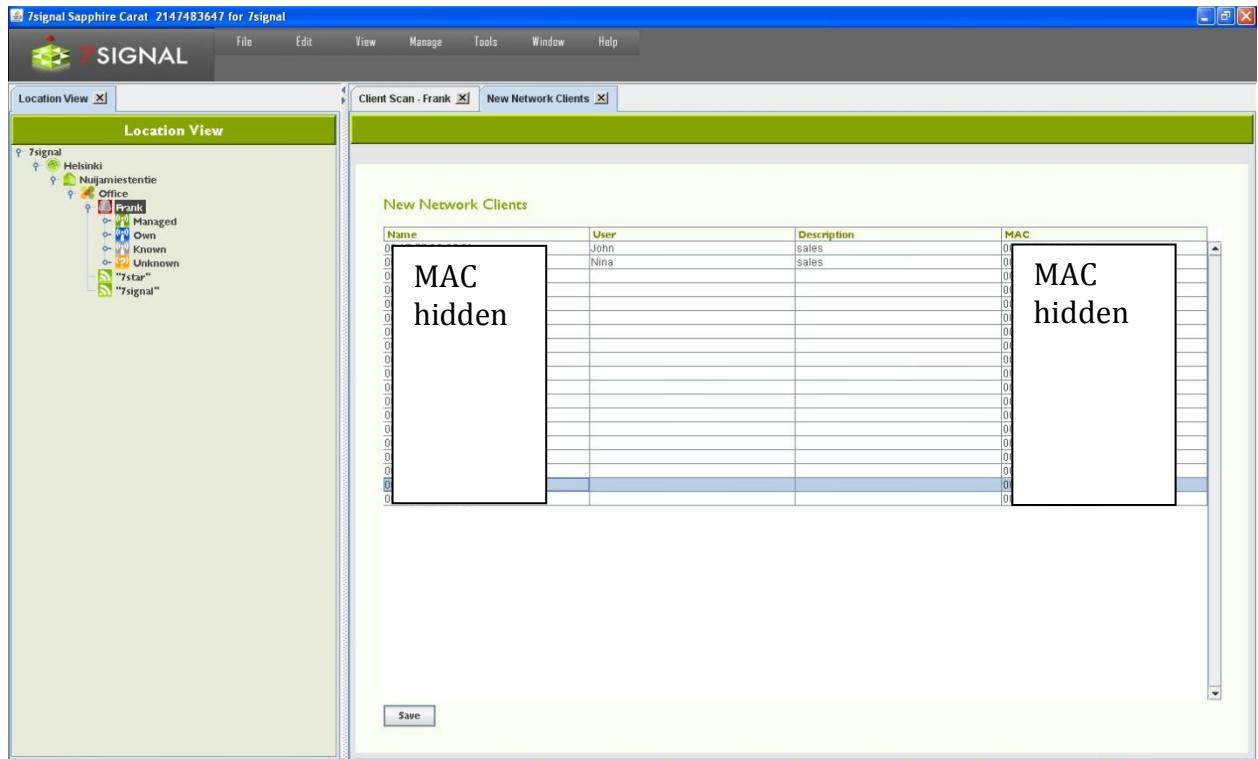
“Client Scan” test

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



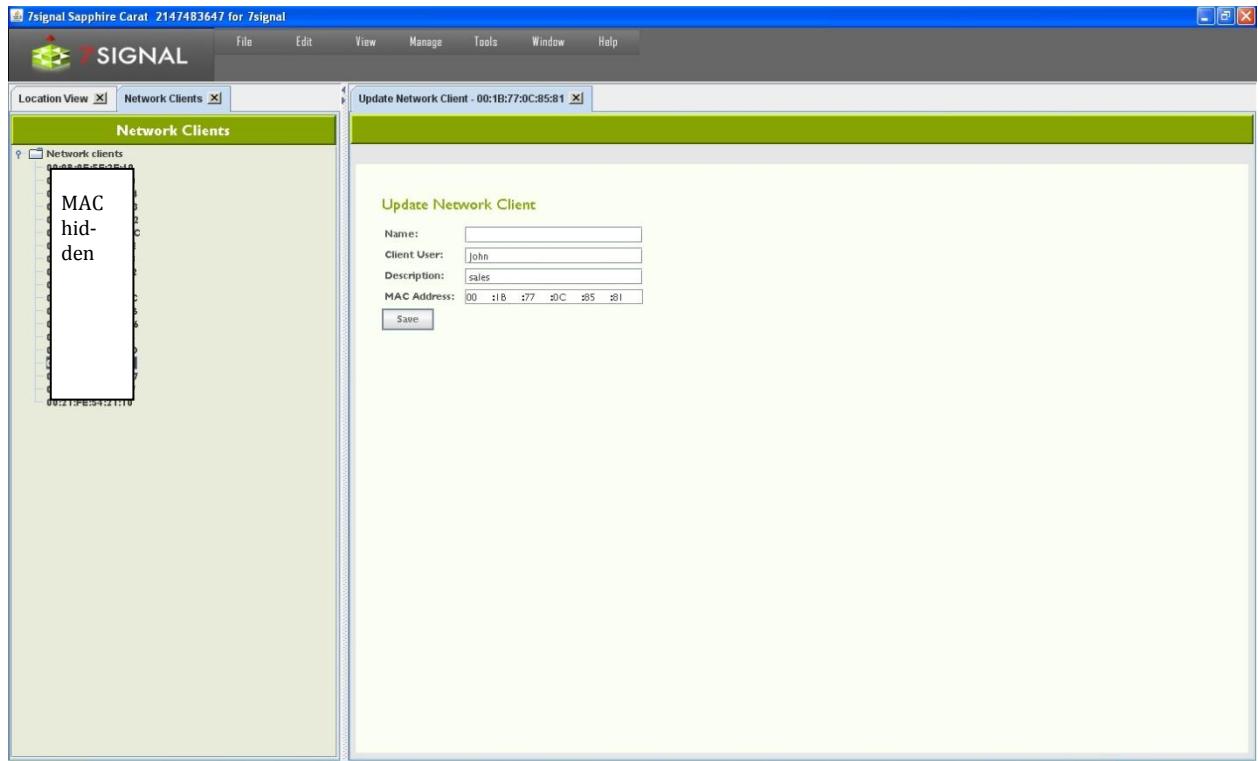
8. Select “Save”; the clients detected remain in the table
9. You can enter a friendly name and description for each user; this name will be displayed in future results instead of the MAC address



10. Select “Save” to save the friendly names and descriptions

The data can be viewed and edited.

