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# **Indoor RadioPlanner 2.1**

# Planning tool for indoor wireless networks

User Manual



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# **From the Developers**

We have made every effort to create a user-friendly and intuitive application. However, we recommend taking some time to read this User Manual to fully utilize Indoor RadioPlanner's capabilities. Created by engineers with over 25 years of experience in designing radio communication networks, Indoor RadioPlanner is a full-featured yet simple and convenient planning tool.

## **Features**

Indoor RadioPlanner 2.1 is an easy-to-use software for planning Wi-Fi networks and other wireless networks deployed both indoors and in open local areas.

With Indoor RadioPlanner you can design any network, including:

- Wi-Fi networks in the 2.4 GHz, 5 GHz and 6 GHz bands
- Mobile networks: 5G (NR), LTE, UMTS, GSM, WCDMA, DECT
- Public safety mobile networks: P25, TETRA, DMR, dPMR, NXDN
- Wireless IoT LPWAN networks: LoRa, SigFox

Indoor RadioPlanner 2.1 also allows you to survey and visualize Wi-Fi networks.

Indoor RadioPlanner 2.1 uses propagation models:

 ITU-R P.1238-11 propagation model "Propagation data and prediction methods for the planning of indoor radiocommunication systems and radio local area networks in the frequency range of 300 MHz to 450 GHz".

Indoor RadioPlanner 2.1 performs various prediction types:

- Received Power
- Secondary Received Power
- Best Server
- C/(I+N) Ratio
- Maximum Throughput
- Number of Servers
- RSRP for LTE and 5G
- RSRQ for LTE and 5G
- Signal to Noise Ratio for Wi-Fi
- Channel Interference for Wi-Fi
- Maximum aggregated Throughput
- Number of Networks

In Indoor RadioPlanner 2.1, you can work with two types of projects:

- 1. **Indoor project:** When access points are placed inside a single- or multi-story building. In this type of project, it is possible to predict detailed coverage on different floors inside buildings, taking into account individual parameters of signal loss of internal walls, RF Zones of different rooms, as well as losses in floor slabs.
- 2. **Outdoor project:** When access points are placed in an outdoor local area up to 2 by 2 km in size. In this type of project, it is possible to predict coverage inside and outside buildings - along streets, in open local areas, etc. Buildings in such a project have two parameters - RF zone type (one for

the entire building) and external wall type. In an outdoor project, you can use a regular base map (OpenStreetMap, etc.), or a base map based on a calibrated image.

Indoor and Outdoor projects are not compatible with each other; the user must select the project type in Settings before starting work.

# Installation and Activation

Indoor RadioPlanner is compatible with x64 and ARM processors on Windows 10/11. The minimum computer requirements include a 64-bit Windows operating system, Core i3 CPU, 4GB RAM, 200GB HDD, video card, and monitor with support for 1366x768 resolution. For optimal performance, it is recommended to use a monitor with support for 1920x1080 resolution.

To install Indoor RadioPlanner, run the Setup\_Indoor\_ RadioPlanner.exe file. Select your language and click Install to launch the installation process. Click Next to continue. To proceed with the installation, read and accept the License Agreement by checking the box next to "I accept the terms in the License Agreement" and clicking Next.

After installing Indoor RadioPlanner, you will see a new entry in the Start menu and a shortcut on your desktop.

During the 7-day trial period, you can try out all the software features without activation (except for the ability to save project files).

After the trial period has expired, you must purchase a license and activate the software to continue using it.

Note: The activation process requires an internet connection.

To purchase Indoor RadioPlanner, click Help - Purchase in the program menu. This will open the purchase page in your web browser. After completing your purchase, you will receive an activation ID code via email. To activate your software, click Help - Enter Activation ID Code in the program menu, enter your code, and click ACTIVATE.

# Software Update

We periodically release free updates to improve the functionality and stability of Indoor RadioPlanner. The software supports both manual and automatic checking for updates and will check for available updates every time it starts. To check for updates manually, click "Help - Check for updates." If an update is available, a window will open with information about the current and available versions. You can download the update from the provided link and install it manually. Be sure to exit Indoor RadioPlanner before installing the update.

# **User Interface**

The program window includes the following elements:

- The **main tree view menu** on the left side of the window.
- The **main toolbar**, located at the top of the window.
- The **central work area**, which displays the level (floor) plan with access points, RF zones, walls, and coverage prediction results.
- The **objects control panel**, located in the lower-left part of the window. This panel allows you to enable or disable editing of objects on the map (Access Points, Reference Points, Walls, RF Zones, Level Plans, Survey Points, Survey Visualization and Predicted Coverage), as well as control their visibility.

To zoom in and out, roll the mouse wheel. To move the level plan, click and drag it.

Indoor RadioPlanner 2.1 D:\Dropbox\01_Indoor RadioPlanner 2\Project Si	amj	oles1\Indoor_Wi-Fi_2_5_	6_GI	Hz.irp2					
🖆 🗧 🗧 7 🔹 🛜 Maximum Throughput (DL)	•	Wi-Fi 5 GHz	٠	1 🛷   🔻	≣	0	PNG	CSV	?

When you hover over each of the icons, a hint appears.

Standard tools for working with files: Create, Open, Save



7 • The zoom of the level plan



Calculate Coverage for current level

Maximum Throughput (DL)

Calculation type shown on display

Wi-Fi 5 GHz Network for which calculation results are displayed

The "ruler" tool allows you to measure the distance and azimuth between any two points on the map. To use this tool, click on the ruler icon and then click on any two points on the map. The distance between the points and the azimuth from the first to the second point will be displayed. To exit the tool, click it again or press Esc.



Wi-Fi Monitor

≣	Wi-Fi Survey List
0	Wi-Fi Survey Visualization
¥2	Snap to Nodes. Enable/disable snapping to nodes when drawing walls and RF zones
	Show / Hide Legend
PNG	Save the map as an image in PNG format
	Save the access points and networks settings to a CSV file
?	Help

For more detailed information about each tool, please refer to the corresponding sections in the User Manual.

# **Quick start of Indoor Project**

- 1. Make sure the project type is set to "Indoor" in the settings (this is the default).
- Create at least one network: Go to "Networks Add network". Network settings can be loaded from a template. Templates for some networks are located in the "Templates" folder and have a \*.nwirp extension.
- 3. Create at least one level (floor): Select "Levels Add level". Then, from the Level menu, load and scale the level image. Specify the reference point to which all other levels will be aligned.
- 4. Draw RF zones and walls on the level.
- 5. Add at least one access point with one System (communication technology) to the level: Access point parameters can be loaded from a template. Templates for some access points are located in the "Templates" folder and have a \*.apirp extension. Link the access point system with the previously created network. After creating one access point and entering all its parameters, you can easily replicate it to create additional ones.
- 6. Configure the calculation parameters in the network settings as needed.
- 7. **To perform calculations:** Click "Calculate Coverage for current level" on the main toolbar. This will execute all types of calculations for all networks simultaneously.
- 8. **Select the type of calculation and the network for display:** Use the drop-down list on the main toolbar to choose the calculation type and the network for which the results will be displayed.

#### *Tip:* To get started quickly, utilize the example project files available in the installation folder.

A new project is automatically created when Indoor RadioPlanner is launched. The File menu contains standard buttons (New, Open, Save, Save As) for performing standard file operations. Project files can be saved with the \*.irp2 extension and contain all information about the project.

# **Project Information**

General information about the project can be specified in the project information panel.

Project Informat	tion
Project name	Test project
Customer	
Date	2023.05.23
Logo	wireless-planning.com

#### **Project Information**

Project name	Text field
Customer	Text field
Data	Text field - When creating a new project, it records
	the date and time of the project creation.
Logo Your company logo. The recommended res	
	is approximately 270 by 60 pixels.

# Settings

In the project settings, the user selects the project type. If the project type is **Indoor**, no additional settings are required. If you select the project type **Outdoor**, additional settings will appear.

Please note that when changing the project type, all previously entered information about wireless access points in the project will be lost!

Project Settings Project Type Indoor Outdoor	Application Settings X Path to folder with cache files C:\Users\user\AppData\Roaming\IndoorRadioPlanner2\cache

#### Indoor Projects Settings

Project Settings		Application Settings					
Project Type Coordinate Format		Path to folder with cache files					
O Indoor      O Decimal Degrees		C:\Users\user\AppData\Roaming\IndoorRadioPlanner2\cache					
Outdoor	<ul> <li>Degrees, Minutes, Seconds</li> <li>Degrees, Decimal Minutes</li> </ul>	Proxy settings         Use proxy server         The proxy server requires authentication         Proxy IP       80.255.145.41         Username         Port       3128					
Base map settings							
Name		URL					
Open Street Map	http://a.tile.openstreetmap.org/[Z]/[X]/[Y].png						
Open Topo Map	http://a.tile.opentopomap.org/[Z]/[X]/[Y].png						
Carto Basemap	https://cartodb-basemaps-c.global.ssl.fastly.net	:/light_nolabels/[Z]/[X]/[Y].png					
Google Map	http://mt2.google.com/vt/lyrs=m@169000008	3hl=en&x=[X]&y=[Y]&zoom=[17-Z]&s=Galile					
Google Satellite	http://khms2.googleapis.com/kh?v=969&src=a	app&x=[X]&y=[Y]&z=[Z]&s=					
Bing Sat	http://ecn.t0.tiles.virtualearth.net/tiles/a[RES].jpeg?g=0						
US Topo (Zoom 3-16)	https://basemap.nationalmap.gov/arcgis/rest/services/USGSTopo/MapServer/tile/[Z]/[Y]/[X]						
US Imagery Topo (Zoom 3	https://basemap.nationalmap.gov/arcgis/rest/services/USGSImageryTopo/MapServer/tile/[Z]/[Y]/[X]						
Esri Satellite	https://server.arcgisonline.com/ArcGIS/rest/services/World_Imagery/MapServer/tile/[Z]/[Y]/[X].jpg						
Esri Topo	https://services.arcgisonline.com/ArcGIS/rest/services/World_Topo_Map/MapServer/tile/[Z]/[Y]/[X].jpg						
F4map(OSM)	https://tile2f4map.com/tiles/f4_2d/[Z]/[X]/[Y].png						
Geofabrik Topo	https://c.tile.geofabrik.de/15173cf79060ee4a66573954f6017ab0/[Z]/[X]/[Y].png						
HERE WeGo Hybrid	https://1.aerial.maps.api.here.com/maptile/2.1/	/maptile/newest/hybrid.day/[Z]/[X]/[Y]/256/png8?app_id=xWVlueSv6JL0aJ5xqTxb&token					
HERE WeGo Map	https://3.base.maps.api.here.com/maptile/2.1/	/maptile/newest/normal.day/[Z]/[X]/[Y]/256/png8?app_id=xWVlueSv6JL0aJ5xqTxb&token					
HERE WeGo Terrain	https://3.aerial.maps.api.here.com/maptile/2.1	/maptile/newest/terrain.day/[Z]/[X]/[Y]/256/png8?app_id=xWVlueSv6JL0aJ5xqTxb&token					
HERE WeGo Satellite	https://3.aerial.maps.api.here.com/maptile/2.1/	/maptile/newest/satellite.day/[Z]/[X]/[Y]/256/png8?app_id=xWVlueSv6JL0aJ5xqTxb&toke					
Michelin Map	http://map3.viamichelin.com/map/mapdirect?map=viamichelin&z=[Z]&x=[X]&y=[Y]&format=png&version=201503191157&layer=background						
Michelin Map Simplified	http://map1.viamichelin.com/map/mapdirect?map=light&z=[Z]&x=[X]&y=[Y]&format=png&version=201503191157&layer=background						
Waze World	https://worldtiles4.waze.com/tiles/[Z]/[X]/[Y].png						
Waze US	https://livemap-tiles1.waze.com/tiles/[Z]/[X]/[Y].png						
*							

**Outdoor Projects Settings** 

# **General Calc Parameters**

Here, a number of general calculation parameters are specified, well as penetration losses for different wall types. As is known, same materials have different attenuation values for different frequencies. The default attenuation values are provided for the 800 MHz, 2.4 GHz, 5 GHz, and 6 GHz ranges. If a frequency outside the specified ranges is used in the calculations, the attenuation value will be determined by interpolation or extrapolation.

