Siradel Planner User Guide

Version 3.7

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CONTENT

Introduction

Software Siradel Planner is a radio planning tool for the design of

- Outdoor & Indoor mobile networks
- FWA (Fixed Wireless Access)
- IOT (LoRaWAN) networks

Two modes of Siradel Planner are available

- Standalone (Desktop): compatible with Windows 10 and 11, and Windows Server 2019
- SaaS: remote connection to Siradel's SaaS server with login information

Main Features and Scope

Coverage simulation : coverage and capacity simulations for outdoor, indoor, outdoor-to-indoor and indoor-to-outdoor scenarios.

Automatic cell selection : identify optimal locations for new sites, whether it's for greenfield deployments or network densification.

Automatic cell planning : optimize the antenna configurations (tilt, azimuth, transmit power, etc.) to reach network planning objectives.

3D coverage simulation and visualization : offer 3D views of buildings to illustrate their indoor penetration and facade coverage.

Point to Point and Point to Multiple Points simulation: model radio links either between two defined locations (Point-to-Point) or from a single transmitter to multiple receivers (Point-to-Multipoint). It generates vertical path profiles for each link and provides detailed input parameters, link budget calculations, and performance results, including link reliability and capacity estimates for each simulated path.

Fixed Wireless Access network planning : determine available service levels before signing up new FWA subscribers and use location data and radio access network insights to optimize cell selection.

Backhaul network planning and simulation : point-to-point and point-to-multipoint analysis and automatic planning.

Multiple technologies and multiple frequency bands :

LTE/5G, LoRa, Wifi and non-standard technologies

Sub-6 GHz, mmWave bands

Vector editor : create and edit polygons in the LOD1 environment.

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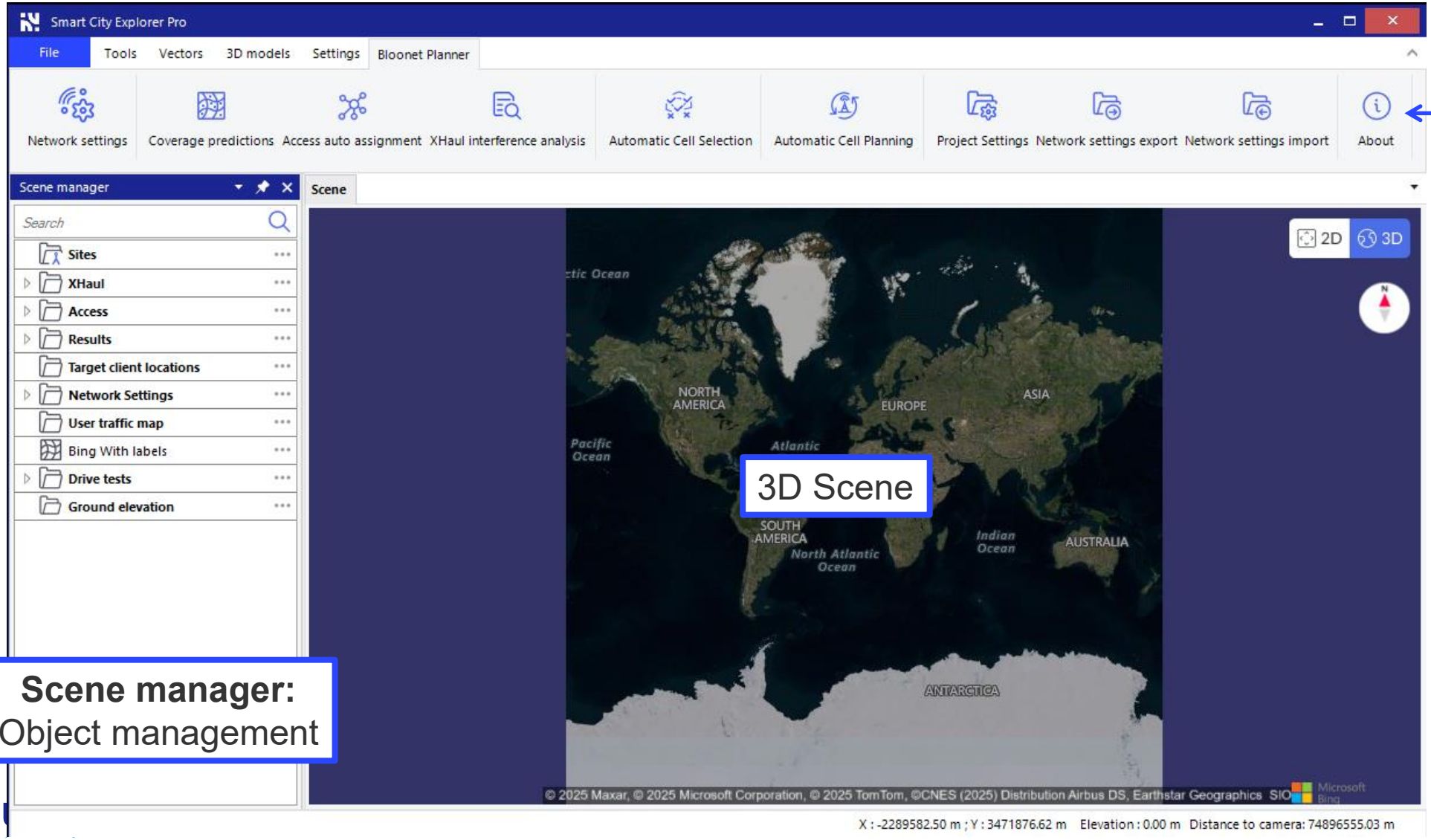
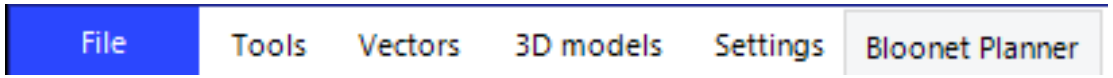
Main Windows



Scene manager:
Object management

Menu Bar : main items



Tools

- Address search
- Bing Maps display
- Ruler
- **Add zones**
- Clipping
- Viewpoints
- Screenshot
- **GIS select/extract**
- **Projection**
- **Point mapping**
- Terrain colorization options
- Resize

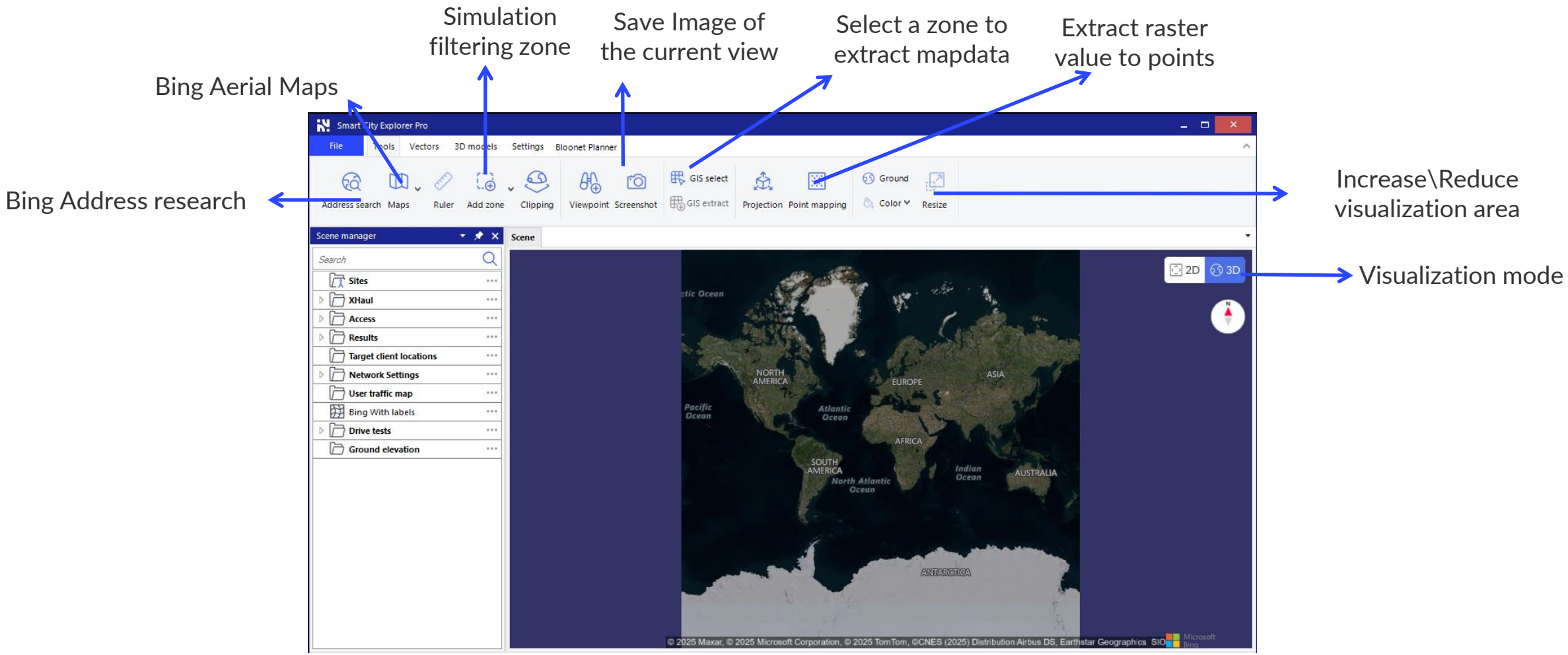
Settings

- Display
- Compass
- Windows → **Windows**
  - Animation editor
  - Legend
  - Logs
  - Palette editor
  - Properties
  - Scene manager
- Full screen
- Plugins

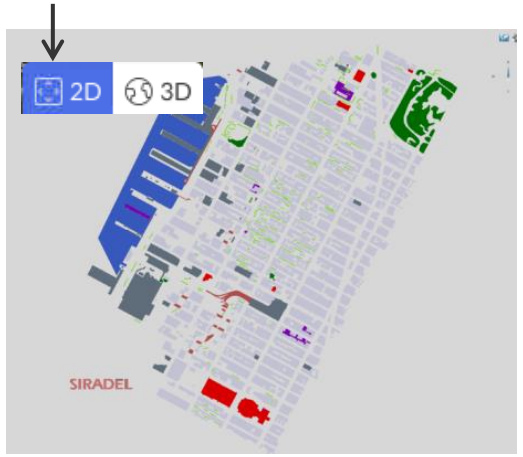
Bloonet Planner

- Network settings (Create/Export/Import)
- Shortcut for Coverage predictions
- Shortcut for Access auto assignment
- Shortcut for XHaul Interference analysis
- Shortcut for Automated Cell Selection
- Project Settings
- About

GUI Overview - Tools

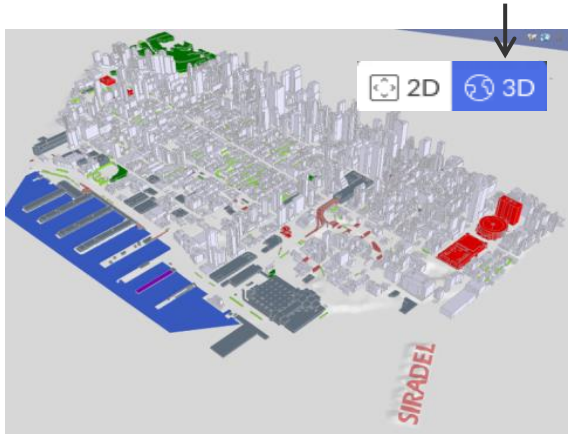


Visualization and navigation tips



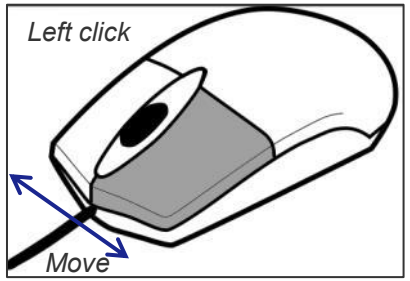
2D view

- Equivalent to the 3D view with the camera positioned in top view
- Camera rotation is blocked

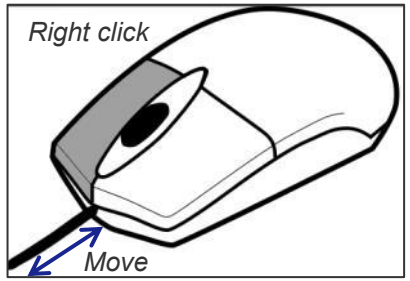


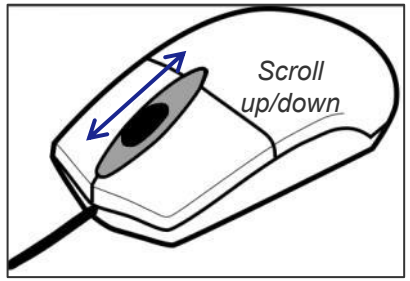
3D view

- Movement of the camera possible in the 3 axes with a left click + movement of the mouse and the wheel
- Rotation of the camera possible in 2 axes with a wheel click + mouse movement

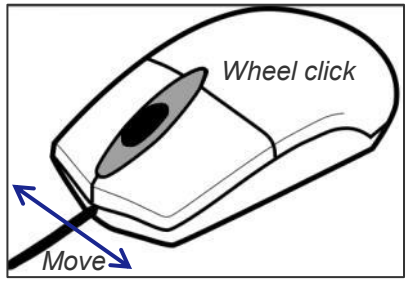


Move map



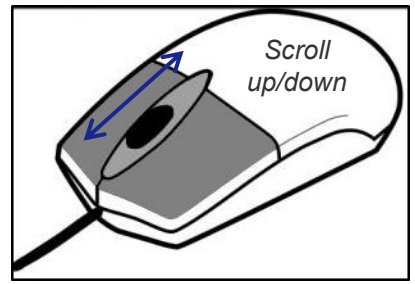


Zoom in/out



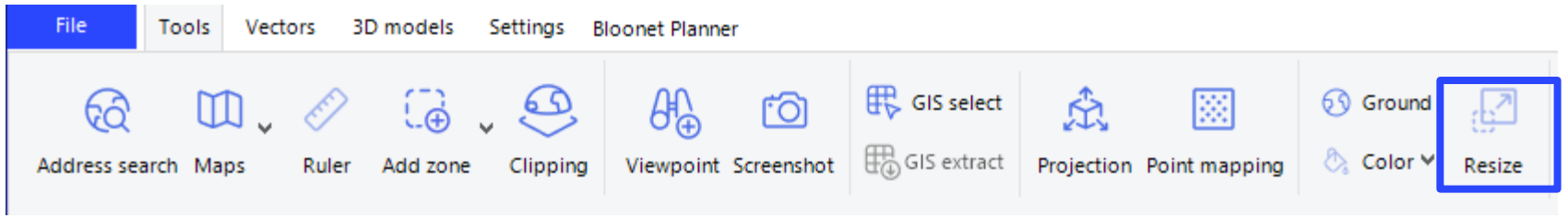
Move around

Use left and right clicks to move around with mouse without scrolls



Change viewpoint

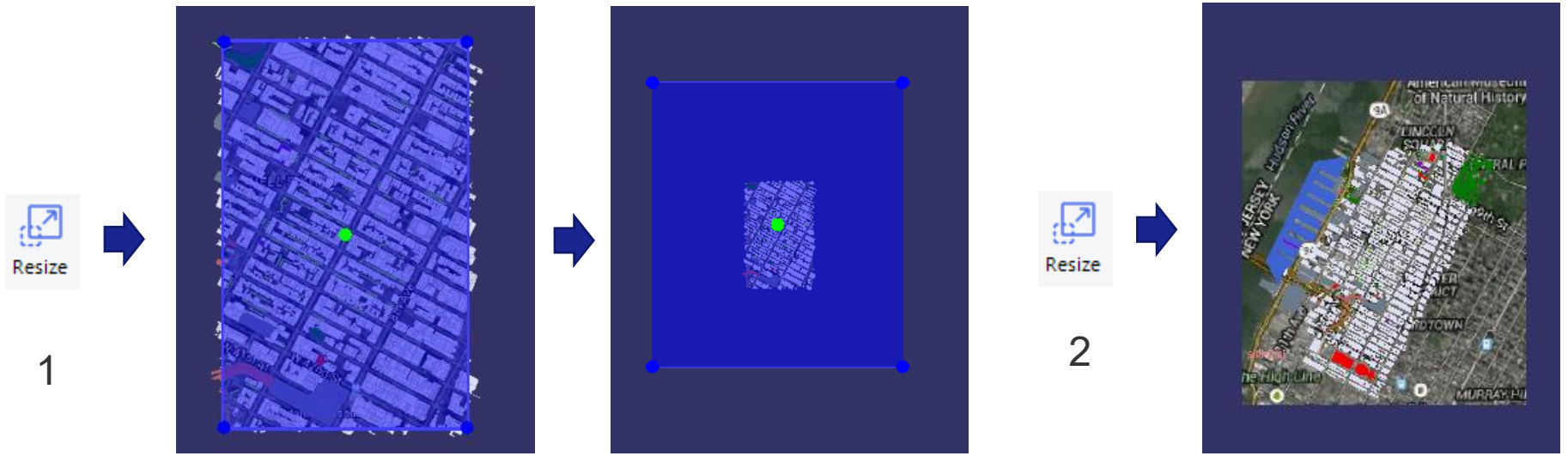
Resize



Resize enables to increase or reduce the working area that the user can visualize in the scene

1, Click on Resize to select the geographical area

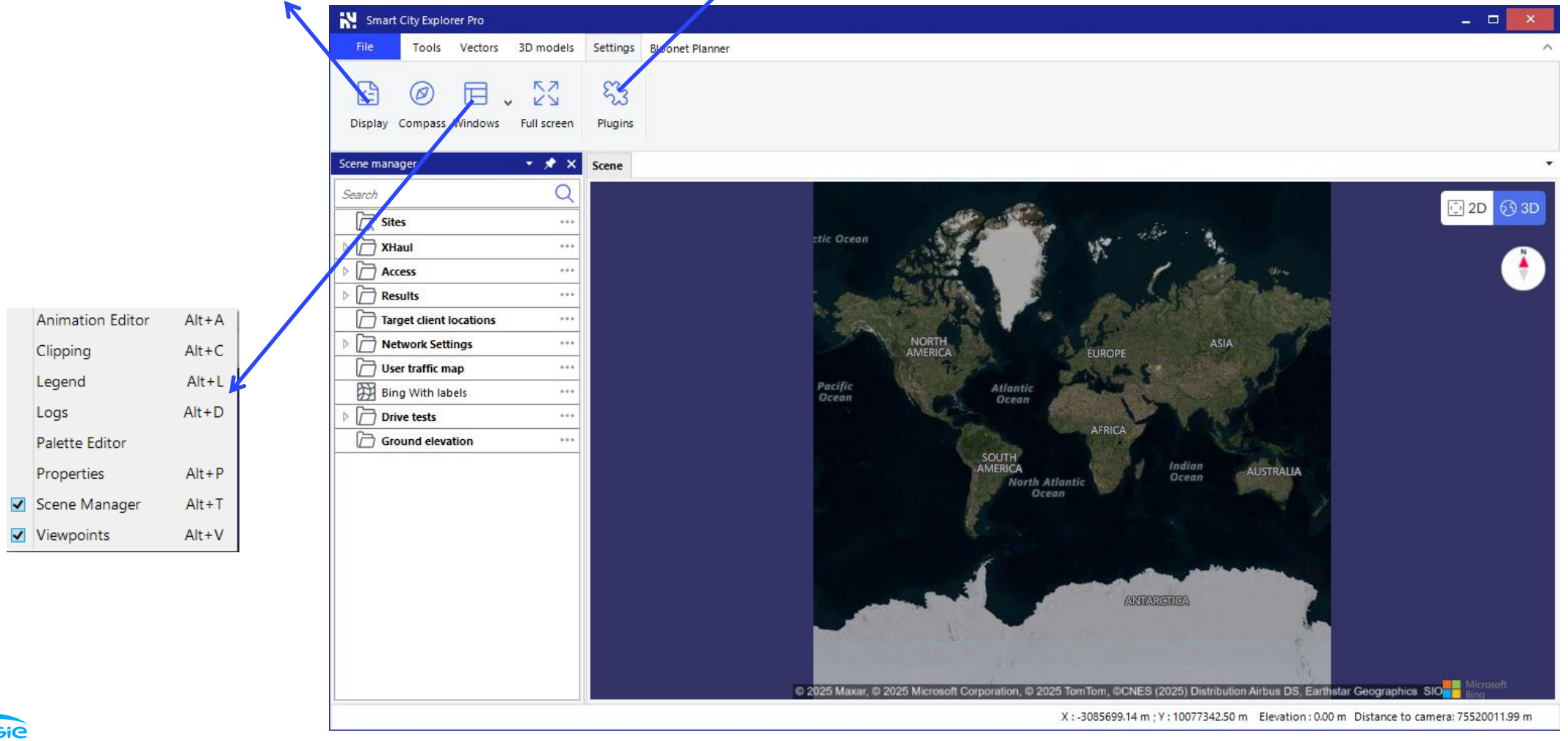
2, Click again on Resize to validate



GUI Overview - Settings

Display properties
(e.g. switch from Metric to Imperial system)

Siradel tool plug-ins (Bloonet Planner, InoWave, Building Creator.)