1. From the top menu bar, select “Manage | Network clients”
2. To change the information, select the MAC address or name
3. Right-click and select “Edit”
4. Edit the information
5. Select “Save”



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:

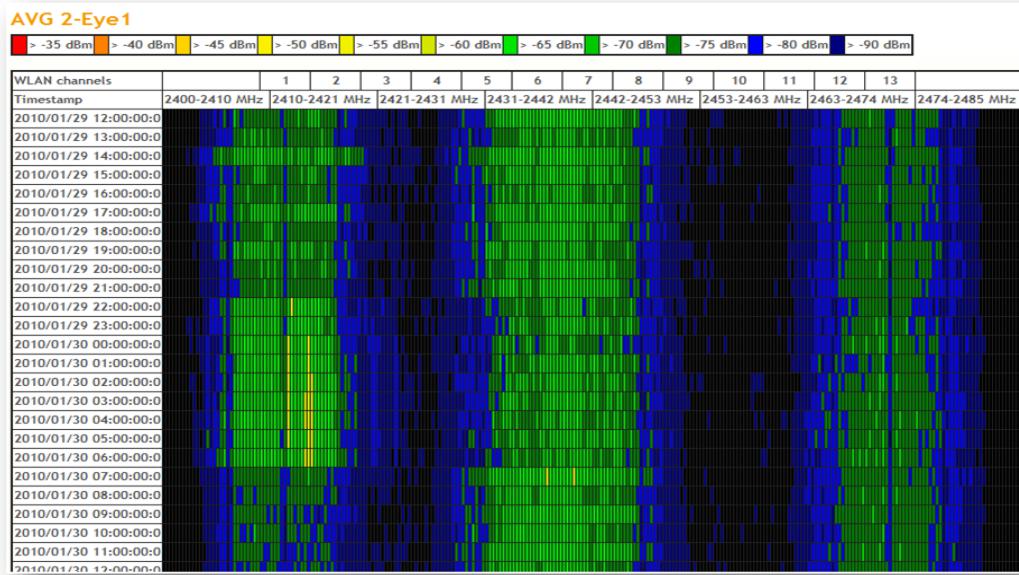
field	MAC	Name	User	Description
explanation	MAC address, required	Client name, (optional)	Client user if known (optional)	Client description (optional)
example	complete	A:B:C:D,pda,Pda User,personal digital assistant		
	description omitted	A:B:C:D,officeLaptop,J.D.,		
	partial	A:B:C:D,barCodeReader,,		

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

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”



Active Tests

Active test means that the monitoring station assumes the role of a network client i.e. it is active by attaching itself to the wlan network to run some operation.

Active tests may be run continuously from the test profiles. This is automated and continuous right after the test parameters has been set for each profile and profiles are bound to the monitoring stations (See chapter Test Profiles).

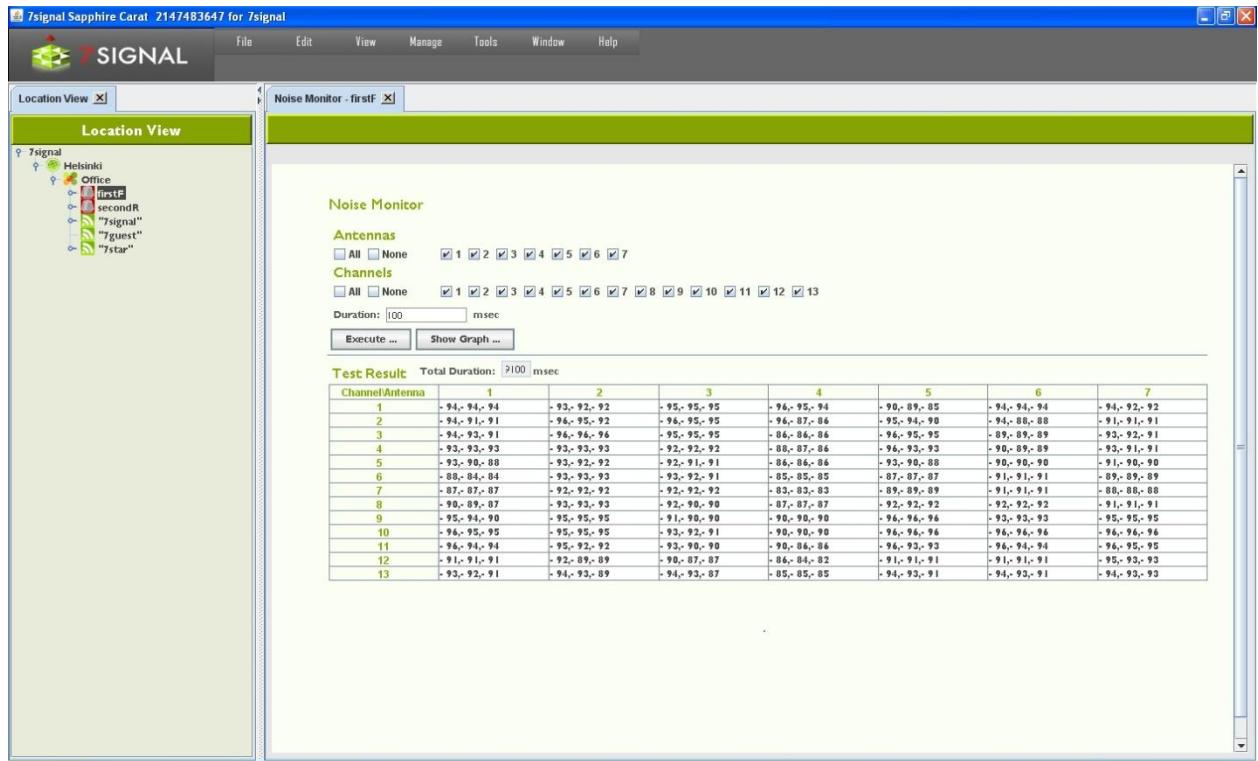
Below it is instructed how to run tests interactively from the user interface. This approach is suitable to both deployment phase and detailed and interactive troubleshooting cases.

The test are activated from the Network topology by right-click on icon of either the monitoring station or an access point. The test selection is available on the menu.

“Noise monitor” test

You can measure the noise levels surrounding the monitoring station. This test is available based on backward compatibility and for entry-level systems, more accurate results are available with spectrum analysis.

