Ranplan WIRELESS

Ranplan PROFESSIONAL

On-Site Training

September – 2018 – Plano, TX

Course Introduction

The Ranplan Professional Basic Training Course is offered to partners from across the industry and is typically delivered face-to-face.

This course is an excellent opportunity for attendees to learn basic tool usage skills, best practice and tips/tricks which will be paramount for completing full certification at a later date.

Several Ranplan Professional Basic Training Courses are held annually so if you or your colleagues missed out please check our website or contact your account holder for more information on the next session!

Confidential

Course Prerequisites

- Basic knowledge of LTE, CDMA2000 and WiFi technologies
- Prior experience of either planning or deploying in-building RAN systems
- Access to Ranplan Professional
    - If you have not received and deployed your training licenses please let your instructor know ahead of the session.

Course Objectives

- After completing this two day course attendees will be:

1. Familiar with the user interface and databases of Ranplan Professional
2. Confident importing DWG and DXF files using the Smart Extract Tool to create a 3D building model
3. Confident creating 3D building models manually
4. Able to import components in to Ranplan Professional
5. Able to create generic passive and active DAS systems in Ranplan Professional
6. Confident running predictions for LTE and UMTS technologies and check these against provided design criteria
7. Competent at generating a basic capacity report using the Wireless Network Simulator (WNS)
8. Able to generate a bill of materials (BoM) and wired link budget

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Day 1 Agenda

- Tool basics - basic concepts, hints and tips, general work-flow.
- Smart Extract Tool, CAD files - esp. messy files.
- Building design using other sources + best practice.
  - PDF.
  - Standard image file.
- Creating an atrium
- Staircases & inclined planes
- 3D view – navigation & manipulation.

Day 2 Agenda

- System design.
  - Templates.
  - Device DB.
  - Intelligent Topology Optimizer (ITO)
- Importing measurement data - introduction & best practice.
- Prediction plots - (RSSI,RSRP, RSRQ -95/95%).
- Intelligent Network Profiler (INP) – check against coverage KPIs.
- Reporting – basic template customization.
- Simulations.
  - User profiles.
  - Traffic maps.
  - Carrier aggregation / LTW-WiFi aggregation.
- Indoor-outdoor module overview.

Formal Certification

- This course is a prerequisite for formal level 1 certification for Ranplan Professional
- Attendees will be offered the opportunity to progress to formal certification
- More details on formal certification will be provided at a later date. This includes agenda, cost, timing and location

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Learning Aid

- The following section contains supporting information for the content delivered face-to-face and is intended as a learning aid.
- Please feel free to use this information as future reference and also make notes!

Download This!

- goo.gl/DjC1yi

Ranplan Professional

Introduction to the user interface

Design Challenges

- Traffic happens mostly indoors
- Interaction between outdoor and indoor networks
- Different technologies used at the same time
- Different operators coexist
- Different traffic demands depending on service (Voice or Data)
- Minimize deployment costs
- High data rates requirements
- High capacity demand
- Low latency
- Minimize leakage to outdoors

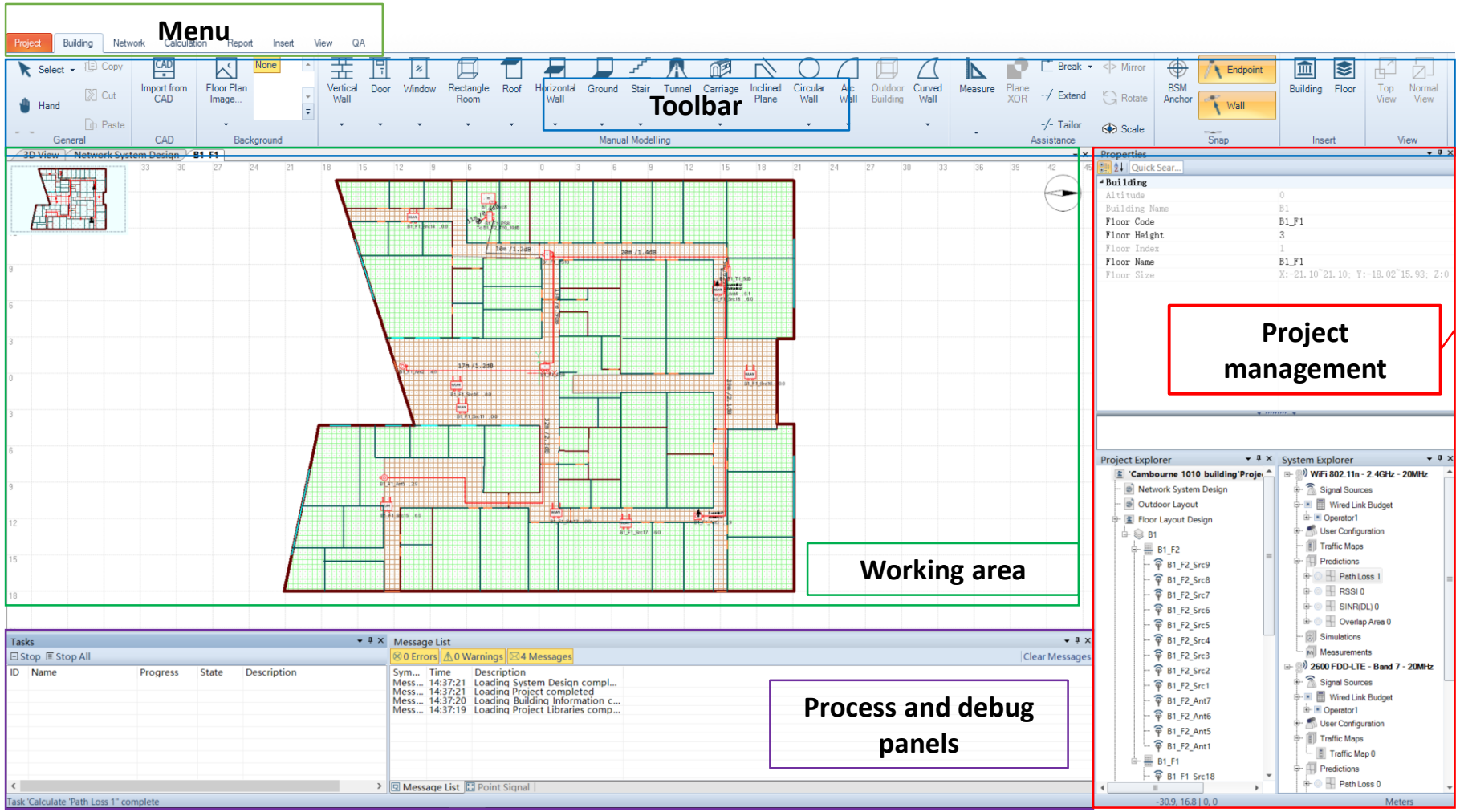
What is Ranplan Professional?

- All-in-one solution for in-building and indoor/outdoor dense urban planning
- Easy to use, drag and drop
- Quick design wireless networks
- Plan and optimize in-building and C-RAN/D-RAN/outdoor systems
- Evaluate network performance
- Generate project documentation and reports
- Evaluate a complete design with indoor-outdoor interactions
- Design multi-technology and multi-operator systems

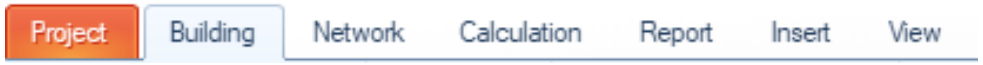
Benefits of using Ranplan Professional

- Fast and accurate planning and design
  - Multi-band, multi-operator and multi-technology projects
  - Simulate and **optimize** your designs
  - Design indoor and outdoor networks and simulate the effects between them
- Improve efficiency and reduce design time
  - Import CAD floorplans or quick design your buildings with Ranplan
  - Reduce design time using the **optimization modules**
- Document your project and **report**
  - Generate project reports and manage design costs
- Share projects tablet users
  - Ranplan Professional projects are easily shared and interchangeable with the tablet version
- OEM device database which is accurate and actively maintained

Ranplan Professional Workspace



Menus

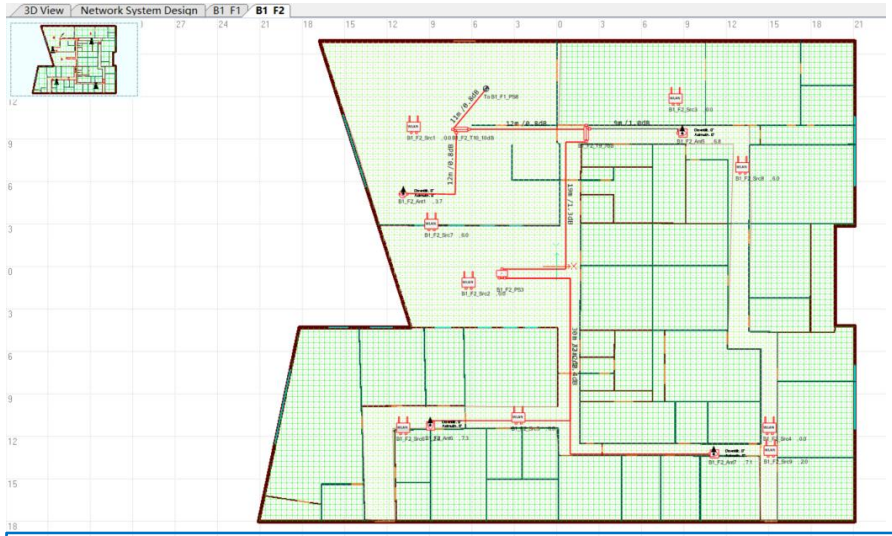


- The Menu system is divided in 7 categories:
  - **Project:** sub-menu used to manage Ranplan projects (Open, Save, Print …)
  - **Building:** provides access to all building element drawing tools
  - **Network:** provides access to network design tool including, adding devices to the work area
  - **Calculation:** region drawing and batch calculate prediction tools can be accessed from this menu
  - **Report:** all report generation and manipulation is accessed via this menu
  - **Insert:** provides tools to insert images, shapes, annotations and other such objects to embellish your design in the working area
  - **View:** tool which change how the building/system design is displayed in the working area can be accessed here

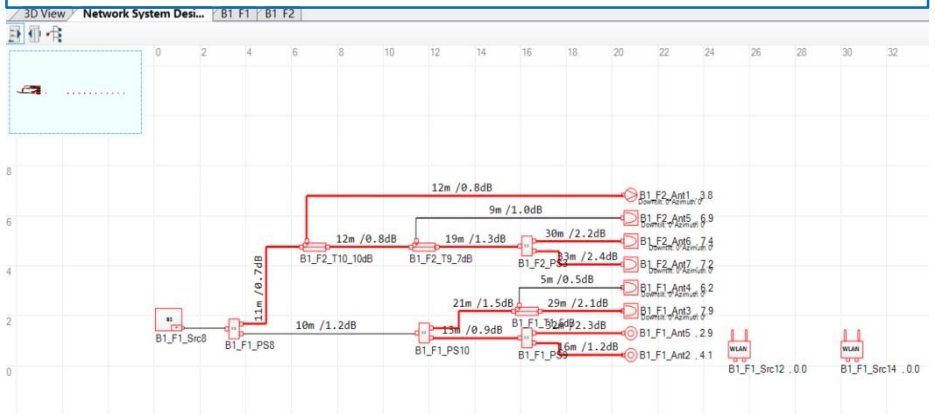
Workspace

- The Workspace is located below the Tool Bar. Users can edit objects in this area, draw the building environment and define the physical network infrastructure.
- Three different views are available
  - 3D View
  - Network System Design (NSD)
  - Floor Layout Design (FLD)

Floor Layout Design (FLD)



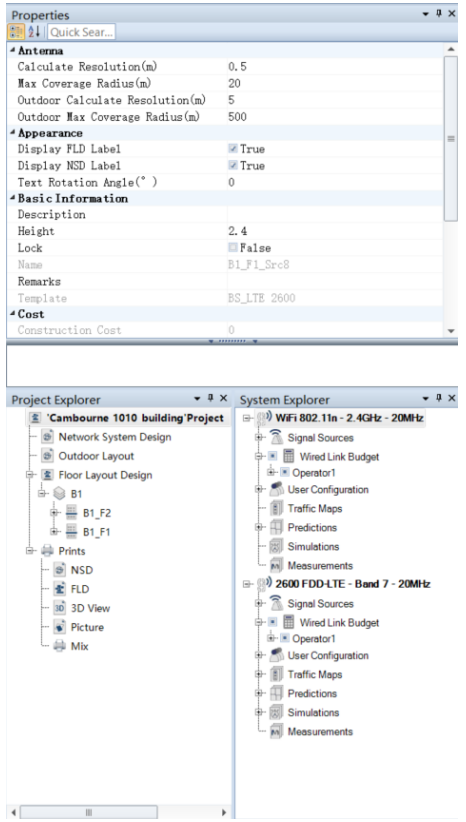
Network System Design (NSD)



Project Management

- The Project management windows include the following options:
  - **Project explorer:** displays the buildings floors and the print layouts present in the current project
  - **System explorer:** all of the system analysis can be finished here, and users can choose to display different analysis results from this window
  - **Properties window:** used to show the properties of a selected object

Project Management Windows

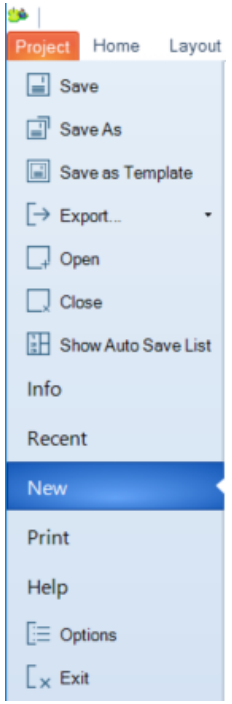


Ranplan Professional

Starting a project

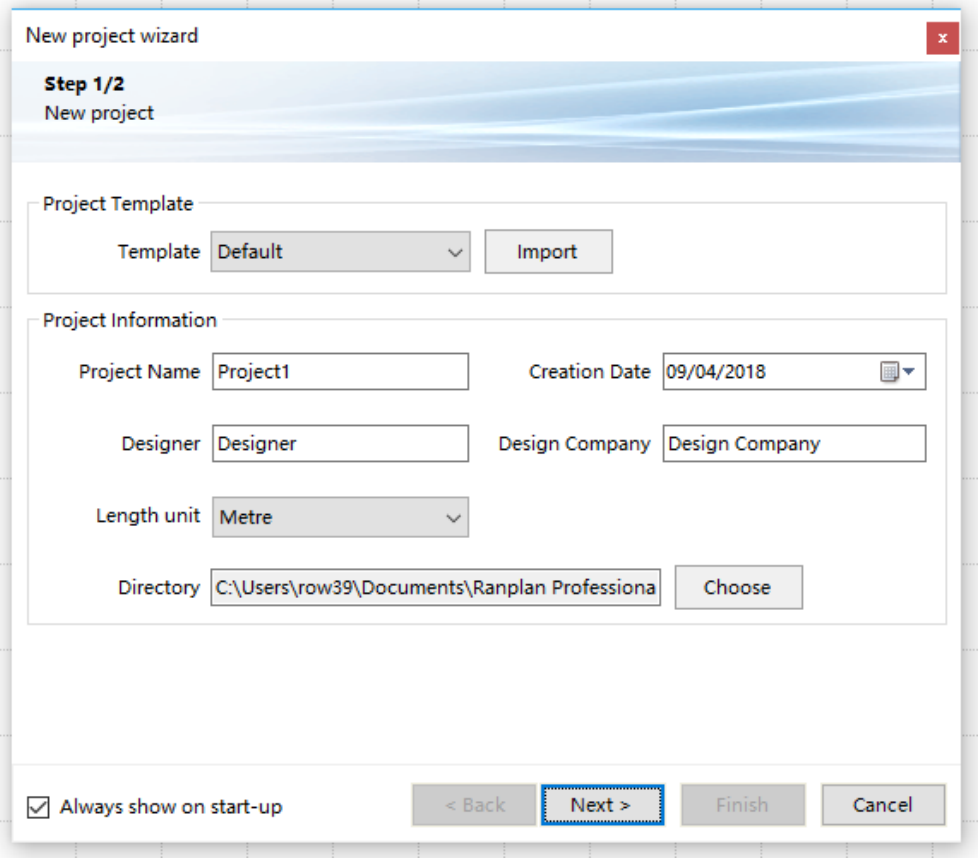
New Project

- A new project can be created via two methods
  - Project → New
  - Pressing the key combination ‘Ctrl + N’



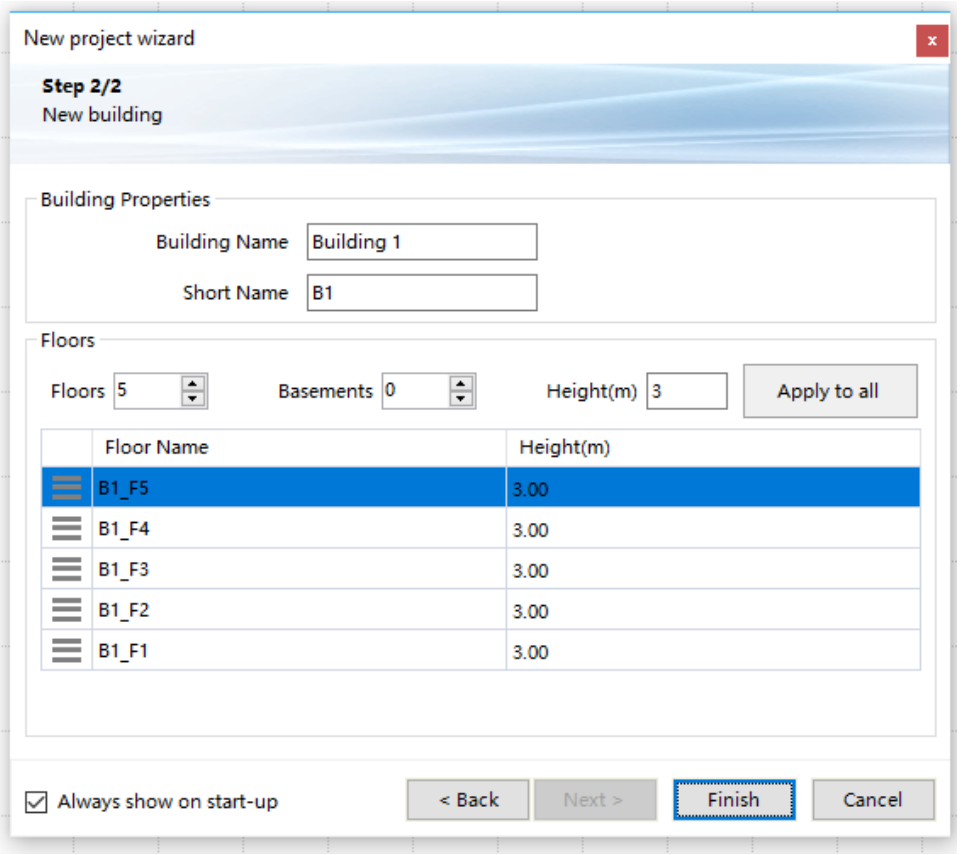
New project wizard

- Set:
  - Template
  - Project information
  - Unit of measurement
  - Local save directory
- Press '**Next >**' to continue



New project wizard

- Create a new building
  - Set ‘Building Name’
  - Set ‘Building Short Name/Alias’
- Define number of floors
- Define number of basements
- Define floor alias
- Set individual floor height
- Press **‘Finish’** to create the project



Ranplan Professional

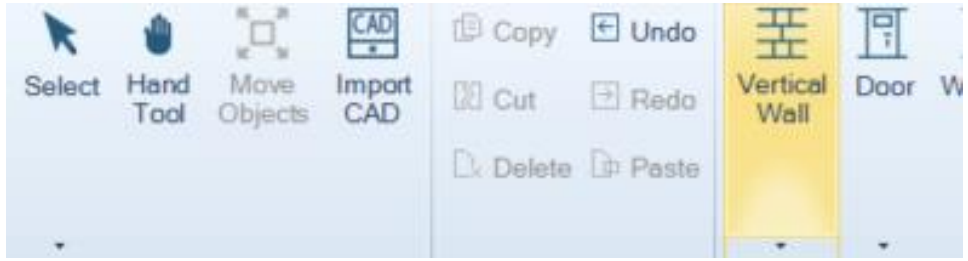
Create building structure

Introduction

- This section contains detailed steps for the following:
  - Create walls using existing templates
  - Create doors using existing templates
  - Create windows using existing templates
  - Create ground using existing templates
  - Create horizontal walls using existing templates
  - Create stairs using existing templates
  - Create tunnels using existing templates
  - Create incline planes using existing templates

Creating Walls

- Select the Vertical Wall tool in ‘Home’ → ‘Building’

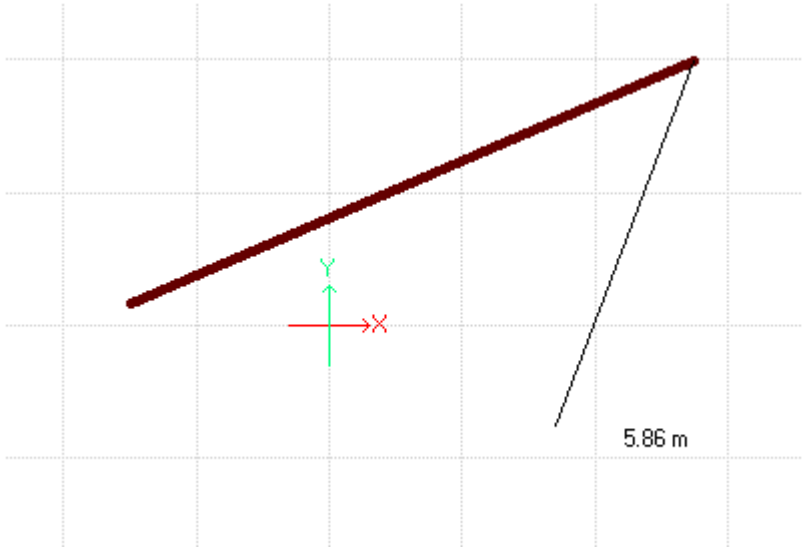


Creating Walls

- Left click anywhere on the design plan to place the starting point of the wall. Drag the mouse to the ending point

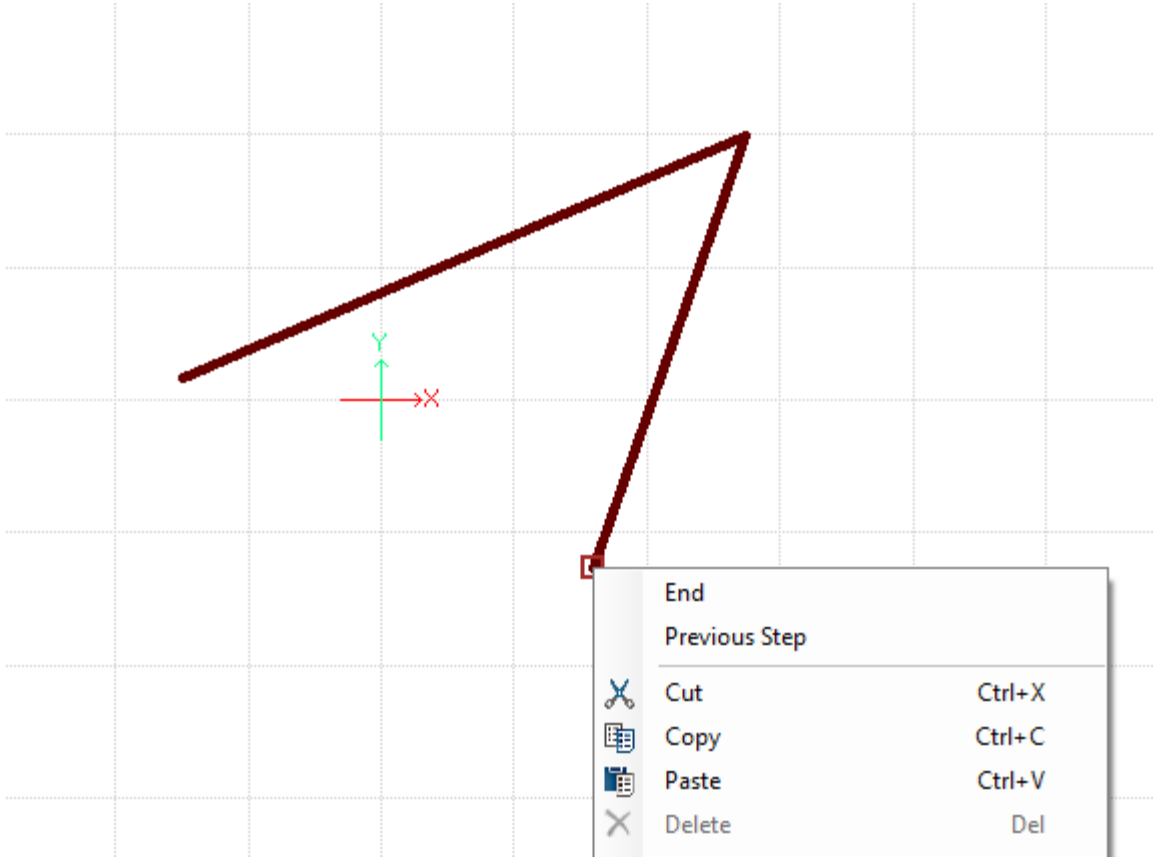
Creating Walls

- Click again to place the end point. Repeat this action until the structure is created or a change in material is required



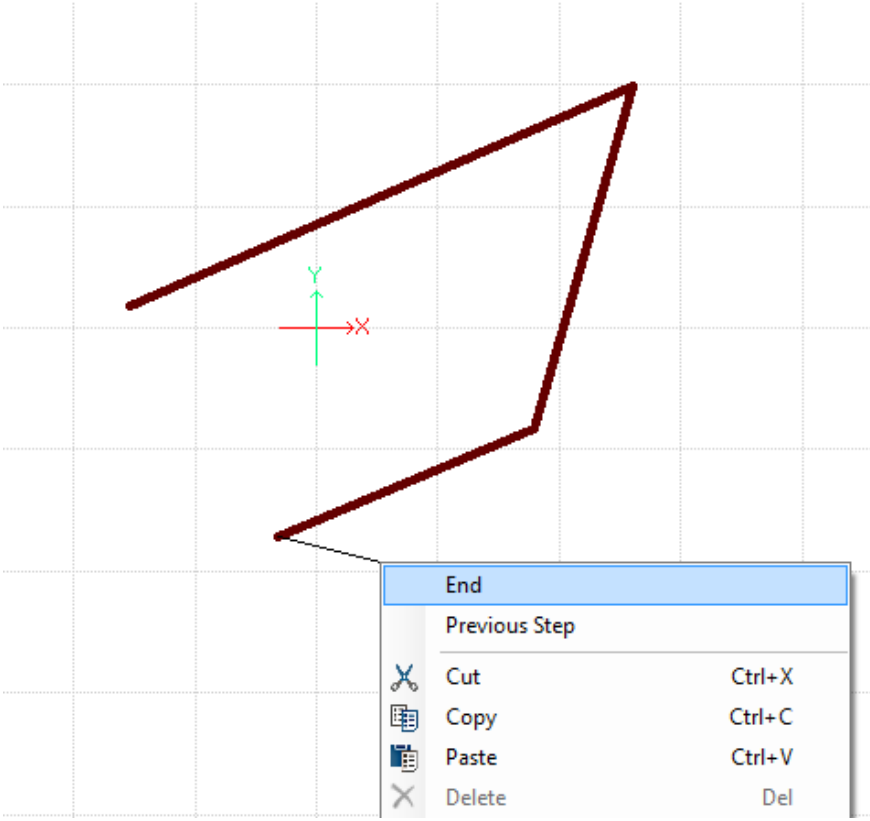
Creating Walls

- Right click and select ‘Previous Step’ if you need to redo your last step



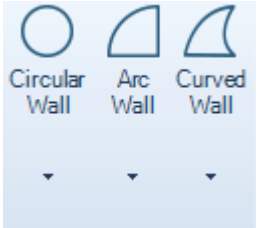
Creating Walls

- To end a wall drawing right click after your last wall has been drawn and select ‘End’
- Double-click the end position of the current wall
- You can also end a wall by press ‘Esc’ key



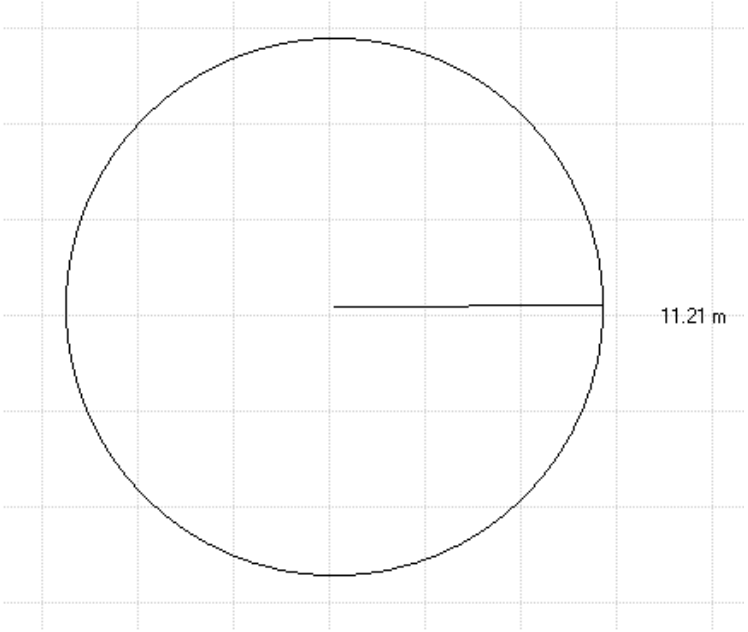
Curved Walls

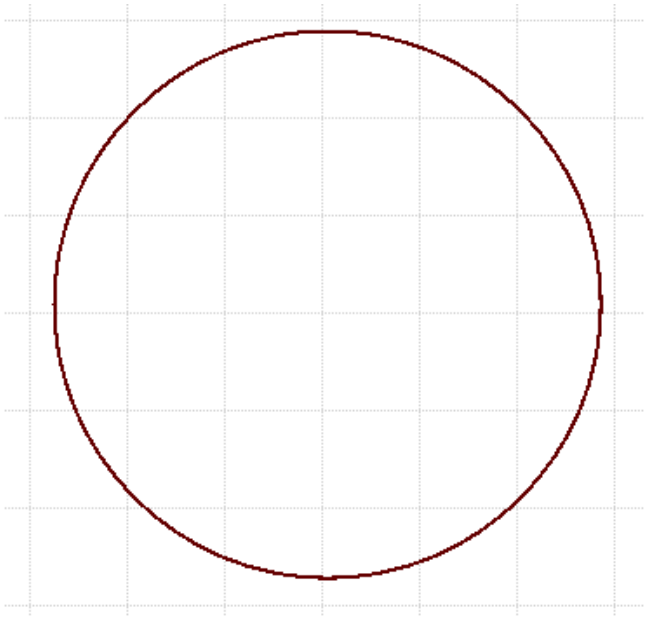
- Ranplan also offers the ability to create curved walls easily, avoiding the tedious process of drawing them in small steps
- There are three modes to draw curved walls:
  - Circular wall
  - Arc wall
  - Curved wall



Circular Wall

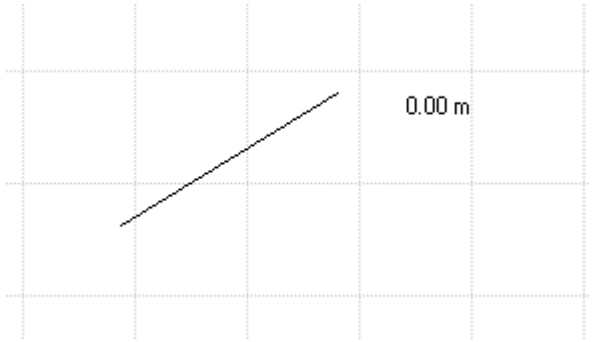
- This tool offers the ability to create closed circular walls in two steps:
  - Select the center of the circle
  - Select the end point to define radius size

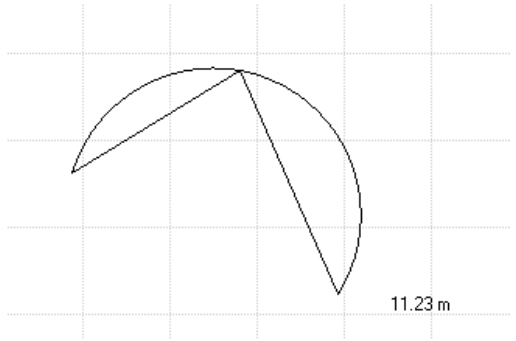


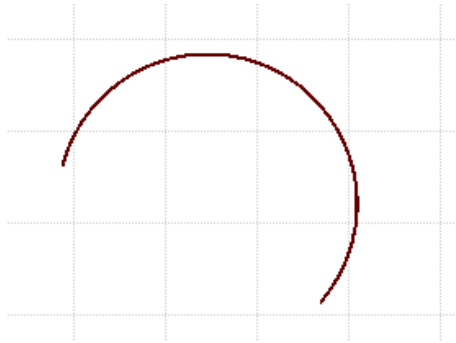


Arc Wall

- There is also the ability to draw arc walls in the tool following these steps:
  - Select the arc starting point
  - Select the middle point
  - Select the end point

