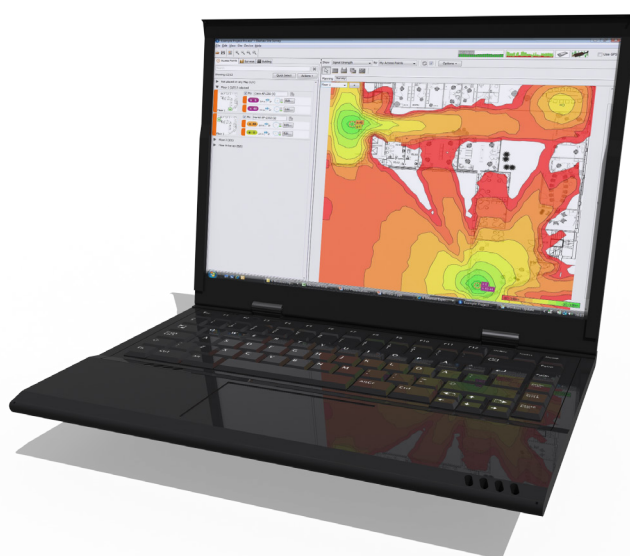


# Ekahau Site Survey

Wi-Fi Planning, Verification, Troubleshooting



## User Guide

v5.0

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# 1 Introduction

Welcome to Ekahau Site Survey (ESS). ESS is a tool for deploying and maintaining high-performance 802.11 Wi-Fi networks. This user guide is designed to help you to understand and make use of the many features of Ekahau Site Survey and demonstrate how these features can benefit you in the design, deployment and troubleshooting of Wi-Fi networks.

## Note

Do not operate Ekahau Site Survey and drive or carelessly walk at the same time. Stop using ESS and switch off the Wi-Fi device when it is forbidden to use radio equipment or when it may cause interference or danger.

## 1.1 Overview

Deploying and maintaining wireless networks offers many challenges beyond those of traditional wired networks. Because of the unpredictable and invisible nature of wireless, visual, professional tools are needed to achieve high performance. In order to support the business requirements of the organization, several important factors need to be considered:

- **Wi-Fi is invisible:** it is hard to make a clear picture of how far your network will reach and how it will work in different locations.
- **Wireless is fluctuating and unpredictable:** Whereas wired networks can be said to operate in a predictable way over a long period of time, wireless connections may work differently at any given time, depending on the conditions.
- **Wireless is ubiquitous:** Whereas a wired Ethernet only has a certain number of connection points, wireless access points can host numerous simultaneous connections, offering connectivity over great distances.
- **Capacity planning is fairly straightforward in wired networks .** However, wireless is a shared medium where the overall capacity is shared by multiple users at any given time.

For these and many other reasons, proper tools are required when designing, deploying, maintaining and troubleshooting Wi-Fi networks. Ekahau Site Survey is a state-of-the-art tool that makes Wi-Fi understandable and allows you to get the best out of your Wi-Fi network.

## 1.2 Features

Ekahau Site Survey is designed for use throughout the life cycle of your Wi-Fi network. Whether you are in the planning, deployment, verification, or troubleshooting phase, ESS has features to assist you. The key features of ESS are:

- **Automated Network Planning:** Automatically determine the optimal the number and location for your access points prior to physical deployment (*Ekahau Site Survey Pro only*)
- **Verification:** Perform active and passive indoor and GPS assisted outdoor site surveys to verify coverage and performance (*GPS support in Ekahau Site Survey Pro only*)
- **Analysis and Optimization:** Visualize network coverage and performance, fine-tune them, and simulate changes in the network or environment
- **Troubleshooting:** Solve various Wi-Fi issues
- **Reporting:** Generate reports of Wi-Fi coverage and performance (*Ekahau Site Survey Pro only*)

## 1.2.1 Feature Differences Between Professional and Standard

Ekahau Site Survey Standard includes tools for network verification, analysis, optimization, and troubleshooting. Ekahau Site Survey Professional version includes all the features in Standard, plus the following features:

- **Automated Network Planning:** Design a network off-site in 3D. Also enables planning for extended coverage or capacity for an existing network
- **Automated Reporting:** Automatically generates comprehensive network documentation, including coverage and performance maps, network infrastructure layout and configuration, and other information
- **GPS Enabled Outdoor Site Surveys:** For performing outdoor site surveys without clicking on the map using a GPS receiver (GPS receiver not included)

## 1.3 Technical Support

Ekahau provides technical support free of charge for all customers for 30 days. Customers who have purchased Ekahau Support will receive Ekahau Support services for 12 months from the date of purchase.

Ekahau Support includes:

- All upgrades and patches for the product(s) and documentation purchased
- Free-of-charge support via e-mail at [support@ekahau.com](mailto:support@ekahau.com) (preferred) and telephone during regular business hours (PST, EST, GMT+2)

Bug fix patches are free of charge for all customers.

To renew your Ekahau Support, please contact your Ekahau representative or [sales@ekahau.com](mailto:sales@ekahau.com).

## 1.4 Backward Compatibility

Ekahau Site Survey is backwards compatible with the following Ekahau products:

### 1.4.1 Compatibility with previous Ekahau Site Survey versions

- The Ekahau Site Survey 5.0 is able to open older project files (.esx). ESS 5.0 can open files created with any previous Ekahau Site Survey 4.x version as well as with Ekahau Site Survey 2.2 version.
- Older ESS 4.x versions are not able to open ESS 5.0 project files.
- RTLS Compatibility: Only Ekahau RTLS Controller (ERC) 5.0 can open ESS 5.0 project files. None of the previous Ekahau Positioning Engine versions can open ESS 5.0 project files. If you have an older EPE version and want to use the latest ESS, you will need to update the EPE.

### 1.4.2 License compatibility with previous Ekahau Site Survey versions

Ekahau Site Survey 5.0 and later versions require a new license that is not compatible with Ekahau Site Survey 4.x versions. If you have a valid Ekahau Site Survey Support package, but you have

not received a new Ekahau Site Survey 5.0 license, please contact Ekahau Support at [support@ekahau.com](mailto:support@ekahau.com) or your Ekahau Sales representative.



## 2 Installation

### 2.1 System Requirements and Software Limitations

The following hardware and operating system are required to run the program:

- Windows 7 (64 bit & 32 bit) , Vista (64 bit & 32 bit), or XP (32 bit only) Operating System
- 1+ GB RAM, 2GB+ RAM recommended for large projects
- 1GB free hard disk space
- A supported Wi-Fi adapter (visit <http://www.ekahau.com/devices>)
- Laptop computer (required for recording surveys, a desktop computer is sufficient planning and analysis)
- Screen resolution of 1024 x 768 or higher, 32-bit color quality recommended

#### Note

Ekahau recommends Windows 7 OS (64 bit) with 4GB RAM for project larger than 300,000 square feet.

#### Note

Currently GPS assisted site surveys are not supported in 64 bit operating systems.

The following is required for simultaneous active and passive surveys (Hybrid Surveys):

- Supported external Wi-Fi adapter for traditional passive surveys
- Integrated Wi-Fi adapter for end-to-end connectivity testing
- Network connection via the Integrated Wi-Fi adapter using Windows Wi-Fi management tool (Disable the third party Wi-Fi connectivity tool if enabled!)

Please consider the following limitations that apply to the program:

- The software may become unstable if a single Project file contains more than 10 000 access point MAC addresses
- The software may become unstable if images larger than 5000 x 5000 pixels are used
- The software may become unstable if more than 100 hours of survey data is recorded into a single Project

#### Note

USB Wi-Fi adapters are not fully supported in Windows XP OS. To take full advantage of Ekahau Site Survey in laptop with Windows XP OS, Ekahau recommends using Ekahau NIC-300-Cardbus Wi-Fi adapter.

### 2.1.1 Supported Wi-Fi Adapters

Ekahau Site Survey supports most common 802.11 Wi-Fi network adapters for conducting surveys regardless the card type. A wireless network adapter is not required if you do not wish to record signal data such if you just want to use the automated network planning feature.

Please visit our website for the complete list of supported Wi-Fi adapters:

<http://www.ekahau.com/devices>

The Ekahau Site Survey can conduct surveys in traditional passive mode as well as in active mode. When these surveys are conducted simultaneously, we call this as Hybrid Survey. The Hybrid Survey requires two Wi-Fi adapters to be used at the same time:

- An external Wi-Fi adapter (such as *Ekahau NIC-300-Cardbus* or *NIC-300-USB*) for Passive Survey
- An integrated Wi-Fi adapter for end-to-end connectivity testing in Active Survey

#### Warning

Intel Centrino Laptops with the built-in Wi-Fi chipset can be used for passive site surveys (RSSI measurement). However, since the measurement accuracy and network scanning speed is not optimal for passive site surveys, it is recommended to use a third-party network adapter, such as Ekahau NIC-300-Cardbus or NIC-300-USB instead for the passive site survey measurements.

## 2.2 How to Install

1. Make sure you have a supported network adapter inserted into your laptop (visit <http://www.ekahau.com/devices> for a list of supported adapters)
2. Double-click the executable file (.exe file) to start installation
3. Follow the on-screen instructions given by the Installation Wizard to install ESS
4. Follow the on-screen instructions to install Wi-Fi adapter driver and Ekahau Wireless Utility (see below for details)

### 2.2.1 Wi-Fi Network Adapter Driver Update

The external Wi-Fi adapter driver needs to be updated in order to collect signal measurements. The Wi-Fi adapter driver will be updated automatically during the installation.

Make sure you have a supported Wi-Fi adapter inserted when installing the product. Skip driver installation if you do not wish to conduct Surveys, or do not have a supported external wireless network adapter available at the time of the installation.

#### Note



If you did not have a supported adapter at the time of the installation (or if you chose to install the driver later for some other reason), you can install the WLAN adapter driver and the wireless connection utility later by selecting the **Install Cardbus/USB Wi-Fi Adapter Driver** from the program folder in the Start menu.

#### Note

It is also highly recommended to update the integrated Wi-Fi adapter's driver if used for either passive survey or active survey.

For Windows XP, the driver installation will also install the Ekahau Wireless Utility for managing the wireless connectivity. The Wireless Utility can be started from the Start menu. For more information, please use the help features in the Wireless Utility user interface. You may also choose to only install the driver and skip the Wireless Utility installation if you want to continue using a third party wireless utility.

If you wish to stop using the program, and thus also the customized network adapter driver, simply run the Wi-Fi Adapter Driver Installer from the Start menu again, and select Uninstallation.

## 2.2.2 Upgrading the Ekahau Site Survey License

The first time you start the software, you will be prompted for a license key. If you are evaluating the software, you do not need a license.

If you have purchased the product, you should have received the license key via e-mail. When prompted, type in the license key, as well as your name and company.

The software license will be tied to a selected network adapter. When starting the software, you will need to select the network adapter you wish to pair the license key with. The network adapter does not need to be a Wi-Fi adapter, you can pair the license with a fixed Ethernet adapter also - the network adapter just needs to be present when the software is started. The adapter you select at this point does **not** limit what Wi-Fi cards can be used with the tool.

After inserting the license, the tool will register the MAC address and the license key on-line. For this, **an internet connection is required when starting the software for the first time**.

If you wish to continue in the evaluation mode and upgrade the license later, go to **Help > About** and select Upgrade License.

#### Note

After registering the software, the network adapter will be checked every time the software is started. If the network adapter is removed or disabled, the software will not start.

---

The evaluation license has several limitations. For evaluating the product for network design and site surveys, the limitations are:

- Network planning is time-limited to 15 minutes
- Surveying is limited to 15 minutes
- Opening (except the Example Project), merging, reporting, and saving are disabled

## 3 Designing, Deploying and Troubleshooting Wi-Fi Networks

Below is shown a typical example on how high-quality wireless networks are designed, deployed and managed using Ekahau Site Survey. Network deployment strategies may vary, but most of the network deployments include several of the following steps:

1. **Define the Requirements**  
Determine what applications and the anticipated number of users the network will host. Determine service areas, network security policies, end user devices, funding and scheduling. From these, define the network coverage, performance, compatibility, and security requirements. Conduct a visual site inspection.  
In Ekahau Site Survey, you define the network requirements by selecting the type of application used in the network, such as “data” or “voice over IP”. You can also create your own custom network requirements. The requirements can be edited from **Site > Edit Requirements**.  
Once the requirements for your network have been defined, you can easily compare the network (simulated or measured) against the requirements using the Network Health visualization.
2. **Automatically Create the Network Plan with Auto-Planner** (*Ekahau Site Survey Pro only*)  
Use the ESS Auto-Planner to create a network plan for you automatically. The Auto-Planner automatically simulate access point locations and configurations without going on-site. ESS can visualize predicted coverage and performance, based on your requirements. In addition, you can manually adjust the AP locations and configurations or just manually create the complete network plan with simulated access points if needed.
3. **Perform Pre-Deployment Site Survey**  
The goal of the pre-deployment survey is to verify the accuracy of the network plan prior to purchasing and installing all the equipment. By performing pre-deployment site surveys, you can be more confident of the number of APs and that their installation locations are optimal. During the pre-deployment survey, you will also find all the third-party or rogue access points that may be radiating to the facility.  
When on site, power up an access point in one of the location defined in the Network Plan phase. Perform a site survey in the coverage area of the AP. Use the Freeze Access Point feature, and move the access point to the next location. Repeat this process for all the APs planned in the network design. The end results is a site survey of the whole facility, without having to purchase all the necessary network equipment.
4. **Fine-tune the Network Design**  
If the network meets your requirements, you can directly proceed to the next step. If the network does not meet the requirements, fine-tune the configuration using the simulation capabilities ESS in until it does.
5. **Deploy the Network Infrastructure**  
Based on the network plan, and the pre-deployment site surveys, deploy the wireless network infrastructure. Use ESS to store notes about the installation.
6. **Conduct a verification survey**  
Verify the network coverage and performance by conducting a site survey throughout the entire site.
7. **Analyze and fine-tune to finalize the network design**  
Analyze the network coverage and performance. If the verification survey reveals that the network still does not meet the network requirements, fine tune and re-survey until it does. Use the simulation and optimization features of ESS to perfect the network.
8. **Create documentation** (*Ekahau Site Survey Pro only*)  
Use the reporting feature to create complete documentation of the network installation, coverage, and performance with the click of a button.
9. **Troubleshooting, Monitoring, Maintenance, Expansion**

Problems do occur that cannot be “seen” from the Wi-Fi Controller, but have to be investigated on the client side. Use Ekahau Site Survey in combination with your Wi-Fi Controller to keep your wireless network up and running. Use the Live Network Status feature to quickly detect and solve basic Wi-Fi issues such as finding defective and / or misconfigured Wi-Fi Access Points. Conduct periodic site surveys to ensure flawless operation. Design for additional coverage or performance using the network planning features by simply opening the surveyed project file, and adding simulated access points on the surveyed data.

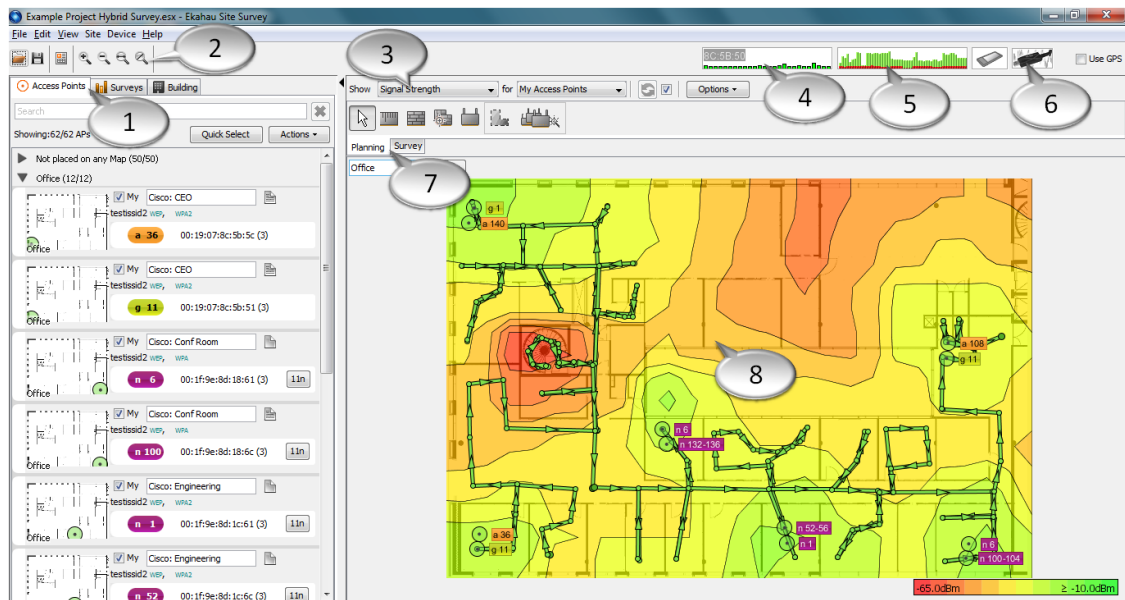
## 3.1 Ekahau Site Survey and Other Wi-Fi Tools

Ekahau Site Survey is a comprehensive tool that assists during the entire life cycle of a Wi-Fi network. However, there are other tools available that are complementary and worth considering also:

- **Wi-Fi Management softwares** are designed to assist in the set-up, monitoring and management of the network. While Wi-Fi controllers assist you in setting up the network configurations and monitoring the network on a high level, site survey tools can provide more detailed information not visible to the Wi-Fi controller. Some scenarios that ESS can solve are: Broken APs, unsuccessful configuration updates to the APs, rogue APs beyond the reach of your Wi-Fi APs, and coverage holes not detected by your APs. In addition, Ekahau Site Survey provides state-of-the-art tools for network planning and expansion whereas some controllers may provide basic tools for “ballpark” type network planning.
- **Spectrum Analyzers** help understand the radio frequency in more detail. Whereas Ekahau Site Survey provides a view to the audible Wi-Fi signals, a spectrum analyzer shows the non-Wi-Fi interference: It allows you to solve problems caused by such interfering devices as microwave ovens, wireless video cameras, and baby monitors. Ekahau recommends using Wi-Spy DBX Spectrum Analyzer which can be purchased together with Ekahau Site Survey. To purchase the the Wi-Spy DBX Spectrum Analyzer, please contact Ekahau Sales at [sales@ekahau.com](mailto:sales@ekahau.com).
- **Packet Analyzers (Protocol Analyzers)** solve issues that are not related to the Wi-Fi signals, but lie in the packet level. You can figure out exactly what kind of packets are being sent and received, and detect otherwise hard-to-detect problems, such as issues related to AP/Client configuration or incompatibility between the devices.

## 4 User Interface Overview

Figure 4.1. User Interface Overview



1. Access Point, Survey list, and Building view tabs
2. Toolbar
3. Visualizations Selections
4. Miniature Ping view - The digits on the top left are the last digits of the associated AP MAC address
5. Miniature Signal view
6. Spectrum analyzer quick launch
7. Planning and Survey tabs
8. Map view

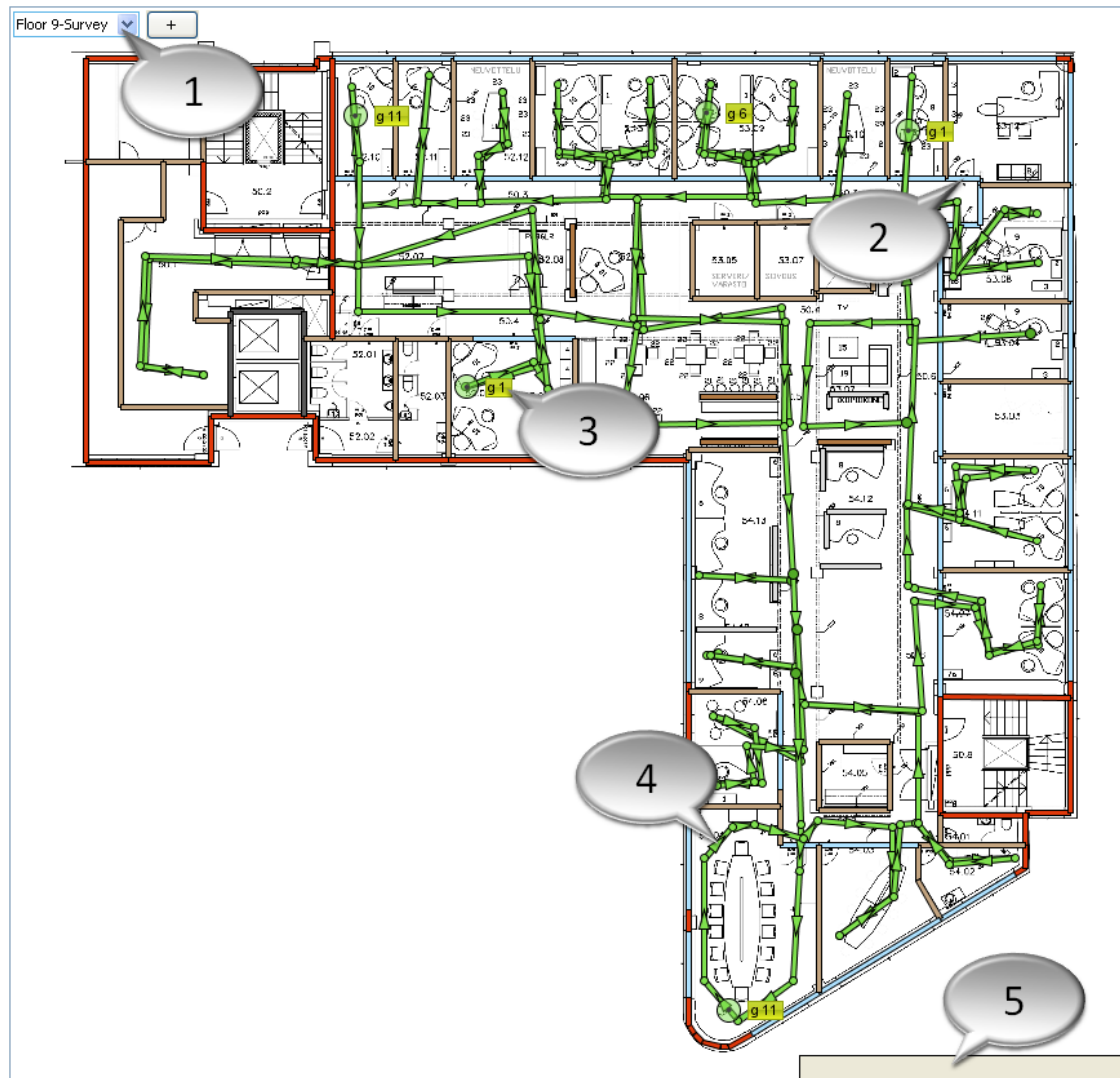
### 4.1 Map View

The map view is the most commonly used view in ESS. Use the map view to:

- Create network plans
- Perform site surveys
- Place and move access points
- Analyze and optimize the network coverage and performance

Zooming the map is done using the zooming buttons in the toolbar, using the mouse wheel, or from the View menu. You can also zoom by right-clicking on the map when using the Edit, Simulated Access Point, and Wall tools.

Figure 4.2. ESS map view










1. Select and add map
2. Drawing walls is not required if network planning is not used
3. An 802.11g access point on channel 1
4. Survey route - Arrows indicate survey direction
5. Visualization Legend - Click to adjust visualization value range and color scheme

## 4.2 Planning and Survey Tabs

Use the Planning and Survey tabs to access the most commonly used tools:






## The Planning Tab

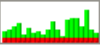


These tools are needed when working with a predictive design of a Wi-Fi network.

Icon	Name	Description
	Edit	<b>Edit Items on the Map.</b> Allows you to perform various functions to items on the map, such as move and delete.
	Scale	<b>Indicate Scale.</b> Indicate the scale of the map. Can also be used as a distance measurement tool.
	Simulated Access Point	<b>Place a Simulated Access Point on the Map.</b> Optionally select the properties of the AP prior to placing it.
	Floor Alignment	<b>Place a Floor Alignment Point.</b> Aligns the floor with the neighboring floors. Only needed when the 3D planner is used.
	Wall	<b>Draw Walls.</b> Only needed when the 3D planner is used.
	Coverage Area	<b>Indicate Coverage Areas for Auto-Planner.</b> Draw areas where you want Auto-Planner to provide Wi-Fi coverage and to place access points.
	Auto-Planner	<b>Open Auto-Planner.</b> Click to open the Auto-Planner configuration dialog and configure the Auto-Planner.

## The Survey Tab

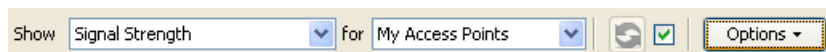
**Survey** - These tools are needed when performing site surveys or troubleshooting the network

Icon	Name	Description
	Edit	<b>Edit items on the map.</b> Allows you to perform various functions to items on the map, such as move and delete.
	Scale	<b>Indicate Scale.</b> Indicate the scale of the map. Can also be used as a distance measurement tool.
	Record Survey	<p><b>Perform Surveys:</b> Record signal measurements around the facility. Enable the tool, and walk around the map while clicking on your current location when you stop, start walking or change direction. If you check the <b>Auto-Place APs After Survey</b> checkbox, the access points will be automatically located after the survey.</p> <p>The GPS Record button is used for performing GPS assisted outdoor surveys.</p>
	Survey Inspector	<b>Inspect surveyed data in detail.</b> Click on the tool, and you will see the surveyed measurements on the map. Double click on the measurement to see measurement details.
	GPS Reference Point Tool	<b>Place GPS Reference Points</b> on the map. Without the reference points, the GPS coordinates cannot be converted to map coordinates, and thus the GPS information cannot be displayed on the map.

Icon	Name	Description
	Miniature Signal View	<b>Displays the currently measured signal strength (green) and noise (red) values.</b> Click to access the Live Network Status view. Shows "No Devices" if no devices are present.
	Network Adapter Setting	<b>Change Network Adapter Settings:</b> Click on the network adapter to change its settings or to select a different adapter to be used.
	Miniature Ping View	<b>End-to-end Testing:</b> Click to configure the host that is being used for end-to-end network connection testing and to access the Live Network Status Ping view








### 4.3 Visualization Selections

You can select the visualization by adjusting the two drop-down menus at the top of the screen - one selects the visualization and the other selects the access points to show the visualization for. More about visualizations in chapter *Analyzing the Wi-Fi Coverage and Performance* on page 53.



### 4.4 Toolbar

The toolbar includes the icons for the most common actions:

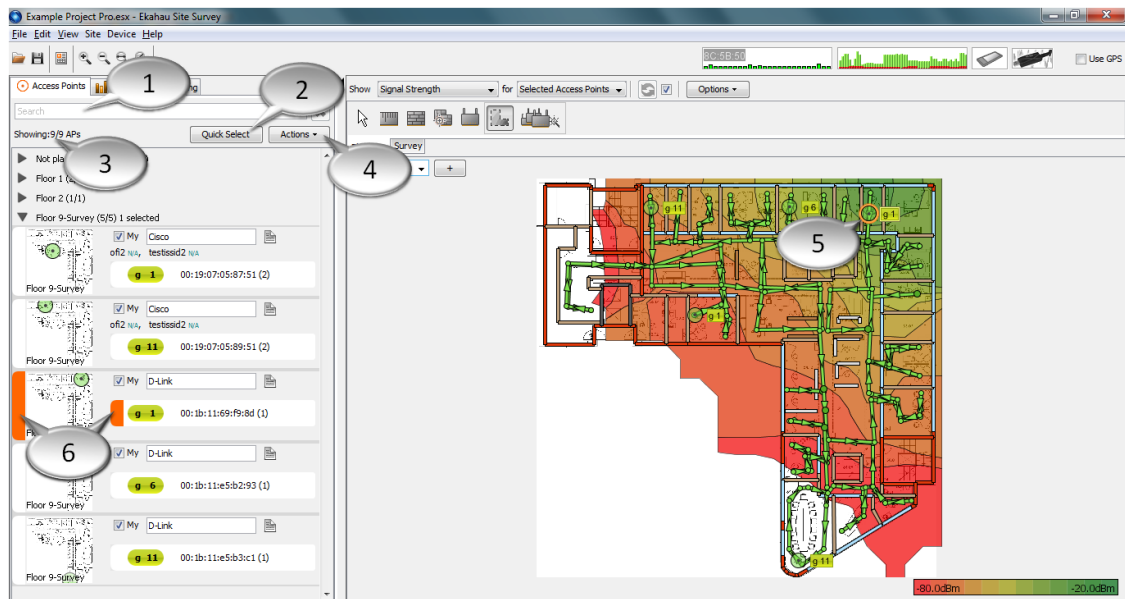
Icon	Name	Description
	Open	Open a Project
	Save	Save the Project
	Report	Generate a Report in PDF or RTF
	Zoom In	Zoom in to see an area in more detail
	Zoom Out	Zoom out to see a wider area of the map at once
	Zoom to Fit	Fit the map into the window
	Zoom 1:1	Zoom to see the map in its actual pixel size

### 4.5 The Access Point List

Both simulated and measured access points are listed in the Access Point List on the left-hand side of the screen. The access points are grouped by floor. Only the access points on the floor you are currently viewing are displayed by default. To see APs on other floors, click on the floor name to see the APs for that floor.