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., antenna lobes
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”



“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

The screenshot shows the 7signal Sapphire Carat software interface. On the left, there is a 'Location View' window showing a tree structure of network locations: '7signal' > 'Helsinki' > 'Office' > 'firstRF'. The 'firstRF' node is selected. On the right, the main window title is 'Optimal Antenna Selection - firstRF'. The interface includes a 'Test Input' section with fields for 'Target' (Sonar checked), 'Test host' (empty), 'Port' (0), 'Upload' (set to 1KB), 'Use DHCP' (checked), 'Local IP address' (empty), 'Local net mask' (empty), and 'Gateway IP address' (empty). Below this is a 'Test Result' table:

Access Point	Sel. Ant.	Antenna	Elapsed Time	Throughput	Codecs	Info
"7signal" .00:1A:70:4F:2A:...	3	1	119	0.07	48 (13.3%), 54 (79.3...)	
		2	22	0.36	54 (84.6%)	
		3	78	0.10	54 (100%)	
		4	24	0.33	54 (92.85%)	
		5	29	0.27	54 (92.85%)	
		6	17	0.46	48 (53.33%), 54 (44.6...)	
		7	20	0.39	48 (7.69%), 54 (84.61...)	

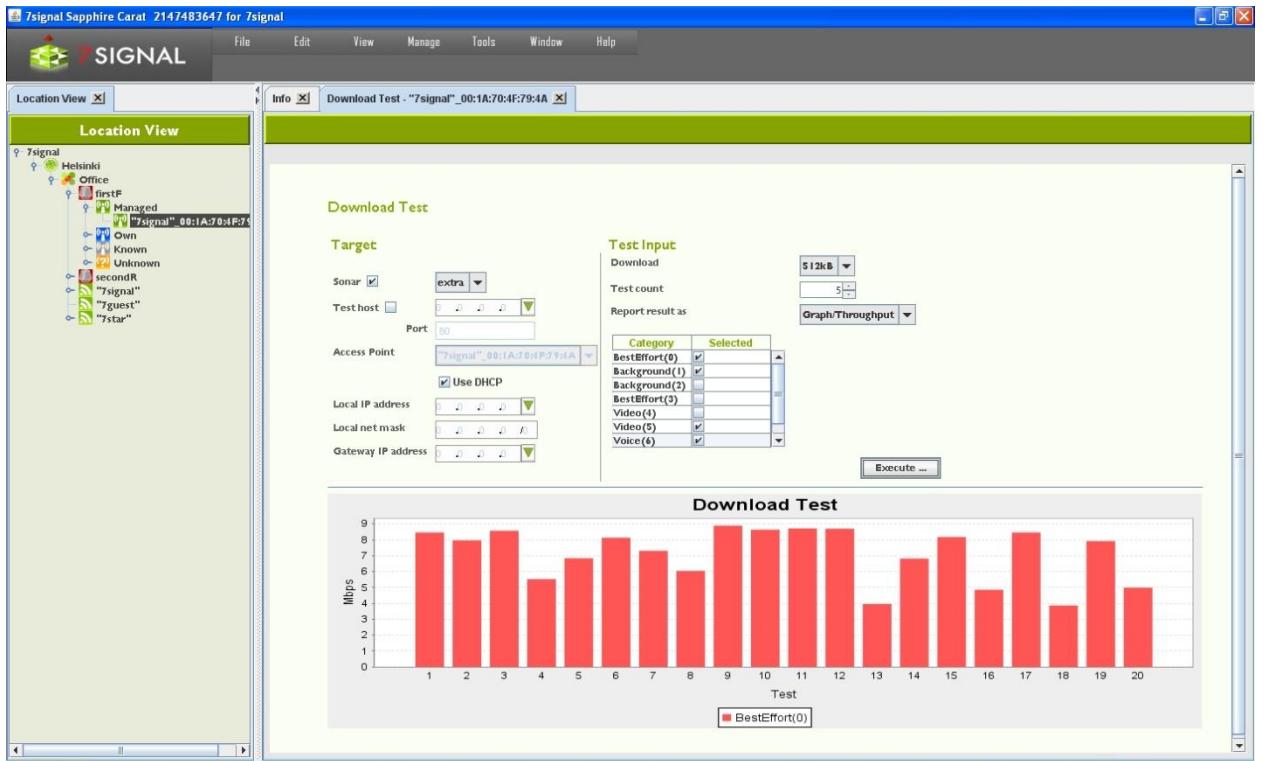
At the bottom of the main window, there is a button labeled 'Change and save antenna'.

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 MOS test ports shall be used. User-given port overrides this setting. Please observe possible firewall settings.
 - d. (UDP only): Receiver (Eye) port. Default 0 means that MOS test ports shall be used. 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

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



Upload tests

This test gives an indication of an access point's FTP or uplink 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 MOS test ports shall be used. User-given port overrides this setting. Please observe possible firewall settings.
 - d. (UDP only): Receiver (Sonar) port. Default 0 means that MOS test ports shall be used. 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.

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

The screenshot shows the 7signal Sapphire Carat software interface. On the left, there is a 'Location View' tree with nodes like 'Tsignal', 'Helsinki', 'Office', 'FirstF', 'SecondR', and several 'Managed', 'Own', 'Known', and 'Unknown' status icons. The main window is titled 'Upload Test - "7star" 00:1F:9E:CE:B3:B1'. It contains two main sections: 'Target' and 'Test Input'. In the 'Target' section, 'Sonar' is selected, 'Testhost' is set to 'LastIn', 'Port' is 80, and 'Access Point' is '7star' 00:1F:9E:CE:B3:B1. A checked checkbox 'Use DHCP' is present. In the 'Test Input' section, 'Upload' is selected, 'Test count' is 10, and 'Report result as' is set to 'Table'. Below these sections is a table with columns 'Category' and 'Selected'. The 'Selected' column has checkboxes for 'BestEffort(0)', 'Background(1)', 'Background(2)', 'BestEffort(3)', 'Video(4)', 'Video(5)', and 'Voice(6)'. At the bottom right of the main window is a large 'Execute ...' button. Below the main window is a detailed table of test results:

Test	Time (ms)	Throughput (Mbps)	Percent from practical max	Traffic category
1	504	7.94	32.44	BestEffort(0)
2	173	8.46	34.80	BestEffort(0)
3	920	4.35	17.89	BestEffort(0)
4	886	4.51	18.58	BestEffort(0)
5	875	4.57	18.81	BestEffort(0)
6	925	4.23	17.80	BestEffort(0)
7	899	4.45	18.21	BestEffort(0)
8	445	8.89	34.89	BestEffort(0)
9	447	8.95	34.93	BestEffort(0)
10	3479	1.15	4.73	BestEffort(0)

"Ping test"