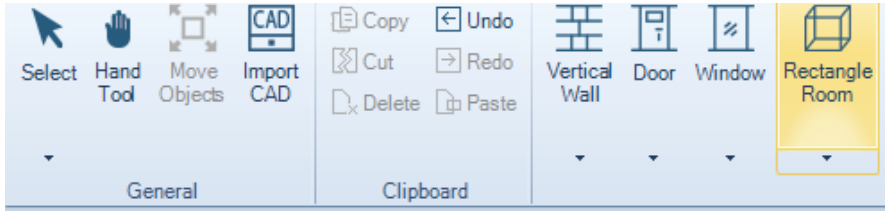






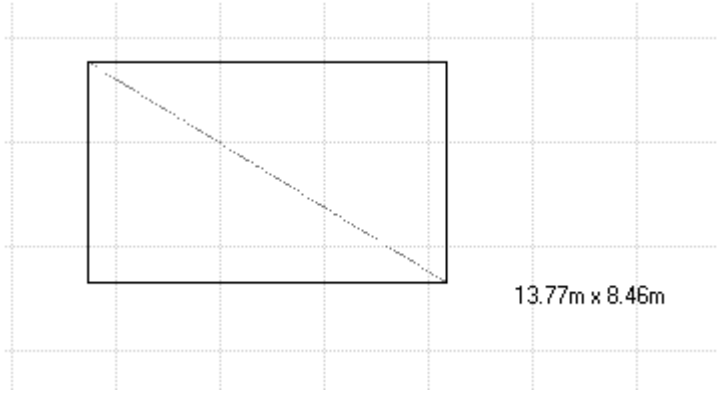
Creating a Square Room

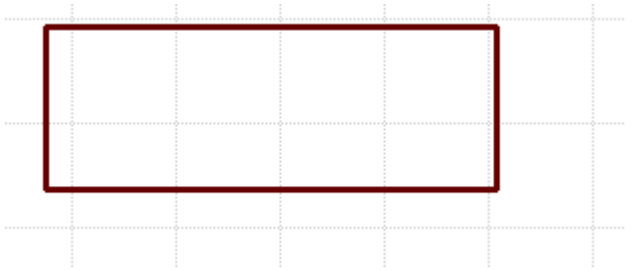
- In order to expedite the building design Ranplan includes the ‘Rectangle Room’ mode to define enclosed rooms



Creating a Square Room

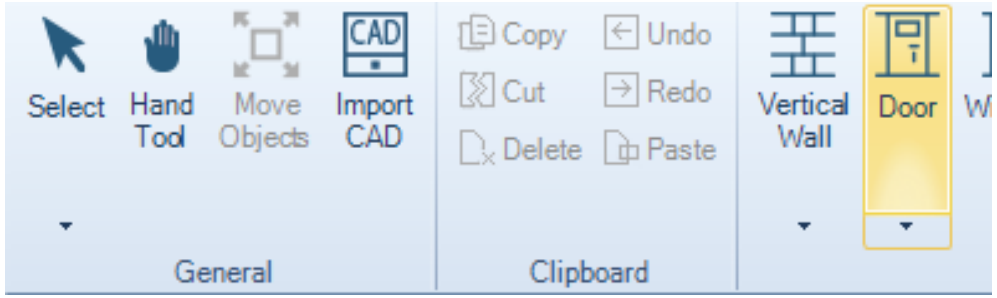
- Once the ‘Rectangle Room’ tool is selected:
  - Click on the floorplan to begin drawing the rectangular room
  - Click again to create the room





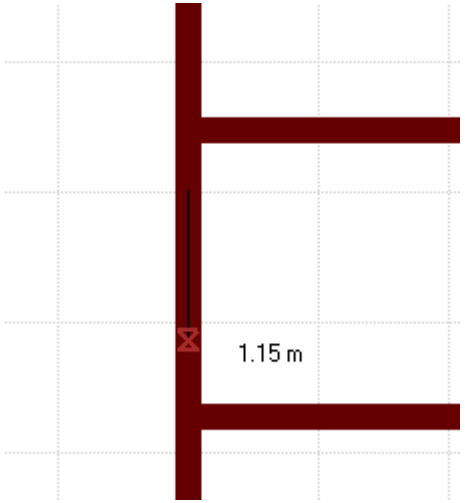
Creating Doors

- Doors can only be created over existing walls
- Select the Door tool in ‘Home’ → ‘Building’



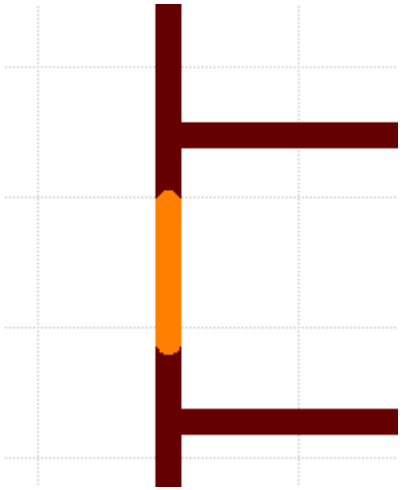
Creating Doors

- Click on an existing wall to place the starting point of the door. Move the mouse to the ending point



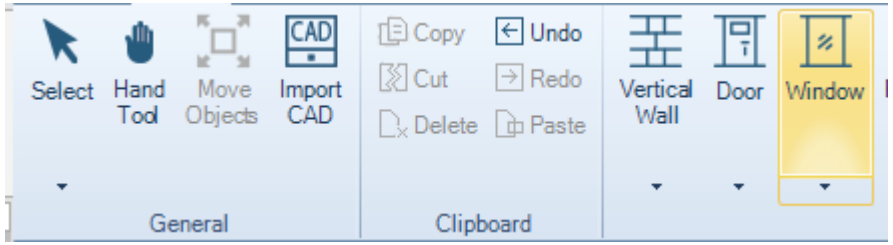
Creating Doors

- Click where there door should finish, the will be created



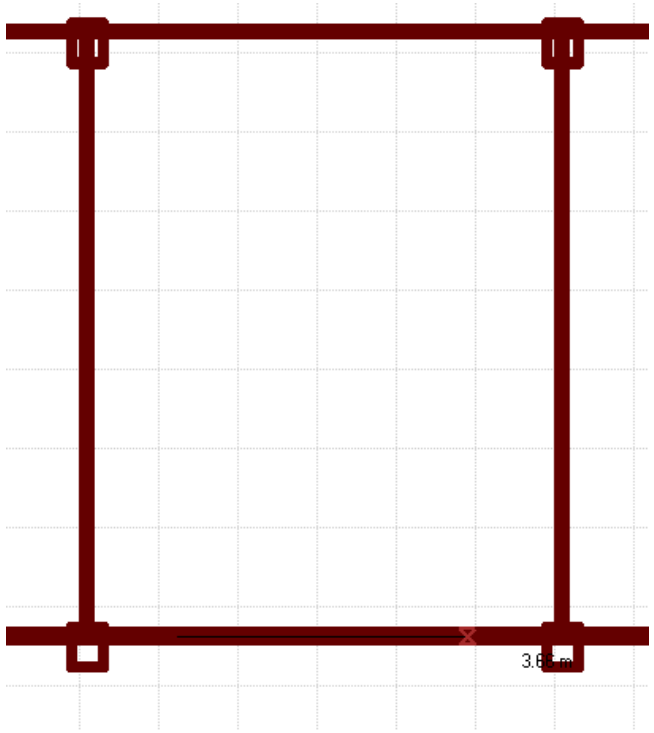
Creating Windows

- Windows can only be created over existing walls
- Select the Window tool in ‘Home’ → ‘Building’



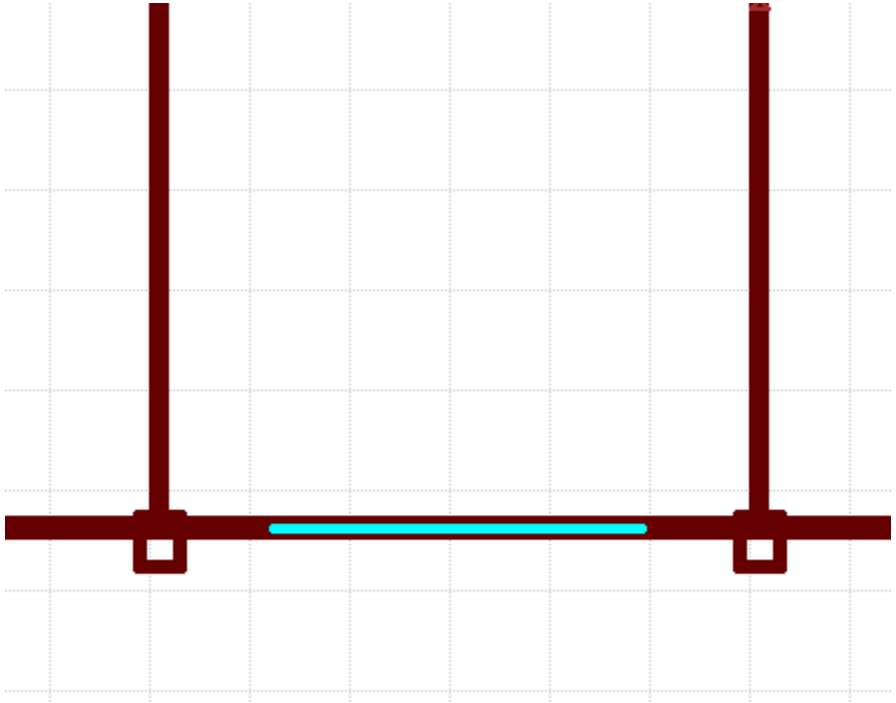
Creating Windows

- Click on an existing wall to place the starting point of the window. Drag the mouse to the ending point



Creating Windows

- Click where there window should finish, the window has now been created

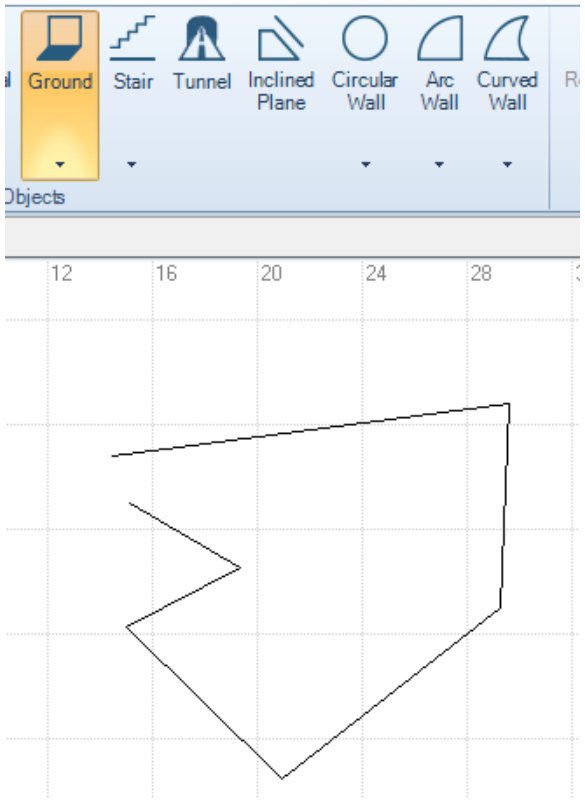


Creating the Ground

- The ground can be generated in two different ways:
  1. Manual - Drawing the area it should cover
  2. Auto-Generated - Selecting the walls that will enclose the ground

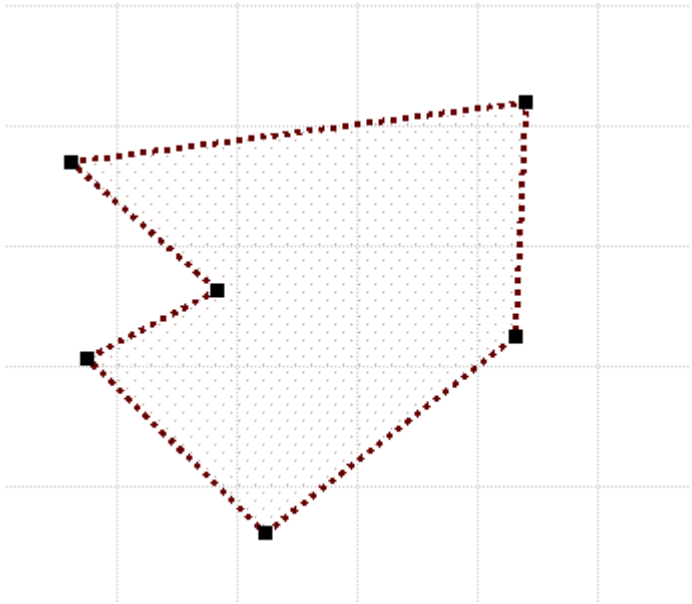
Creating the Ground

- In ‘Manual’ creation mode the user needs to draw the area to be covered by the ground



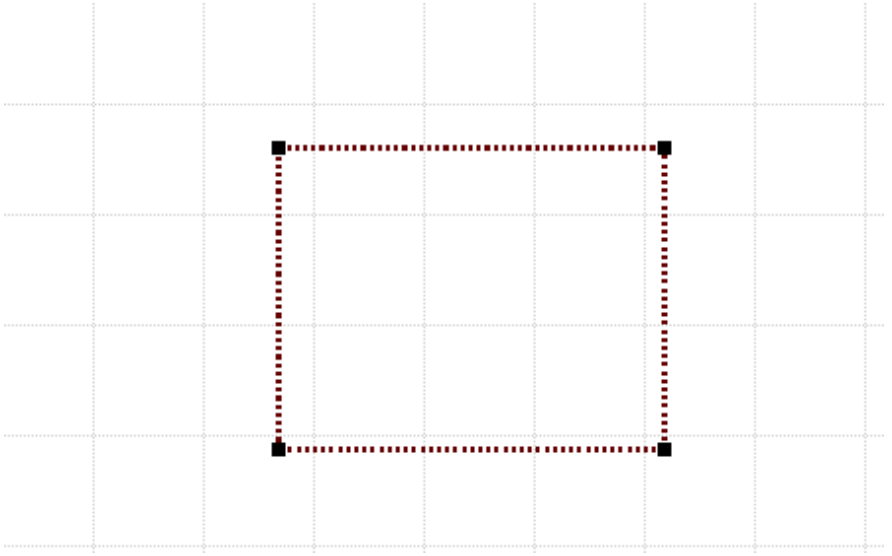
Creating the Ground

- Once the polygon is closed the ground will be generated. To quickly close the polygon double left click.



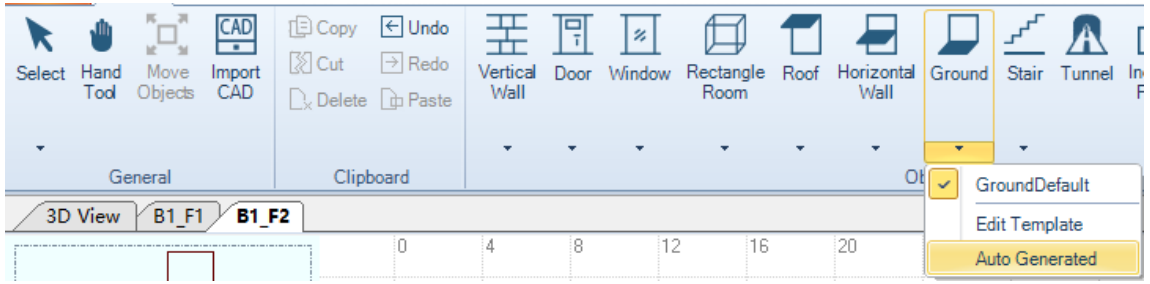
Creating the Ground

- In ‘Auto-Generated’ mode the user selects the walls that will delimit the ground area – these are usually the perimeter walls of the building



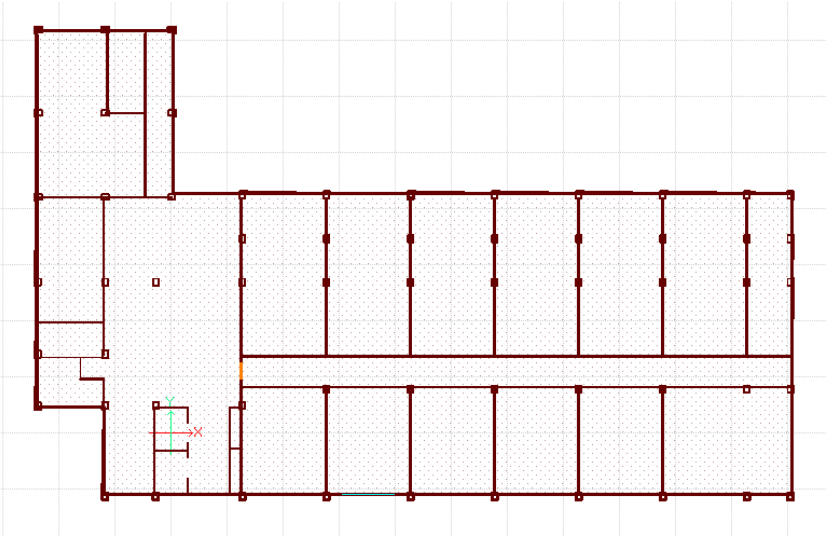
Creating the Ground

- Once the walls are highlighted, select ‘Ground’ → ‘Auto Generated’



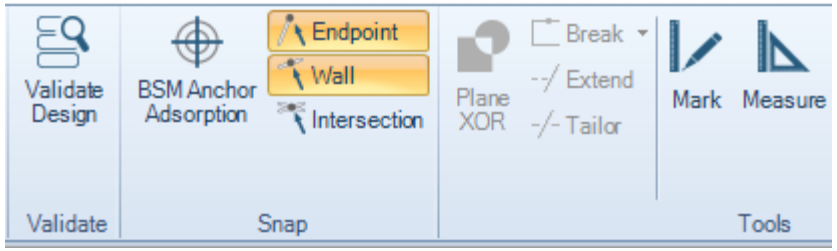
Creating the Ground

- The ground will be generated covering the selected area



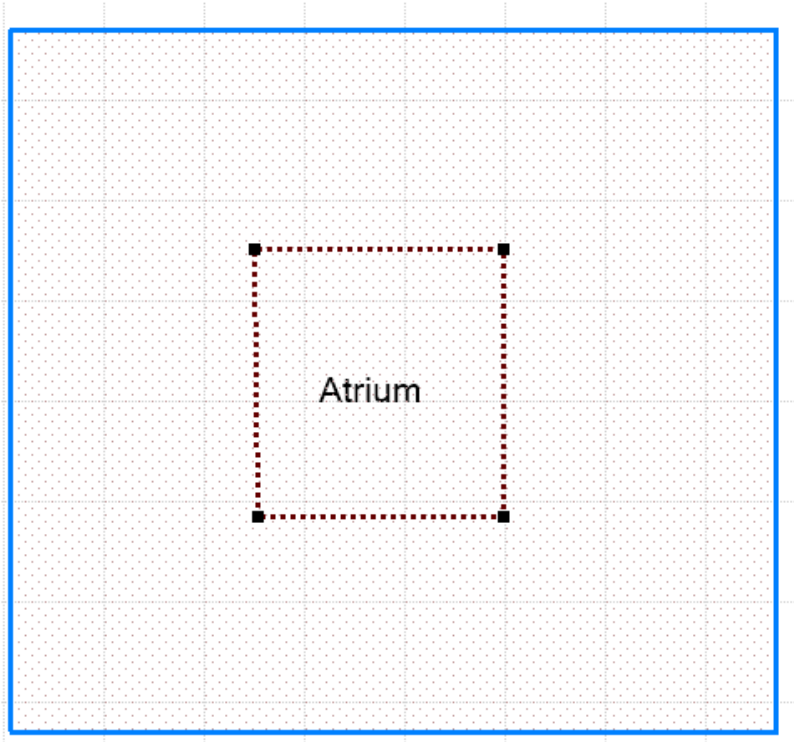
Creating the Ground

- Ranplan eases the creation of atriums and floor holes with the ‘Plane XOR’ tool
- To create an atrium the user needs to follow the steps in the coming slides



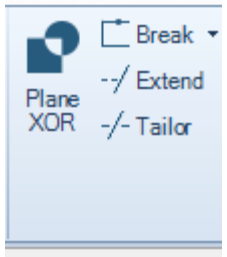
Creating the Ground

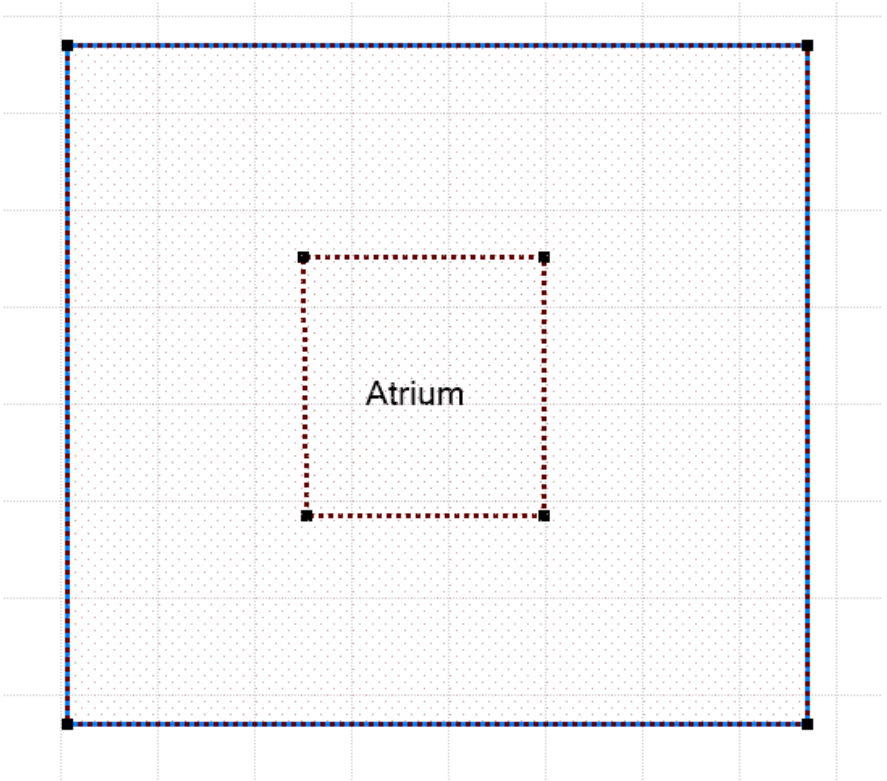
- Step 1
  - Create a new ground covering the area where the atrium will be placed



Creating the Ground

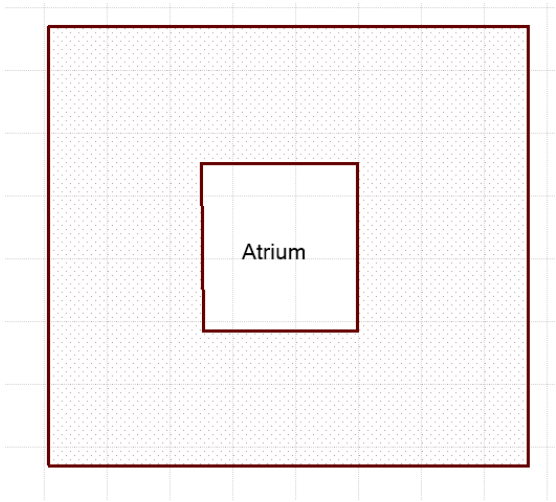
- Step 2:
  - Select both ground floors by holding down the CTRL key and left clicking on each:
    - Ground 1: Represents the floor where the atrium will be cut
    - Ground 2: Represents the atrium

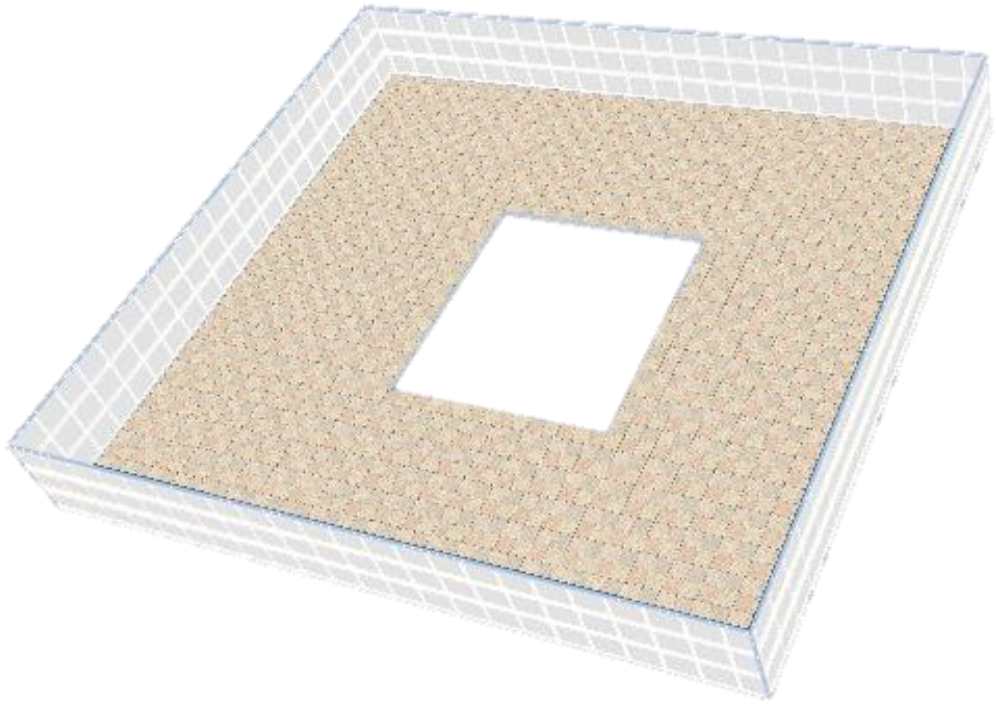




Creating the Ground

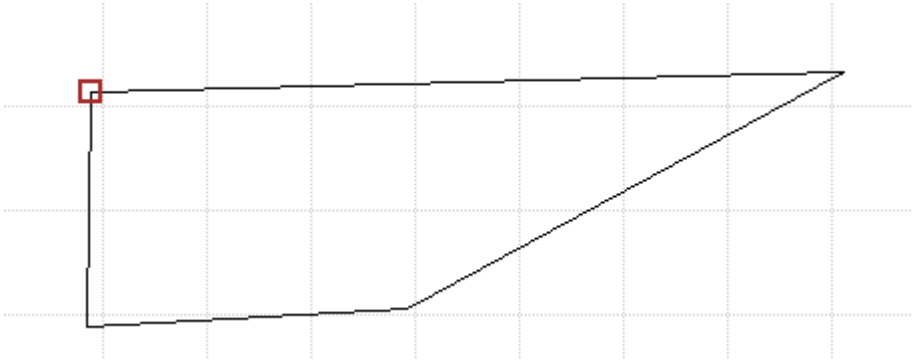
- Step 3:
  - Click on ‘Plane XOR’ and the atrium/elevator hole will be cut out





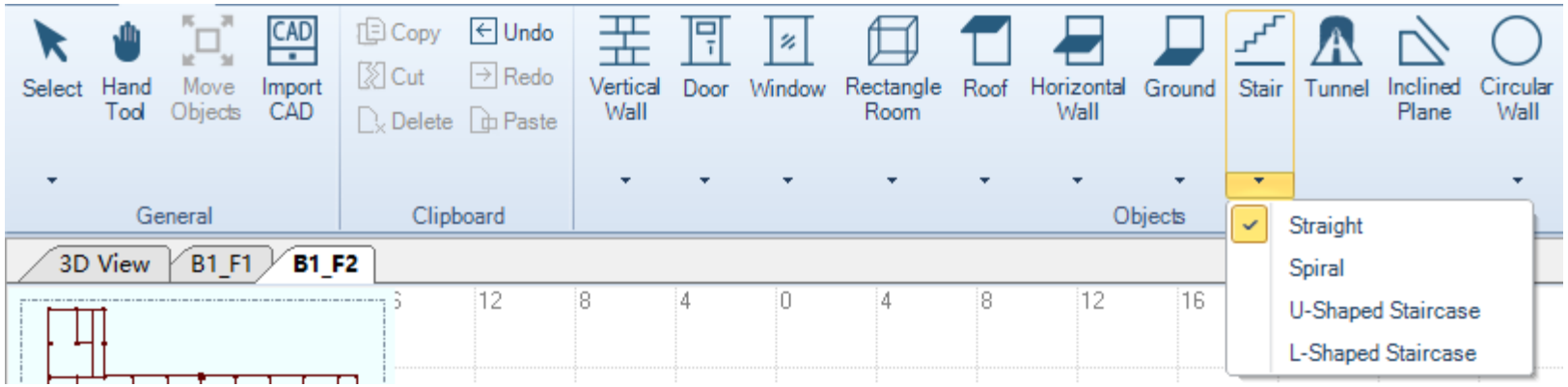
Creating Other Horizontal Walls

- Roofs and horizontal walls are created following the exact same procedure as the manual mode creation for Ground



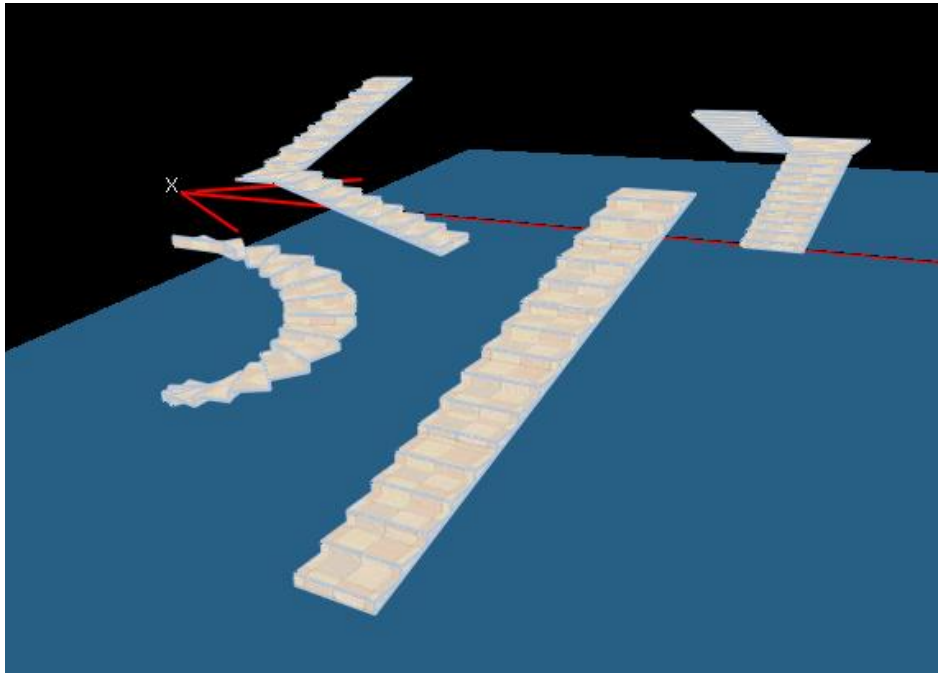
Creating Stairs

- Select the ‘Stair’ tool in the Building menu



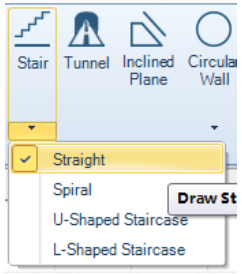
Creating Stairs

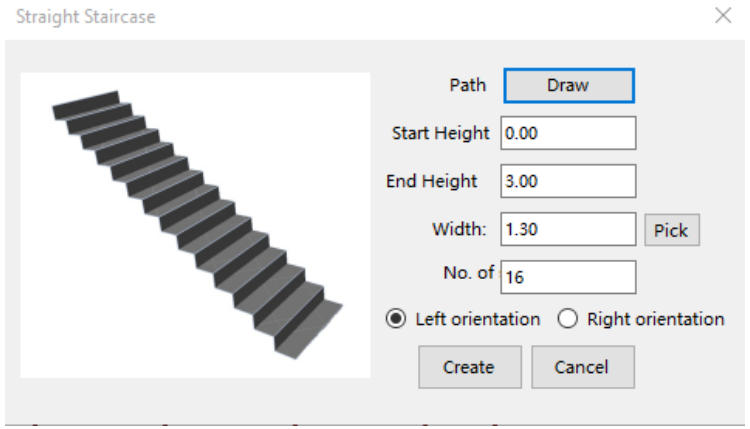
- Ranplan supports 4 different types of stairs and the work flow is similar for all of them
  - Straight
  - Spiral
  - U-Shape
  - L-Shape

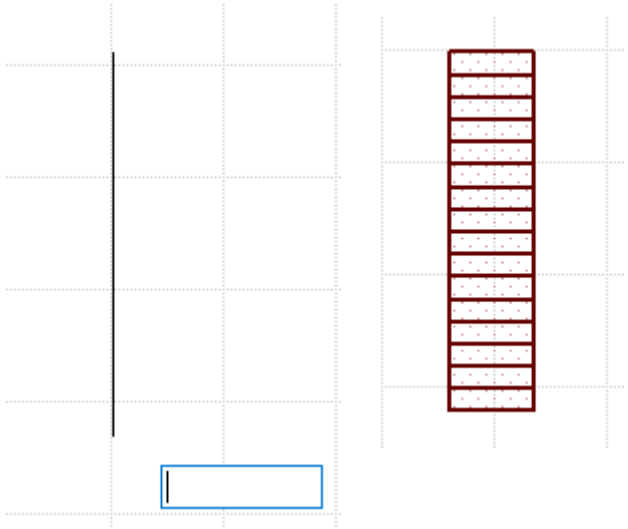


Creating Stairs: Straight Staircase

- Straight stair creation:
  - Select ‘Stair’ → ‘Straight’
  - Straight Staircase creator will open
  - ‘Draw’ the path
  - Complete the form
  - Click ‘Create’

