

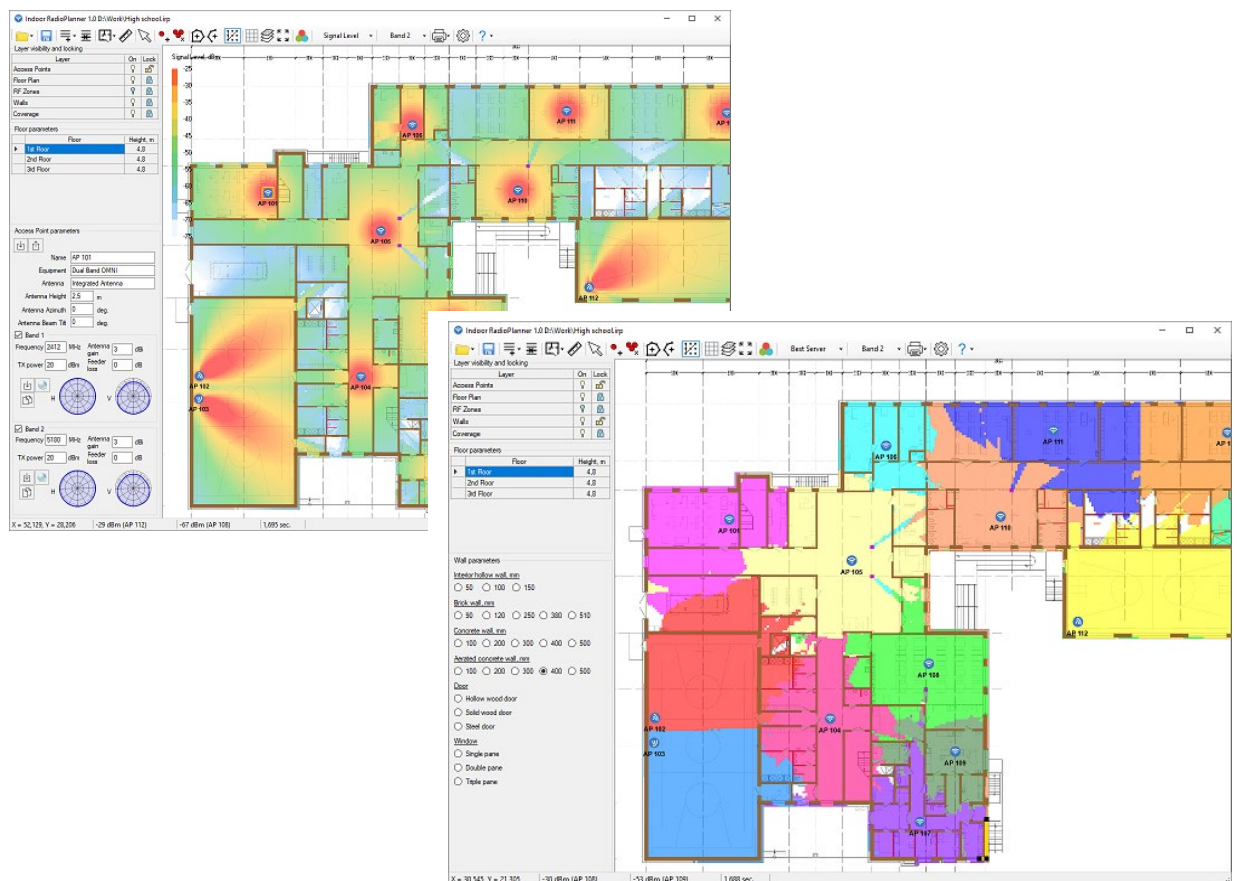
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# Indoor RadioPlanner 1.0

## Planning tool for Wi-Fi and other indoor wireless networks

### User Manual



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## About

Indoor RadioPlanner is designed for planning indoor wireless networks. Release 1.0 is mainly intended for planning Wi-Fi networks in the 2.4 GHz, 5 GHz, and 6 GHz bands, but it can be used for planning indoor GSM/ 3G / LTE / 5G networks in the frequency range 300 MHz – 7.5 GHz.