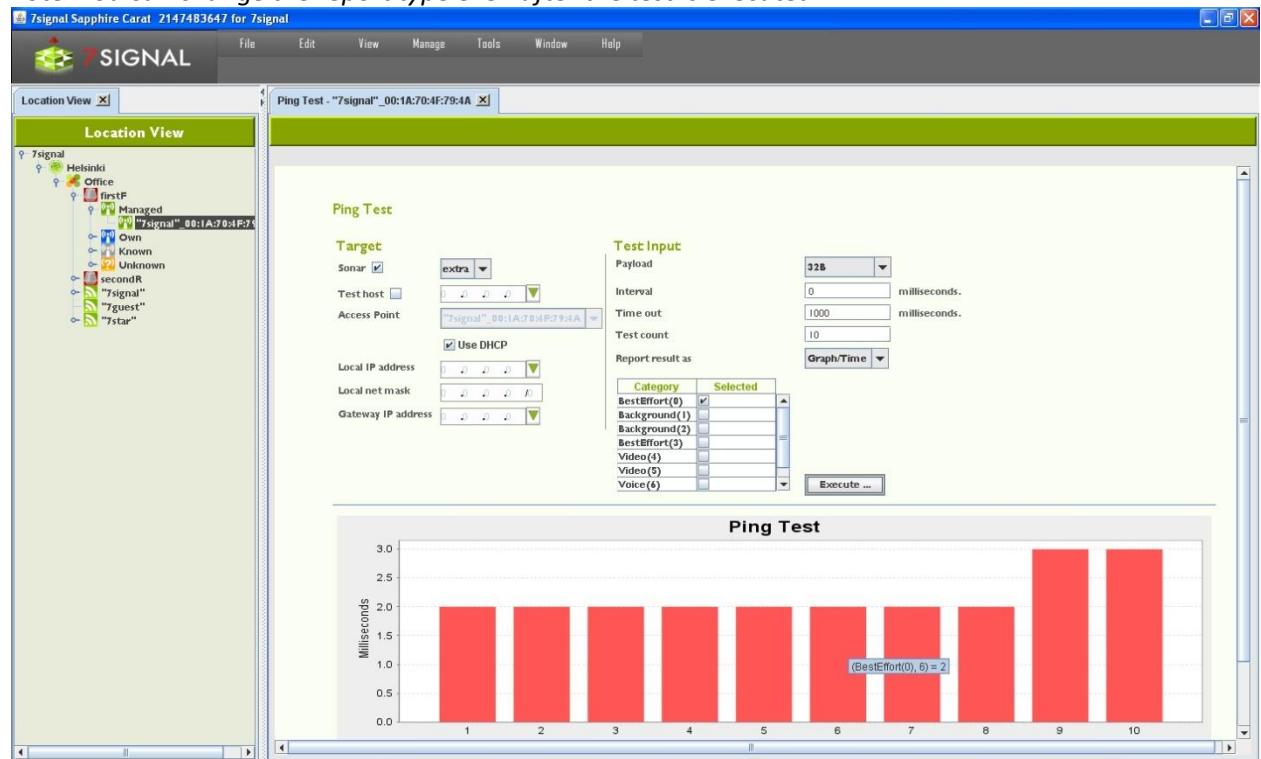
A ping test tests the accessibility of a device, the number of packets sent and received, and latency time.

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 tests (in milliseconds)
 - c. Select the waiting time (in seconds) before termination of a test that does not progress
 - d. Specify how many times the test is to be run
 - 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.

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



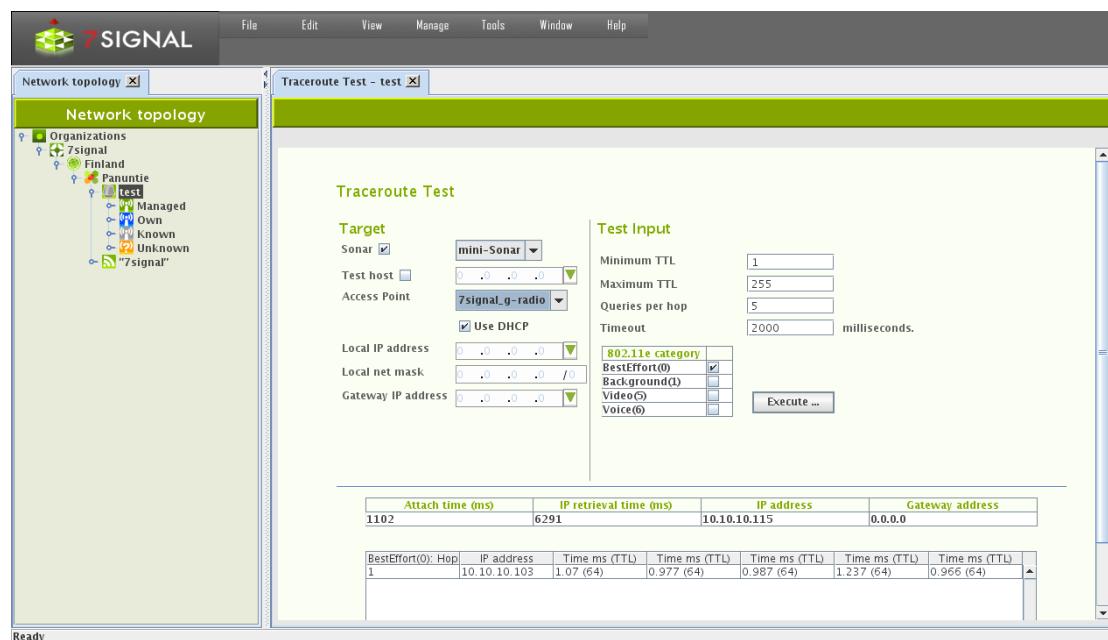
"Traceroute Test"