GUI Overview - Bloonet Planner

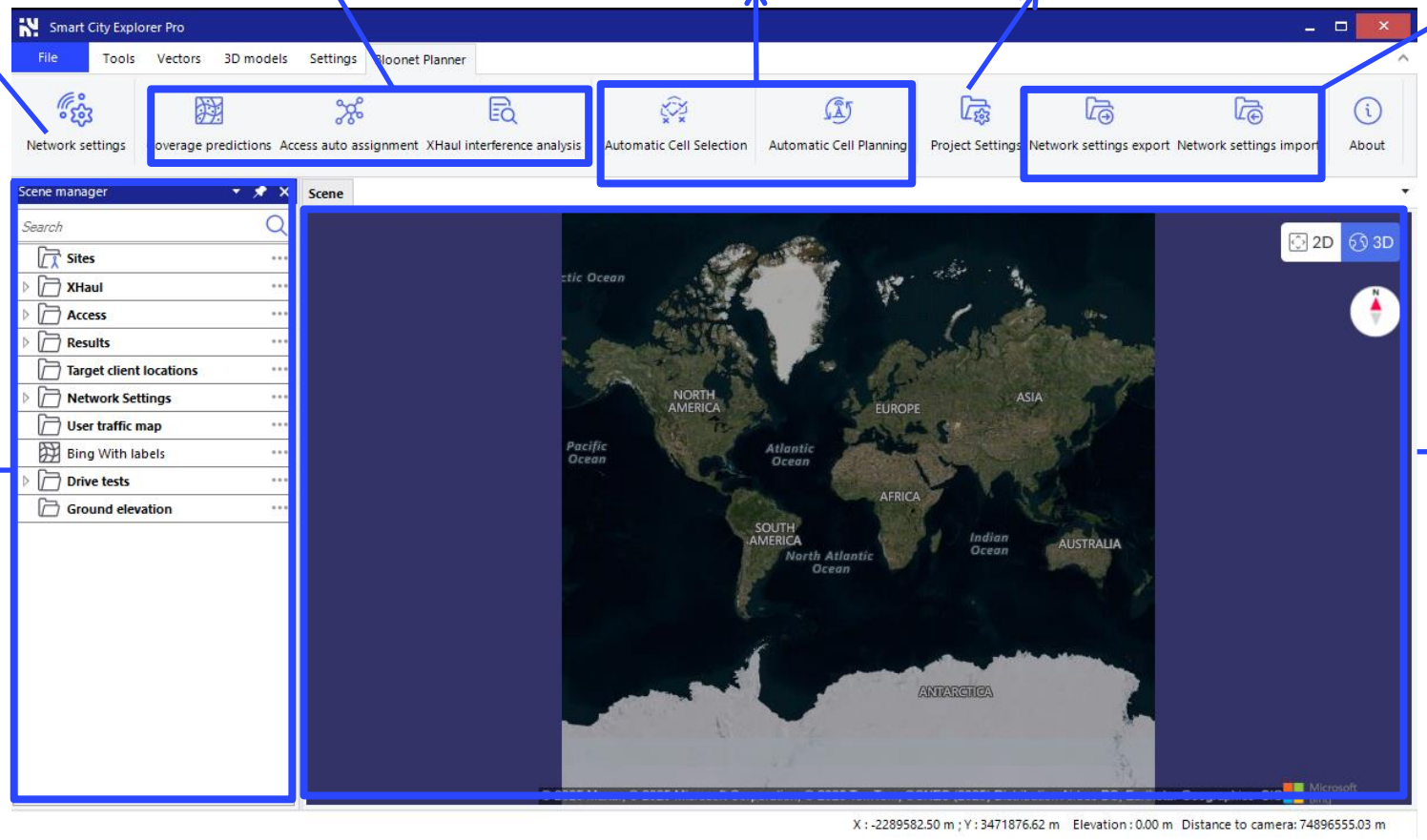
Network setting (Create)

Network simulations and analysis

Automatic Site Selection and Cell Planning

Project level Computation related parameter settings

Network settings export/import



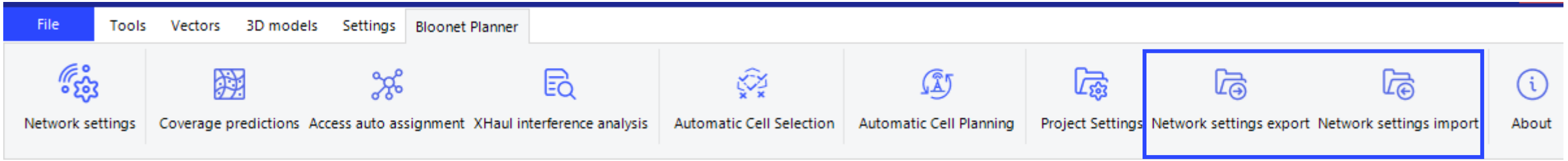
Scene manager

- Network settings
- Network element management
- Simulation results

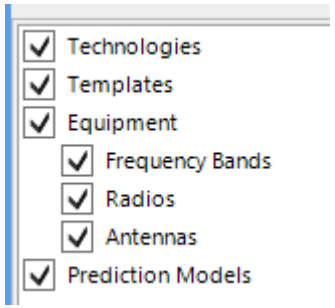
Scene

- Map data visualization
- Network elements visualization
- Coverage maps visualization

Network settings Import / Export



- **Network Settings Export** allows to export the entire network settings in a XML file
- XML files can be imported with **Network Settings Import**.
- During the import process, it is possible to select the categories of network settings to import.



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Map data format overview

This section introduces the **Outdoor** LoD1 outdoor map data import.

LoD1 is the first level of 3D building modeling, used for large-scale urban planning and basic simulation needs.
It represents buildings as **simple blocks** without any roof shapes, facade details, or interior structures.

For **Indoor** or **Hybrid** environments (outdoor + indoor), accurate simulations may require creating a **3D model** of the environment. This detailed 3D model is referred to as **LoD4** (Level of Detail 4).
Bloonet Planner supports **LoD4** models in **DXF** format. For **Indoor** or **Hybrid** environments modeling and other related information, please refer to **Indoor & Outdoor/Indoor Hybrid Scenario.**

LoD1 Outdoor Map data import

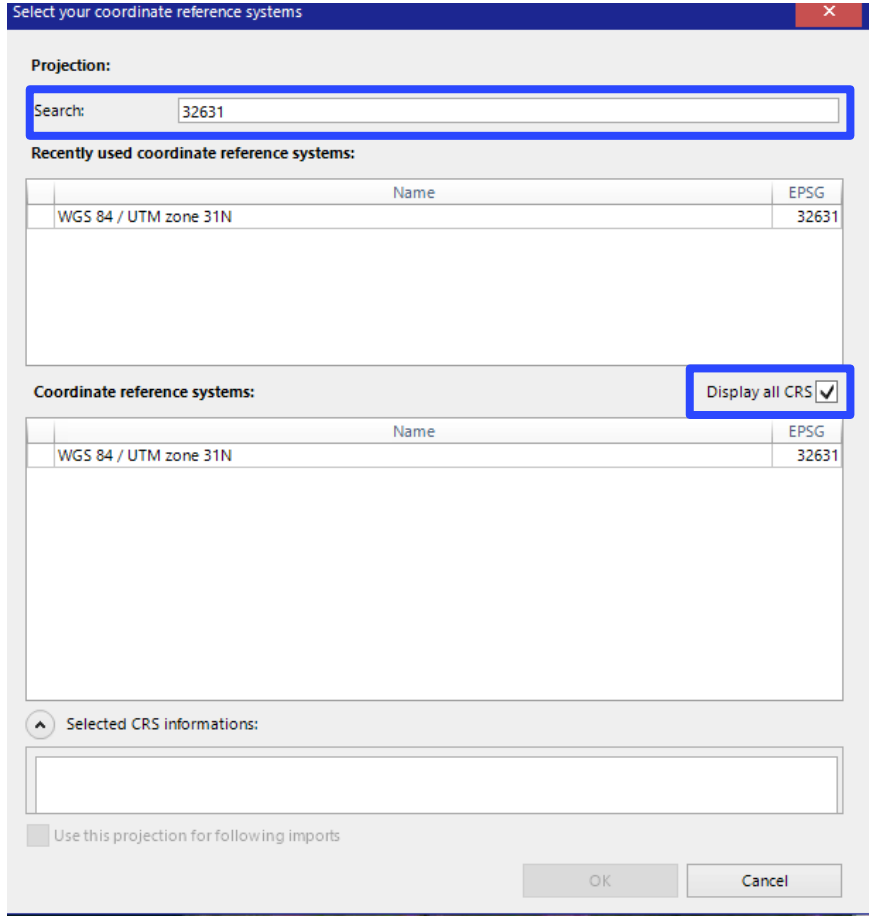
Layer		Planet format	Asset format	Bil format	Mapinfo format	Shape format
DTM	Map data files	*.bin	*.bin	*.bil, *.hdr	*.tab,*.grd	NA
	Volcano required files	index	index.txt	index.xml	index	
	Siradel Planner Import file	index	index.txt	*.bil	*.grd	
DLU	Map data files	*.bin	*.bin	*.bil, *.hdr	*.tab,*.grc	
	Volcano required files	index menu	index.txt menu.txt	index.xml menu	index menu	
	Siradel Planner Import file	index	index.txt	*.bil	*.grc	
DHM	VoMap data files	*.bin	*.bin	*.bil, *.hdr	*.tab,*.grd	
	Volcano required files	index	index.txt	index.xml	index	
	Siradel Planner Import file	index	index.txt	*.bil	*.grd	
Vector	Map data files	*.txt	*.txt	NA	.*.dat,*.id,*.map,*.tab	*.shp, *.shx, *.prj, *.dbf, *. .cpg
	Volcano required files	index menu	index.txt menu.txt	NA	index.xml menu.dat	index.xml menu.vol
	Siradel Planner Import file	index	index.txt	NA	*.tab	*.shp

Import vector data data

Vector data are imported using a “drag and drop” of the suitable file in the visualization scene or use the **File - import** from the menu , then select the **Vector & Linear** layer type.

Files to be imported vary according to the map data format, refer to the previous page for more information.

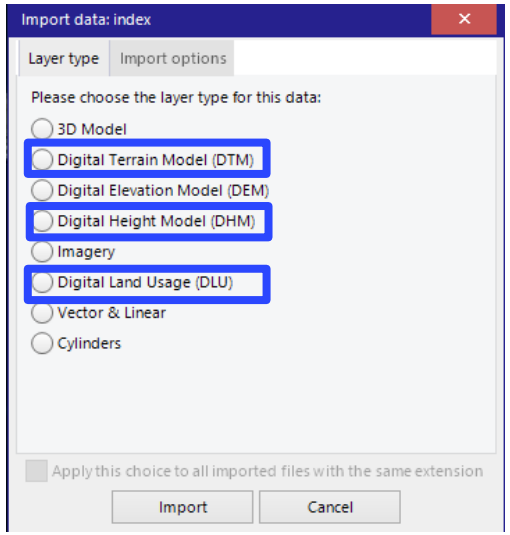
To select a **projection system**, use the **Search** field to enter the name or code of the projection system corresponding to the map data you want to import. If the desired projection system does not appear in the initial list, enable the **Display all CRS** option to view the complete list of available coordinate reference systems.



Import raster Map data(DTM/DLU/DHM)

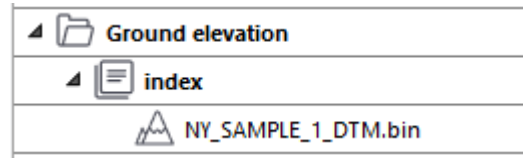
Raster data are imported using a "drag and drop" of the suitable file in the visualization scene or use the File - import from the menu, then select the corresponding layer type.

Files to be imported vary according to the map data format, refer to the previous page for more information.



To select a **projection system**, use the **Search** field to enter the name or code of the projection system corresponding to the map data you want to import. If the desired projection system does not appear in the initial list, enable the **Display all CRS** option to view the complete list of available coordinate reference systems.

After import, DTM and DHM layers can be found in the **Ground elevation** folder in the Scene Manager window, and DLU layers can be found at the top of the Scene Manager window.

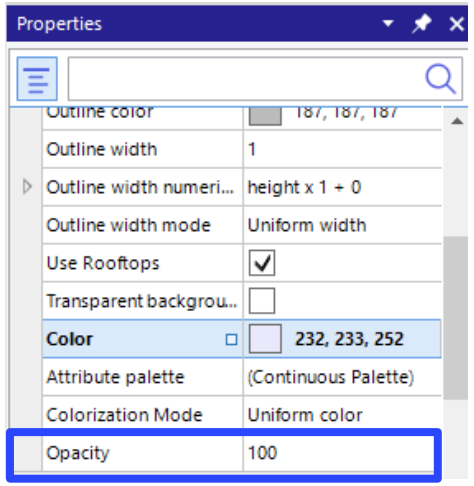


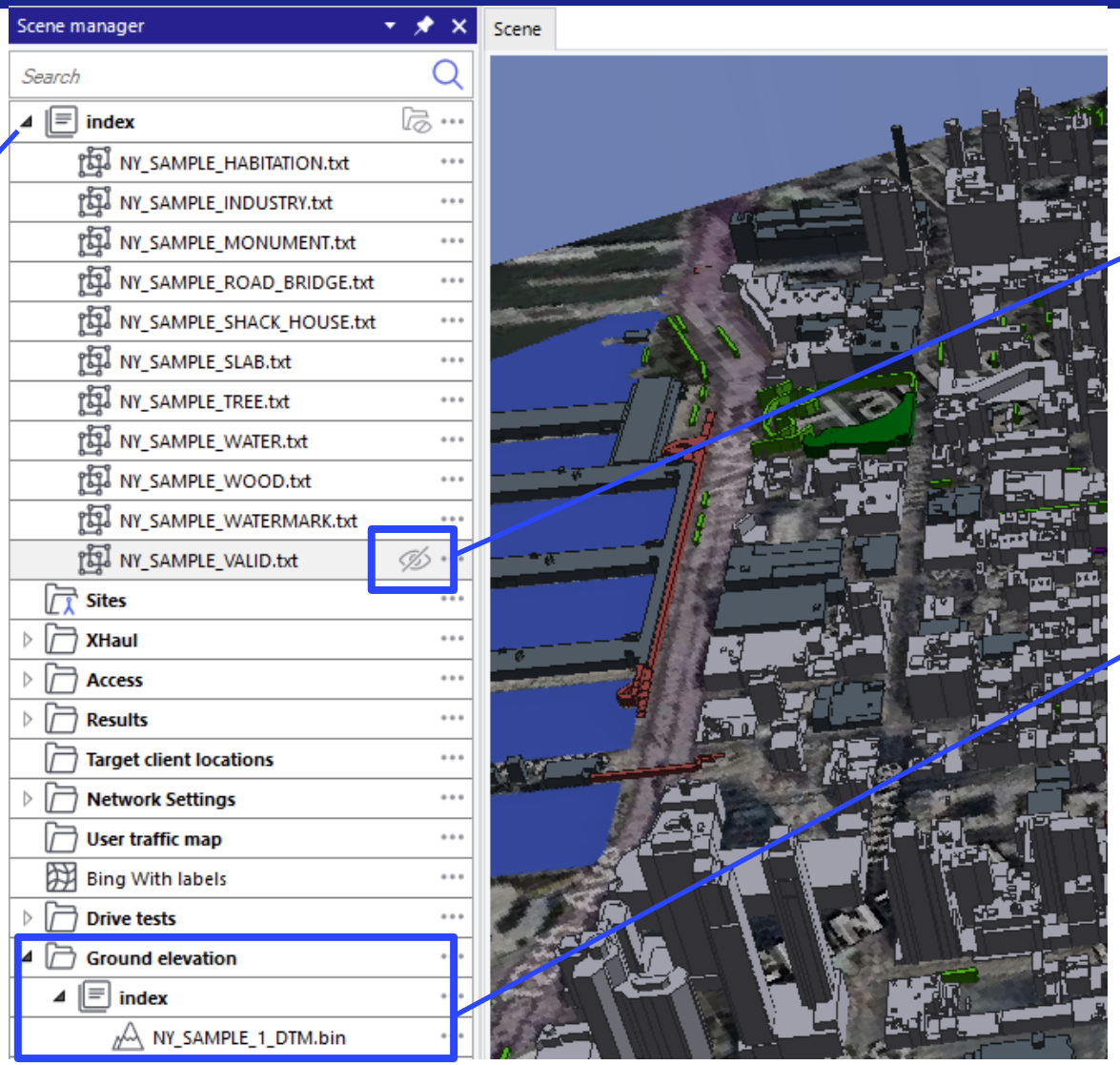
Map data visualisation

The higher layer in the Scene manager has higher priority in Scene display.

Click on the triangle icon at the left side of a folder to extend or fold the layers

Select a folder or a layer and use Properties window (Settings – Windows – Properties) to adjust **Opacity** of the layer. It works the same way for the coverage simulation results.





Click on the eye icon at the right side of a folder or a layer to hide or show

Ground elevation folder: **DTM** (Digital Terrain Model) and DHM (Digital Height Model) data

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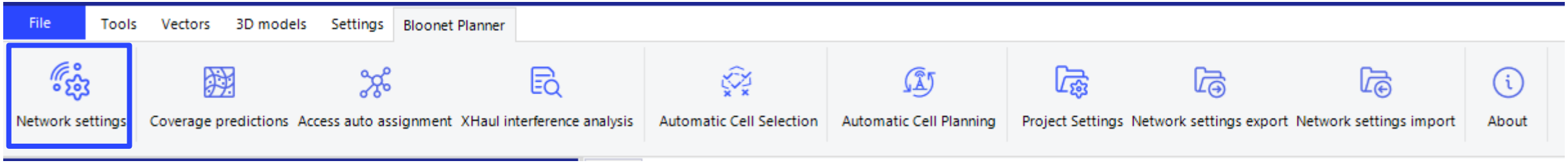
Layer Information

The user can access information about any layers (Map data, coverage maps, network elements…) directly in the scene by **left-click + Ctrl** on any point of the layer.