Figure 4.3. Access point list view



1. Search for specific AP(s) such as all APs manufactured by *D-Link*
2. Quickly select a group of APs
3. There are 12 APs on this floor, out of which 3 are shown
4. Perform actions to APs: Select All/None, Freeze, Join, Automatically Place APs on map, Edit
5. This AP is selected (Notice the orange color)
6. This AP is selected - Click here to select or de-select

### 4.5.1 Selecting Access Points

There are several methods to select which access points to visualize, edit, or select as My APs.

**APs can be selected one by one** either from the map or from the AP list:

- **To select APs on the map**, simply click on the AP to be selected. Click on the AP again to de-select it. The selected AP will be highlighted on the map, and in the AP list.
- **To select APs on the AP List**, click on the handle on the left-hand side of the AP list to select an AP - an orange color will indicate that the AP has been selected. Click on the handle again to de-select. You will also see the AP being highlighted on the map.

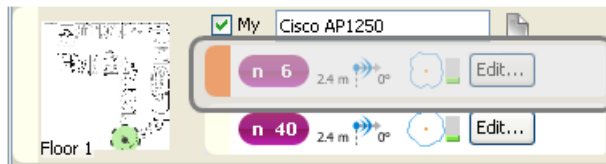
**Simulated APs can be selected in the same way as measured APs.** However, simulated multi-radio APs can be selected one radio at a time:

- **To select radios on the map**, click on the rectangle on the right-hand side of the AP. The rectangle will become highlighted with orange when it is selected.



- **To select radios on the AP List**, click on the handle on the left-hand side of the radio properties field.

Figure 4.4. Selecting one radio at a time

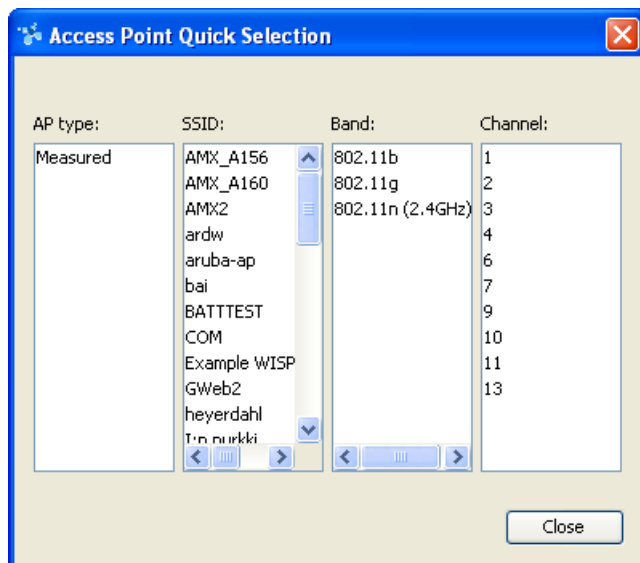


## Selecting Multiple Access Points at Once

To select multiple access points at once, you have two options:

- **To select all the access points**, choose **Actions > Select All**. Please note that if a search is used, **this action will only select all the searched access points**. To deselect all access points, select **Actions > Select None**.
- **To quickly select the APs with a given SSID, channel, or band**, click **Quick Select**, and click on the SSID, channel or band to select only the appropriate APs. You can also select only simulated or measured access points. If you select multiple criteria, such as SSID **and** band, only the access points matching **all** the criteria will be selected.

Figure 4.5. Access Point Quick Selection



## 4.5.2 Searching for Access Points

Use the Search text box to search one or more APs. Only the APs matching the search criteria will be displayed. To display all access points, either delete the search field or click on the X button next to the search field. The following search options are available:

Example Search Terms	Description
00:17:0f, 00:17:0f:12:ab:a1	Search by a partial or complete <b>MAC address</b>

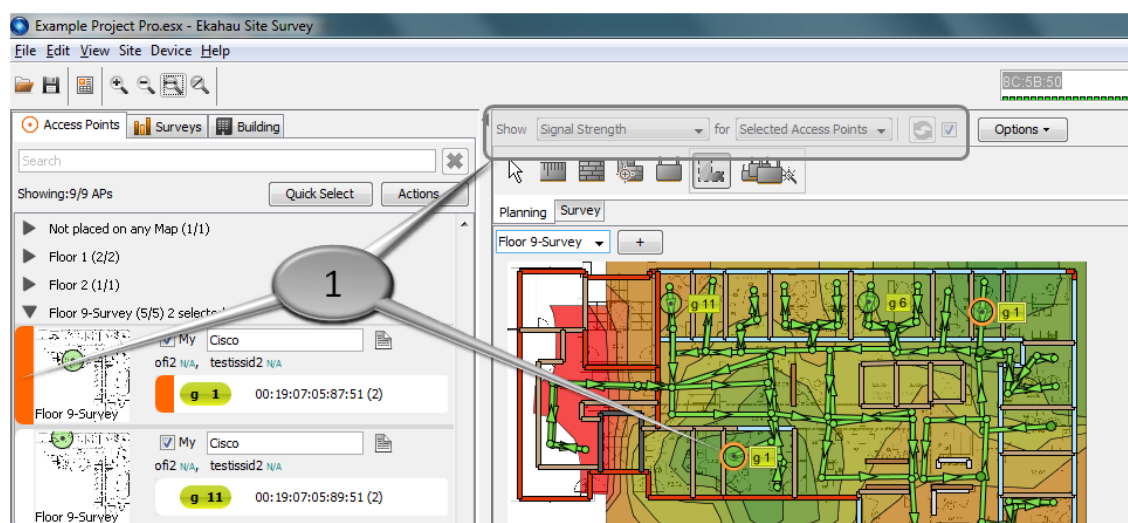
Example Search Terms	Description
Nortel, Siemens, Simulated AP 4	Search by the <b>name</b> of the AP. The name is defaulted to the vendor with measured access points.
guest, tsunami	Search by the <b>SSID</b> the AP is on
802.11a, 802.11b	Search by the <b>802.11 standard</b> the AP supports
my	Search only the <b>APs selected as My</b>
other	Search only the <b>APs not selected as My</b>

### 4.5.3 Visualizing Selected Access Points

You can limit the access points to be included in the heat map visualizations from the drop-down menu next to the Visualization Selection menu.

- Showing the visualization for **All Access Points** displays the visualization (heat map) using the information from all the access points. For example, if you want to see the total number of access points on a given map, select *Show Number of APs for All Access Points*
- If **My Access Points** is selected, the visualizations will only be shown using the data of the access points checked as *My* from the AP List. For example, if you want to see the coverage area of **your network**, select *Show Signal Strength for My Access Points*. Selecting *All Access Points* instead of *My Access Points* would include neighboring and rogue access points, and thus overly optimistic results would be displayed.
- Having **Other Access Points** selected is the exact opposite for selecting My Access Points. For example, if you want to show the signals from access points that are not in your network, select *Show Signal Strength for Other Access Points*.
- If **Selected Access Points** is selected, only the access points that have been selected in the Access Points list will be taken into account into the visualization. For example, if you wanted to see the coverage area of a single access point, first highlight that access point from the AP list, and then select *Show Signal Strength for Selected Access Points*. See the example picture below.

Figure 4.6. Visualizing only selected access points



1. In the example, ESS visualizes only those APs that are selected (notice the orange color)

#### 4.5.4 Selecting My Access Points

During the site survey, all the audible access points will be detected. It is important to segregate the access points in your network from the other access points, such as the APs radiating from the nextdoor building. The **My** checkbox in the AP list indicates whether an AP is in your network or not.

You can select My APs either one by one, or by selecting multiple access points first and then selecting or de-selecting the My checkbox to select or de-select multiple APs to/from My APs. For example, if you have Nortel APs (and there are no other Nortel APs around):

1. De-select all the APs from My selection: Click **Actions > Select All** and then choose **Actions > Deselect from My**. Now none of the APs are selected as My.
2. Next, type "Nortel" into the Search text box
3. then click **Actions > Select All** to select all the Nortel APs.
4. To select all the searched Nortel APs as My, click **Actions > Select as My**, and all the Nortel APs will now be selected as My.

#### 4.5.5 Renaming Access Points

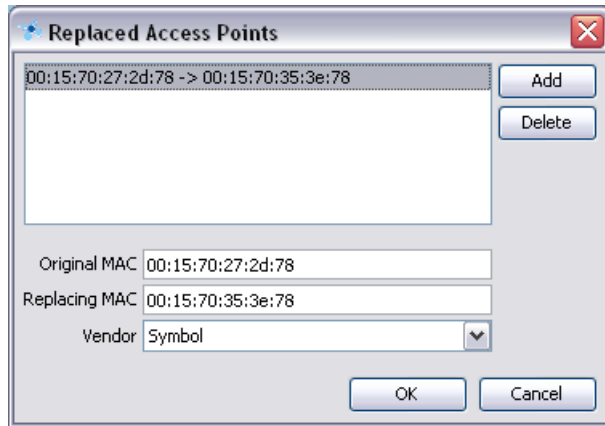
By default, the measured access points are named by the AP brand, such as Nortel, Cisco or Siemens. The simulated APs are named using running numbers by default. To rename the APs, simply click on the name field, and type in a custom AP name.

#### 4.5.6 Replacing Access Points

If an access point breaks down, there is no need to perform a new survey. There are two options you can do:

- **If the access point is replaced by another, identical AP in the same location:** In the AP List, click on the MAC address of the access point and select Replace MAC, and type in the MAC address of the new access point to the *Replacing MAC* field.

Figure 4.7. When replacing access points, remember to select the correct Vendor setting (if not selected by default) to ensure that the multi-MAC access points are replaced correctly.



- **If the access point is not replaced by an identical AP:** Deselect the access point from the My Access Points using the Surveys list.

#### Note

If the access point is replaced by another AP, but not with an identical one, you need to perform a new survey within the coverage area of the new access point.

### 4.5.6.1 Replacing Single-MAC and Multi-MAC Access Points

**When replacing access points distributing just one MAC address,** use the "Generic - one MAC replaced" Vendor option.

**In case of Multi-MAC access points** (APs that are sending out one MAC per SSID), ensure that the vendor has been selected correctly to apply the changes to the whole MAC range of the AP. If your vendor has not been listed, there are several options:

- Change the MAC addresses of the replaced AP one-by one using the *Generic - one MAC Replaced* vendor option .
- Use the *Generic - Up to 16 Virtual MACs Replaced* option to replace all the MAC addresses automatically. This option should be used if the last hex number (4 bits) of the MAC address changes between different SSIDs.
- Use the *Generic - Up to 64 Virtual MACs Replaced* option to replace all the MAC addresses automatically. This option should be used if the last 6 bits of the MAC address change between different SSIDs.

### 4.5.7 Adjusting the Properties of Measured Access Points

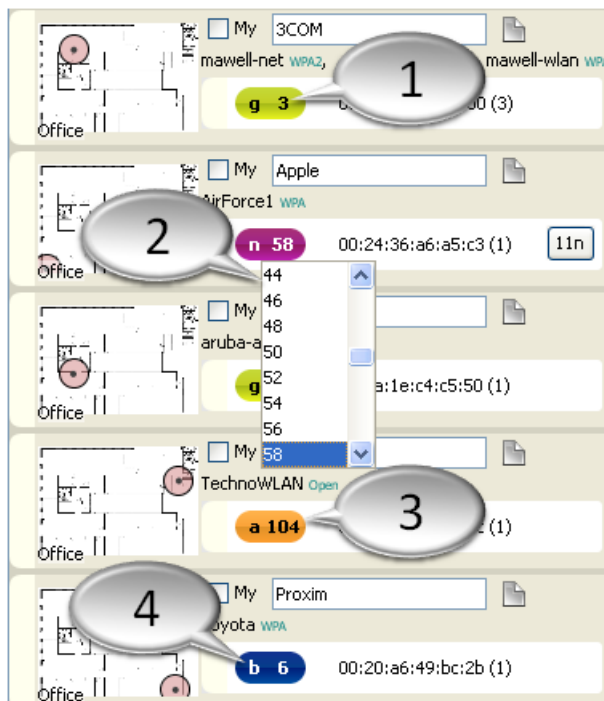
By default, the names of the measured access points are defaulted as the AP manufacturers. To change the name, edit the text box.

Edit the AP notes by clicking on the note icon. This information may include AP mounting information, name of the person responsible for installation, cabling information and so on. An empty

paper is displayed if there are no notes for the AP, and a paper with text will be displayed if notes are written for the AP.

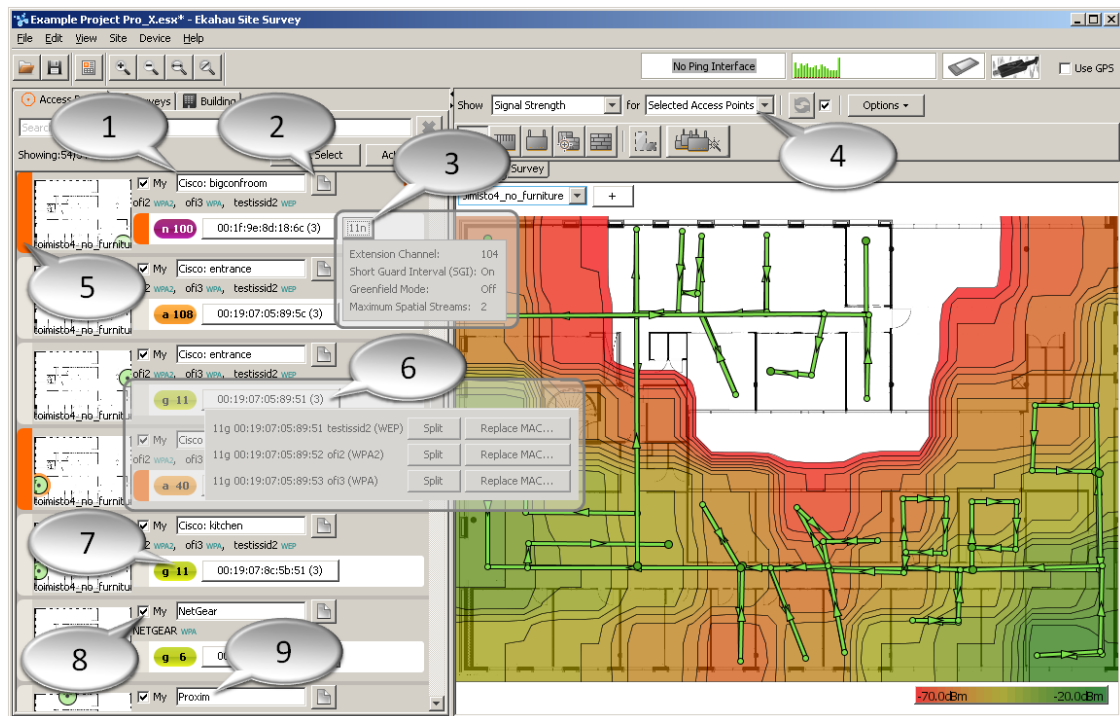
In some cases, the surveyed network shows high interference due to inoptimal channel selections of the APs. Ekahau Site Survey allows you to simulate how interference (and thus, network performance) would change if the AP channels were changed. To simulate a channel change for a measured AP, simply click on the 802.11 channel selection drop-down menu and change the channel. 802.11b band channels are presented in blue, 802.11g channels in green, 802.11a channels in orange, and 802.11n channels in purple. The impact of the channel change will be visualized on the map thereafter.

*Figure 4.8. Channel selection view*



1. 802.11g Band (Green)
2. 802.11n Band channel selection (Purple)
3. 802.11a Band (Orange)
4. 802.11b Band (Blue)

Figure 4.9. Working with access points



1. The names of Cisco APs are automatically shown
2. Notes
3. Measured 802.11n properties
4. If "Selected Access Points" is selected, the visualization will be displayed only for selected APs
5. This AP is selected - Select and de-select from here or from the map
6. Multi-MAC and SSID access point - This AP has three SSIDs and MACs
7. The channels of the AP - Click to see how changing the channel(s) would impact the network
8. Selected as "My" which means that this AP belongs to my network
9. Name (defaults to brand)

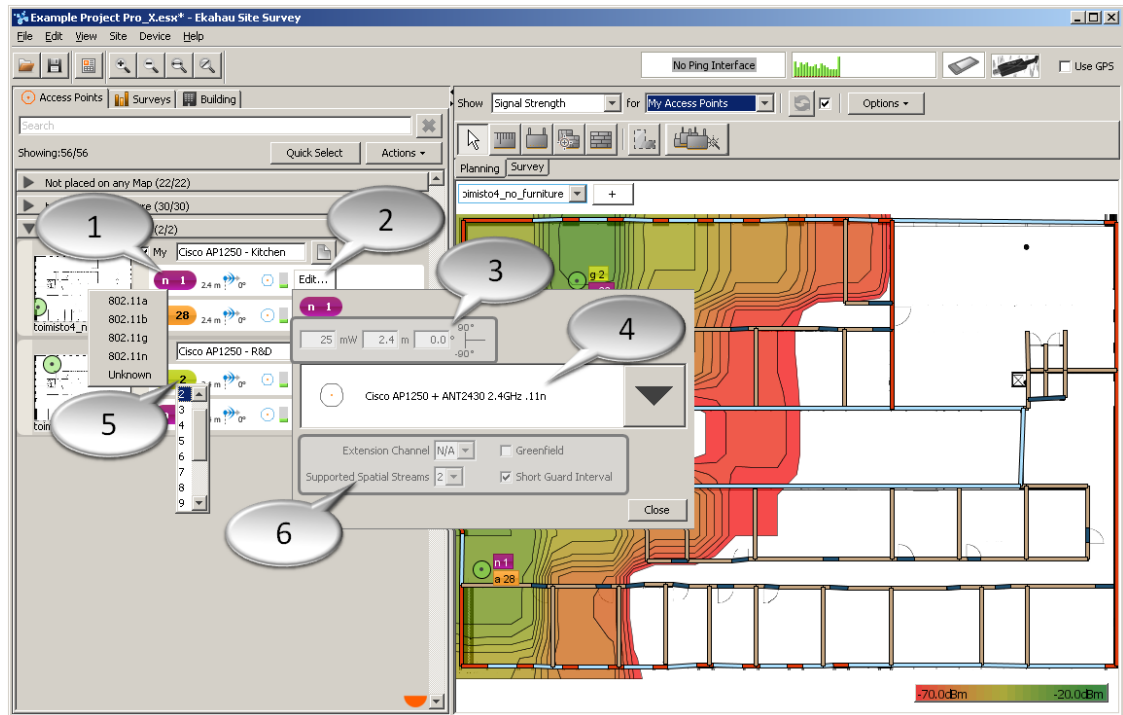
### 4.5.8 Adjusting the Properties of Simulated Access Points

For simulated APs, you can change the following parameters:

- **AP Band:** Whether the AP is 802.11a, 802.11b, 802.11g, or 802.11n. Select from the 802.11 technology button.
- **AP Channel:** The frequency channel the AP is operating at. Select from the channel button.
- **AP Radio Transmission Power:** The transmission power at which the AP radio is transmitting the signal. Click on the Edit... button and edit the text field to adjust.
- **Antenna Type:** Directly impacts the coverage area of an AP. Click on the Edit... button and click on the drop-down menu to select an antenna.
- **Antenna Height:** The higher the antenna, the weaker the signal strength will be below the AP. To adjust the height, click on the Edit... button and edit the height text field.
- **Antenna down tilt:** Some antennas are meant to be tilted down for optimal coverage. To adjust the downtilt, click on the Edit... button and type in the downtilt in degrees to the textbox.
- **Notes:** Add text information about the access point.

To edit the properties of multiple APs at once, select the simulated access points you would like to edit, and click **Actions > Edit Selected Simulated Access Points**.

Figure 4.10. Adjusting simulated access points



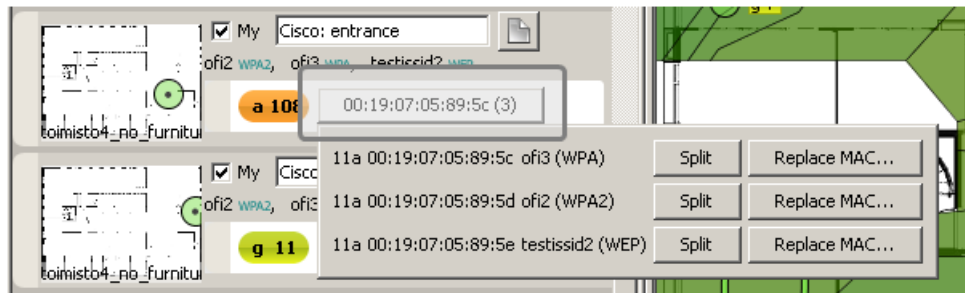
1. 802.11 Technology (a/b/g/n)
2. Click on the Edit... button to adjust antenna properties
3. Tx Power, Height, and Antenna downtilt properties
4. Antenna type
5. Channel
6. 802.11n properties

### 4.5.9 One Access Point, Multiple MAC Addresses

Many modern access points can be configured to broadcast several MAC addresses from a single physical access point. An example of this feature is when an AP is configured for multiple SSIDs. In order for Ekahau Site Survey to work properly in "multi-MAC environments", the MAC addresses coming from a single AP should be joined together. Ekahau Site Survey can join the MAC addresses automatically and alternatively manually. To view all the (joined) MAC addresses one single AP broadcasts and their corresponding 802.11 technologies and encryption methods, click on the **MAC address** button.



Figure 4.11. This single physical access point broadcasts three different MAC addresses and SSIDs



### 4.5.9.1 Automatic and Manual Joining of Multi-MAC Access Points

#### Automatic Detection of Multi-MAC Access Points

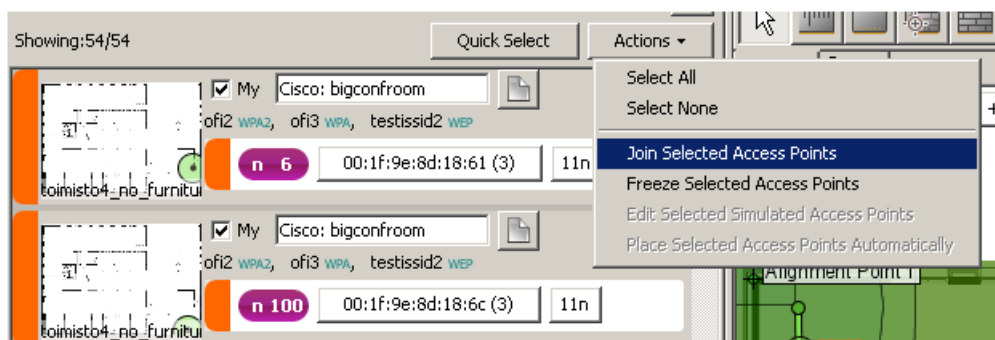
By default, Ekahau Site Survey automatically joins together all major Wi-Fi vendors' light-weight, enterprise access points working on a multi-SSID. This option can be removed from **View > Auto-Detect Multi-MAC Access Points**. You can also adjust the auto-detection to only automatically join only selected brands of access points.

#### Manual Joining of MAC Addresses

If the access points are not joined together automatically and are broadcasting several MAC addresses, they can be joined manually:

1. Select all the access points from the AP List that are actually a single access point
2. Select **Actions > Join Selected Access Points**  
The two MAC addresses are now treated as a single access point.

Figure 4.12. Joining multi-MAC access points manually

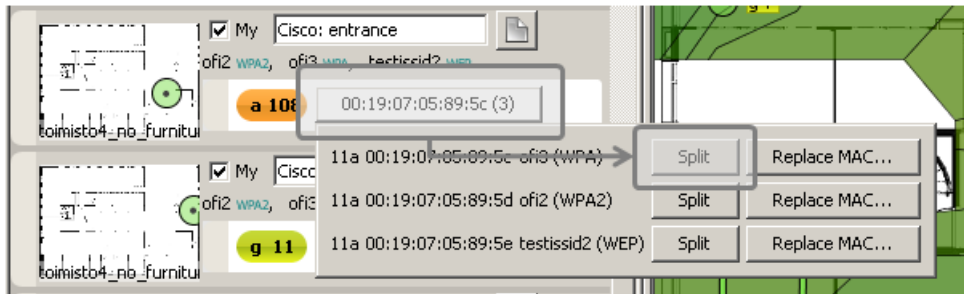


### 4.5.9.2 Splitting Falsely Joined Access Points

There might be cases where Ekahau Site Survey falsely detects and joins access points as Multi-MAC AP. This might be the case for example with some legacy Cisco access points. These falsely joined APs can be recognized from oversized signal coverage and from multiple distributed high signal strength peaks.

To split an falsely joined access point, click on the **MAC address** button of the falsely joined AP on the AP List view and after that, click on the **Split** button of the MAC address you want to be distinguished.

Figure 4.13. Splitting access points



### 4.5.10 802.11n Characteristics

802.11n is the latest iteration of Wi-Fi, promising higher bandwidth up to 600Mbps, range, reliability and throughput than its predecessors 802.11a/b/g standards. Some of the main technical characteristics that enable these improvements in 802.11n are the number of Spatial Streams which is related to MIMO (Multiple Input Multiple Output), Extension Channel, Greenfield, and Short Guard Interval (SGI):

#### Spatial Streams

In 802.11n the data stream is divided into multiple parts called spatial streams. Each spatial stream is transmitted through separate antennas to corresponding antennas on the receiving side. When the number of spatial streams is doubled from one to two, the *maximum* data rate is also doubled from 150Mbps to 300Mbps. With three spatial streams it is possible to achieve 450Mbps data rate and with four spatial streams 600Mbps data rate.

#### Extension Channel

The 802.11n's optional extension channel is used to double the available bandwidth to achieve higher data rates. This is done by bonding two channels to occupy 40MHz channel width. In legacy 802.11 Wi-Fi networks, the typical channel width is 25MHz. Thus, there is a good chance that the 40MHz extended channel overlaps with some nearby legacy Wi-Fi networks enough to cause interference. It is highly recommended to use extension channel only in 5GHz frequency band due to the limited number of non-overlapping channels available in 2.4GHz frequency band.

#### Greenfield Mode

The Greenfield mode is used to improve efficiency in pure 802.11n networks by eliminating the unnecessary support for 802.11a/b/g devices. When this mode is enabled, only 802.11n clients can access the network. Thus, if you have legacy 802.11 clients that cannot access the network, make sure that you have this mode disabled.