## Main Features

1. Coverage prediction according to the propagation model ITU-R P.1238-11 "Propagation data and prediction methods for the planning of indoor radiocommunication systems and radio local area networks in the frequency range 300 MHz to 450 GHz".
2. Floor plans:
  - CAD files of DWG / DXF formats
  - Raster images of the main formats: PNG, JPG, BMP
3. A simple built-in editor that allows you to quickly create a structural model of a building using various types of walls and RF Zones.
4. The ability to customize the attenuation in various types of walls
5. Loading multi-story buildings into the project
6. Fast access point configuration
7. Prediction types:
  - Signal Level
  - Best Server
  - Number of APs
8. Increased detail and high speed of calculations due to algorithm optimization and parallel computations in different processor threads.
9. Two Wi-Fi frequency bands planning
10. Report as PDF document or picture

## Installation and Activation

The Indoor RadioPlanner runs only on 64-bit Windows 7, 8, 8.1, 10.

The minimum computer configuration is Core i3 CPU, 4GB RAM, 200GB HDD, video card, and monitor with support for 1366x768.

Run the Setup\_Indoor\_RadioPlanner.exe file. Select your language and press the Install to launch the installation process. Click Next. To continue the installation process, read and accept the License Agreement. Activate the check box "I accept the terms in the License Agreement" and press Next.

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

During the 7-day trial period, you can try all the program's features without activation (except for the option to save the project file).

After the trial period has expired, you have to purchase a license and activate the software to use the product.

Attention: The process described below requires that your computer be connected to the internet during the activation process.

To buy Indoor RadioPlanner, click on **Help - Purchase**, after which the purchase page will open in the browser. After making a purchase, you will immediately receive an activation ID code to your email. Then click **Help - Enter your Activation ID code**, enter your code and click on **ACTIVATE**.

## Software Update

Periodically, we release free, ongoing updates that improve the functionality and stability of the software.

Indoor RadioPlanner supports both manual and automatic update checks. The program will check for available updates each time it starts. To check for updates manually, click **Help - Check for Updates**. If there is an available update, a window will open with current and available versions. Download the update from the link and install it manually (close Indoor RadioPlanner before installing the update).

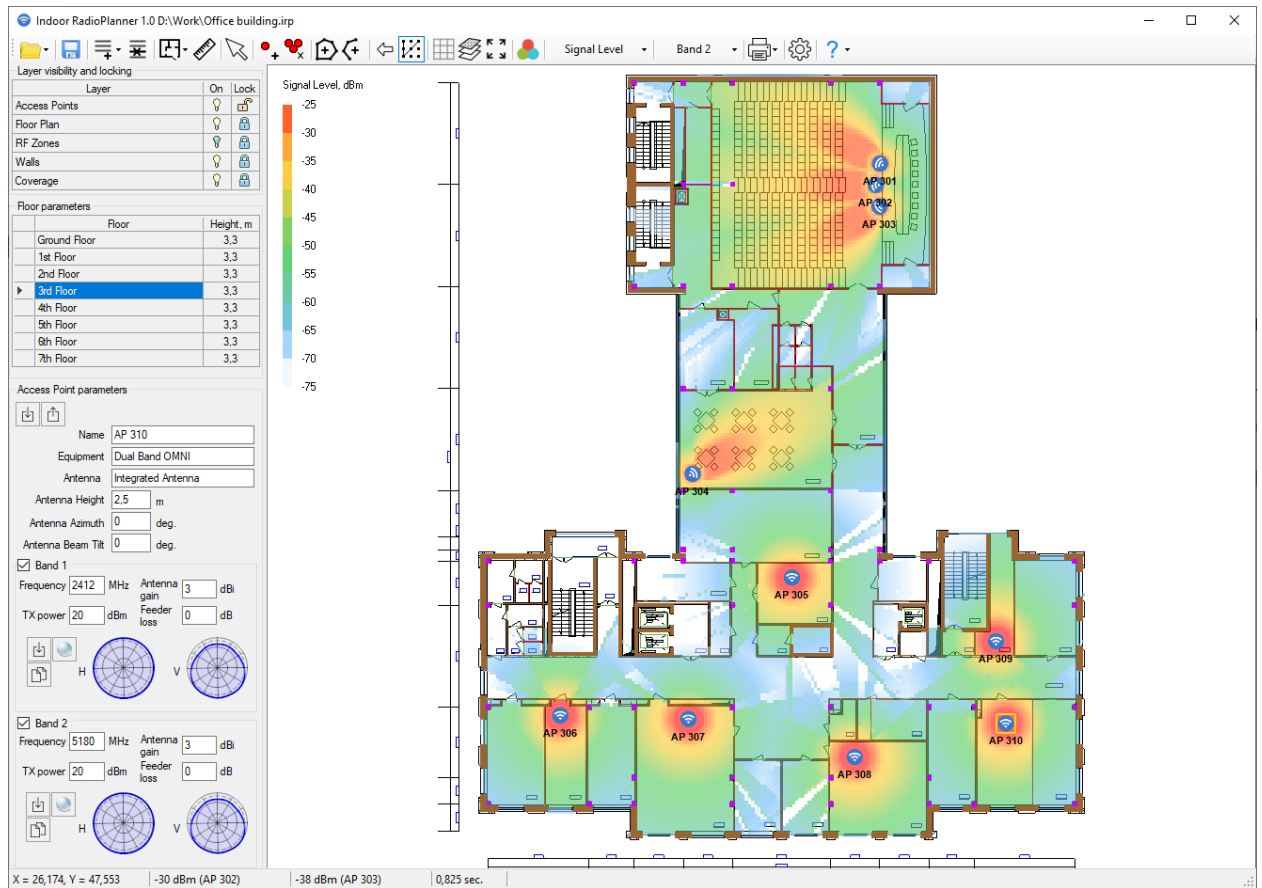
## RF Predictive Modeling in Indoor RadioPlanner