CONTENT

Network settings - Overview



Before adding new network elements, use the **Network Settings wizard** which will take you step by step to configure some important information for the target **radio (access)** network, which includes:

- Frequency band
- Technology
- Radio equipment (gNodeB, Gateway, AP, and UE device characteristics)
- Deployment-related parameters (number of sectors, cable loss, etc.)

The Network settings wizard does not cover the XHaul network settings. To configure the XHaul network elements, use the Network settings menu in the Scene manager.

Technology types and active technology type

Technology types

Multiple technologies are proposed to the user depending on the use cases to be addressed.

To differentiate from the different technologies for the same technology type, here we use the term **Technology type** to represent the 3 technology types inside the tool:

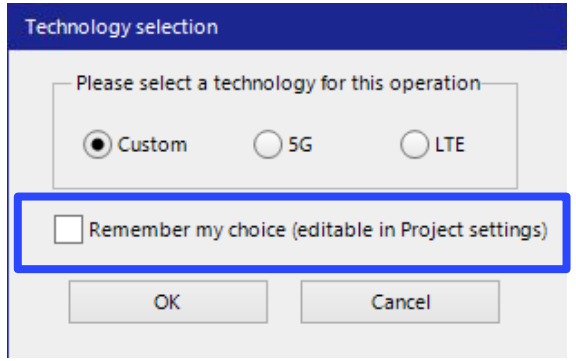
- Custom: High flexibility for the user to define a proprietary technology (typically non-3GPP)
- 5G-NR: Technology parameters to support 5G-NR simulations
- LTE: Technology parameters to support LTE simulations

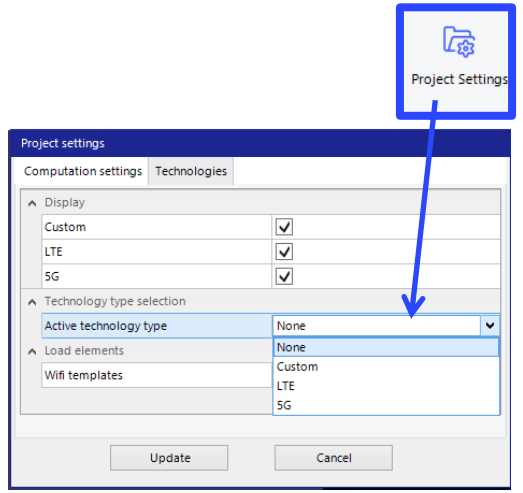
Each technology type has different output metrics and specific formulas, while the workflows remain the same for all three technology types.

Active technology type

When users open a new project and run Network settings or other simulation workflows (such as coverage prediction or automatic cell selection) for the first time, a **Technology selection** window appears, prompting users to select a technology type from Custom, 5G, or LTE.

- Users can check the '**Remember my choice**' option to save the selected technology type as the active technology type. In this case, the tool will remember the users' choice and will not prompt them again for each new simulation.
- Users can later modify their choice in the **Project settings – Technologies** window by changing the **Active technology type** parameter. They can reset their choice or set it to None, then click the **Update** button to apply the changes.



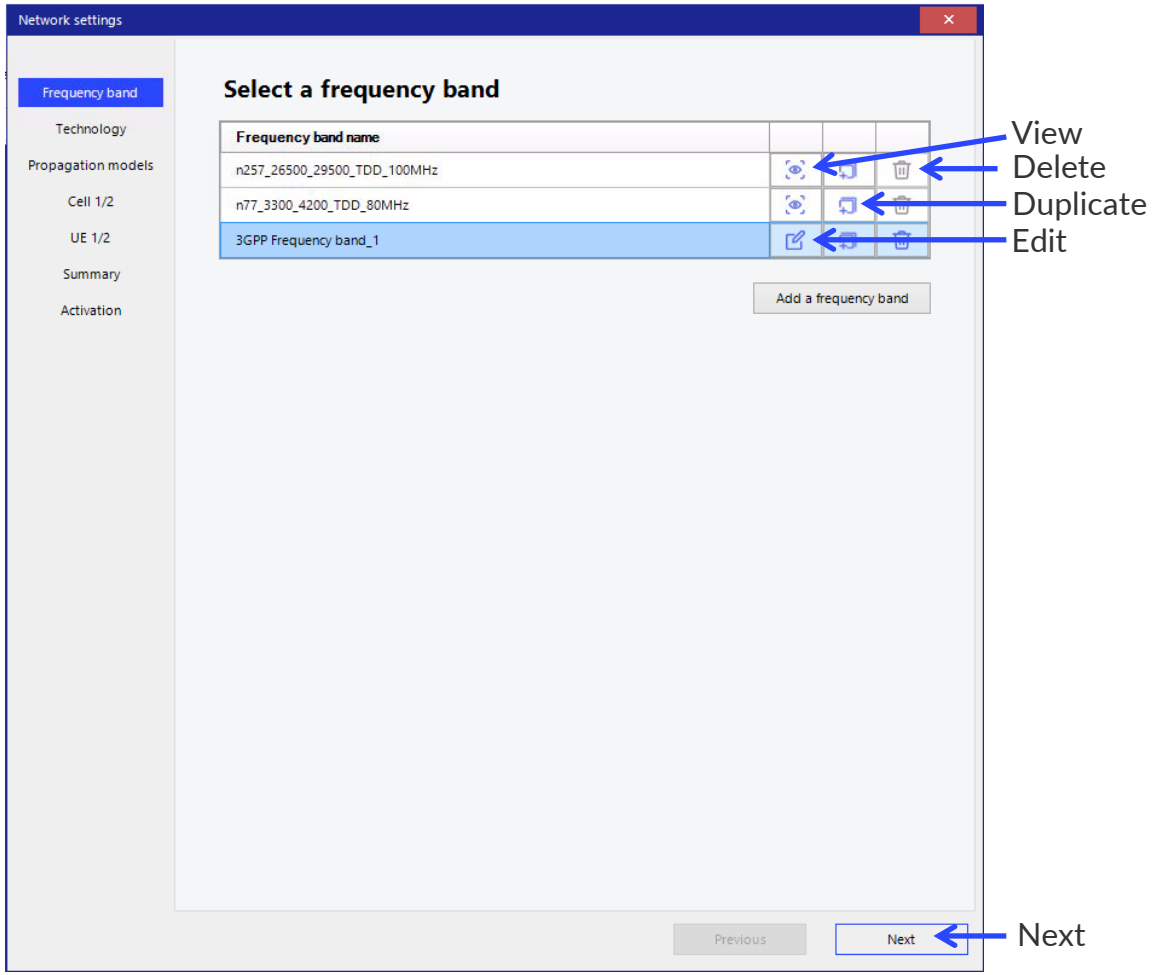


Network settings wizard - principles

The Network Settings wizard offers a step-by-step guide for users to configure network settings parameters.

Some principles of the wizard:

- The existing elements in the project can be viewed by users, but they cannot be modified.
- Users can click the **Add** button (e.g. **Add a frequency band**) to add a new element. During the network settings workflow, users can edit these new elements.
- Users can click the **Duplicate** button to duplicate an existing element, then use Edit to modify the new element.
- During the network settings workflow, users have the option to delete a newly added element by clicking the **Delete** button.
- The selected (highlighted) element will be utilized for the configuration inputs in the subsequent steps. Users can also choose another element if required.
- After configuring all required parameters, click the **Next** button to proceed to the next step in the Network settings wizard.

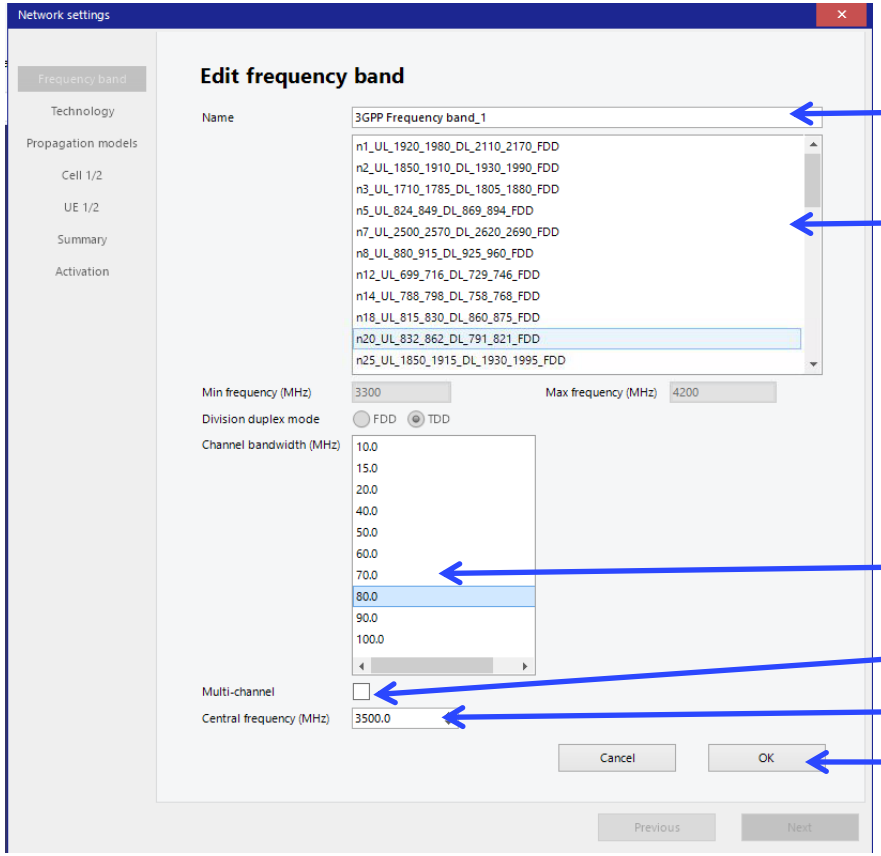


Network settings – Frequency band (5G/LTE)

- **Frequency band**
- Technology
- Propagation models
- Cell
- UE
- Summary
- Activation

The definition of Frequency Band for 5G-NR or LTE in Siradel Planner is based on a list of pre-defined standard frequency bands following 3GPP TS 38.104 Release 16 specification.

The following window prompts when you click on **Add a frequency band** of 5G or LTE technology type or the **Edit** icon of a 5G or LTE frequency band.



name the frequency band

Select a pre-defined standard frequency band

Select a channel bandwidth

Multi-channel option

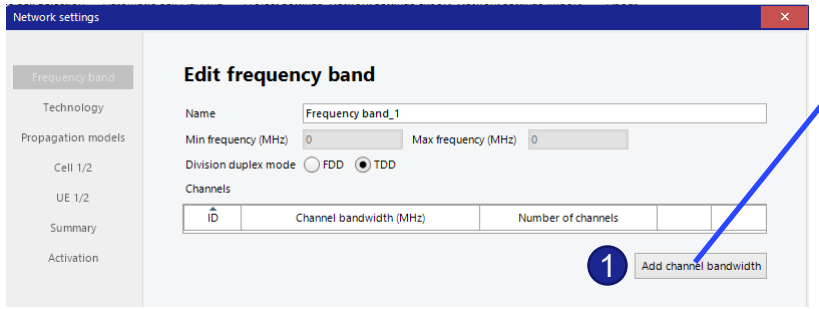
Configure the central frequency(ies)

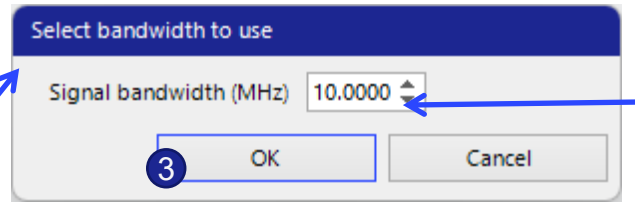
Click **OK** to save the configured parameters and return to the wizard

Network settings – Frequency band (Custom)

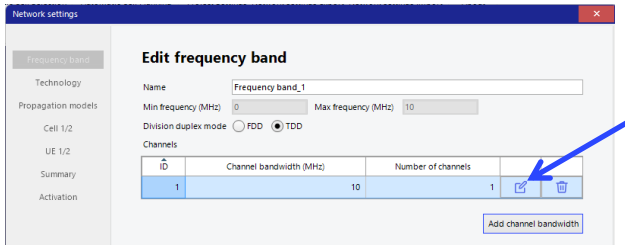
- Frequency band
- Technology
- Propagation models
- Cell
- UE
- Summary
- Activation

For Custom technology, multiple bandwidths can be set. Follow the steps to **Add a frequency band** of Custom technology type, select the division duplex mode and define a list of channels, grouped by their bandwidth:

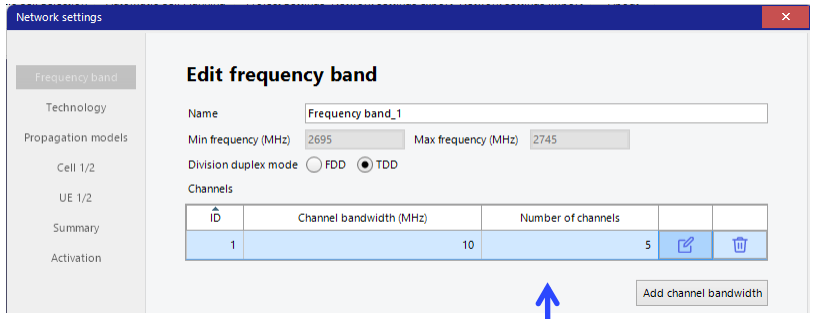


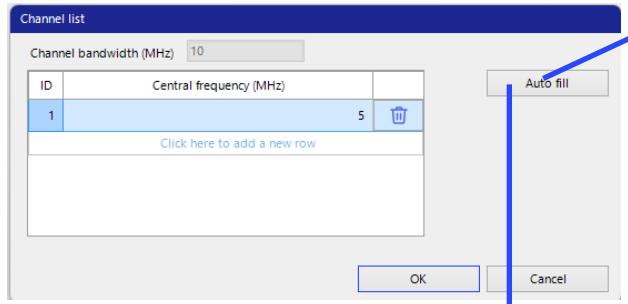


2 Set the signal bandwidth. Several different signal bandwidths can be added. Finish the first signal bandwidth editing workflow, then start the next one.

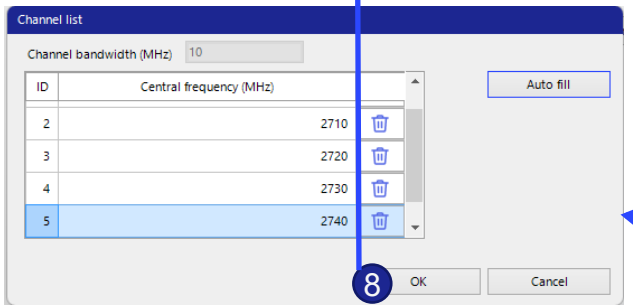


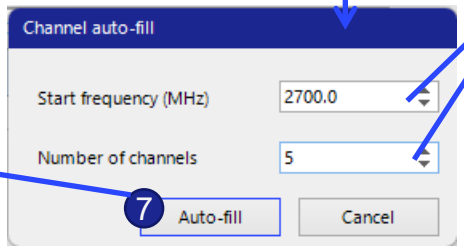
4 Click Edit icon to configure channels.





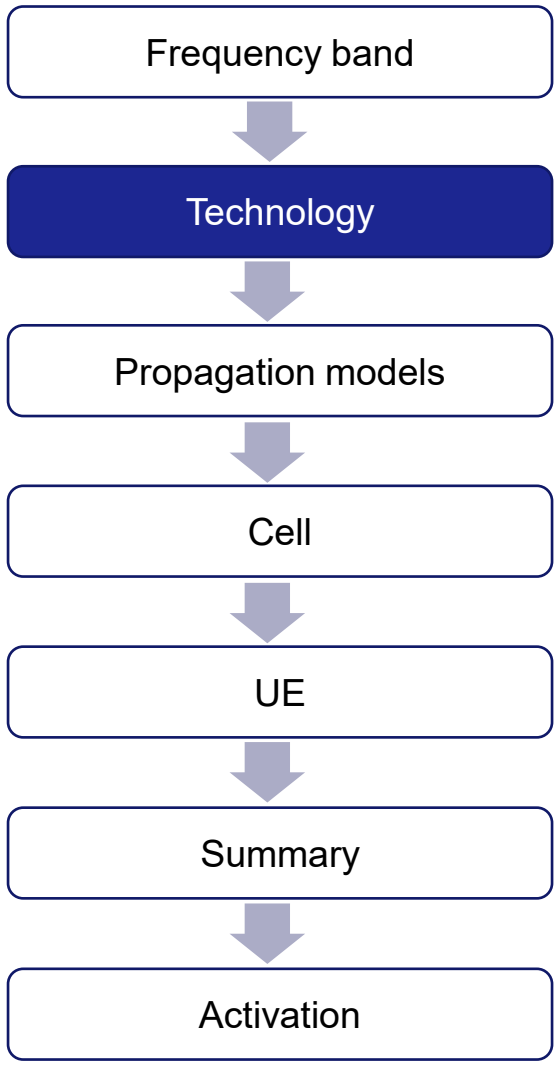
5 If the target channels are consecutive, use **Auto fill** to add them automatically. Otherwise, add the channels manually.





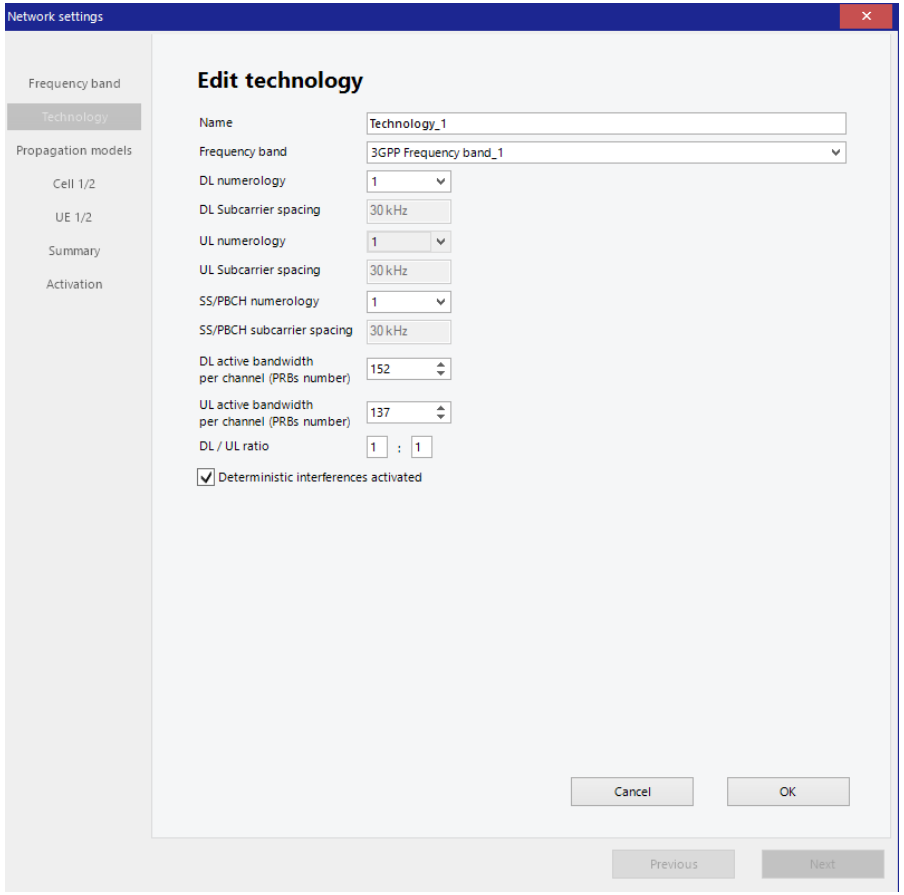
6 Configure the starting frequency and the number of channels of this signal bandwidth.