The user can change the penetration loss values in the table for 24 wall types and one type of interfloor ceiling at their own discretion, based on the available for different frequency ranges (no more than four frequency bands).

All fields in the table with a white background are editable; that is, the can change the name of the wall type, the frequency range, and the corresponding loss value. The wall and wall thickness in pixels affect only the display of the corresponding wall the monitor.

The table with user-defined penetration loss data can be saved as template in a \*.wlirp file for use in other projects. It is also possible to restore the default loss data. The corresponding buttons are provided on the above the table.

Area Study Resolution	Wall parameters						
Resolution 0.2 m							
User equipment parameters		Color	Width pixels	Loss (dB)	Loss (dB)	Loss (dB)	Loss (dB)
	Frequency (MHz)			800	2400	5000	6000
UE Antenna Height 1.5 m	Interior hollow wall 50mm (2")		2	1	1	2	3
	Interior hollow wall 100 mm (4")		3	2	3	5	6
Area study parameters	Interior hollow wall 150 mm (6")		4	3	4	9	10
Study radius 100 m	Brick wall 90 mm (3.5")		2	5	6	10	11
	Brick wall 120 mm (5")		3	6	8	13	14
Coverage transparency	Brick wall 250 mm (10")		4	8	10	25	26
coverage nanaparency	Brick wall 380 mm (15")		5	13	15	30	31
Transparency (0-10) 5	Brick wall 510 mm (20")		6	15	20	37	38
	Concrete wall 100 mm (4")		2	4	6	10	11
Adjacent floors	Concrete wall 200 mm (8")		3	8	10	13	14
Z Take into account adjacent floors	Concrete wall 300 mm (12")		4	12	14	22	23
	Concrete wall 400 mm (16")		5	15	18	30	31
	Concrete wall 500 mm (20")		6	20	25	37	38
	Aerated concrete wall 100 mm (4")		2	3	4	7	8
	Aerated concrete wall 200 mm (8")		3	5	7	9	10
	Aerated concrete wall 300 mm (12")		4	8	10	15	16
	Aerated concrete wall 400 mm (16")		5	10	13	21	22
	Aerated concrete wall 500 mm (20")		6	14	18	26	27
	Hollow wood door		2	3	4	7	8
	Solid wood door		2	4	6	10	11
	Steel door		2	10	13	25	26
	Window single pane		2	2	3	6	7
	Window double pane		2	5	7	13	14
	Window triple pane		2	10	13	20	21
	Floor slab			12	14	22	23

#### General Calc Parameters

Area Study Resolution	Coverage prediction resolution, m		
	The recommended value for Indoor projects is 0.2-0.3 meters. For		
	Outdoor projects - 0.5m-1m.		
UE Antenna Height	User Equipment antenna height, m		
Study radius	Maximum study radius from access point, m The larger the radius, the		
	longer the computation time. Do not set an unnecessarily large		
	calculation radius.		
Coverage Transparency	Set coverage opacity in the range from 0 (fully transparent) to 10		
	(not transparent)		
Take into account adjacent	Indoor RadioPlanner takes into account the penetration of useful		
floors	signal and interference only from access points located on adjacent		
	floors, i.e. one floor above and one floor below.		
Outdoor RF Environment	RF Environment for outdoor spaces (for Outdoor project type only)		
Wall parameters:			
4	Load wall parameters from a template		

Û	Save wall parameters as a template
	Fill the table whith default values
Color	Wall color on screen
Width (pixels)	Wall thickness on screen in pixels

# **Objects visibility and locking Panel**

The **Objects Visibility and Locking Panel** is located in the lower-left part of the program window. This panel enables you to:

- Control the visibility of objects on the map, such as Access Points, Reference Points, Walls, Buildings (for outdoor project types), RF Zones, Floor Plan (base map for outdoor project), Survey Points, Survey Visualization and Predicted Coverage, by toggling them on or off.
- Lock or unlock layers to permit or restrict editing.

Object visibility and locking		
Objects	On	Lock
Access Points	8	ß
Reference Point and Line	8	8
Walls	8	8
Buildings	8	8
RF Zones	8	8
Coverage	8	8
Floor Plan (Base Map)	8	8
Survey Points	8	Ĥ
Survey Visualization	8	8

Visibility and locking of objects are managed by clicking on the icons located opposite the corresponding objects in the list. To edit objects, they must be both visible and unlocked. This is achieved by setting the icons to the **S a**.

# Levels

In Indoor projects, you can create buildings with an unlimited number of levels (floors). In outdoor projects, you can only create one level.



Levels menu for Indoor project

4 - = =	×
Level Plan Options	
O Calibrated Level plan image	
Base map	

Levels menu for Outdoor project

÷	Add a new level
<b>D</b>	Collapse all level nodes
•	Collapse all AP nodes
	Expand all AP nodes

Level plan options Calibrated image or base map (for outdoor project only)

## Level

	×
<b>¤ ಒ ¤ Ҵ ぺ Ҟ ロ 〇 匝</b> Ѽ Ф	
Level Parameters	
Level name 1 floor (0m)	
Level Height 5 m	

Level menu

63 Level plan image Ŷ Move the Level up Ŷ Move the Level down ß Delete Level ⊕ Add a new Level with the same parameters (duplicate the Level) ٢ Position the plan with Reference Point at the screen center 0 Move the reference point and the line to the screen center ቍ Add a new Access Point Delete all APs from the Level ⊠ X Delete all walls from the Level

IJ	Add new RF Zone
<b>ئ</b> ہ	Add new wall
83	Add wall or building like as circle or rectangle
$\square$	Square corners of selected objects
14	Add a node. Select an object (RF zone or wall) and click in the desired location to create a node.
*	Delete node. Select an object (RF zone or wall) and click on the node you want to delete.
	Select walls, RF Zones, Buildings inside square area
$\bigcirc$	Select walls, RF Zones, Buildings inside area
$\ \ \square$	Duplicate selected objects (walls, RF Zones, buildings)
67	Add a new building
Φ	Import buildings from OpenStreetMap database
+•	Add Wi-Fi Survey Point
ħ	Copy selected object to clipboard
Ô	Paste objects from clipboard
$\Diamond$	Undo
$\Rightarrow$	Redo

Level plan image	×
File Name: D:\Dropbox\01_Indoor RadioPlanner 2\school first floor.png	
File Size: 4434 x 3158       Reference Line Length     50.7	
Close	



₽	Import level plan image
ß	Delete level plan image

# **Creating a RF Environment Model**

The basic propagation model ITU-R P.1238-11 takes into account two parameters related to the propagation environment:

$$L_{total} = L(d_o) + N \log_{10} \frac{d}{d_o} + L_f(n)$$
 dB

N: Power loss over distance (RF propagation parameter) shows how much the signal level drops in dB when the distance from the signal source changes by a factor of 10 (per decade).

Lf, dB: Floor slab or wall penetration loss factor (in dB) for floor slabs or walls located between the access point and the subscriber terminal (UE).

In Indoor RadioPlanner 2.1, different approaches to forming an RF environment model are used for indoor and outdoor projects.

In the Indoor project, a model of a single- or multi-story building is created with the ability to specify individual loss parameters for each wall and RF Zone of individual rooms.

For Outdoor projects, buildings are created with their own RF Zone (one type per building) and the external wall (also one type per building). And one type of RF Zone is also specified for the external environment.

#### **Indoor Projects**

#### **RF Environment (RF Zones)**

To create RF environment model inside a building, you need to draw different RF zones and walls with corresponding loss parameters.



#### **RF** Zone parameters

You can draw the following RF environment types on the floor plan:

• Open Space (large open space with almost no obstacles) - 25 dB/dec

- Light RF Environment (cubicle office area, low warehouse stock) 30 dB/dec
- Medium RF Environment (closed office area, medium warehouse stock) 35 dB/dec
- Dense RF Environment (many rooms with light material, high warehouse stock) 40 dB/dec
- High-Density RF Environment (many rooms with heavy material, elevator shaft) 45 dB/dec
- Atrium large opening in the floor (hole), excluded from prediction calculations

#### Working with RF Zones

Before drawing RF zones, ensure the object layer is unlocked for editing.

#### Adding an RF Zone:

- 1. Click on the **RF Zone tool** in the level toolbar.
- 2. Draw a polygon to represent the RF environment using the mouse (right-click to complete the polygon).
- 3. Select the **RF environment coefficient** from the list that appears.
- 4. Press Esc or select another tool from the toolbar to complete your entry.
- 5. For added convenience, use the **Snap to Nodes** tool on the main toolbar.

#### **Operations on RF Zones:**

- Edit Shapes: Drag the nodes of polygons to modify their shape.
- Move Polygons: Click and drag to reposition entire polygons.
- Delete Polygons: Select a polygon and press Delete to remove it.
- **Cancel Drawing:** Press the **Esc** key to cancel the current RF zone drawing. Pressing **Esc** again will exit the RF zone drawing mode.

#### Walls

You can draw on the plan and take into account the walls whose parameters are specified in the **Calculation Parameters panel – Wall Parameters**. You can use the default wall parameters or set your own by editing the Wall Parameters table at your discretion (see the Calculation Parameters section).



Wall parameters

#### **Drawing Walls**

Before drawing walls, ensure the object layer is unlocked for editing.