### User Interface

The program window includes the following elements:

- The main menu and toolbar (located at the top)
- The central work area - the floor plan with access points, RF zones, walls, and the coverage prediction results.
- Layers control panel (located on the left). Here you can enable/disable editing of the layer, as well as control its visibility.
- The floor selection panel (located under the panel for working with layers)
- The panel with the selected element parameters (located at the bottom left). This panel displays the options for the selected access point, RF zone, or wall.
- The status bar (located at the bottom) provides information about the coordinates and power levels for the two access points with the strongest levels

Roll the mouse wheel to zoom in and out. To move the floor plan, click on the mouse wheel and drag.



Standard tools for working with files:



- New
- Open
- Save
- Save as...



Save



Add floor



Delete selected floor



Import floor plan:

- Import a CAD DWG/DXF file
- Import a image



Ruler/Floor plan scaling



Object selection













Add Access Point



Delete all APs on the floor



Add RF Zones

-  Add Walls
-  Undo. Undo is possible only for the following objects: APs, RF zones, walls. After changing the floor or deleting all APs using the "Delete all APs on the floor" button, undo is impossible.
-  Snap to nodes
-  Display grid (1m grid space)
-  Setting the view of floor plans imported from a DWG / DXF file
-  Fit to screen
-  Calculate Coverage:
  - Signal Level
  - Best Server
  - Number of APs
 Band:
  - Band 1
  - Band 2
  - Band 1 & Band 2
-  Report to PDF or to printer/ Save Coverage as a picture/ AP parameters list
-  Settings
-  Help

More information about each of the tools is in the relevant sections of the manual.

**The trial package contains two Wi-Fi network project samples for multi-story buildings. One project (High School) uses a picture as floor plans; another project (Office Building) uses drawings in CAD format. Projects are entirely ready for coverage prediction; open the project and press "Calculate coverage."**



### Layers

The layer panel is on the left side of the screen. Using this panel, you can enable/disable the visibility of the layer on the map, as well as enable/disable the ability to edit the layer (lock the layer).

Layers:

|               |
|---------------|
| Access Points |
| Floor Plan    |
| RF Zones      |
| Walls         |





## Coverage

Controlling the visibility and blocking of a layer is performed by clicking on the icons opposite the corresponding layer. To edit the elements of a layer, you need to make this layer visible and unlock it. To do this, set the icons as  .

## Floor plans

The program allows you to load floor plans of the entire building into the project. The floor selection panel is under the layers panel.

Adding/removing floors from the project, as well as importing floor plans and scaling them, is done using the following tools on the main toolbar:

-  Add empty floor/ Create a floor with this floor plan / Create a floor with this floor plan and RF zones / Create a floor with this floor plan, RF zones, and APs
-  Delete selected floor
-  Import the plan of the selected floor as a DWG / DXF CAD file or an image in PNG, JPG, or BMP formats
-  Ruler / Floor plan scaling

To add a floor plan to your project, follow these steps:

1. Add a new empty floor using the "Add Floor" tool.
2. Load the floor plan from a DWG / DXF CAD file or PNG, JPG, BMP image.
3. Use the ruler to scale the floor plan - click on the "Ruler" tool, then mark a known distance on the plan with a line, specify the line length and click on the "Apply scaling."