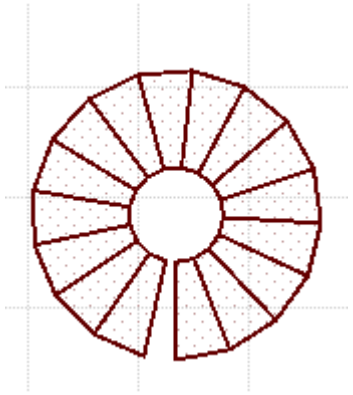


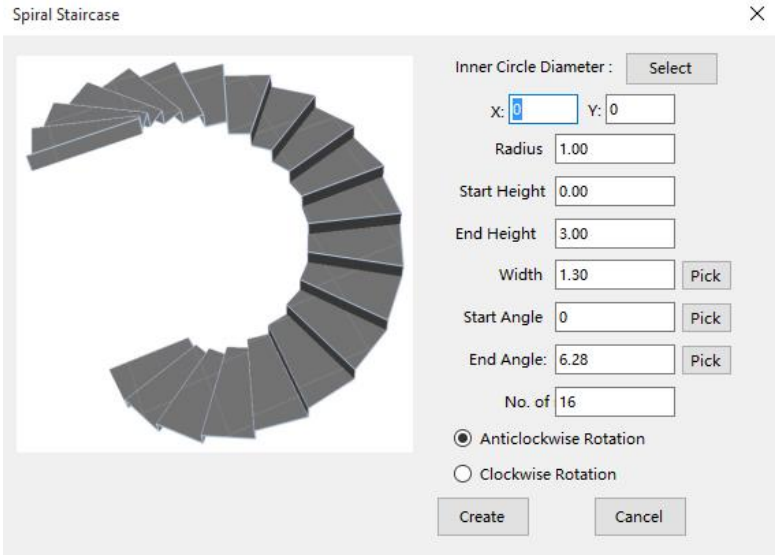




Creating Stairs: Spiral Staircase

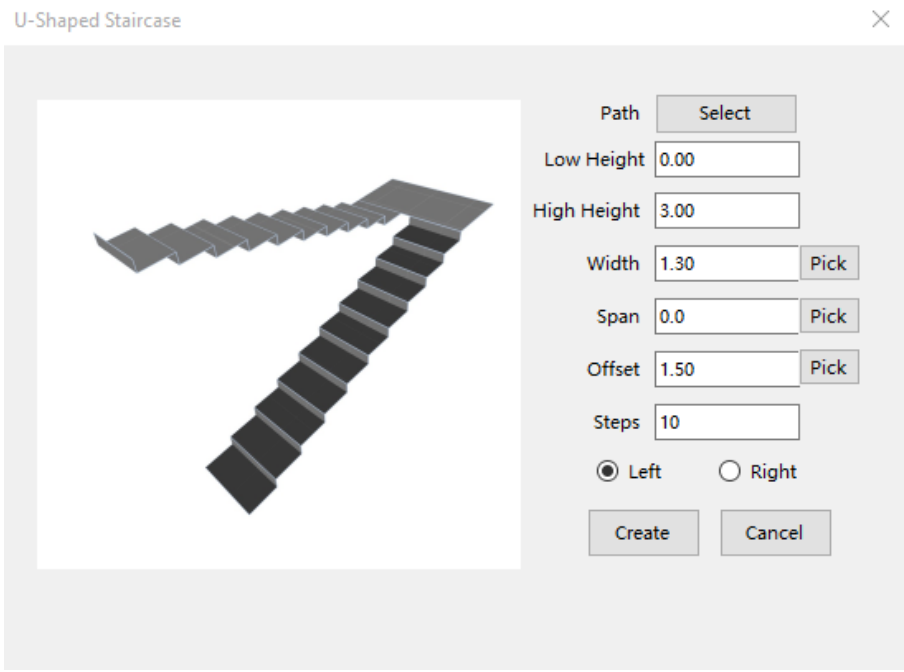
- Spiral stair creation
  - Select ‘Stair’ → ‘Spiral’
  - Spiral Staircase creator will open
  - ‘Draw’ the inner diameter
  - Complete the form
  - Click ‘Create’





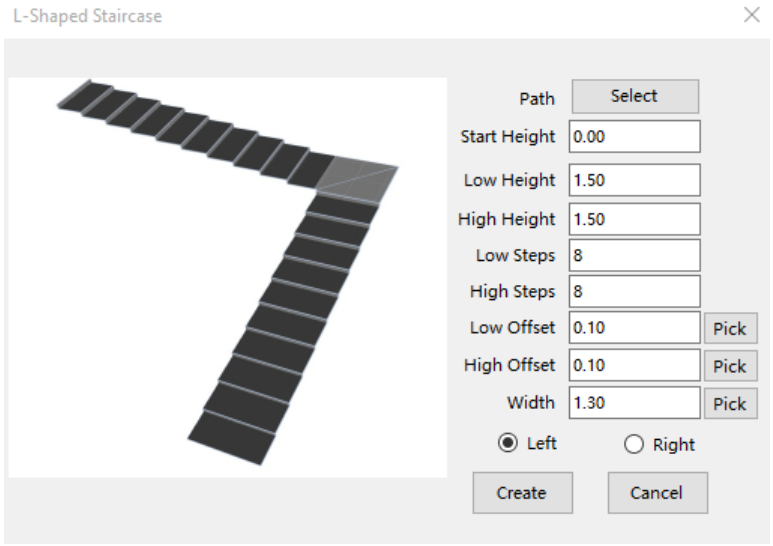
Creating Stairs: L-Shaped Staircase

- L-Shaped stair creation:
  - Select ‘Stair’ → ‘U-Shape’
  - Straight Staircase creator will open
  - ‘Draw’ the path
  - Complete the form
  - Click ‘Create’



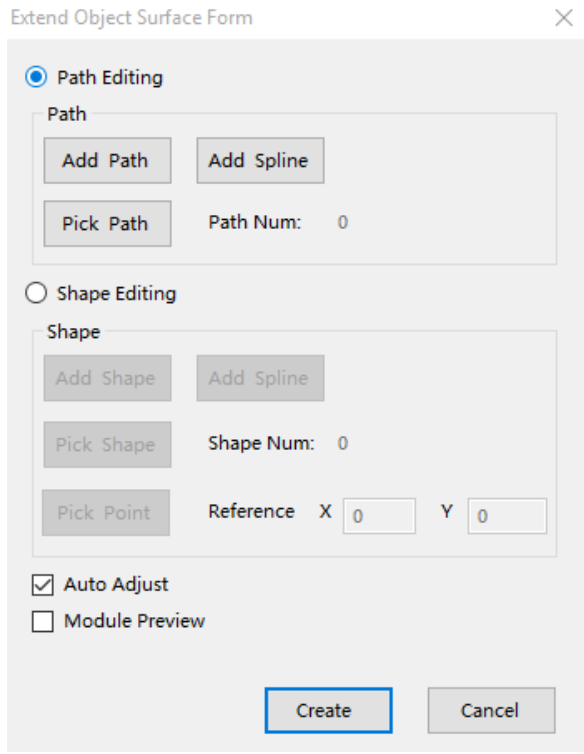
Creating Stairs: : L-Shaped Staircase

- L-Shaped stair creation:
  - Select ‘Stair’ → ‘L-Shaped’
  - Straight Staircase creator will open
  - ‘Draw’ the two sections path
  - Complete the form
  - Click ‘Create’

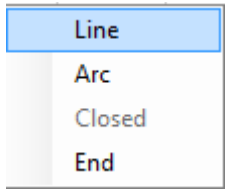


Creating Tunnels

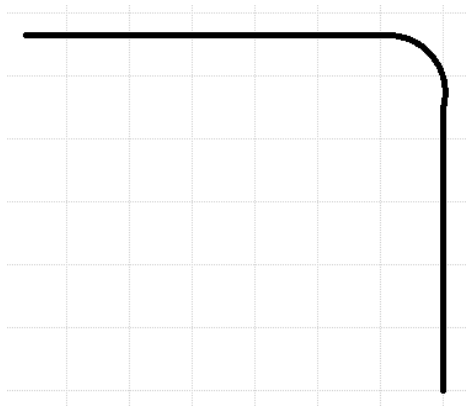
- Ranplan offers the ability to create and design simple and complex tunnels within the tool in two steps
  - Path editing
  - Shape editing



Creating Tunnels

- Path editing consists of two main steps
  - Drawing the path using:
    - Add path:
      - 

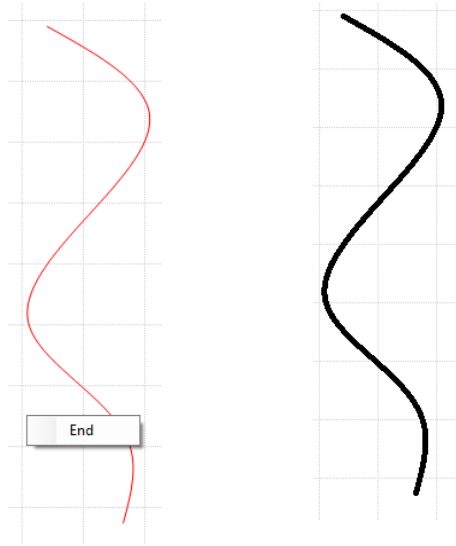
to select the type of line you will be drawing



      - Draw the tunnel path
      - To end the path drawing user can:
        - Select ‘Closed’ to create a closed loop
        - Select ‘End’ to finish the tunnel path
      - Last step is to select the tunnel path and click ‘Pick Path’

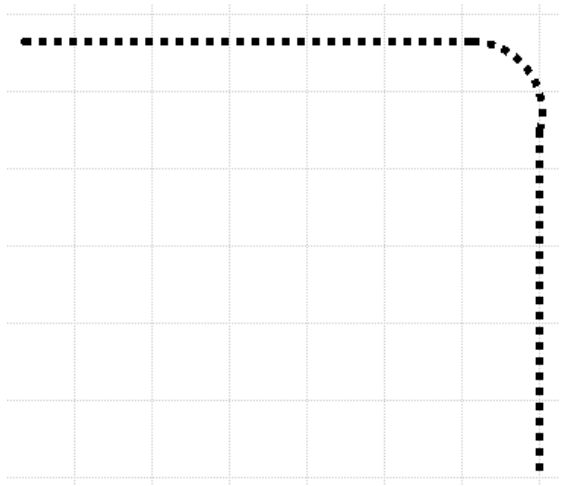
Creating Tunnels

- The path can also be drawn using the ‘Add Spline’ mode following these steps:
  - Select ‘Add Spline’
  - Draw the tunnel path
  - Right click and select end to complete the path



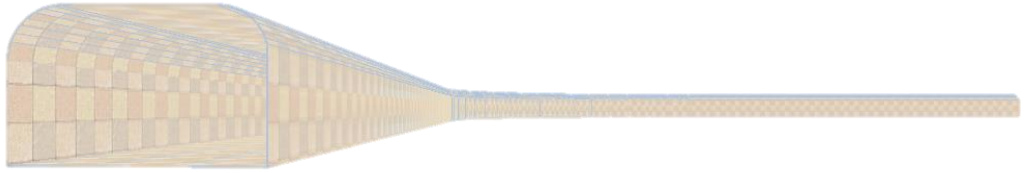
Creating Tunnels

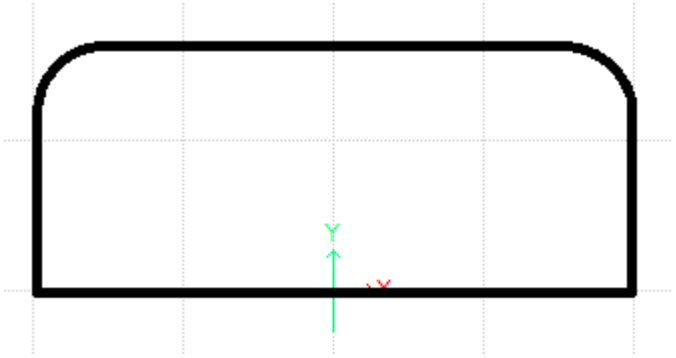
- Next step is to pick the tunnel path
  - Click ‘Pick Path’
  - Select the path to be used

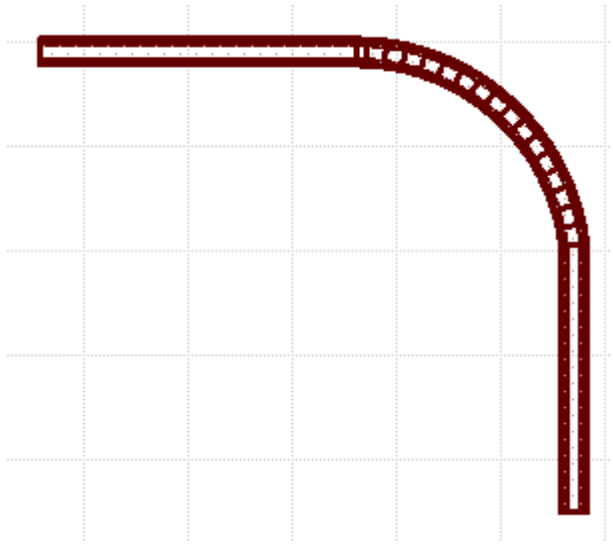


Creating Tunnels

- Next step is to define the tunnel shape
  - Select ‘Shape Editing’ radio button
  - Draw shape. Similar to the path editor you can
    - ‘Add Shape’ with lines and curves
    - ‘Add Spline’
  - ‘Pick Shape’ to select the tunnel’s shape
  - Click ‘Create’ to complete the tunnel

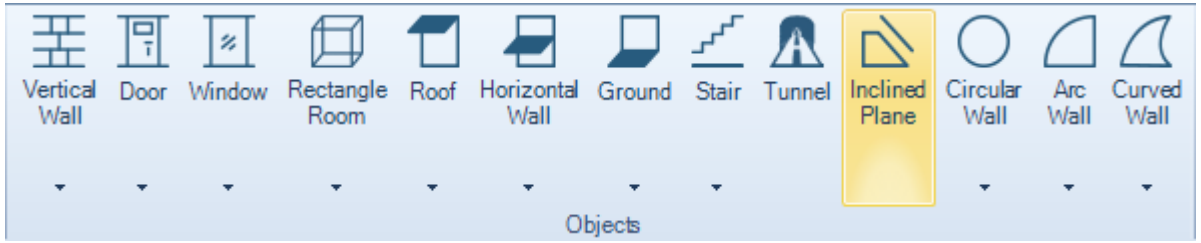






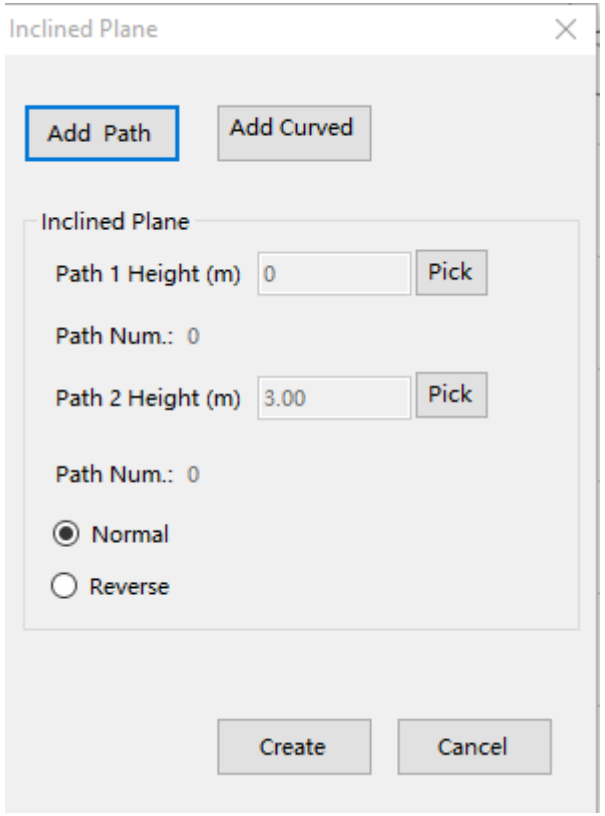
Creating an Inclined Plane

- Step 1:
  - Select the ‘Inclined Plane’ tool on the ‘Home’ tab



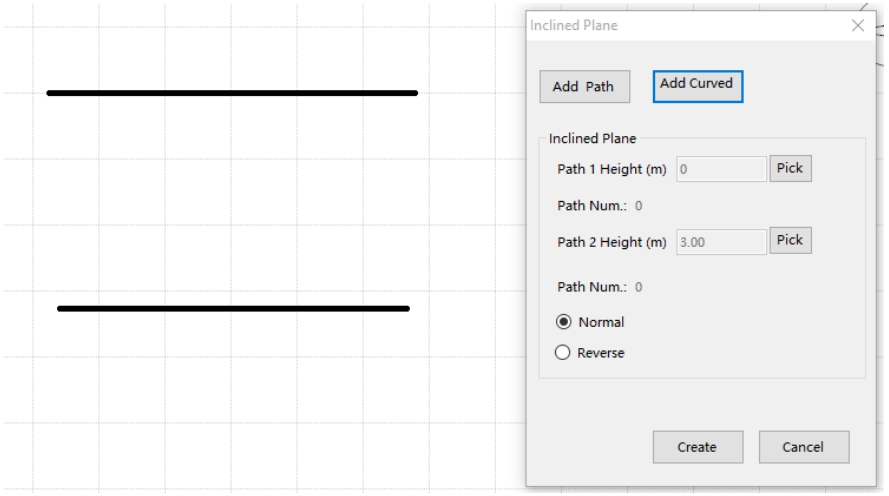
Creating an Inclined Plane

- The ‘Inclined Plane’ tool will open offering to create:
  - Straight inclined planes
  - Curved inclined planes



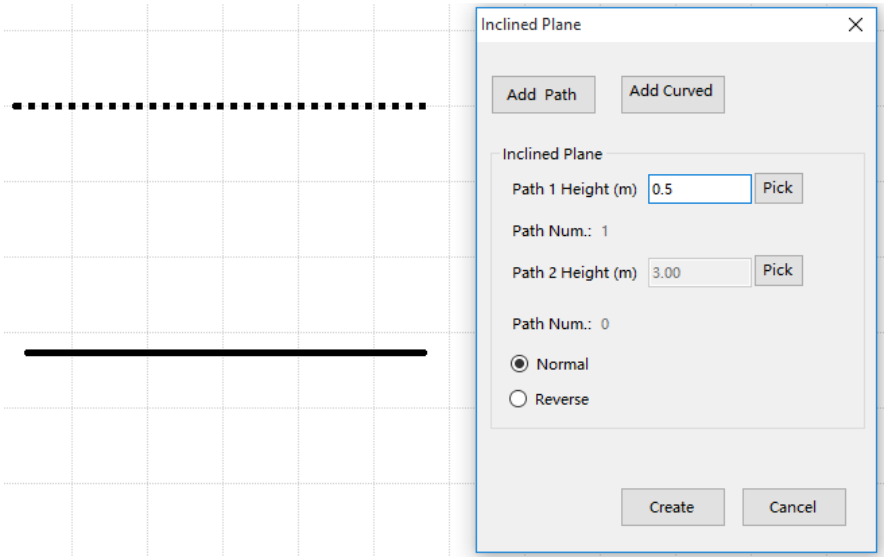
Creating an Inclined Plane

- Step 2:
  - Select ‘Add path’ and define the beginning and end of the inclined plane



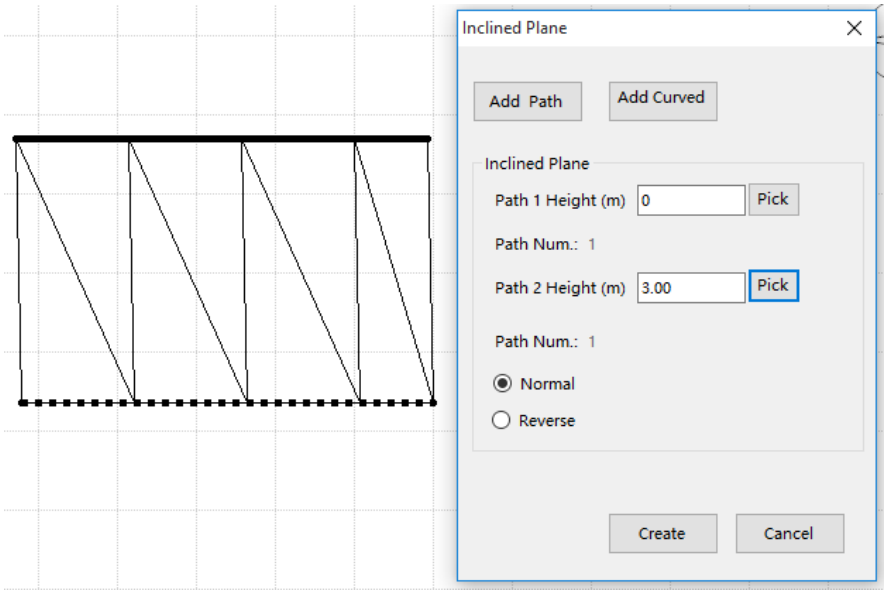
Creating an Inclined Plane

- Step 3:
  - Select the inclined plane start point:
    - Highlight the path
    - Click on ‘Pick’
    - Set the Path height



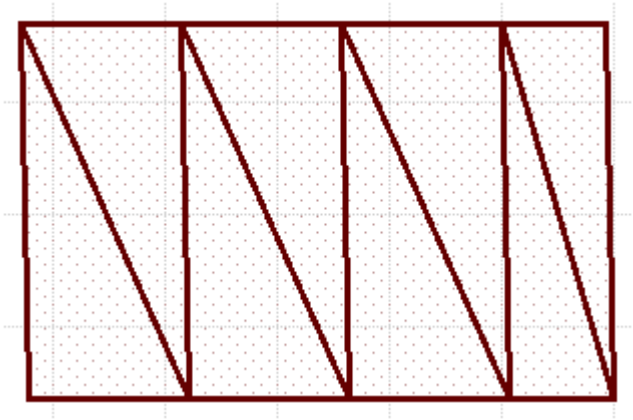
Creating an Inclined Plane

- Step 4:
  - Select the inclined plane end:
    - Highlight the path
    - Click on ‘Pick’
    - Set the Path height
  - A preview of the Inclined Plane will be generated in the working area



Creating an Inclined Plane

- Step 5:
  - Click on the ‘Create’ button to complete the Inclined Plane.



Ranplan Professional

Creating a Network Design

Introduction

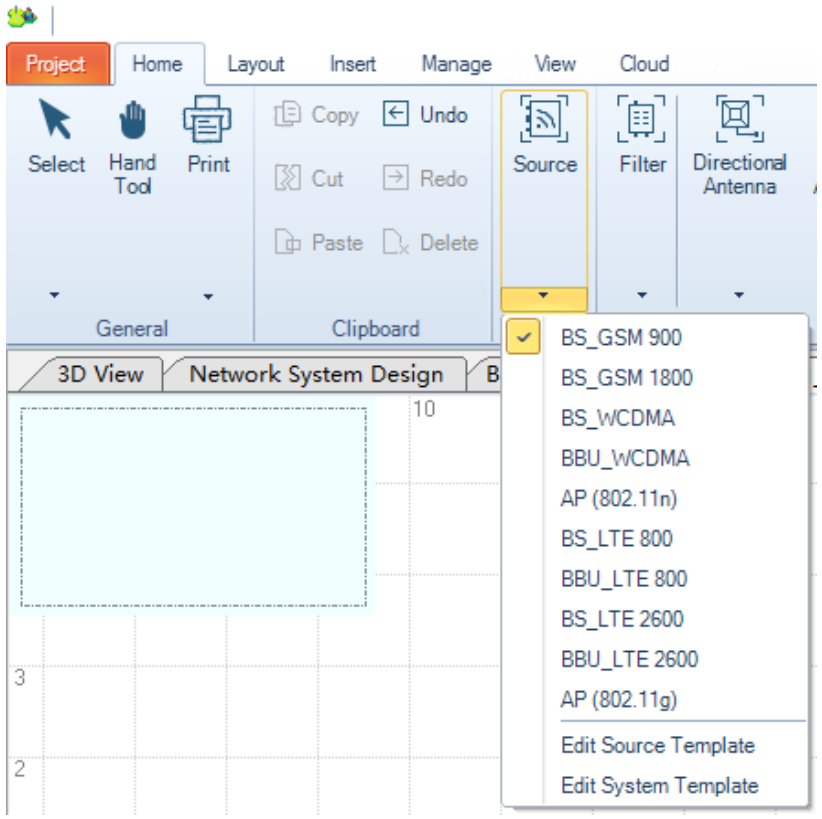
- This section contains detailed steps for the following:
  - Signal source
  - Antennas
  - Cables
  - Splitters and Combiners
  - Amplifiers and Repeaters
  - Cable crossing
  - Network System Design view

Signal Source

- Signal sources are the **core** of the wireless network
- **Mandatory** element of the system
- **Each** technology can have one **corresponding** signal source or if the signal source supports this functionality it can have several technologies and bands associated with it

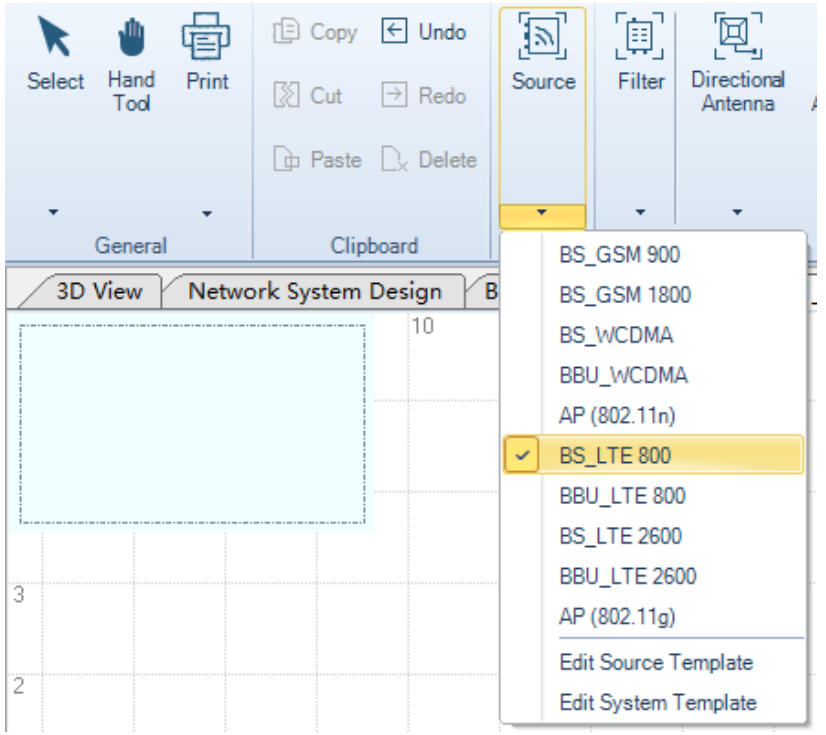
Signal Source

- Adding a signal source
  - Step 1: Select the ‘Source’ tool in the ‘Home’ → ‘Network’ ribbon



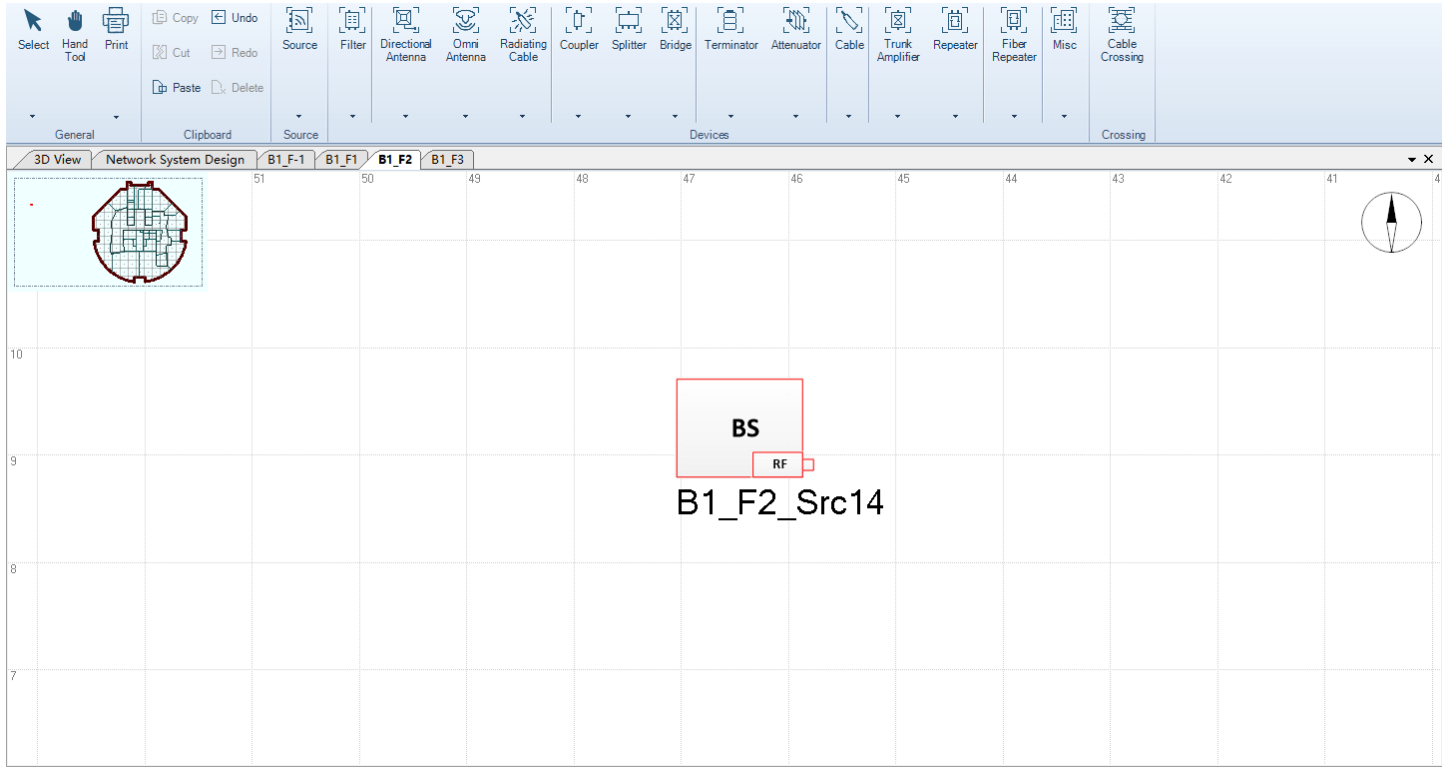
Signal Source

- Adding a signal source
  - Step 2: Select the signal source corresponding to the system under design

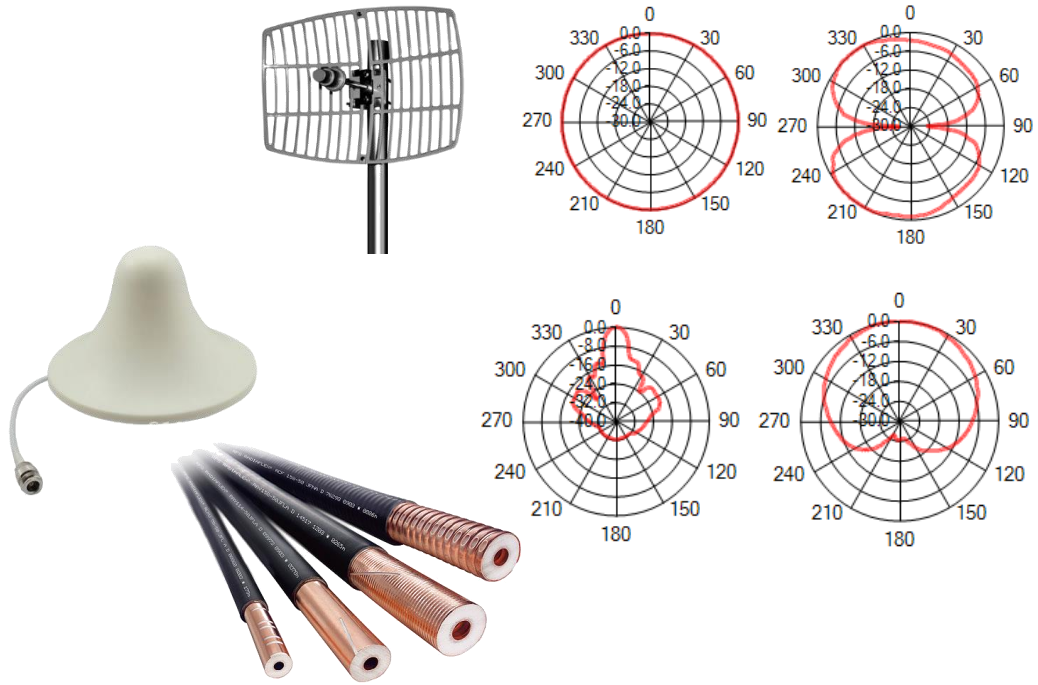


Signal source

- Adding a signal source:
  - Step 3: Place the component on the floor plan



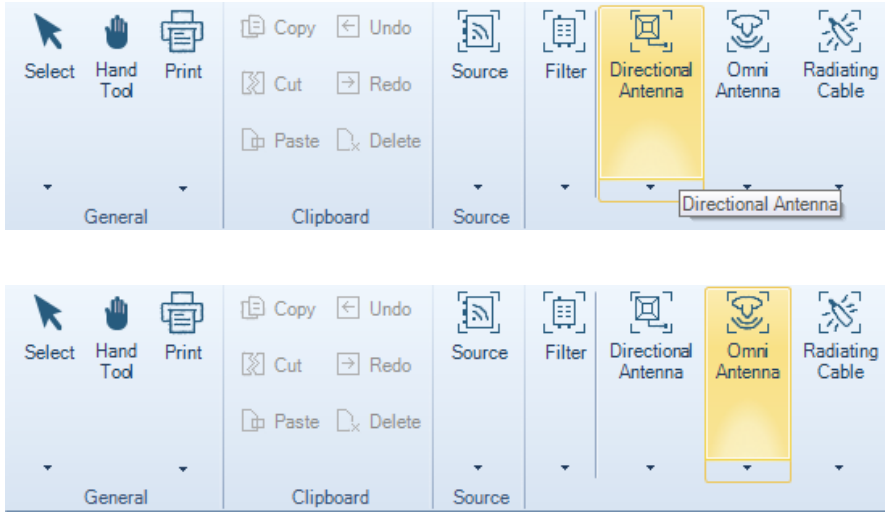
Antenna



- Essential elements of a wireless system
- Transmit and receive radio signal
- Two types:
  - Directional
  - Omnidirectional
    - Omni
    - Radiating cable