#### To Add a Wall:

- 1. Click on the **Wall tool** on the level toolbar.
- 2. Use the mouse to draw the wall (right-click to finish).
- 3. Select the **wall type** from the list that appears.
- 4. Press **Esc** or select another tool from the toolbar to complete your entry.
- 5. For more convenient work, use the **Snap to Nodes** tool on the main toolbar.

#### **Operations on Walls:**

- Edit Shapes: Drag the nodes of walls to modify their shape.
- Move Walls: Click and drag to reposition entire walls.
- Delete Walls: Select a wall and press Delete to remove it.
- **Cancel Drawing:** Press the **Esc** key to cancel the current wall drawing. Pressing **Esc** again will exit the wall drawing mode.

# **Outdoor Projects**

#### **Buildings**

For outdoor projects, buildings are created, each with only three parameters: internal RF zone attenuation, external wall losses, and building height. Additionally, in the general calculation parameters, it is necessary to specify the type of RF zone for the external environment. You can either draw buildings or import them from the OpenStreetMap database.



**Building parameters** 

The wall type and penetration loss parameters for different ranges are specified in the Wall Parameters table in the Calculation Parameters panel. You can use the default parameters or specify your own (for more information, see the Calculation Parameters section).

#### Working with Buildings

Before drawing Buildings, ensure the object layer is unlocked for editing.

#### Add Buildings manually:

- 1. Click on the Add a new Building in the level toolbar.
- 2. Draw a polygon to represent the building using the mouse (right-click to complete the polygon).
- 3. Specify building height.
- 4. Select the exterior wall type from the list
- 5. Select the indoor RF Zone from the list.
- 6. Press **Esc** or select another tool from the toolbar to complete your entry.

#### Import buildings from OpenStreetMap database (Only for outdoor projects with basemap):

- 1. Click Import buildings from OpenStreetMap database on the level toolbar.
- 2. Mark the area on the map where the buildings will be imported (no more than 2 by 2 km).
- 3. In the form that appears, specify the parameters of the heights and floors of the buildings if there is no information about them in the database.
- 4. Specify the RF Zone type and the type of external walls for all buildings at once or separately for each building.

Buildings imported in this way can then be edited manually.

#### **Operations on Buildings:**

- Edit Shapes: Drag the nodes of polygons to modify their shape.
- Move Polygons: Click and drag to reposition entire polygons.
- Delete Polygons: Select a polygon and press Delete to remove it.
- **Cancel Drawing:** Press the **Esc** key to cancel the current RF zone drawing. Pressing **Esc** again will exit the Buildings drawing mode.

# **Networks**

Indoor RadioPlanner 2.1 allows you to work with multiple networks in one project. When creating a new project, the first network is created by default.

÷					×
Area Study	у Туре —				
Maximum	Aggrega	ted T	hroughpu	rt (UL)	~
Maximum	Aggregate	ed Th	nroughput		
5 ~	Numbe	r of le	evels		
Color	Value				Description
>	600	Mb	ps		
	400	to	600	Mbps	
	200	to	400	Mbps	
	50	to	200	Mbps	
	10	to	50	Mbps	

Networks menu

Add a new network

ቍ

Area Study Type	Coverage predictions for multiple networks:
	- Number of Networks (DL)
	- Number of Networks (UL)
	<ul> <li>Maximum Aggregated (DL) Throughput</li> </ul>
	<ul> <li>Maximum Aggregated (UL) Throughput</li> </ul>
	See Coverage predictions for multiple networks section

The "Network" menu is used to set all parameters for the selected network and calculation parameters.

## **Network Parameters**

Network
Network name DECT
System type Generic TRX $\checkmark$
Network parameters
Band 1890 MHz UE Tx Power 10 dBm
Downlink Rx Threshold -90 dBm Uplink Rx Threshold -90 dBm
UE Antenna Gain 0 dBi UE Loss 0 dB
Use UE directional antenna pattem
Area study type
Received Power (DL)
Received Power Visualization
○ Composite Grid  ● Heatmap
Max Level -30 dBm Min Level -90 dBm
0



- Add a new network with the same parameters (duplicate the network)
  - Delete the network

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- Move the Network up
- Move the Network down
- Activate/Deactivate all systems for current network
- System parameters
- Load network parameters from a template
  - Save network parameters as a template

Network name	Name of network, text field
System type	System type options:
	- Wi-Fi
	- LTE

	- 5G
	- Generic TRX
	The selected system type will determine the set of additional system
	parameters, as well as the types of coverage predictions available.
Band	Average band frequency, MHz
UE Tx Power	User Equipment (mobile unit) transmitter power, dBm
Downlink Rx threshold	This threshold value will limit the coverage prediction display based
	on whether the signal received at the UE from the access point is
	above or below this threshold, dBm
Uplink Rx threshold	This threshold value will limit the coverage prediction display based
	on whether the signal received at the access point from UE is above
	or below this threshold, dBm
UE Antenna Gain	User Equipment antenna gain, dBi
UE Loss	User Equipment cable loss, dB
Use UE directional antenna	Use the antenna pattern at the UE. By default, the UE antenna pattern
pattern	is assumed to be isotropic. The use of directional antennas on the UE
	significantly reduces interference from neighboring cells and, as a
	result, increases throughput.
Use co-channel interference	Perform coverage calculation taking into account co-channel
	interference using frequency assignments.
Use adj-channel interference	Perform coverage calculation taking into account adjacent channel
	interference using parameters in network settings (Channel
	bandwidth and Adjacent Channel rejection) as well as frequency
	assignments.

# Wi-Fi System Parameters

Network
Network name Wi-Fi 5 GHz
System type Wi-Fi ~
Network parameters
Band $5 \sim GHz$ Signal Correction $0$ dB
Minimum Received Power -85 dBm Bandwidth 20 MHz -94 dBm
Area study type
Received Power (DL) ~
Received Power Visualization
○ Composite Grid  ● Heatmap
Max Level -30 dBm Min Level -85 dBm
•
0

Wi-Fi Network menu

Band	Band:
	2.4GHz/5GHz/6GHz
Signal Correction	Signal Correction (Offset), dB.
	When calculating the Rx level, it is assumed by default that the Wi-Fi
	client device has an antenna gain of 0 dBi and that there are no
	additional losses in the receiving path. If your client device has different
	Rx parameters, you can account for this here. If the receiving path
	parameters your client device are worse, the offset will be negative.
Minimum Received Power	The minimum level at the receiver that is taken into account in
	calculations is measured in dBm. It also determines the minimum RSSI
	threshold for the Best Server overlapping.
Noise Floor for Bandwidth 20	The specified value of noise from external sources for 20 MHz
MHz	bandwidth that is used to calculate the SNR in dBm.

System parameters				2	
Wi-Fi Parameters					
802.11 Standard	802.	11ax ~	1		
Bandwidth	40 M	Hz ~	]		
Spatial Streams	4	~	]		
Guard Interval Duration	0.8 µ	is V	]		
Modulation Coding		Data Rate (Mb	ps)	SNR (dB)	
BPSK 1/2		68.8		5	
QPSK 1/2		137.6		8	
QPSK 3/4		206.5		12	
16-QAM 1/2		275.3		14	
16-QAM 3/4		412.9		18	
64-QAM 2/3		550.6		21	
64-QAM 3/4		619.4		23	
64-QAM 5/6		688.2		28	
256-QAM 3/4		825.9		32	
256-QAM 5/6	256-QAM 5/6			34	
1024-QAM 3/4		1032.4		37	
1024-QAM 5/6		1147.1		39	
			ОК	Cancel	

Wi-Fi System Parameters

This form is used to enter SNR values different modulation indices across all standards and bandwidths. It is also possible to estimate the data rate (physical rate) for the given parameters: standard, bandwidth, spatial streams, guard interval.

# **LTE System Parameters**

Syste	em p	arametei	rs											×
LTE	Para	meters	Network	Channel Plar	MIMO Cor	figuration	Noi	ise and Int	erference					
		Mod	e FDD		~			R1/R3 F	DD Ratio	25xR	1+0xR3 (No	FFR) ~		
		Bandwidt	h 5 MH	z	~			TDI	D R1 Ratio	0.5	;			
	~		47	NORMAL										
	U.	yclic Preti	x 4./μ	S NORMAL	~		FFR	SINR Thre	shold (dB)	) 4				
TD	D UL	./DL Ratio	<b>3</b> - (0	.54)				Cel	l Load (%)	75				
D	ownlir	nk					_	Uplink						
:	3GPP	TS Table	e 36.21	3 Table 7.1.	7.1-1A v	<u>r</u>		3GPP	TS Table	36.21	3 Table 8.6.	1-3 ~		]
N In	MCS ndex	odulatio	TBS Index	Transport block size	Throughput (Mbps)	SINR (dB)	^	MCS Index	odulatio	TBS Index	Transport block size	Throughput (Mbps)	SINR (dB)	^
	12	64QAM	17	9144	8.7	12.2		0	QPSK	0	680	0.6	-2.6	
	13	64QAM	18	9912	9.5	13.2		1	QPSK	2	1096	1	-1.6	
	14	64QAM	19	10680	10.2	14.2		2	QPSK	4	1800	1.7	-0.1	
	15	64QAM	20	11448	10.9	15.2		3	QPSK	6	2600	2.5	1.7	
	16	64QAM	21	12576	12	16.4		4	QPSK	8	3496	3.3	3.5	
	17	64QAM	22	13536	12.9	17.8		5	QPSK	10	4392	4.2	5.1	
	18	64QAM	23	14112	13.5	19.3		6	16QAM	11	4968	4.7	6.1	
	19	64QAM	24	15264	14.6	21		7	16QAM	12	5736	5.5	7.1	
	20	256Q	25	15840	15.1	21.5		8	16QAM	13	6456	6.2	8.2	
	21	256Q	27	16416	15.7	23		9	16QAM	14	7224	6.9	9.2	
	22	256Q	28	17568	16.8	24		10	16QAM	16	7992	7.6	10.3	
	23	256Q	29	18336	17.5	25		11	16QAM	17	9144	8.7	11.3	
	24	256Q	30	19848	18.9	27		12	16QAM	18	9912	9.5	12.2	
	25	256Q	31	20616	19.7	28		13	16QAM	19	10680	10.2	13	
	26	256Q	32	21384	20.4	29		14	64QAM	20	11448	10.9	13.8	
	27	256Q	33	24496	23.4	30		15	64QAM	21	12576	12	14.6	
							<b>Y</b>	16	64QAM	22	13536	12.9	15.3	~
												OK	Can	cel
												-		