#### Short Guard Interval (SGI)

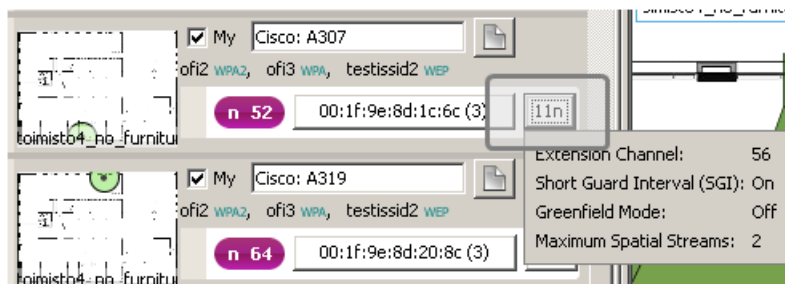
Guard Interval defines the time between each distinct data transmissions. It is used to ensure that the distinct transmissions in the network do not interfere with each other when there are propagation delays, echoes, and reflections. Typically the guard interval should be two to four times the transmission delay spread. In 802.11a/g networks, the (long) guard interval is 800 ns allowing 200

ns delay spread. By shortening the guard interval it is possible to increase throughput of the network. Most office and home environments have much smaller delay spread than 200 ns, typically 50-100 ns. Thus, Short Guard Interval of 400 ns can boost the throughput by avoiding unnecessary idle times in the network.

#### 4.5.10.1 Measured Access Points

Ekahau Site Survey can measure the 802.11n characteristics during site surveys. To view the characteristics of an 802.11n AP, click the **11n** button on the Access Point List view.

Figure 4.14. 802.11n characteristics

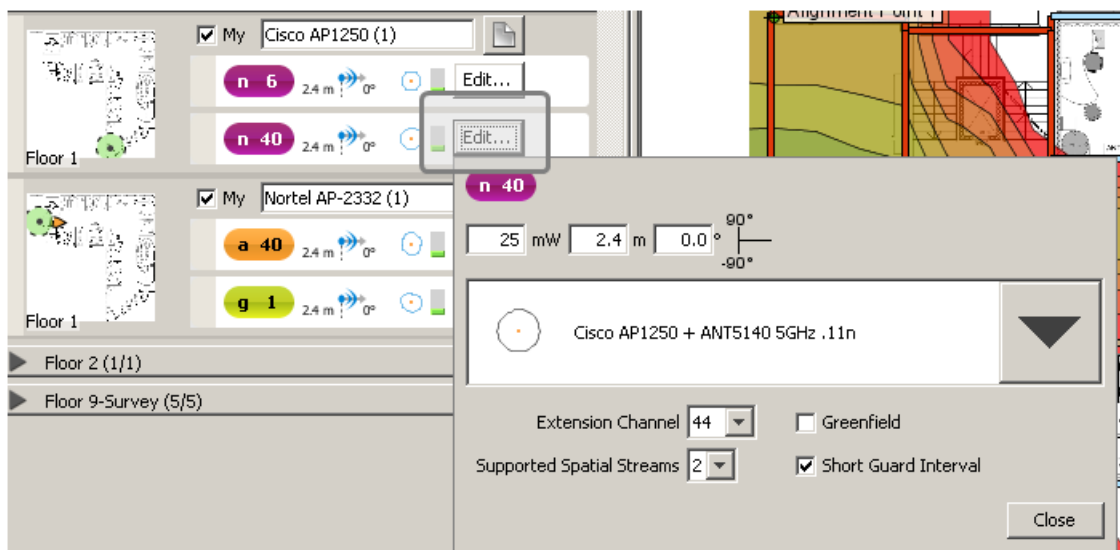


In the above example, the AP with *Cisco: A307* SSID has bonded two channels, 52 and 56 where the channel 56 is the extension channel. The AP has SGI enabled, Greenfield mode disabled, and it uses two spatial streams.

#### 4.5.10.2 Simulated Access Points

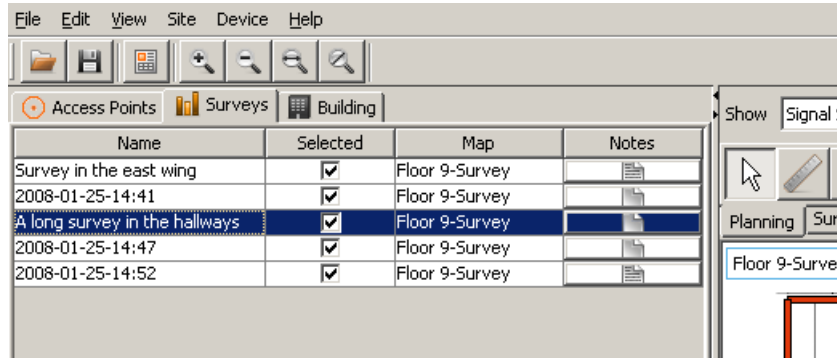
The 802.11n characteristics can also be adjusted when working with simulated 802.11n access points. To adjust the characteristics of an 802.11n AP, click the **Edit...** button of the simulated AP on the Access Point List view. Note that access points with multiple radios need to be adjusted one radio at a time.

Figure 4.15. Adjusting 802.11n characteristics of an simulated access point



## 4.6 The Surveys List

Figure 4.16. Surveys list



Every time you stop a survey (by right-clicking the mouse when surveying), a Survey will be added to the Surveys list. The Surveys list will show the name of the survey, as well as the map the survey was performed on.

Using the Surveys list, you can select and de-select the surveys. If you want to visualize the network coverage and performance for specific surveys only (such as only the surveys that have been performed recently), simply de-select the other surveys. **To select, de-select, and delete multiple Surveys**, simply select more than one Survey, right-click on one of the surveys, and select the desired action from the context menu.

Similarly to access point notes, you can also write down notes for each survey. Simply click the note icon to edit the survey notes.

## 4.7 The Building View

The building view is only necessary when creating three dimensional network plans. For information on how to use the Building View, see chapter Designing a Wi-Fi Network.

## 4.8 Menus

Use the menus to access file operations, site specific operations, zooming and more.

Menu	Selection	Description
File	New	Create a new Project
File	Open	Open an existing Project
File	Save	Save the Project using the existing file name
File	Save As	Save the Project using a different file name
File	Export as XML	Export the Project as an XML file

Menu	Selection	Description
File	Export Image	Export the currently displayed map image and visualization
File	Print Image	Print the currently displayed map image and visualization
File	Report	Generate a report of the network
File	Merge	Merge another Project with the current Project
File	Preferences	Change the product preferences, such as the length unit
File	Exit	Exit the program
Edit	Undo	Undo the previous action
Edit	Redo	Redo the undone action
View	Zoom In	Zoom in to see an area in more detail
View	Zoom Out	Zoom out to see a wider area of the map at once
View	Zoom to Fit	Fit the map into the window
View	Zoom 1:1	Zoom to see the map in its actual pixel size
View	Surveys	Show or hide the survey routes
View	GPS Reference Points	Show or hide the GPS Reference Points
View	Access Points	Show or hide the access point icons
View	Access Point Names	Show or hide the access point names
View	Floor Alignment Points	Show or hide the Floor Alignment Points
View	Walls	Show or hide the Walls
Site	Add Map	Add a map to the Project
Site	Duplicate Map	Make a duplicate of the currently displayed map
Site	Change Map Image	Change the currently displayed map image
Site	Remove Map	Remove a map from the Project
Site	Active Map	Select the currently displayed map
Site	Edit Requirements	Edit the network requirements

Menu	Selection	Description
Site	Start Auto-Planner	Open Auto-Planner dialog and choose network requirements for the network simulation
Site	Locate Surveyed Access Points	Automatically place the access points (that were detected during the survey) on the map
Site	Clear Surveyed Access Points Locations	Clear all AP locations from the map
Site	Auto-Detect Multi-MAC APs	Automatically detect access points distributing multiple MAC addresses
Site	Replaced Access Points	View Replaced Access Points
Site	Edit Project Notes	Edit text notes about the Project
Device	Live Network Status	View the currently audible Wi-Fi signals, and quickly troubleshoot issues without a map
Device	Devices	Shows the currently connected Wi-Fi devices
Help	Quick Guide	Open the Quick Guide
Help	User Guide	Open the User Guide
Help	About	See product information, upgrade license

## 4.9 Software Preferences

To adjust software preferences, go to **File > Preferences**. The preferences include:

- Changing the length unit (meters / feet)
- Setting the regulatory domain to limit network adapter scanning
- Enabling or disabling Real-Time Location Tracking System features
- Enabling or disabling automatic map scrolling while surveying

## 5 Starting to work with Ekahau Site Survey

### 5.1 Starting Ekahau Site Survey

After the installation, ensure the following before starting Ekahau Site Survey:

- For traditional passive surveys: A supported Wi-Fi adapter is enabled and connected to your laptop (Visit <http://www.ekahau.com/devices> for the list of supported adapters)
- For Hybrid Surveys: A supported external Wi-Fi adapter is connected to your laptop and a supported integrated Wi-Fi adapter is enabled and associated with a Wi-Fi network using the Windows Wi-Fi Management tool
- All other programs are closed
- You are logged in as the computer administrator, or have administrative privileges

To start Ekahau Site Survey, click **Start > Programs > Ekahau > Ekahau Site Survey**.

### 5.2 Setting the Map and Scale

The functionality of the program mostly relies on the floor plan(s) of the facility. You will need to insert at least one map and set its scale. For multi-floor buildings, add multiple maps, one for each floor.

#### Note

Maps larger than 5000 x 10000 pixels are not recommended to be used as this slows down the software. For optimal performance, please use maps smaller than 5000 x 5000 pixels.

To insert a map, click **Site > Add Map** or click the **+** sign next to the map selector.

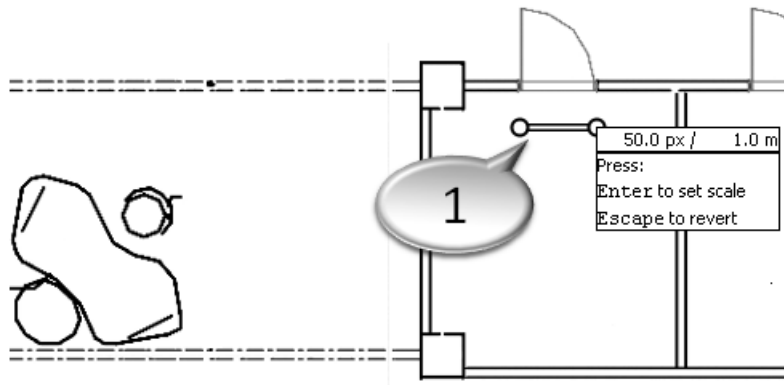
The following image formats are supported for maps:

- BMP, WBMP
- JPG, JPEG
- PNG
- GIF
- SVG (SVG drawings)
- DWD, DXF (CAD drawings)

You also need to set the scale for each map. To set the scale, you need to know the distance between two points on the map. It is recommended to use a measuring tape to measure the distance between the points. Once measuring the real-world distance, set the scale in ESS:

- Select the scale tool
- Indicate the distance between the two points by clicking the first point, and holding down the left mouse button while moving the mouse pointer to the second point
- You will see a line between the two points, and a tooltip indicating the number of pixels. Click on the tooltip on the ft / m field and type in the distance between the two points in feet or meters.

*Figure 5.1. Use common objects whose width / length is typically known such as doors to set the correct scale*



1. The door width is 1 meter / 3.3 feet which in this map image corresponds to 50 pixels.

#### Tip

To set the length unit between feet and meters, go to **File > Preferences**.

#### Note

It is highly important to set the correct scale! Otherwise some visualizations and simulations may not be shown correctly.

### 5.2.1 Changing the Map Image

In some cases, the underlying map image used needs to be changed, without losing all the information about the surveys or about the predictive design. To change the underlying map image, go to **Site > Change Map Image**.

#### Note

The replacing map image needs to be of the same size and scale as the original map image.

## 5.3 Defining Network Requirements

Each Wi-Fi installation is different. Whether the network is used for e-mails, voice over Wi-Fi, or location tracking, the application determines what kind of coverage and performance is required from the network. Ekahau Site Survey allows you to set the requirements for the network, and see



if the requirements are met, with a single view. In Ekahau Site Survey, the following criteria are included in a Requirement:

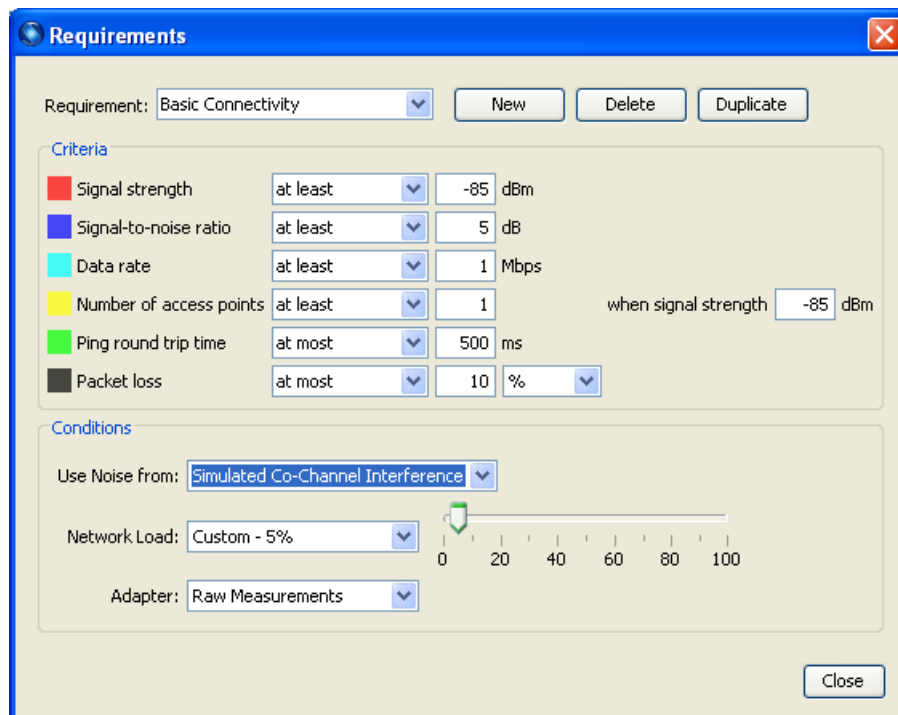
- **Signal strength** (minimum signal strength for the strongest AP)
- **Signal-to-noise ratio** (minimum SNR, given a minimum allowed data rate in the network)
- **Data rate** (minimum)
- **Number of audible APs** (the minimum number of audible APs, given a minimum signal strength)
- **Ping Round Trip Time** (minimum round trip time for ping)
- **Packet Loss** (packet loss %, calculated from the last 10 packets)

In addition to requirements, you can choose the following conditions that affect the coverage and network performance:

- **Use Noise from** (the source of the noise data - choose either Measured Data, Simulated Interference or Automatic which uses Measured Data when available )
- **Network load** (the estimated amount of wireless traffic in the network)
- **Adapter** (the end users' wireless adapter)

To define the Requirements, select **Site > Edit Requirements**.

Figure 5.2. Setting the wireless network requirements using the Requirements dialog



The Requirement defines what your network is used for. You can either select one of the pre-defined Requirements, such as Basic Connectivity or Voice over WLAN. If none of the Requirements matches the purpose your network will be used for, you can either customize the existing profiles or create new ones. If you want to keep the existing Requirement, and want to make a slightly different one, you can make a duplicate of the selected Requirement. The requirements are explained in more detail in chapter **Visualizing Network Coverage and Performance**.



## 6 Designing a Wi-Fi Network

### Note

The network design capabilities are only available in Ekahau Site Survey Pro version. You may skip this chapter if you want to directly perform site survey, or troubleshooting.

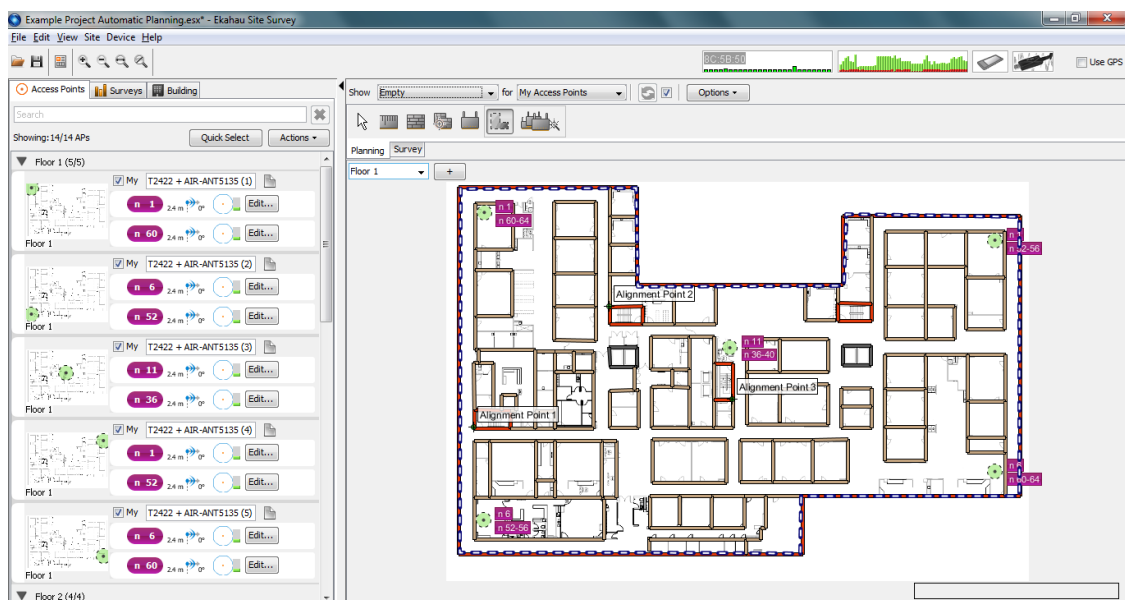
When designing a new Wi-Fi network, Ekahau Site Survey is able to create a network plan for you automatically. In ESS this feature is called as **Auto-Planner**. The Auto-Planner saves you significant amounts of time by cutting down the manual work of placing access points and configuring their channels by hand.

Prior to deploying a Wi-Fi network with the Auto-Planner, you will need to indicate the coverage area(s) where you need Wi-Fi coverage. In addition, you will need to draw walls for the coverage area(s) so that ESS can calculate the optimal AP locations and configuration(s). In case you want to deploy a network plan for multi-floor building(s), please refer to chapter *Designing Wi-Fi Networks for Multi-Floor Buildings* on page 40 for more information on how to define multi-floor buildings.

Proper network planning will reduce costs in the long run, and will lead to better coverage and performance also. After creating the network plan, you will know:

- The optimal locations for your Wi-Fi access points
- Antennas and their alignment
- Optimal AP configurations, such as transmission power and channels
- The predicted coverage and performance of your network

Figure 6.1. A network plan with walls, simulated access points, and floor alignment points



### Note

If you leave the access point transmit power settings to Automatic Radio Management (Radio Resource Management, Radio Management) from your wireless LAN management software, using the default 25mW transmit power is recommended when creating simulated APs .

## 6.1 Creating a Network Plan with Auto-Planner

### Note

You can use the Auto-Planner only with empty projects. In case there are simulated access points in the project, the Auto-Planner will clear them from the project. The auto-planner will not take in account recorded survey data either. Thus, the Auto-Planner cannot be used for network expansion.

In order to create an accurate network plan, you will need to have the map(s) and scale(s) set. You will also need to define the main walls of the building. With this information, ESS can calculate the Wi-Fi signal propagation. Once the environment has been defined as well as the desired coverage area, you can use the Auto-Planner to create the network plan. Alternatively, you can create the network plan by yourself by placing and configuring simulated access points. Both methods are explained in detail in the following chapters. For more information on how to add maps and how to set scales, please refer to chapter *Setting the Map and Scale on page 29*

### 6.1.1 Drawing and Editing Walls

To define the environment, you will have to draw walls. To do this, you will need to go to the **Planning tab** and select the **Wall tool**. First, you will need to select the wall material that most closely matches the wall you're going to draw. To draw the walls, simply keep left-clicking on the map. If you want to end the wall drawing, just right-click.

You can edit the walls that you have drawn by first selecting the **Edit tool** and left-clicking the wall you want to edit. You can edit multiple walls at the same time by holding down the **Ctrl** key while selecting the walls. To edit the wall(s), simply drag-and-drop the wall(s) to its new location. You can also change the wall material by right-clicking the wall and selecting **Change Wall Type**.

### Note

By default, the walls are drawn in 15 degree angles. To draw walls in any angle, hold down the **Ctrl** key while drawing walls.

#### 6.1.1.1 Customizing the Wall Materials

If you want to customize the wall materials, you will need working knowledge of XML or HTML, and a plain text editor. The wall materials are specified in the wallTypes.xml file, located in the

conf folder under the product installation folder. To edit the wall materials, open the wallTypes.xml file with a plain text editor, and add, remove or edit the wall materials. The tags are explained in the table below:

Tag	Description
id	An identifier for the wall material. Needs to be unique for each material.
name	The name of the wall material, displayed in the user interface
width	The width of the wall material
absorption	The absorption factor of the wall material, in dB per meter
color	The color of the wall material, represented as hex triplets. For more information, see <a href="http://en.wikipedia.org/wiki/Web_colors">http://en.wikipedia.org/wiki/Web_colors</a>

When inserting new wall materials, you will need to measure the signal strength both in front and behind the wall. Subtract the former from the later and you will get the signal loss in dB. Then measure the width of the wall, and calculate the absorption factor by dividing the signal loss with the wall width in meters. Insert the new wall material into the conf file, save the file, and re-start ESS.

#### Note

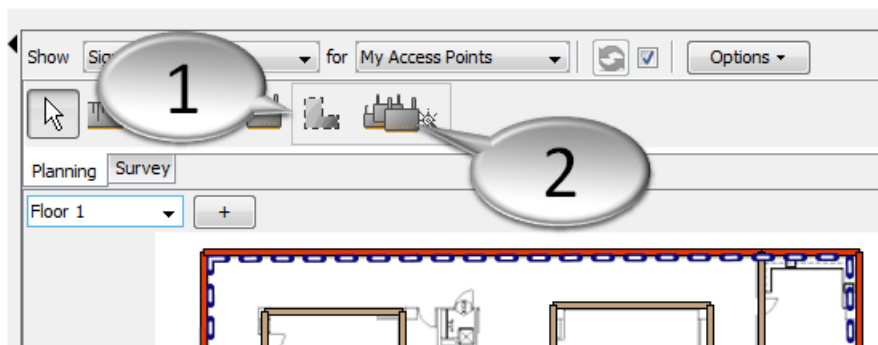
It is recommended to make a backup copy of the wall materials list before editing it.

### 6.1.1.2 Duplicating Maps with Similar Layouts

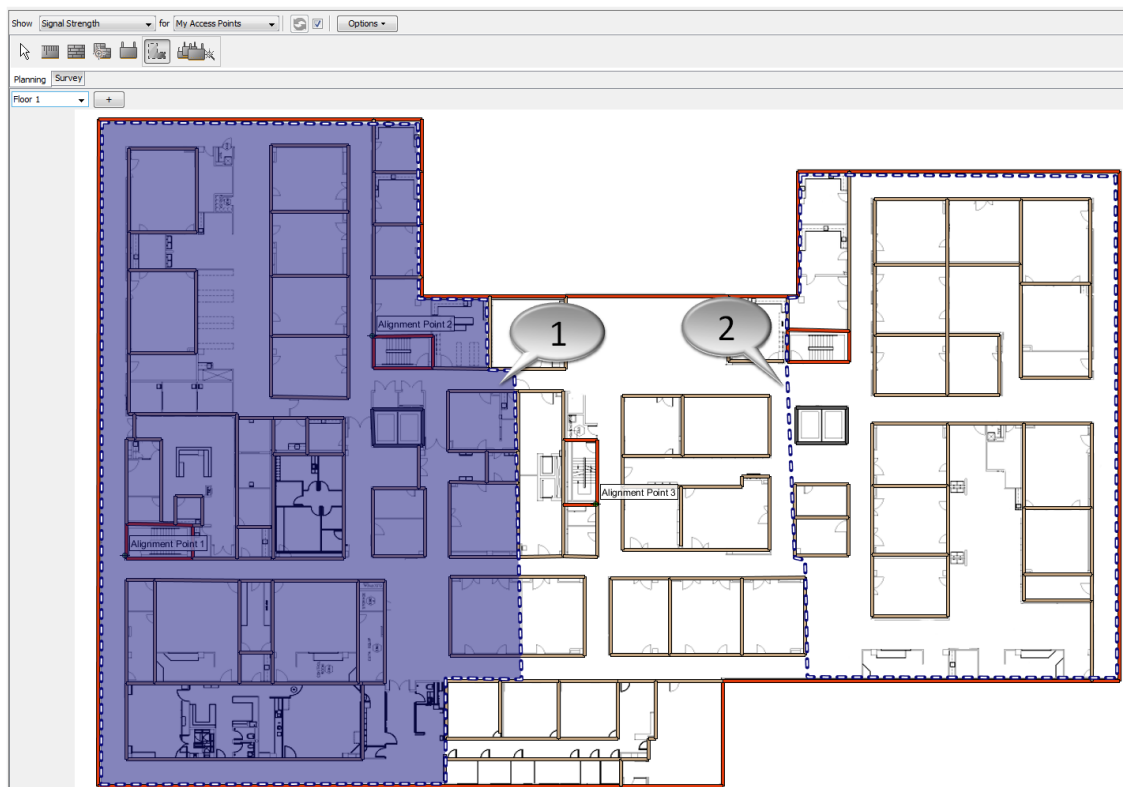
If several floors have similar or fairly similar wall layouts, it is recommended to duplicate the map to avoid unnecessary drawing of walls. When you duplicate a map, the map image and the walls will be duplicated. This allows you to only draw the walls to a single floor, and use the same wall structure for the other floors. If the floors are slightly different, it may still be easier to duplicate the floor and then edit the walls for the areas that are not similar. Click **Site > Duplicate Map** to make a duplicate of the map.

### 6.1.2 Indicating Network Coverage Areas

In order to create the automated network plan, you will have to define the network coverage area where you would like to have Wi-Fi coverage. To do this, use the Coverage Area tool in the Planning tab to indicate the areas where you need Wi-Fi coverage. When using the tool, left-click to add points to the polygon, and right-click to end the polygon.