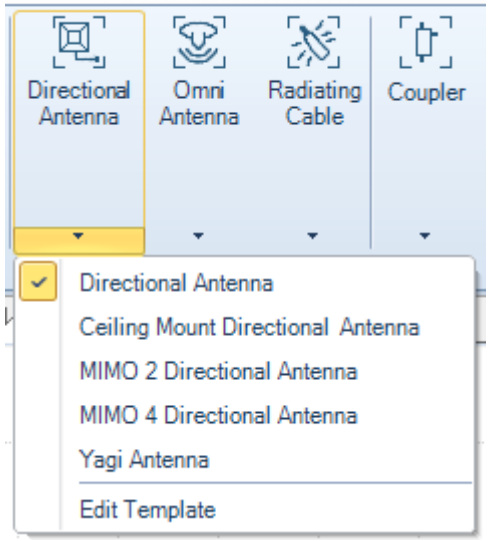
Antenna

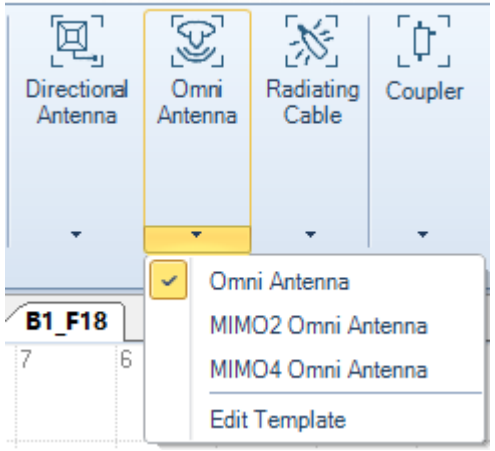
- Adding an antenna:
  - Step 1: Select the Antenna type you need in the ‘Home’ → ‘Network’ ribbon



Antenna

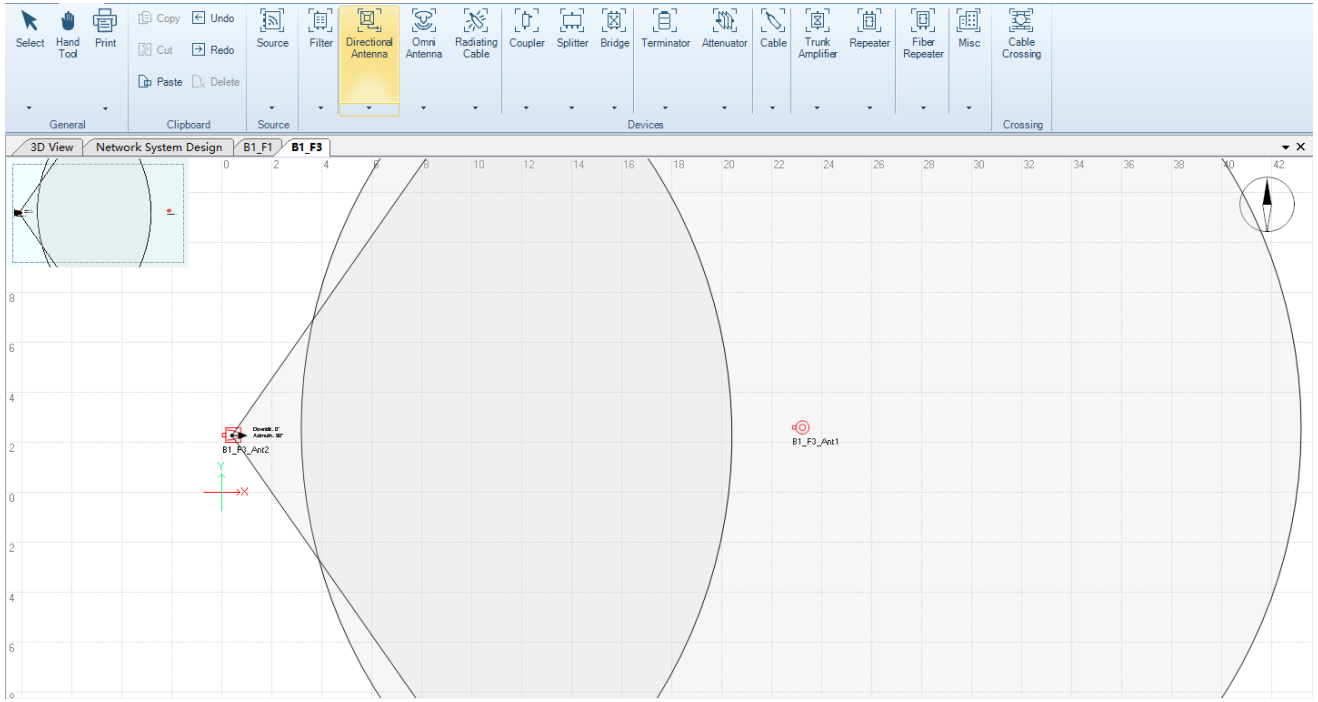
- Adding an antenna
  - Step 2: Select the desired antenna type





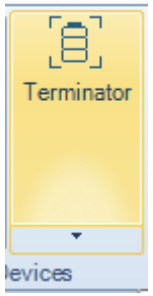
Antenna

- Adding an antenna:
  - Step 3: Place the component on the floor plan



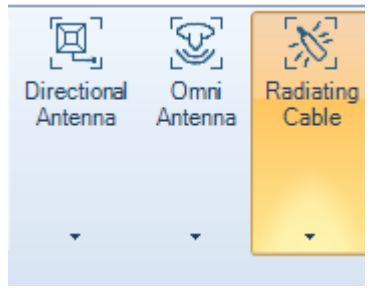
Radiating Cable

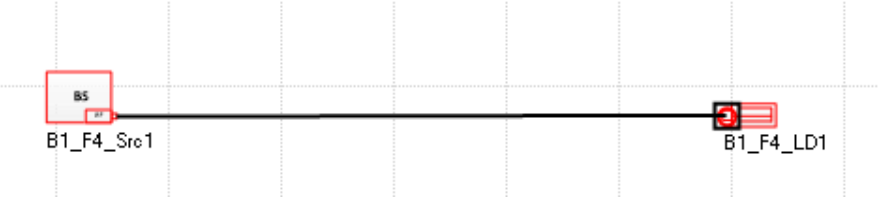
- Adding a radiating cable
  - Step 1: Insert a terminator where your radiating cable will end



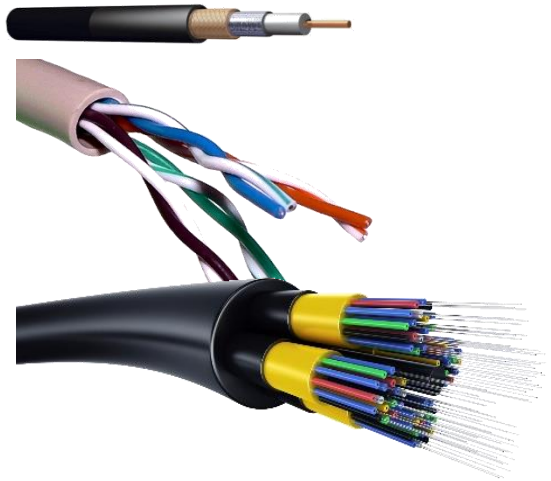
Radiating Cable

- Adding a radiation cable:
  - Step 2: Select the radiating cable tool
  - Step 3: Connect the source with the terminator





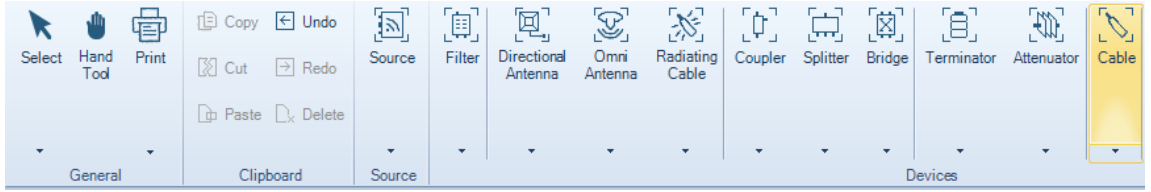
Cables



- Interconnect the different devices in our network
- Transfer the signal from source to antennas
- Cabling types:
  - Coaxial
  - Twisted pair
  - Optical fiber

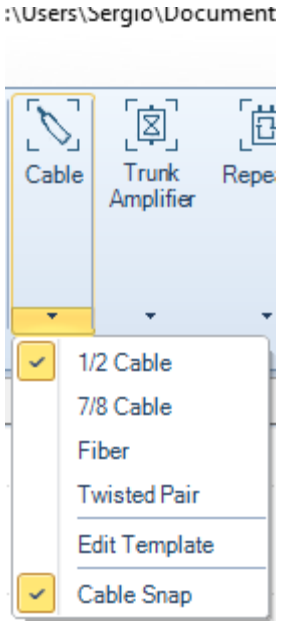
Cables

- Adding a cable:
  - Step 1: Select the ‘Cable’ tool in the ‘Home’ → ‘Network’ ribbon



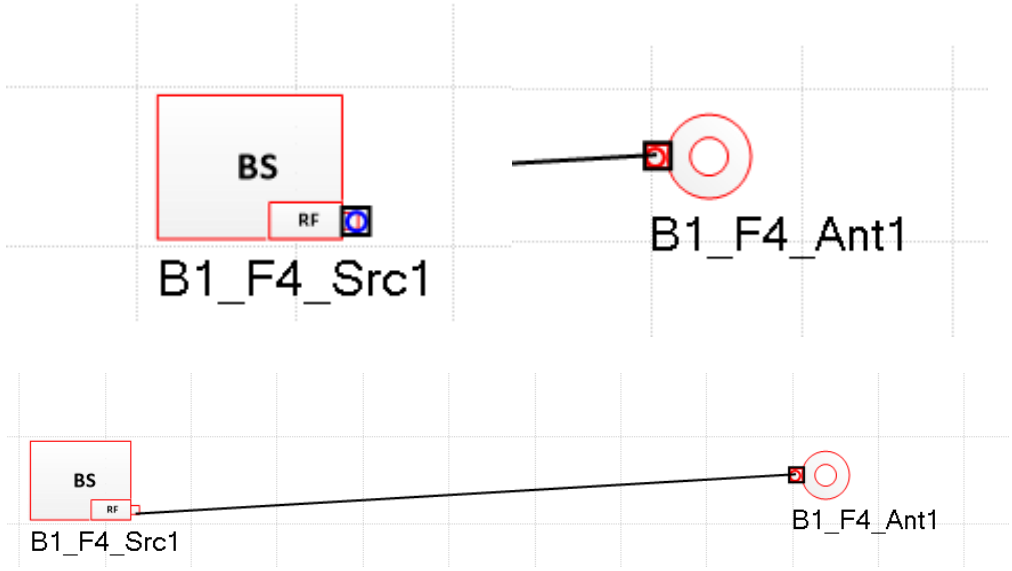
Cables

- Adding a cable
  - Step 2: Select the desired cable type



Cables

- Adding a cable:
  - Step 3: Connect the selected two devices using the cable
  - Available ports will be highlighted once you hover over them
  - Cables can **ONLY** be used two connect two ports

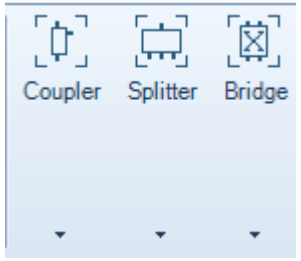


Splitters and Couplers

- Passive devices
- Used to separate or merge the signal
- Bidirectional
- Types:
  - Coupler: Uneven signal distribution
    - Coupled port loss < 1dB
    - Coupling port loss = Coupling factor (3dB, 5dB, 10dB…)
  - Splitter: Even signal distribution through different output ports
  - Bridge: Signal combiners, signal distribution, signal isolation

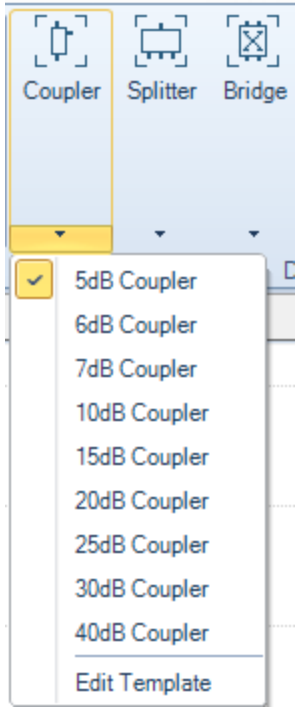
Splitters and Couplers

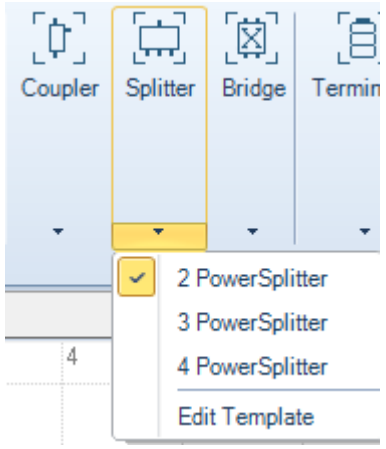
- Adding a Splitter, Combiner or Bridge:
  - Step 1: Select the device type in the ‘Home’ → ‘Network’ ribbon

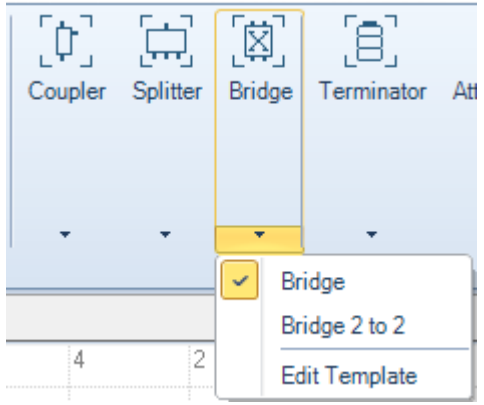


Splitters and Couplers

- Adding a Splitter, Combiner or Bridge:
  - Step 2: Select the device type needed

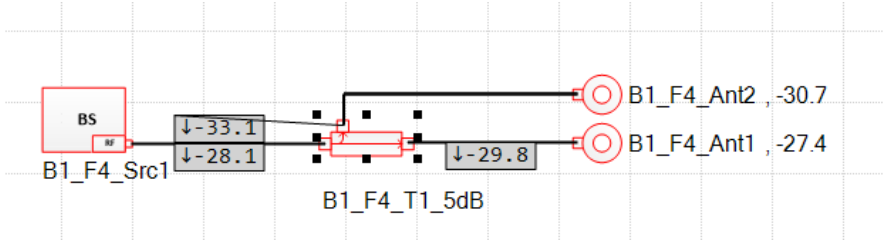






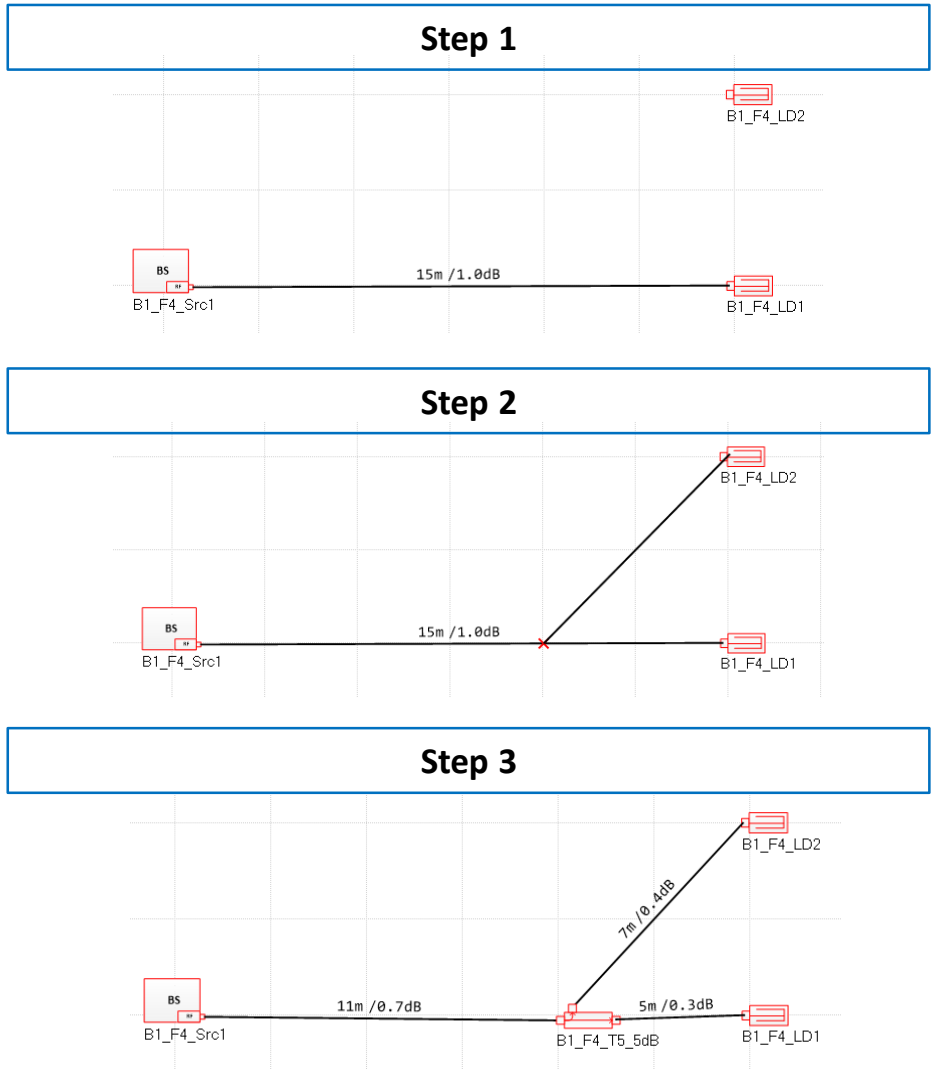
Splitters and Couplers

- Adding a Splitter, Coupler or Bridge:
  - Step 3: Place the component on the floorplan and connect the ports



Splitters and Couplers

- Tip
  - 5dB Couplers can automatically be inserted by connecting a cable from a source to another cable directly

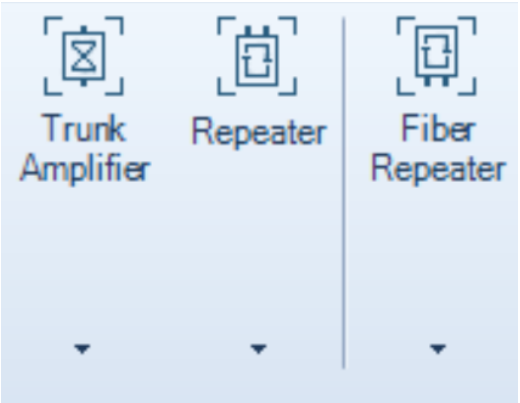


Amplifiers and Repeaters

- Compensate transmission loss through the network
- Increase signal power
- Regenerate signal to improve detection at receiver
- Types:
  - Bi-directional amplifiers (BDA)
  - Repeaters
    - Cable
    - Optic

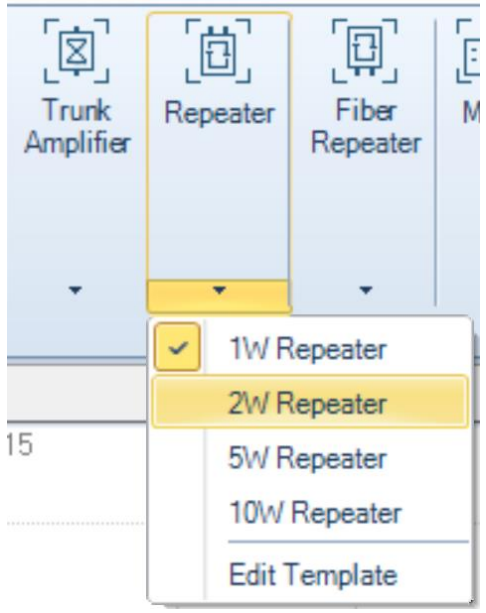
Amplifiers and Repeaters

- Adding an amplifier or repeater:
  - Step 1: Select the device type in the ‘Home’ → ‘Network’ ribbon



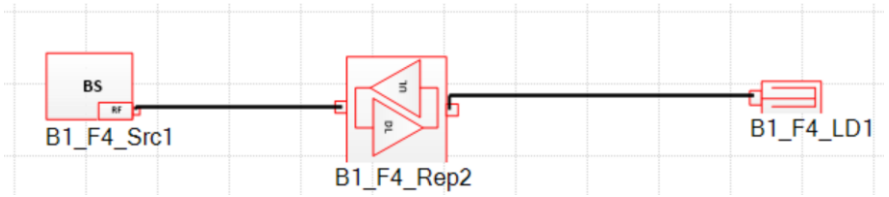
Amplifiers and Repeaters

- Adding an amplifier or repeater:
  - Step 2: Select the device type needed



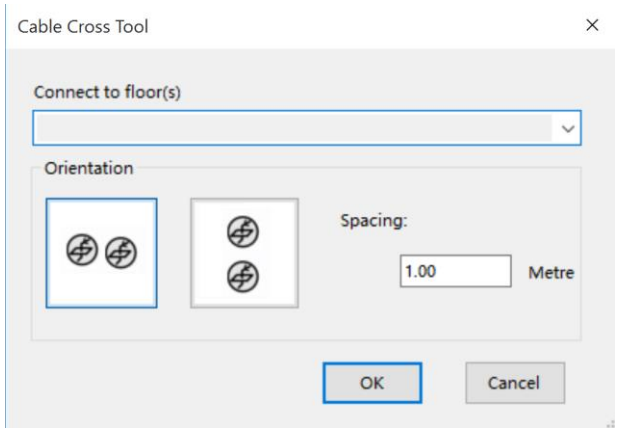
Amplifiers and Repeaters

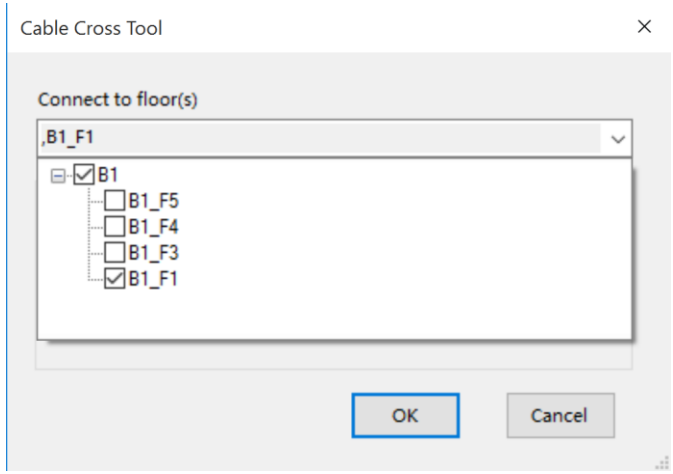
- Adding an amplifier or repeater:
  - Step 3: Place the component on the floorplan and connect the ports



Cable Crossing

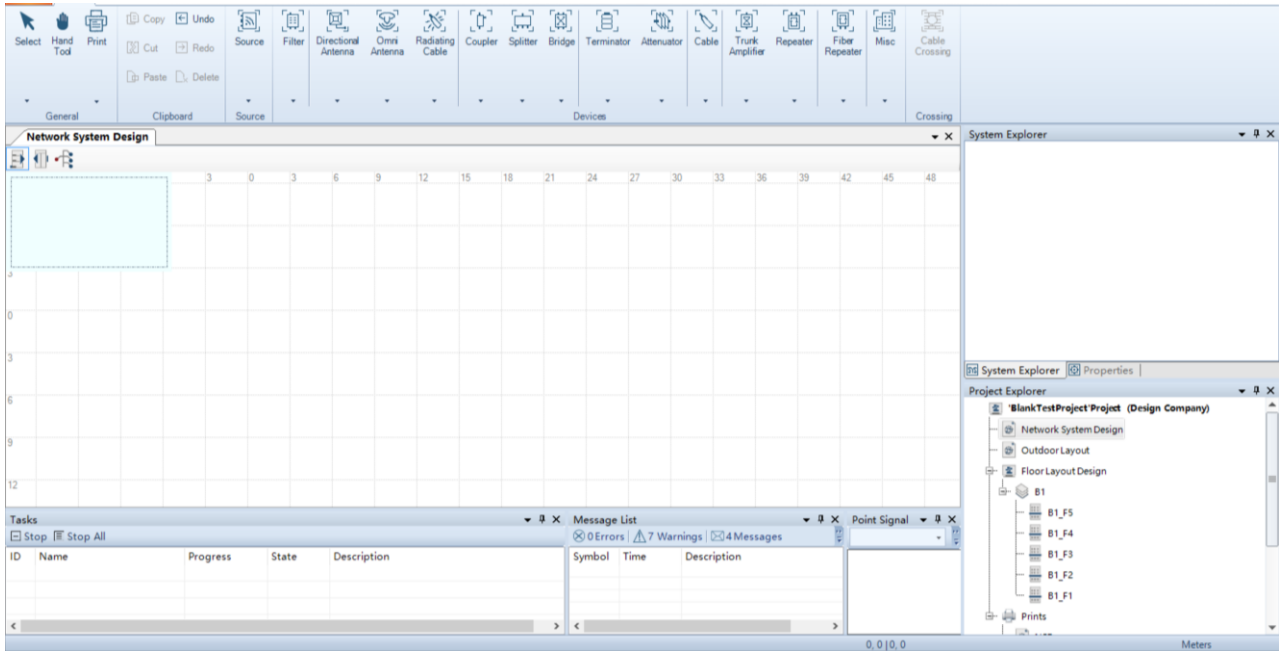
- Cable crossing points serve a connection ports between floors
- Adding a Cable Cross point:
  1. Select the ‘Cable Crossing’ tool in the Network ribbon
  2. Click on the floorplan where the ‘Cable Crossing’ point will be located
  3. Cable Cross tool will open
  4. Select the floors to be connected
  5. Select the Cable Cross orientation an spacing and click OK





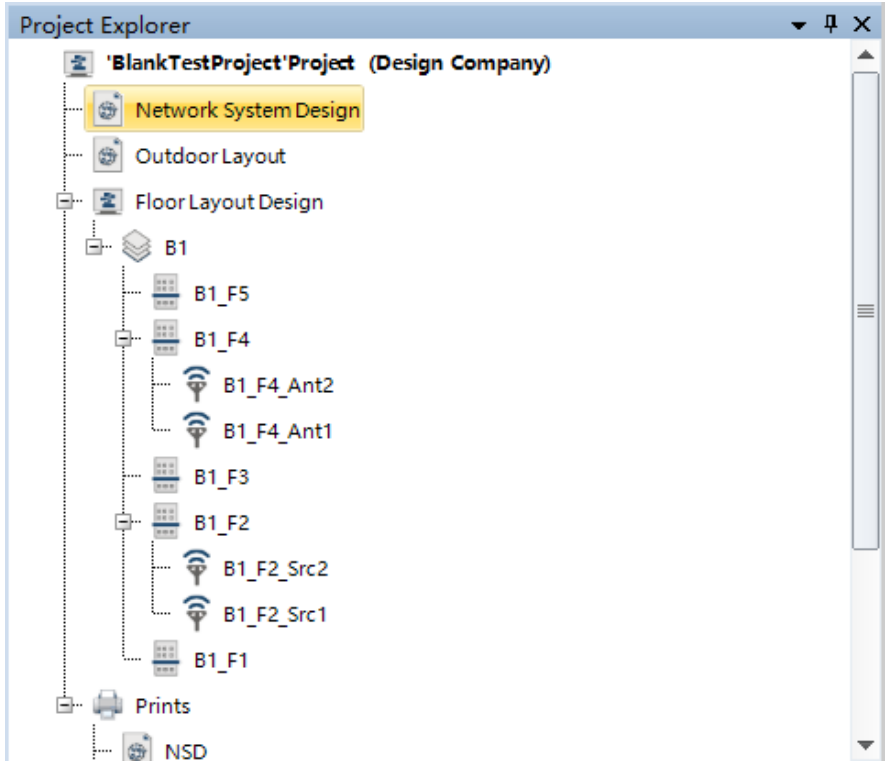
Network System Design (NSD)

- The NSD view is an alternative mode used for constructing and designing the network system
- Add different kinds of network devices to the design view, and connect them together with different links
- Create the logical structure and relationships



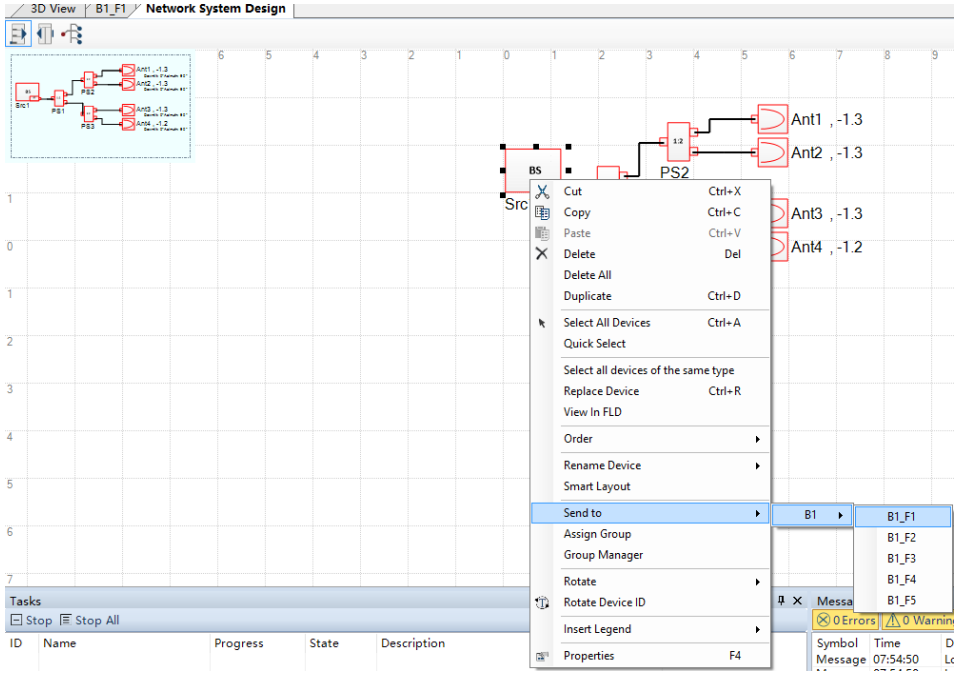
Network System Design (NSD)

- Open NSD: double click ‘Network System’ design in the **Project Explorer** panel



Network System Design (NSD)

- Designing in the NSD:
  - Design your network scheme in NSD
  - Send the components to its corresponding floor
  - Place the components in their final location on the floorplan



Ranplan Professional

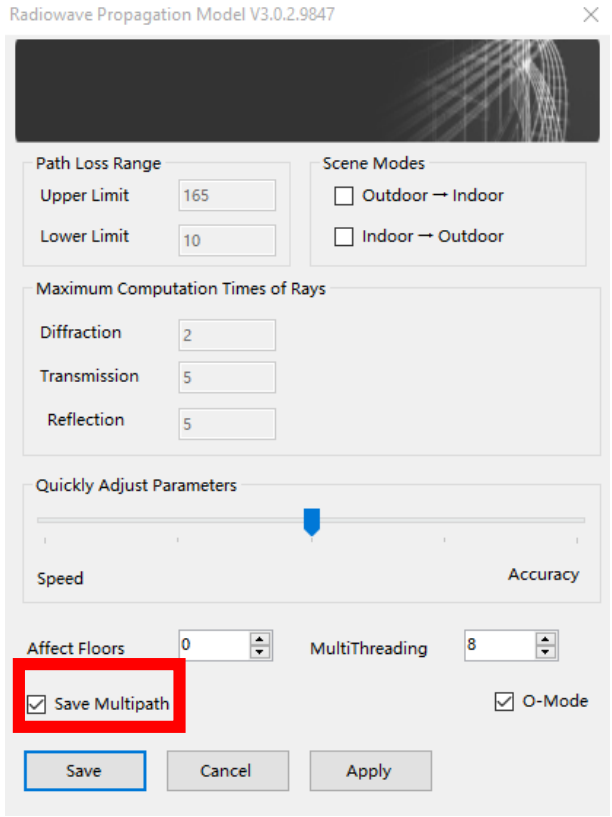
Advanced Sector Configuration

Introduction

- Ranplan includes several advanced functions, such as:
  - MIMO
  - Range Expansion
  - Uplink-Downlink Separation
  - Coordinated MultiPoint (CoMP)
  - Inter-Cell Interference Coordination (ICIC)

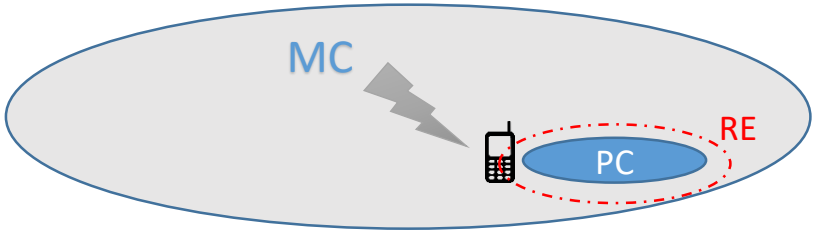
MIMO System Simulation

- Ranplan offers the possibility to simulate MIMO systems
- In order to simulate MIMO systems, users must configure the ray tracing model as a MIMO system model:
  - Right-click the system name in the **System Explorer** window
  - Select **Calculation Config**
  - Check **Save Multipath** box



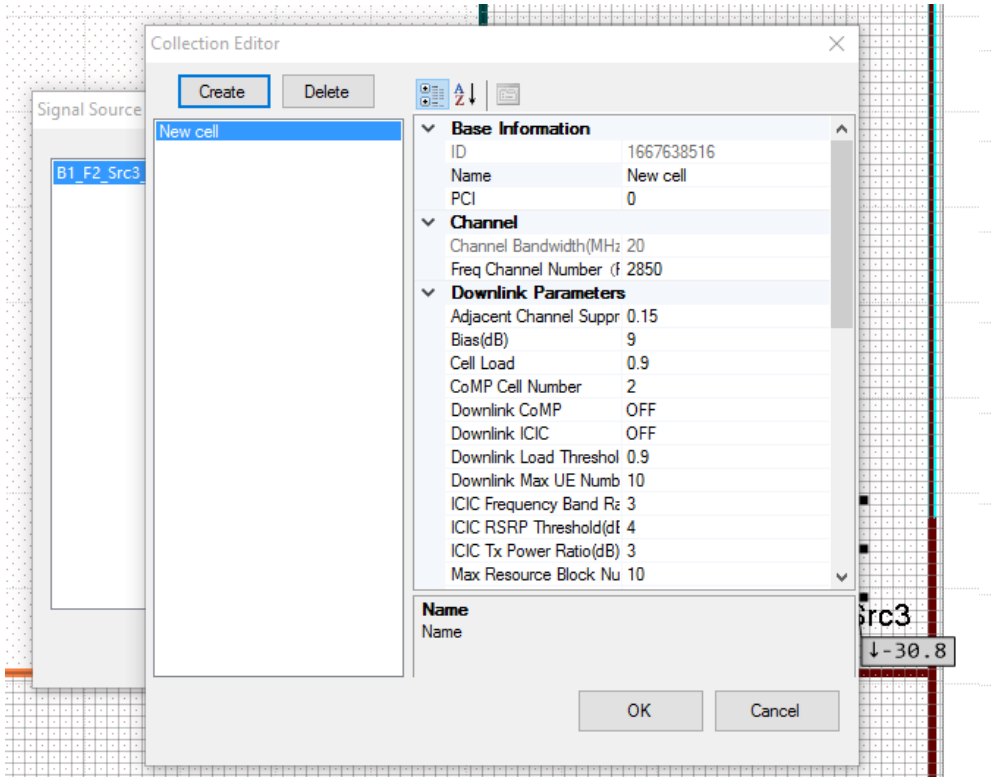
Range Expansion (RE)

- Range Expansion (RE) is a technique used to improve performance for LTE systems
- This technique is used to offload traffic from Macro Cells (MC) to Pico Cells (PC)
- This can be done even if the signal from the MC is better than the signal received from the PC.