A coordinate grid carries out the floors' alignment with each other. Turn on the display of the coordinate grid and align the floors at the point X = 0, Y = 0 (thick lines indicate zero axes).

## Creating a building RF environment model

Create a model of the building's RF environment that will directly account for coverage predictions from the floor plans.

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

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

N: distance power loss coefficient (parameter of the RF propagation), showing how much the signal level drops in dB when the distance from the signal source changes by a factor of 10. In practice, RF Environment coefficient N/10 is usually used, which is in the range of 2.5-4.5.

Lf, dB: floor or wall penetration loss factor (dB), which are located between the access point and the subscriber terminal.

**Please note that release 1.0 does not support 3D calculation; the calculation only considers access points located on the same floor.**

## RF environment (RF Zones)

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

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

- Open space (large open space with almost no obstacles) - 2.5 dB
- Light RF environment (cubicle office area, warehouse stock low) - 3.0 dB
- Medium RF environment (closed office area, warehouse stock medium) - 3.5 dB
- Dense RF environment (many rooms with light material, warehouse stock high) - 4.0 dB
- High-density RF environment (many rooms with heavy material, elevator shaft) - 4.5 dB
- Atrium (large opening in the floor (hole), excluded from prediction calculations)


To add an RF environment to the floor plan, click on the appropriate tool in the toolbar. Next, use the mouse to draw a polygon for the RF environment (right-click to finish drawing the polygon). Then select the RF environment coefficient from the list that appears. To complete the entry, press Esc or click on the Select tool on the panel.

You can perform the following operations on RF environment polygons (to do this, you must unlock the layer):




- Edit the shape of the polygon by dragging their nodes with the mouse
- Drag and drop entire polygons
- Delete the polygon (select it and press Delete)

## Walls

You can draw the following wall types on the floor plan:

| Type                 | Thickness | Color   | 2.4 GHz Loss, dB | 5 GHz Loss, dB |
|----------------------|-----------|---|------------------|----------------|
| Interior hollow wall | 50 mm     |  | 1                | 2              |
|                      | 100 mm    |   | 3                | 5              |
|                      | 150 mm    |   | 4                | 9              |
| Brick wall           | 90 mm     |  | 6                | 10             |
|                      | 120 mm    |   | 8                | 13             |
|                      | 250 mm    |   | 10               | 25             |
|                      | 380 mm    |   | 15               | 30             |
|                      | 510 mm    |   | 20               | 37             |
| Concrete wall        | 100 mm    |  | 6                | 10             |
|                      | 200 mm    |   | 10               | 13             |
|                      | 300 mm    |   | 14               | 22             |
|                      | 400 mm    |   | 18               | 30             |
|                      | 500 mm    |   | 25               | 37             |



|                       |             |   |    |    |
|-----------------------|-------------|---|----|----|
| Aerated concrete wall | 100 mm      |  | 4  | 7  |
|                       | 200 mm      |   | 7  | 9  |
|                       | 300 mm      |   | 10 | 15 |
|                       | 400 mm      |   | 13 | 21 |
|                       | 500 mm      |   | 18 | 26 |
| Door                  | hollow wood |  | 4  | 7  |
|                       | solid wood  |   | 6  | 10 |
|                       | steel       |   | 13 | 25 |
| Window                | single pane |  | 3  | 6  |
|                       | double pane |   | 7  | 13 |
|                       | triple pane |   | 13 | 20 |

To add a wall to the floor plan, click on the appropriate tool on the toolbar. Next, draw the wall with the mouse (press the right mouse button to finish drawing the wall). Then select the wall type from the list that appears. To complete the entry, press Esc or click on the Selection tool in the toolbar.

You can perform the following operations on walls (to do this, you must unlock the layer):

- Edit the shape of walls by dragging their nodes with the mouse
- Drag and drop entire walls
- Delete the wall (select it and press Delete)

Since the same materials have different attenuation values for different frequencies, the table lists two different attenuation values for 2.4 GHz and 5 GHz—these attenuations you can edit in the Settings menu. If the calculations use a frequency range other than the above, then interpolation or extrapolation will determine the attenuation value.