*Figure 6.2. Coverage Area and Auto-Planner buttons*

1. Click the Coverage Area button to define network coverage areas
2. Click the Auto-Planner button to open network requirements dialog and to create the network plan

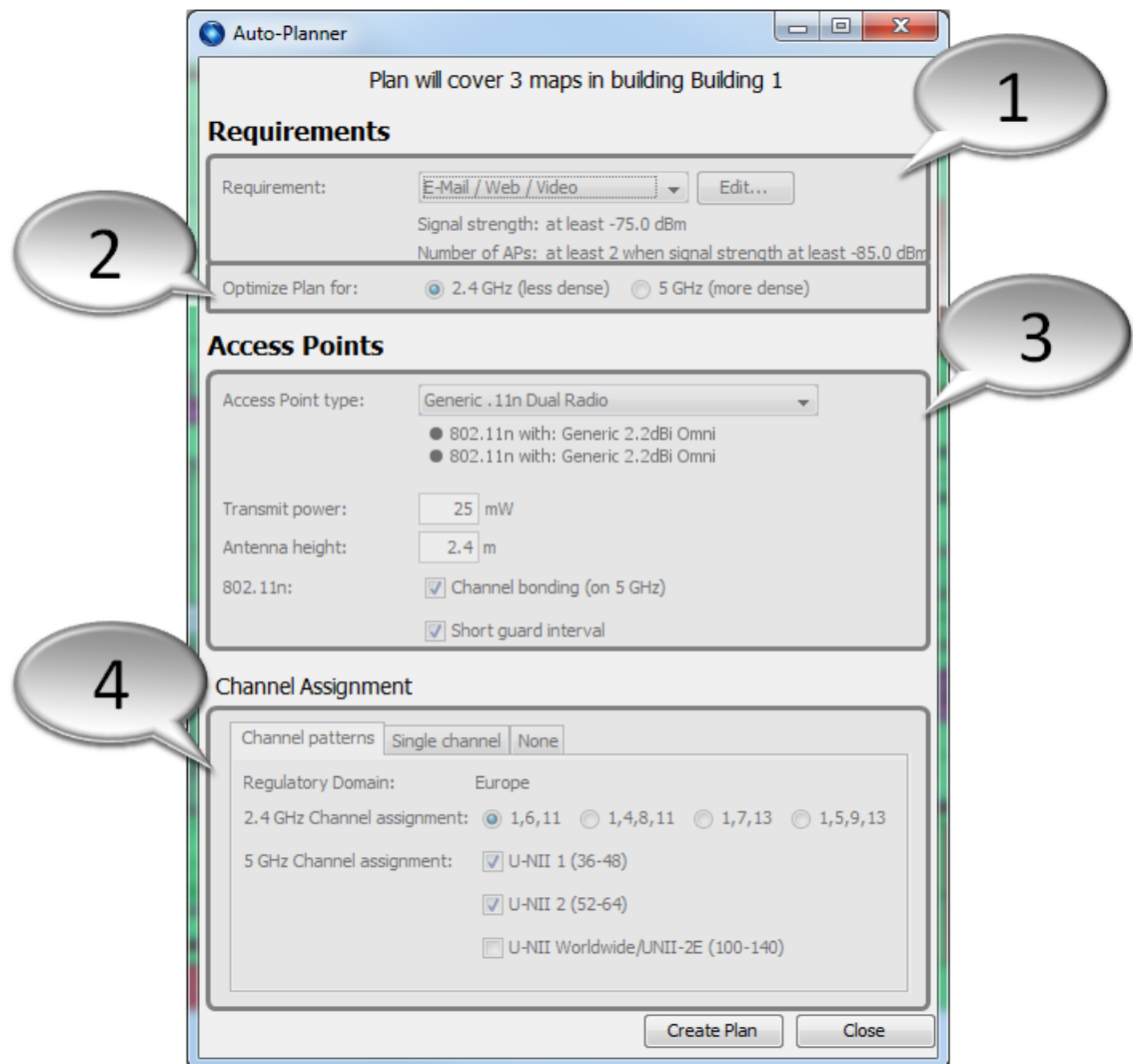
*Figure 6.3. Drawing the network coverage area*

1. When you are drawing the network coverage area, the currently selected area will be displayed as lilac
2. After you have drawn the desirable network coverage area, it will be bordered with a dash line and the lilac colour will disappear

### 6.1.3 Configuring Auto-Planner

After you have defined the network coverage areas, click the **Auto-Planner** button to open the Auto-Planner dialog where you can select the Network Requirement, Access Point type as well as Channel Assignment.

Figure 6.4. Auto-Planner dialog

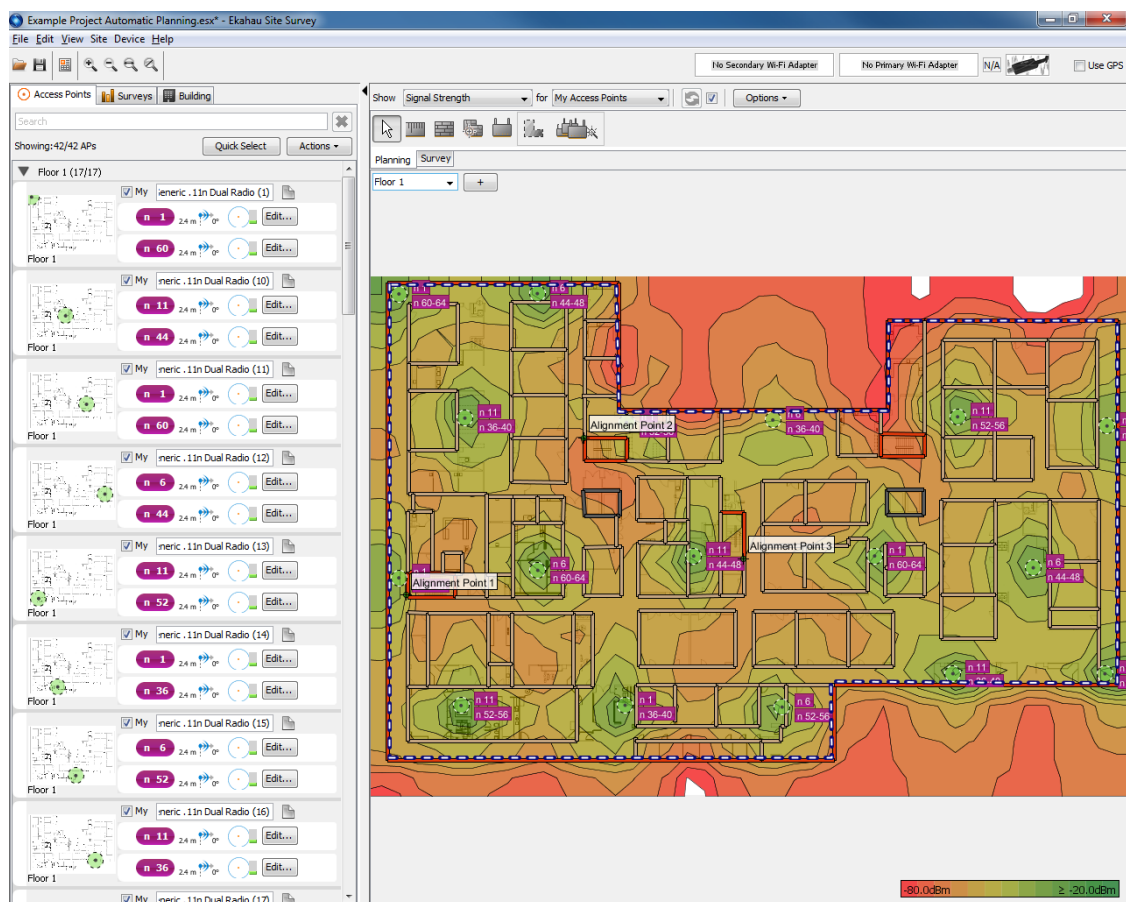


1. Choose the network requirement type for your plan - You can select from one of the predefined requirements or define your own requirement - How to edit or define your own network requirements is explained in more details in chapter *Defining Network Requirements* on page 30 - Note that the in Auto-Planner only the Signal Strength and Number of APs requirements are taken in account
2. Select the Wi-Fi band, either 2.4 GHz or 5 GHz - If you want to optimize your network for 5 GHz Wi-Fi band, the network will be more dense than for 2.4 GHz
3. Select the Access Point type you want to use in the network plan as well as Transmit power, Antenna height, and 802.11n characteristics
4. Define the Channel Assignment you want to use for your network plan - You can select a predefined channel assignment, just a single channel for example if you are using Meru Access Points, or none meaning that you will assign the channels after the network plan has been deployed

After you have defined the requirements for your network plan, click the **Create Plan** button to deploy the network plan. The plan will be deployed for all floors in the building where you have defined the coverage areas. For separate floor maps that are not defined as a building, the network plan needs to be deployed separately for all floor maps.

If you are not satisfied with the network plan, you can just re-run the Auto-Planner with a different Requirement, Access Point type, and/or Channel Assignment. Every time you re-run the Auto-Planner, it will clear the previous Access Point layout(s) and the AP configurations. Alternatively, you can manually change the location of the Access Point(s) with the **Select** tool or add more simulated access points. For more details on how to work with simulated access points, please refer to chapter *Creating the Network Plan Manually Using Simulated Access Points* on page 38.

*Figure 6.5. An example Wi-Fi network plan created with the Auto-Planner - This particular network plan is optimized for Location Tracking*



## 6.2 Creating the Network Plan Manually Using Simulated Access Points

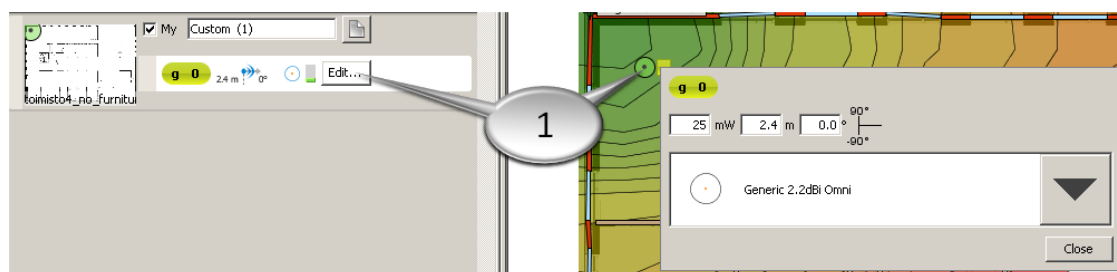
Before you can start working with simulated access points, you need to define the environment which includes adding the necessary maps, defining the scale, and drawing walls. How to draw walls is explained in more details in chapter *Drawing and Editing Walls* on page 34. After the environment has been defined, you can start simulating your network to find out the optimal network configuration.



To start predicting the network performance, place one or more simulated access points on the map:

1. Select the **Simulated Access Point Tool** from the **Planning Tab**
2. Choose the access point you want to simulate. You can simulate either a pre-defined AP or a customized AP with a particular antenna.
3. Place the access point on the map with a left-click. If Always Refresh Automatically visualization option is enabled, you should instantly see a visualization for the placed access point.
4. Click either the rectangle on the right-hand side of the AP or the Edit... button on the AP List to edit the antenna, band, channel, and transmission power for the simulated access point. If you are simulating a 802.11n AP, you can also edit the Extension channel, # of Supported Spatial Streams, Greenfield, and Short Guard Interval properties.
5. Repeat steps 2-4 to place more access points

Figure 6.6. Editing simulated access point



1. Click to edit a simulated access point

You can **move a simulated access point** by simply dragging them on the map when the Edit tool is selected (hold down the left mouse button while moving the AP).

To **delete a simulated access point**, right-click on the access point on the map and select "delete".

After placing the APs on the map, the properties of the APs can be changed using the AP list. Refer to the chapter User Interface Overview to read more about changing the properties of the access points that have already been placed.

## 6.2.1 Optimizing Access Point Layout and Configuration

There are several ways to find the optimal number, placement and configuration for your APs. Here's one recommended method:

1. Set the maps, scale, walls, and optionally building layout and floor alignment points
2. Select **Network Health for My APs**, and select the appropriate Requirement
3. Start placing access points and configuring them. Use the Network Health visualization to see if the network meets your requirements. If it does not, use the Network Issues visualization to see what the problem is. If it is low signal strength or overlap, add more access points or move the existing access points.  
If the problem is low signal-to-noise ratio, or low data rate, the problem may be in the channel separation - there is probably just too much channel interference. Optimize the channel separation by adjusting the channels of the APs - for 802.11b/g, channel separations such as 1-6-11, 1-4-8-11, 1-5-9-13, or 1-7-13 are typically recommended.
4. Continue until you have found a satisfactory wireless network.

## 6.3 Designing Wi-Fi Networks for Multi-Floor Buildings

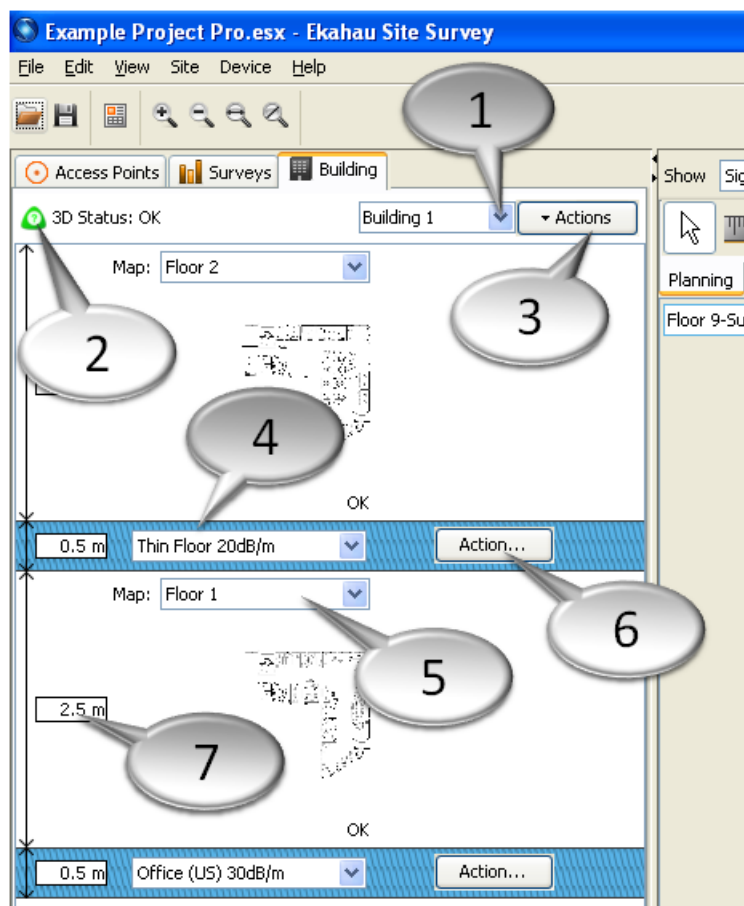
In multi-floor buildings, signals propagate through floors, just like they propagate through walls. It is essential to take this into account when designing Wi-Fi networks, as the floor-to-floor signal propagation can be used to your benefit: You may need less access points as an access point on the floor above or below may cover an area that would have need an additional access point otherwise.

However, the signals penetrating floors may also harm the network performance if there is co-channel interference created between access points on nearby floors. This must be accounted for also in the network design.

To simulate a multi-floor model in ESS, you will need to **define the building layout** (the floor order, height, and floor material), and **set at least three Floor Alignment Points** per floor.

### 6.3.1 Defining the Building Layout

Figure 6.7. A sample building view enabling 3D planning for two floors



1. Select building
2. 3D planning status indicator
3. Add / Remove buildings
4. Floor material
5. Map image
6. Add / Remove floors

## 7. Floor height

To define the building layout, go to the **Building tab** in the left-hand side lists.

1. **Assign a map image with the floor:** You will need to select the appropriate map image for each floor. It is important to note that the lowest floor is on the bottom in the Building view. A single map can only be assigned for one floor.
2. **Select a floor material:** Select the floor material that best matches your environment.
3. **Set the floor height:** Measure the height of the floor (from floor to ceiling), and set it.

A status indicator at the top of the screen will assist you in defining the building layout. Once the status indicator states OK, you will be able to see the simulated AP signals penetrating the floors.

Use the Actions button to add buildings. This allows making network plans for multiple buildings within a single project.

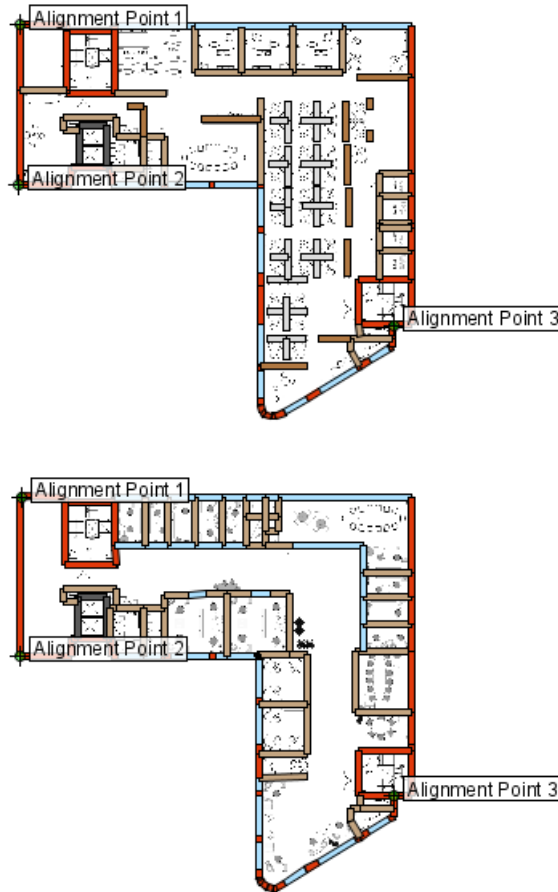
### 6.3.2 Setting Floor Alignment Points

Map images between floors may differ in terms of rotation, and offset, for example. To align the floors for 3D prediction, you will need to use Floor Alignment Points.

You will need to find three locations in the building that are identifiable at each floor. Stairwells, elevator shafts, building corners, and building pillars are good examples: Typically they are in the same locations on each floor. These will serve as your Floor Alignment Points. To mark them:

1. Select the map you want to place the Floor Alignment Points to
2. Select the **Floor Alignment Point Tool** in the **Planning Tab**
3. Optionally name the floor alignment point, such as "Staircase West"
4. Place the floor alignment point on the map by left-clicking.
5. Repeat steps 2-4 so that each map has at least 3 Floor Alignment Points.

Figure 6.8. Two floors of a building with alignment points correctly placed in the same locations in both floors



#### Note

The floors that are connected to each other need to share three reference points. If you use reference points in different locations for different floors, ensure that each floor is connected by a minimum of three reference points.

### 6.3.3 Visualizing Floor-to-Floor Signal Coverage

To visualize how access points are audible from one floor to another:

1. Ensure from the Building tab that your 3D propagation model has been correctly defined
2. Clear the AP selections by clicking **Actions > Select None**
3. Select a floor that you want to see the signals radiating to
4. Using the AP list, select the access points that are of interest (for example, the access points on the floor above and floor below the floor you're currently looking at)
5. Select **Show Signal Strength for Selected Access Points**. If any of the APs on the floors below and above are audible to this floor, you will see their coverage.

## 7 Site Surveys - Ensuring Sufficient Coverage and Performance On-Site

### 7.1 Performing Site Surveys

With Ekahau Site Survey, you simultaneously perform traditional **passive** surveys as well as **active** surveys - this is called Hybrid Survey. Passive surveys measure signal strength, SNR, and other information, whereas active surveys measure end-to-end connectivity.

During the active survey, an end-to-end connection is made to a specific host, ensuring that the network truly works and delivers the required performance. The end-to-end network connectivity testing can be used for:

- **Detecting significant latency** - Excellent for investigating latency-sensitive applications such as VoIP over WLAN
- **Detecting dropped packets** - Solve problems possibly caused by low coverage, roaming issues, and hardware defects
- **Visualize roaming areas** - Visualize which AP the Wi-Fi adapter was connected to in different locations

During the traditional passive survey, signal readings from all the audible access points are measured and all the audible access points will be discovered and added to the AP list. In addition to the access points in your network, you are likely to discover other access points as well: some may be audible from the neighboring office or even the neighboring building, and some may be "rogue" access points placed in your environment without authorization.

**To perform a Hybrid Survey, you will need two Wi-Fi network adapters.** Please visit <http://www.ekahau.com/devices> for the list of supported adapters. The external network adapter (such as Ekahau NIC-300) will be used to capture passive signal readings whereas the integrated Wi-Fi adapter will be used for the end-to-end testing. The integrated Wi-Fi adapter has to be associated with a Wi-Fi network and the network has to allow ICMP echo requests (Ping).

To perform a Site Survey:

- Ensure that both of your wireless network adapters (external & integrated) have been enabled in your laptop. Check the *Miniature Signal View* to see if the external network adapter is successfully scanning access points. Alternatively, you can use your integrated network adapter to scan access points when not performing end-to-end connectivity testing.

*Figure 7.1. The Miniature Signal View should show signals updating before starting the survey.*



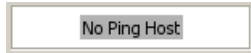
- If you are using an inappropriate driver with your external adapter, a warning will be given. To achieve the optimal accuracy, use the driver provided by Ekahau. For information on how to update the driver, see chapter Wi-Fi Network Adapter Driver Update.

*Figure 7.2. A warning will be given if an inappropriate driver is used.*



- When testing the end-to-end connectivity, ensure that you are able to collect Ping data. The *Miniature Ping View* will display **No Ping Host** message if valid Ping Host has not been found. By default, the Ping Host is Default Gateway, but it can be changed by clicking the *Miniature Ping View*.

Figure 7.3. No Ping Host message will be displayed if valid Ping Host has not been set.



- Click the *Record Survey* button. ESS will start the end-to-end connectivity testing automatically if the internal Wi-Fi adapter has been enabled for Hybrid Survey and valid Ping Host has been found / set.

Figure 7.4. Miniature Ping View displaying successful Ping packets (green) vs. lost packets (red).



- Click your current location on the map to start collecting signal information as well as end-to-end connectivity measurements.
- Start walking at a slow, steady speed. Click the map whenever you start or stop walking, and whenever you change your speed or direction.
- Right-click the map when you want to finish the current survey and continue from another location.
- Release the Record button when finished surveying.

#### Note

Ekahau Site Survey automatically scrolls the map when you click your location close to the edge of the screen. You can disable this feature from **File > Preferences**.

The data is recorded continuously during a Survey, not just when you click on the map. The data will be interpolated on the map between two mouse clicks. If you do not stop at any point, but rather continue walking when reaching a given point, you only need to click on the map once at every turn. If you stop somewhere for more than one second, you should click on the map when you arrive, and click again on the same location as you leave. The upside of the continuous recording is that you gather more data during your survey. In addition, you only need to click twice (at the beginning and at the end) when walking a straight line, such as a hallway.

If **SSID Broadcast** has been disabled in the access points, the SSID will not be detected by ESS. However, the MAC address and other information of the AP will still be detected. Enabling at least one SSID to be broadcast for the duration of the site survey may help in organizing and selecting the access points.

#### Tip

You will see the signal strength of the strongest access point (red=low, green = high) on the survey route while performing the survey. If you do not see anything on the survey route while performing the survey, check your network adapter and network adapter driver.

**Tip**

Keep the surveys fairly short to allow more flexibility for deleting and modifying the survey data. An optimal survey length varies from a few rooms to a wing of a building. Right-click to end the survey every now and then, and continue surveying by simply left-clicking on the map again. There is no need to manually create a new survey - the current survey is ended with a right-click, and a new survey is created automatically when you continue surveying.

**Warning**

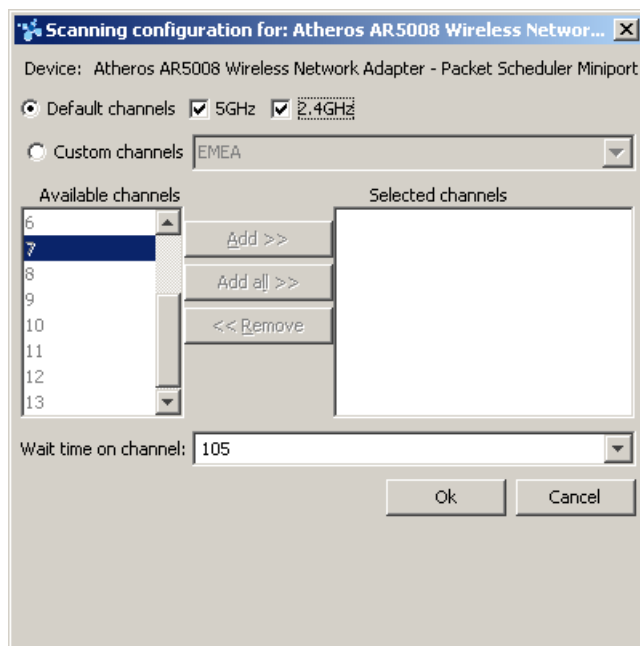
Do not insert or remove network adapters or other devices during the survey.

### 7.1.1 Configuring the Wi-Fi Device for Passive Surveys

To configure your Wi-Fi device, go to **Device > Devices** or click the **Network Adapter Settings** icon. From the Devices Window, you can see the connected Wi-Fi devices, their status and device information. To activate a different Wi-Fi device, select the adapter from the Devices list and click **Activate**. To configure the signal scan settings of the selected Wi-Fi adapter, click **Scanning Configuration**. This allows you to configure:

- **Bands:** Select to scan either 2.4GHz or 5GHz frequency. Scanning just one band reduces the overall scan time, which allows more data to be collected over time, which, in turn, allows faster surveys.
- **Channels:** Select which channels to scan on 2.4GHz by adding it to the Selected Channels list. Limiting the number of channels allows faster surveys. Channels will only be limited if Custom channels setting is selected.
- **Wait time per channel:** Set the number of milliseconds to wait on each channel for 802.11 packets (probe responses or beacons). The smaller the channel wait time, the less time the access point has to send packets to the network adapter, but the faster you can survey the facility. If your wireless network is extremely crowded, increase the wait time. If broadcast SSID is disabled in your access points, increase the wait time to 100ms or more.

Figure 7.5. The Scanning Configuration Tab

**Note**

The scan settings cannot be configured for all Wi-Fi devices. For example, the scan settings in the built-in Wi-Fi adapter of an Intel Centrino cannot be configured.

### 7.1.2 Configuring the Wi-Fi Devices for Hybrid Surveys

The end-to-end network performance testing is always made with the laptop's integrated Wi-Fi network adapter. The integrated network adapter has to be connected to the Wi-Fi network to be able to measure the network performance. To connect, use Windows Wi-Fi Management tool.

By default, Ekahau Site Survey pings the Default Gateway. You can change the Ping Host by clicking the *Miniature Ping View* icon. To ensure the defined Ping Host replies to ping, click the *Start* button. It is not necessary to leave the Ping enabled as ESS will enable it automatically when you start recording Hybrid Surveys.

In Hybrid Survey mode, the traditional signal measurement is always made with the external Wi-Fi adapter. To configure the external Wi-Fi adapter, please see chapter *Performing Site Surveys* on page 43.

### 7.1.3 Moving and Deleting Survey Points

After the survey, it may be necessary to move or delete Survey points - perhaps because the location was not clicked properly in some locations. To move or delete Survey Points, right-click



on a survey point and select *Move Survey Point* or *Delete Survey Point*. When you delete a Survey point from a survey, the Survey will be split into two.

## 7.1.4 GPS Assisted Outdoor Site Surveys

ESS allows you to use a GPS handheld to perform site surveys outdoors, without having to click on the map. For example, by connecting a GPS receiver to your Wi-Fi enabled laptop, you can simply drive around the coverage area of a municipal Wi-Fi network, and ESS will automatically plot the route on the map in addition to taking the Wi-Fi measurements.

### 7.1.4.1 Supported GPS Receivers

A GPS receiver is required for the GPS survey feature to work. The following GPS receivers are supported:

- Bluetooth GPS devices, that support NMEA
- USB GPS devices that support NMEA, Garmin Protocol or Trimble TAIP
- Network connected GPS devices (usually using TCP/IP or UDP), that supports TAIP or NMEA
- GPS devices connected to PC-CARD that supports NMEA
- GPS devices that are connected to an RS-232 port, that support NMEA, Garmin or TAIP

GPS Navigators are typically not supported, even if they have a USB connection.

### 7.1.4.2 Performing GPS Assisted Surveys

To perform an outdoor survey using GPS:

1. Connect a GPS receiver to your laptop
2. Turn on the receiver, make sure it is outputting data in one of the supported formats. You will need to be outdoors for the GPS receiver to work properly.
3. In the user interface, check the **Use GPS** checkbox. If you do not see the Use GPS checkbox in the top-right corner of the user interface, ensure that you have purchased ESS Professional version.
4. If your GPS device has not been previously configured, a GPS configuration dialog will pop up.  
Typically, the default settings are recommended.  
When asked "Do you want to use this device", select Yes.  
In the output selection, ensure that the "share my GPS between several applications" option has been selected.
5. ESS needs to be able to transform the GPS coordinates into map coordinates. For this, you will need to place three GPS Reference Points on the map.  
To place the Reference Points, use the GPS Reference Point Tool on the Survey tab. Click on the map to place a GPS Reference Point. When placing the Reference Points, you will need to either know the latitude/longitude coordinates for the Reference Point location, or alternatively be physically located there with your GPS receiver turned on, in which case the coordinates will be taken from the GPS receiver. Repeat until you have three reference points on the map.
6. Now you should see the blue circle on the map, indicating your current location. If it is not, check if you see an exclamation mark next to the Use GPS button. If so, move your mouse over the exclamation mark to see the error.
7. In the Survey tab, click the GPS Record button to start the survey.
8. Drive or walk throughout the outdoor area you wish to survey.