## LTE System Parameters

Mode	LTE duplex mode:						
	- FDD						
	- TDD						
Bandwidth	LTE bandwidth: 1.4 M	IHz; 3 MHz; 5 MH	z; 10MHz; 15 MHz; 20 MHz				
Cyclic Prefix	LTE Cyclic Prefix:						
	- 4.7 μs (Norma	al)					
	- 16.7 μs (Exter	nded)					
TDD UL/DL Ratio	TDD configurations in	3GPP LTE specific	cation:				
	TDD Configuration #	UL/total ratio	DL/total ratio				
	0	0.7	0.3				
	1	0.5	0.5				
	2	0.3	0.7				
	3	0.35	0.65				
	4	0.25	0.75				
	5	0.15	0.85				
	6	0.6	0.4				

R1/R3 FDD Ratio	Type of Fractional Frequency Reuse (FFR) plan that is being used in
	LTE project in the R1/R3 zone Resource Blocks drop-down list
TDD R1 Ratio	Part (from 0.1 to 1) the R1 zone subcarriers of physical resource
	blocks (PRB) for TDD
FFR SINR Threshold	SINR threshold for switching between R1 and R3 zones in FFR, dB
Cell Load	Cell Load, 0-100 % Cell Loading is considered uniform.
Downlink and Uplink 3GPP	These tables contain the MCS Index, modulation type, and transport
Tables	block size (TBS) specified in the tables of 3GPP TS 36.213. Minimum
	C/(I+N) values for 1% SER (dB) can be specified separately for both
	uplink and downlink. The theoretical defaults shown in this table are
	from published MATLAB simulations of LTE radio link performance.
	The throughput for each modulation index is determined from the
	3GPP tables, taking into account the transport block size. This
	throughput does not take into account the MIMO multiplier.

#### Network Channel Plan

In the channel table, specify all possible uplink and downlink frequencies (channels) that will be used in the network. For TDD, enter the same frequency. If the network operates on a single channel, then the frequencies in the Network Channel Plan may not be specified.

System pa	arameters								×
Network C	hannel Plan	MIMO Configuration	Noise and Ir	nterferend	e LTE Paran	neters			
<u>≞</u> d	ul								
Downlin	k			Uplink					
	Channel Number*	Frequency, N	1Hz		Channel Number*		Frequency, MHz		
	1	1935			1	1855			
				*					
* - optiona	al								
								OK	Cancel

LTE Network Channel Plan

#### **MIMO** Configuration

The MIMO table is fully configurable for all downlink and uplink scenarios.

LTE Parameters Network Channel	Plan MIMO Cor	nfiguration N	oise and Interfe	rence		
МІМО Туре	DL Coverage Gain (dB)	UL Coverage Gain (dB)	DL Throughput Multiplication Factor	UL Throughput Multiplication Factor	DL Interference Reduction (dB)	UL Interference Reduction (dB)
Diversity Rx BS antenna	0	3	1	1	0	0
MIMO-A 2x1	3	3	1	1	0	0
MIMO-A 2x2	6	6	1	1	0	0
MIMO-B 2x2	3	3	1.9	1	0	0
MIMO-A 4x2	9	9	1	1	0	0
MIMO-B 4x2	6	6	1.9	1	0	0
SDMA/Adaptive (FDD) 4x2	8	9	1.5	2	10	15
SDMA/Adaptive (TDD) 4x2	9	9	3	3	15	15
MIMO-A 4x4	12	6	1	1	0	0
MIMO-B 4x4	6	6	3.8	1	0	0
MIMO-B 8x8	9	9	8	8	0	0
SDMA/Adaptive (FDD) 8x1	8	9	1.5	2	15	20
SDMA/Adaptive (TDD) 8x1	9	9	3	3	20	20
SDMA/Adaptive (FDD) 8x2	11	12	2	2.5	15	20
SDMA/Adaptive (TDD) 8x2	12	12	4	4	20	20
					OK	Cancel

## LTE MIMO Configuration

#### Noise and Interference

The receiver parameters in this tab are used for noise and interference calculations.

System parameters			×
Network Channel Plan MIMO Configuration	Noise and Int	efference LTE	Parameters
Rx parameters Rx equivalent noise bandwidth (MHz) Rx noise figure (dB) Rx noise level (dBm) Adjacent channel rejection (dB)	DL 9 6 -98.4 30	UL 9 4 -100.4 30	
		OK	Cancel

LTE Noise and Interference

Dy any ivalant naisa handy vidth	Desciver Fruitislant Naiss Dendwidth MUL
KX equivalent noise bandwidth	Receiver Equivalent Noise Bandwidth, MHZ
	In LTE systems, when using all resource blocks, the following noise
	bandwidths are obtained:
	1.08 MHz (1.4 MHz Bandwidth)
	2.7 MHz (3 MHz Bandwidth)
	4.5 MHz (5 MHz Bandwidth)
	9 MHz (10 MHz Bandwidth)
	13.5 MHz (15 MHz Bandwidth)
	18 MHz (20 MHz Bandwidth)
Rx noise figure	Receiver noise figure, dB Typically 3-4 dB for eNodB and 6 dB for UE
Rx noise level	Receiver noise level, dB This value is used to estimate the noise on
	the receiving path when calculating all types of interference.
Adjacent channel rejection	Adjacent channel rejection, dB It is assumed that the receiver has a
	rectangular "brick wall" bandpass shape with a width equal to the
	equivalent noise bandwidth. Under these conditions, you can set the
	amount of attenuation on adjacent channels (one bandwidth above
	and below the desired bandwidth) by entering a value here for
	adjacent channel rejection.

# **5G (NR) System Parameters**

twork Ch	annel Plan	MIM	IO Configuration	Noise and	Interference	5G Par	ameters		
	Mode	TDD		~	DL sy	mbols pa	rt in TDD	slot (0.	.1) 0.7
Confi	guration	BW=4	0MHz; SCS=30k	Hz v			Cel	l Load (	%) 70
3GPP T	S Table	38.21	4 Table 5.1.3.1-2	~					Ħ
MCS Index	Modulat	ion	Target code Rate R x [1024]	DL Throughp (Mbps)	ut DL SIN	IR (dB)	Ul Throu <u>c</u> (Mbp	- jhput os)	UL SINR (dB)
0	QPSH	(	120	5.0	-3	.7	2.3	3	-2.6
1	QPSH	(	193	8.1	-2	.3	3.7	7	-1.6
2	QPSH	C	308	12.9	-0	.4	5.9	Э	-0.1
3	QPSH	(	449	18.8	1.	8	8.6	6	1.7
4	QPSH	(	602	25.2	3.	9	11.	6	3.5
5	16QAI	M	378	31.7	5.	7	14.	5	5.1
6	16QAI	M	434	36.3	6.	9	16.	7	6.1
7	16QAI	M	490	41.0	7.	9	18.	8	7.1
8	16QAI	M	553	46.3	ę	)	21.	2	8.2
9	16QAI	M	616	51.6	1	0	23.	7	9.2
10	16QAI	M	658	55.1	10	10.6		3	9.8
11	64QAI	М	466	58.5	11	.1	26.	8	11.3
12	64QAI	М	517	65.0	12	.2	29.	8	12.2
13	64QAI	М	567	71.2	13	.2	32.	7	12.8
14	64QAI	М	616	77.4	14	.2	35.	5	13
15	64QAI	М	666	83.7	15	.2	38.	4	13.8
16	64QAI	М	719	90.3	16	.4	41.	4	14.6
17	64QAI	М	772	97.0	17	.8	44.	5	15.3
18	64QAI	M	822	103.3	19	.3	47.	3	16
19	64QAI	M	873	109.7	2	1	50.	3	16.7
20	256QA	М	682.5	114.3	21	.5	52.	4	17
21	256QA	М	711	119.1	2	3	54.	6	18
22	256QA	М	754	126.3	2	4	57.	9	19
23	256QA	M	797	133.5	2	5	61.	2	20
24	256QA	М	841	140.9	2	7	64.	6	21
25	256QA	М	885	148.2	2	8	68.	0	22
26	256QA	М	916.5	153.5	2	9	70.	4	23
27	256QA	M	948	158.8	3	0	72.	8	24

## 5G Parameters

Mode	Duplex mode:
	- FDD
	- TDD

Configuration	Choice from bandwidth (BW) and Subcarrier Spacing (SCS) configurations.
Downlink and Uplink 3GPP Tables	These tables contain the MCS Index, modulation type, and Target code rate specified in the tables of 3GPP TS 36.214. Minimum C/(I+N) values for 1% SER (dB) can be specified separately for both uplink and downlink. The theoretical defaults shown in this table are from published MATLAB simulations of 5G radio link performance. The throughput for each modulation index is determined from the 3GPP tables. This throughput does not take into account the MIMO multiplier.
DL symbols part in TDD slot (01)	Part of the TDD resource that is intended for downlink
Cell Load	Cell Load, 0-100 % Cell Loading is considered uniform.

#### Network Channel Plan

In the channel table, specify all possible uplink and downlink frequencies (channels) that will be used in the network. For TDD, enter the same frequency. If the network operates on a single channel, then the frequencies in the Network Channel Plan may not be specified.

#### **MIMO** Configuration

The MIMO table is fully configurable for all downlink and uplink scenarios.

System parameters						×
LTE Parameters Network Channel Pla	an MIMO Cor	figuration No	oise and Interfe	rence		
F						
	1	1				
MIMO Type	DL Coverage Gain (dB)	UL Coverage Gain (dB)	DL Throughput Multiplication Factor	UL Throughput Multiplication Factor	DL Interference Reduction (dB)	UL Interference Reduction (dB)
Diversity Rx BS antenna	0	3	1	1	0	0
MIMO-A 2x1	3	3	1	1	0	0
MIMO-A 2x2	6	6	1	1	0	0
MIMO-B 2x2	3	3	1.9	1	0	0
MIMO-A 4x2	9	9	1	1	0	0
MIMO-B 4x2	6	6	1.9	1	0	0
SDMA/Adaptive (FDD) 4x2	8	9	1.5	2	10	15
SDMA/Adaptive (TDD) 4x2	9	9	3	3	15	15
MIMO-A 4x4	12	6	1	1	0	0
MIMO-B 4x4	6	6	3.8	1	0	0
MIMO-B 8x8	9	9	8	8	0	0
SDMA/Adaptive (FDD) 8x1	8	9	1.5	2	15	20
SDMA/Adaptive (TDD) 8x1	9	9	3	3	20	20
SDMA/Adaptive (FDD) 8x2	11	12	2	2.5	15	20
SDMA/Adaptive (TDD) 8x2	12	12	4	4	20	20
					ОК	Cancel

#### 5G MIMO Configuration

#### Noise and Interference

The receiver parameters in this tab are used for noise and interference calculations.