### Access points

To add an access point to the floor plan, select the Add Access Point tool and click on the desired location on the floor plan. If you need to install the same access point in a different place - click on this place and so on. To exit the setting access points mode, press Escape or the Select objects tool.

You can change the type of access point by loading the appropriate template.

Access Point parameters

Name

Equipment

Antenna

Antenna Height  m

Antenna Azimuth  deg.

Antenna Beam Tilt  deg.

☒ Band 1

Frequency  MHz Antenna gain  dBi

TX power  dBm Feeder loss  dB

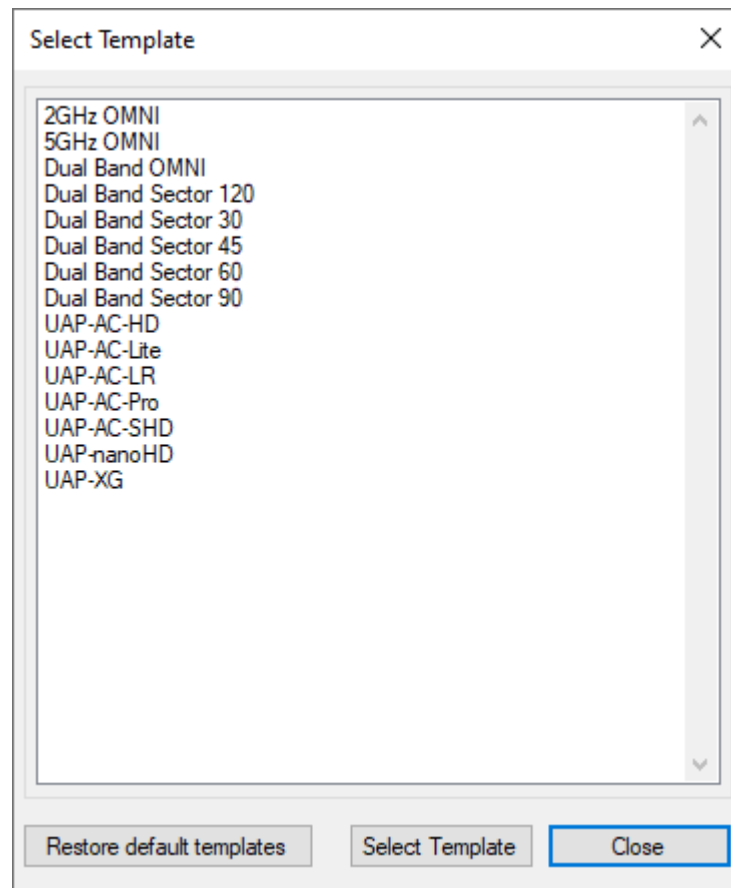
☒ Band 2

Frequency  MHz Antenna gain  dBi

TX power  dBm Feeder loss  dB

Access point parameters

|                                  |  |
|----------------------------------|--|
| <input type="button" value="↓"/> | Load AP parameters from the template   |
| <input type="button" value="↑"/> | Save the AP as a template  |
| Name                             | AP name, the text field  |
| Equipment                        | AP equipment model, text field   |
| Antenna Type                     | Antenna model, text field. Automatically filled with the antenna pattern file name when selecting a pattern. |
| Antenna Height, m                | Height of the antenna radiation center relative to the floor level, m  |
| Antenna Azimuth, degree          | Antenna azimuth in degrees   |
| Antenna Beam Tilt, degree        | Tilt the antenna in degrees. Down is negative; up is positive.   |
| Frequency, MHz                   | Frequency, MHz   |
| TX Power, dBm                    | Transmitter power, dBm   |
| Antenna gain, dBi                | Antenna gain relative to isotropic radiator, dBi   |
| Feeder loss, dB                  | Cable and connectors loss, dB  |



*Creating a new AP using a template*

You can change the antenna azimuth for the access point directly on the floor plan. To do this, double-click on the corresponding access point and rotate the circle that appears in the desired direction. The antenna icon will show the direction of maximum antenna radiation.