9. End the survey by clicking the GPS record button again.

**Note**

If the GPS device is not detected, re-try the GPS device detection. If the GPS device is not detected after several retries, try using the advanced options to adjust the GPS configuration to your needs.

**Note**

To ensure measurement accuracy, take the reference points at least 300 meters (1000 feet) apart from one another, and don't place the reference points on a straight line.

**Tip**

Using an external antenna for the Wi-Fi network adapter improves the outdoor survey accuracy.

## 7.2 Post-Deployment and Pre-Deployment Surveys

**Post-deployment surveys** are performed after the complete network is already in place. Post-deployment surveys are used for network verification immediately after the network has been deployed, and for periodic checks to ensure the network is still operating at a required level. The periodic maintenance surveys may cover the entire area or just parts of it, whereas the verification surveys done immediately after the network has been built usually cover the whole desired coverage area. To perform post-deployment surveys, no specific actions need to be taken - just survey as specified in the previous section.

**Pre-deployment surveys** are used for on-site validation of network plan. In pre-deployment surveys, you would use one or few access points to ensure the network coverage and performance on-site - prior the complete network has been deployed. Simply move the AP(s) between the planned locations and make a survey whenever the AP has been moved.

To simulate a complete network with a limited number of access points in the pre-deployment survey phase, use the Freeze Access Point tool. The Freeze Access Point tool allows a single access point that as been placed in several locations to be treated as multiple access points. Using Freeze AP, you can individually visualize and analyze each location where the AP was placed. If Freeze AP is not used, you would simply see one AP detected, and be able to visualize one huge coverage area. Moreover, it allows simulating a complete network in terms of overlap, channel interference, and data rate, by using just one or a few access points.

To use Freeze AP:

1. Turn on the access point
2. Perform a survey within the coverage area of the access point
3. Stop surveying, and unplug off the access point
4. From the user interface, select the access point (and only that access point) and select **Actions > Freeze Selected Access Points**

5. Move the access point to the next location
6. Repeat steps 2-4 until all the necessary AP locations have been surveyed

#### Note

Although the previous instructions are for one access points, several access points can also be used in the pre-deployment survey, and several access points can be frozen at once.

## 7.3 Placing Access Points on the Map

Ekahau Site Survey is able to place access points on the map automatically after the survey. These are estimated locations. You can disable the feature by unchecking the "Auto-Place APs" checkbox during the survey. If you have disabled the Automatic Placement, you can manually force the automatic on-demand placement of access points from **Site > Place Access Points Automatically**.

The AP locations guessed by ESS may not be exact. You can move the AP to its exact location by simply dragging the AP to the desired location when using the Edit tool. After an AP has been manually moved, the Auto-Locate features will not try to locate the AP any more. Also, if you exit the program or re-open the project, the current AP locations will be fixed, and the Auto-Locate features will not try to locate those APs any more. However, all the newly discovered APs will still be automatically located.

The Automatic Placement will only try to locate the access points that are well audible (surveyed signal strength has exceeded -50dBm in one or more locations). This is to avoid locating the access points inaccurately.

To place an AP that has not been automatically placed, just drag and drop the AP from the AP list to the map.

To find the position of a single AP, click on the "*Drag on the map to place*" text in the AP list and select **Automatically Place Access Point**.

## 7.4 Selecting My Access Points

After the surveys have been completed, and you have located your access points, you should indicate which APs actually belong to your network. My access points are defined by using the "My" checkbox in the AP list. By default, all the APs are checked as My. You need to uncheck the APs that are not a part of your wireless network.

#### Warning

**IMPORTANT:** If your My APs are not properly selected, the visualizations as well as many other features will not work properly.

To learn more about My Access Points, see chapter Selecting My Access Points.

## 7.5 Simultaneous Survey Work: Merging Two Projects as One

If several persons are surveying the areas at one time, the results need to be merged as one in the end. The Merge feature imports surveys, access points, walls, everything in the Project To merge two or more files as one:

- Open the first Project
- Select **File > Merge**
- Browse for the second Project which needs to be merged with the first one
- If more than two surveyors have been on the field, repeat the previous step for all the Projects

### Warning

In many cases, some access point locations are lost in Merge. Always check the AP locations of the Merged file and make the necessary corrections.

### Note

The Merge feature does not Merge surveys within the same map. The surveyors need to operate on different floors (maps) for the Merge to work properly.

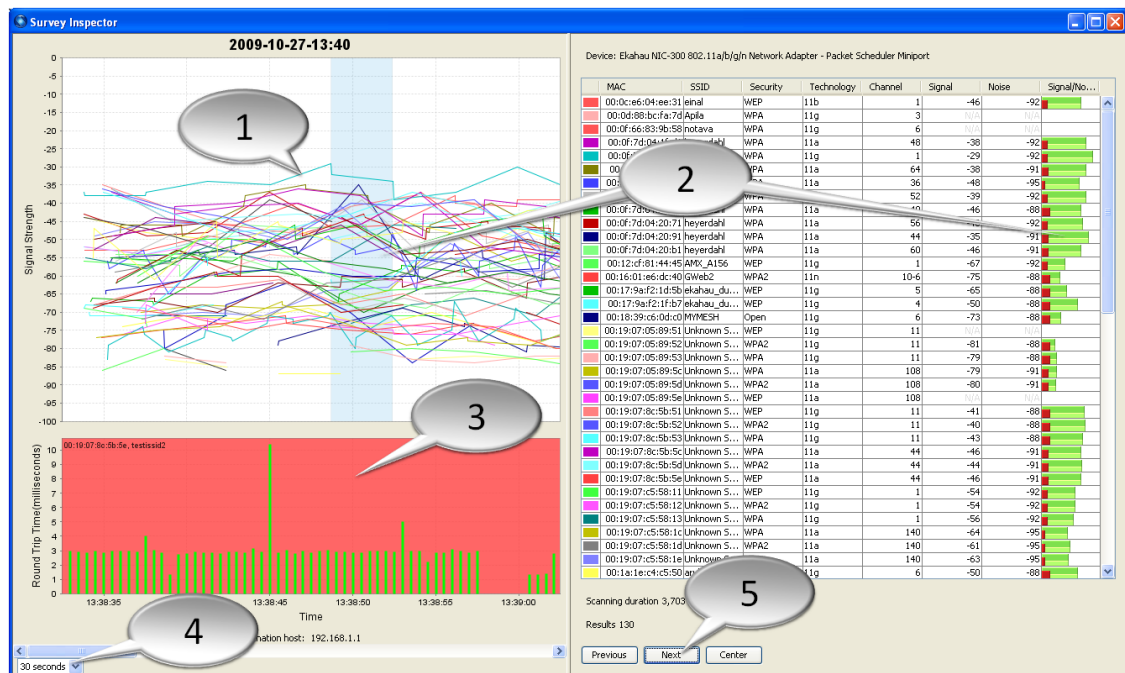
## 7.6 Inspecting Surveys in More Detail

In some cases, if network is not behaving normally, the signal behavior may need closer inspection.

During the survey, the network adapter keeps constantly scanning the network for signal readings from the access points. To see the individual signal measurements on the map, select the Survey Inspector tool. To view the individual measurements and analyze the survey data in more detail, double-click on the position of the survey route you want to inspect, or right-click on a Survey in the Surveys list and select **Inspect**. A **Survey Inspector** window will open, displaying the recorded signal readings in the point nearest to the clicked location as well as measured Round Trip Time (Ping) and the associated Access Point during the measurement. An orange dot on the map will indicate which measurement point is currently analyzed.

The window will also show the recorded data over time for a given survey. Use the *Next* and *Previous* buttons to move to the next and previous survey point along the survey path. To analyze the measurement data for select access point(s), highlight the APs on the AP list in the dialog.

Figure 7.6. Survey Inspector allows you to analyze the signal behaviour in more detail



1. Signal behaviour over time for the selected access points
2. These signals were heard at the highlighted point on the graph
3. Ping / Round Trip Time graph displaying the latency at the selected time interval
4. The time window shown in the graph
5. Move to next signal measurement



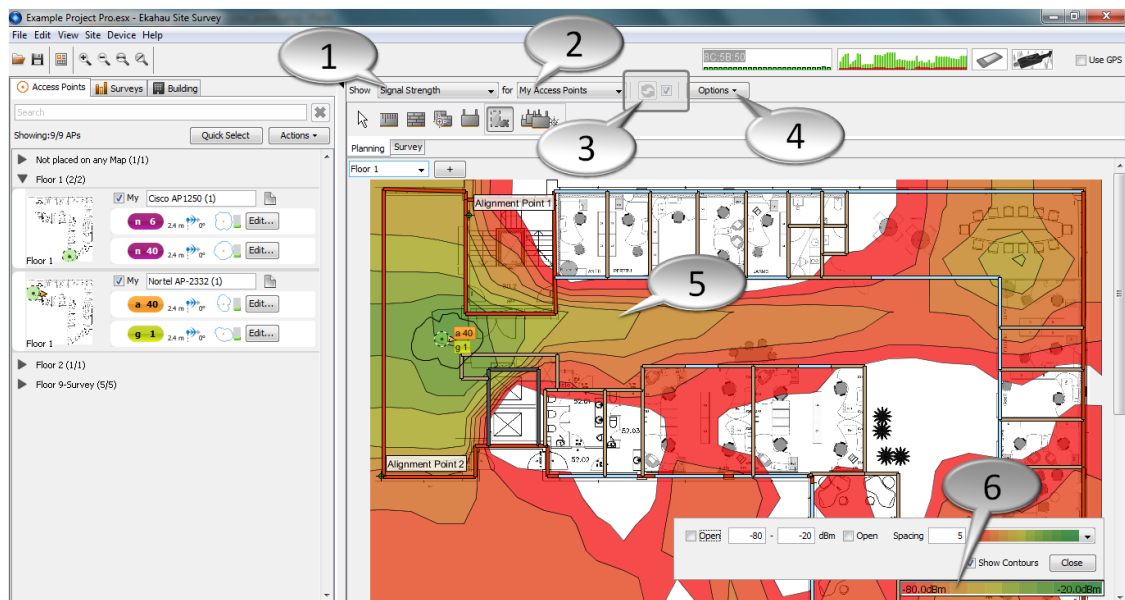
## 8 Analyzing the Wi-Fi Coverage and Performance

There are various visualizations that allow you to estimate network coverage and performance. The visualizations are displayed as "heat maps" on the map image.

The displayed visualization is selected using the two drop-down menus above the map window. The default visualization is Signal Strength for My Access Points. The first drop-down menu selects the visualization type, for example signal strength or data rate. The second drop-down selects what access points will be included in the visualization. If you want to visualize signal strength for one access point only, for example, you would select Show Signal Strength for Selected Access Points and just select the AP you want to see the signal strength for. The AP can be selected either from the map, or from the AP list.

When the visualization is displayed, roll over the map with the mouse to see the actual values on the map at a given point as a tooltip.

Figure 8.1. Visualization view



1. Visualization type
2. Visualized access points
3. Refresh visualization button - Uncheck the box to manually refresh the visualization
4. Visualization options
5. Visualization
6. Editing legend

### Note

Automatic refresh option refreshes the visualization automatically when changes are made. Automatic refresh works well for small and medium-sized projects. If you are working with a large project, you may want to disable the automatic refresh to keep the software running smoothly, and only refresh the visualization when needed.

For quick reference for visualization, see the tables below.

Visualization	Purpose
Data Rate	What is the estimated data rate (in Mbit/sec) for the clients
Interference / Noise	How bad is the co-channel interference (in dBm)?
Network Health	Does the network meet your requirements?
Network Issues	If requirements are not met, what is wrong?
Number of Access Points	How many APs are audible in each location?
Signal Strength	How good is my signal coverage (in dBm)?
Signal-to-Noise Ratio	How much stronger is the useful signal than the co-channel interference (in dB)?
Strongest Access Point	What is the strongest access point at each location?
Ping / Round Trip Time	What is the network latency between a client and host?
Ping Packet Loss	What is Packet Loss %? (Calculated from the last 10 packets)
Associated Access Poin	With what Access Point was the client associated with?
802.11n Channel Bonding	Where has 802.11n Channel Bonding been enabled?

Visualize for	Purpose
All access points	Display the visualization for all the access points
My Access Points	Display the visualization only for the APs checked as "My"
Other Access Points	Display the visualization only for the APs NOT checked as "My"
Selected Access Points	Display the visualization only for the APs selected from the list or the map

#### Note

In order to see any visualization, surveys need to be recorded, or at least one simulated access point needs to be placed on the map.

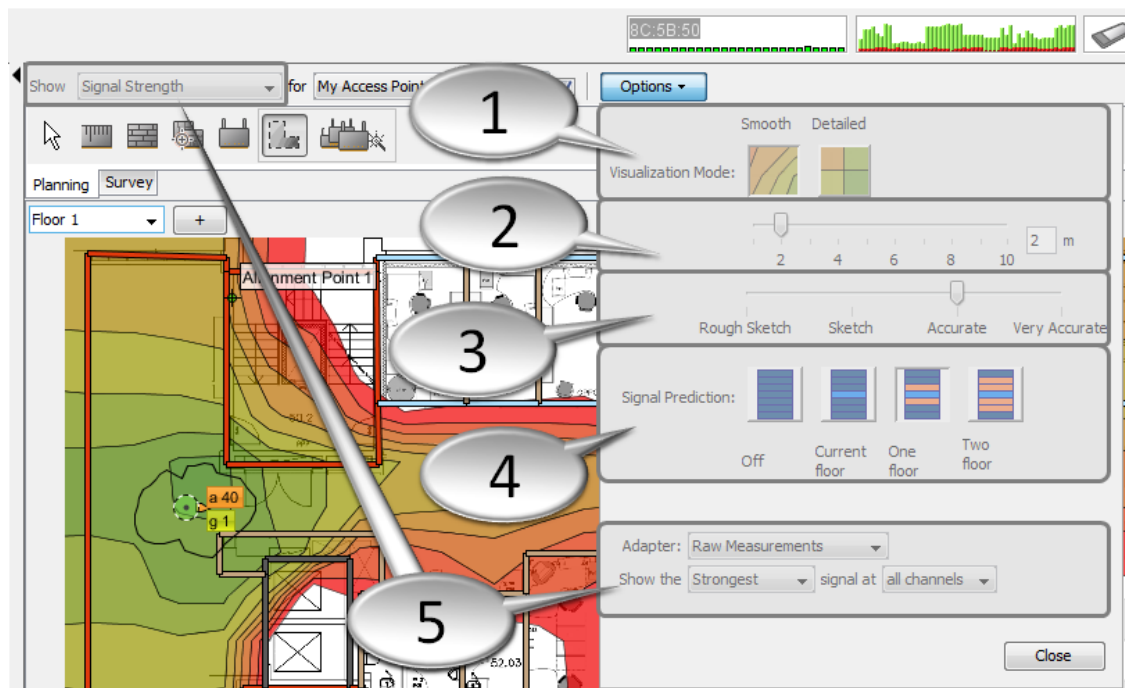
## 8.1 Visualization Options

Visualizations contain parameters that can optionally be set using Visualization Options. Some visualization options are specific to the selected visualization, whereas some are generic and apply to all the visualizations.

The Visualization Options allow you to set parameters concerning the visualization accuracy, performance and overall appearance:



Figure 8.2. Some visualization options are generic, some are visualization specific



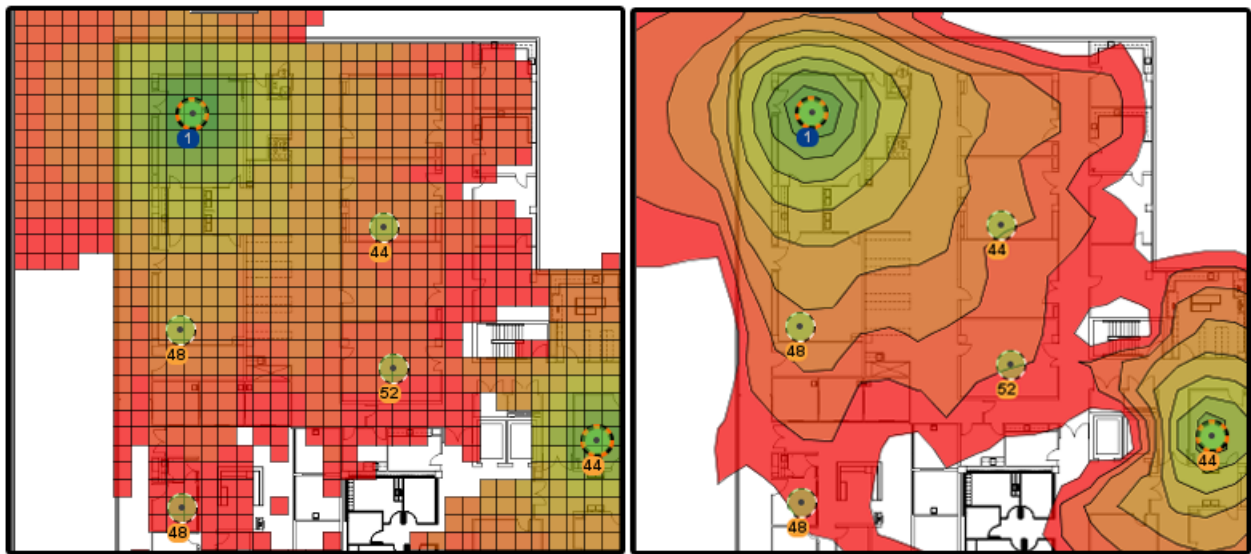
1. Visualization Mode - See the visualization in Smooth mode (polygons) or Detailed mode (rectangles)
2. Extrapolation - When Smooth Visualization Mode is selected, adjust the level of extrapolation in meters/feet
3. Speed vs. Accuracy - Allows the visualizations to be refreshed more quickly at the expense of the accuracy, or vice versa
4. Signal Prediction - Enable or disable all signal prediction. Can be used to predict signal propagation through other floors
5. Visualization specific options (In this case for Signal Strength visualization)

### 8.1.1 Visualization Mode

The visualization heat maps are overlaid on the map using some amount of extrapolation, because every inch of the facility can not be surveyed. To adjust the amount of extrapolation, click the *Options* button next to the visualization selection.

There are two Visualization Modes:

- **Detailed:** The extrapolation is fixed. The Detailed Mode provides low extrapolation and accurate results. Does not allow adjusting the amount of extrapolation of data. Use Detailed mode when in-depth analysis is needed.
- **Smooth:** Adjustable amount of detail, as the user can set the extrapolation (in feet or meters).

*Figure 8.3. Visualization modes and extrapolation slider**Figure 8.4. Detailed and Smooth visualization modes*

When designing large Projects with lots of walls and simulated access points, you may want to get visualizations updated quickly to find out the optimal number of access points, their locations and configurations as quickly as possible. At this point, the accuracy of the visualization may not be essential to find out the "ball park" locations and configurations of access points.

In situations like these, you can increase the visualization speed by adjusting the slider above the Signal Prediction options. The Rough Sketch will provide the fastest response with the least amount of detail, whereas the Very Accurate setting will provide most detail, sacrificing some of the response time.

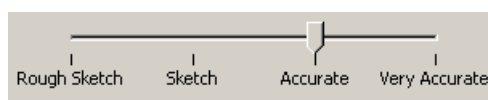
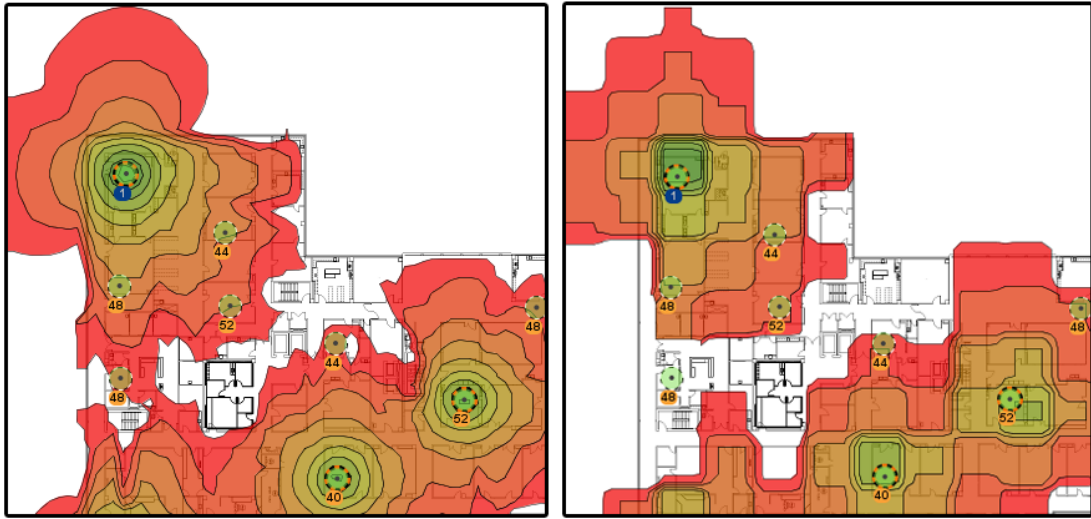
*Figure 8.5. Visualization speed vs. accuracy slider*

Figure 8.6. Very Accurate Mode (on the left) and Rough Sketch Mode (on the right)



## 8.1.2 Signal Prediction

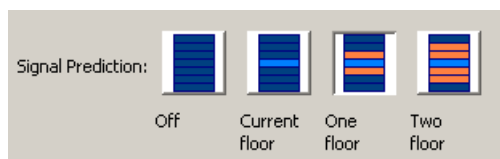
It may not always be feasible or even possible to survey all areas and rooms of the project. Instead, signal prediction can be used. There are two main types of signal prediction in ESS:

- Signal prediction of simulated access points: All signals from the simulated APs are predicted.
- Signal prediction of measured (surveyed) access points: The signals outside the surveyed areas are predicted.

Ekahau Site Survey can predict signal propagation through floors. There are five options to choose:

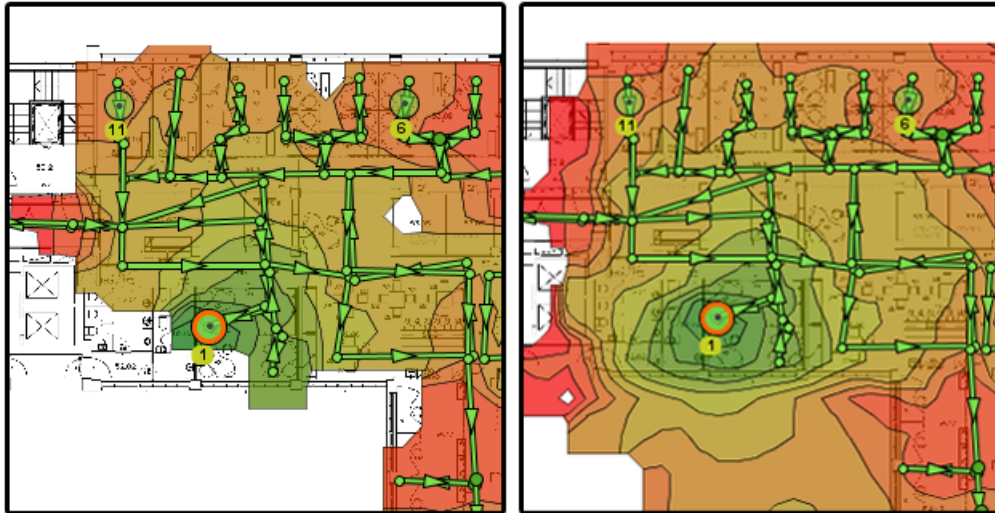
- **Off** - No signal prediction is used at all
- **Current floor** - Signal propagation in current floor is only predicted
- **One floor** - Signal propagation to one floor above and below is predicted
- **Two floor** - Signal propagation to two floors above and below is predicted

Figure 8.7. Signal Prediction options



By default, Signal Prediction is enabled. If it is necessary to see only the measured (surveyed) data of the access points, and disregard all the prediction calculations, disable Signal Prediction.

Figure 8.8. Viewing a measured access point with signal prediction (on the right) and without (on the left)



### 8.1.3 Visualization Specific Options

Some visualizations have specific options that only apply for them. These visualization specific options include:

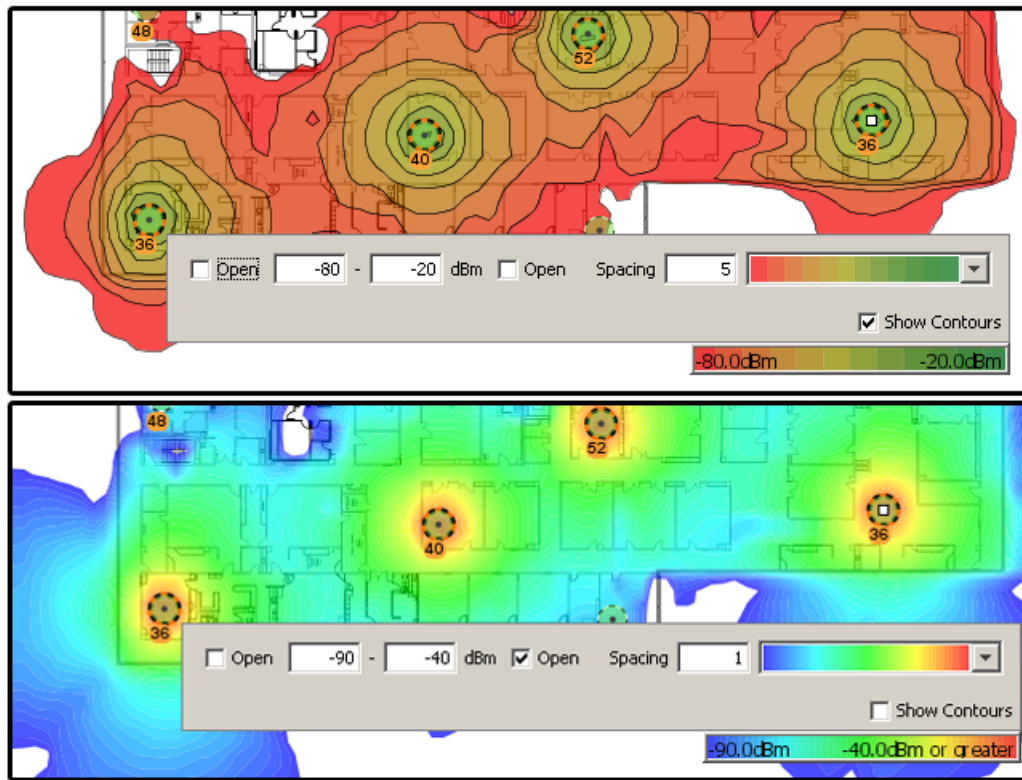
- **Minimum Signal Strength** - The visualization is only shown in areas where the signal strength exceeds this threshold
- **Adapter** - The visualization is shown according to how the selected adapter would have perceived the measured data
- **Network Load** - Is used with simulation visualizations to demonstrate how different network loads affects on the network performance
- **Use Noise From** - Defines whether the visualization uses measured *Noise* or *Simulated Co-Channel Interference* - With *Automatic* option, the measured Noise is always used when available
- **Show <xx> Strongest Signal at <xx> Channel** - Visualizes the selected strongest signal at the selected channel(s)

## 8.2 Adjusting the Legend

You can adjust the visualization appearance and value range by adjusting the Legend. The Legend can be adjusted by clicking on the Legend at the bottom-right corner of the screen. The Legend adjustments are automatically saved with the project. The following adjustments are provided:

- **Contours**: The contour line between each color in the visualization can be enabled or disabled.
- **Value Range**: Adjusts the range of values to be displayed. The **Open** setting at each end of the value range allows you to see the values outside the value range also.
- **Spacing**: Each color in the visualization may represent one or many values. The spacing controls how many values each color represents.
- **Colors**: Select the desired color range from the drop-down menu.
- **Requirements**: Since the colors for these visualizations are fixed, and the results of Network Health and Network Issues visualizations depend on the Requirements, clicking the Legend when these visualizations are enabled allows you to edit the Requirements.