System parameters		×	
Network Channel Plan MIMO Configuration	Noise and Inte	erference 5G Parameters	
Rx parameters	DL	UL	
Rx equivalent noise bandwidth (MHz) Rx noise figure (dB) Rx noise level (dBm) Adjacent channel rejection (dB)	38.16 6 -92.2 30	38.16 4 -94.2 30	
		OK Cancel	

#### 5G Noise and Interference

Rx equivalent noise bandwidth	Receiver Equivalent Noise Bandwidth, MHz
	In 5G, the noise band can be obtained from the formula:
	Rx equivalent noise BW= 12*SCS*Resource Blocks.
	For example, for BW=100 MHz, SCS=30 kHz
	Rx equivalent noise BW=12*0.03*106=38.16 MHz
Rx noise figure	Receiver noise figure, dB Typically 3-4 dB for gNodeB and 6 dB for UE
Rx noise level	Receiver noise level, dB This value is used to estimate the noise on
	the receiving path when calculating all types of interference.
Adjacent channel rejection	Adjacent channel rejection, dB It is assumed that the receiver has a
	rectangular "brick wall" bandpass shape with a width equal to the
	equivalent noise bandwidth. Under these conditions, you can set the
	amount of attenuation on adjacent channels (one bandwidth above
	and below the desired bandwidth) by entering a value here for
	adjacent channel rejection.

## **Generic TRX System Parameters**

Generic TRX in Indoor RadioPlanner includes all mobile communication systems except Wi-Fi, LTE and 5G:

- DECT
- UMTS / GSM / GSM-R / WCDMA mobile networks
- P25 / TETRA / DMR / dPMR / NXDN land mobile radio networks

- Networks based on wireless IoT LPWAN technologies: LoRa, SigFox, and others

#### Adaptive Modulation Table

The adaptive modulation table is filled with SINR values and their respective throughput for one spatial stream (no MIMO). This table is used to predict downlink and uplink throughput in Generic TRX.

Please note that Wi-Fi, LTE and 5G have different adaptive modulation tables.

System	parameters					×
Network	k Channel Plan Adaptive Modulation Table	MIMO Configu	ration Noise an	d Interference		
->	ê					
	Modulation Type	DL Throughput (kbps)	DL SINR (dB)	UL Throughput (kbps)	UL SINR (dB)	
	C4FM	9.6	16	9.6	16	
*						
⊖ Mb	pps					
💿 kbp	ps					
					OK	Cancel

#### P25 Modulation Table

Modulation Type	Modulation Type (text field)
DL Throughput	Downlink Throughput, Mbps or kbps
DL SINR (dB)	Downlink SINR,dB
UL Throughput	Uplink Throughput, Mbps or kbps
UL SINR (dB)	Uplink SINR,dB
Mbps or kbps	Select Throughput Units

#### **Network Channel Plan**

In the channel table, specify all possible uplink and downlink frequencies (channels) that will be used in the network. For TDD, enter the same frequency. If the network operates on a single channel, then the frequencies in the Network Channel Plan may not be specified.

Downli	nk		Uplink			
	Channel Number*	Frequency, MHz	Ch Nu	annel mber*	Frequency, MI	łz
•	1	1881.792		1	1881.792	
	2	1883.52		2	1883.52	
	3	1885.248		3	1885.248	
	4	1886.976		4	1886.976	
	5	1888.704		5	1888.704	
	6	1890.432		6	1890.432	
	7	1892.16		7	1892.16	
	8	1893.888		8	1893.888	
	9	1895.616		9	1895.616	
	10	1897.344		10	1897.344	
- optior Chan	nal nel bandwidth	n 1.728 MHz				

DECT Channel Plan

Ē	
dl	
ul	

Sort frequencies in ascending order

Autofill downlink frequencies

Autofill uplink frequencies

If your network has a large frequency grid, then you can use the autofill feature:

Channel Autofill		×
First channel frequency	1881 792	MH7
First channel number	1	
Step	1.728	MHz
Number of channels	10	
C	OK Ca	ncel

Channel Autofill

## **MIMO** Configuration

The MIMO table is fully configurable for all of	downlink and uplink scenarios.
---	--------------------------------

en l						
		1		111	DI	1.11
MIMO Type	DL Coverage Gain (dB)	UL Coverage Gain (dB)	Throughput Multiplication Factor	Throughput Multiplication Factor	Interference Reduction (dB)	Interference Reductio (dB)
Diversity Rx BS antenna	0	3	1	1	0	0
MIMO-A 2x1	3	3	1	1	0	0
MIMO-A 2x2	6	6	1	1	0	0
MIMO-B 2x2	3	3	1.9	1	0	0
MIMO-A 4x2	9	9	1	1	0	0
MIMO-B 4x2	6	6	1.9	1	0	0
SDMA/Adaptive (FDD) 4x2	8	9	1.5	2	10	15
SDMA/Adaptive (TDD) 4x2	9	9	3	3	15	15
MIMO-A 4x4	12	6	1	1	0	0
MIMO-B 4x4	6	6	3.8	1	0	0
MIMO-B 8x8	9	9	8	8	0	0
SDMA/Adaptive (FDD) 8x1	8	9	1.5	2	15	20
SDMA/Adaptive (TDD) 8x1	9	9	3	3	20	20
SDMA/Adaptive (FDD) 8x2	11	12	2	2.5	15	20
SDMA/Adaptive (TDD) 8x2	12	12	4	4	20	20

Generic TRX MIMO Configuration

#### Noise and Interference

The receiver parameters in this tab are used for noise and interference calculations.

System parameters			×
Network Channel Plan	Adaptive Modulation Table	MIMO Configuration	Noise and Interference
Rx parameters	D	L UL	
Rx equivalent Adjacent	noise bandwidth (MHz) Rx noise figure (dB) Rx noise level (dBm) channel rejection (dB)	1.728     1.728       6     4       105.6     -107.6       30     30	
			OK Cancel

Generic TRX Noise and Interference

Rx equivalent noise bandwidth	Receiver Equivalent Noise Bandwidth, MHz
Rx noise figure	Receiver noise figure, dB Typically 3-4 dB for access point sector and
	6 dB for UE
Rx noise level	Receiver noise level, dB This value is used to estimate the noise on
	the receiving path when calculating all types of interference.
Adjacent channel rejection	Adjacent channel rejection, dB It is assumed that the receiver has a rectangular "brick wall" bandpass shape with a width equal to the equivalent noise bandwidth. Under these conditions, you can set the amount of attenuation on adjacent channels (one bandwidth above and below the desired bandwidth) by entering a value here for adjacent channel rejection.

## **Access Points**

An access point within Indoor RadioPlanner is a device that can encompass one or more systems (technology standards). For example, a Wi-Fi hotspot can support multiple bands, such as 2.4 GHz, 5 GHz, and 6 GHz. In the program, each technology standard is called a "System."

To create a first Access Point, click on Level in the Tree View interface, then click the Access Point" button in the panel that opens. Subsequently, it is efficient to generate additional access points based on the first one created.

유 🕀 🔀	ŷ ≷ © Ŀ Ů ₽ ×	
Access Point Parameters		
Name	AP301	
Equipment	Ubiquiti U6 Enterprise	
Coordinates		
Latitude		
Longitude		
Antenna system options		
<ul> <li>all systems have omnidirectional antennas</li> </ul>		
$\bigcirc$ all systems have directional antennas with same azimuth		
$\bigcirc$ all systems have directional antennas with different azimuths		
Antenna system parameters		
Antenna Height	4 m	
Antenna Azimuth	0 🚖 deg.	
Antenna Beam tilt*	0 🚖 deg.	
* - negative value means downward beam tilt		

Access Point Parameters

÷	Add a new system
⊕	Add a new Access Point with the same parameters (Duplicate)
x	Delete this Access Point
∲ ک	Move Access Point up or down
٢	Position the plan with the Access Point at the center of the screen
₽	Load Access Point parameters from a template
Û	Save Access Point parameters as a template
ħ	Copy this AP to clipboard

Name	AP name, text field
Equipment	Name (model) of AP equipment, text field
Latitude	Latitude (only for outdoor projects with Basemap underlay)
Longitude	Longitude (only for outdoor projects with Basemap underlay)

The antenna configuration at one Access Point can be of three options:

- All systems have omnidirectional antennas
- All systems have directional antennas with same azimuth

• All systems have directional antennas with different azimuths (for outdoor projects only)

Antenna parameters depend on system configuration options and may be specified here or in specific system parameters.

There is an activity icon next to each access point and system in the tree view of the interface. For a system to be calculated, it must be marked as active (the dot in the center). When you click on a system, a panel with its parameters will open.

## All Systems Except Wi-Fi

⊕
System parameters
Name 5G_CBRS_40 MHz
Network 5G CBRS N48_3500 MHz ~
MIMO MIMO-B 2x2 ~
TX power 26 dBm Feeder Loss 0 dB
Antenna Gain 5.8 dBi Antenna Height 4 m
Antenna Azimuth 0 🚖 deg. Antenna Beam tilt 0 🚖 deg.
Antenna pattems H
Best Server Color Channels DL: 3570 MHz Channels UL: 3570 MHz

5G System Parameters

### Toolbar:

Ð	Add a new System with the same parameters		
23	Delete the System		
\$ \$	Move the System up or down		
Ħ	Channel Plan		
$\odot$	Position the map with the system at the center of the screen		
ᅇ	Global Active System parameters change. You can replace the selected parameters for all active Systems as the current System.		
Name	System name, text field		
-------------------	---	--	--
Network	The network to which the System belongs, select from the drop-down list		
	of networks.		
MIMO	MIMO type for the System, selection from a drop-down list of all possible		
	MIMO configurations specified in the parameters of this network.		
Tx Power	Transmitter power, dBm		
Cable Loss	Loss in cable, dB		
Antenna Gain	Antenna gain, dBi		
Azimuth	The azimuth of the antenna in degrees		
Antenna Height	The antenna height, m		
Antenna Beam Tilt	Tilt the antenna in degrees. Down is negative; up is positive.		
	Load MSI antenna pattern file. An antenna pattern file is a standard MSI		
소	file that can be downloaded from the antenna manufacturer's website.		
	Antenna patterns are integrated into the project file.		
	Select OMNI antenna pattern		
Best Server Color	Coverage color for Best Server study		

Global active system parameter changes ×				
System parameters				
Channel plan	Antenna gain			
MIMO	Antenna height			
Tx power	Antenna azimuth			
Feeder loss	Antenna beam tilt			
Best Server color	Antenna pattem			
	Select/unselect all			
The changes will only apply to APs of network: 5G CBRS N48_3500 MHz				
	Cancel OK			

Global Active Systems parameters change

**Global Active System parameters change** is a feature that allows you to instantly change the parameters of any active Systems to match those of the current System. To perform group parameter changes, mark the Systems whose parameters need to be changed as active, set the required parameter values in the

current System, click on the button *equivalent*, select the parameters that need to be changed in the previously marked active systems from the list, and click on the OK button.