## Prediction Types

Indoor RadioPlanner 1.0 version supports the following types of prediction:

- Signal Level
- Best Server
- Number of APs

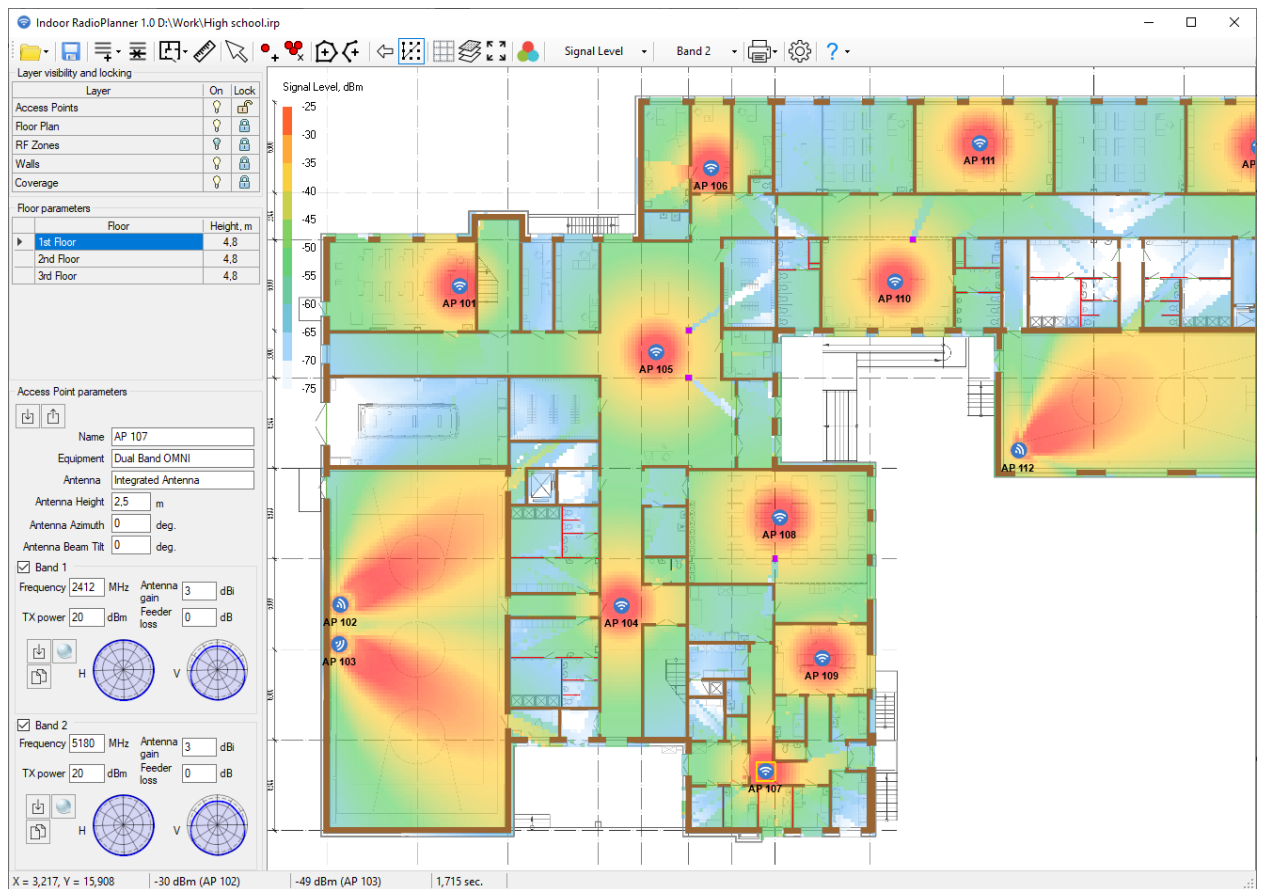
**Please note that release 1.0 does not support calculations related to frequency planning, interference, or the number of wireless clients.**

## Signal Level

This visualization shows the signal strength map (also called the coverage map or heatmap) measured in dBm. Signal strength is one of the most important factors that influence WLAN performance, as in the areas with low signal, establishing a reliable and high-throughput link between the AP and client devices is impossible. Signal level is shown for the AP that has the strongest signal in the given map area.

A signal level above -60 dBm is considered excellent. Levels between -60 and -85 dBm are mediocre, and levels below -85 dBm provide only marginal connectivity. Signal strength is affected by the distance from the AP, AP output power, type and direction of the antenna, and, most importantly, physical obstructions, such as walls, doors, windows, and their material.