Figure 8.9. Adjusting the legend has a significant impact inn the visualizations



Not all options are customizable for all visualizations. The table below explains the visualization default values and adjustment options:

Visualization	Legend Adjustment Options	Default Values
Data Rate	Contours On / Off	From 1Mbps up to 600Mbps
Interference	Value Range, Spacing, Colors, Contours On / Off	-100dBm through -50 dBm or More
Network Health	Requirements	Pass / Fail
Network Isseus	Requirements	Pass / Fail
Number of APs	Value Range, Spacing, Colors, Contours On / Off	1 through 10 or more APs
Signal Strength	Value Range, Spacing, Colors, Contours On / Off	-80dBm through -20 dBm or more
Signal to Noise Ratio	Value Range, Spacing, Colors, Contours On / Off	0dB through 50 dB or more
Strongest Access Point	Contours On / Off	MAC addresses of the APs
Ping / Round Trip Time	Contours On / Off	0.0 ms throught 1000.0 ms
Ping Packet Loss	Value Range, Spacing, Colors, Contours On / Off	0 % through 100 %
Associated Access Point	Contours On / Off	Automatic
802.11n Channel Bonding	Contours On / Off	On / Off

## 8.3 Visualization Views

### 8.3.1 Data Rate

Data Rate is the speed at which the client device and the access point are communicating at. The higher the data rate, the more data is expected to be transferred between the client device and the access point in a period of time. In 802.11, the advertised data rate is the theoretical maximum at which the devices are able to communicate. However, the net data throughput between two devices is typically less than half of the advertised data rate.

In ESS, the data rate is calculated using the following Visualization Options as parameters:

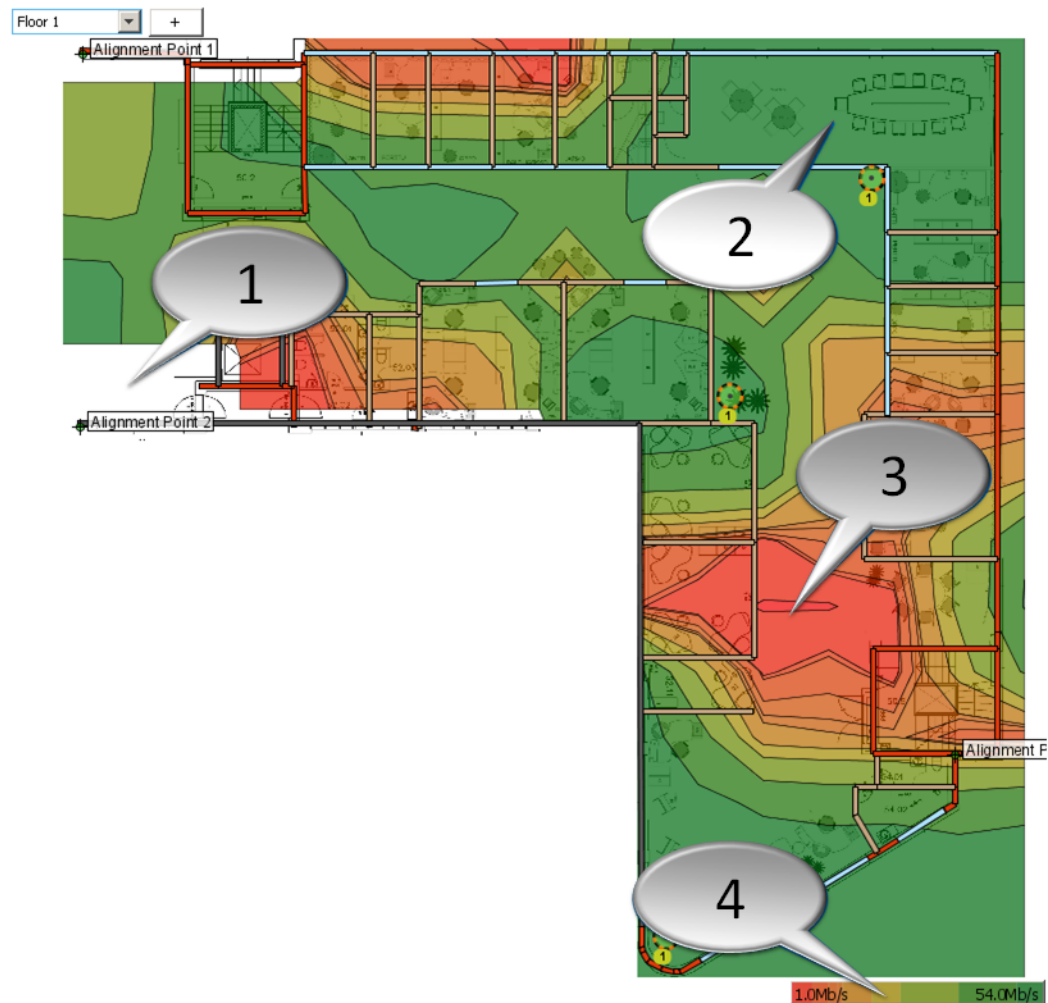
- **Network Load** affects the data rate: The higher the network load, the more interference. The more interference, the lower the SNR, and the lower the SNR, the lower the data rate.
- Different **Adapters** have different receiver sensitivity capabilities, and even support different 802.11 standards. Thus, using different adapters may have a significant impact to the data rate. For example, an 802.11b adapter can only communicate at a maximum of 11Mbps.

#### Note

The data rate is calculated only for access points that are marked as **My** APs. If you are visualizing with *Selected Access Points* view, the APs that are currently Selected will work as sources of noise.



Figure 8.10. Data Rate visualization



1. No data transfer possible
2. High data rate (54Mbps)
3. Low data rate
4. Red = 1Mbps <-> Green = 54Mbps

### 8.3.2 Interference / Noise

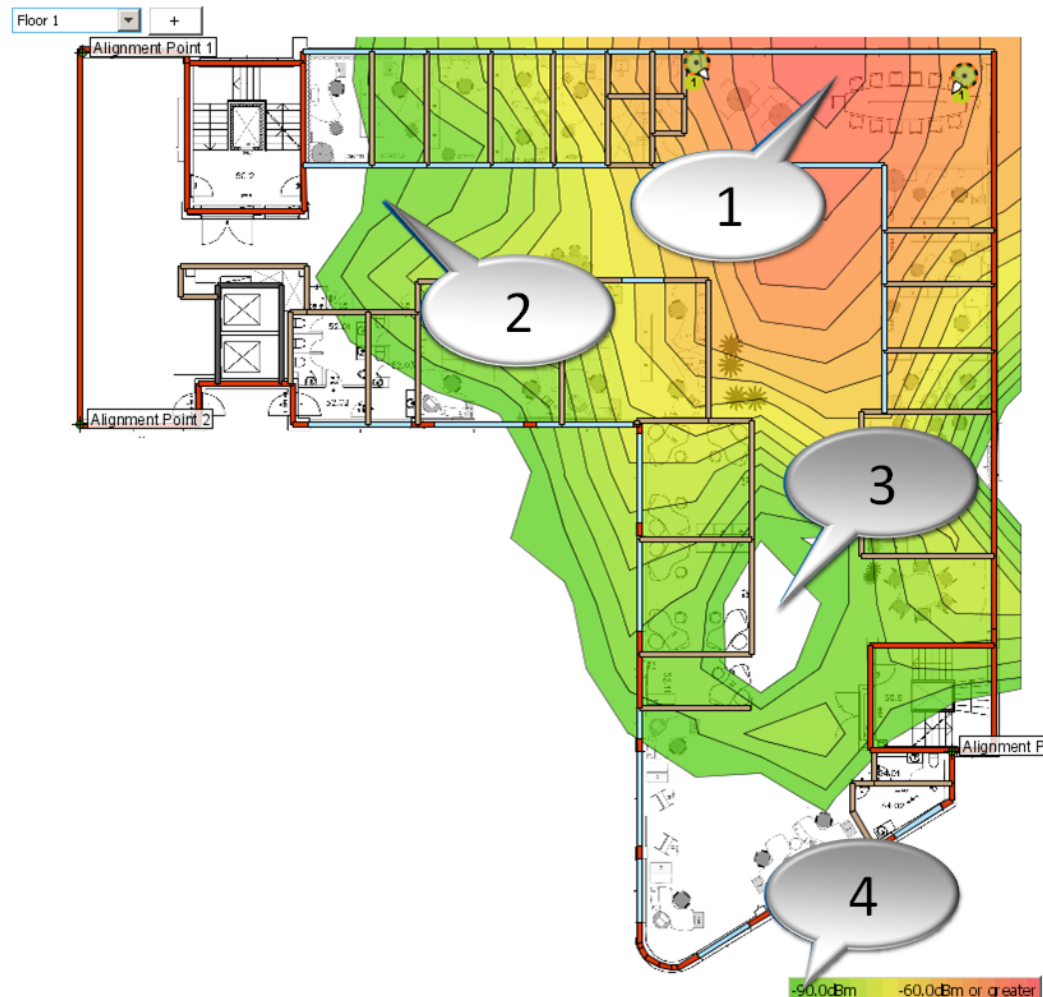
If two access points are close to each other on nearby channels, co-channel interference is generated. In many cases, some amount of co-channel interference is inevitable, but excessive co-channel interference will result in degraded performance in the wireless network.

The Interference visualization will display the amount of estimated co-channel interference, based on the signal strengths and channels of the access points. Interference is affected by

- **Network Load:** Network Load is the estimated amount of traffic in your network. **The more Network Load, the more channel interference is generated.** With low network usage, the load is typically between 1 and 10%. The network load of a typical enterprise Wi-Fi network is between 10 and 20 percent. If the network is extremely crowded, the network loads may reach 30 or even 40 percent.

- **Adapter** also has an impact to interference, since different adapters have slightly different radio characteristics.

Figure 8.11. Interference visualization

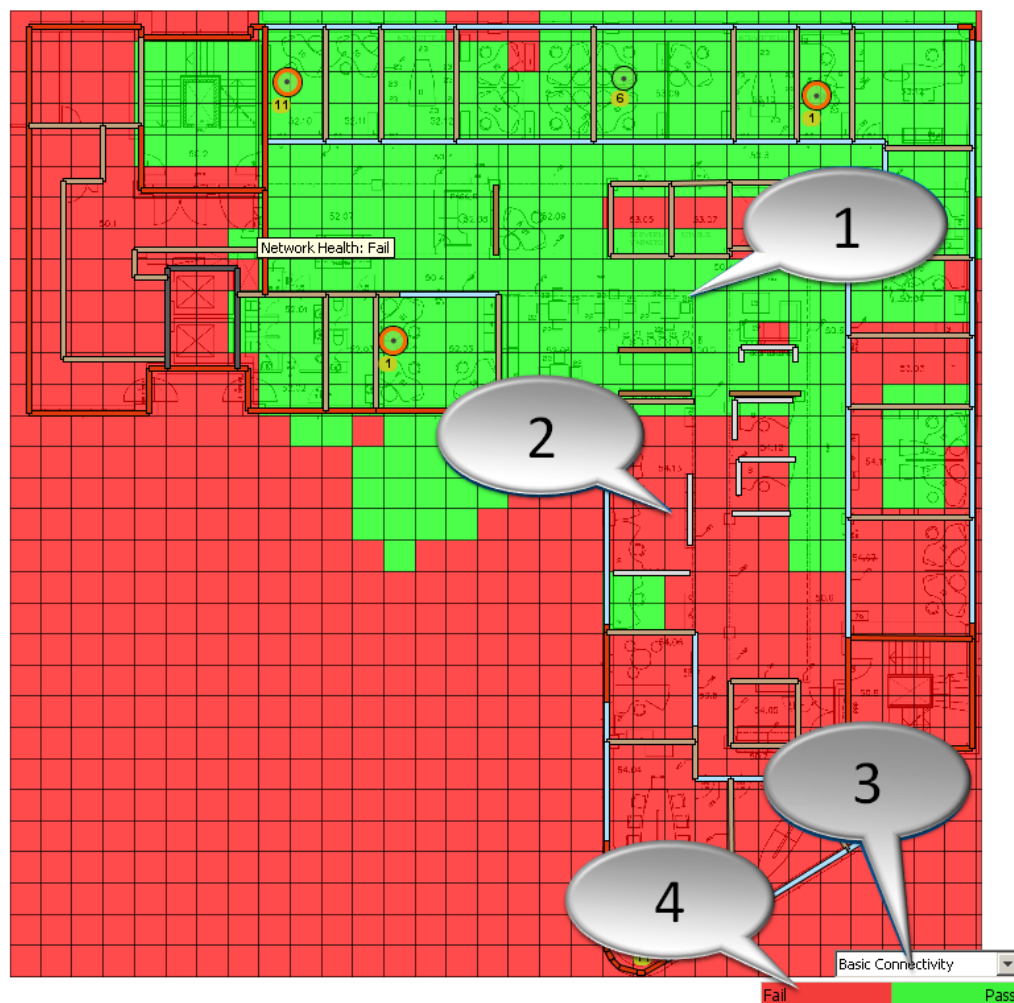


1. High interference
2. Low interference
3. Very low or no interference
4. Adjust interference visualization value range, colors, etc.

### 8.3.3 Network Health

Network Health provides a summarized overview of the network. It shows whether **all** of your network requirements (see also chapter Defining Network Requirements) are met or not. If one or more of the network requirements are not yet, Network Health will fail, and red color will be displayed for those areas. If all of the network requirements are met, green color will be displayed. To adjust the requirements, click on the color legend, or click **Site > Edit Requirements**.



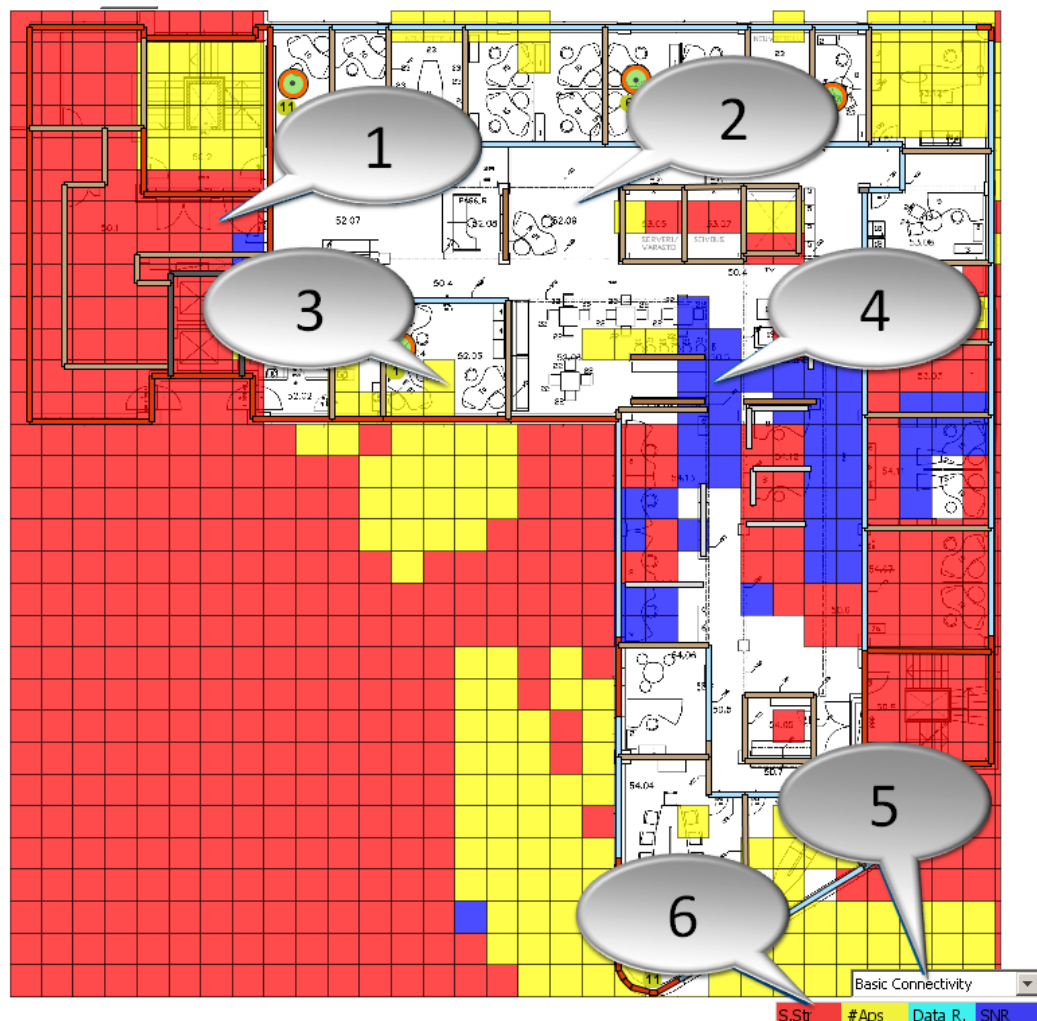
*Figure 8.12. Network Health visualization*

1. Network meets requirements
2. Network does not meet requirements
3. Select requirement
4. Click to adjust requirement

### 8.3.4 Network Issues

If one or more of your network requirements are not met in one or more locations (see also Network Health), the Network Issues visualization will display which requirement fails. If more than one requirement fail, only one failing requirement will be displayed.

Figure 8.13. Network Issues visualization



1. Insufficient signal strength
2. Network meets requirement
3. Not enough audible access points
4. Insufficient Signal-to-Noise Ratio
5. Select requirement
6. Click to adjust requirement - Each network issue is represented by a color

### 8.3.5 Number of APs

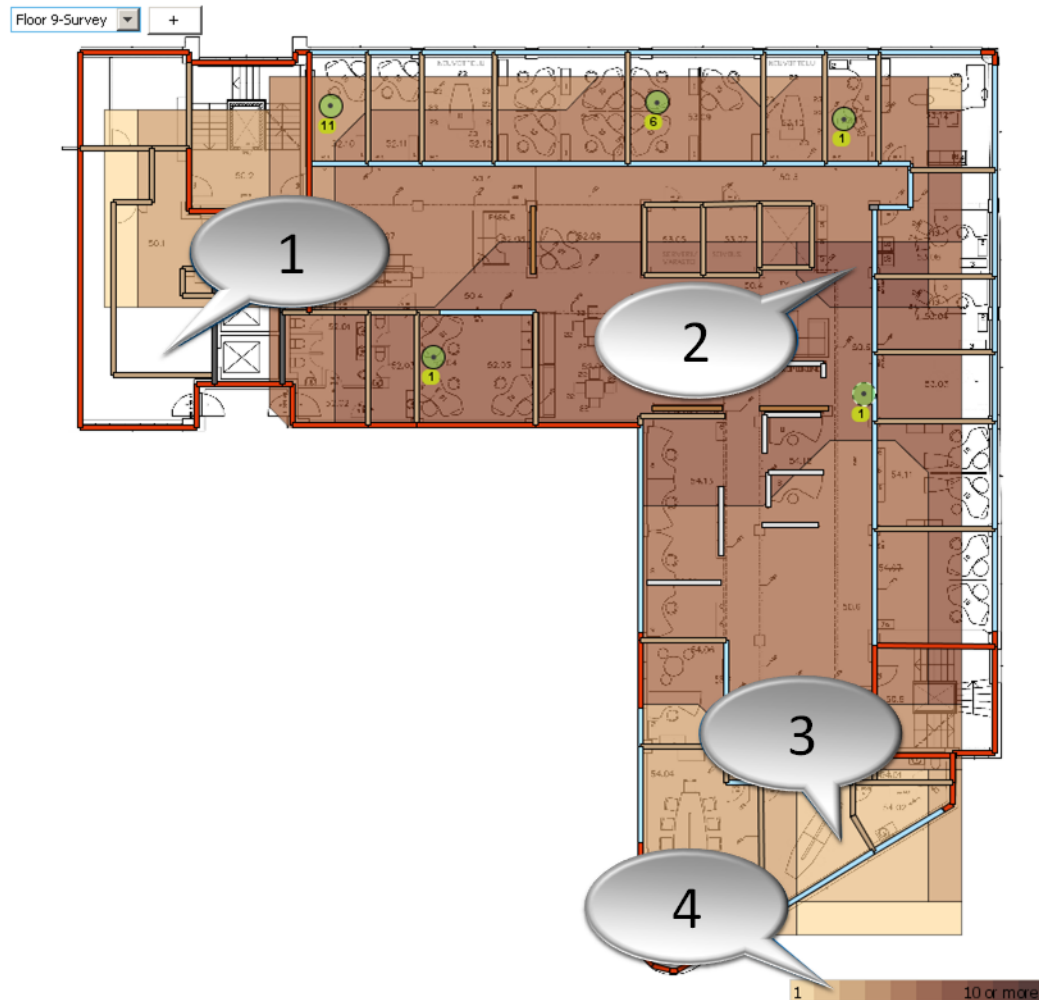
The Number of APs visualization shows how many access points are audible in a given location. The number of APs must be sufficient to ensure sufficient overlap in the network. Overlap is needed for seamless roaming between access points, as well as load balancing.

The following selections will affect the Number of APs:

- **Minimum Signal Strength** allows you to set a minimum signal strength for an AP that is to be included in the number of APs to be visualized. For example, if you set it to -90, the number of APs audible at stronger than -90dBm signal strength will be shown.

- **Adapter** affects the Number of APs visualization, as some adapters are more sensitive, and can thus hear more APs in a given location than the others.

Figure 8.14. Number of APs visualization



1. No audible APs
2. Lots of audible APs
3. Only 2 audible APs
4. Click to adjust the visualization value range, colors, etc.

### 8.3.6 Signal Strength

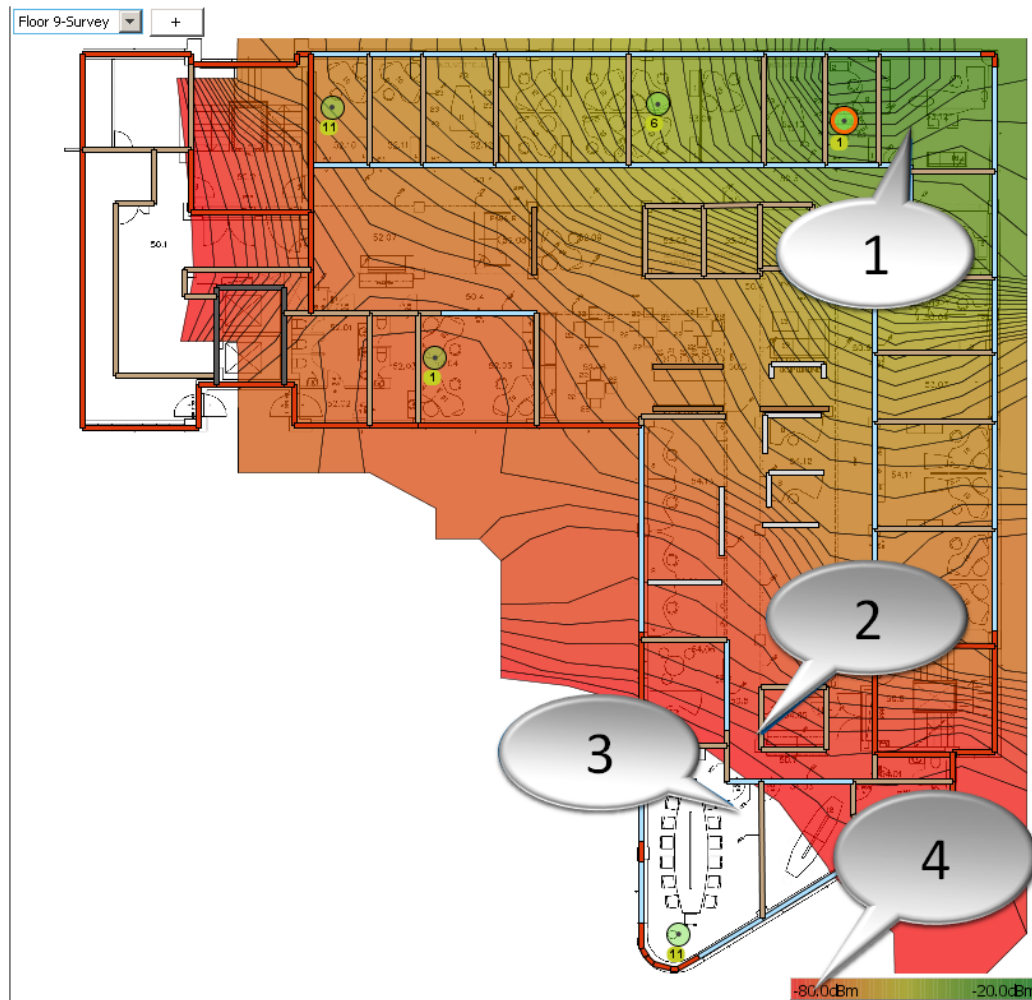
The Signal Strength visualization displays the signal strength of the selected set of access points in dBm. By default, the signal strength of the strongest access points per location will be displayed.

Signal Strength has the following options accessible via Visualization Options:

- **Viewed Signal** allows you to disregard the signals from the strongest access points, visualizing the second or third strongest signals instead of the strongest one. This is useful for visualizing AP failover scenarios and redundancy.
- **Signals at Channel** limits the Signal Strength visualization to only show the signals at a selected channel.

- The **Adapter** selection allows you to visualize the signal strength as the selected adapter would "see" it. For example, the signal strength may be sufficient using a high-quality network adapter, but may not be sufficient using a wireless VoIP phone with different antenna characteristics.  
Ekahau Site Survey has characterized and field-tested various wireless adapters and VoIP phones to allow accurate simulation when deploying wireless networks for different adapters.

Figure 8.15. Signal Strength visualization



1. High signal strength
2. Low signal strength
3. Signal strength below -80dBm
4. Click to adjust signal strength visualization value range, colors, etc.

### 8.3.7 Signal-to-Noise Ratio

In wireless data communication, the signal strength must exceed the noise level. Otherwise two devices will not be able to communicate with one another. The Signal-to-Noise Ratio (SNR) visualization shows if the signal level exceeds the noise level, and by how many dB.

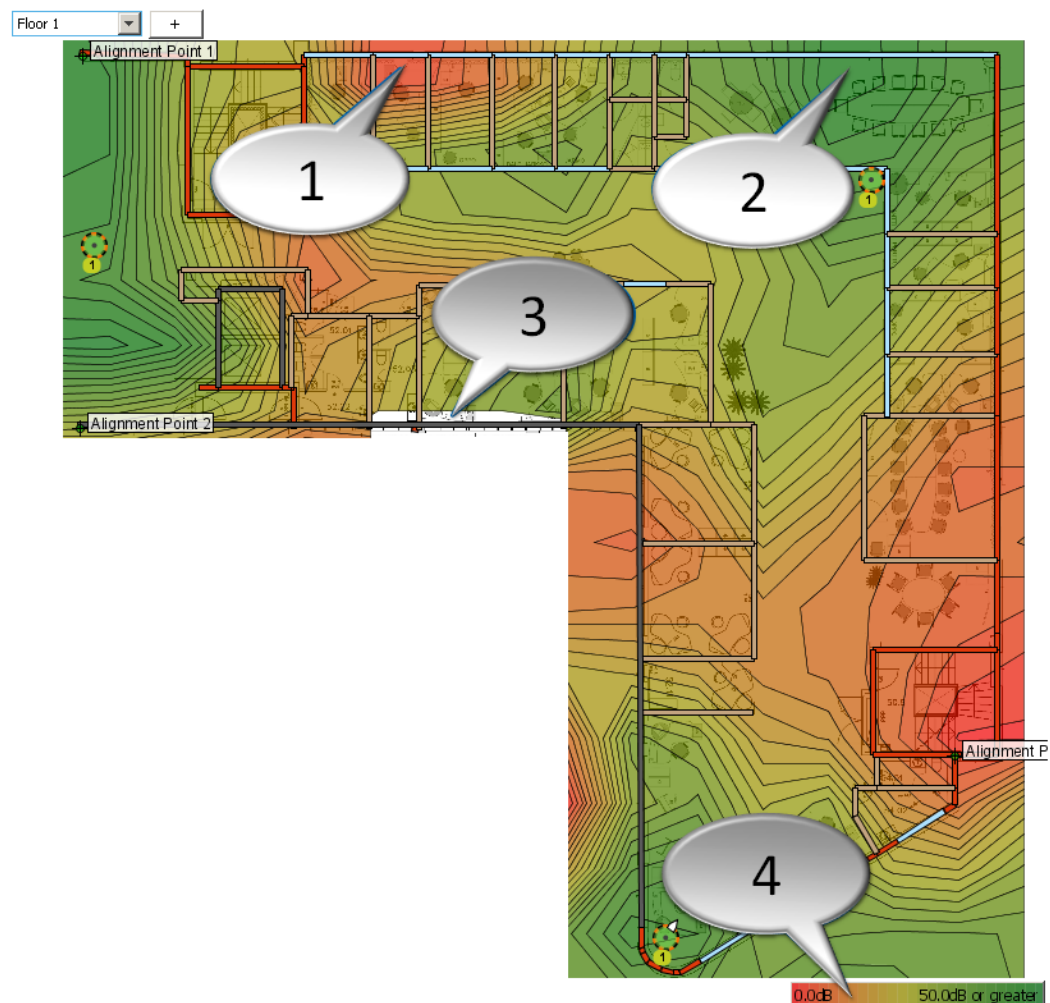
Signal-to-Noise Ratio is affected by:

- **Minimum Data Rate** which should be adjusted if connections at low speeds are disallowed in the network. For example, if your network is only set to accept speeds 6Mbps or higher, set the Minimum Data Rate accordingly.
- **Network Load** affects SNR as it affects interference. The higher the Network Load, the lower the SNR will be.
- Different Wi-Fi **Adapters** have different characteristics for receiver sensitivity and antenna implementation. Thus, some adapters provide a higher SNR in a given location than others.