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

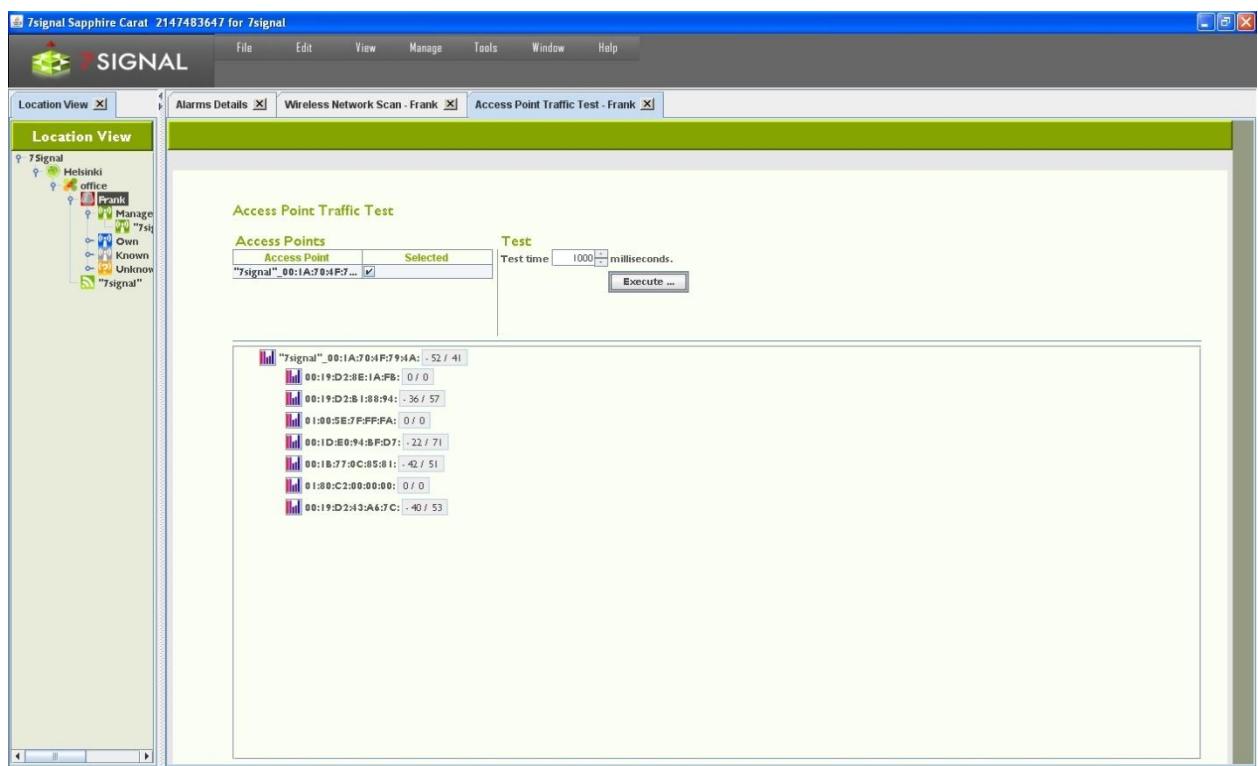


"Access point traffic" test

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.



"Client Scan"

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.

Network Clients	
Client	Selected
00:1B:77:71:EE:48	<input type="checkbox"/>
F8:1EDF:41:AF:D8	<input type="checkbox"/>
01:40:96:FF:FF:00	<input type="checkbox"/>
00:0B:68:2E:99:F3	<input type="checkbox"/>
01:00:0C:CC:CC:CC	<input type="checkbox"/>

Test Input	
Antenna	Selected
1	<input type="checkbox"/>
2	<input type="checkbox"/>
3	<input type="checkbox"/>
4	<input type="checkbox"/>
5	<input type="checkbox"/>
6	<input type="checkbox"/>
7	<input type="checkbox"/>

Channel: 1 ▾
 Test time: 1 seconds

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 channels 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.

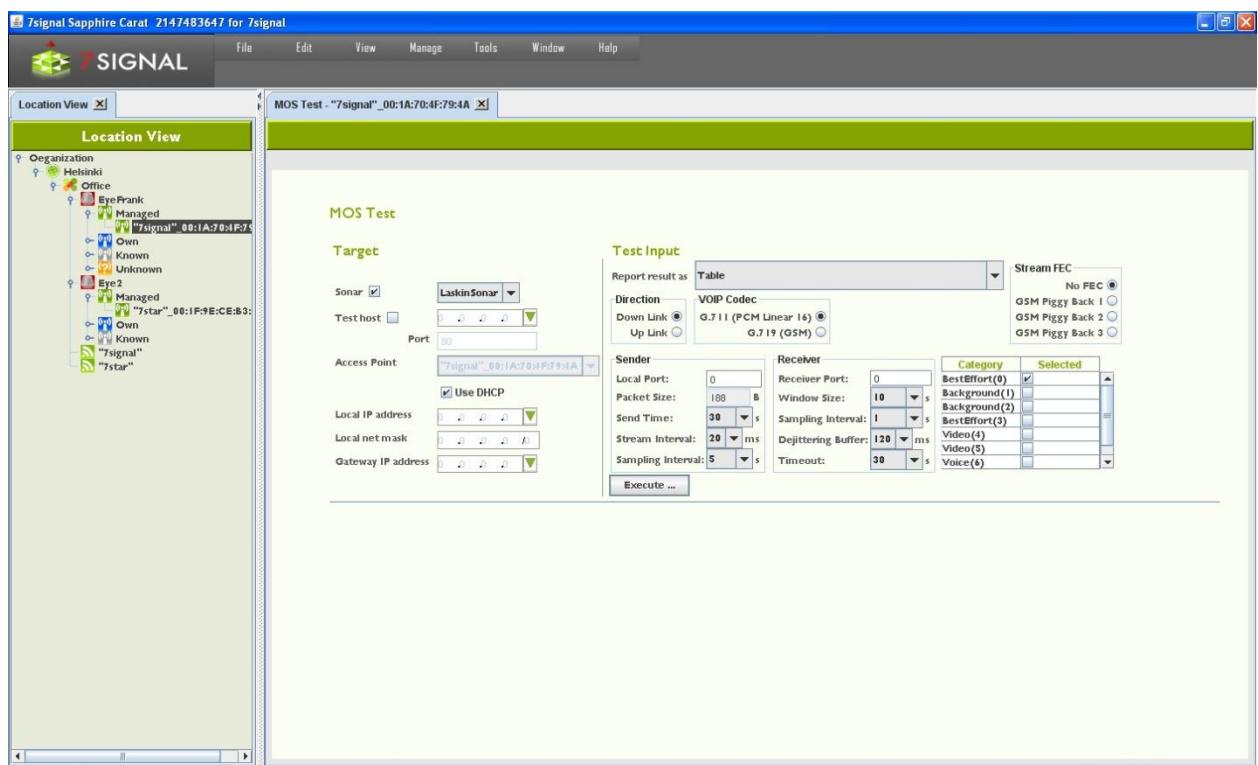
Client Scan Results			
Client MAC	Antenna	Signal	Noise
00:08:68:2E:99:F3	2	-65	-91
	2	-77	-95
	3	-72	-94
	4	-81	-93
	5	-79	-96
	6	-74	-94
	7	-70	-94
00:08:68:2E:99:F5	3	-53	-93
	2	-50	-96

Client Results			
Client	Strongest Antenna	Channel	Access Point
00:08:68:2E:99:F5	4	1	00:1A:70:46:79:4A

"MOS Test"

This test creates a VoIP call between Sapphire Eye and Sonar. Both uplink and downlink call quality are measured, simultaneously and independently.