You can change the color scheme in the Settings menu.

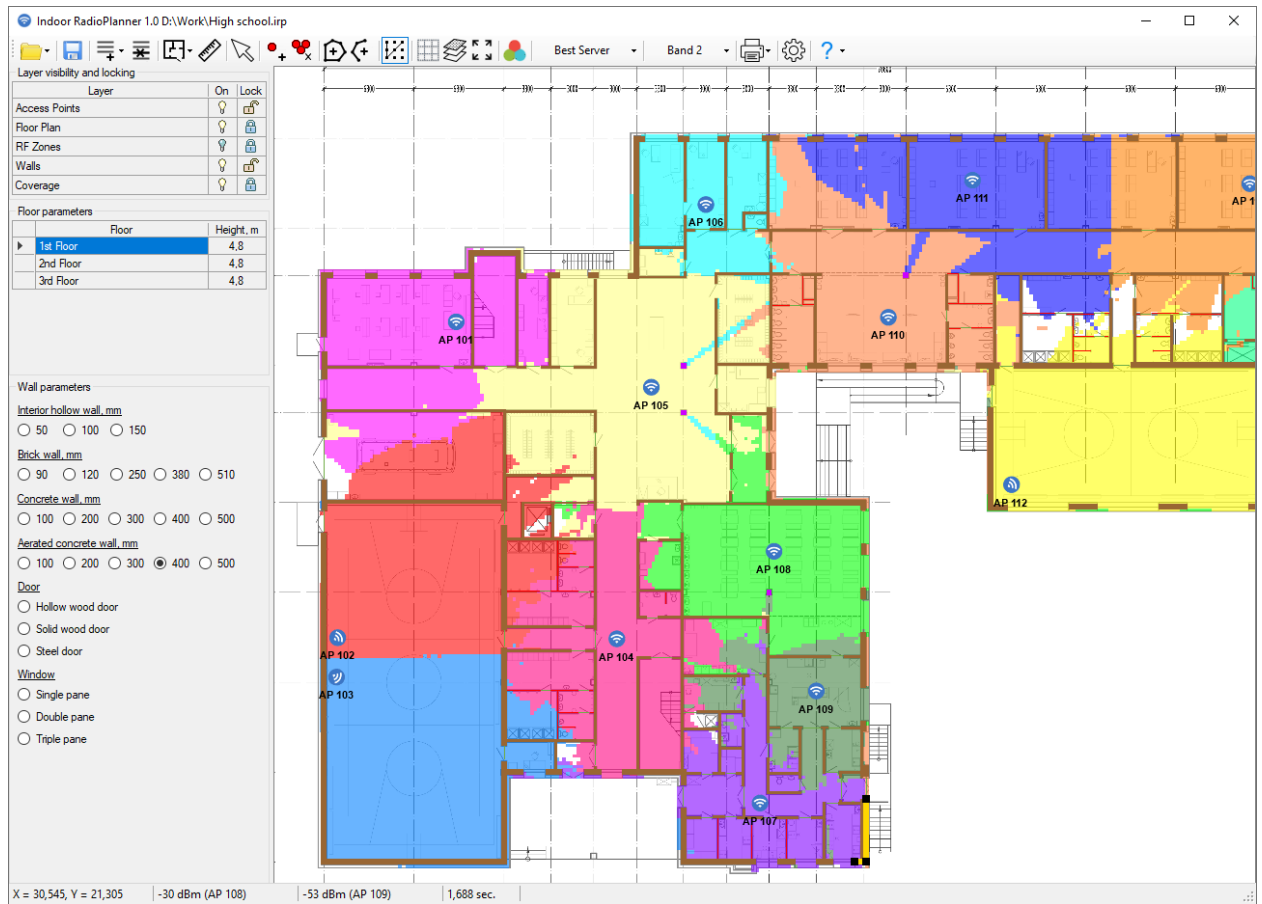


### Signal Level

### Best Server

The Best Server map shows the identity of the AP supplying the strongest received signal at the location. The colors that indicate the coverage from various access points are assigned automatically from a standard set.