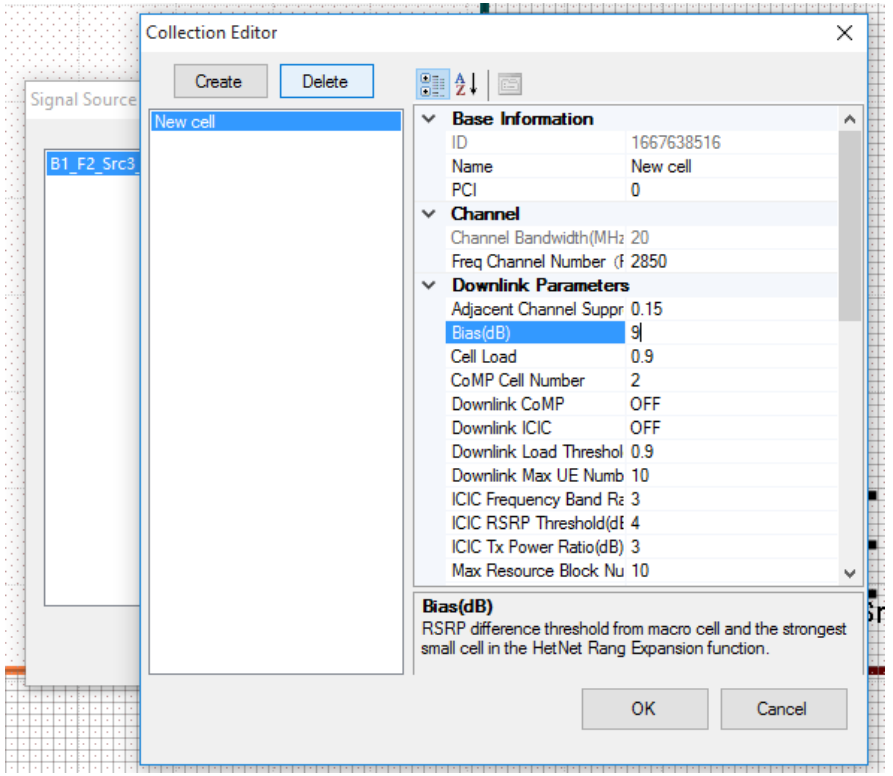
Range Expansion (RE)

- In order to enable RE the user needs to:
  1. Double-click the LTE source which will implement RE
  2. Signal Source List Editor menu will open
  3. Click '…' icon
  4. Collection editor will appear



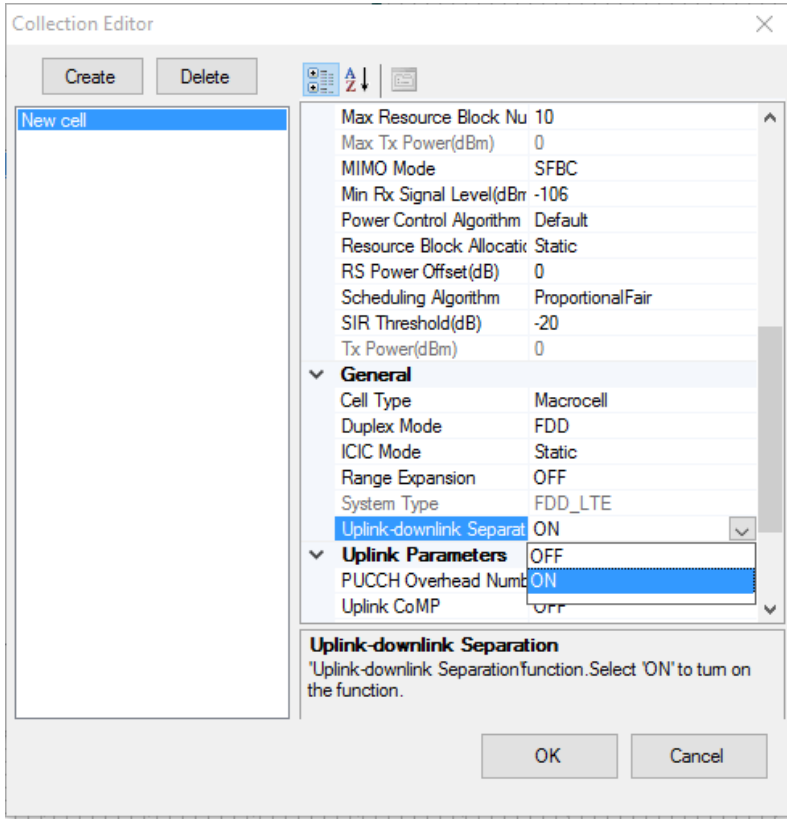
Range Expansion (RE)

- In order to enable RE the user needs to:
  4. In the small cell parameter configuration table
  5. **General** section
  6. '**Range Expansion**' should be enabled by switching from 'OFF' to 'ON'
  7. The last parameter to configure will be the **Downlink Parameter 'Bias'** for the Small Cell.



Uplink-Downlink Separation

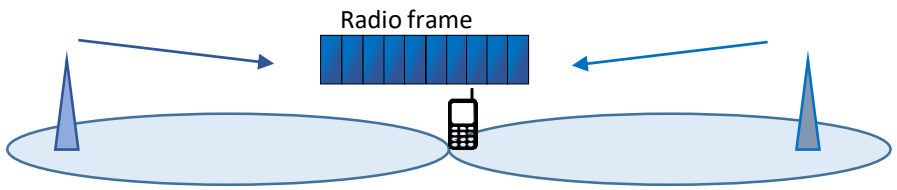
- In HetNet systems, users' uplink and downlink transmission can be based on different cells to improve the uplink performance
- In Ranplan, '**Uplink-Downlink Separation**' can be enabled by switching it '**ON**' in the cell parameter configuration
- After configuring this function, the feature is enabled and the uplink performance can be evaluated when a **simulation** is run.



Coordinated MultiPoint

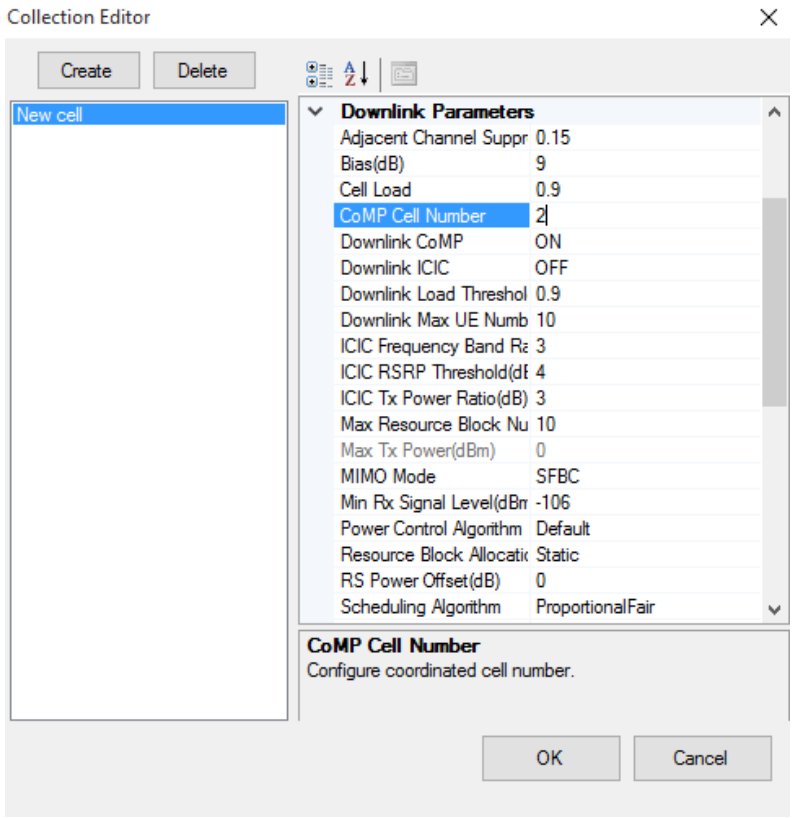
- Ranplan supports the **Coordinated MultiPoint (CoMP)** transmission and reception introduced in Rel.11, only in **Joint Transmission** mode currently
- CoMP is used to **reduce interference** for downlink and uplink between cells, and then improve the system performance, especially at the cell edges.

Joint Transmission: Data is transmitted in the same frequency at the same time from multiple TX points



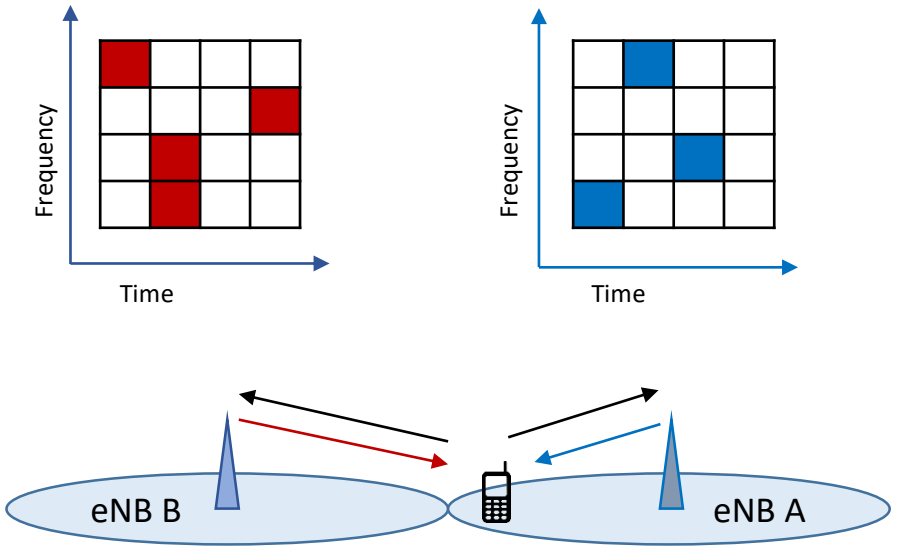
Coordinated MultiPoint

- In Ranplan, '**CoMP**' can be activated separately on **Downlink** and/or **Uplink** via switching it '**ON**' in the cell parameter configuration
- After enabling the CoMP function, the **number of coordinated cells** should be set
- After configuring this function, the feature is enabled and the uplink performance can be evaluated when a **simulation** is run.



Inter-Cell Interference Coordination

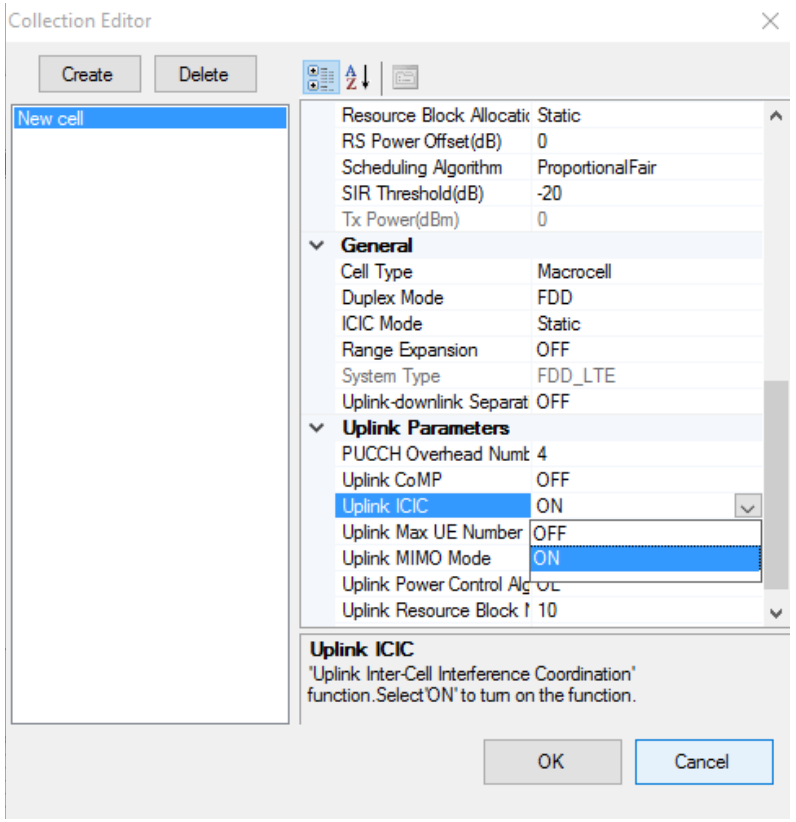
- Inter-cell interference coordination (ICIC) is introduced in 3GPP rel.8
- ICIC advanced feature implements transmission coordination for cell edge UEs in the downlink and uplink LTE system to reduce the interference from the adjacent cells
- UEs receive multi-cells' signals in the downlink, which are pre-coded to separate the different transmission signals based on different coordinated algorithms
- Uplink, BSs receive multi-UEs' signals, and coordinate via backhaul to reduce the interference



HINT: ICIC is used if there is coordination between the Small Cell and the Macro Cell and the Small Cell is an active system

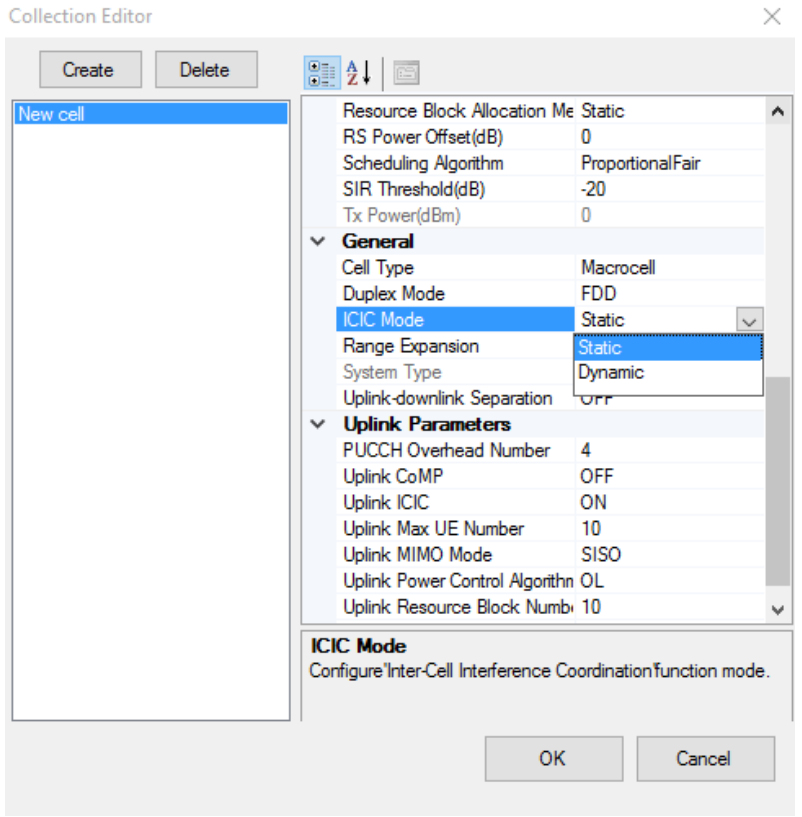
Inter-Cell Interference Coordination

- In Ranplan, '**ICIC**' can be activated separately on **Downlink** and/or **Uplink** via switching it '**ON**' in the cell parameter configuration



Inter-Cell Interference Coordination

- After enabling the ICIC function for downlink and uplink system, the cell parameters for ICIC function should be configured
- First the ICIC mode parameters should be configured, which include:
  - **Dynamic mode**
  - **Static mode** which needs to configure:
    - **ICIC Frequency Band Ratio** parameter should be set to determine the cell edge frequency bandwidth. Also the ratio in dB between the whole frequency band and cell edge bandwidth should be set to a real number larger than 1
    - **ICIC RSRP Threshold** parameter should be configured in static and dynamic mode. It denotes the RSRP signal difference from serving cell and the strongest interfering cell for determining the cell edge users
    - **ICIC Tx Power Ratio** denotes the ratio in dB between the Tx power of frequency band for cell edge user and Tx power of frequency band for cell central user



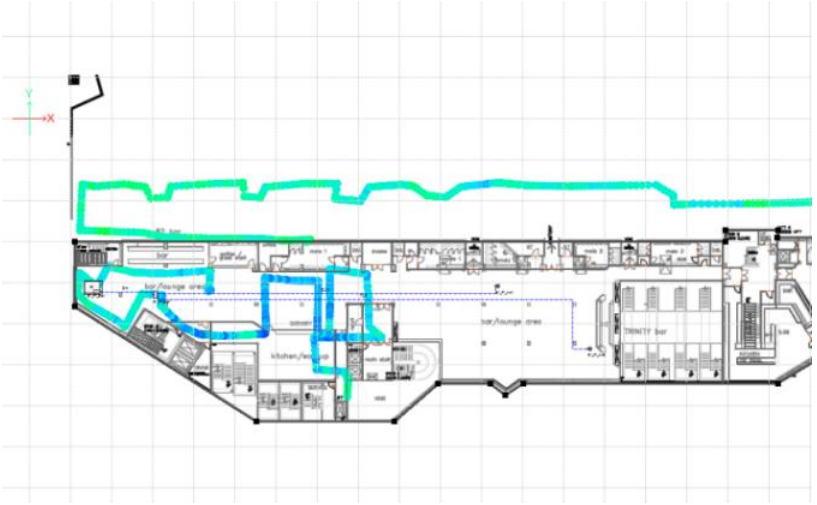
Ranplan Professional

Importing & Using Walk Test Data

Introduction

- This section will introduce the **Measurement** functionality in Ranplan:
  - Measurements
  - Measurement templates configuration
  - Wi-Fi data collection
  - Collect 3G, 4G measurements
  - Material calibration
  - Statistical information

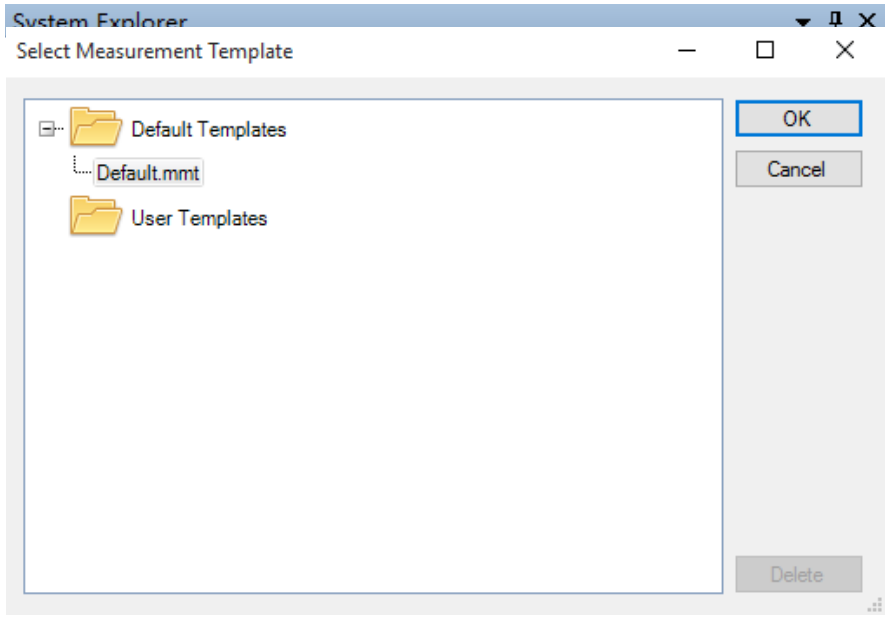
Measurements



- The measurements module in Ranplan allows users to:
  - **Import third party** and custom format measurement campaign data in to Ranplan
  - Define **Floor Interference** levels
- The measurements can then be displayed within the building model and used to calibrate the propagation module for greater accuracy

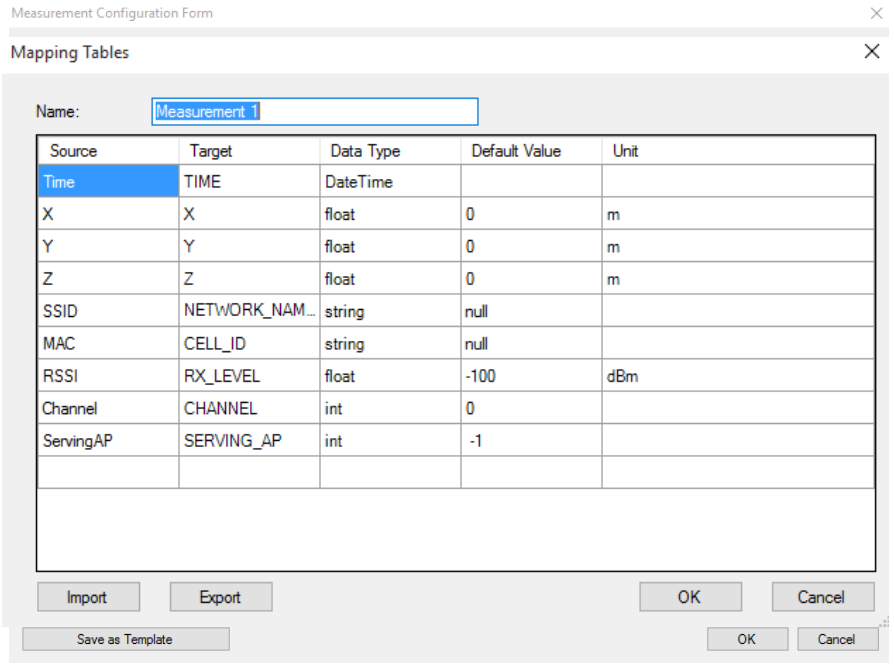
Measurement Template Configuration

- The **Measurement** module is accessed via the system explorer window as shown in the figure
- To create a new template to import measurement campaign data into:
  - From the system explorer window right-click **Measurements** and select **New** from the context menu
  - **Select a template** to be used for the data import, in most cases the default template is recommended
  - Select **OK**



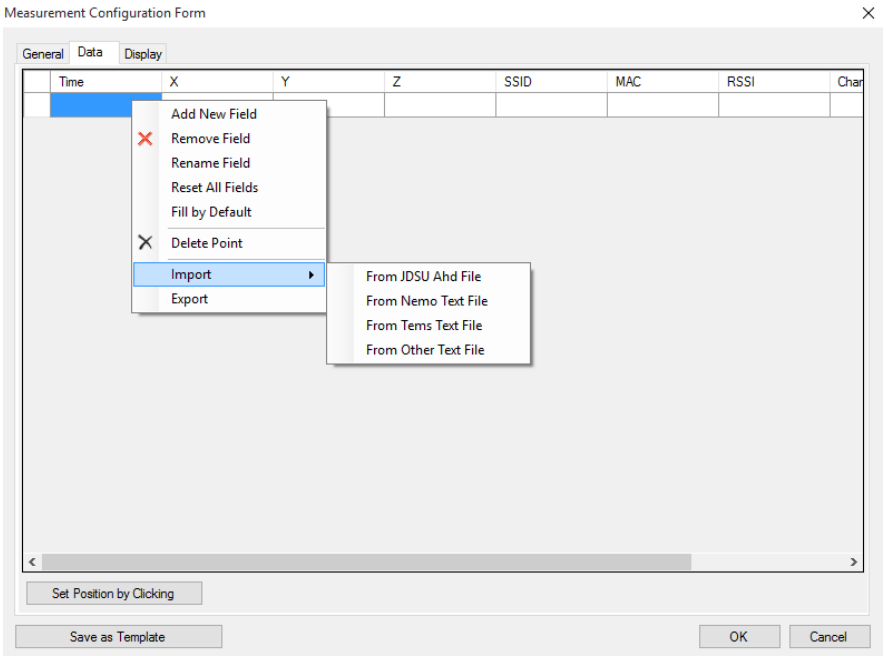
Measurement Template Configuration

- Once an import template has been selected the measurement configuration form will open as show in Figure
- From the **General** tab a **name** for the instance of the configuration form can be set and also a **comment**
- The **Mapping Table** defines which external fields (to be imported) match the internal fields within in the software by default, their default values, and also default unit of measurement



Measurement Template Configuration

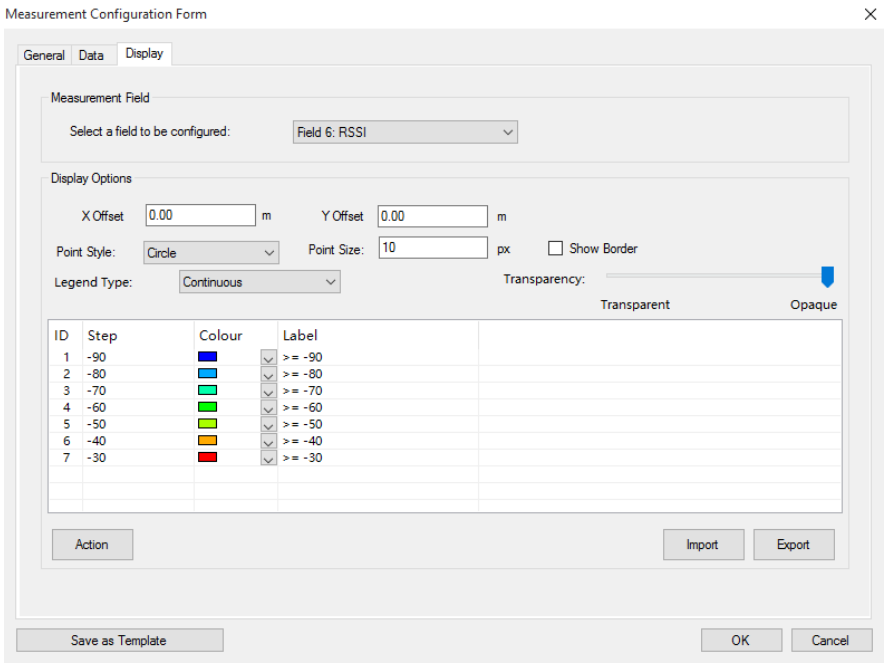
- User may either **Collect** measurement data from any predictions run using the RRPS by using the **Set Position by Click** button
- **Import** actual measurement campaign data by right clicking anywhere in the data tab, hovering over 'Import' in the context menu and then selecting the relevant data format type.



Measurement Template Configuration

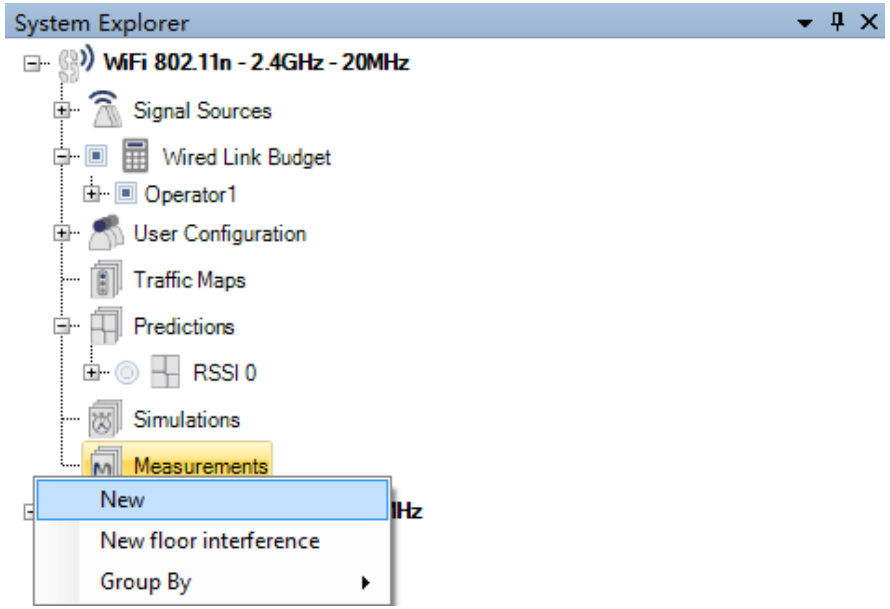
- Last step is to configure the **Display** settings
- **Offset** levels can be defined for both X and Y coordinates
- The **Point Style** can also be configured

- Once everything is configured user can **Save as Template** the current configuration for future uses



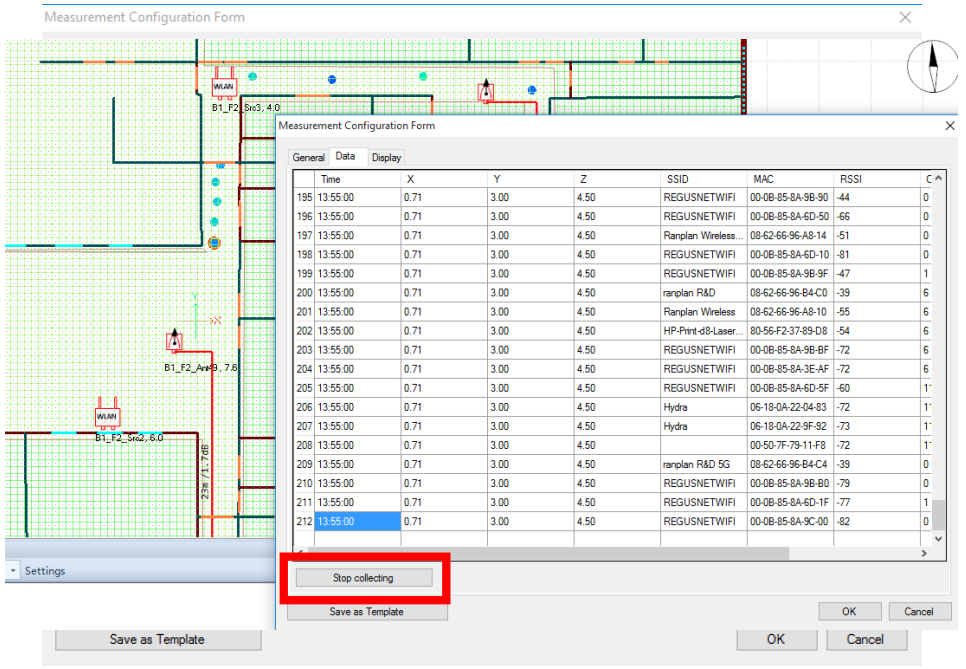
Wi-Fi Data Collection

- Ranplan allows users to gather Wi-Fi system data using a wireless network card built in to the system
- This data can then be used to calibrate material properties in the material database or mapped on the floor layout design
- The Wi-Fi data collection function is based on a pre-built Wi-Fi system in the **System Explorer**



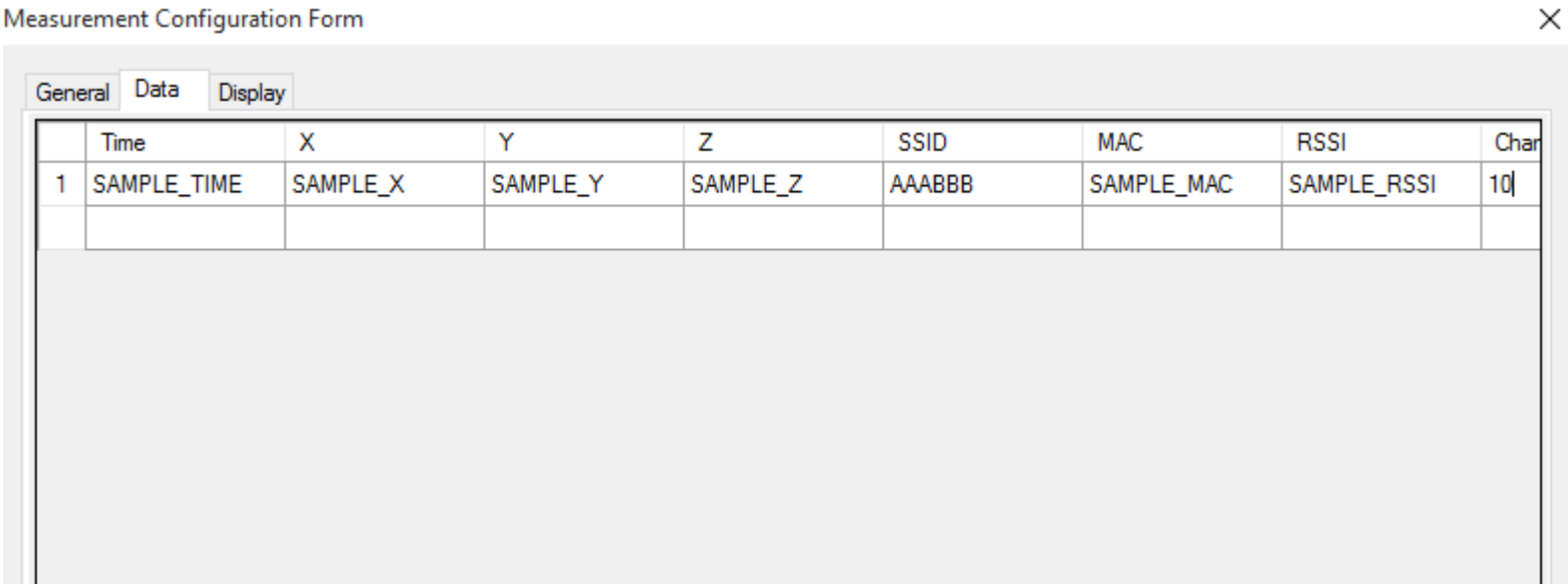
Wi-Fi Data Collection

- In **Data** panel start collecting data by pressing **Set position by click** button
- **Click on the floorplan** where you want to collect measurements
- Ranplan will start **Collecting Data…**
- Once collected **move to the next point** and **click on the floorplan**
- Collection locations will appear as **Circles** in the floor plan
- Once all the measurements are collected **Stop collecting**
- Press **OK**