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"

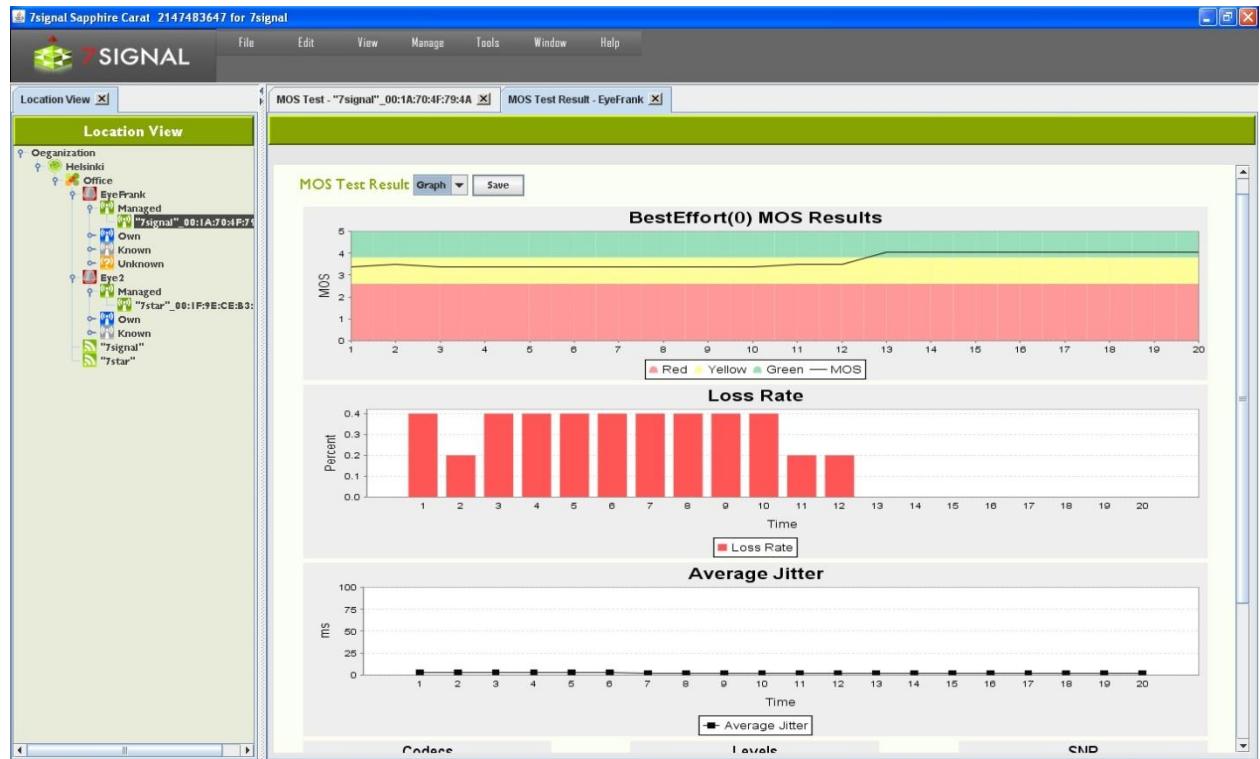


MOS test parameters

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

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.

For more information on interpretation of the test results, see the description of mean opinion score, MOS, at http://en.wikipedia.org/wiki/Mean_Opinion_Score.

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.

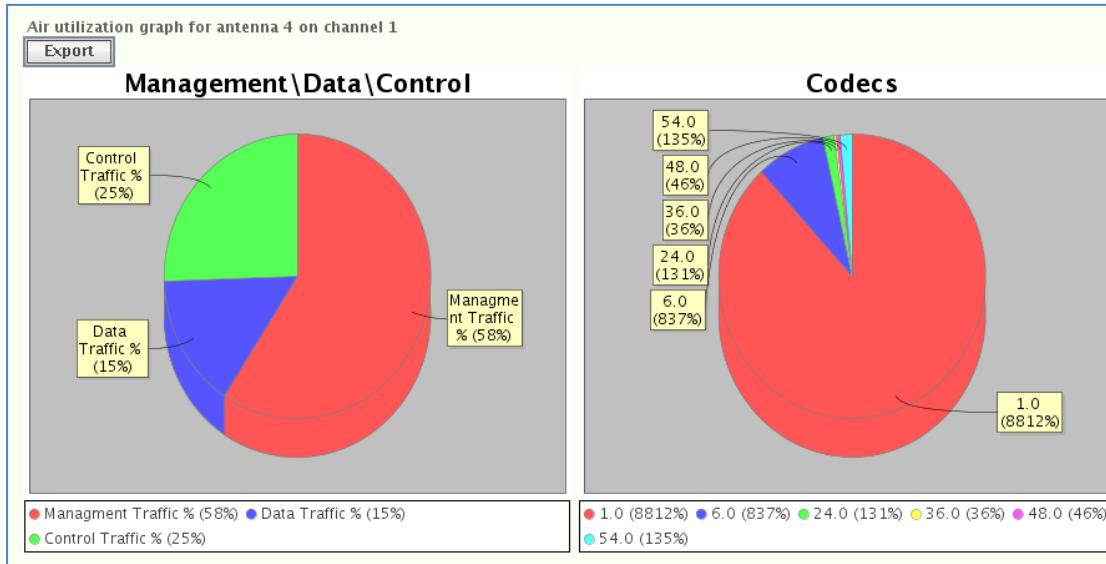
Air Utilization Test

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.

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 time – in minutes – to listen to each selected channel on each selected antenna.

The result is 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.

"HTTP URL (Intranet) test"

Http test (Sonar) and Http URL test (Intranet) serve different purposes. While the former is close to ftp test with detailed download measurements, the latter merely checks the availability and success of the page download.

Typically intranet pages contain dynamic elements. Http download against Sonar brings fixed size downloads thus providing tools for analysis.

HTTP URL Test

Target

Access Point:

Use DHCP

Local IP address:

Local net mask:

Gateway IP address:

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.

"Internet Availability Test"