### **Channel Plan**

In the Sector Channel Plan, you can select specific frequencies (or channel numbers) from the entire frequency grid specified in the System Parameters of this network.

Chann	el Plan							×
Down	link —			Uplink				
	Use	Channel Number	Frequency (MHz)		Use	Channel Number	Frequency (MH	z)
		1	1881.792			1	1881.792	
		2	1883.52			2	1883.52	
		3	1885.248			3	1885.248	
		4	1886.976			4	1886.976	
		5	1888.704			5	1888.704	
•	$\checkmark$	6	1890.432	•	$\checkmark$	6	1890.432	
		7	1892.16			7	1892.16	
		8	1893.888			8	1893.888	
		9	1895.616			9	1895.616	
		10	1897.344			10	1897.344	
							OK Canc	el

Channel Plan for BS DECT

## Wi-Fi Systems

● \
System parameters
Name 6 GHz_80 MHz
Network Wi-Fi 6 GHz ~
802.11 Standard 802.11ax ~
Channel Width 80 ~
Spatial Streams 4 ~
Guard Interval 0.8 ~
Channel 33 ~
TX power 26 dBm Feeder Loss 0 dB
Antenna Gain 6 dBi Antenna Height 4 m
Antenna Azimuth 0 🚖 deg. Antenna Beam tilt 0 🚖 deg.
Antenna pattems H
Best Server Color



Toolbar:

ŝ



Global Active System parameters change. You can replace the selected parameters for all active Systems as the current System.

Name	System name, text field			
Network	The network to which the System belongs, select from the drop-down list			
	of networks.			
802.11 Standard	Select a standard from the 802.11 list. The list of available standards may			
	differ depending on the selected band for the Network.			
Channel Width	Channel Width, MHz			
Spatial Streams	Spatial Streams			
Guard Interval	Guard Interval, μs			
Tx Power	Transmitter power, dBm			
Cable Loss	Loss in cable, dB			
Antenna Gain	Antenna gain, dBi			
Azimuth	The azimuth of the antenna in degrees			
Antenna Height	The antenna height, m			
Antenna Beam Tilt	Tilt the antenna in degrees. Down is negative; up is positive.			
	Load MSI antenna pattern file. An antenna pattern file is a standard MSI			
소	file that can be downloaded from the antenna manufacturer's website.			
	Antenna patterns are integrated into the project file.			
	Select OMNI antenna pattern			
Best Server Color	AP coverage color for Best Server study			

Global active system parameter changes				
System parameters 802.11 Standard, Channel Width, Spartial Streams, Guard Interval Channel number Tx power Feeder loss Best Server color	<ul> <li>Antenna gain</li> <li>Antenna height</li> <li>Antenna azimuth</li> <li>Antenna beam tilt</li> <li>Antenna pattern</li> <li>Select/unselect all</li> </ul>			
The changes will only apply to APs of net	twork: Wi-Fi 6 GHz Cancel OK			

Global Active Systems parameters change for Wi-Fi

**Global Active System parameters change** is a feature that allows you to instantly change the parameters of any active Systems to match those of the current System. To perform group parameter changes, mark the Systems whose parameters need to be changed as active, set the required parameter values in the

current System, click on the button select the parameters that need to be changed in the previously marked active systems from the list, and click on the OK button.

## Area Study (Coverage Prediction) types

Indoor RadioPlanner 2.1 performs various types of area studies:

- Received Power
- Secondary Received Power
- Best Server
- C/(I+N) Ratio
- Maximum Throughput
- Number of Servers
- RSRP for LTE and 5G
- RSRQ for LTE and 5G
- Signal to Noise Ratio for Wi-Fi
- Channel Interference for Wi-Fi
- Maximum aggregated Throughput
- Number of Networks

Coverage calculation parameters are configured in the Network Parameters.

When you click the "Calculate Coverage for Current Level" button on the main toolbar, all prediction types are performed at once. The prediction displayed on the screen can then be selected from the main toolbar.

Area Study\System Tupe	Generic TRX	LTE	5G	Wi-Fi
Received Power	V	V	V	V
Secondary Received Power	V	V	V	V
Best Server	V	V	V	V
Number of Servers	V	V	V	V
C/(I+N) Ratio	V	V	V	
Maximum Throughput	V	V	V	V
RSRP for LTE and 5G		V	V	
RSRQ for LTE and 5G		V	V	
Signal to Noise Ratio (SNR) for Wi-Fi				V
Channel Interference for Wi-Fi				V

The availability of a particular area study type is determined by the type of system chosen:

## **Received power (RSSI) Downlink/Uplink**

Received power maps show those areas where a given signal power level is present at the receiver.

You can choose prediction visualization as a heat map or a composite grid.

Received power as a heatmap visualization

Max Level	Max visualization level, dBm
Min Level	Min visualization level, dBm

Area study type					
Received	Received Power (DL)				
Received	Received Power Visualization				
Co	Composite Grid     Heatmap				
6 ~	Numbe	r of le	vels		
Color	Value				Description
>	-40	dBr	n		
	-50	to	-40	dBm	
	-60	to	-50	dBm	
	-70	to	-60	dBm	
	-80	to	-70	dBm	
	-90	to	-80	dBm	

Received power as a composite grid visualization

Number of Levels	The number of levels (1-8)		
Color	Color level		
Values	Received power level, dBm		
Description	Text field to describe signal level		



Indoor Received Power (RSSI) Coverage Prediction for Wi-Fi



Outdoor Downlink Received Power Coverage Prediction

## **Secondary Received power Downlink**

The Secondary Received Power Coverage Map shows the areas of the second strongest signal at the receiver. You can choose prediction visualization as a heat map or a composite grid.

Area study type				
Secondary Received Power (DL)				
Secondary Received Power Visual	ization			
Composite Grid	Heatmap			
Max Level -30 dBm	Min Level -85 dBm			
•				
0				

Secondary Received Power as a Heatmap Visualization

Max Level	Max visualization level, dBm
Min Level	Min visualization level, dBm

Area study	Area study type					
Secondary	/ Receive	ed Po	wer (DL)		~	
Secondary Received Power Visualization						
C	omposite	Grid			○ Heatmap	
6 ~	Numbe	r of le	vels			
Color	Value				Description	
>	-40	dBr	n			
	-50	to	-40	dBm		
	-60	to	-50	dBm		
	-70	to	-60	dBm		
	-80	to	-70	dBm		
	-90	to	-80	dBm		

Secondary Received power as a composite grid visualization

Number of Levels	The number of levels (1-8)		
Color	Color level		
Values	Secondary Received power level, dBm		
Description	Text field to describe signal level		



Indoor Secondary Received Power Coverage Prediction for Wi-Fi

### **Best Server Uplink/Downlink**

The Best Server map shows the identity of the system supplying the strongest received signal at each location. The minimum received signal level for calculating the Best Server is downlink/uplink Rx threshold. The system color is defined in the sector parameters or can be assigned automatically.

Area study type	
Best Server DL	~
Color assignment for Mobile Unit №1	
<ul> <li>Apply automatic color assignment</li> </ul>	
<ul> <li>Use colors from sectors</li> </ul>	

Best Server Study Type Parameters





Best Server Indoor



Best Server Outdoor

# C/(I+N) Ratio Downlink/Uplink

The carrier-to-interference+noise ratio (C/(I+N)) is an essential quantity used in assessing system performance and affecting frequency planning. Indoor RadioPlanner allows you to calculate and display areas with different downlink/uplink C/(I+N) values for interference on co-channel and adjacent channels.

Carrier-to-interference+noise ratio is calculated by first finding the strongest received signal power at each location, then calculating the sum of received signal powers from all other co-channel and adjacent systems (taking into account adjacent channel rejection) that also have relevant signal levels at that location. After finding the sum of interference, the carrier-to-interference+noise ratio is calculated.

The interference calculation always takes into account the noise component, which depends on noise bandwidth and receiver noise figure entered in Noise and Interference in Network system settings. The calculation of adjacent channel interference can be disabled to only take into account co-channel interference.

🗹 Use d	Use co-channel interference				Use adj-channel interference	
Area study	Area study type					
C/(I+N) R	atio (DL)				~	
C/(I+N) R	atio Numbe	er of le	evels			
Color			Value		Description	
<			7	dB		
	7	to	10	dB		
	10	to	15	dB		
	15	to	20	dB		
	20	to	25	dB		
	25	to	89	dB		



Number of Levels	The number of levels
Color	Color level
Value	Carrier-to-interference+noise ratio C/(I+N), dB
Description	Text field



C/(I+N) Downlink for LTE

### Signal to Noise Ratio (SNR) for Wi-Fi

Signal-to-Noise Ratio visualization displays how much stronger the signal strength is than the noise in the given location.

Signal must be stronger than noise for data transfer to be possible. SNR is calculated by finding the strongest received signal power at each location and then calculating the ratio of that power to the noise floor, taking into account the channel bandwidth. In a typical environment, the noise level is about -90 dBm.

Network par	ameters			
	Band 5	∼ GH	z S	Signal Correction 0 dB
Min Received P	imum ower -85	j dBm	<sup>n</sup> Ba	Noise Floor for ndwidth 20 MHz -94 dBm
Area study ty	/pe			
Signal To No	oise Ratio	(SNR)		~
Signal To No	oise Ratio	(SNR)		
7 ~	Number of	flevels		
Color		Value		Description
<		10	dB	
	10 to	20	dB	
	20 to	30	dB	
	30 to	40	dB	
	40 to	50	dB	
	50 to	60	dB	
	60 to	89	dB	

Signal to Noise Ratio (SNR) Study Type Parameters

Number of Levels	The number of levels
Color	Color level
Value	SNR, dB
Description	Text field



Signal to Noise Ratio (SNR) for Indoor Wi-Fi Network

## **Channel Interference for Wi-Fi**

The Channel Interference shows how many access points are overlapping in a single channel in the given area.

This visualization can display both Co-channel and Adjacent Channel Overlap (for 2.4 GHz only). Channel overlap should be kept to a minimum to ensure interference-free operation.

Area study type					
Channel Interference	Channel Interference ~				
Channel Interference					
15 C/I Thresho	ld (dB)				
🗹 Adjacent Ch	annels (only for 2.4 GHz)				
5 V Maximum nu	imber of channel interference				
Color Channel interference	Description				
0					
1					
2					
3					
4					
≥ 5					

Channel Interference for Wi-Fi Study Type Parameters

C/I Threshold	C/I Threshold, dB
	The minimum ratio of the useful signal to the sum of the
	interference signals for the correct operation of the demodulator
	with the required quality. The smaller this ratio, the less the
	influence of interference. This parameter is analyzed to decide
	whether there is interference.
Maximum number of interfering	Maximum number of interfering channels
channels	
Color	Color corresponding to the number of interfering channels. 0 -
	means no interference
Description	Text field



Channel Interference for Indoor Wi-Fi Network

## Maximum Downlink / Uplink Throughput

This prediction type shows maximum cell throughput for LTE, 5G and Generic TRX, as well as the maximum data rate (PHY) for Wi-Fi.