Network settings – Technology (5G/LTE)



The 5G/LTE technology settings allow users to:

- Select the frequency band defined from the standard frequency bands.
- Select the **numerology** (i.e. subcarrier spacing) to cover specific service and usage
  - SS/PBCH (Synchronization Signal/Physical Broadcast Channel) block
  - Traffic channels in DL (i.e. PDSCH and CSI-RS)
  - Traffic channels in UL (i.e. PUSCH)
- Select the DL & UL **active bandwidth** for traffic channels (number of PRBs × SCS × 12).
- Set the **Downlink/Uplink ratio** (TDD only), i.e. the time spent by the network to transmit DL data and the time spent by the network to transmit UL data
- State if the deterministic computation of interferences in DL (from Cells other than the best-server to the UE) is activated

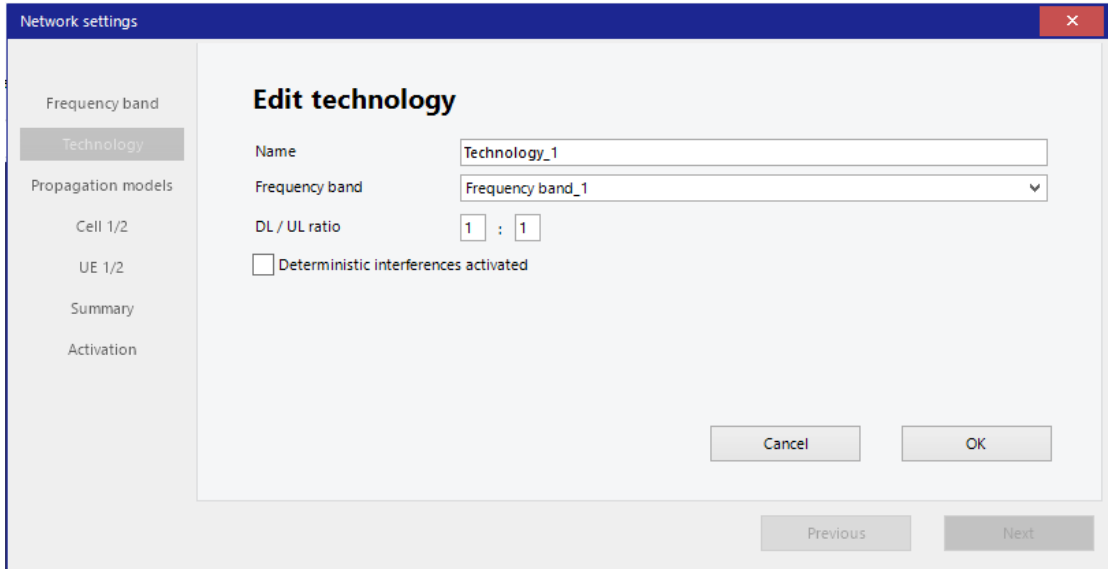


Network settings – Technology (Custom)

- Frequency band
- **Technology**
- Propagation models
- Cell
- UE
- Summary
- Activation

The Custom technology settings allow users to:

- Select the frequency band defined from the custom frequency bands.
- Set the Downlink/Uplink ratio (TDD only), i.e. the time spent by the network to transmit DL data and the time spent by the network to transmit UL data
- State if the deterministic computation of interferences in DL (from Cells other than the best-server to the UE) is activated

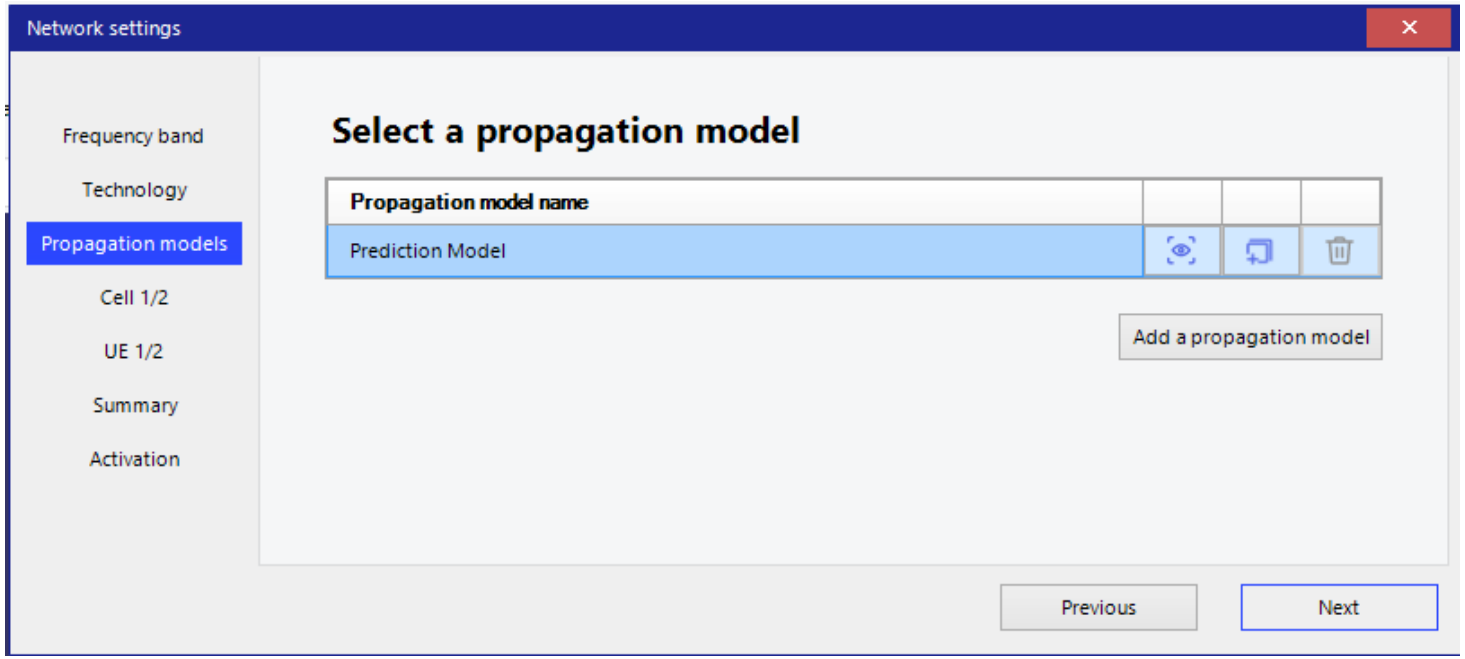


Network settings – Propagation model

- Frequency band
- Technology
- **Propagation models**
- Cell
- UE
- Summary
- Activation

Prediction models gather the various simulation and propagation settings considered during a computation.

- A prediction model is associated to a Cell.
- Several propagation models can be added in the project, when creating a new cell, users can use a specific propagation model to assign to the cell.
- Refer to Volcano Propagation Model for more details concerning the propagation model settings.
- In the absence of a specific context, the default prediction model can be used. Click **Next** to continue.



Network settings – Cell

- Frequency band
- Technology
- Propagation models
- **Cell**
- UE
- Summary
- Activation

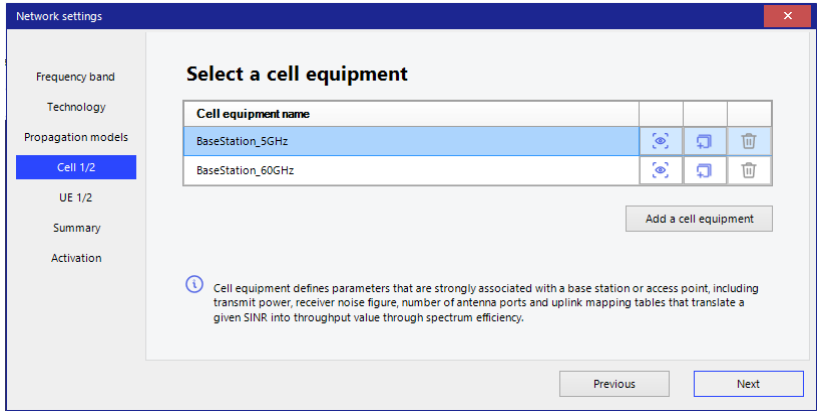
There are two sub-steps for configuring Cells in Network settings :

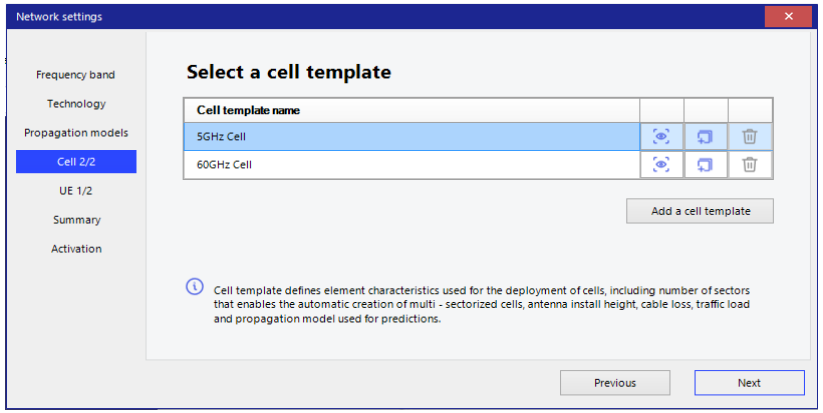
Cell 1/2

Cell equipment defines parameters that are strongly associated with a base station or access point, including transmit power, receiver noise figure, number of antenna ports and uplink mapping tables that translate a given SINR into throughput value through spectrum efficiency.

Cell 2/2

Cell template defines element characteristics used for the deployment of cells, including number of sectors that enables the automatic creation of multi-sectorized cells, antenna install height, cable loss, traffic load and propagation model used for predictions.





Network settings – UE

- Frequency band
- Technology
- Propagation models
- Cell
- **UE**
- Summary
- Activation

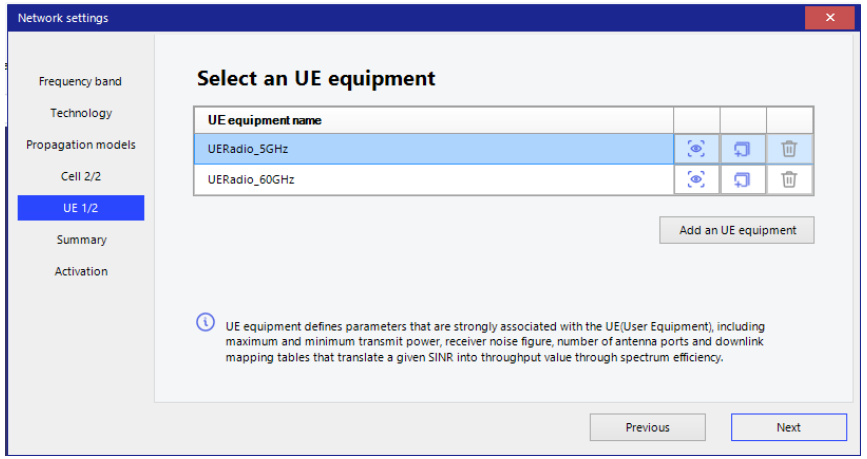
There are two sub-steps for configuring UEs in Network settings :

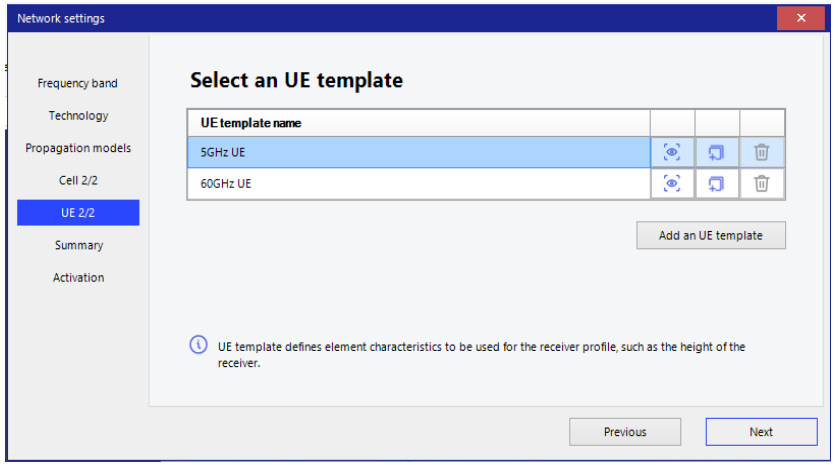
UE 1/2

UE equipment defines parameters that are strongly associated with the UE (User Equipment), including maximum and minimum transmit power, receiver noise figure, number of antenna ports and downlink mapping tables that translate a given SINR into throughput value through spectrum efficiency.

UE 2/2

UE template defines element characteristics to be used for the receiver profile, such as the height of the receiver.

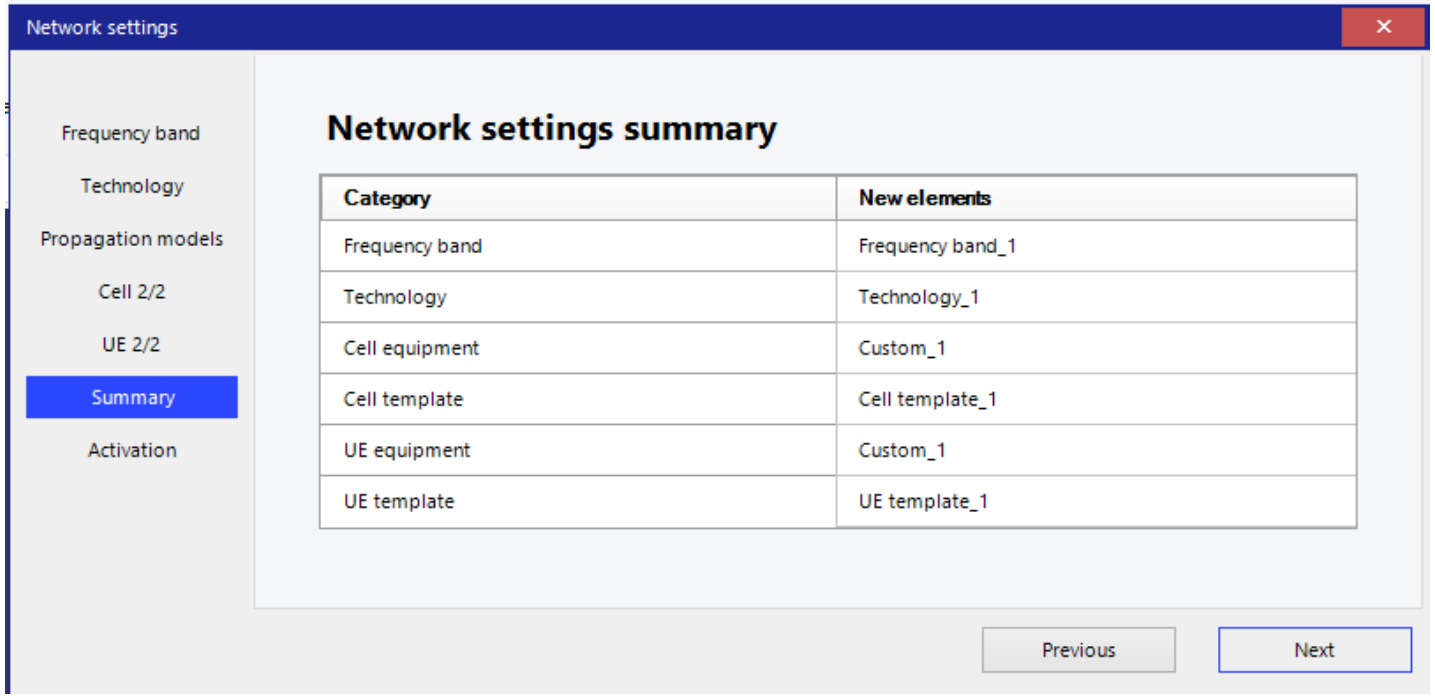




Network settings – Summary

- Frequency band
- Technology
- Propagation models
- Cell
- UE
- **Summary**
- Activation

The **Summary** step displays all the new elements added during the network settings wizard process. This step is informational only; users cannot make direct edits in this GUI. However, users can return to previous steps to modify some elements or parameters.

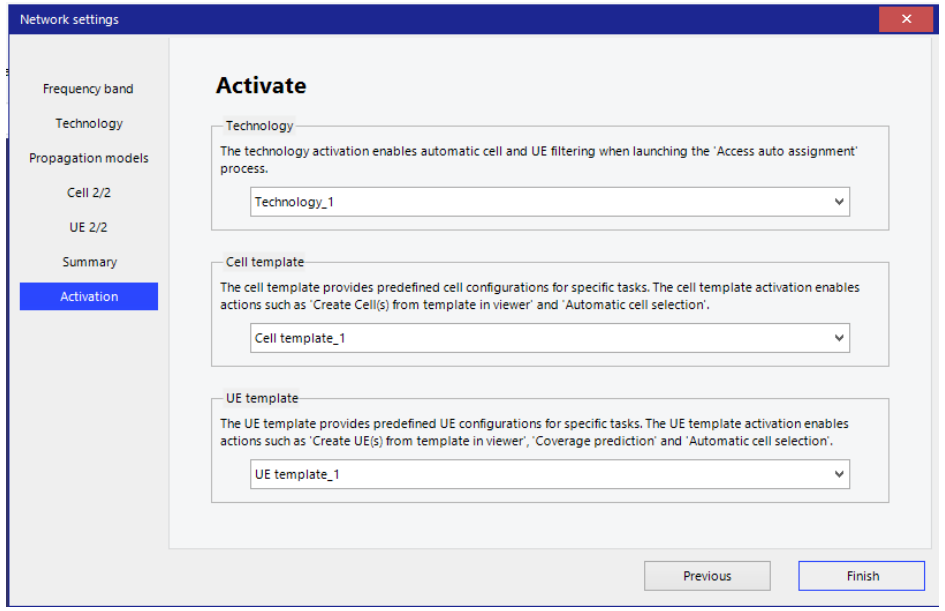


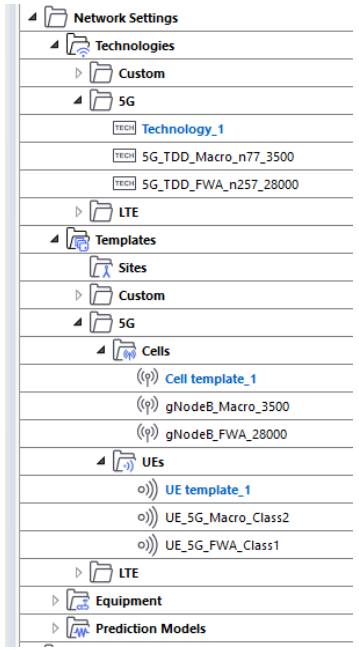
Network settings – Activation

- Frequency band
- Technology
- Propagation models
- Cell
- UE
- Summary
- Activation

The Activation is the last step of Network settings wizard. There are 3 elements to be set as active:

- **Technology** (not Technology Type): The technology activation enables automatic Cell and UE filtering when launching the ‘Access auto assignment’ process (and ‘Automatic Cell Selection’ process in the 3.7 and later versions)
- **Cell template**: The cell template provides predefined cell configurations for specific tasks. The cell template activation enables actions such as ‘Create Cell(s) from template in viewer’ and ‘Automatic cell selection’.
- **UE template**: The UE template provides predefined UE configurations for specific tasks. The UE template activation enables actions such as ‘Create Cell(s) from template in viewer’, 'Coverage prediction' and ‘Automatic cell selection’.