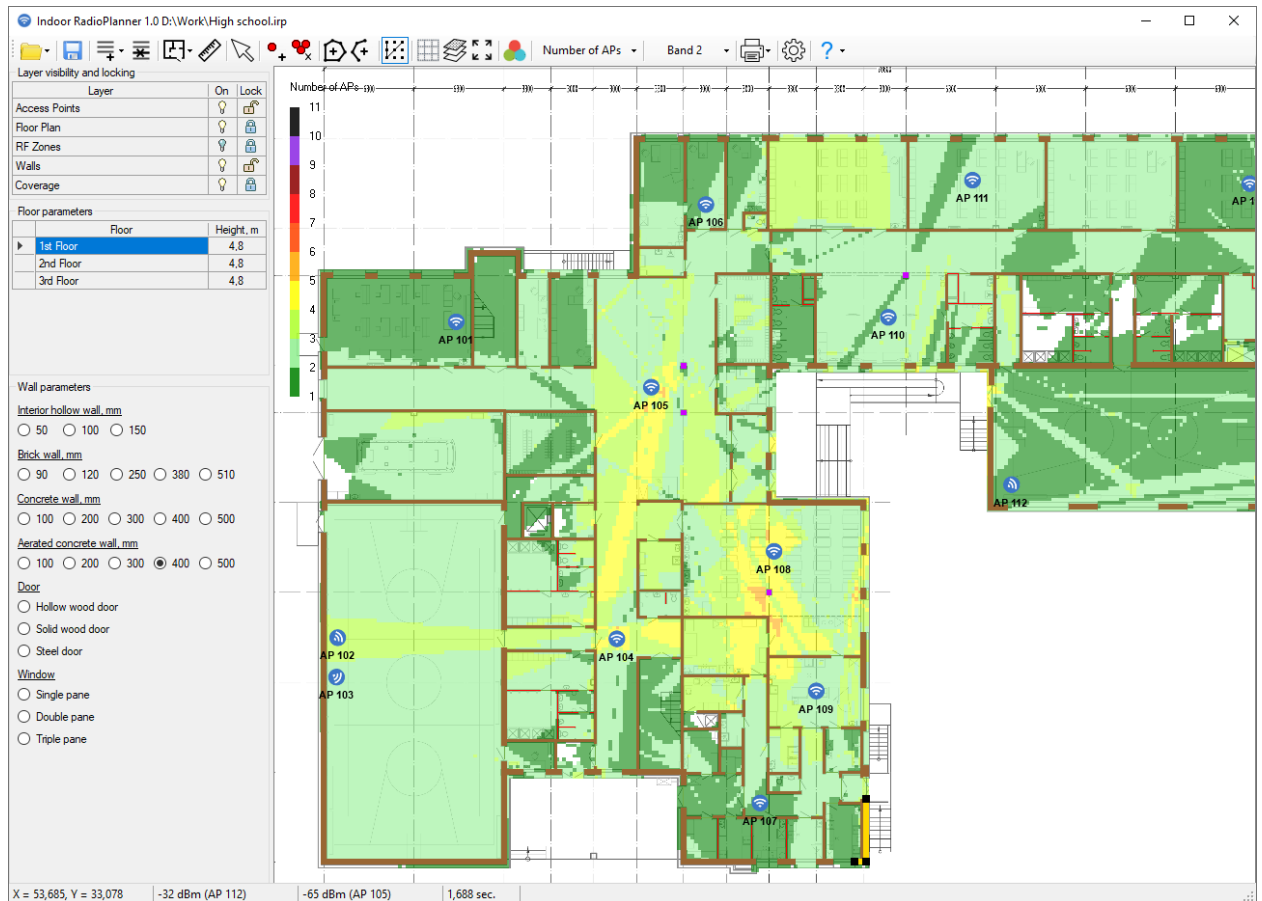
Only levels above the RSSI level set in the Settings menu are taken into account.

*Best Server*

### Number of APs

This visualization shows how many APs cover the given area. Only levels above the RSSI level set in the Settings menu are taken into account.

Indoor RadioPlanner can perform visualizations both for one frequency band and for two at once.



Number of APs

## Report

|                                   |  |
|-----------------------------------|--|
| Save Coverage as a picture        | Save coverage for this floor as a picture  |
| Coverage report to PDF or printer | Get the coverage report for each floor of the building. The coverage report can be printed or saved in PDF format using the standard Microsoft print to the PDF printer. |
| Access point parameter list       | Save AP parameter list as CSV file   |

## Settings

In this menu, you can customize the color scheme for the Signal Level heatmap, customize the wall penetration loss, and set client terminal parameters.

## Help

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