#### Note

In ESS, the Noise consists of co-channel interference generated by nearby 802.11 access points. To see the impact of non-802.11 noise sources, such as Microwave ovens, use a spectrum analyzer.

Figure 8.16. Signal-to-Noise Ratio visualization

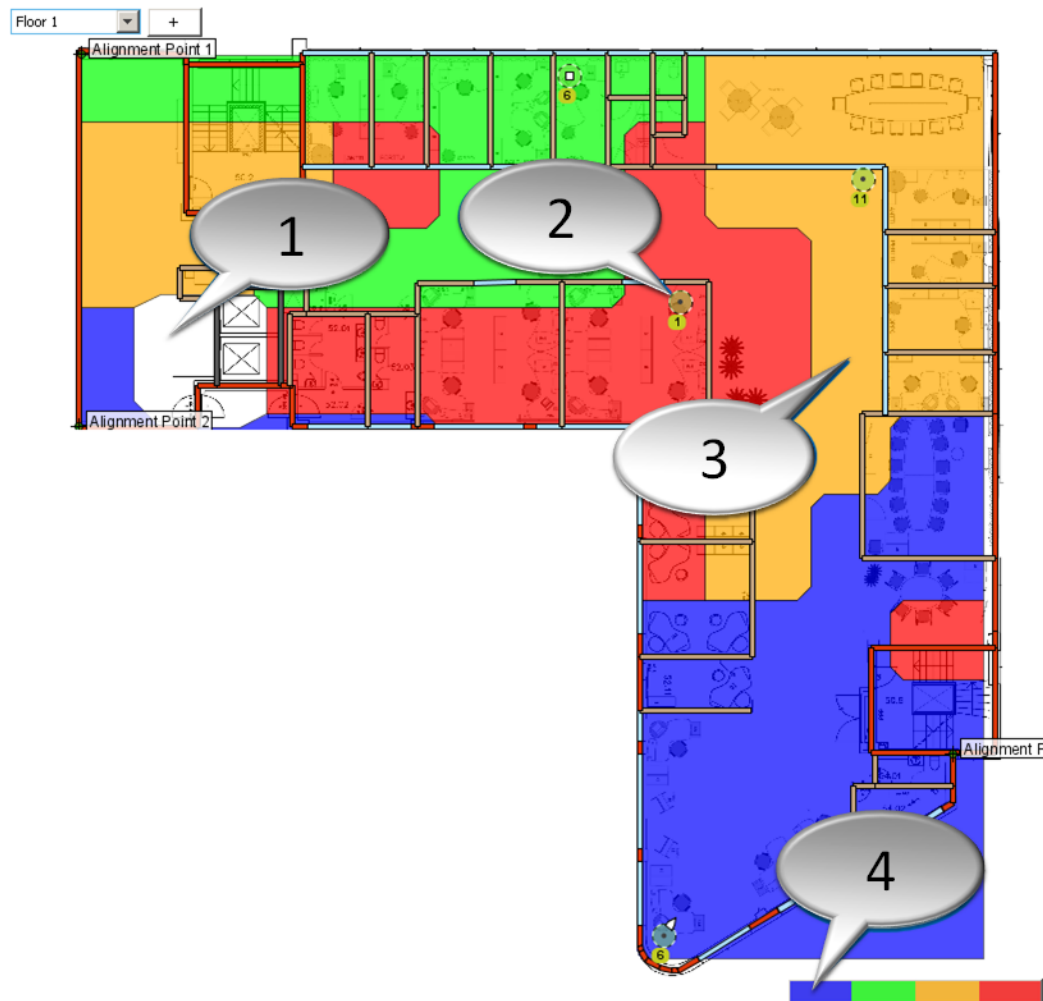


1. Low SNR
2. High SNR
3. SNR below 0dB (Noise level greater than signal level)
4. Click to adjust SNR visualization value range, colors, etc.

### 8.3.8 Strongest Access Point

The client devices have a tendency of associating to the strongest audible access point by default. To visualize which AP is the strongest in each location, use the Strongest AP visualization. The strongest AP visualization is affected by the Adapter selection, since some adapters are not able to associate to some access points. For example, an 802.11b/g adapter is not able to associate with an 802.11a access point.

Figure 8.17. Strongest Access Point visualization



1. No audible access points
2. Red color shows where this AP is the strongest one
3. Orange color shows where this AP is the strongest one
4. The area where each AP is the strongest is color-coded per AP

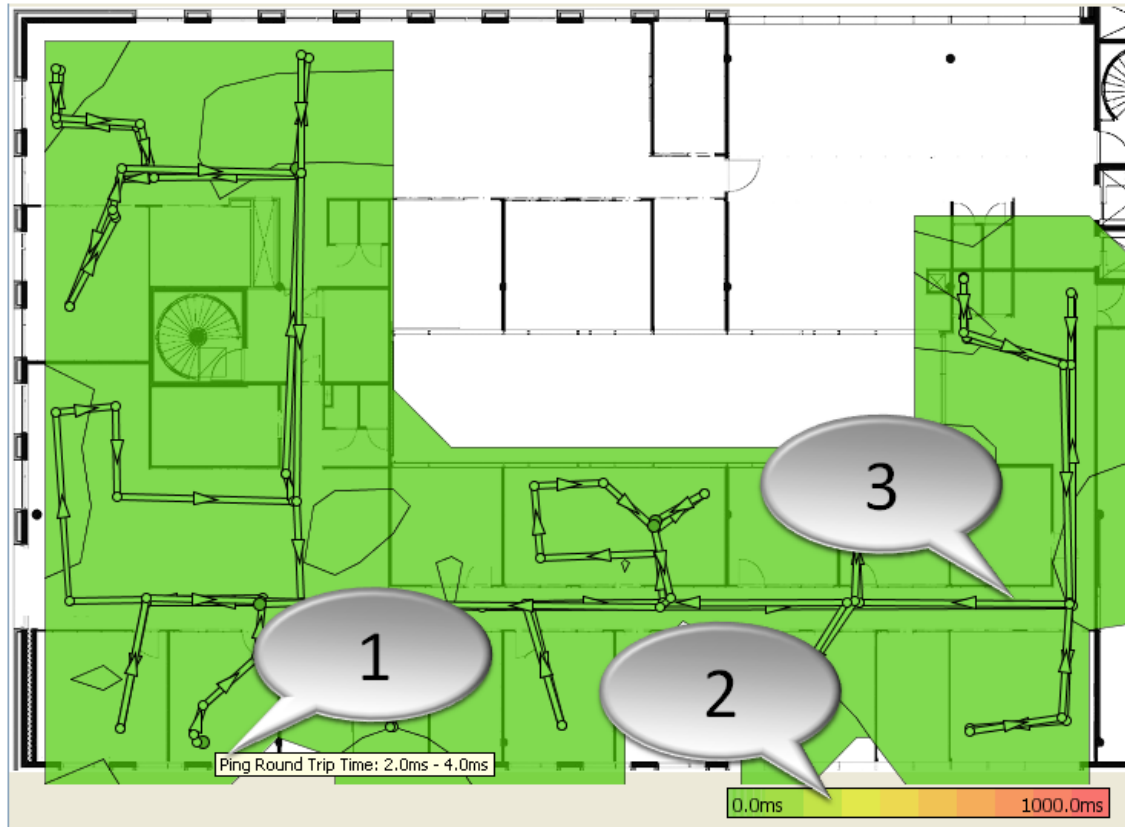
### 8.3.9 Ping / Round Trip Time

Ping is perhaps the most common tool for ensuring the network is working by measuring the network latency. During the Hybrid Survey, the ESS sends ICMP request packets to the target host, which by default is Default Gateway, and listens for ICMP response packets and measures the Round Trip Time (RTT) of the packets.



The visualization displays the Round Trip Time of the Ping packets over the floor map. The visualization varies from 0.0 ms to 1000.0 ms. When the RTT approaches 1000 ms, the users may experience the network connection quality as decreased having problems from low quality VoIP calls to slow file / Internet browsing. The Legend of the visualization is not customizable.

Figure 8.18. Ping / Round Trip Time visualization



1. In this area the Round Trip Time has been 2.0 - 4.0 ms
2. Click to enable or disable Contours
3. Survey route

### 8.3.10 Ping Packet Loss

When ESS measures the network performance by pinging the target host, it measures the number of lost packets at the same time. Packet Loss occurs when ESS fails to receive a ICMP response packet to the ICMP request packet from the target host. The Packet Loss can be caused by several factors such as interference and / or congestion in the network medium, corrupted packets, faulty network hardware, or faulty network drivers.

The Ping Packet Loss visualization displays the relative Packet Loss % over the floor map. The Packet Loss % is calculated from the 10 last packets.

*Figure 8.19. Ping Packet Loss visualization*

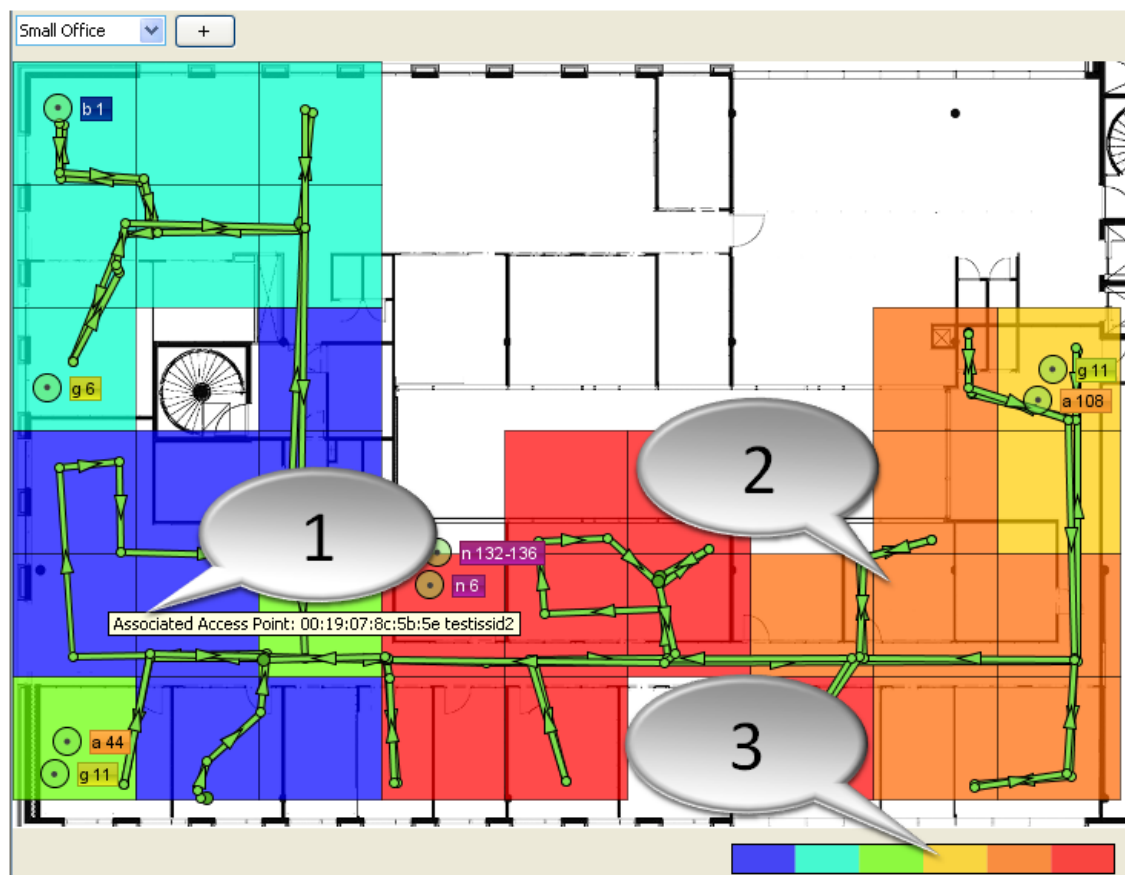
1. Ping Packet Loss: 0 % - 10 %
2. Ping Packet Loss: 50 % - 60 %
3. Ping Packet Loss: 90 % - 100 %
4. Click to adjust the visualization value range, colors, etc.

### 8.3.11 Associated Access Point

The Associated Access Point visualization displays the access point the client adapter was associated with in each floor area. The visualization is especially handy for recognizing roaming behaviour such as with which access point the wireless network adapters typically associates in each area. Thus, you can use the visualization to recognize areas where you might want to consider re-positioning access points for better load balancing.



Figure 8.20. Associated Access Point visualization

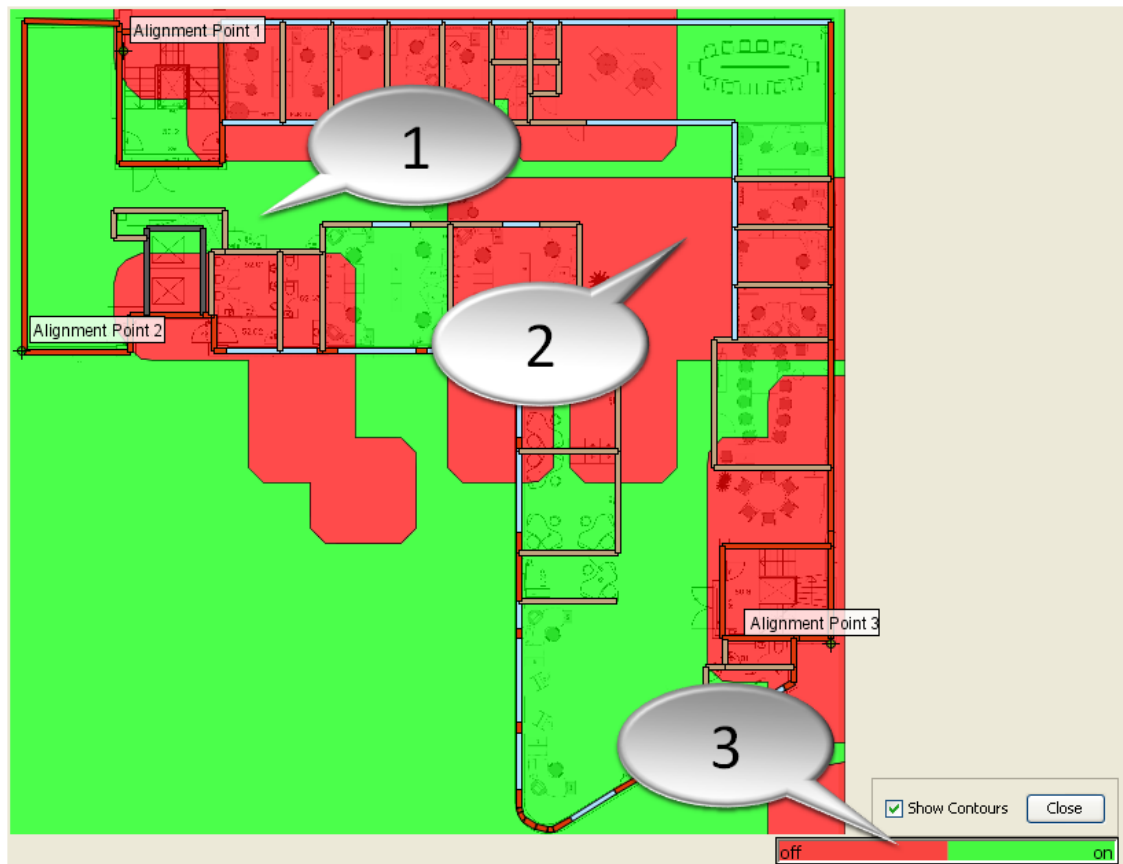


1. Moving the mouse cursor over each area displays the MAC address and SSID of the Access Point the client adapter was associated with
2. Each roaming area is represented with different colors
3. Click to enable or disable Contours

### 8.3.12 802.11n Channel Bonding

To better visualize your 802.11n network characteristics, use the 802.11n Channel Bonding visualization to see in which areas Channel Bonding is used to achieve higher bandwidth and to recognize the area where it could be enabled.

Figure 8.21. 802.11n Channel Bonding visualization



1. 802.11n Channel Bonding enabled
2. 802.11n Channel Bonding disabled
3. Click to enable or disable visualization Contours

## 8.4 Different Survey Methods vs. Visualizations

Not all visualizations are available with just passive surveys, or when working with simulated access points. The visualizations that require Hybrid Surveys do not work for simulated data. The Network Health and Network Issues visualizations provide all the functionality only when using Hybrid Surveys

The below table outlines which survey methods affect on each visualization:

Visualization	Passive Survey (Traditional Signal Reading)	Hybrid Survey (End-to-end Connectivity Testing)	Simulation
Data Rate	X	X	X
Interference / Noise	X	X	X
Network Health	X	X	X
Network Issues	X	X	X
Number of Access Points	X	X	X

Visualization	Passive Survey (Traditional Signal Reading)	Hybrid Survey (End-to-end Connectivity Testing)	Simulation
Signal Strength	X	X	X
Signal-to-Noise Ratio	X	X	X
Strongest Access Point	X	X	X
Ping / Round Trip Time		X	
Ping Packet Loss		X	
Associated Access Point		X	
802.11n Channel Bonding	X	X	X



## 9 Troubleshooting - Detecting and Solving the Most Common Wi-Fi Problems

### 9.1 On-Spot Troubleshooting Using Live Network Status

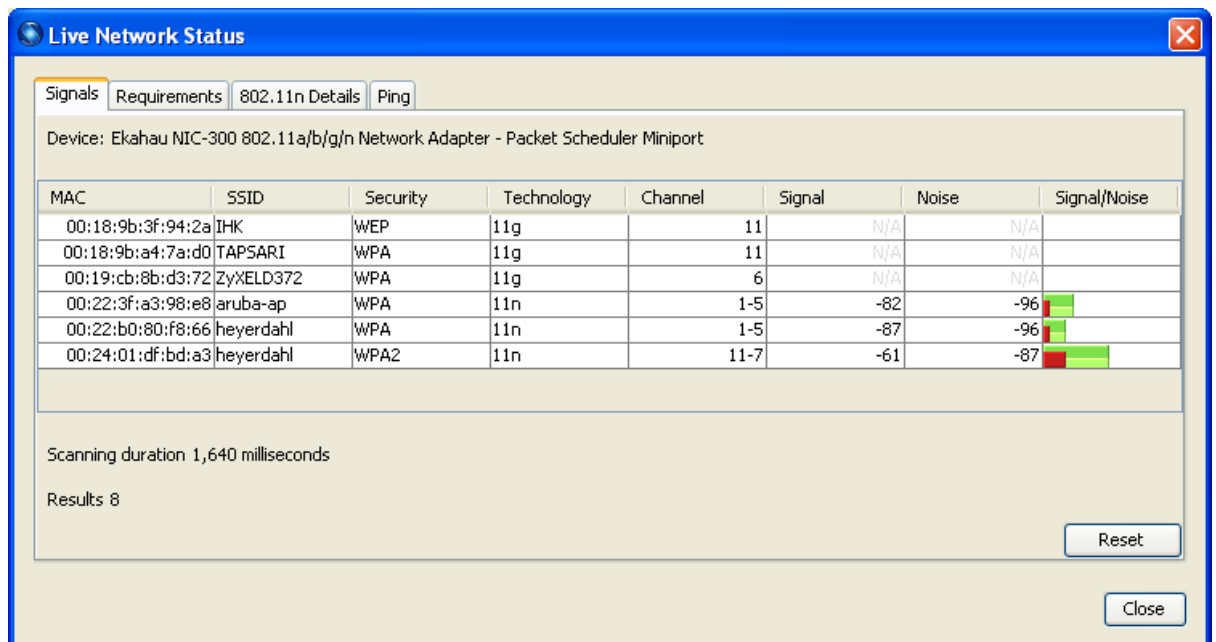
Ekahau Site Survey provides excellent tools for visualizing and troubleshooting your network on the map - we will cover these later in this chapter. However, Ekahau Site Survey also provides a powerful troubleshooting tool called Live Network Status. It works without a map, without having any surveys performed.

In a typical troubleshooting scenario, the wireless network does not function in one or more locations for some reason at a particular time. With ESS, you need to take the laptop to the problematic area, and use the Live Network Status view to troubleshoot the issue. You can use the pre-defined Requirements to see whether the network meets different application requirements or not. To start the Live Network Status, click **Device > Live Network Status**, or click on the Miniature Signal View.

#### 9.1.1 Signals

The Signals tab of Live Network Status displays the current signal measurements from all audible access points. Click Reset to clear the list of currently audible APs.

Figure 9.1. Signals view displays all currently audible access points



#### 9.1.2 Requirements

The Requirements tab of Live Network Status compares your network requirements with the current network measurements. If the network requirements are met at the moment, green color will be

shown for each measurement. If your network requirements are not met right now, red color will be shown for that requirement.

You need to choose the access points that are considered yours when using the Live Network Status for troubleshooting. If you have not defined My APs (for example when using Live Network Status on a blank Project without any surveys performed), choose **Identify My Access Points by SSID** and select the SSID of your network. If you are working on an existing project with My APs defined, select Identify My Access Points by Access Point List. If you do not choose either, all of the APs will be considered to belong to your network - which may lead to overly optimistic results.

Figure 9.2. Quick on-spot troubleshooting without a map

The screenshot shows the 'Live Network Status' window with the 'Requirements' tab selected. The 'Identify My Access Points by:' section has 'SSID' selected with a dropdown menu. The 'Requirement:' dropdown is set to 'Basic Connectivity'. The 'Criteria' section displays a table of network metrics with their requirements and current values. The 'Conditions' section shows 'Network Load: 5%' and 'Adapter: Raw Measurements'. The 'Connection Details' section shows 'Associated Access Point: None' and 'Ping Host: None'. A 'Close' button is at the bottom right.

Criteria	Requirement	Value
Signal strength	at least -85 dBm	-39.6 dBm
Signal-to-noise ratio	at least 5 dB	56.4 dB
Data rate	at least 1 Mbps	63 Mbps
Number of access points	at least 1 when signal strength -85 dBm	36
Ping round trip time	at most 500 ms	- ms
Packet loss	at most 10 %	0 %

#### Note

To be able to compare Ping / Round Trip Time and Packet Loss measurements, the Ping tool must be started. To do this, go to the Ping tab and click the *Start* button. Remember to make sure you have valid Network Host configured.

### 9.1.3 802.11n Details

The 802.11n includes several improvements that offer higher throughput, range, reliability, and bandwidth than legacy 802.11 standards. However, sometimes these 802.11n settings may cause

interference and/or other problems with legacy 802.11 networks and devices. The 802.11n Details view is very helpful to identify problems related to 802.11n.

The view displays the current signal measurements from 802.11n access points including their 802.11n characteristics. With the 802.11n Details view it is possible to identify for example how many spatial streams different 802.11n access points are using and which channels are bonded thus consuming available channels from other access points and/or possibly even causing interference. The 802.11n Details view also displays whether SGI and Greenfield mode are used in the network. For example, you can check whether Greenfield mode is enabled in some of the 802.11n access points when a 802.11g client can not access your 802.11n network. In this case the Greenfield mode should be disabled.

Figure 9.3. Live 802.11n network details

MAC	SSID	Channel	Signal	Noise	SGI	Greenfield	Max supp...	Max Spati...
00:1f:9e:8d:20:8d	Unknown SSID	132-136	N/A	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	300.0 Mbps	2
00:1f:9e:8d:20:8d	Unknown SSID	132-136	-62	-95	<input checked="" type="checkbox"/>	<input type="checkbox"/>	300.0 Mbps	2
00:1f:9e:8d:20:82	Unknown SSID	6	N/A	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	144.4 Mbps	2
00:1f:9e:8d:20:82	Unknown SSID	6	-56	-85	<input checked="" type="checkbox"/>	<input type="checkbox"/>	144.4 Mbps	2
00:1f:9e:8d:1c:6d	Unknown SSID	52-56	N/A	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	300.0 Mbps	2
00:1f:9e:8d:1c:6d	Unknown SSID	52-56	-60	-92	<input checked="" type="checkbox"/>	<input type="checkbox"/>	300.0 Mbps	2
00:1f:9e:8d:1c:62	Unknown SSID	1	N/A	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	144.4 Mbps	2
00:1f:9e:8d:1c:62	Unknown SSID	1	-55	-96	<input checked="" type="checkbox"/>	<input type="checkbox"/>	144.4 Mbps	2
00:1f:9e:8d:18:6d	Unknown SSID	100-104	N/A	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	300.0 Mbps	2
00:1f:9e:8d:18:6d	Unknown SSID	100-104	-75	-91	<input checked="" type="checkbox"/>	<input type="checkbox"/>	300.0 Mbps	2
00:1f:9e:8d:18:62	Unknown SSID	6	N/A	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	144.4 Mbps	2
00:1f:9e:8d:18:62	Unknown SSID	6	-73	-85	<input checked="" type="checkbox"/>	<input type="checkbox"/>	144.4 Mbps	2
00:1d:73:bb:0b:a8	SOPIMA	3	N/A	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	144.4 Mbps	2
00:1d:73:73:3c:2c	AMX_A160	4	N/A	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	144.4 Mbps	2
00:1b:11:e5:c0:7b	I13	6	-54	-85	<input checked="" type="checkbox"/>	<input type="checkbox"/>	130.0 Mbps	2
00:1b:11:69:f9:8d	ikal	3	-55	-96	<input checked="" type="checkbox"/>	<input type="checkbox"/>	130.0 Mbps	2
00:16:01:e6:dc:40	GWeb2	10-6	-77	-85	<input checked="" type="checkbox"/>	<input type="checkbox"/>	6.7 Mbps	1

#### Note

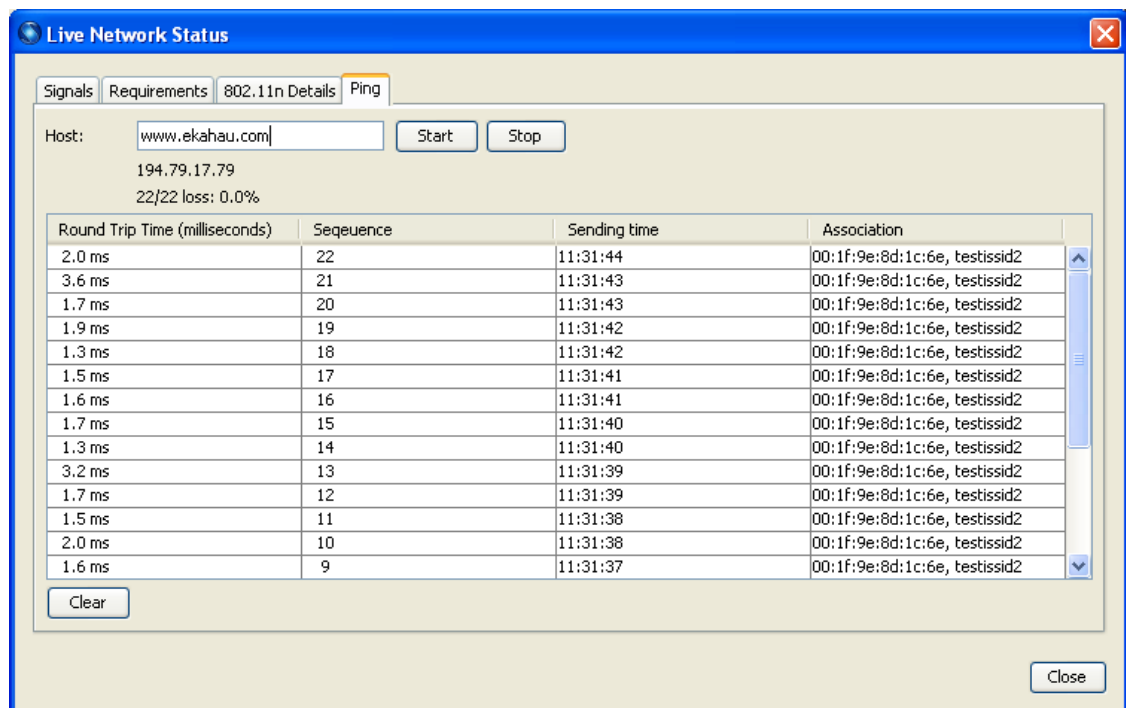
The 802.11n details can also be viewed per each 802.11n AP by clicking their 11n button in the Access Points list.