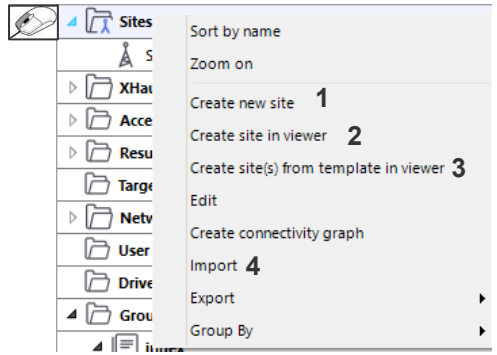
Once all parameter settings are verified, users can click the **Finish** button to complete the network settings wizard.
All new elements will be added to the project, and the elements selected in the **Activation** step will be activated in the scene manager under Network settings.

CONTENT

Network element – Sites

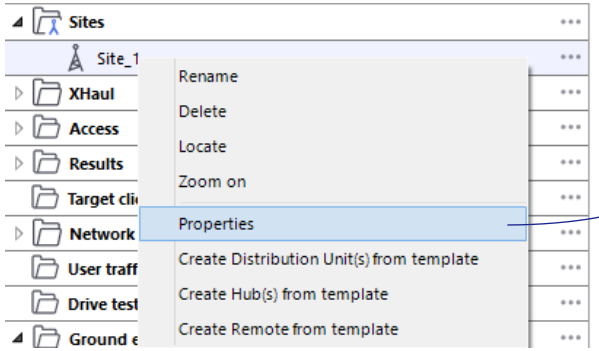
Site creation process main options :

1. Create new site from coordinates
2. Create site in viewer (To create sites, **right-click** in the scene after choosing this action)
3. Create site from template in viewer (characteristics of the **active template** is considered. To create sites, **right-click** in the scene after choosing this action). Please refer to Active templates for more details.
4. Import from CSV file (Please refer to Network Elements Import \ Export for more details)

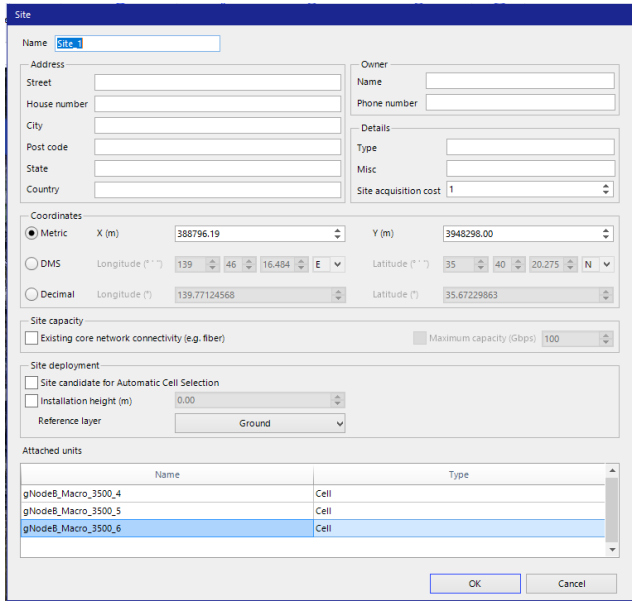


Right-click "Sites" to access its actions

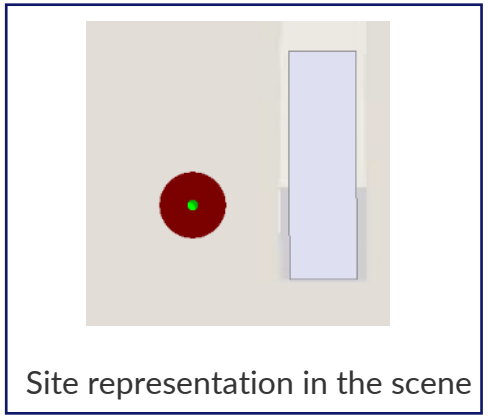
ℹ Sites define the location of Cells and UEs within the project. A site is described by its X/Y Metric or Lat/Long coordinates, defined in same metric coordinate system as the Geo data.



Right-click a network element to access its actions



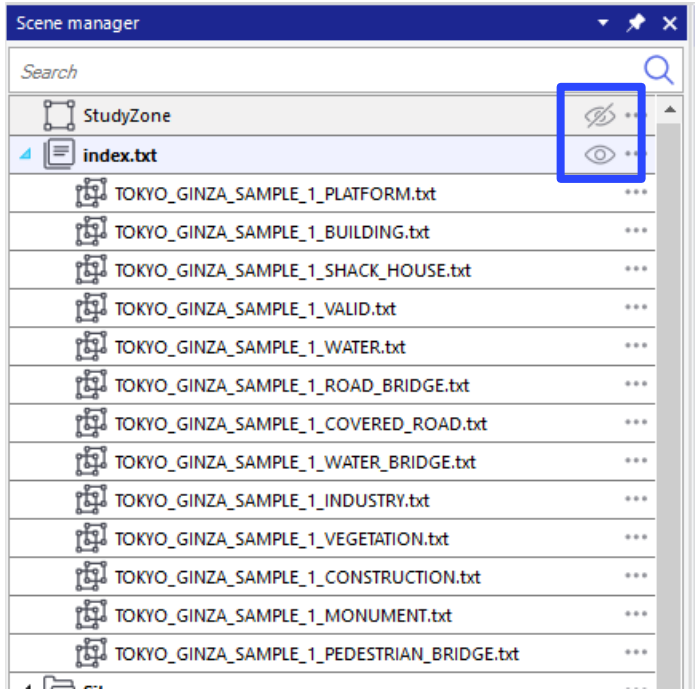
Optional information



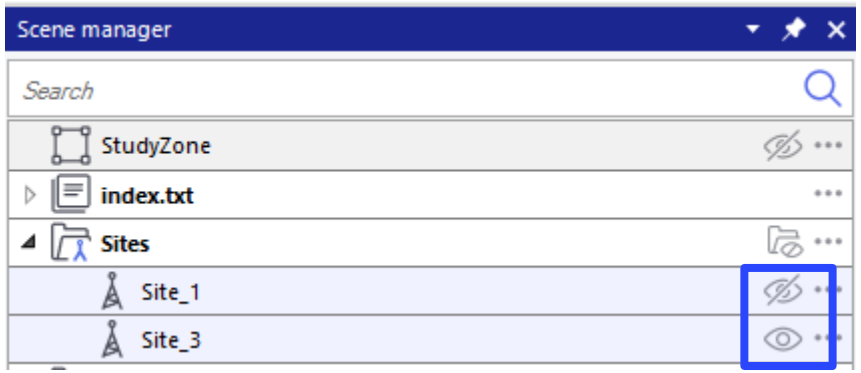
Site representation in the scene

Display / Hide Elements in Scene

Display or hide a whole layer (or folder)

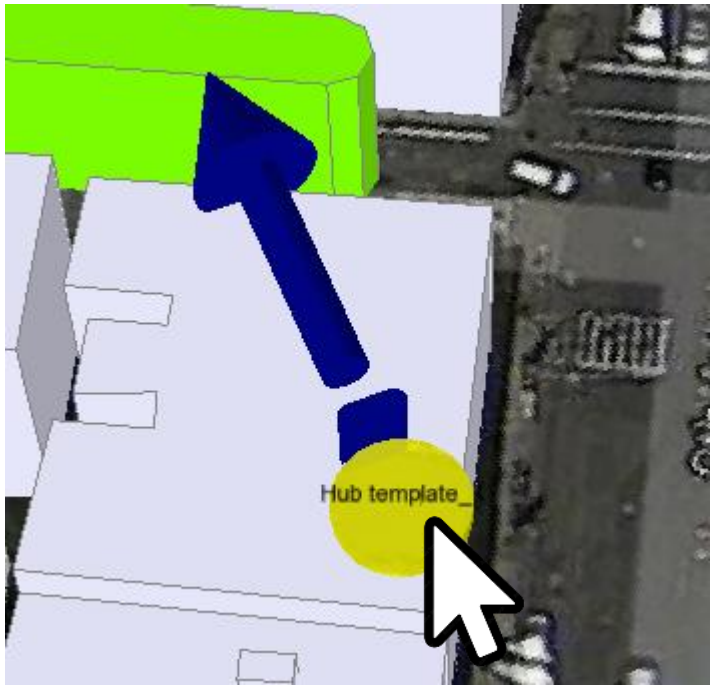


Display or hide one element

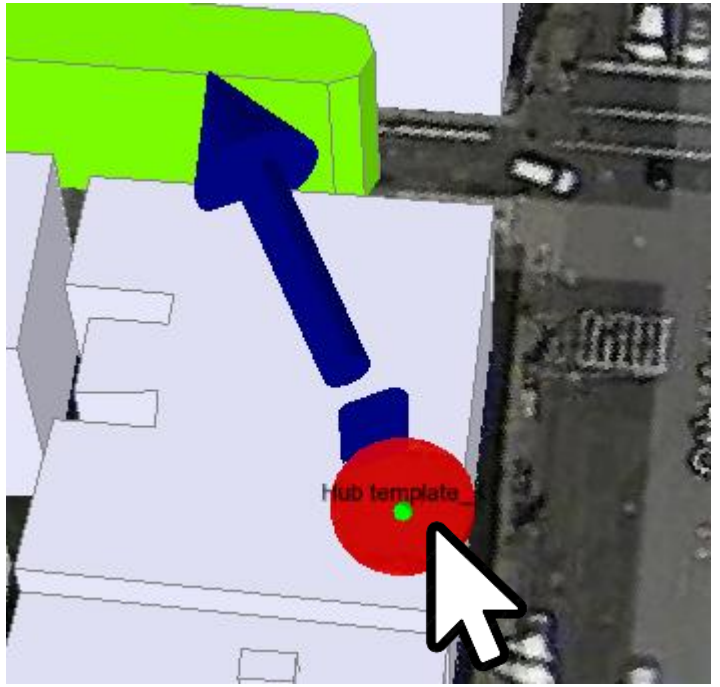


Move a Site

Sites can be moved manually in the scene



The Site highlights when cursor is located on it



Press on the Ctrl button
Left click on the Site to select it and move green point by holding the left click

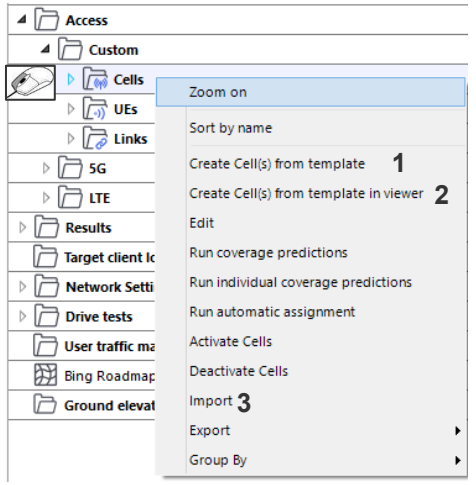
Network element : Access \ Cells creation

Cell creation process main options :

1. Create Cell(s) from template (characteristics of the active template is considered)
2. Create Cell(s) from template in viewer (characteristics of the **active template** is considered. To create Cells, **right-click** in the scene after choosing this action). Please refer to Active templates for more details.
3. Import from CSV file (Please refer to Network Elements Import \ Export for more details)
   - Mandatory information in the CSV files are:

     Name

     X \ Y location
   - All other parameters are optional.
   - Cell template information are considered when no parameters is provided during import

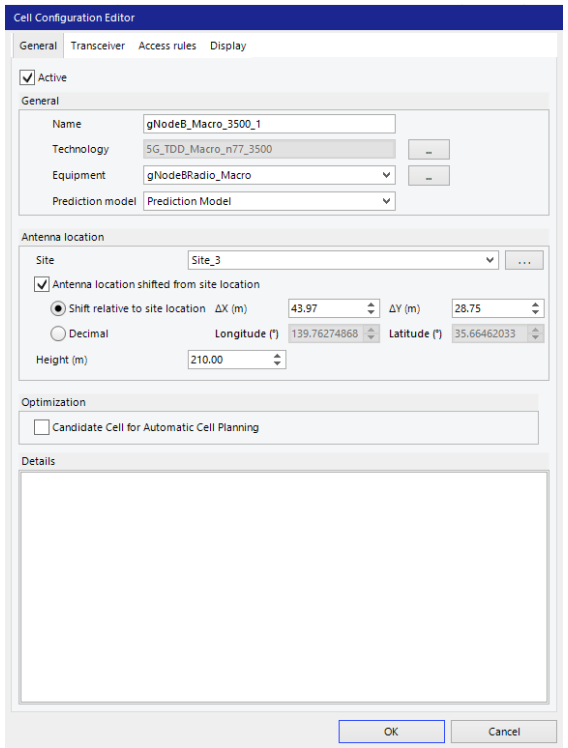


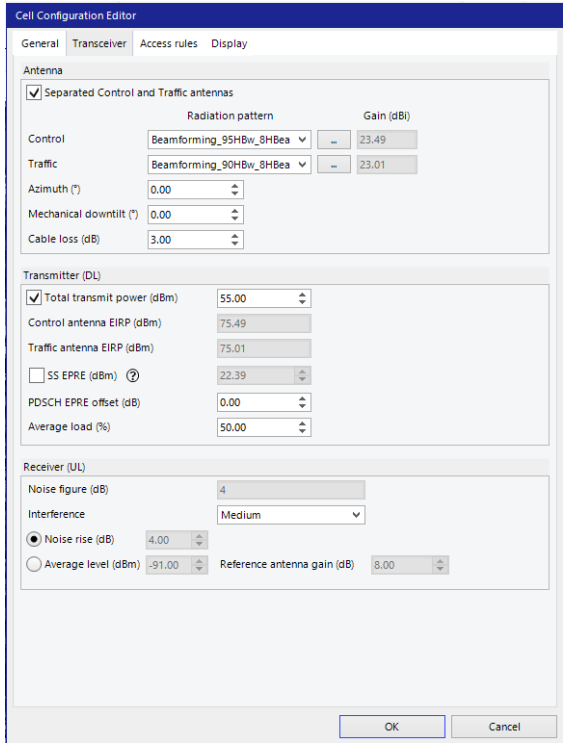
Right-click a network element to access its actions

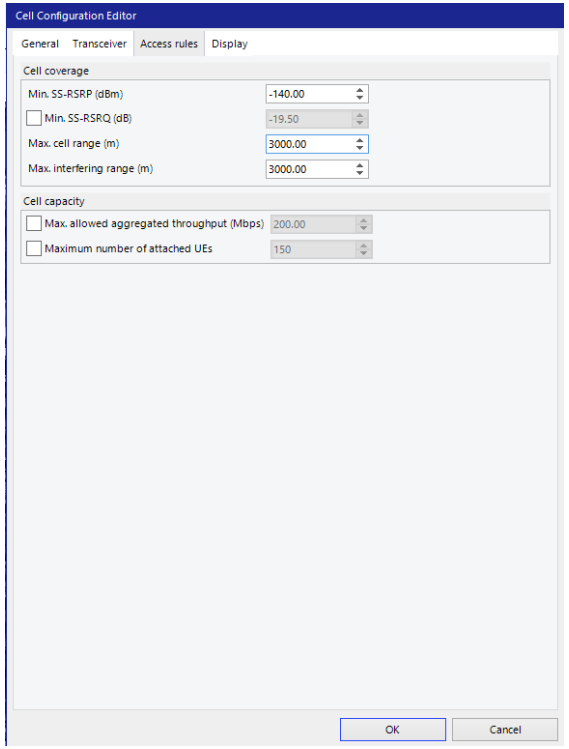
- Cell export files (CSV) can be open with XLS to perform table operations. Importing the CSV file will create new Cells and update existing Cells
- If Cell height above rooftop is unknown and no information is available during import, then Bloonet Planner will automatically set the Cells above rooftop when located on a building

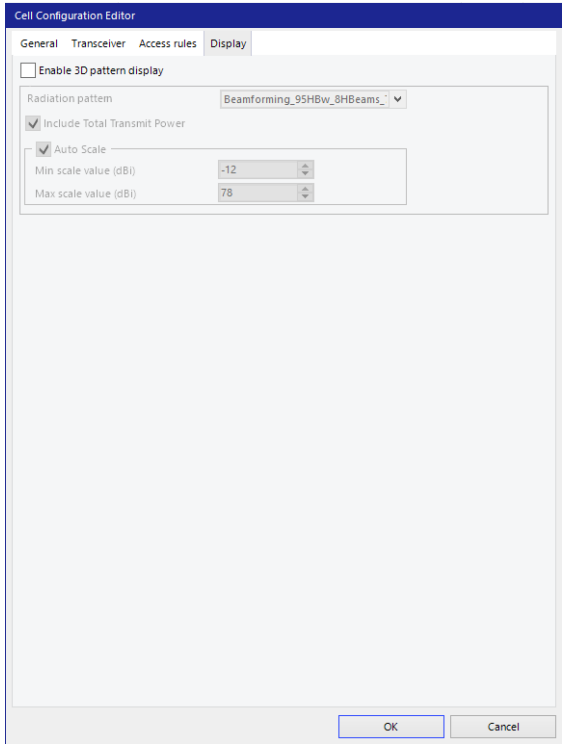
Network element : Access \ Cells properties

- A Cell consists an antenna, an equipment (mandatory), radio characteristics and information about the interference and attachment ranges
- Cells can be deployed on rooftops or at street-level





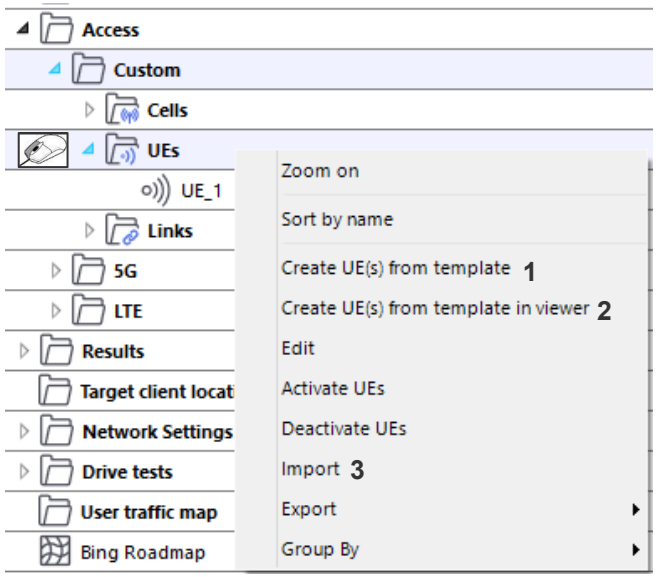




Network element : Access \ UEs creation

UEs creation process main options

1. Create UE from template (characteristics of the active template is considered)
2. Create UE from template in viewer (characteristics of the **active template** is considered. To create Cells, **right-click** in the scene after choosing this action). Please refer to Active templates for more details.
3. Import from CSV file (Please refer to Network Elements Import \ Export for more details)
   - Mandatory information in the CSV files are:
     Name
     X \ Y location
   - All other parameters are optional. UE template information are considered when no parameters is provided during import