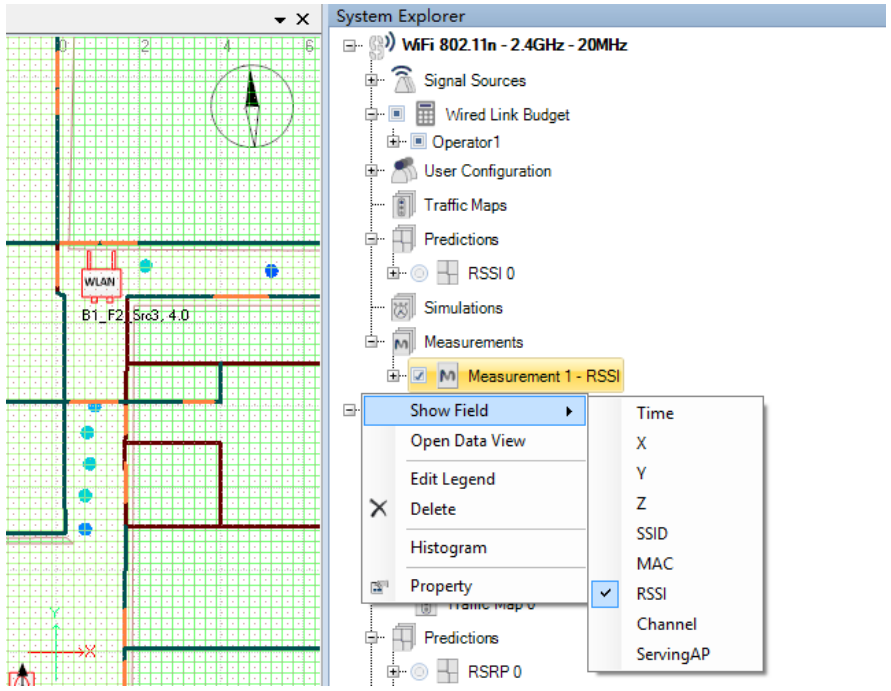
Wi-Fi Data Collection

- Data can be also entered **manually** simply **by typing** the values on each corresponding cell



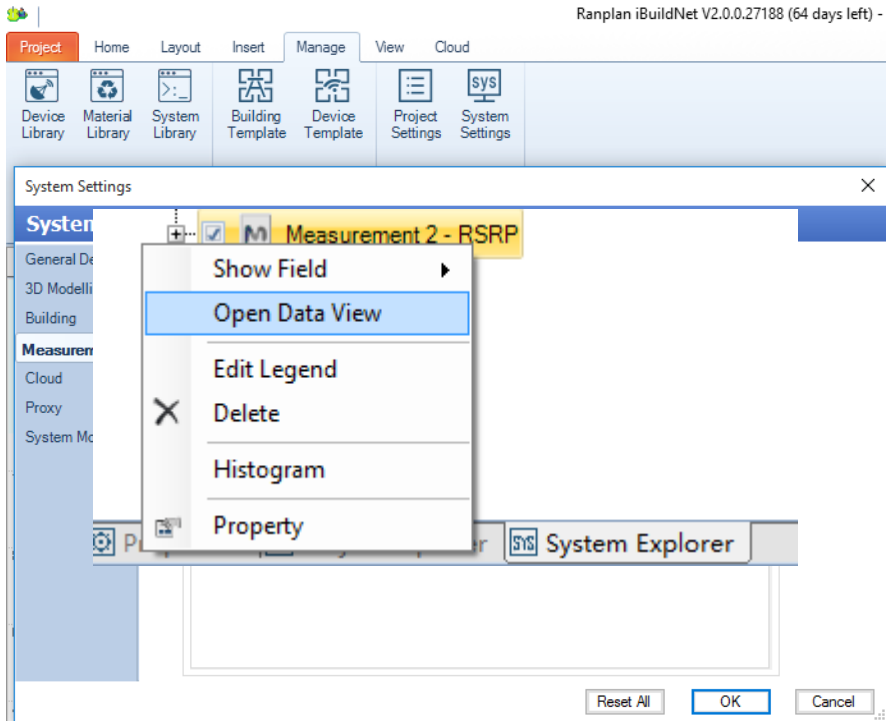
Wi-Fi Measurement Data Display

- Once the **measurement** has been collected user can choose the specific display method by simply ticking the box next it and selecting the option in the **Right-click** menu



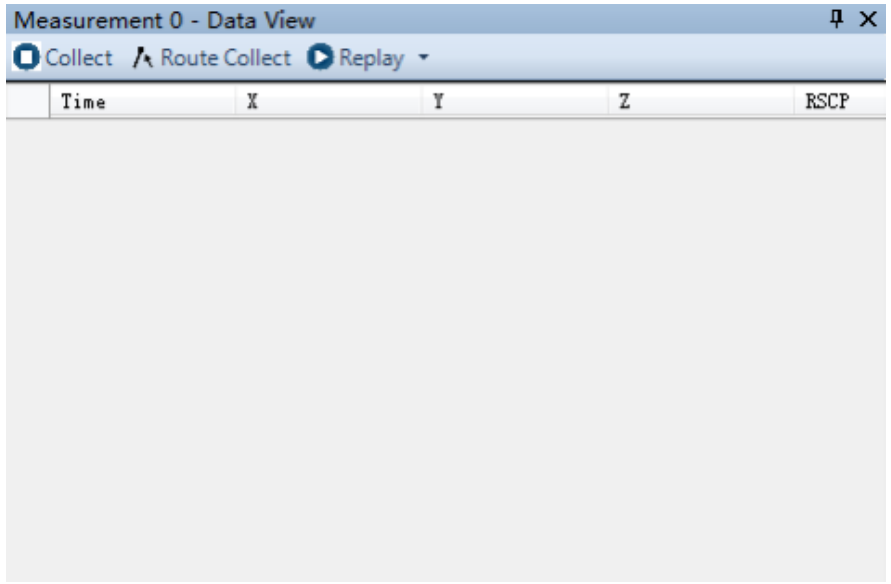
Collecting 3G, 4G Measurements

- A wireless network card can be used to collect 3G and 4G signal data by following these steps:
  - First insert a suitable wireless network card into the notebook and select the correct port under **Manage → System Setting → Measurement and Sampling → Cellular**
  - Click **Configure Modem** and configure the relevant 3G / 4G parameters
  - Add the signal source in the work area and to create new measurement under **Import Measurements**, right-click the measurement name and choose **Open Data View**, as shown in Figure



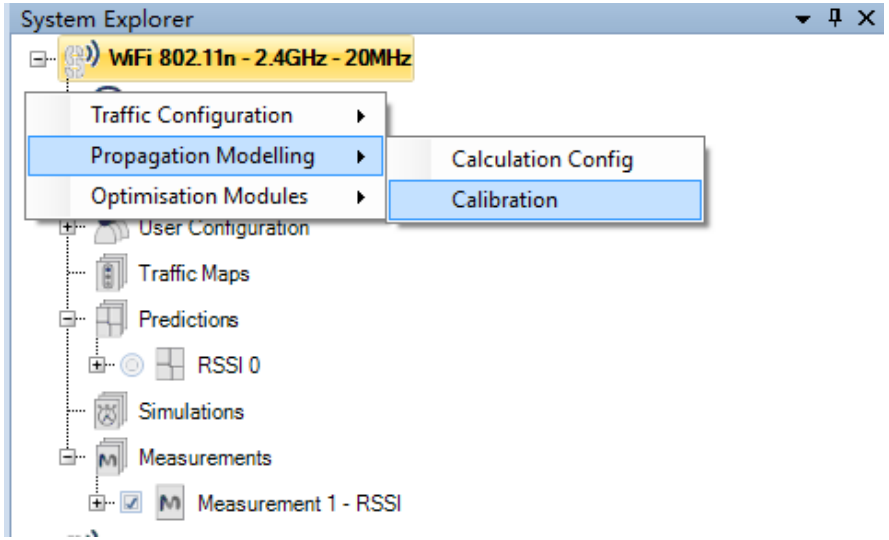
Collecting 3G, 4G Measurements

- To collect:
  - Click the **Collect** button, and use the mouse to select the corresponding location to collect the measurement data
  - Click the **Collect** button then press ‘Ctrl’ and use the mouse to select the number of collection points to be displayed in the data view form and use the mouse to click the interface to finish the collection
  - **Route Collect**: Draw a line and click the **Route Collect** button, then use the mouse to click one endpoint of the line, the collection start.
  - To **finish**, click the other end point and the collection data points are distributed on the line



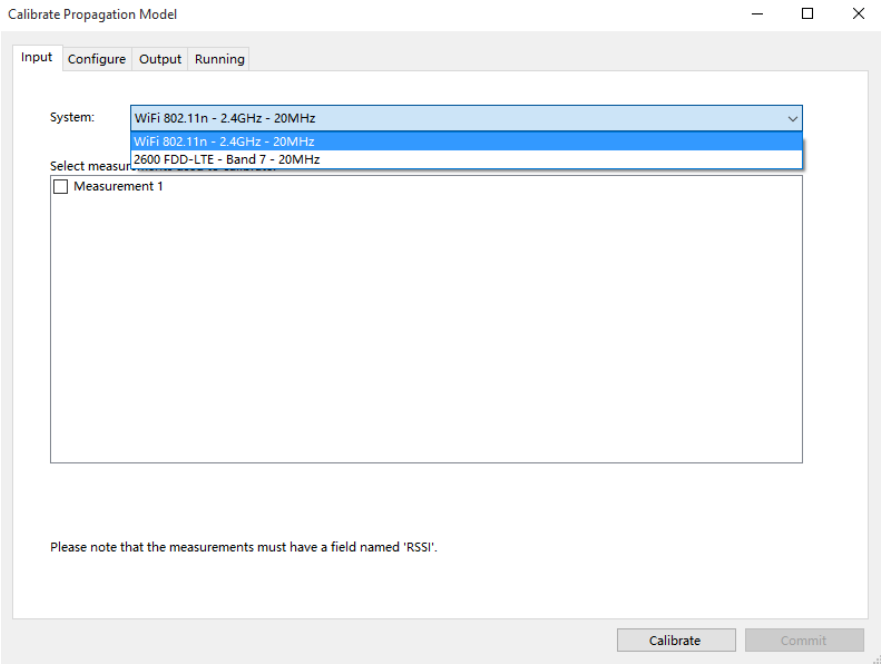
Indoor Material Calibration

- Ranplan offers the ability to **Calibrate Material** properties within the tool
- In order to calibrate a material follow these steps:
  - Choose the measurement campaign system in **System Explorer**
  - Right-click this and select **Calibration** under **Propagation Modelling**



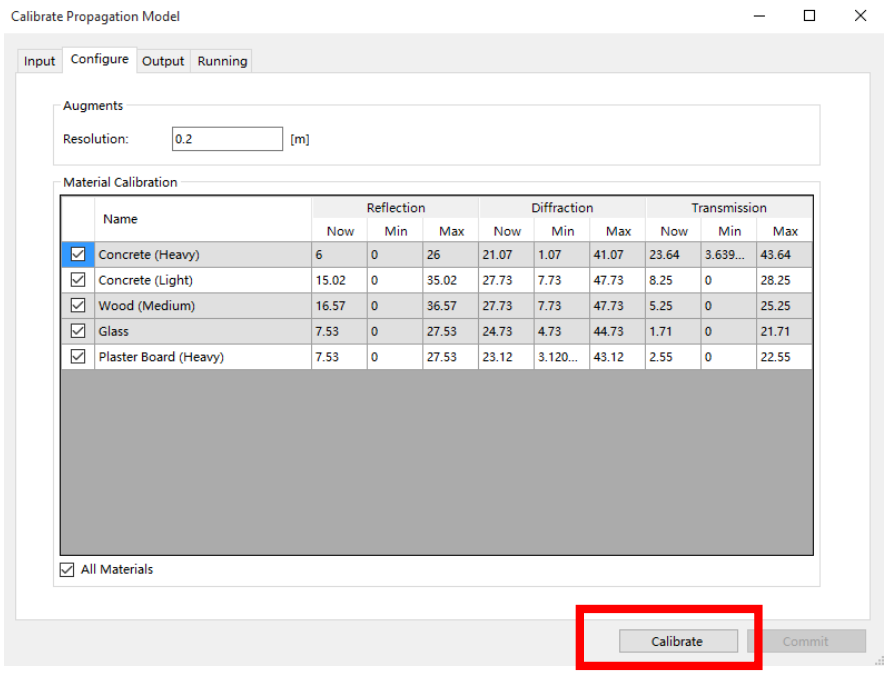
Indoor Material Calibration

- In the **Input** tab under **Calibrate Propagation Model** window, select the network system for calibration
- Select the **measurement data project** under that system



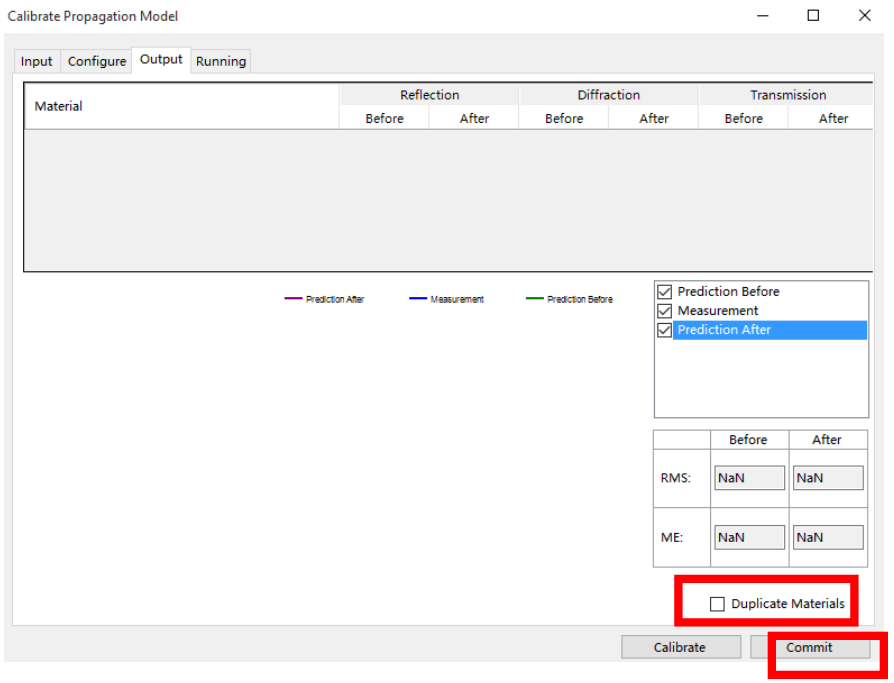
Indoor Material Calibration

- In the **Configure** tab choose the **minimum resolution** for the calibration
- **Tick** the material for calibration
- Click **Calibrate** button to start the calibration



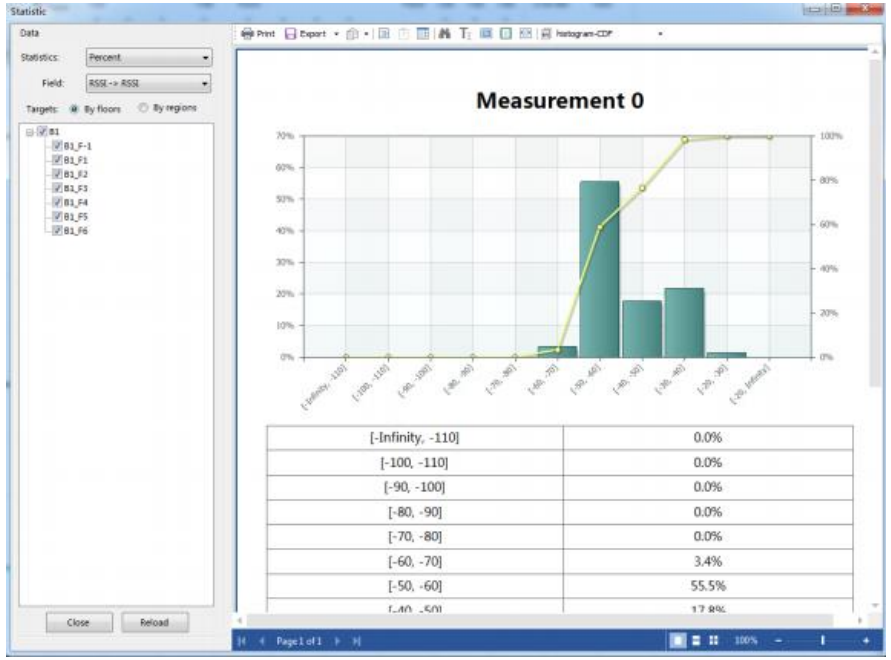
Indoor Material Calibration

- After calibration, in the **Output** tab users' can compare the current network signal loss after the calibration
- By selecting the **Before** and **After** buttons various path-loss attributes of the material can be compared before and after the calibration
- After the calibration, user can tick the **Commit** button to apply the material property into the material property database
- Also users' can choose the **Duplicate materials** option to paste the material property into the newly created material inside the material database



Statistical Information

- Statistical Information is very important to network engineers, and using Ranplan statistics can be viewed and exported from the Statistic dialog, which can be accessed via a right-click on a measurement result and selecting **Show Statistic**
- The statistical information can be presented in terms of percentage and area
- A number of chart types can be applied, such as Column, Point, Pie, Bar and Radar. Users are able to customise the statistics chart and export the chart as shown



Ranplan Professional

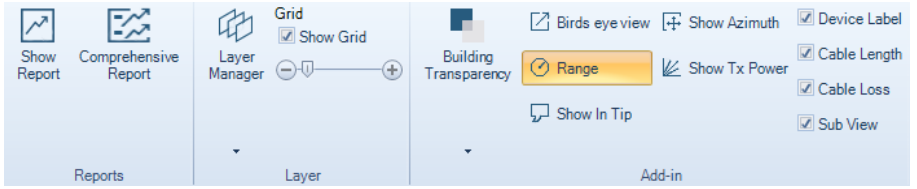
Predictions

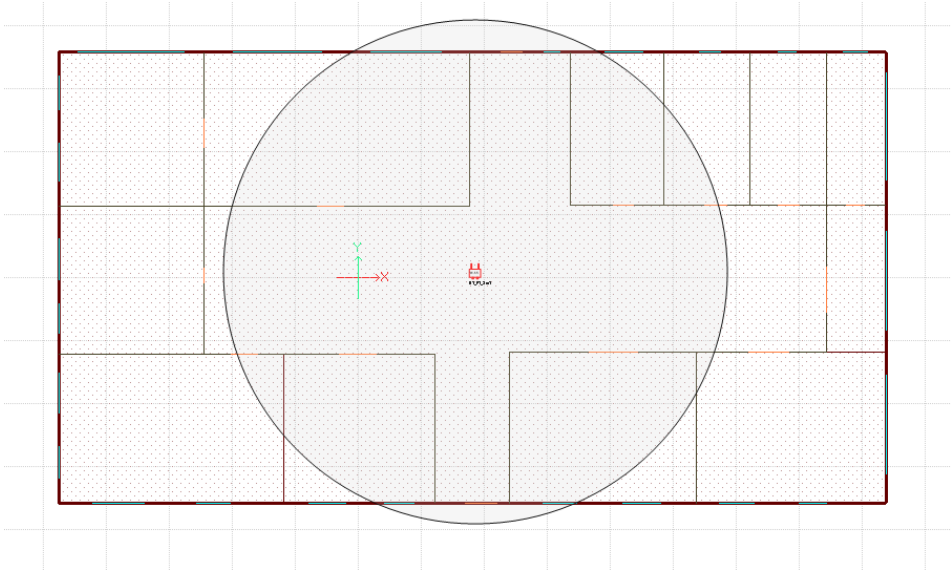
Introduction

- This section contains detailed steps for the following:
  - Enabling and disabling antenna contours
  - Creating and manipulating regions
  - Configuring, running and displaying predictions
  - Configuring, running and displaying simulations

Antenna Contours

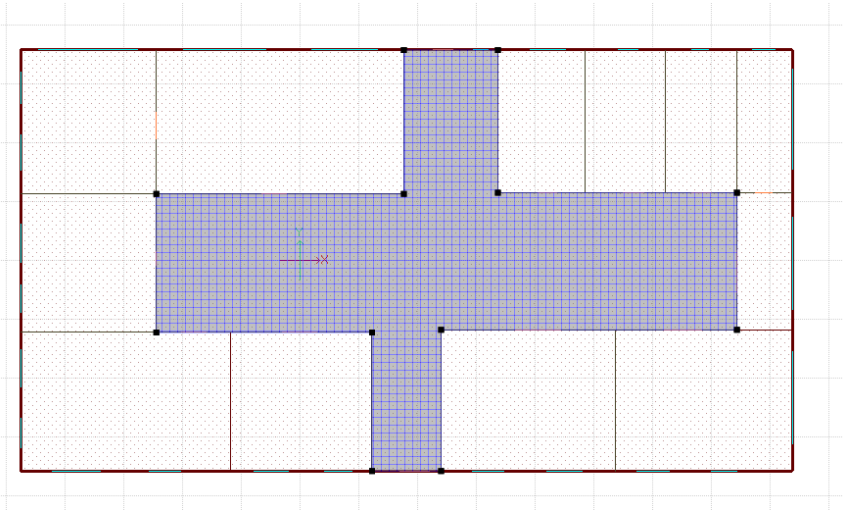
- Antenna contours can be displayed to have an idea of the ideal antenna coverage
- Used for coffee-cup design
- Display antenna coverage in free space
- Display antenna contours:
  - Insert the antenna in the floorplan
  - Go to **View** tab
  - Activate **Range** display





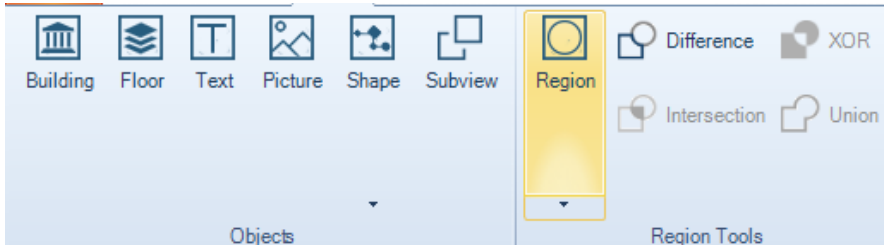
Regions

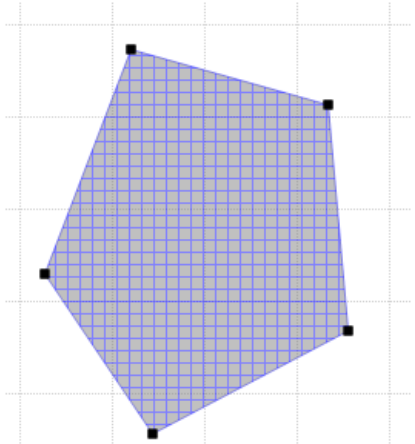
- Region can be used to mark a certain part of the canvas to display specific information
- Region can also be used as target for automated designs or for **Predictions**
- This information can be selected by other applications. E.g. signal display can be used to support the whole communication system’s simulation task
- Ranplan provides region creation, layout, region Boolean operation and region display functions.

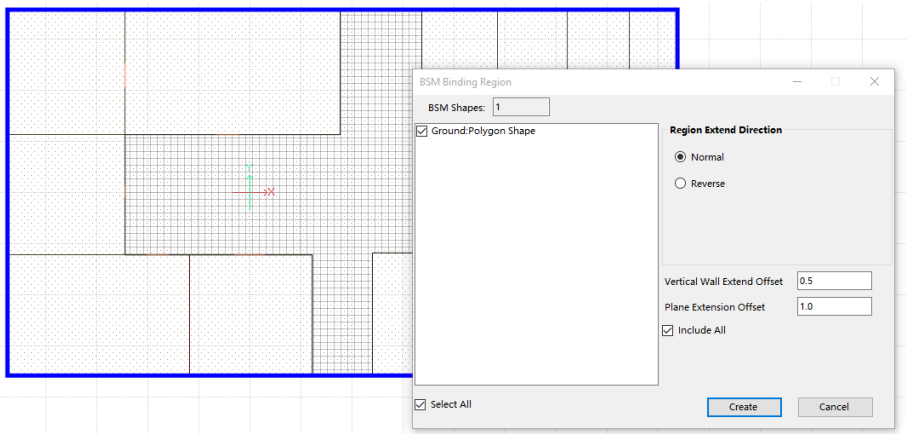


Regions

- Regions are created like any other plane
- Select the **Region** tool in the ‘Insert’ tab and choose either drawing a **Polygon** or use **Plane binding**
  - Draw a **polygon** the **Region** will cover **OR**
  - Choose the plane the **Region** will be bind to
  - Right click and the **BSM Binding Region** tool will launch, select the polygon to bind and click ‘Create’

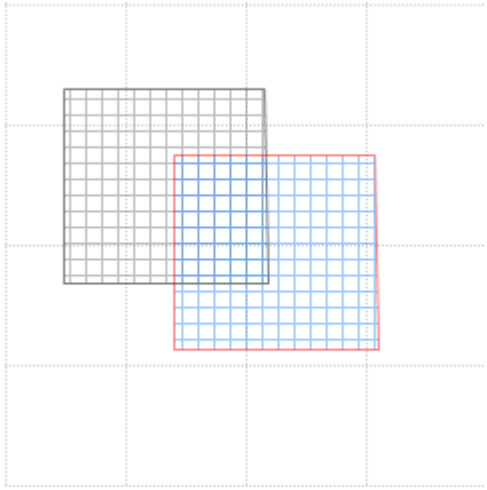






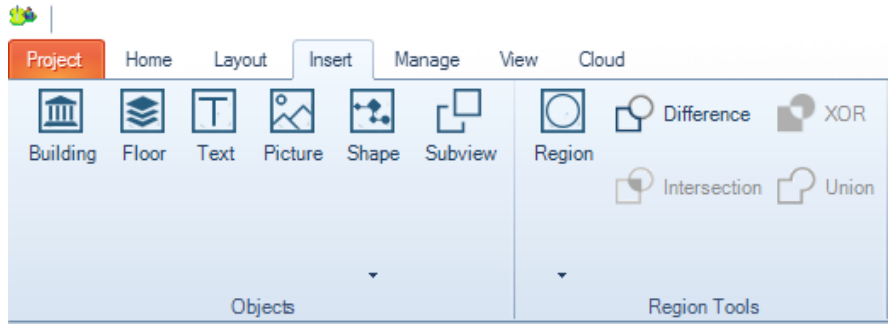
Regions

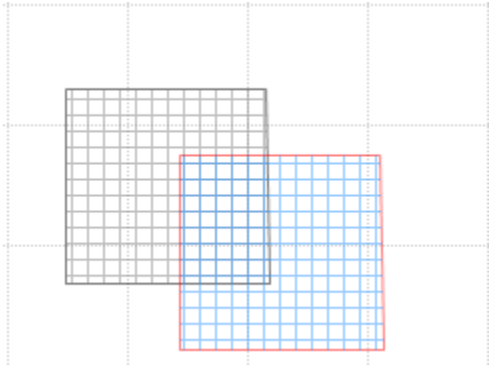
- There are four different tools which can manipulate user created regions:
  - Difference
  - Intersect
  - XOR
  - Union

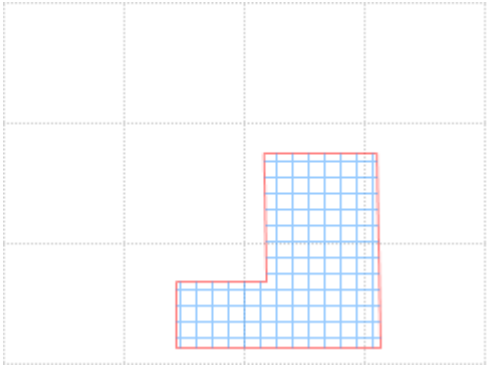


Regions: Difference

- Region operation: Difference
  - Select a region: the currently selected region will be used as the difference base
  - Choose the **Difference** tool
  - Select the area representing the difference in target region
  - Confirm with a right-click and the difference operation will be applied

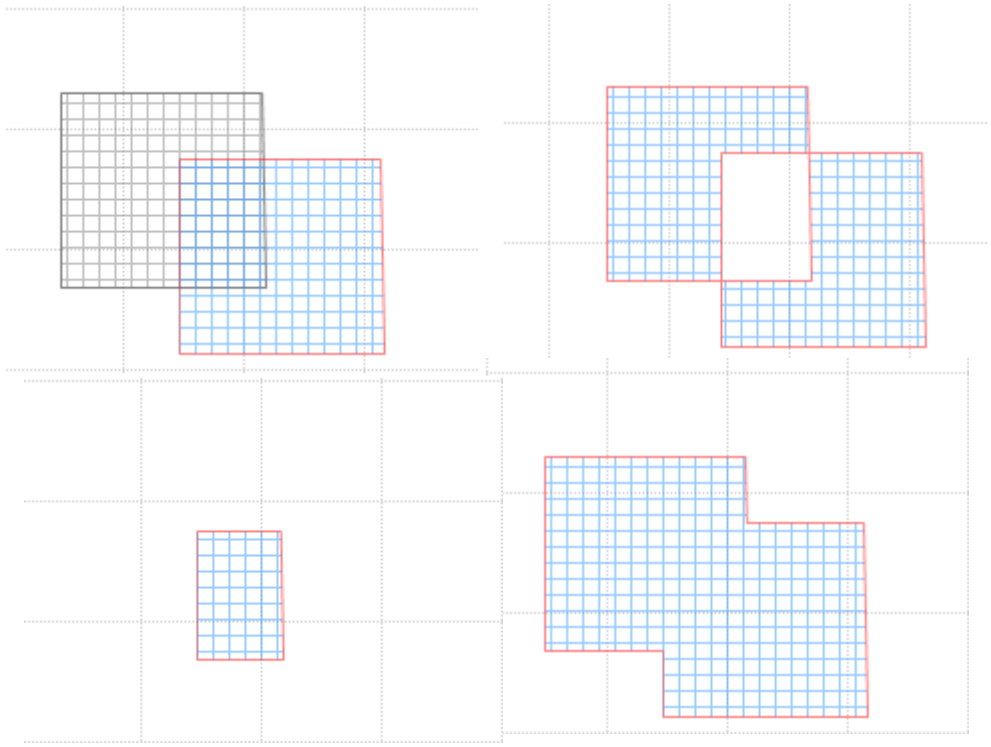






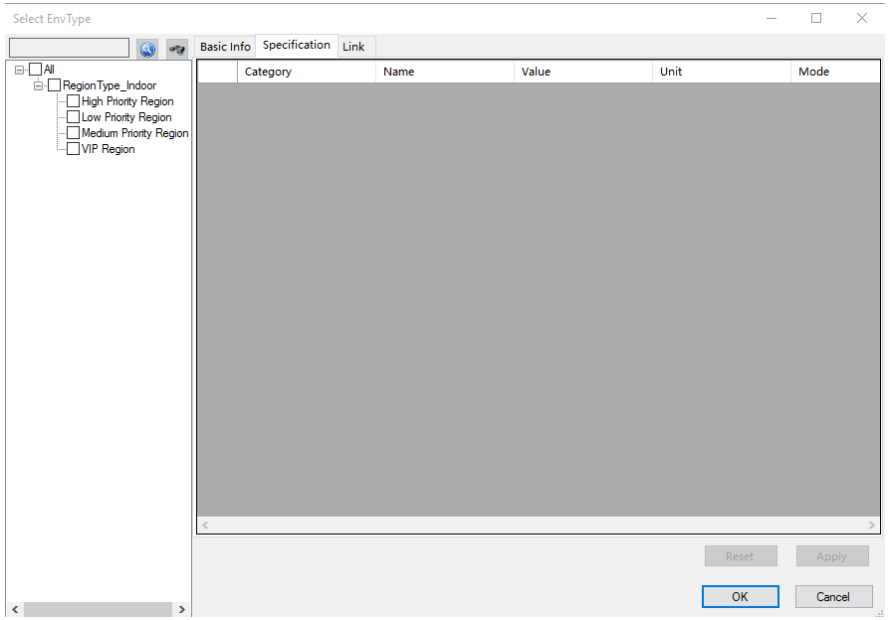
Regions: XOR

- Other tools:
  - Select two or more regions
  - Choose the operation to be used:
    - XOR
    - Intersection
    - Union

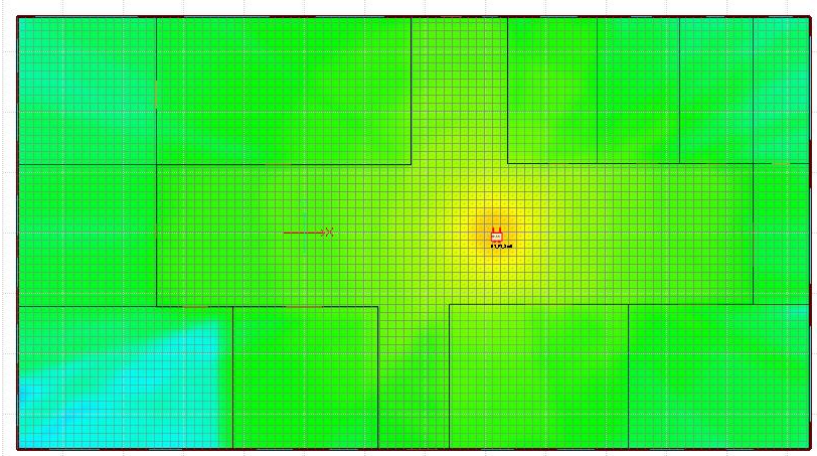


Regions

- Regions can be assigned with different **Target** KPIs to be accomplished in your designs
  - Select a Region
  - In the properties window select **Target** and click the **dotted icon**
  - Select one of the **Environment Types** in the pop-up window
  - **Apply**
  - **OK**