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 <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>Access Point <input style="width: 100%;" type="text" value="7test_00:18:F8:71:23"/></p> <p><input checked="" type="checkbox"/> Use DHCP</p> <p>Local IP address <input style="width: 100%;" type="text" value="0 . 0 . 0 . 0"/></p> <p>Local net mask <input style="width: 100%;" type="text" value="0 . 0 . 0 . 0 /0"/></p> <p>Gateway IP address <input style="width: 100%;" type="text" value="0 . 0 . 0 . 0"/></p> </div> <div style="width: 45%;"> <p>DNS Servers</p> <p>Primary <input style="width: 100%;" type="text" value="0 . 0 . 0 . 0"/></p> <p>Secondary <input style="width: 100%;" type="text" value="0 . 0 . 0 . 0"/></p> <p>Tertiary <input style="width: 100%;" type="text" value="0 . 0 . 0 . 0"/></p> <p>DNS Resolve Names</p> <p>First <input style="width: 100%;" type="text" value="www.fi"/></p> <p>Second <input style="width: 100%;" type="text"/></p> <p>Third <input style="width: 100%;" type="text"/></p> </div> </div>			<input style="width: 100px;" type="button" value="Execute ..."/>												
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Used IP</th> <th>Attach time</th> <th>Retrieval time</th> <th>Router Addre...</th> </tr> </thead> <tbody> <tr> <td>0.0.0.0</td> <td>0</td> <td>0</td> <td>?</td> </tr> </tbody> </table>						Used IP	Attach time	Retrieval time	Router Addre...	0.0.0.0	0	0	?		
Used IP	Attach time	Retrieval time	Router Addre...												
0.0.0.0	0	0	?												
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>DNS Server Address</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <td>89.18.234.2</td> <td>Unavailable</td> </tr> <tr> <td>89.18.235.2</td> <td>Unavailable</td> </tr> </tbody> </table>						DNS Server Address	Availability	89.18.234.2	Unavailable	89.18.235.2	Unavailable				
DNS Server Address	Availability														
89.18.234.2	Unavailable														
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<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>DNS Name</th> <th>Resolve Status</th> <th>Resolve elapsed ti...</th> <th>Aliases</th> <th>Ip adreses</th> </tr> </thead> <tbody> <tr> <td>"Try again" status</td> <td>"Try again" status</td> <td>0</td> <td></td> <td></td> </tr> </tbody> </table>						DNS Name	Resolve Status	Resolve elapsed ti...	Aliases	Ip adreses	"Try again" status	"Try again" status	0		
DNS Name	Resolve Status	Resolve elapsed ti...	Aliases	Ip adreses											
"Try again" status	"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)
 - v. Enter 1st network name to be resolved
 - vi. Enter 2nd network name to be resolved (optional)
 - vii. 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.

"SIP Register Test"

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

802.11e category	
BestEffort(0)	<input checked="" type="checkbox"/>
Background(1)	<input type="checkbox"/>
Video(5)	<input type="checkbox"/>
Voice(6)	<input type="checkbox"/>

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 from the Network topology
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

REPORTING

Detailed explanation of reporting options requires a description of key performance indicators and knowledge of the Loupe application. As a result, report configuration and subscription are described in the Loupe user guide.

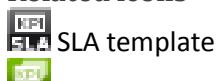
SERVICE LEVEL AGREEMENT

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.

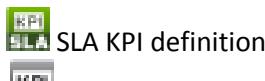
The ultimate goal is to bind together a contractual agreement and actual measurements, the expression of the desired or required level of the service and the proven real-life phenomena. As such, the SLA is a communication medium between the service provider and the customer.

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.

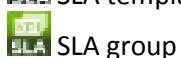
Related icons



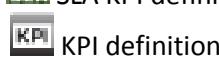
SLA template



SLA KPI definition



SLA group



KPI definition

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.

NOTE: 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.

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. Network topology elements that an SLA group can be bound to are Organization, Link and Link Group.

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

SLA definitions are inherited throughout the network topology as follows:

- If an organization has an SLA group bound to it, the performance indicators defined in the group are inherited by all links and link groups in the organization.
- If a link group has an SLA group bound to it, only the performance indicators defined in the group's own SLA group are applied regardless of whether the organization above it has an SLA group bound to it or not.
- If a link has an SLA group bound to it, only the performance indicators defined in the link's own SLA group are applied regardless of whether the link group or organization above it have SLA groups bound to them or not.

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.

Example: Upload throughput KPI

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

Boundary value	above 5,5 Mbit/s	<p>This is a relatively low value. One should bear in mind that this target is for numerous access points and the calculation interval might be rather long.</p> <p>On the other hand, an alarm might be bound to this KPI with a higher alarming threshold for access points with extreme performance expectations.</p>
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.

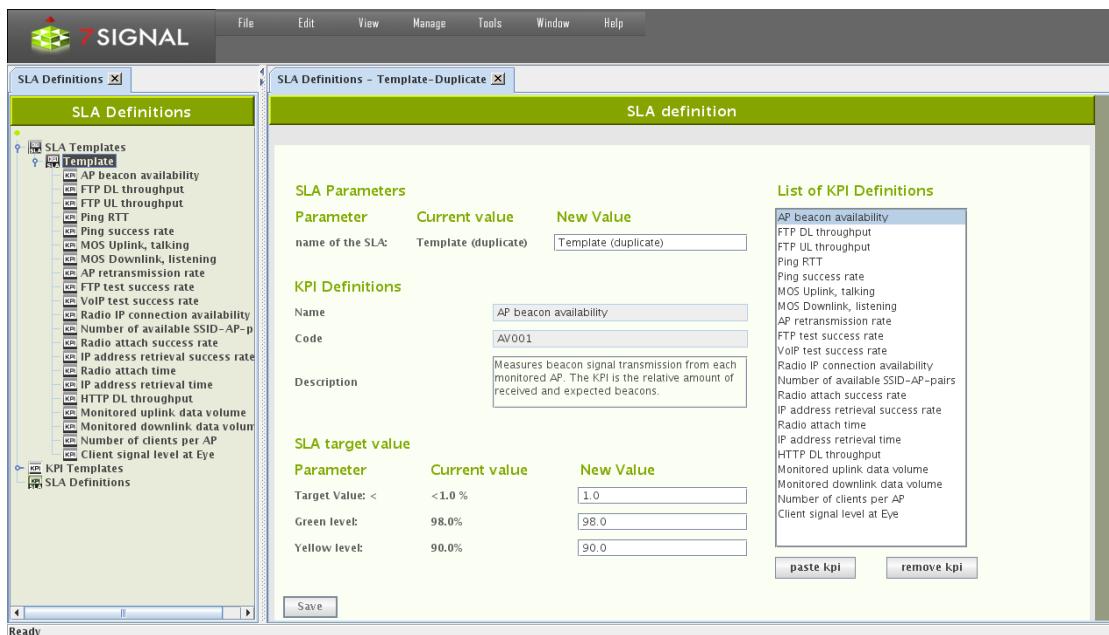
Creating an SLA group

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

1. By modifying 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.

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. Right-click on "SLA templates" from the tree hierarchy
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. 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.
8. Edit the boundary values to your liking.
9. Repeat from step 7. until every boundary value is as desired.
10. Click "Save"

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"

Binding SLA groups to network topology elements

Topology elements that an SLA group can be bound to are Organization, Link Group and Link.