### 9.1.4 Ping

The Ping tab in the Live Network Status view allows testing connectivity between the Site Survey laptop and a selected server. The ping host is user configurable. By default, the Default Gateway is used as the ping host.

The Ping tool can be used without performing any surveys.

Figure 9.4. Live Network Status with Ping tool

**Note**

You can define the target host as an IP address or as a host name. When performing Hybrid Surveys, ESS will automatically start the Ping tool. There is no need for starting it separately.

## 9.2 Troubleshooting After the Survey

The amount of troubleshooting scenarios ESS can be used for is almost endless. Here we will present a couple of the most common Wi-Fi problem scenarios, and how to solve them with ESS. Unlike in the previous section, The scenarios in this chapter assume that a site survey has been performed, as the troubleshooting happens using the map.

### 9.2.1 Finding Network Problems with a Single View

After having your Requirements set, simply use the Network Issues visualization to identify network trouble spots. Select the appropriate visualization to look at a given network parameter in more detail.

### 9.2.2 Basic Wireless Issues - Low Coverage, High Interference

Problems like low coverage and high interference are easy to identify and troubleshoot.



With low coverage, identify the spots of low coverage by selecting Show Signal Strength for My Access Points. After identifying the spots with low coverage, first check that all of your APs are transmitting signals. If the APs are working properly, you may need to increase transmission power, or add more access points to the problematic areas (recommended). To simulate how adding an AP to the problematic area would impact the coverage and performance, use the **Simulated Access Point tool** in the **Planning tab** to place a Simulated AP on the map.

#### Note

Drawing walls prior to placing Simulated APs is recommended.

To identify high interference or low Signal-to-Noise Ratio, use the respective visualizations. If SNR is below 0, or interference is above -70dBm, issues are likely to occur. After identifying the issue, ensure first that the channel separation of your network is optimal.

Nearby access points should not be on the same or nearby channels. If there rogue or neighbor access points audible to your facility, check their signals and channels by selecting Show Signal Strength for Other APs. Use the Signals at Channel visualization option to see which channels are crowded. If you suspect that there is non-802.11 interference, such as cordless phones, microwave ovens or other machinery in the area, use the Ekahau DBx Spectrum Analyzer.

To optimize the channel separation, change the channels from your access points to more suitable ones. This can be done for measured as well as simulated access points. When changing the channels, the visualizations are updated appropriately (using Always Refresh Automatically visualization option is recommended). Keep the Interference or SNR visualization active to see the impact of changing the channels.

#### Tip

Go to Visualization Options to visualize the calculated co-channel interference instead of measured noise when optimizing channel separation.

### 9.2.3 Misconfigured SSIDs

Sometimes in enterprise networks, the SSID configuration may not be correct for all the access points. In many cases, some of the APs are missing a given SSID because of either human error or an incomplete configuration update by the Wi-Fi controller.

The quickest way to resolve this is to check the number of SSIDs in your network. To check the number of SSIDs, use the Quick Select button in the AP list. Select the desired SSID, and the respective APs will be selected in the AP list. You will see a per-floor summary of how many access points are selected per floor.

#### Note

Alternatively to using Quick Select, you can type the desired SSID to the Search box in the Access Point list. Only the APs with that SSID will be displayed, and a per-floor access point count will be displayed, as well as the total number of searched access points.

**Tip**

You can also visualize the coverage easily per SSID by using Quick Select and selecting **Show Signal Strength for Selected Access Points**.

## 9.2.4 Defective Access Points

Defective APs can be found after the survey by looking at the AP locations. If ESS has not discovered any access points close to a location where an AP should be, the AP is probably broken.

Visualizing **Signal Strength for My Access Points** may also reveal a broken AP: If there is low coverage near a location where an AP should be operating at, it's probably broken.

The third way of discovering broken APs is to use the AP list: Either use the Quick Select or the Search box to select an SSID, and look at the total count of APs, or the count of APs per map in the AP list.

Finally, the AP may provide good signal coverage, but the Ping Packet Loss may show 100 % loss for the AP. In this case, check the cabling of the AP, as well as the AP bridging and VLAN settings.

## 9.2.5 Rogue Access Points

ESS automatically locates access points after the survey. After identifying and selecting My APs, the detected rogue APs will be the ones that are displayed in red color. If there are APs that are not automatically located and are not a part of your network, they are probably not in your facility, and may not be distributing strong enough signals to interfere with your network.

## 9.2.6 Misconfigured 802.11n settings

The 802.11n includes several improvements that offer higher throughput, range, reliability, and bandwidth than legacy 802.11 standards. However, sometimes these 802.11n settings may cause interference or other problems with legacy 802.11 networks and devices.

## 9.2.7 Connectivity and Latency Issues

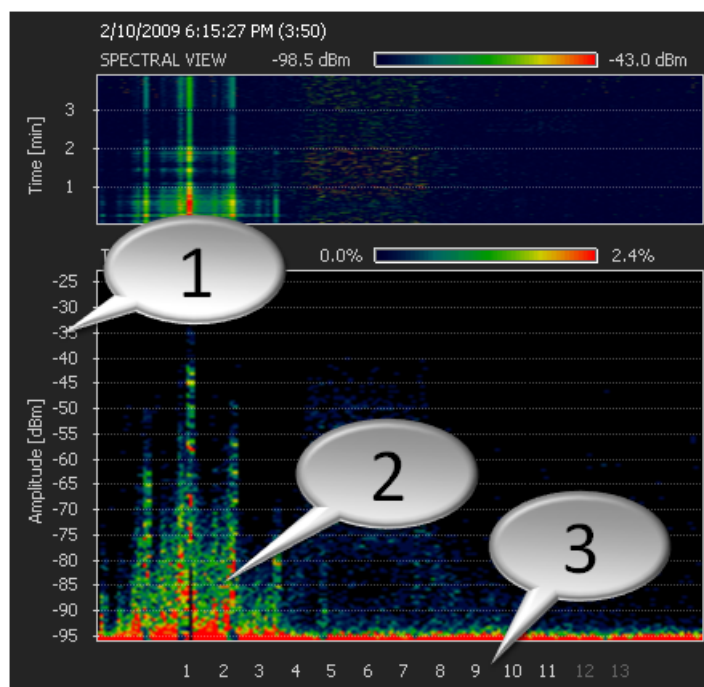
After performing Hybrid Surveys, it's easy to find connectivity and latency issues. Use the Ping Packet Loss and Ping Round Trip Time visualizations to identify such issues. The issues may be caused, for example, by high interference, excessive network traffic, or bad configurations in the APs or the wired network.

## 9.3 Troubleshooting Non-Wi-Fi Interference Using Spectrum Analyzer

Wi-Fi devices operate on license-free frequency bands. This means that these frequency bands are not limited to Wi-Fi - devices other than Wi-Fi also operate on the same frequencies. Some examples of non-Wi-Fi devices that may operate on Wi-Fi frequencies are:

- Microwave ovens
- Wireless video cameras
- Wireless headsets
- Cordless phones
- Zigbee (IEEE 802.15.4)

*Figure 9.5. Interference caused by a wireless video camera on 2.4 GHz frequency, as seen by a spectrum analyzer*



1. Interference intensity in dBm
2. Interference on Wi-Fi channels 1-3
3. Wi-Fi channels

Ekahau Site Survey uses the Wi-Fi adapter to take signal measurements. In cases where the interference is caused by a non-Wi-Fi device, the interference issues may not be detected by the Wi-Fi adapter. Connectivity issues caused by non-Wi-Fi interference may include:

- Occasional, momentary connectivity cut-offs
- Low voice quality
- Lower than expected network performance
- One or more channels completely unusable momentarily or permanently
- Other suspicious network issues

For the reasons mentioned above, it is highly recommended to use a spectrum analyzer when deploying or troubleshooting a wireless network. For Ekahau Site Survey users, using spectrum analyzer is recommended in the following scenarios:

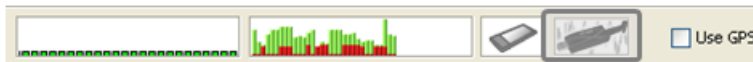
1. **Network planning:** Find out the interference sources before you deploy any access points by making spot-checks with the spectrum analyzer around the facility - Detecting the interference issues in advance may affect the access point placement and configuration
2. **Network verification:** A Wi-Fi site survey done with Ekahau Site Survey is always highly recommended when verifying the network - This is typically done before the network production use starts, and periodically (for example, every month) - During the verification check, you may choose to perform spectrum analysis spot-checks at selected locations to ensure that there are no significant interference sources present
3. **Troubleshooting:** The most common purpose for a spectrum analyzer is troubleshooting - Whenever Wi-Fi issues arise that are not solvable with a Wi-Fi site survey, Ekahau recommends using a spectrum analyzer - Typically, collecting a minute or two of data with a spectrum analyzer will reveal the underlying issue

### 9.3.1 Using Wi-Spy DBX Spectrum Analyzer

Firstly, you will need to insert the Wi-Spy DBx spectrum analyzer device to your computer, and install the appropriate software. The spectrum analysis software is called Chanalyzer. Consult the Wi-Spy DBx documentation for details on the installation.

To start spectrum analysis, click the Spectrum Analysis button. This will start the Chanalyzer software, assuming that it has been installed on your computer.

*Figure 9.6. Wi-Spy Chanalyzer software quick launch*



It is important to note taking measurements using a spectrum analyzer requires a method different from Wi-Fi site surveys. Whereas during Wi-Fi site surveys it is acceptable to fairly quickly walk around the facility taking measurements, spectrum analysis is something done in selected locations only, spending more time (for example one minute) in a given location. This is because a spectrum analyzer typically needs more time to collect meaningful data.

Prior to spectrum analysis, you will need to find out, whether the problems are on the 2.4 or 5GHz frequency space. For example, if the problems are found with 802.11g VoIP phones, but not with laptops operating on 802.11a, you should concentrate on analyzing the 2.4GHz frequency space. Use the Configuration Side Bar (explained below) to configure the spectrum analyzer to scan the appropriate frequency space.

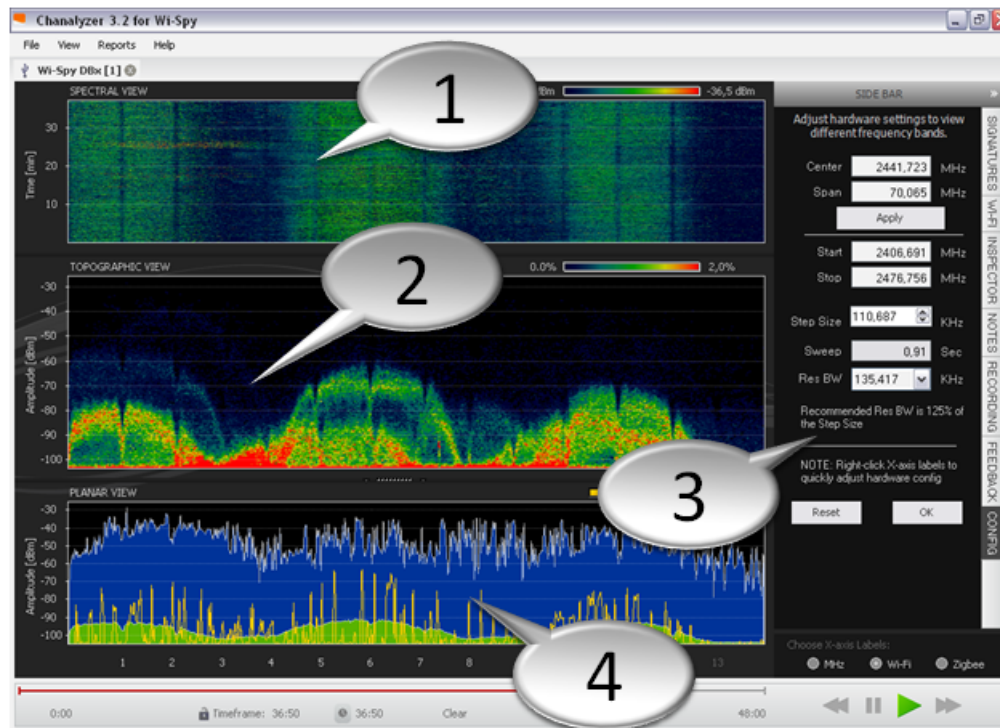
#### User Interface

There are four main components to the Chanalyzer user interface, three of which are most important for typical use: The Spectral View, the Topographic View and the Configuration Side Bar. In all of the views, x-axis presents frequency. This is configurable. By default you are investigating the 2.4GHz frequency space – you can see channels at the bottom of the screen.

- **Spectral View** shows the amount of interference (color) over time (the y-axis) - In this view, you can see how interference changes periodically - This is very helpful to troubleshoot momentary interference sources, such as Microwave ovens
- **Topographic View** shows the amount of interference (color) and its amplitude, or in other words, the strength of the interference (y-axis)

- **Planar View** provides you with current measurement results (yellow line), as well as average (green) and maximum (blue) measurement results
- **Configuration Side Bar** allows you to adjust the frequencies to look at - The following parameters should be typically configured:  
**Frequency space to measure:** The wider the measurement frequency is, the more comprehensive overview you will get - However, the wider the measurement frequency, the slower the results will be updated  
**Start frequency** means the lowest frequency that the spectrum analyzer will scan. For 2.4GHz, this could be 2400Mhz, for example  
**Stop frequency** means the highest frequency that the spectrum analyzer will scan - In the EU (13 channels used), you could use 2480 - In Japan (14 channels used), this could be set slightly higher, and in the US, slightly lower (11 channels used)  
**Measurement accuracy vs. measurement speed:** To increase the measurement accuracy, you can adjust the Step Size and Resolution Bandwidth - The smaller the step size, the higher the accuracy, but the longer time it will take for the analyzer to sweep the frequency – meaning lower measurement speed

Figure 9.7. Wi-Spy DBX Spectrum Analyzer user interface

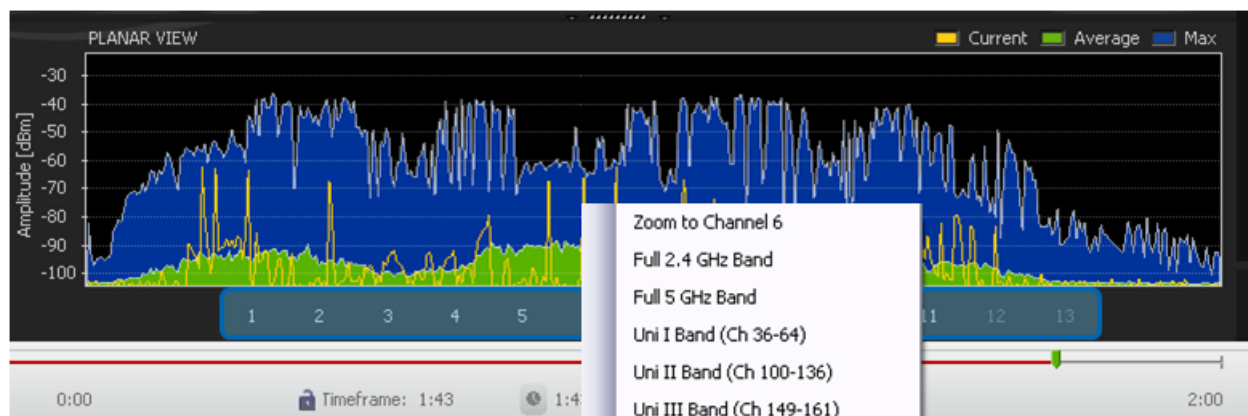


1. Spectral View
2. Topographic View
3. Configuration Side Bar
4. Planar View

#### Note

You can quick adjust the frequencies to look at by right-clicking over the Planar View's channels numbers without knowing the exact frequency of each channel.

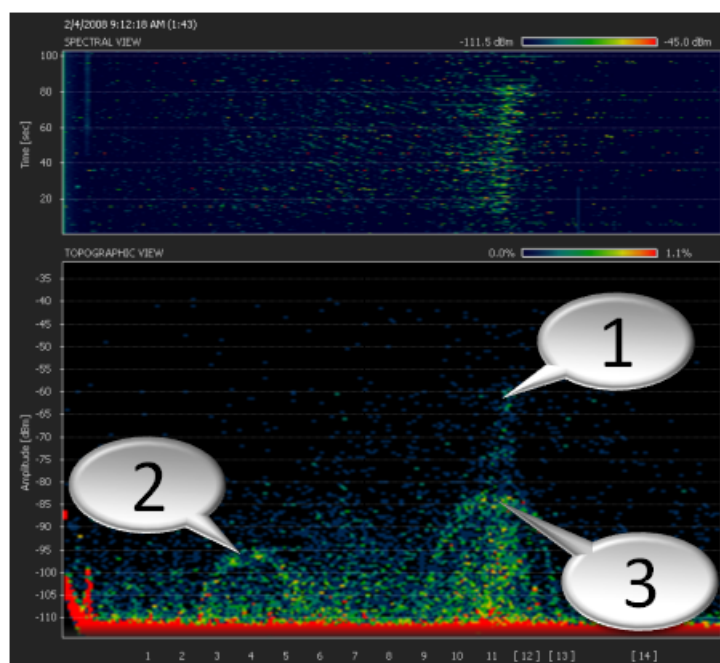
Figure 9.8. Quick adjusting the frequencies to look at



## Finding Interference Issues

When using a spectrum analyzer, the goal is to find the interferers in the Wi-Fi frequencies. The spectrum analyzer will display all the activity in the selected frequency space – meaning you will see Wi-Fi activity as well as other activity. If you have already deployed Wi-Fi at the site, you will need to be able to separate Wi-Fi signals from the actual interference. An example is shown in the image below. You can also use the Signatures tab in the right-hand side of the Chanalyzer user interface to see how Wi-Fi compares to the other interferers.

Figure 9.9. Wi-Fi activity and microwave oven interference on channel 11



1. Interference caused by a microwave oven
2. Wi-Fi activity on channel 4
3. Wi-Fi activity on channel 11

## 10 Reporting, Exporting and Printing

With Ekahau Site Survey, you can easily output the network information by either generating a comprehensive report, or by exporting or printing the images one-by-one.

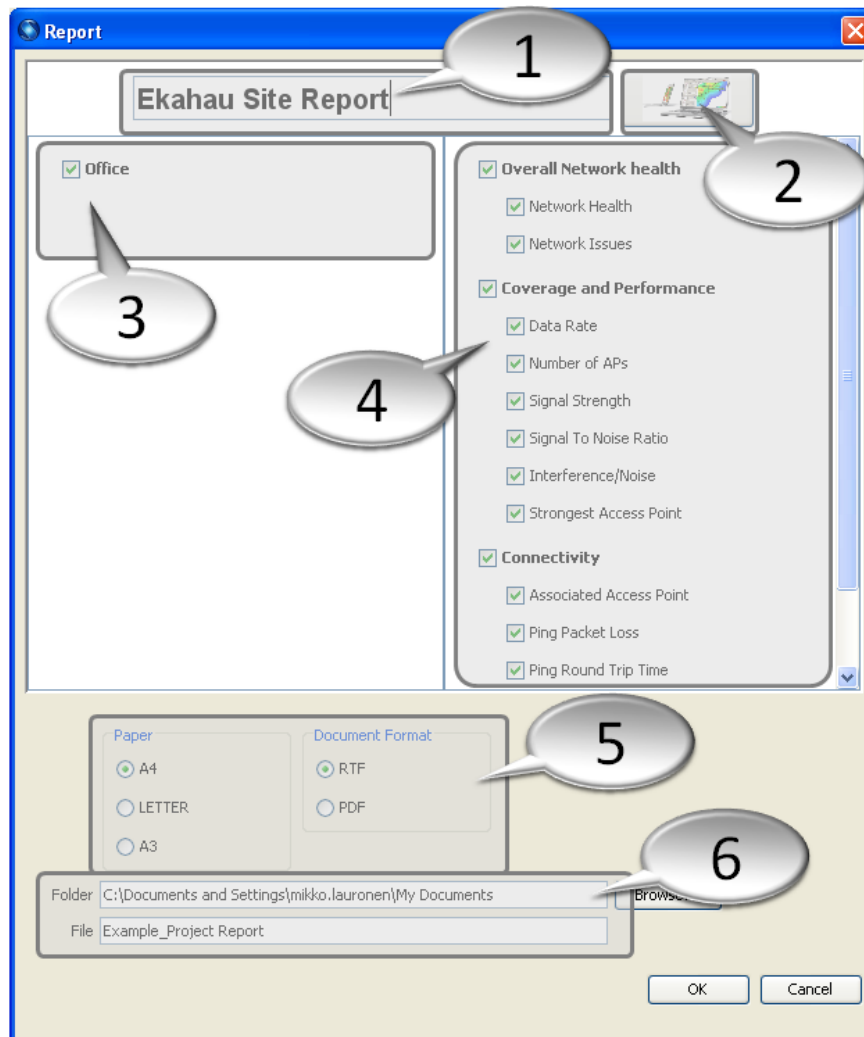
### 10.1 Generating Reports

Generating a report constructs a comprehensive report in RTF or PDF format. To generate a report, go to **File > Report**. From the dialog, choose the visualizations you want to be reported and make the following selections:

Selection	Description
Folder	The output location of the report
File	The file name of the report, followed by the extension (.rtf or .pdf)
Paper	The paper type of the report
Document Format	Choose Adobe PDF, or easily customizable and MS Word compatible RTF
Report title	The title of the report
Cover page image	Choose an Image file, such as a company logo, to be included in the front page of the report



Figure 10.1. Generating reports



1. Renameable title of the report
2. Customizable cover page image - Click to change the image
3. Select the maps that should be included in the report
4. Select the visualizations and Access Points that should be included in the report
5. Choose the paper type and document format
6. Type the name of the report file and select where the report should be saved

The report includes:

- Access point configurations as a table
- Access point locations on the map
- Access Point Notes
- Network coverage and performance visualizations overlaid on a map
- Network Requirements
- Survey routes marked on the map
- Optionally an image in the front page



## 10.2 Exporting and Printing Images

To export or print the currently displayed image, click **File > Export Image** or **File > Print Image**.

### Note

Your current selections will impact the image: For example, if you have selected a visualization for Selected Access Points, the exported or printed image will be constructed with the same settings. What you see in the user interface is what will be exported or printed.



## 11 Real-Time Location Tracking (RTLS) Features

Assets and people can be accurately tracked using a standard Wi-Fi network to improve safety and to locate assets quickly when necessary. Ekahau Site Survey fully integrates with Ekahau Real-Time Location System. This allows you to use your existing site survey data to be used for calibrating the location system. To enable the location tracking features, check the **Enable RTLS Features** checkbox under **File > Preferences**. After re-starting the software, go to the Help menu, and open the Ekahau Site Survey Guide for Deploying RTLS for more information about the RTLS Features.

If real-time location tracking (RTLS) is of interest, visit [www.ekahau.com](http://www.ekahau.com) to read more about Ekahau RTLS, the industry-leading real-time location tracking system.

### Note

If you have the RTLS Features enabled, but you do not use ESS to deploy Ekahau RTLS, you may receive a warning about undefined Rails and Open Spaces when saving a survey project. You can simply ignore this warning and choose **Continue** to save the survey project. However, if you want to avoid this warning in the future, uncheck the **Enable RTLS Features** checkbox under **File > Preferences** and re-start the software.



## 12 Troubleshooting

This chapter includes some of the most common troubleshooting scenarios.

### **The program does not start or is very slow**

- Ensure you have enough memory in your laptop, and that all other system requirements are met
- Ensure you are logged in as the computer administrator, or have administrative privileges
- Ensure that the pixel sizes of the maps you have inserted are reasonable - preferably below 5000 x 5000 pixels
- Ensure all other programs are stopped when running Ekahau Site Survey
- Ensure that the scale has been set to each map
- If the program is running slow, disable Google Desktop, third party Virus/Spamware Scanners (within reason - ensure your computer will not get affected) and other such applications

### **The software does not accept my license**

- Ensure that you are connected to the Internet when starting the software for the first time
- Ensure you have the license for the correct software, and for the correct version
- Ensure the the same network adapter is in the computer which was registered when the product was started for the first time
- Ensure the network adapter is connected and enabled when inserting the license
- Ensure the license you have has not been registered previously by anyone else
- The issue may be in the firewall or proxy. Try activating the license from another location.

**I can't see any signals in the Miniature Signal View. In other words, the network adapter is not scanning.**

- Ensure your Wi-Fi adapter is enabled
- Ensure you have a supported Wi-Fi adapter. See [www.ekahau.com/devices](http://www.ekahau.com/devices) for details
- Ensure you have the correct network adapter driver installed. If using an external Wi-Fi adapter, install the latest adapters from **Start > Programs > Ekahau > Ekahau Site Survey > WLAN Adapter Driver Installer** If using the integrated Wi-Fi in Intel Centrino, use the latest available driver from Intel
- Exit Ekahau Site Survey, remove and re-insert (or disable and enabled) the wireless network adapter, then re-start Ekahau Site Survey

If the problem persists, contact [support@ekahau.com](mailto:support@ekahau.com).



## 13 Additional Information

### 13.1 Meru Virtual Cell

The Meru Networks access points can operate in Virtual Cell mode. When in this mode, all the access points broadcast the same MAC address. This is unlike other access points, that broadcast at least one unique MAC address per access point.

Because of Meru Virtual cell, the mobile devices only see a single MAC address being distributed by all the APs. Thus, the mobile devices think they're constantly connected to a single AP, even though they are actually roaming between several APs. According to Meru, this makes the roaming times shorted.

Because the MAC address is typically the unique identifier of an access point, most site survey tools will not work well with Meru infrastructure - they cannot show per AP coverage or performance maps, just one huge coverage area for all the APs. Unlike most site survey tools, Ekahau Site Survey can read the "unique MAC addresses" of the Meru access points, which will allow the APs to be displayed normally. Ekahau Site Survey displays the "Meru unique MAC addresses" instead of the MAC addresses seen by other 802.11 clients. This feature is enabled by default and requires no user intervention.





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