**For LTE/5G System Types**, this study calculates MCS Index for each point based on predicted C/(I+N) from LTE/5G system parameters tab of Network. Throughput associated with MCS is determined using 3GPP specified formulas and tables.

**For Wi-Fi System Type**, this study calculates MCS Index for each point based on predicted SNR from Wi-Fi system parameters tab of Network. Throughput associated with MCS is determined using 802.11 specified tables.

**For Generic TRX System Type**, this study calculates Throughput for each point based on predicted C/(I+N) from Adaptive Modulation Table in system parameters tab of Network.

🗹 Use o	Use co-channel interference				Use adj-channel interference
Area study	type				
Maximum	Throughp	ut (D	L)		~
Maximum	Throughp	ut			
5 ~	Numbe	r of le	evels		
Color	Value				Description
>	615	Mb	ps		
	460	to	615	Mbps	
	307	to	460	Mbps	
	100	to	307	Mbps	
	50	to	100	Mbps	

Maximum Downlink Throughput Study Type Parameters

Number of Levels	The number of levels (1-8)
Color	Color level
Values	Maximum Throughput, Mbps
Description	Text field



Maximum Downlink Throughput Coverage Prediction for indoor 5G CBRS N48 (3500 MHz) Network



Maximum Downlink Throughput Coverage Prediction for oudoor 5G CBRS N48 (3500 MHz) Network

## Number of Servers Uplink/Downlink

This study indicates total number of systems that provide a signal above Rx threshold at each location.

- Area stud	dy type				
Number	of Servers (D	L) ~			
Number	of servers				
3 ~	3 V Maximum number of servers				
Color	Number of servers	Description			
	1				
	2				
	≥ 3				

Number of Servers Above Downlink Study Type Parameters

Maximum Number of Servers	Maximum number of displayed servers		
Color	Color indicating the appropriate number of servers		
Description	Text field		



Number of Servers Above Downlink for Wi-Fi

## **Reference Signal Received Power (RSRP)**

This study calculates the Reference Signal Received Power (RSRP) from all resource elements of a cell at the remote UE receiver using system parameters of LTE and 5G networks (bandwidth, subcarrier spacing). You can choose prediction visualization as a heat map or a composite grid.

Area study type	
RSRP	~
RSRP Visualization	
O Composite Grid	Heatmap
Max Level -85 dBm	Min Level -115 dBm
۲	
0	

#### RSRP as a heatmap visualization

Max Level	Max visualization level, dBm
Min Level	Min visualization level, dBm

Area study	y type					
RSRP						~
RSRP Visualization <ul> <li>Composite Grid</li> <li>Heatmap</li> </ul>						
A ~~	Number	r of le	wels			
4 V Color	Value	i oi ie			Description	
Color	Value -85	dBr	n		Description	
Color	Value -85 -95	d Br to	n -85	dBm	Description rsrp_bars=5 rsrp_bars=4	
Color	Value -85 -95 -105	dBr to to	n -85 -95	dBm dBm	Description rsrp_bars=5 rsrp_bars=4 rsrp_bars=3	
Color	Value -85 -95 -105 -115	dBr to to	m -85 -95 -105	dBm dBm dBm	Description rsrp_bars=5 rsrp_bars=4 rsrp_bars=3 rsrp_bars=2	
Color	Value -85 -95 -105 -115	dBr to to	m -85 -95 -105	dBm dBm dBm	Description rsrp_bars=5 rsrp_bars=4 rsrp_bars=3 rsrp_bars=2	

RSRP as a composite grid visualization

Number of Levels	The number of levels (1-8)
Color	Color level
Values	Reference Signal Received Power (RSRP), dBm
Description	Text field to describe RSRP level



RSRP coverage prediction for indoor 5G CBRS N48 (3500 MHz) Network



RSRP coverage prediction for outdoor 5G CBRS N48 (3600 MHz) Network

## **Reference Signal Received Quality (RSRQ)**

This study calculates the Reference Signal Received Quality (RSRQ) from all resource elements at the remote UE receiver using system parameters of LTE and 5G networks (bandwidth, subcarrier spacing, cell load, and C/(I+N) ratio).

🗹 Use o	:o-channe	el inte	ference	$\checkmark$	Use adj-channel interference
Area study	type				
RSRQ					~
RSRQ					
5 ~	Numbe	r of le	evels		
Color	Value				Description
>	-10	dB			
	-11	to	-10	dB	
	-13	to	-11	dB	
	-15	to	-13	dB	
	-18	to	-15	dB	



Number of Levels	The number of levels (1-8)		
Color	Color level		
Values	Reference Signal Received Quality (RSRQ), dB		
Description	Text field to describe RSRQ level		



RSRQ coverage prediction for indoor 5G CBRS N48 (3500 MHz) Network

## **Coverage predictions for multiple networks**

### Number of Networks Downlink / Uplink

This prediction shows number of networks providing service at each calculation point for downlink or uplink. Calculation is performed for respective thresholds Rx of each network taken into account in calculation.

Area Study Type				
Number of Networks	s (DL) ~			
Number of networks				
A Maximum	and the standard			
3 V Maximum	number of networks			
Color Number of networks	Description			
1				
2				
≥ 3				

Number of Networks Downlink Study Type Parameters

Maximum Number of Networks	Maximum number networks		
Color	Color indicating the number of networks		
Description	Text field		



Number of Networks Downlink Coverage Prediction for indoor LTE Band 12 and 5G N48

### Maximum Aggregated Downlink / Uplink Throughput

This prediction type shows the total throughput at each point for all networks involved in the calculation.

Area Study Type							
Maximum	Maximum Aggregated Throughput (DL) $\qquad \qquad \lor$						
Maximum	Aggregat	ed Th	roughput				
5 ~	Numbe	r of le	vels				
Color	Value				Description		
>	300	Mb	ps				
	200	to	300	Mbps			
	100	to	200	Mbps			
	50	to	100	Mbps			
	10	to	50	Mbps			

### Maximum Aggregated Downlink Throughput Study Type Parameters

Number of Levels	The number of levels (1-8)
Color	Color level
Values	Maximum Aggregated Throughput, Mbps
Description	Text field



Maximum Aggregated Downlink Throughput Coverage Prediction for indoor LTE Band 2 and 5G N48

## Wi-Fi Site Survey

Indoor RadioPlanner 2.1 allows for passive survey and visualization of a site's Wi-Fi environment.

During a passive survey, the application collects the most comprehensive data about the Wi-Fi environment: information about access points and their characteristics, signal strength, interference, etc. It is called passive because during this type of survey, the application passively listens for packets and does not try to connect to WLAN networks.

Any Wi-Fi adapter available in the laptop can be used for site survey.

After completing the Wi-Fi survey, the following types of visualizations will be available:

- Received Power
- Secondary Received Power
- Best Server (Best AP)
- Number of Servers (Number of APs)
- Signal to Noise Ratio
- Channel Interference

### Performing a Wi-Fi Site Survey

Before performing a survey, you need to create at least one floor (see the Levels section).

The survey is performed using the Step-by-Step method, where the Indoor RadioPlanner collects data only at the location indicated by clicking on the map. In this mode, after marking a location on the map, you must remain in place until the scanner completes its work cycle. Then the data collection stops until you mark the next location, where the scanner again makes a full work cycle.

To work with surveys and subsequent visualization, the main panel of Indoor RadioPlanner 2.1 provides a group of tools:



Wi-Fi Monitor. This tool allows you to get a list of all available access points.



Wi-Fi Survey List. This tool allows you to perform and save multiple surveys in a project.



Wi-Fi Survey Visualization

Wi-Fi Monitor											×
⊳ ≓ S	6 alla						->	×			
SSID	MAC	Freq	Chan	Channel Width	RSSI	^	SSID	MAC	Freq	Chan	Channel Width
Home	68-D7-9A-1D-92-89	2.437	6	20	-58		ASUS_5G	AC-22-0B-8E-93-39	5.22	44	40
	62-ED-00-F4-B4-04	2.452	9	40	-72		Home	68-D7-9A-1E-92-89	5.22	44	40
Ntk-5	40-ED-00-F4-B4-04	2.452	9	40	-72		Home	68-D7-9A-1E-92-8E	5.5	100	20
	52-FF-20-7E-6E-85	2.447	8	40							
Keenetic-3029	50-FF-20-4E-6E-85	2.447	8	40	-76						
RT-WiFi-0A6A	48-3E-5E-B4-0A-6C	2.427	4	40	-76						
RT-WiFi-AD4A	B4-E5-4C-A1-AD-4B	2.462	11	40	-77						
	52-FF-20-74-F9-E6	2.452	9	40	-77						
RT-WiFi-88F6	74-9D-79-3A-88-F8	2.457	10	40							
Uzpuz	68-FF-7B-53-F9-71	2.462	11	40	-79						
DL VAP w1g	00-26-5A-45-C4-E8	2.412	1	20	-81						
RT-5WiFi-AD	B4-E5-4C-A1-AD-4F	5.24	48	80	-81						
	10 A2 D9 EC 26 E1	2/17	2	20	-83						
RT-GPON-2	10-A3-B0-FC-20-E1	2.417	-			b.d.					

#### Wi-Fi Monitor

- Start/stop adding new APs to Full AP list based on new measurement results. The stop is disabled with a delay until the end of the scanning cycle.
- ⊒ ≈

o00o

->

 $\triangleright$ 

- Add new APs to Full AP list based on all survey results
- Clear Full AP list

Spectrum Visualization. This visualization is disabled with a delay until the end of the scanning cycle.

Add selected APs to My AP List



Clear My AP List. Individual rows in the My AP List can be deleted using the Del button.

The Full AP List and My AP List can be sorted in ascending or descending order by any of the columns. This allows you to quickly sort APs by RSSI, band, channel, or bandwidth.



Spectrum Visualization in 2.4GHz

Indoor RadioPlanner 2.1 allows you to make several surveys in a project. Surveys are managed in the Wi-Fi Survey List menu. Current measurements are entered into the active survey.

Wi-F	i Surveys		×
습 Sun	vey List		
	Active Survey	Survey Name	Number of points
		081124	74
•	-	New Survey	0
			Close

#### Wi-Fi Surveys List

To start a survey, click on the Add Wi-Fi Survey Point tool on the panel of the floor you are surveying. Then click on the point on the plan corresponding to your location and wait for the full measurement cycle. Until the cycle is complete, the word MEASUREMENT will remain on the screen. Then go to the next location, click on the corresponding point on the plan, and so on. To exit the measurement mode, release the "Add Wi-Fi survey point" button or press Esc.