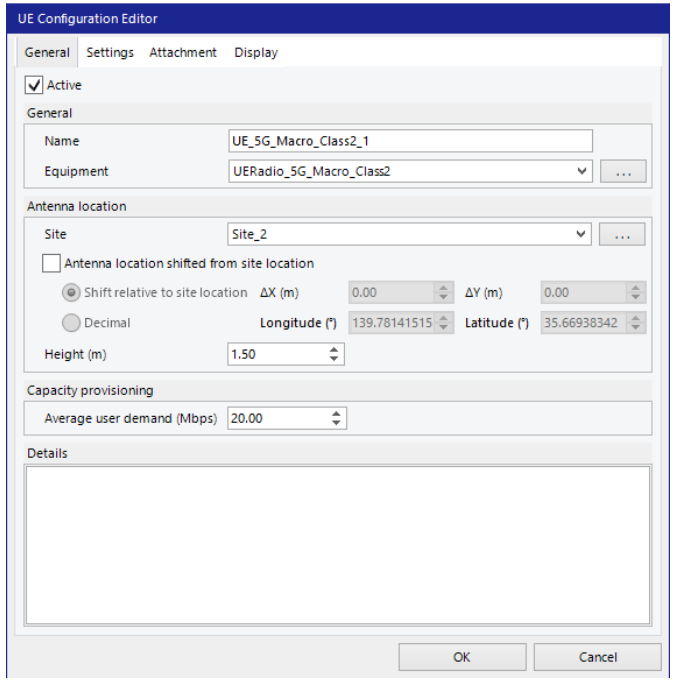


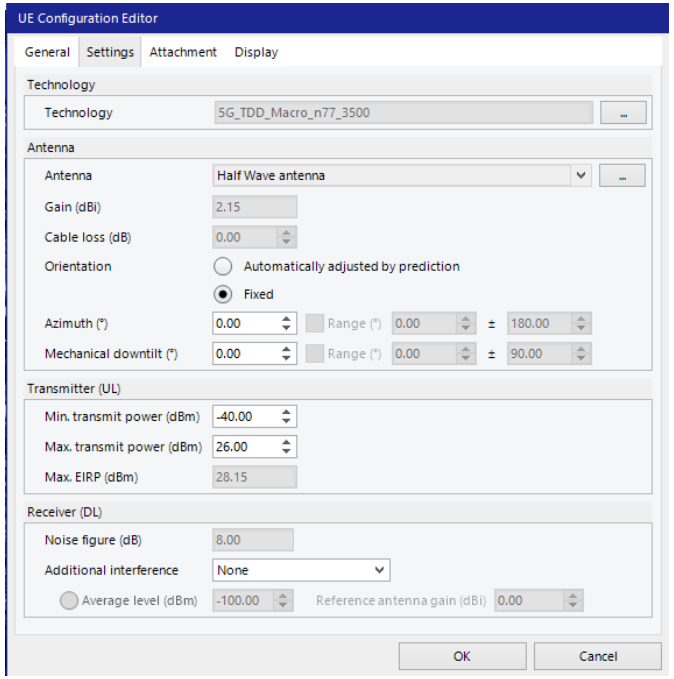
Right-click a network element to access its actions

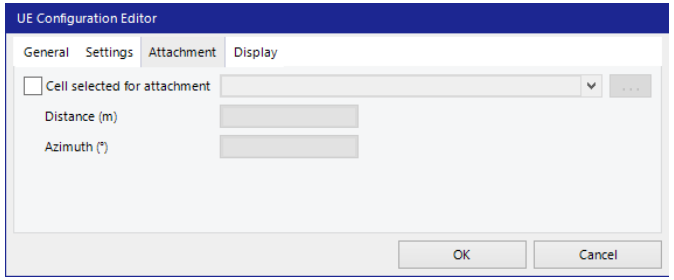
- UE export files (CSV) can be open with XLS to perform table operations. Importing the CSV file will create new Cells and update existing Cells.
- If UE height above rooftop is unknown and no information is available during import, then Bloonet Planner will automatically set the UE above rooftop when located on a building.

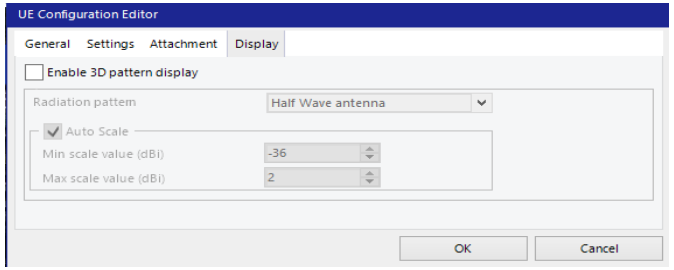
Network element: Access \ UEs properties

- A UE is a UE which consists an antenna, an equipment (mandatory), radio characteristics and information about the Cell attachment
- UEs can be deployed on rooftops or at the street-level









Network Elements Import \ Export

- Sites, Cells and UEs can be imported to the project through CSV files

Name	Technology	Equipment	Site	Site X (m)/Long (°)	Site Y (m)/Lat (°)	Height (m)	DeltaX (m)	DeltaY (m)	Antenna X (m)/Long (°)	Antenna Y (m)/Lat (°)	Channel Bandwith (MHz)	Channel	Polarization	Antenna
Hub1	Techno1	Equip1	Site_1	586884.943	2852719.726	11.69	0	0	586884.943	2852719.726	20	1	Vertical	Antenna1
Hub2	Techno1	Equip1	Site_2	586908.9876	2852614.937	25	0	0	586908.9876	2852614.937	20	1	Vertical	Antenna1
Hub3	Techno1	Equip1	Site_3	586888.9408	2852616.635	21.52	0	0	586888.9408	2852616.635	20	1	Vertical	Antenna1
Hub4	Techno1	Equip1	Site_4	586892.6433	2852243.332	28.1	44.46569567	410.5230519	586937.109	2852653.855	20	1	Vertical	Antenna1

ℹ It is possible to import Cells or UEs with their own Lat/Long coordinates (different from their site coordinates)

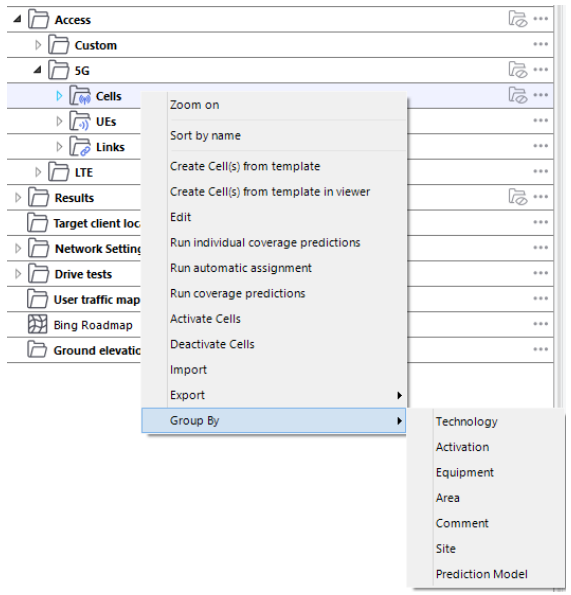
- Mandatory information in the CSV files are:
  - Name
  - X \ Y location

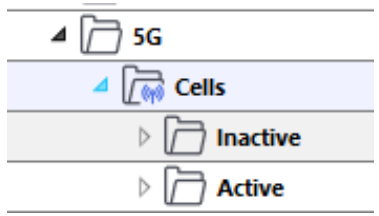
- All other parameters are optional.
  - If optional parameters are defined in the CSV file, they are considered during import
  - If optional parameters are not defined, **active template parameters are considered during import**

ℹ Exporting existing network elements to a file allows the user to access to the CSV format structure.

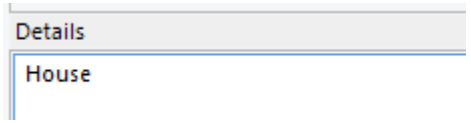
Group By

- Cells and UEs can be organized in different folders with the option “Group by”

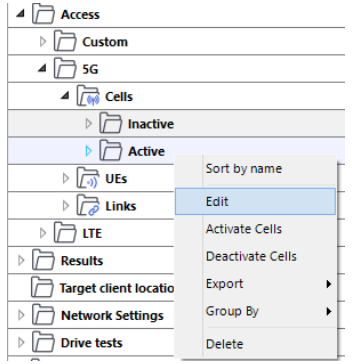




- Adding a comment in the details window (general tab) for Cells and UEs is a convenient way to sort Cells and UEs in different folders

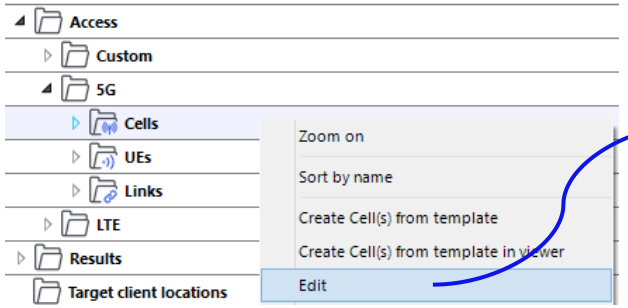


- Table element edition can be open on sub-folders



Tabular Editor

- Tabular edition is available for Cells, UEs and Distribution units from the element folder



Name	Technology	Equipment	Site	X (m)	Y (m)	Height (m)	Use X/Y shift	ΔX (m)	ΔY (m)
5GHz Hub_1	FDD-5GHz	5GHz_Radio	Site_1	332694.16	4693787	12.47	☐	0	0
5GHz Hub_2	FDD-5GHz	5GHz_Radio	Site_2	330423.94	4692087	41.61	☐	0	0
5GHz Hub_3	FDD-5GHz	5GHz_Radio	Site_3	330180.19	4692508	51.07	☐	0	0
5GHz Hub_4	FDD-5GHz	5GHz_Radio	Site_4	330602.53	4692593	14.66	☐	0	0

Use filter field to filter values in the table

- Copy/paste in the table are allowed (from XLS for instance) and the following shortcuts allows an easy edition of the Cells and UEs parameters
  - Ctrl + A – Selection of the entire table
  - Ctrl + C/V – Copy/paste element
  - Ctrl + D – Select the first element of a column and apply the value for the entire column
  - Ctrl + Z – Reverse modifications
  - Ctrl + F – Research elements in the table

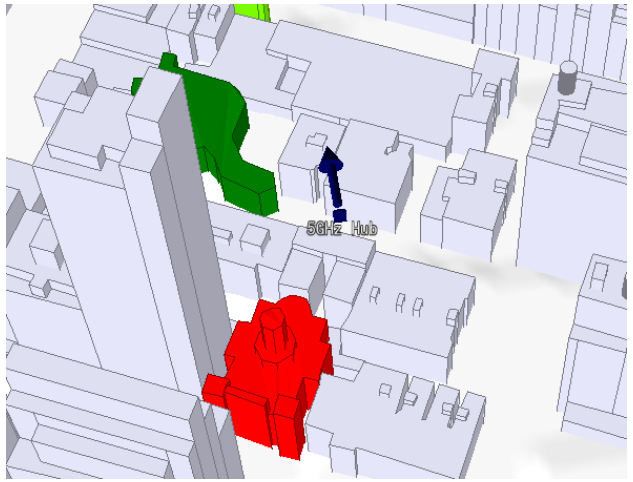
ℹ Table editor is available on sub-folders when grouped by

Site / Cell / UE Visualization

- Two visualization modes are proposed in Bloonet Planner

  When zooming close to an element, a 3D model of the radio element is displayed in the scene. The user can click on it to move the element in the scene

  When zooming out, the 3D model switches to a 2D model to visualize the entire network



- For both visualization modes, the user can left-clicking + ctrl on the 2D or 3D icon to get detailed information

CONTENT

Automatic Cell Selection

Automatic Cell Selection feature aims at determining the best locations to deploy Cells (Transmitters) **to reach Access coverage objectives**

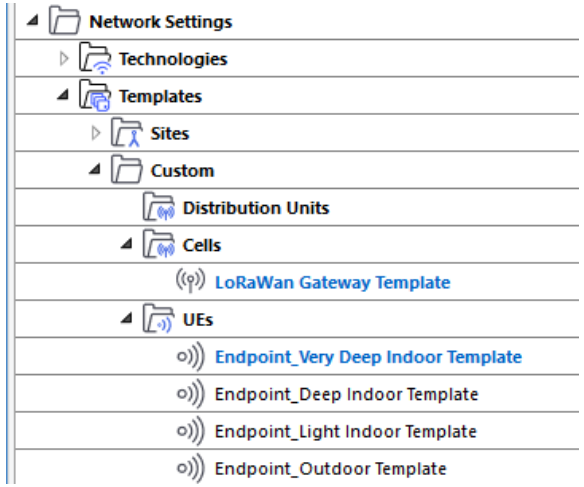
The ACS focuses on selecting sites with minimum cost needed to reach specific coverage targets.

Bloonet Planner provides different simulation modes within the ACP

- **Access only – The study objective is to deploy Cells on site candidates to reach the coverage objectives** (This part will focus on Access Only scenario).
- X-Haul only – The study objective is to deploy Distribution Units to connect active Cells in the study area.
- Joint Access + X-Haul – The study objective is to deploy both Cells to reach coverage targets as well as Distribution Units to provide backhaul connectivity.

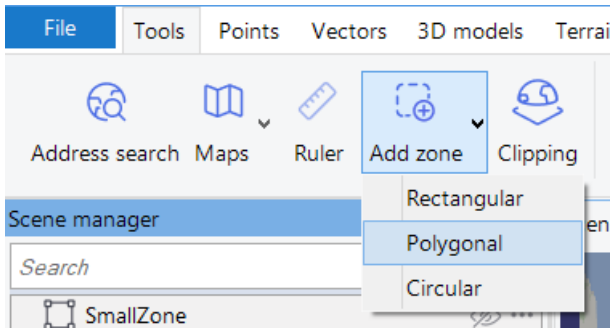
Study initialization 1/3

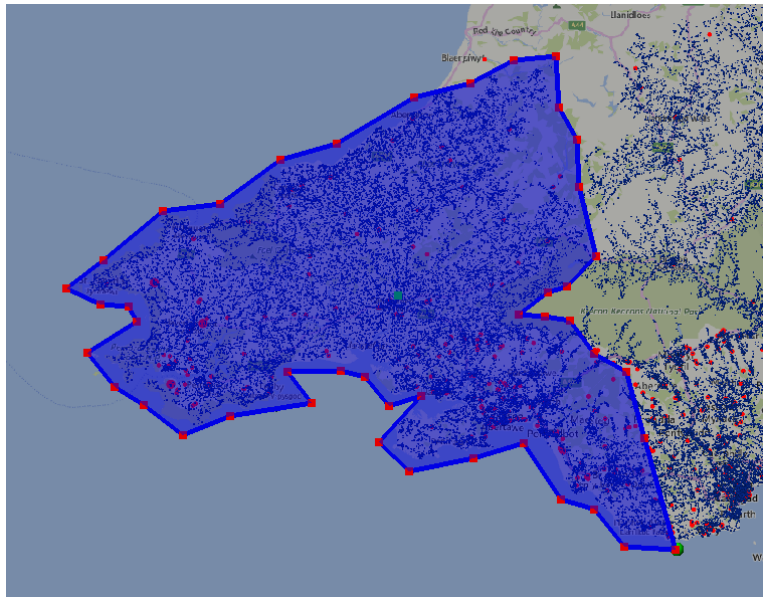
- Define the simulation settings to be considered
  - Cell Template – Defines characteristics of Base Stations (Cells) to be deployed
  - UE Template – Defines characteristics of the receivers (UEs) during the simulation



- Define a study area by creating a rectangular or polygonal zone (**Tools – Add zone**)
  - The area will be used to calculate the coverage statistics as well as selecting the network elements to be included in the simulation
  - See next slide for study area creation

Study Zone Creation





- **Study zone**: predictions will be computed at all pixels inside the study zone, base stations outside of the zone will still be considered for those pixels in its coverage range.

- 3 forms possible for a study zone:
  - Rectangular:
  - Polygonal
  - Circular
- Polygonal zone edition:

  Ctrl + double-click to edit the zone

  In edit mode, click any point of the polygone, when the point turns into blue, drag it to extend to the target location

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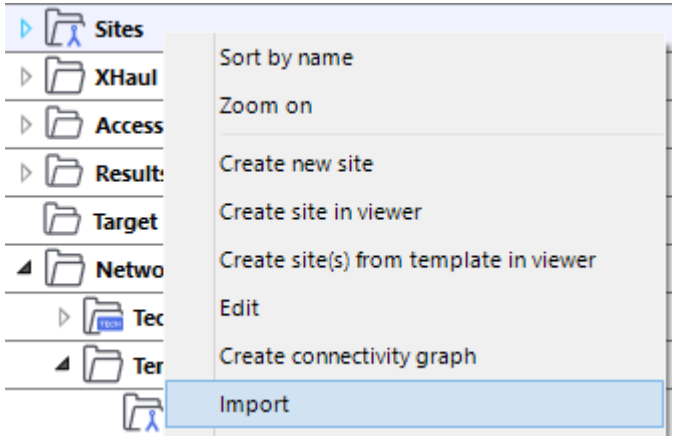
Study initialization 2/3

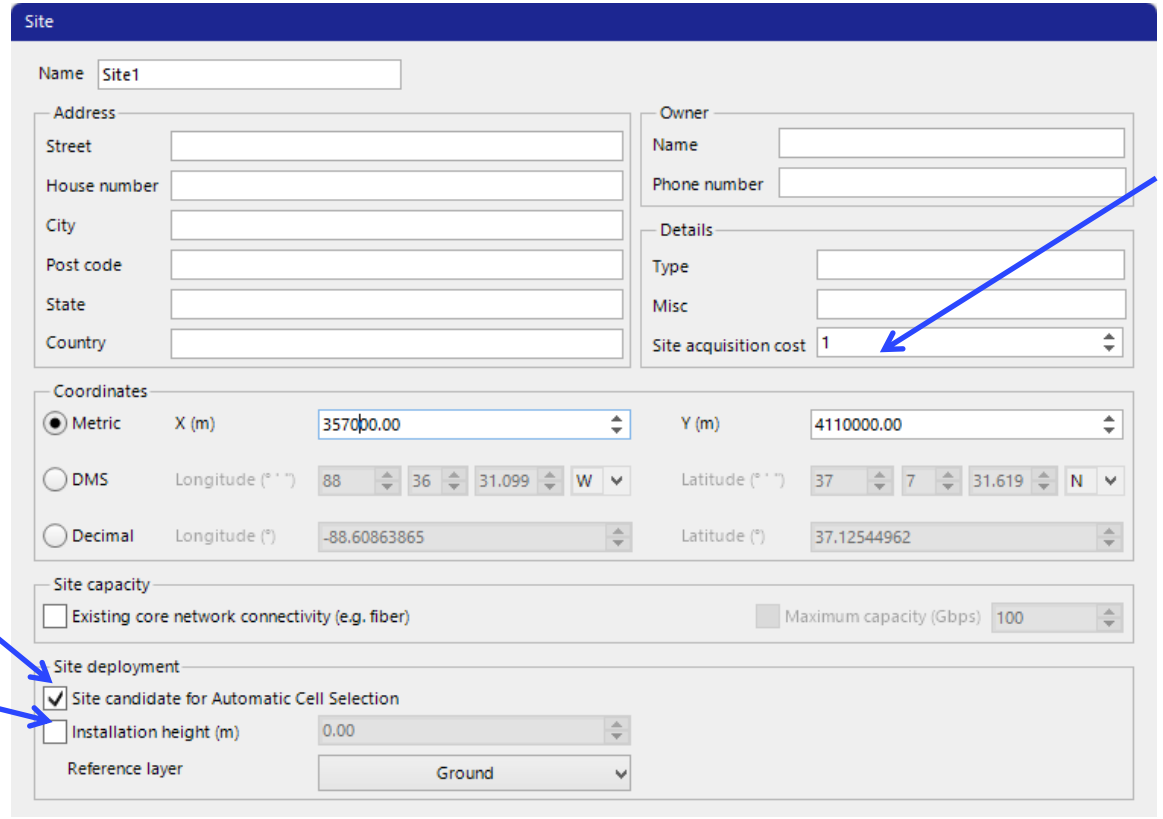
- Define **candidate sites** and characteristics

Import a list of sites and define which sites are candidates to an automatic deployment as well as additional characteristics that will be considered during the study



Candidate status activation for consideration in the simulation process

Installation height defines the preferred deployment height at this site. If no value, default template values will be considered



Cost associated to the deployment of Cells on this site.

When the site acquisition cost is set as 0, the site will be forced into selection.)