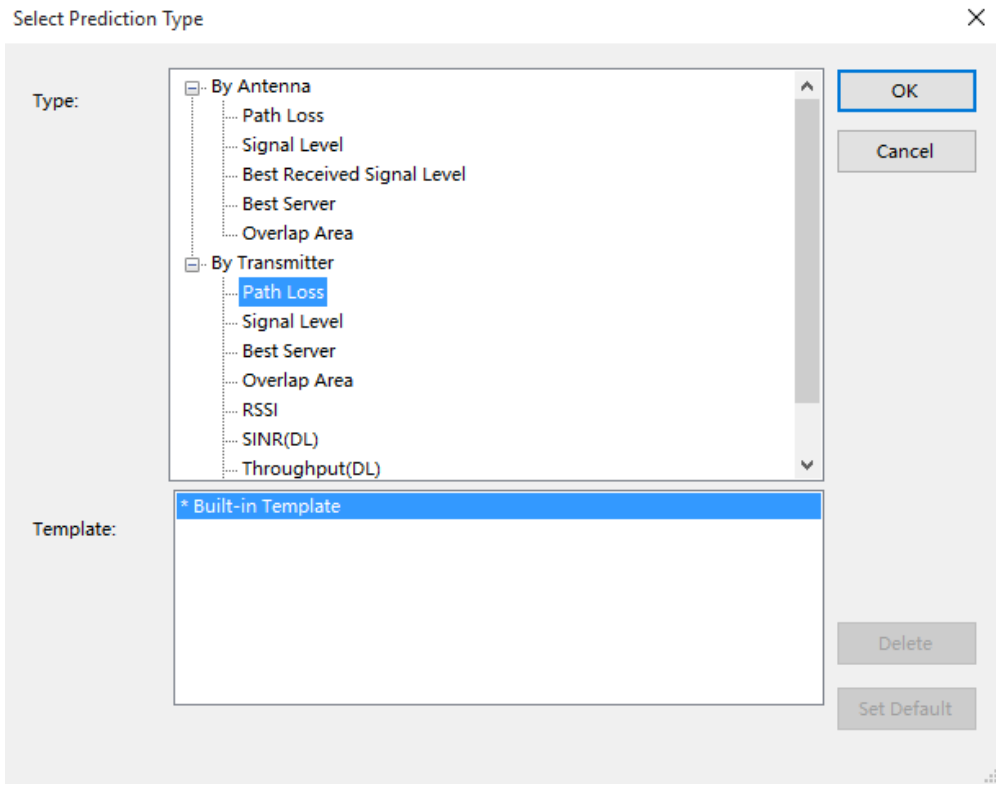
Predictions



- Ranplan includes accurate predictions within the tool
- Predictions are tailored for each wireless system
- Predictions are able to provide accurate performance evaluation in a short period of time, including:
  - path loss calculation
  - signal strength calculation
  - best cell calculation

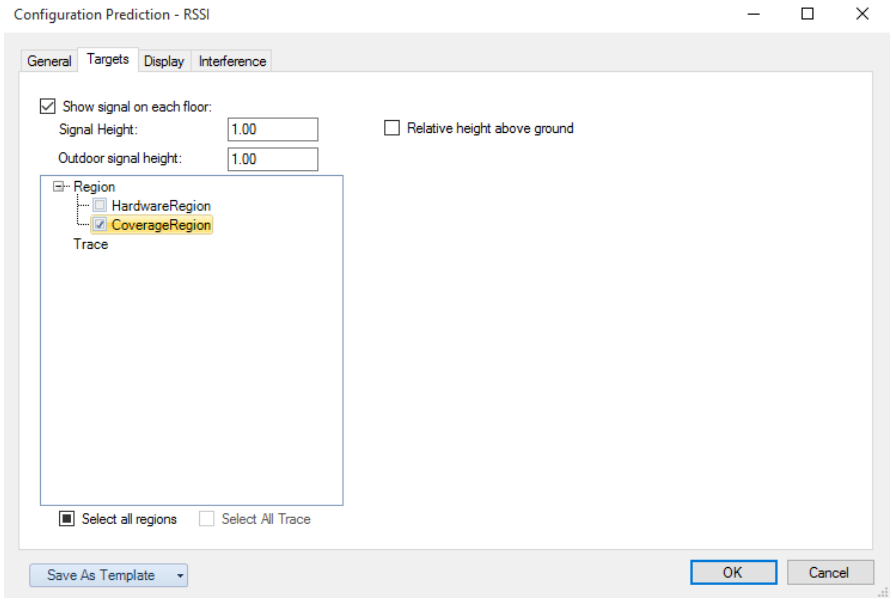
Predictions

- Create a prediction:
  1. Open the **System Explorer** panel
  2. Right Click in **Predictions** under your chosen system
  3. Select **New**
  4. **Select Prediction Type** window will open
  5. Select on of the predictions either by Antenna or by Transmitter



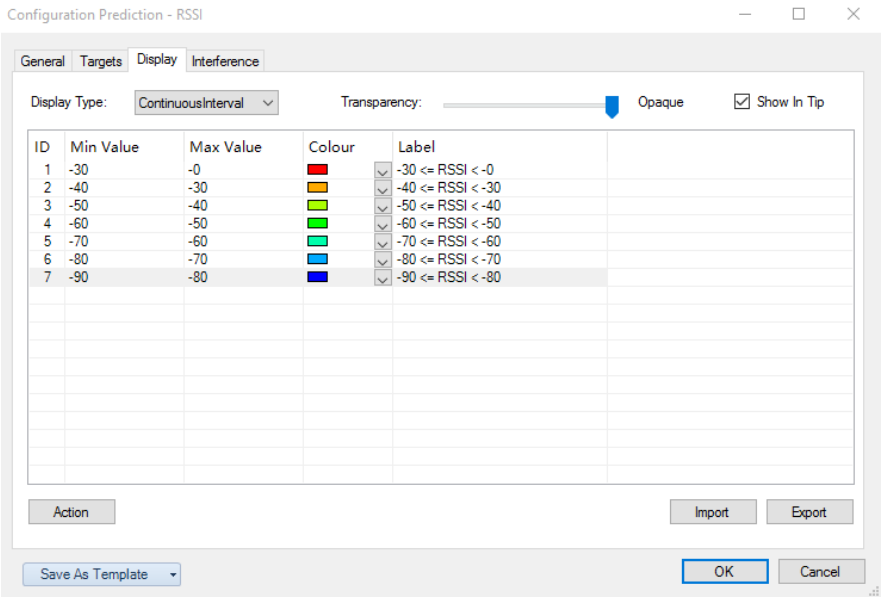
Predictions

- Create a prediction:
  6. The **Configuration Prediction** window will open
  7. In the **General** tab select the **Operator(s)**, **Resolution** and **Comment**
  8. In **Targets** tab user can select the **Regions** where the Prediction will run, if none is selected the whole building will be covered



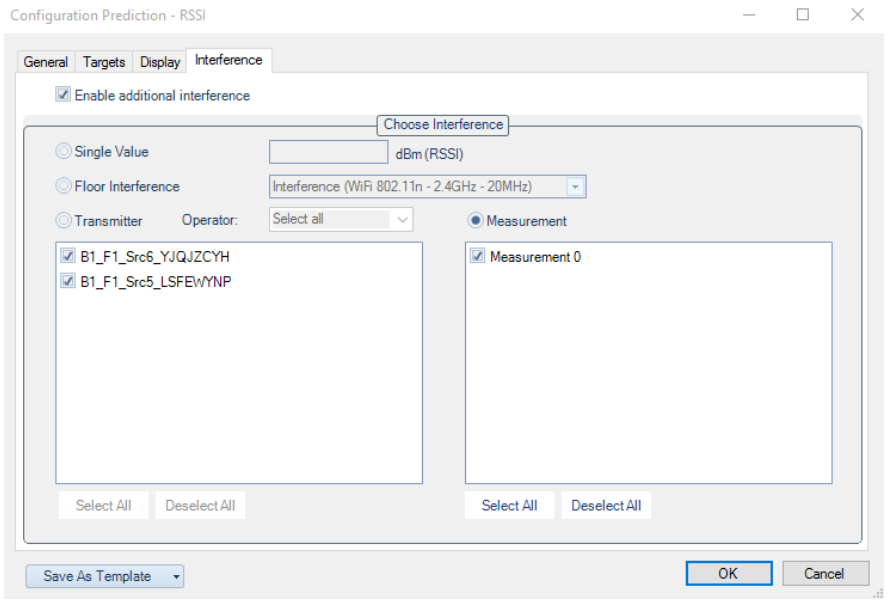
Predictions

- Create a prediction:
  9. In Display tab user can customize the colours and intervals for the predictions
  10. Legend can be Exported as .cfg file
  11. Legends can be imported from a .cfg file



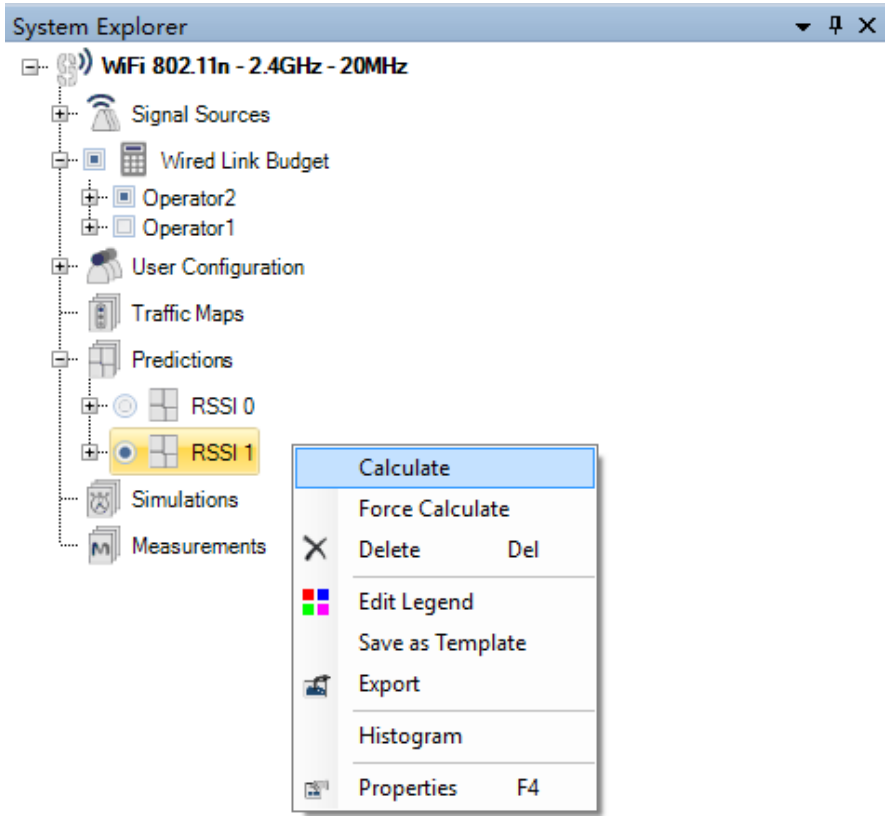
Predictions

- Create a prediction:
  10. Interference effect can be used to generate more accurate predictions with Ranplan.
  11. Ranplan allows to define interference at different levels:
      - Single Value: Homogeneous interference level
      - Floor Interference: Use any Interference defined at any floor level
      - Transmitter: Select which of the transmitters not include in your prediction will be the source of interference
      - Measurement: Use any imported measurement as interference source
  12. Click OK

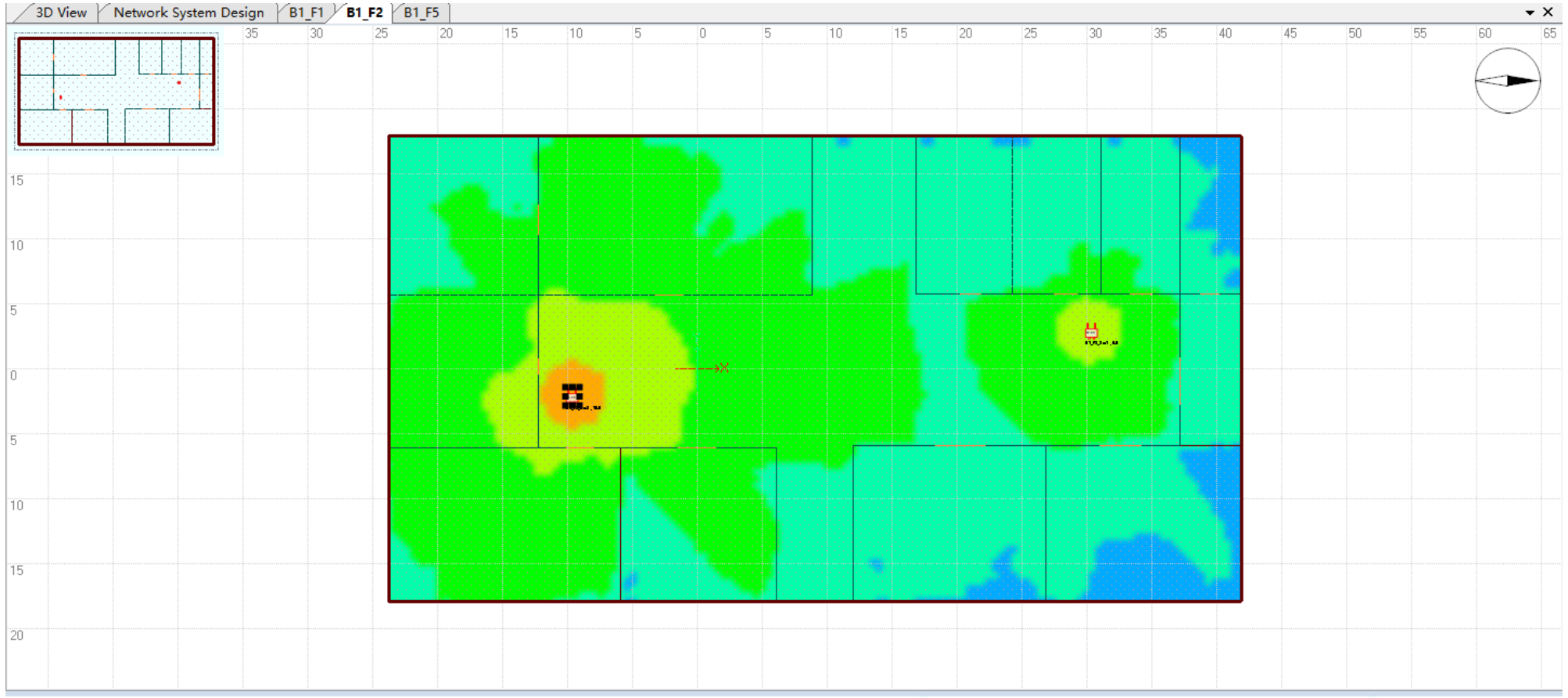


Predictions

- Run a Prediction:
  - In System Explorer panel under Predictions you will see the available predictions
  - Right-click one of the predictions and the Menu will display
  - Press Calculate to run the Prediction (Force Calculate will recalculate the Path-Loss each time)
  - Select the Prediction you want to display once the calculations are finished

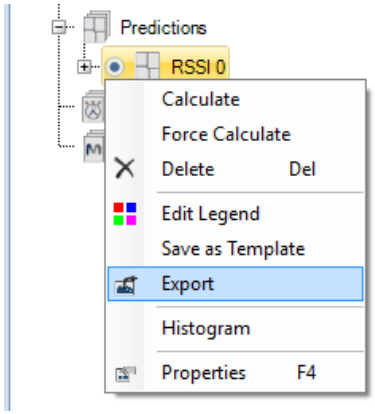


Predictions

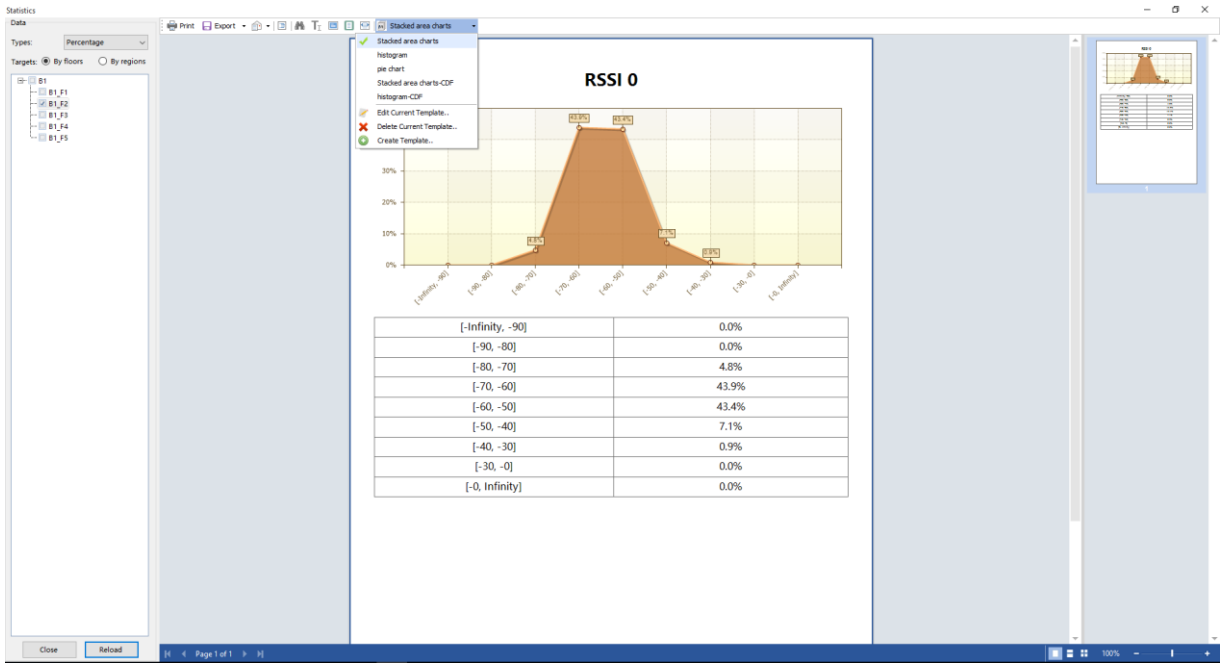


Predictions

- Once the prediction is completed you will be able to:
  - Export the result in text format



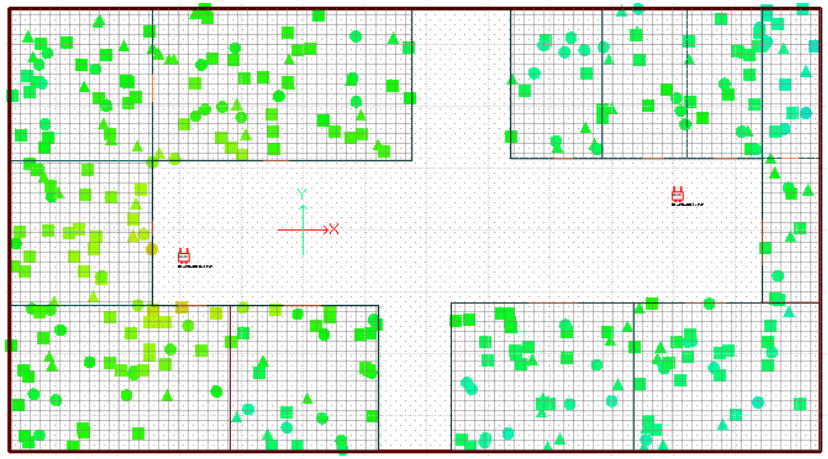
- Generate a report file for your prediction:



Ranplan Professional

Capacity Simulations

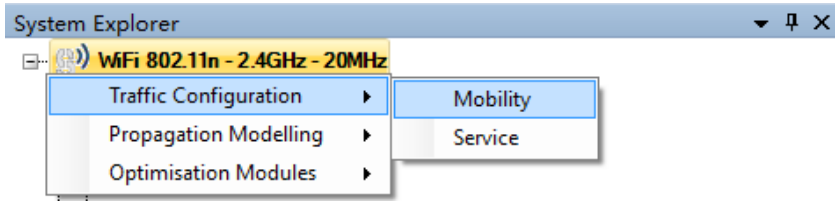
Simulations



- Wireless Network simulation (WNS) is a critical step in the wireless network planning and optimisation
- Provides accurate performance prediction for the deployment of the system
- Ranplan Ranplan uses a semi dynamic simulation method, which means that all wireless network user operations relate to time periods
- This can make full use of the time-frequency resources for scheduling algorithms and improve the performance

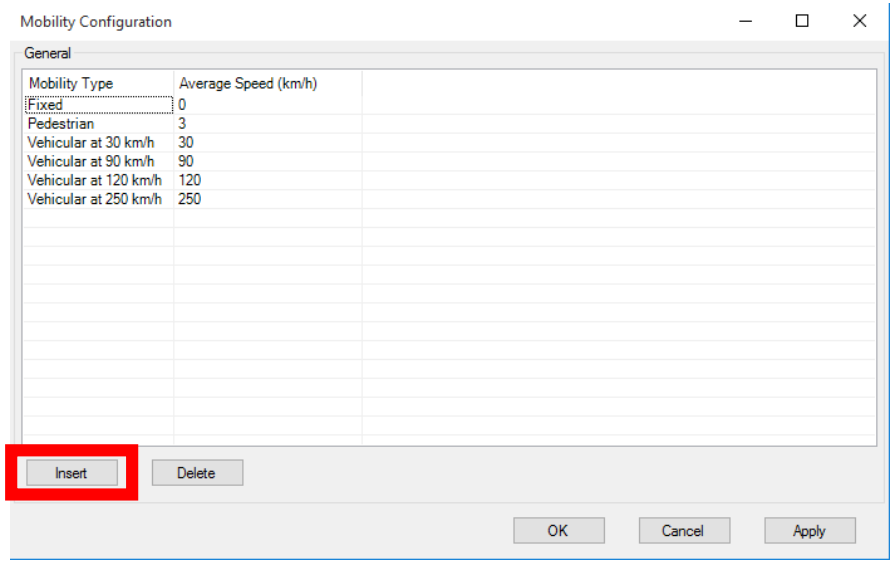
Traffic Configuration

- Before performing a simulation of the designed system, users have to first define the traffic configuration
- To define the traffic configuration:
  - Right-click the signal source's name in the system explorer
  - Select from one of the displayed options in the traffic configuration pop-up menu



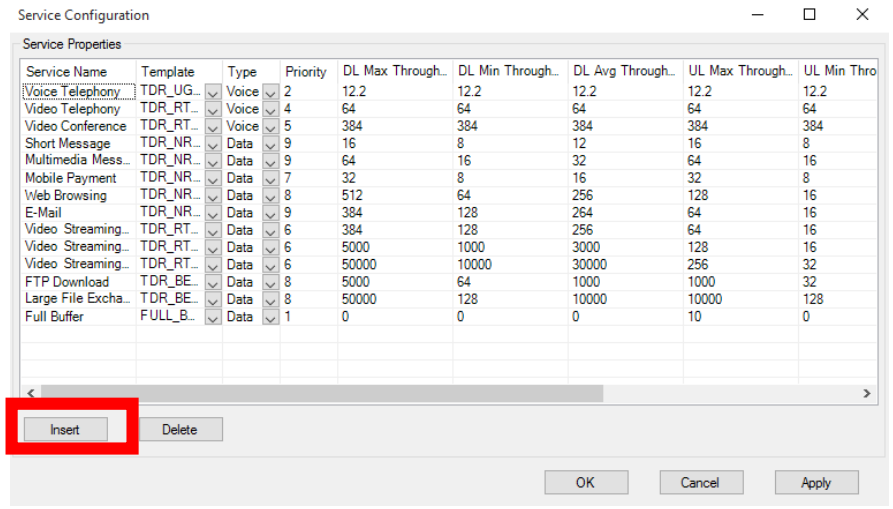
Traffic Configuration

- The **mobility configuration** allows users to set up the terminal's mobility type and average speed
- New templates can be added by clicking **Insert**



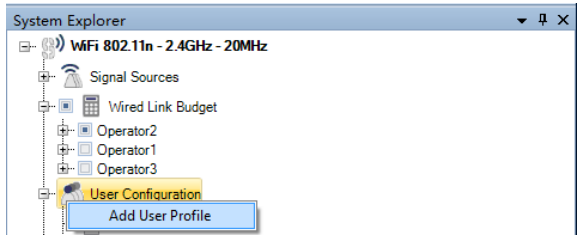
Traffic Configuration

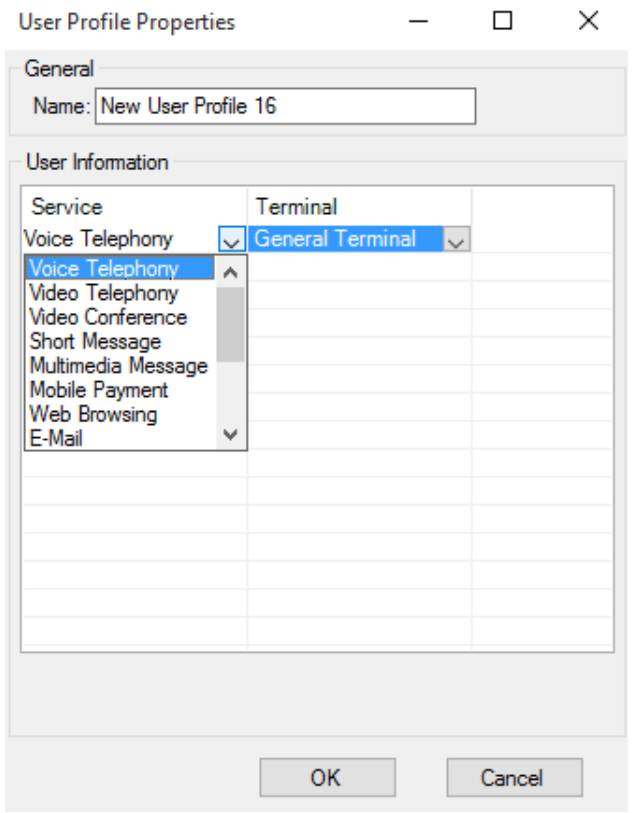
- There are two ways for users to select wireless network services:
  - In the **service management** window, Ranplan provides some default services, users can directly use these default services.
  - Users can change the variables of these default services to meet the system requirements or **Insert** new service template

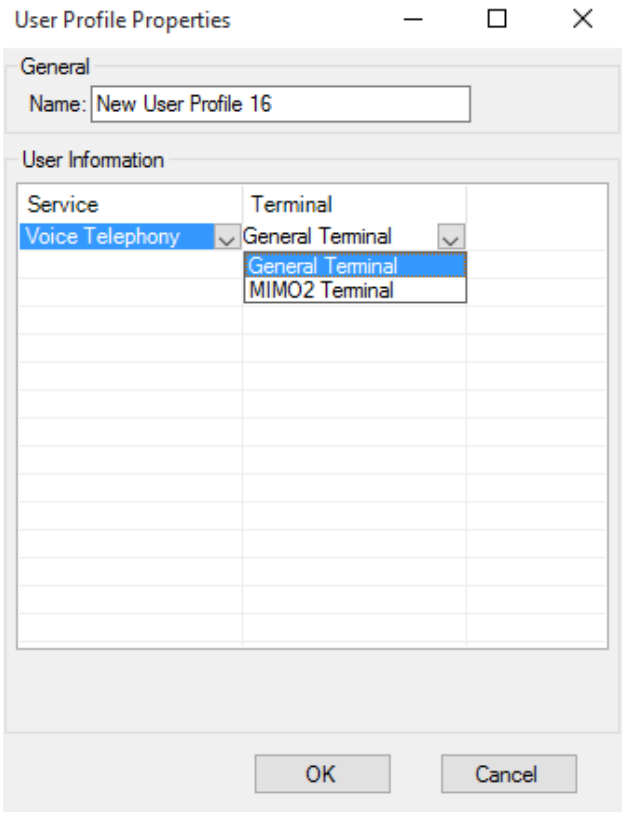


User profile configuration

- This option allows users to **edit** different wireless **network service user profiles** for use within the simulation environment
- Users can right-click on **User Profiles** to add a new user profile

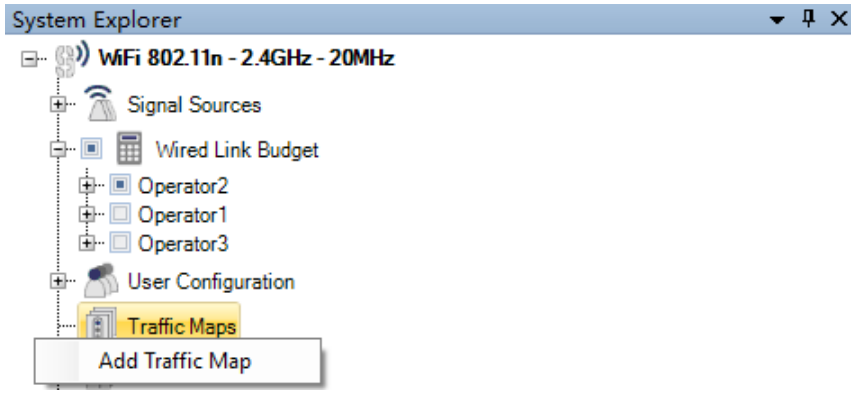


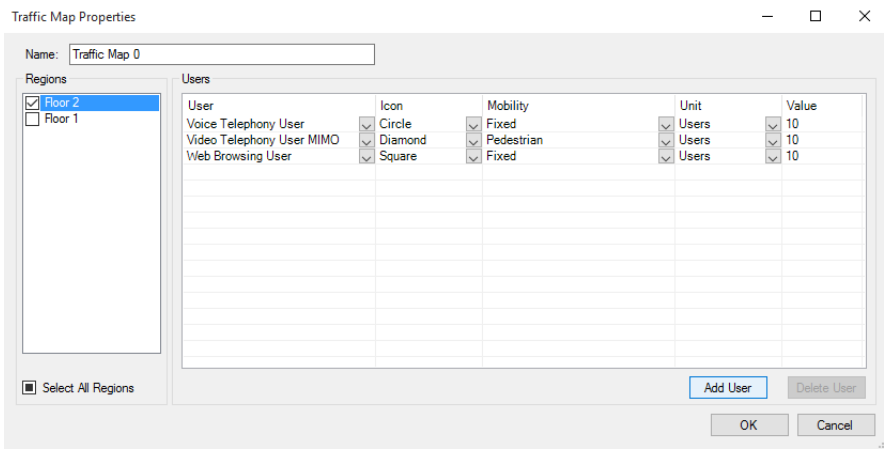




Traffic Map

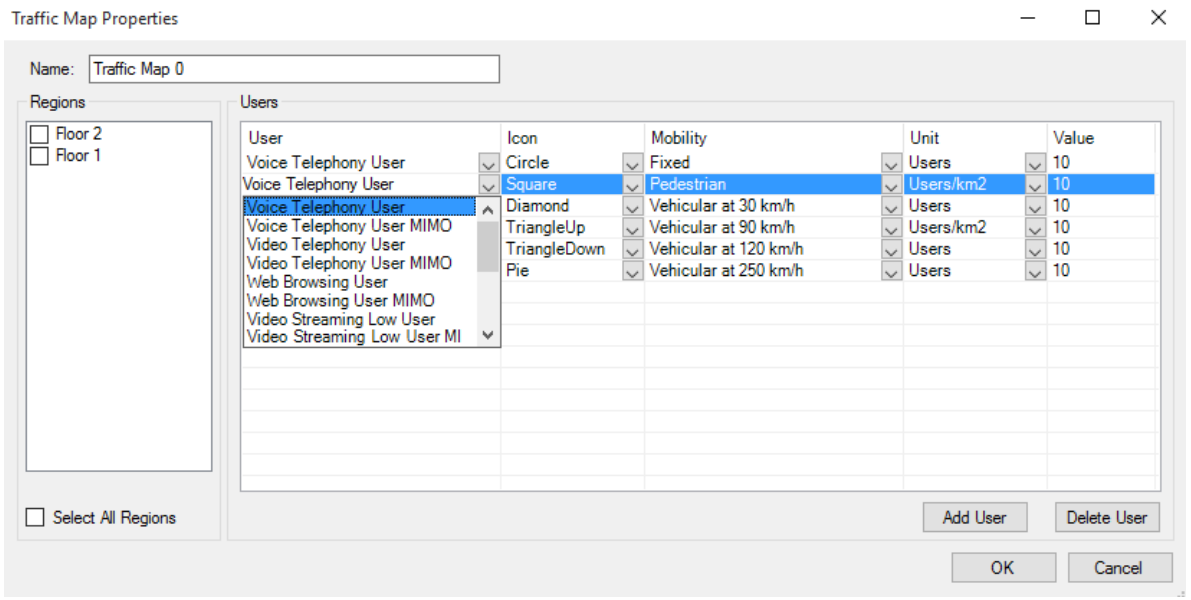
- The traffic map is mainly used to define two things:
  - Which **region** will be **included** in the traffic map
  - **Wireless network users** are present in the traffic map