Performing a Wi-Fi Site Survey

You can work with measurement points on the plan in the same way as with other objects - delete, move, cancel the action, and so on.

Due to the use of standard scanning tools, it is sometimes possible to miss access point beacons. To reduce the impact of this effect on the measurement and visualization of the access points of interest to you, we recommend using the My AP List tool. To do this, first monitor all available Wi-Fi access points on your site using the Wi-Fi Monitor tool. And add the APs you need to My AP List. Now, when performing measurements in the access point list at the measurement point, available access points from My AP List will be marked in green, and unavailable ones in red. Thus, during the measurement process, you can quickly analyze the presence of a signal from the access points of interest and, if necessary, run a repeated measurement cycle for reliability. My AP list has another function - it is used to generate a list of APs for visualization.

### **Survey Visualization**

To visualize survey results, use **Wi-Fi Survey Visualization** on the main toolbar.

In the window that appears, you can select surveys whose measurement data will be used for visualization. Here, you can also select access points from the My AP List for visualization. The types of available visualizations and their parameters are described below.

Wi-Fi	Ni-Fi Survey Visualization X								
Surv	ey List					Visualization Type			
		Survey Na	me		Number of points	Received Power ~			
	081124				74	Signal Strength			
						◯ Composite Grid			
						Max Level -30 dBm Min Level -85 dBm			
AP S	ourvey Visua	alization List				•			
	SSID	MAC	Freq	Chan	Channel Width	0			
	ASUS	AC-22-0B-8E-93-39	5.22	44	40				
$\checkmark$	Home	68-D7-9A-1E-92-89	5.22	44	40	Visualize			
	Home	68-D7-9A-1E-92-8E	5.5	100	20				
						·	1		
						< >>			
						Close	ן		

Survey Visaulization Parameters

#### **Received Power**

Received power coverage map show those areas where a given signal power level is present at the receiver.

You can choose visualization as a heat map or a composite grid.

Visualization Type	
Received Power	~
Signal Strength	
O Composite Grid	<ul> <li>Heatmap</li> </ul>
Max Level -30 dBm	Min Level -85 dBm
۲	
0	
	Visualize

Received power as a heatmap visualization

Max Level	Max visualization level, dBm
Min Level	Min visualization level, dBm

Visualizatio	Visualization Type							
Received	Received Power ~							
Signal Stre	Signal Strength							
O Co	Composite Grid     Heatmap							
6 ~	Numbe	r of le	vels					
Color	Value				Description			
>	-40	dBr	n					
	-50	to	-40	dBm				
	-60	to	-50	dBm				
	-70	to	-60	dBm				
	-80	to	-70	dBm				
	-90	to	-80	dBm				
					Visualize			

#### Received power as a composite grid visualization

Number of Levels	The number of levels (1-8)				
Values	Received power level, dBm				
Description	Text field to describe signal level				





### **Secondary Received Power**

The Secondary Received Power Coverage Map shows the areas of the second strongest signal at the receiver. You can choose visualization as a heat map or a composite grid.

Visualization Type					
Secondary Received Power <					
Secondary Received Power					
Composite Grid	Heatmap				
Max Level -30 dBm	Min Level -85 dBm				
۲					
0					
	Vieualize				
	Visualize				

Secondary Received power as a heatmap visualization

Max Level	Max visualization level, dBm
Min Level	Min visualization level, dBm

Secondary Received Power ~								
Secondary Received Power								
Co	Composite Grid							
6 ~	Numbe	r of le	vels					
Color	Value				Description			
>	-40	dBr	n					
	-50	to	-40	dBm				
	-60	to	-50	dBm				
	-70	to	-60	dBm				
	-80	to	-70	dBm				
	-90	to	-80	dBm				
					Visualize			

Secondary Received power as a composite grid visualization

Number of Levels	The number of levels (1-8)

Color	Color level
Values	Secondary Received power level, dBm
Description	Text field to describe signal level



Secondary Received Power Coverage Visualization

### Best Server (Best AP)

The Best Servers coverage map shows the AP with the strongest signal at each location. An area is considered covered if the signal exceeds a Minimum Received Power level, i.e. strong enough for clients to communicate with the access point.

Visualization Type	
Best Server	~
Best Server	
-85 Minimum Received Power (dBm)	
	Visualize

Best Server Visualization Parameters





#### Number of Servers (Number of APs)

This visualization shows how many access points cover a given area. An area is considered covered if the signal exceeds a Minimum Received Power level, i.e. strong enough for clients to communicate with the access point.

Visualization Type				
Number of Servers ~				
Number of Servers				
-85 Minimum Received Power (dBm)				
3 V Maximum n	number of servers			
Color Number of servers	Description			
1				
2				
≥ 3				
	Visualize			

Number of Servers Visualization Parameters

Minimum Received Power	Minimum Received Power, dBm
Maximum Number of Servers	Maximum number of displayed servers
Color	Color indicating the appropriate number of servers
Description	Text field



Number of Servers

### Signal to Noise Ratio (SNR)

This visualization shows the signal-to-noise ratio measured in dB. SNR is a measure to quantify by how much the signal level exceeds the noise level. Noise is generated by non-802.11 sources of radio waves (this includes 802.11 frames damaged during propagation). In low SNR zones, client devices may not be able to communicate with APs. SNR is shown for the AP that has the strongest signal in the given map area among the APs selected for analysis.

Visualization Type				
Signal to Noise Ratio (SNR) $\qquad \qquad \lor$				
Signal to Noise Ratio (SNR)				
-85 Minimum Received Power (dBm)				
-90 Noise Floor (dBm)				
5 V Number of levels				
Color	Value	Description		
<	10 dB			
10 to	20 dB			
20 to	30 dB			
30 to	40 dB			
40 to	60 dB			
		Visualize		

Signal to Noise Ratio Visualization Parameters

Minimum Received Power	Minimum Received Power, dBm	
Noise Floor	Noise Floor, dB. The noise level created by the sum of all	
	noise sources and unwanted signals. In a typical	
	environment, the noise level is about -90 dBm.	
Number of Levels	The number of levels	
Color	Color level	
Value	SNR, dB	
Description	Text field	



Signal to Noise Ratio Visualization

### **Channel Interference**

The Channel Interference visualization shows how many access points are overlapping in a single channel in the given area. This visualization can display both Co-channel and Adjacent Channel Overlap (for 2.4 GHz only). The channel overlap should be minimized to ensure interference-free operation.
Visualization Type											
Channel Interference ~											
Channel Interference											
-85 Minimum Received Power (dBm)											
15 C/I Threshold (dB)											
Adjacent Channels (only for 2.4 GHz)											
7 ~ Maximum n	umber of channel interference										
Color Channel interference	Description										
0											
1											
2											
3											
4											
5											
6											
≥ 7											
		Visualize									



C/I Threshold	C/I Threshold, dB				
	The minimum ratio of the useful signal to the sum of the				
	interference signals for the correct operation of the demodulator				
	with the required quality. The smaller this ratio, the less the				
	influence of interference.				
Number of Levels	The number of levels				
Color	Color level				
Value	Number of interfering channels. 0 - means no interference				
Description	Text field				



Channel Interference Visualization

## Saving images of Coverage Prediction and Survey Visualization

**Save the level plan as a PNG image** - Save the result of the coverage calculation or survey visaulization as an image file in \*.png format. The saved image will include the same area and Legend placement as currently displayed on the screen. You can select the image resolution and the size of the access point icons. The resolution can match the current size or be two or four times larger. The better the resolution, the larger the saved file size.



Save the level plan as a PNG image

## Report

Using the "Save Access Point Settings List as CSV" button on the main toolbar, you can save a configuration report of all access points and networks. This CSV file can then be opened in Excel.

C	32		f <sub>x</sub>												~
	Α	В	С	D	E	F	G	н	1	J	К	L	м	N	
1	Access p	oint parameter list													
2	1 floor														
3	Ne	Name	Equipment/Network	System	Channels	Channels	MIMO	Height (n	r Gain (dB)	Azimuth	Beam tilt	Feeder Lo	TX Power (	dBm)	
4	1	AP101	eFEMTO 5G Casa Systems												
5			LTE Band 2_1900 MHz	LTE Band2_10MHz	(1)1935	(1)1855	MIMO-B 2	3	4	50	0	0	21		
6			5G CBRS N48_3500 MHz	5G_CBRS_40 MHz	3570	3570	MIMO-B 2	3	5.8	50	0	0	26		
7	2	AP102	eFEMTO 5G Casa Systems												
8			LTE Band 2_1900 MHz	LTE Band2_10MHz	(1)1935	(1)1855	MIMO-B 2	3	4	119	0	0	21		
9			5G CBRS N48_3500 MHz	5G_CBRS_40 MHz	3570	3570	MIMO-B 2	3	5.8	119	0	0	26		
10	3	AP103	eFEMTO 5G Casa Systems												
11			LTE Band 2_1900 MHz	LTE Band2_10MHz	(1)1935	(1)1855	MIMO-B 2	4	3.2			0	22		
12			5G CBRS N48_3500 MHz	5G_CBRS_40 MHz	3570	3570	MIMO-B 2	4	5.8			0	26		
13	4	AP104	eFEMTO 5G Casa Systems												
14			LTE Band 2_1900 MHz	LTE Band2_10MHz	(1)1935	(1)1855	MIMO-B 2	4	3.2			0	22		
15			5G CBRS N48_3500 MHz	5G_CBRS_40 MHz	3570	3570	MIMO-B 2	4	5.8			0	26		
16	2 floor														
17	Ng	Name	Equipment/Network	System	Channels	Channels	MIMO	Height (n	Gain (dB)	Azimuth	Beam tilt	Feeder Lo	TX Power (	dBm)	
18	1	AP 201	eFEMTO 5G Casa Systems												
19			LTE Band 2_1900 MHz	LTE Band2_10MHz			MIMO-B 2	3	0	0	0	0	20		
20	Total APs	4													
21															
22	Network	list													
23	N≘	Network name	BW (MHz)	DL Channels (MH	UL Chann	els (MHz)									
24	1	LTE Band 2_1900 MHz	10	(1)1935	(1)1855										
25	2	5G CBRS N48_3500 MHz	40	3570	3570										
20															1÷
	4 1	LIE_5G	•				:	4							

Report in Microsoft Excel

## Help

In this menu, you will find information about the developer, a link to the user manual, and an option to check for updates. The trial version will also have links to the purchase page and activation menu. After activating the program, these menu items will disappear.