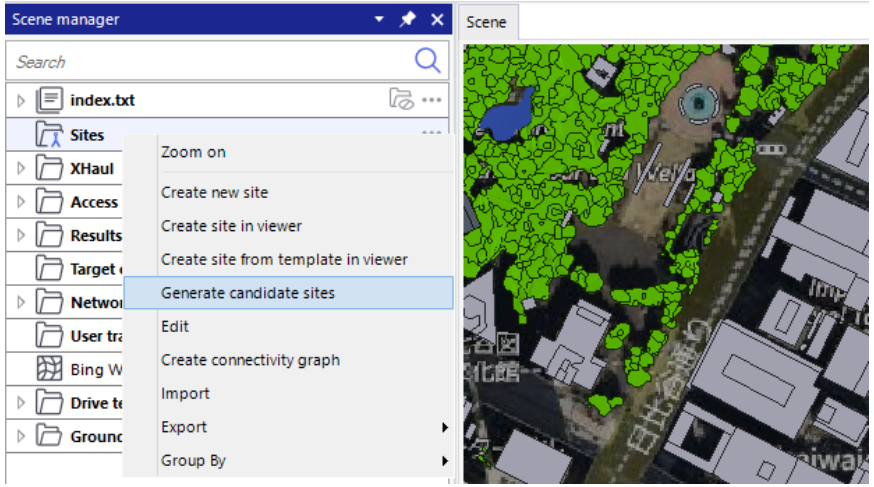
Study initialization 3/3

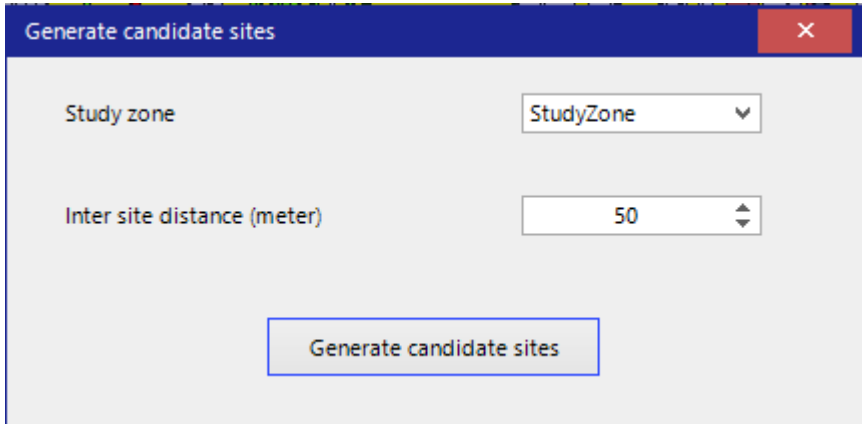
- Candidate sites auto-generation

If there is no candidate list available for the study, Bloonet Planner proposes to automatically generate candidate sites by right-clicking **Scene manager – Sites** and choosing “Generate candidate sites”.

In the **Generate candidate sites** window:

- Select a **Study zone** that predefined in the project
- Complete **Inter site distance**
- Click **OK** to generate candidate sites

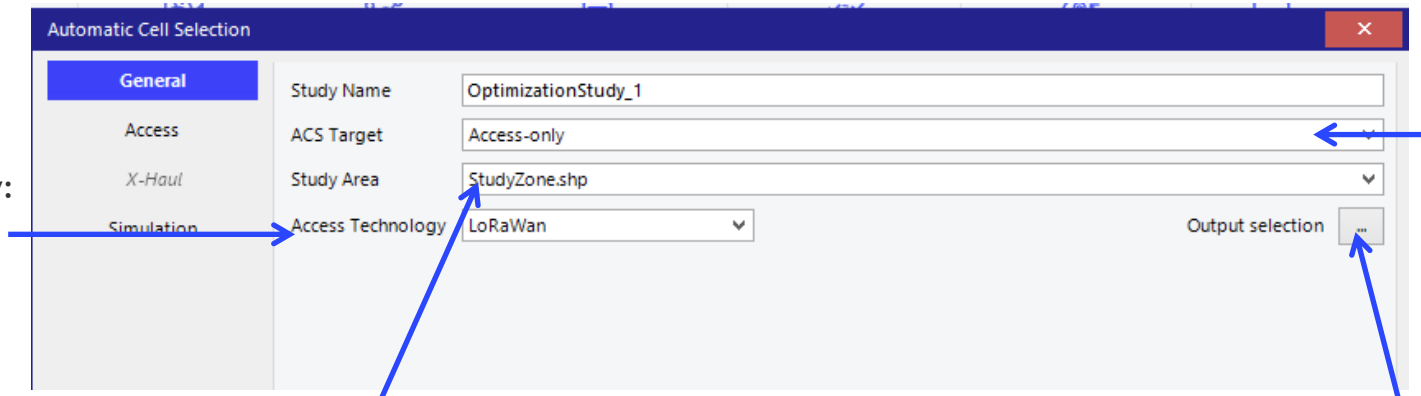




Automatic Site Selection: General settings

Access Technology:

Define the technology to be studied



Area: Study zone is mandatory, if target area is the map data area, a zone can be created to cover the whole area.

ACS Target:

Access only – The study objective is to deploy Cells on site candidates to reach the coverage objectives (This document will focus on Access Only scenario).

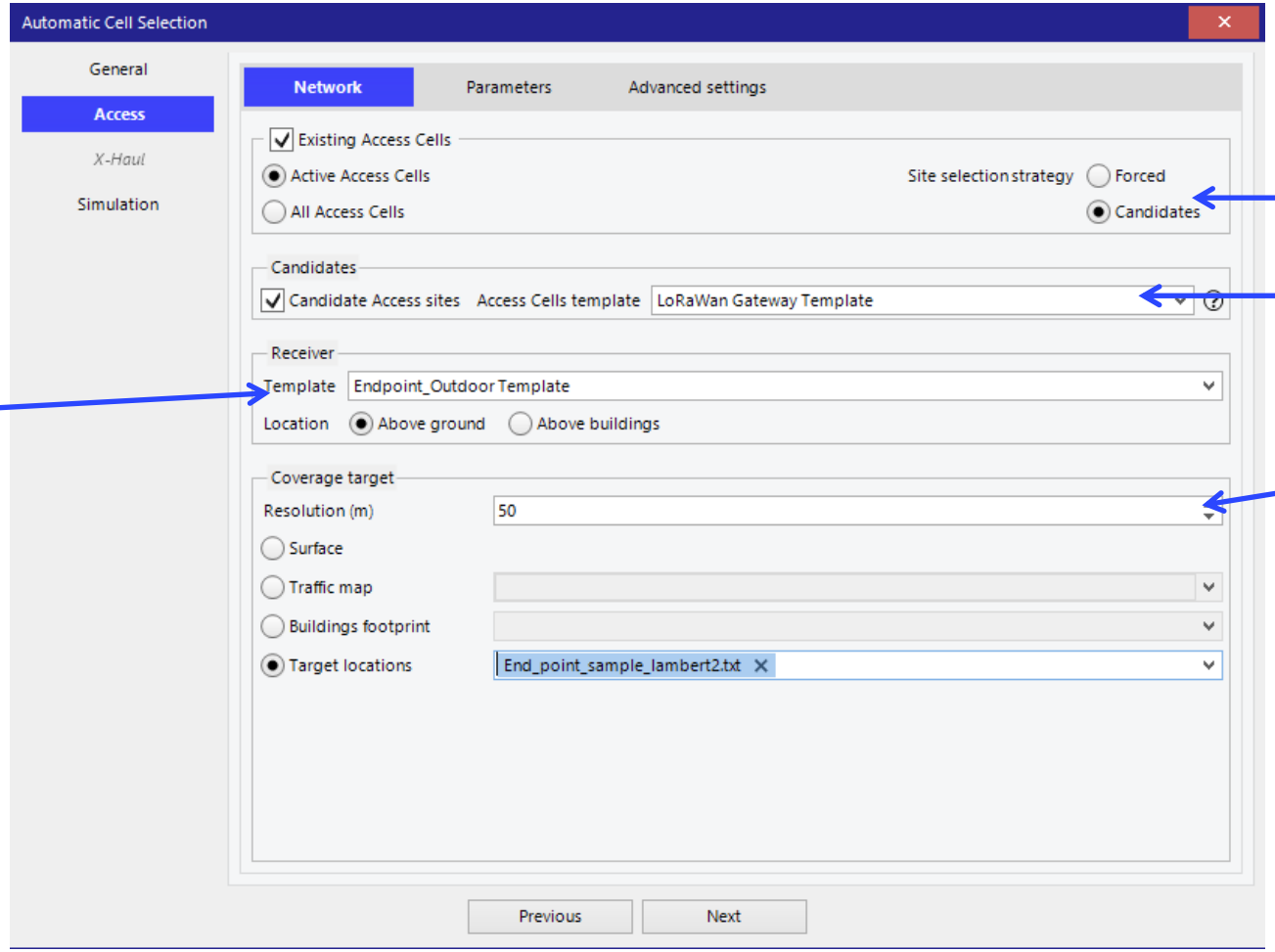
X-Haul only – The study objective is to deploy Distribution Units to connect active Cells in the study area.

Joint Access + X-Haul – The study objective is to deploy both Cells to reach coverage targets as well as Distribution Units to provide backhaul connectivity.

Output selection:

After the ACS process, a coverage prediction will be run with the selected sites, here select the simulation output metrics of this final coverage prediction.

Automatic Site Selection: Study settings



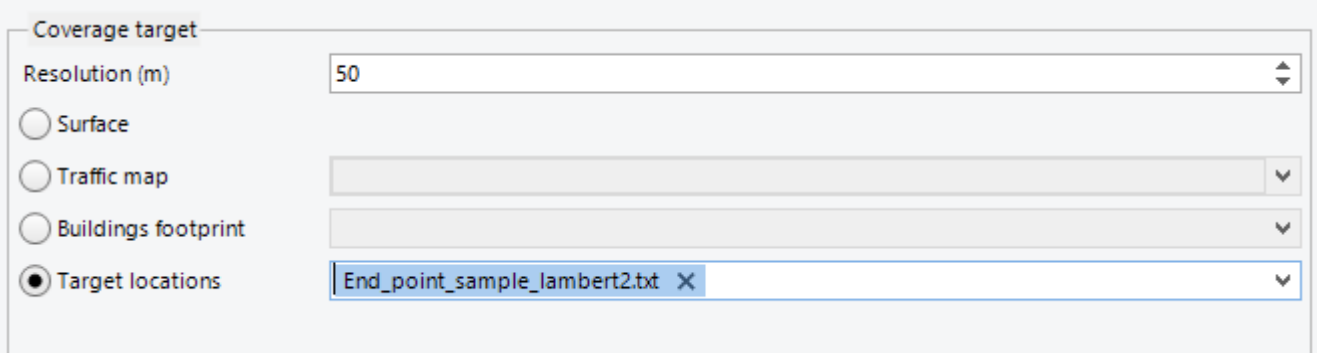
Defines the characteristics of the receiver

Existing Cells in the project can be candidates to the selection or forced in the selection

Define the characteristics of the Access Cells to be deployed.

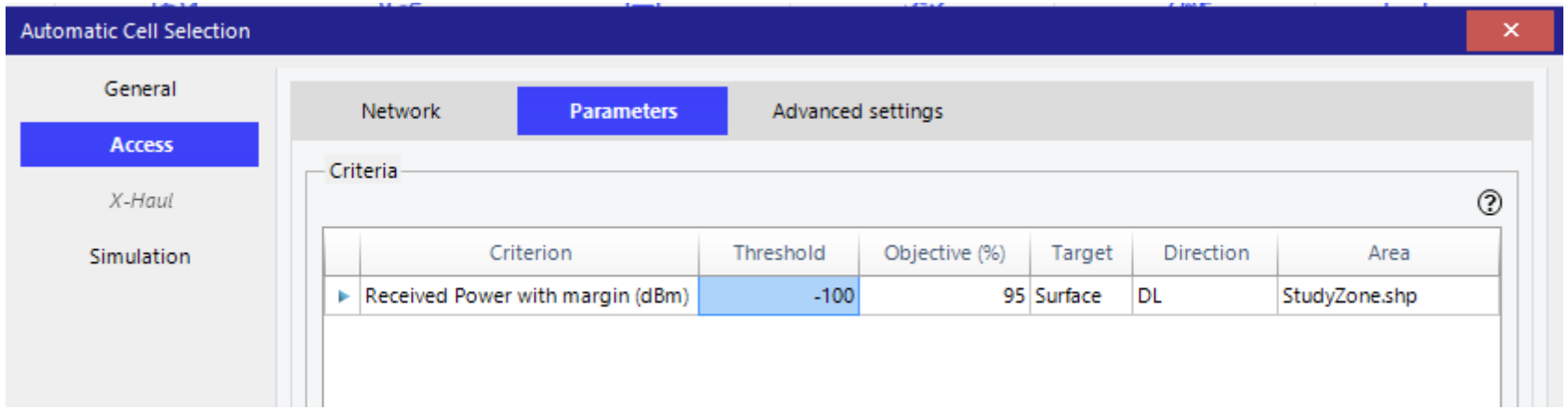
Defines the coverage resolution for the propagation simulation

Automatic Site Selection: Coverage target settings



- **Surface** : % surface covered within the study area
  - The total surface is the sum of the simulated pixels (that are non-excluded) in the study area
  - If location is above rooftop, the % is the ratio between covered building surface and total building surface
- **Traffic map** : % population covered within the study area
  - A user traffic map needs to be imported in the project
- **Building footprint** : % buildings covered within the selected layer(s) within the study area
  - A building is considered as covered as soon as a one pixel in a building footprint is above the defined threshold
- **Target locations** : % points covered within the study area

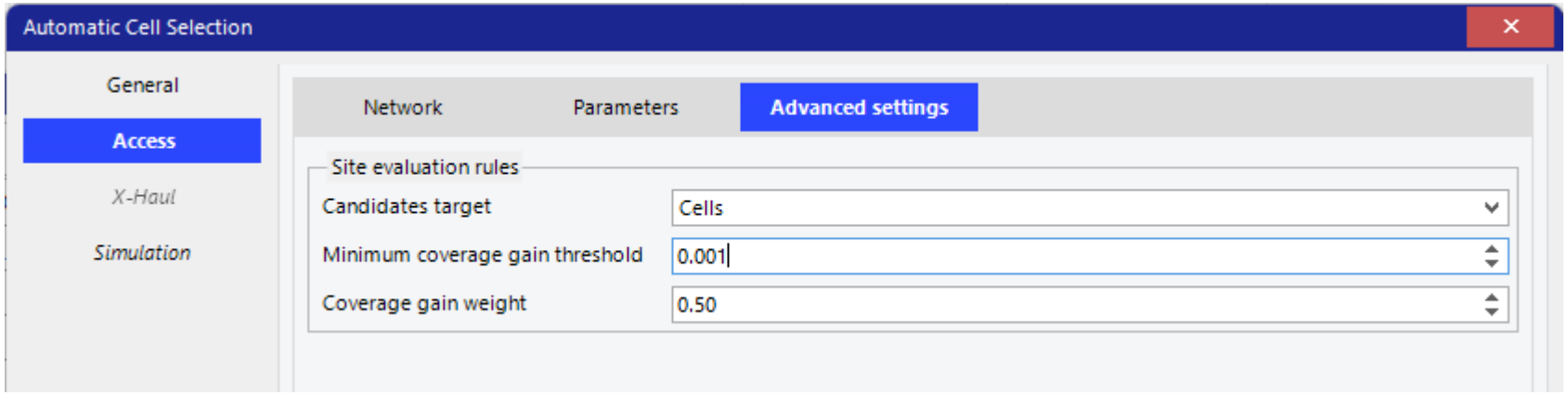
Automatic Site Selection: Criteria definition



Define the criteria for the computation:

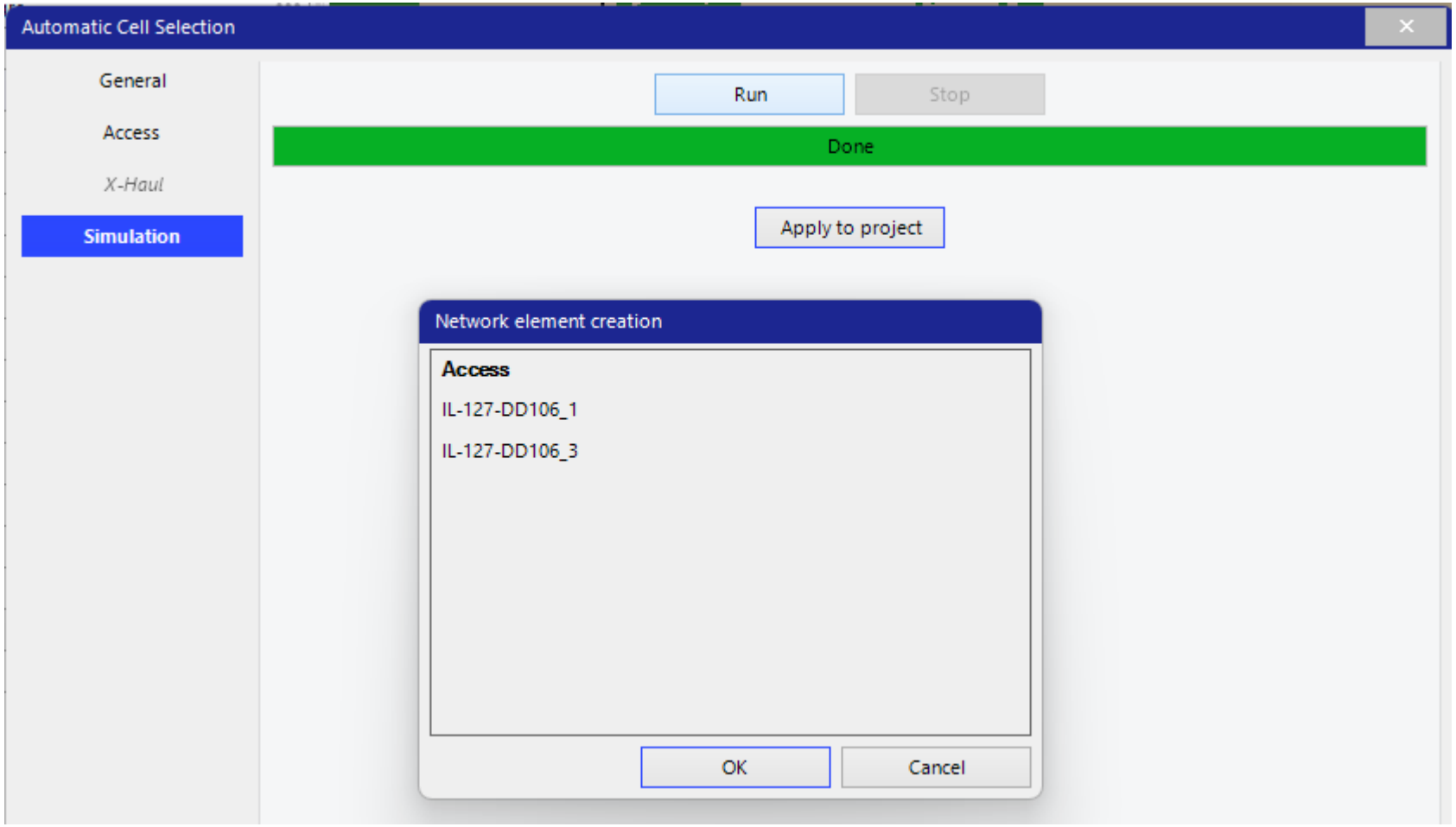
- **Criterion** : metric that will be utilized to determine the most effective sites to achieve the objective.
- **Threshold** : minimum value of the chosen metric. Points with results equal or above the threshold will be considered as covered or qualified capacity.
- **Objective (%)** : percentage of points that are considered as covered or qualified capacity within study area.
- **Target:** indicative, referring to the coverage location target which is defined in the previous step.
- **Direction:** DL or UL, only indicative for the direction-specific metrics.
- **Area:** indicative, referring to the Study area chosen in General settings

Automatic Site Selection: Advanced settings



- **Candidates target:** This parameter provides two options: Sites (default) and Cells. The Sites option enables Automatic Site Selection at the site level, assuming all sites share the same cell configuration (for example, the same number of sectors per site).The Cells option enables ACS at the individual cell level.
- **Minimum coverage gain threshold**: Defines the minimum percentage of coverage contribution required for a candidate site to be considered. For example, a value of 0.01 corresponds to a 1% minimum coverage contribution.
- **Coverage gain weight**: Adjusts the relative importance of coverage gain versus total site cost (including acquisition and equipment costs). A higher value increases the influence of coverage gain in the site selection process, while reducing the weight of cost considerations.