Binding an SLA group to an organization

Bind an SLA group to an organization as follows:

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

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"

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

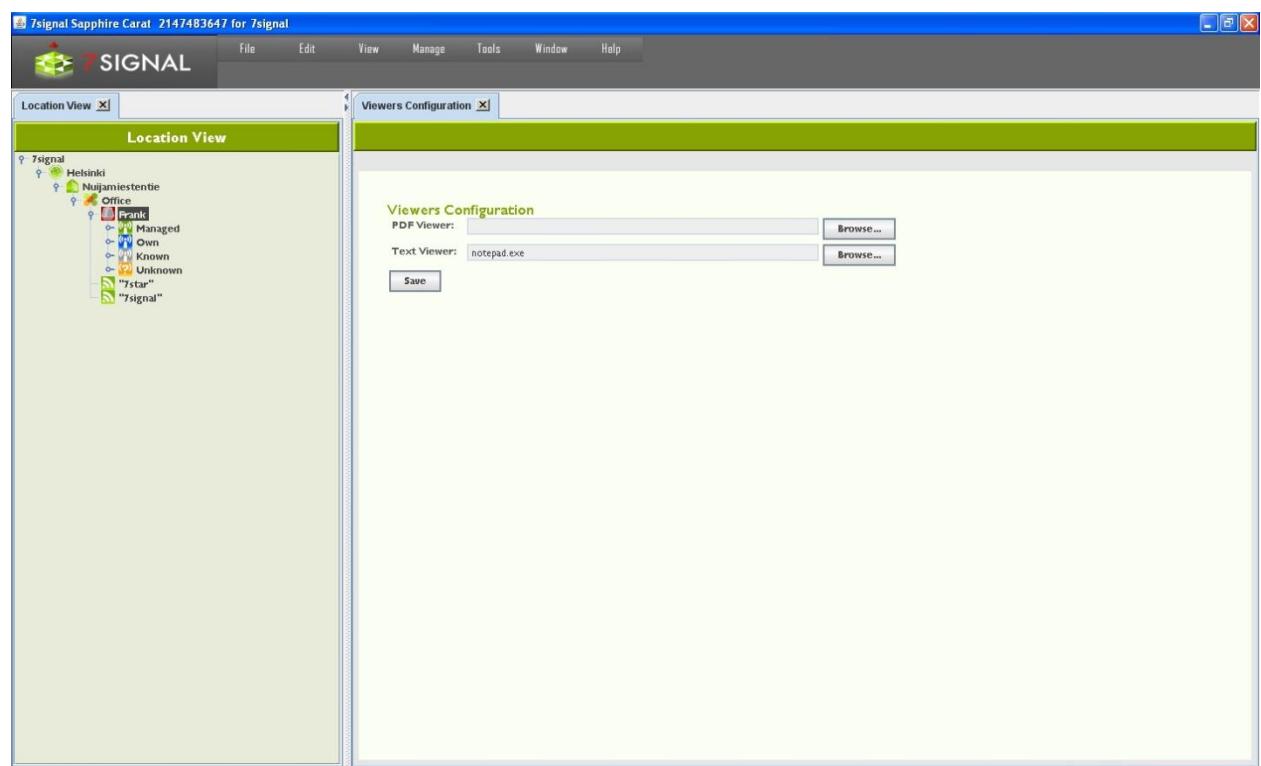
or alternatively

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"

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"

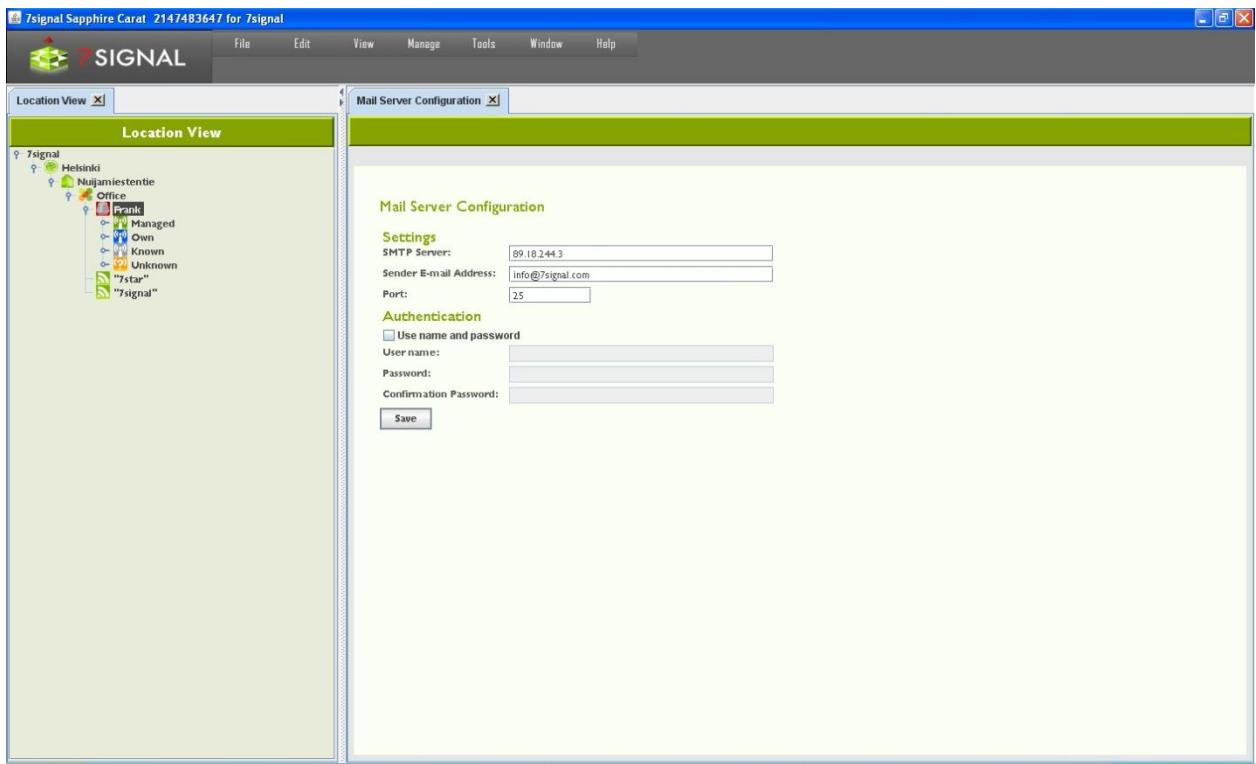


EMAIL SERVERS

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.

NOTE: there should be only one SMTP per user group.
 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”



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.

Backup options

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.

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. While this obviously is the most tempting option, it comes with a price of heavier administration.

To understand the difference between the methods – thus making one able to decide on appropriate backup policy – we must understand database logging methods first.

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'.

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 archive 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.

NOTE: 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.

NOTE: 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.

Backup method options

Default state

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.

Method handicaps:

- 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

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.

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.

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.

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.

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.

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
```

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.

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"

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
```

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.

Install NRPE daemon

Use online install with *yum*:

```
# yum install nrpe
```

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.

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.

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.

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