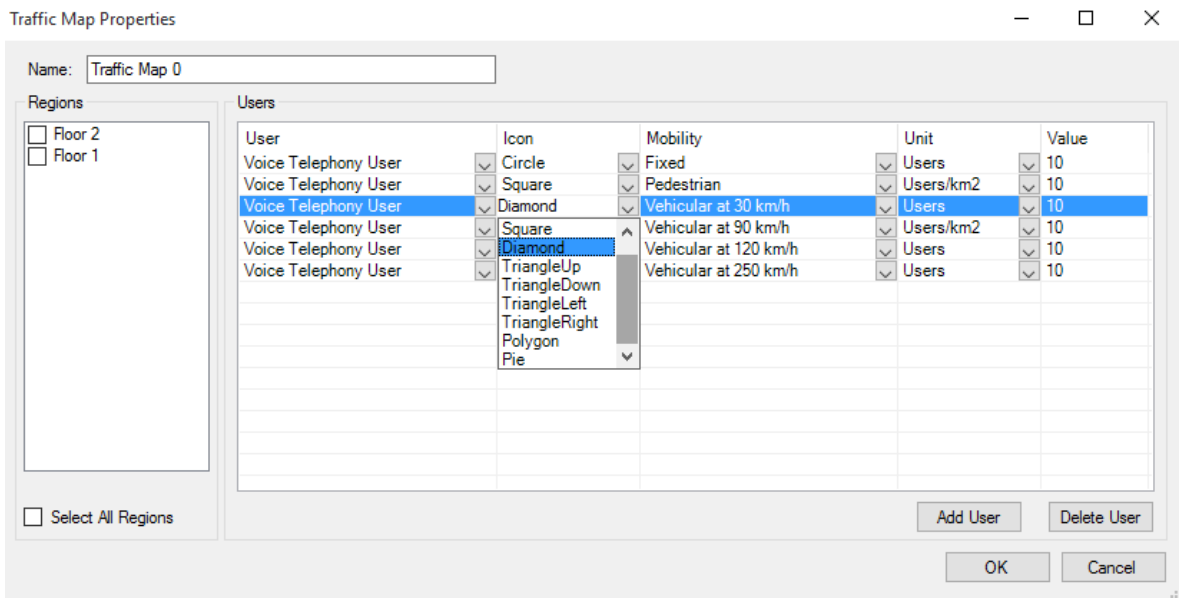
Traffic Map

- **User:** By clicking the drop-down menu icon to select wireless network user type. All of the user types in the drop-down menu are from the previously edited user profiles



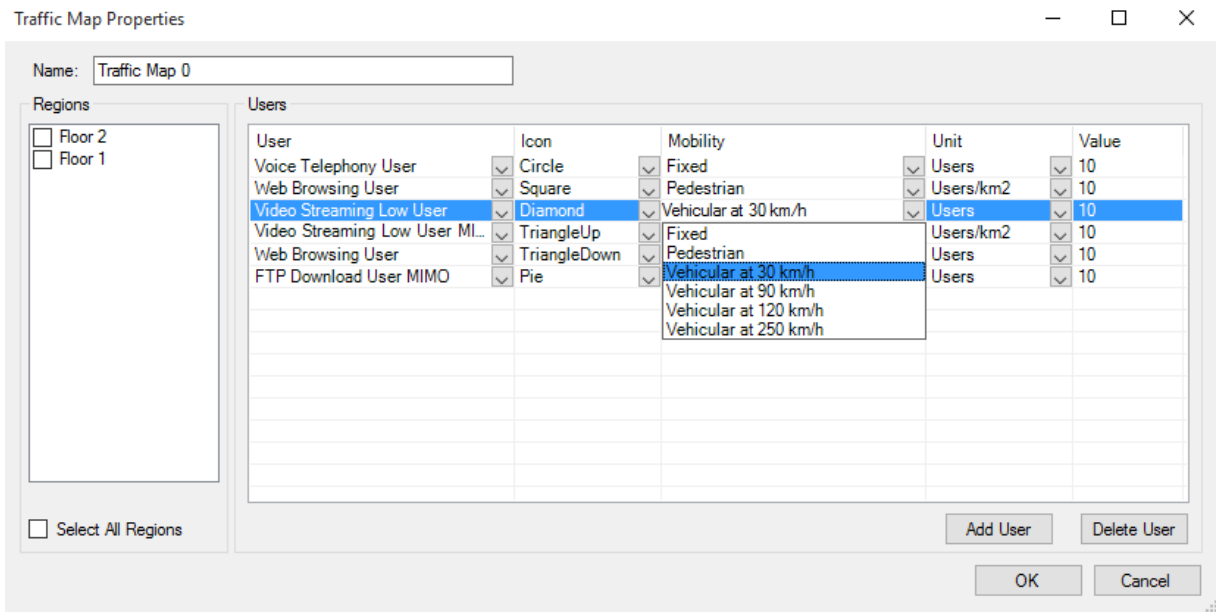
Traffic Map

- **Icon:** Assign different icons to represent different wireless network users



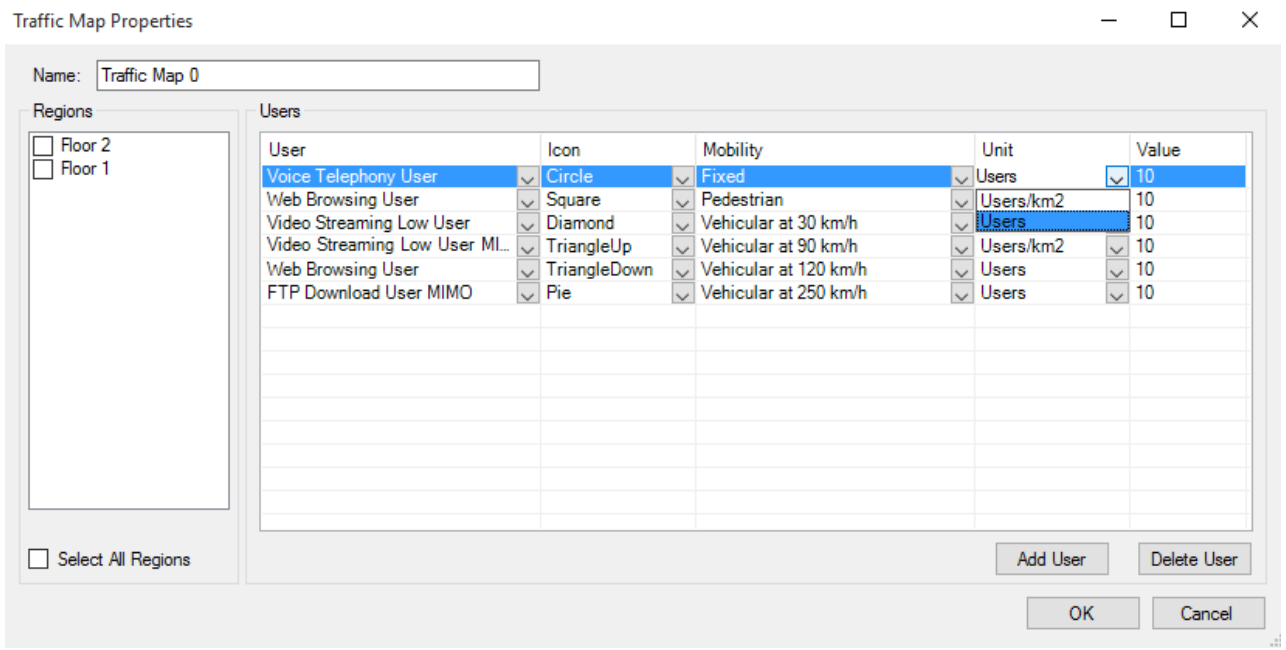
Traffic Map

- **Mobility:** use the mobility drop-down menu to define the terminal mobility type. Mobility templates can be edited in the traffic configuration



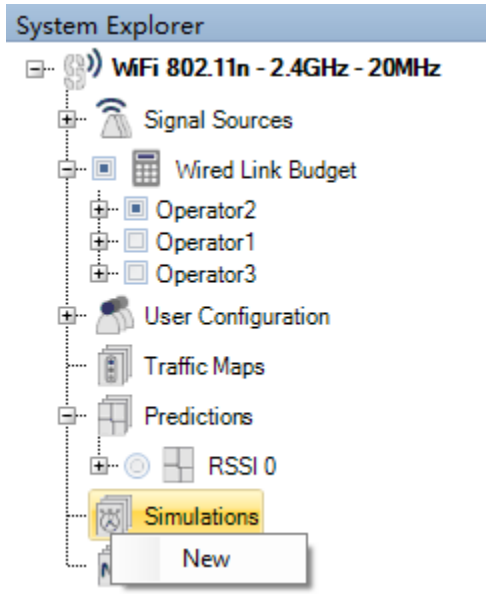
Traffic Map

- **Unit:** Assign user density from *Users* or *Users/km2* from the drop-down menu
- **Value:** Define the amount of users



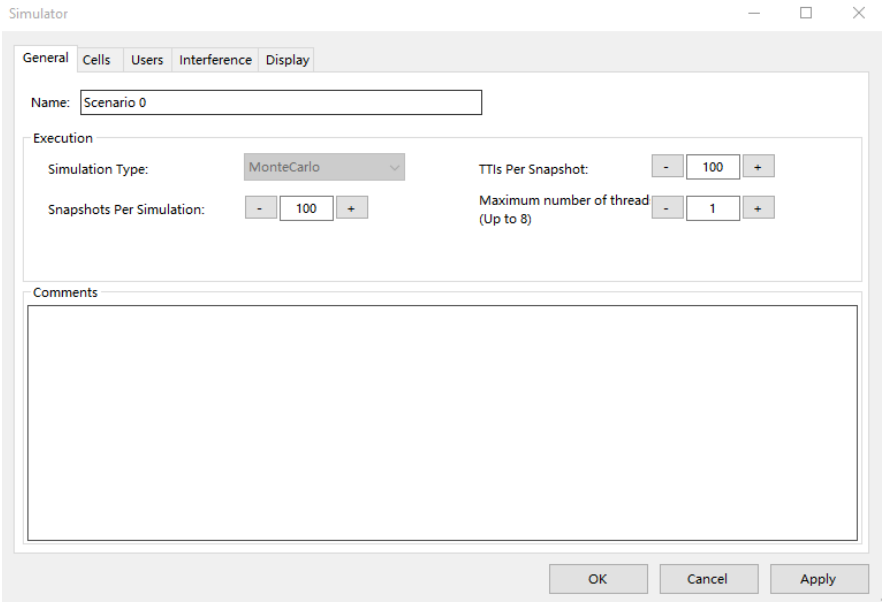
New simulation

- Every system is able to create a number of simulations
- In order to create a new simulation, users have to:
  - right-click on **Simulations**
  - click **New** in the system explorer



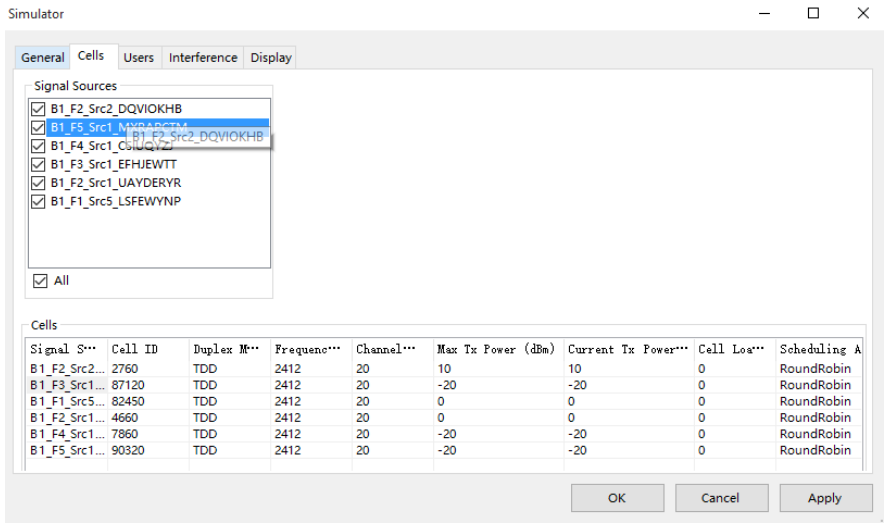
New simulation

- Simulator menu will open
- From the General tab, users are able to define:
  - Name of the current simulation
  - TTIs per snapshot of the simulation
  - Snapshots per simulation
  - Maximum threading
  - Comment
- The TTIs per snapshot and the snapshots per simulation will decide the overall accuracy.



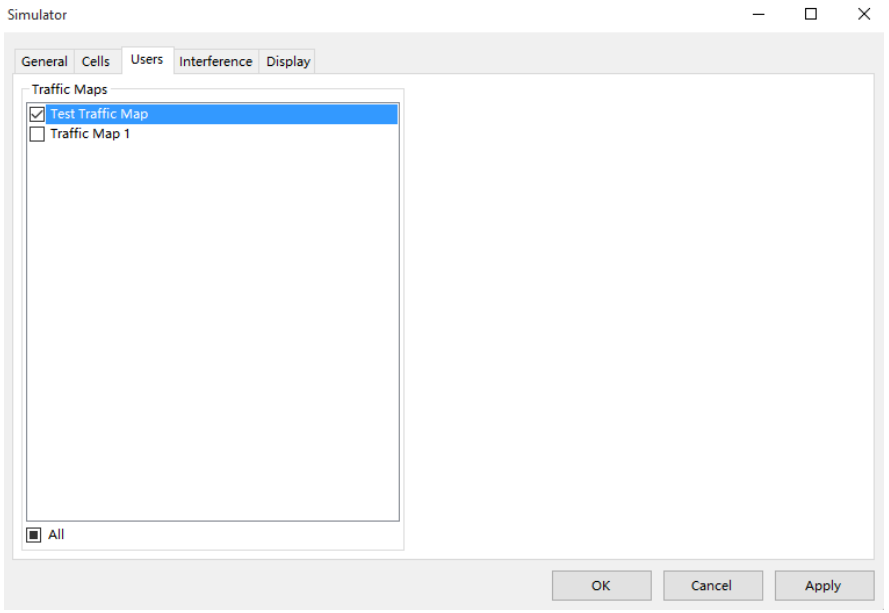
New simulation

- Two parts are included in the **Cells** configuration window:
  - signal sources
  - cells properties



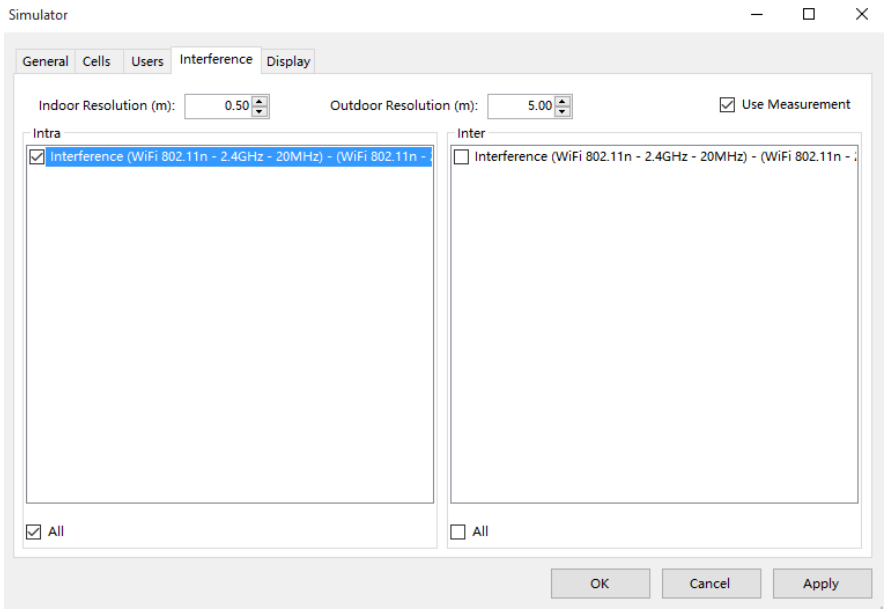
New simulation

- Next step will be selecting the **Traffic Map(s)** defined before to be used in the simulation



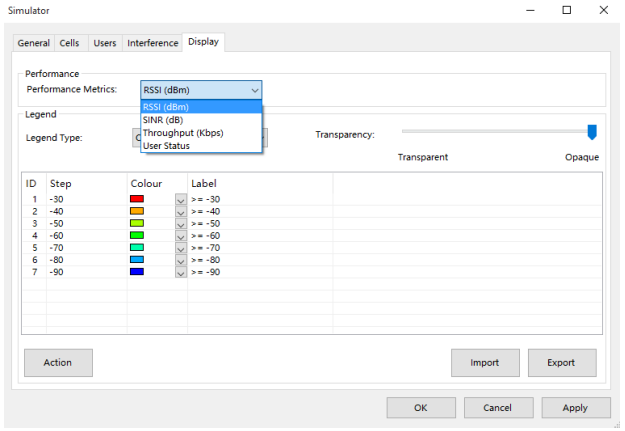
New simulation

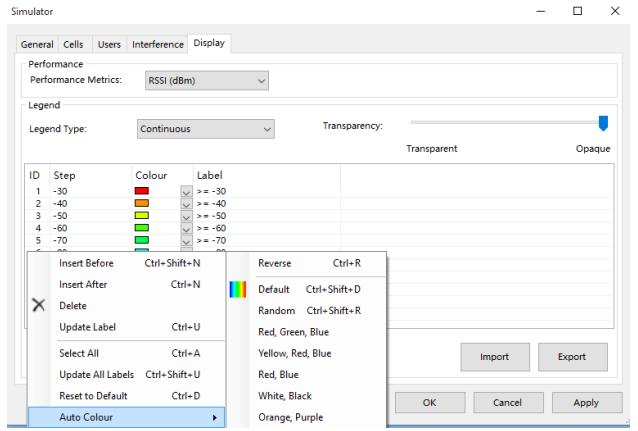
- **Interference** can be defined in the next step
- User can configure:
  - Indoor resolution
  - Outdoor resolution
  - Measurements to be used as:
    - Intra-system interference
    - Inter-system interference

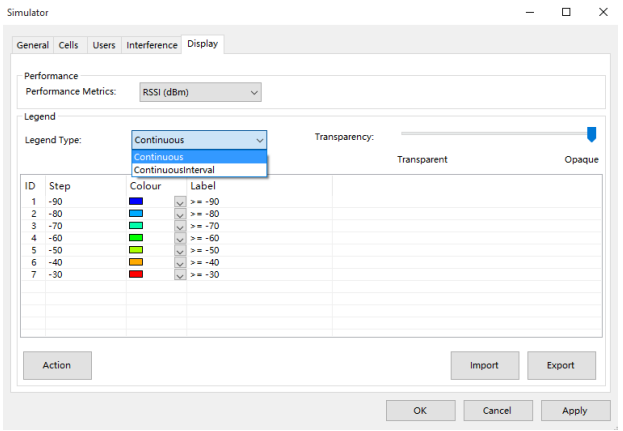


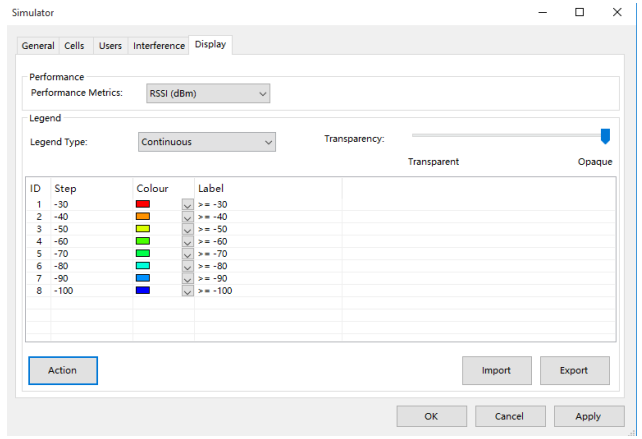
New simulation

- Last step is to configure the **Display** parameters. There are three steps to configure display parameters:
  - Choose the **Performance Metric**
  - Select **Display Type**
  - Configure **Display** legend:
    - Changing
    - Adding
    - Removing
    - Colour of the step can also be customised. The ‘Auto Colour’ function enables users to configure colours of steps automatically



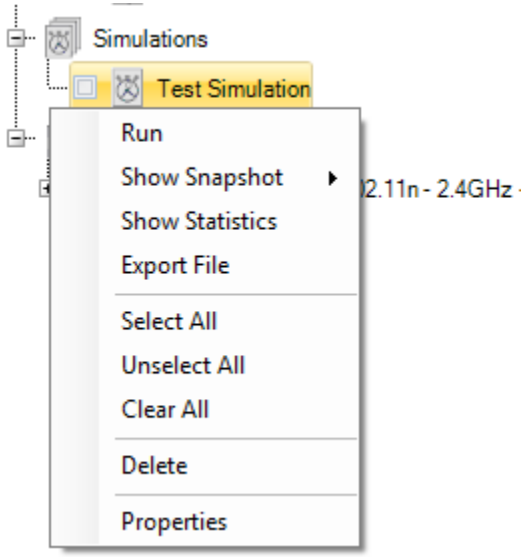






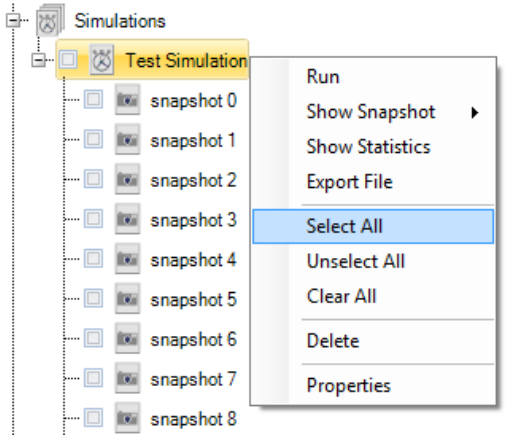
Run simulation

- To **Run** a simulation user needs to:
  - **Right-click** selected simulation in System Explorer panel
  - Select **Run**



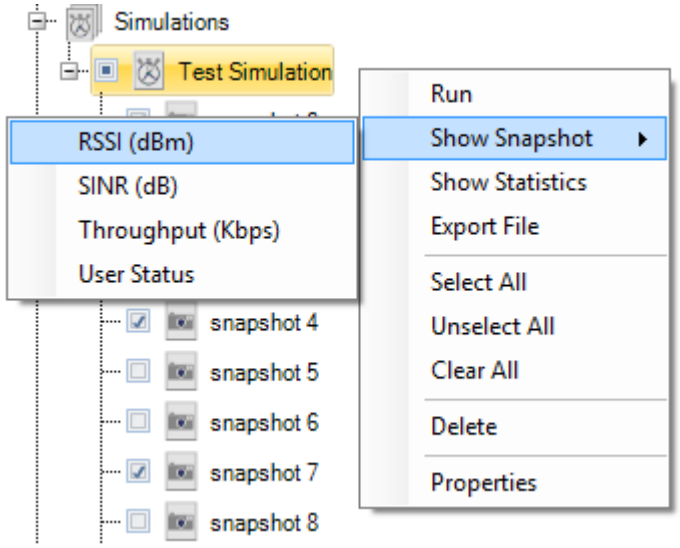
Display simulation

- Users are able to check the simulation results once the calculation has been completed. The result can be viewed as snapshot in FLD (2D) view or by a statistical results list
- Once the calculation is finished, a snapshot list will appear under the newly created simulation. Users can select snapshots individually or right-click the simulation name and select ‘Select All’



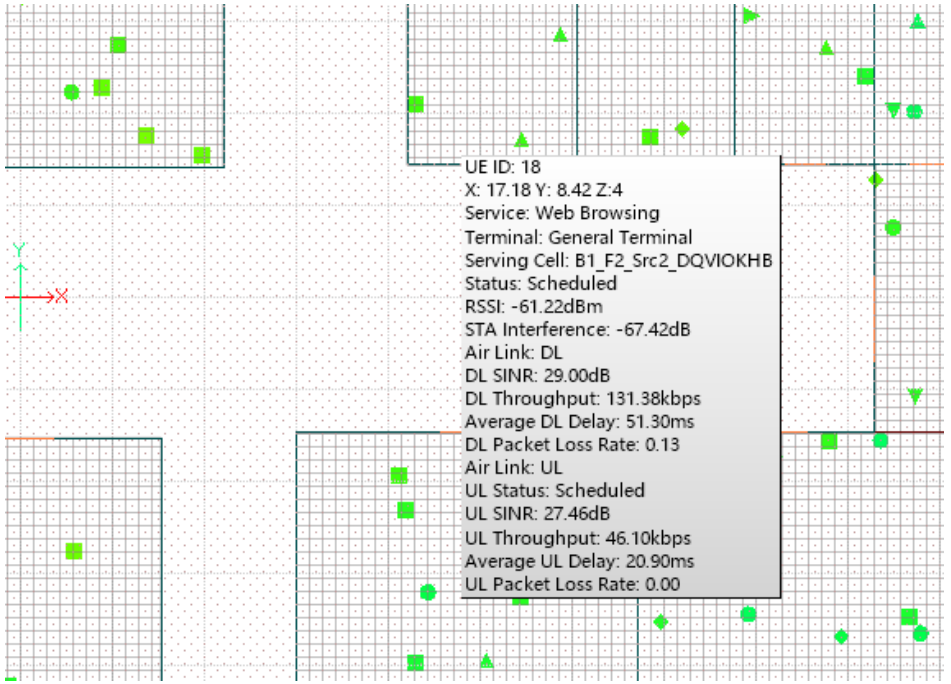
Display simulation

- After these snapshots have been selected, users can right-click the simulation name, and choose what kind of simulation result they want to view in FLD



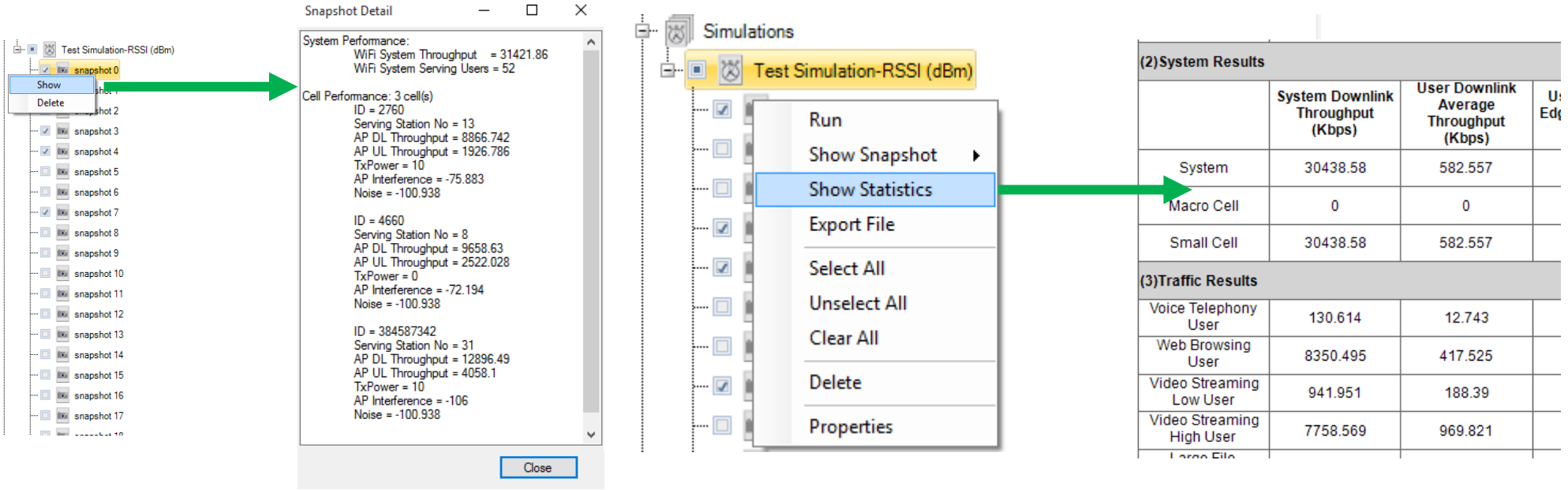
Display simulation

- To check the specific statistical information, users need to move the mouse pointer over the snapshot in the FLD view



Display simulation

- Users can check the snapshot statistical information by right-clicking on the snapshot and selecting **Show**
- Also users can select which snapshot they want by using **Show Statistics**

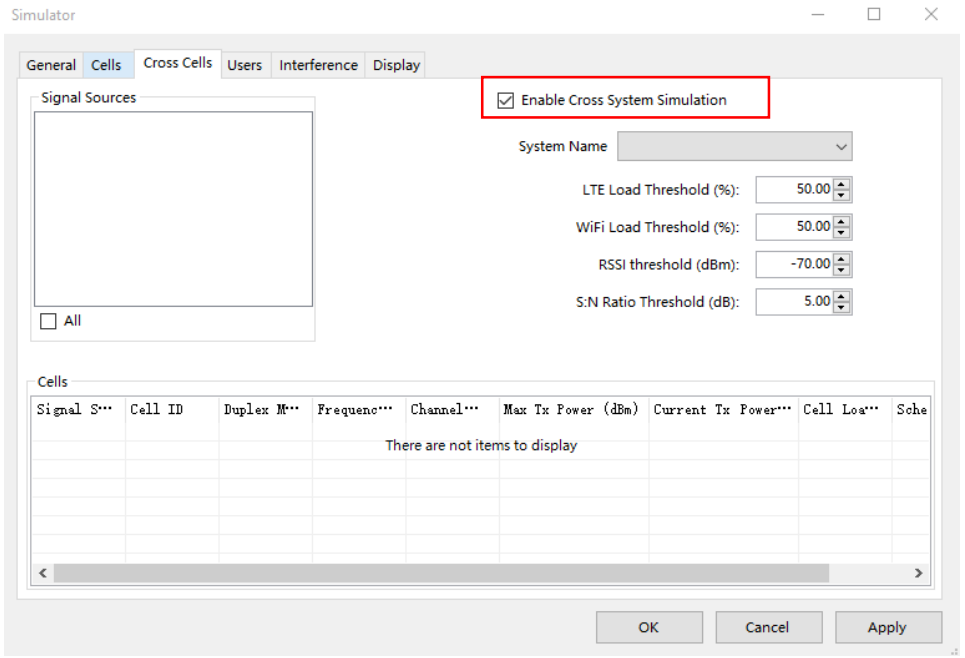


Cross-System Simulation

- Ranplan Professional allows users to perform cross system simulations within the WNS module
- This allows for the accurate modelling of traffic steering based on user definable criteria for UE handover between, for example, the LTE and Wi-Fi systems in the current design
- Users may define the following criteria controlling the handover of UEs between different systems within the current design:
  - Maximum LTE Load Threshold (%)
  - Maximum Wi-Fi Load Threshold (%)
  - Minimum Wi-Fi RSSI Threshold (dBm)
  - S:N Ratio Threshold (dB)

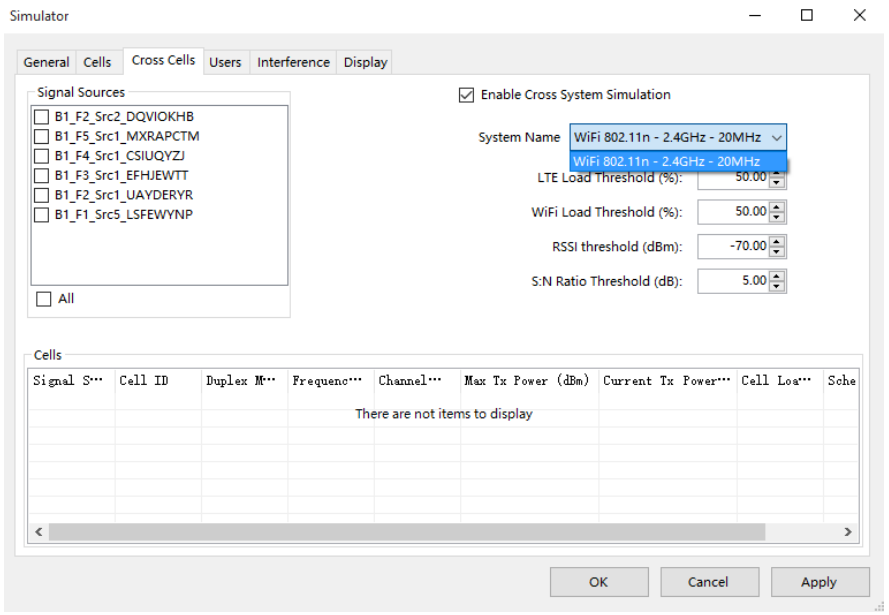
Cross-System Simulation

- To run a cross-system simulation using the **WNS** in Ranplan Professional:
  - Add a **primary system** to the system design
  - Add a **secondary system** to the system design (this can be present on the same or different equipment set)
  - Open and configure the WNS. This includes creating the target region, setting up a traffic map and configuring the primary system and cells to be considered in the simulation
  - Navigate to the **Cross Cells** category of the WNS configuration form and tick the check box labelled **Enable Cross System Simulation**



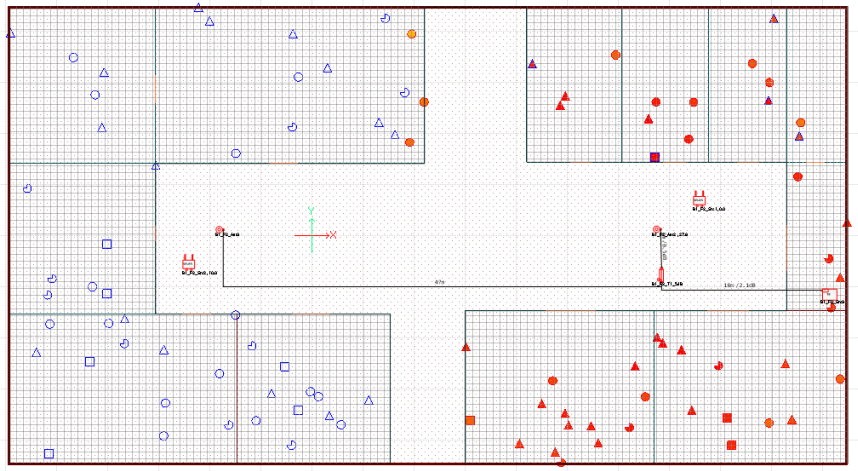
Cross-System Simulation

- New options will now be accessible to the user, these include:
  - **System** – This is the system to which UEs connected to the primary system will be steered
  - **LTE Load Threshold (%)** – This is the cell load threshold for the LTE system. Once exceeded, the system will attempt to steer UEs to the Wi-Fi system if the following conditions are met:
    - **Wi-Fi RSSI Threshold (dBm)** – A UE primarily connected to the LTE system and nominated for offload to the Wi-Fi system will only try to connect to the Wi-Fi system if it is within this signal threshold. 332
    - **Wi-Fi Load Threshold (%)** – Once the Wi-Fi system reaches this threshold the simulation will no longer attempt to offload to the Wi-Fi system.
    - **S:N Ratio Threshold (dB)** – The maximum signal to noise ratio for a handover between systems
  - Wi-Fi **signal sources** or nodes will be considered for the offload or traffic steering of UEs.



Cross-System Simulation

- **Run** the simulation
- **Tick the snapshots** to be displayed on the floor plan
- In the example the red figures represent UEs connected to the LTE system and blue circles represent UEs connected to the Wi-Fi system



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