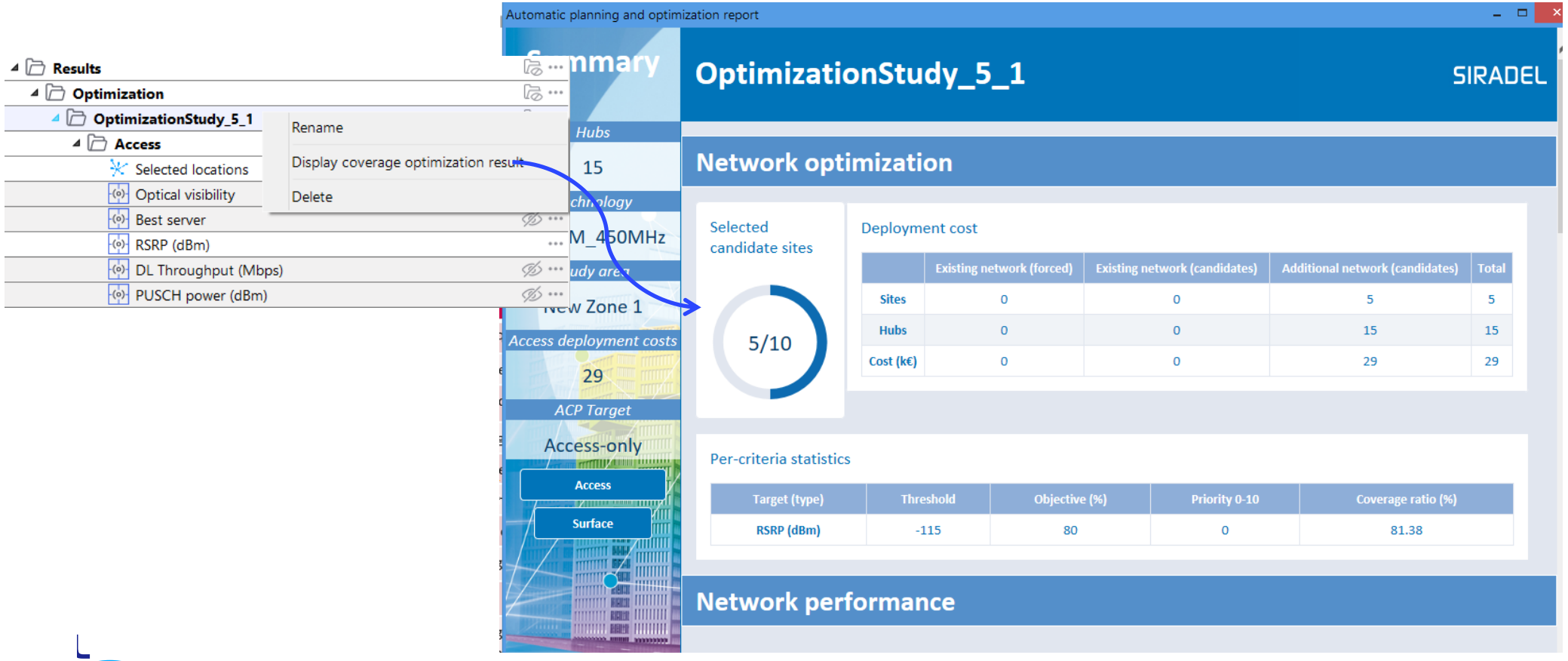
Automatic Site Selection: Simulation Run



- Apply to project will create new selected Cells and update activation state based on the analysis result

Automatic Site Selection: Result and Report

- Once the simulation process is performed, a report is generated providing an overview of the selected network as well as a description of the selected Cells
- Coverage maps generated with the selected network are available in the result folder



CONTENT

Coverage Prediction Workflow

Activate UE template

Define computation area (optional)

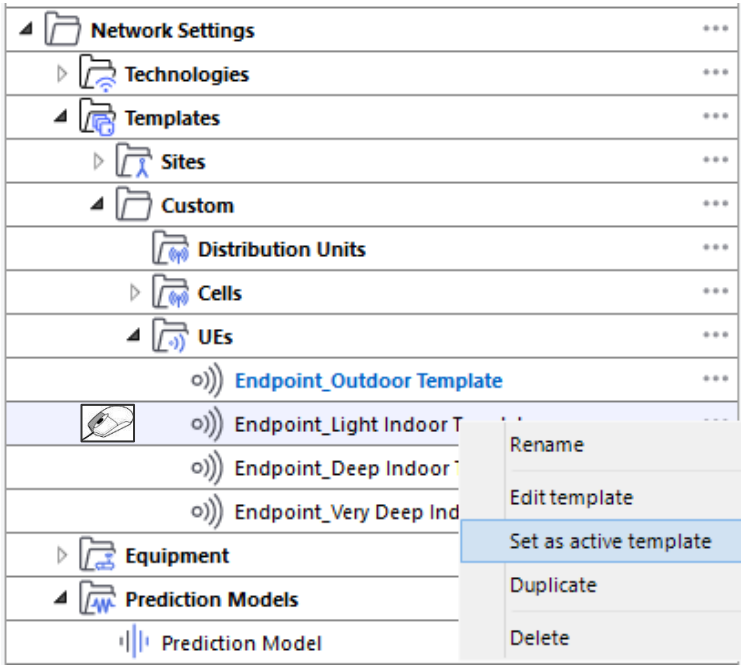
Start prediction for one or several active Cells

Define resolution and select computation area

Results analysis

UE template gathers all receiver characteristics to run the coverage map:

- UE Height
- UE Antenna and Orientation strategy
- Technology
- …



Coverage Prediction Workflow

Activate UE template

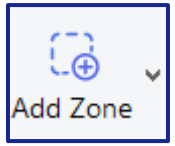
Define computation area (optional)

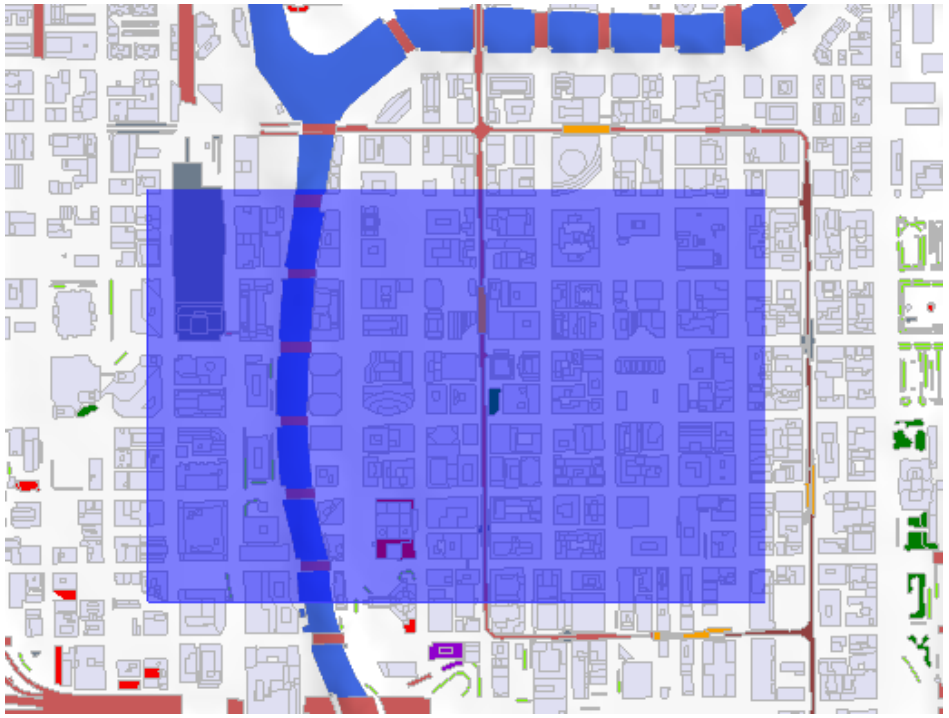
Start prediction for one or several active Cells

Define resolution and select computation area

Results analysis

Tools – Add zone





More details: Study zone creation

Coverage Prediction Workflow

Activate UE template

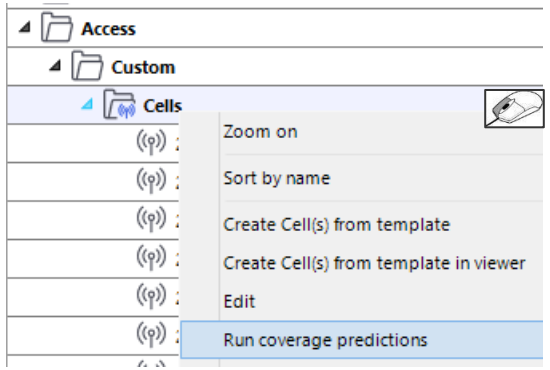
Define computation area (optional)

Start prediction for one or several active Cells

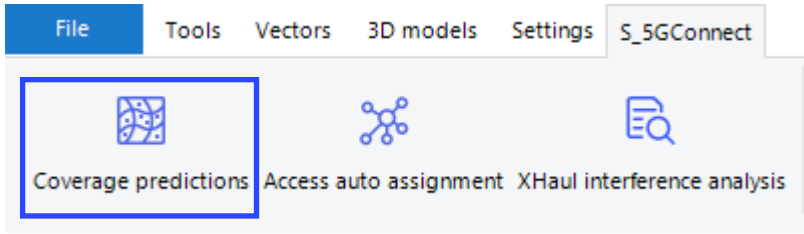
Define resolution and select computation area

Results analysis

Run coverage for all active Cells of a technology

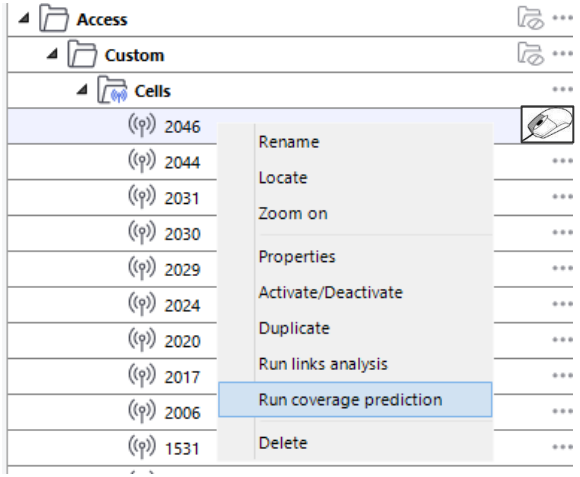


Or



After click « Coverage predictions », select the target technology type (from Custom/5G/LTE)

Run coverage for a single Cell (the Cell technology is selected for the prediction provided that the same technology is defined for the active UE template).



Coverage Prediction Workflow

Activate UE template

Define computation area (optional)

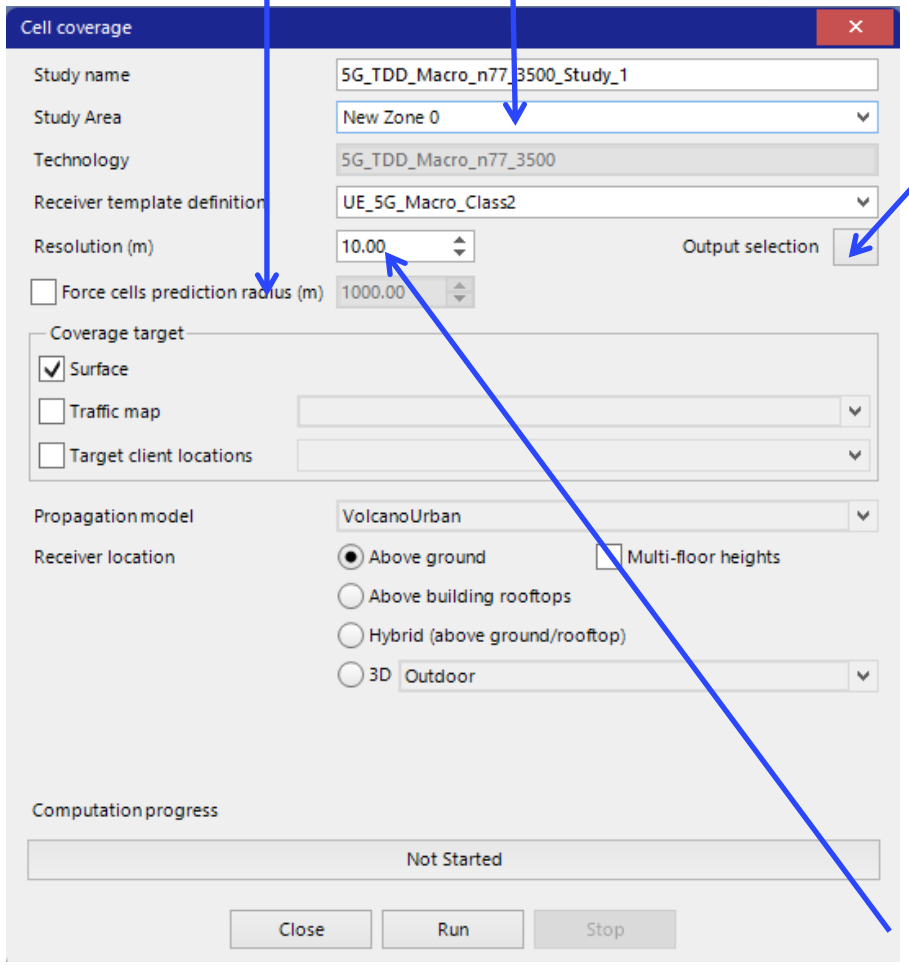
Start prediction for one or several active Cells

Define resolution and select computation area

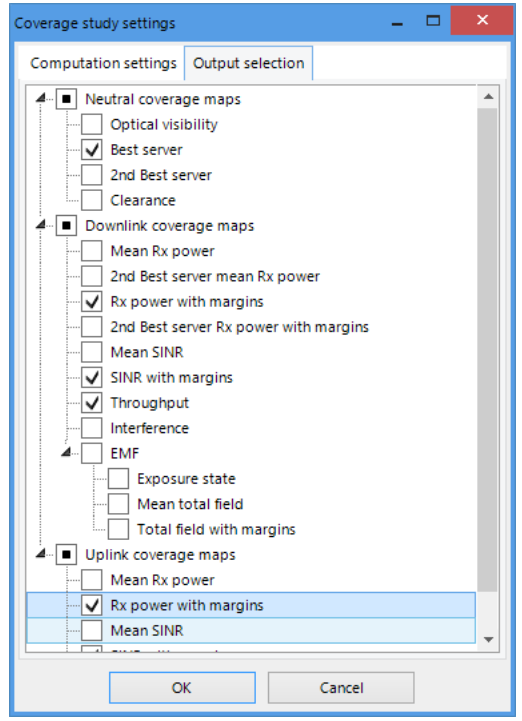
Results analysis

Override prediction radius defined at the Cell level

Study Area:
To be selected among the different existing areas



Output selection
Select coverage layers to be generated

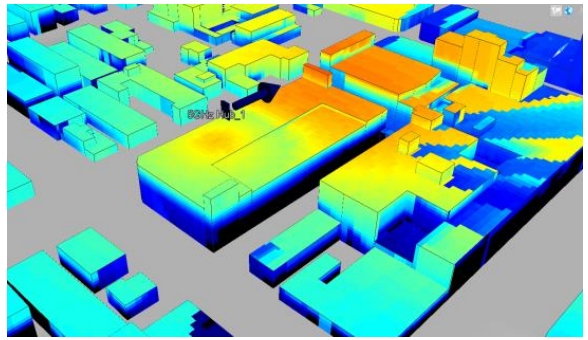


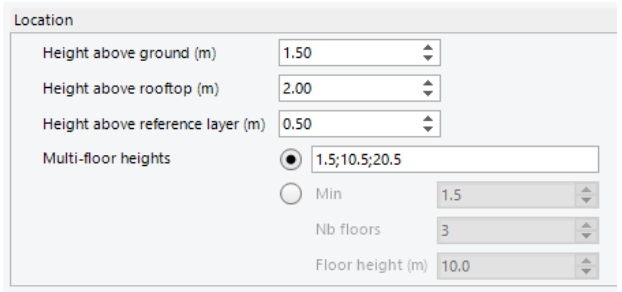
Resolution (m): Computation resolution

Coverage Prediction Workflow - 3D simulations

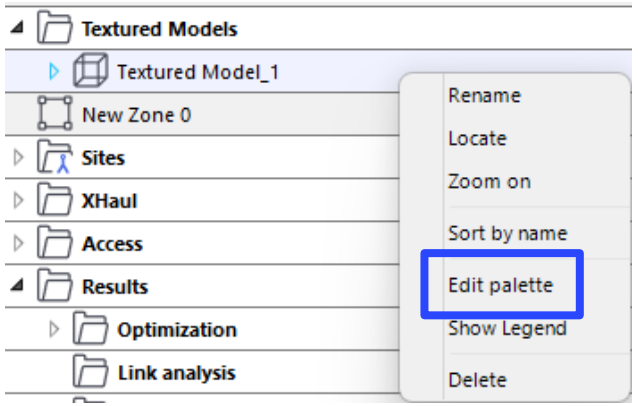
3D simulations are performed on building polygons, providing either coverage on building external facades in **Outdoor** mode or coverage inside buildings (internal facades and different floors) in **Indoor** mode, with computations based on multiple heights defined in the active Remote template.

During first 3D computation, a textured model is automatically created, there is color and value smoothing applied between two floors. (Currently there is no smoothing applied between the rooftop and last floor.)

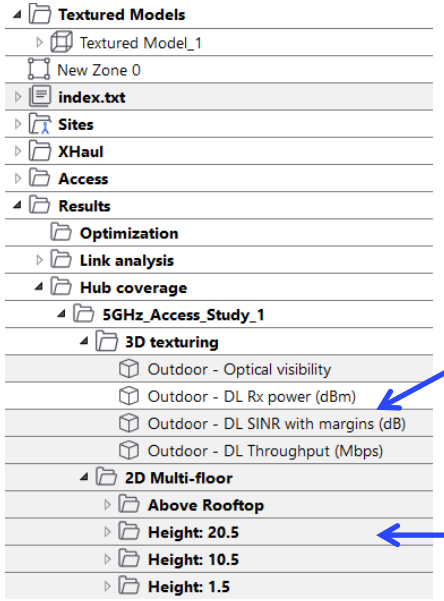




3D Simulations are performed on multi-heights based on the heights provided in the active Remote template (under Network settings – Templates – Custom/5G/LTE – Ues)



To modify the color palette of textured 3D simulation result, right-click the **textured model** and select **Edit palette**



3D texturing simulations are available in the Scene manager under Results (linked to the textured model)

2D multi-heights Volcano results used in input of the texturing are also available

Coverage Prediction Workflow

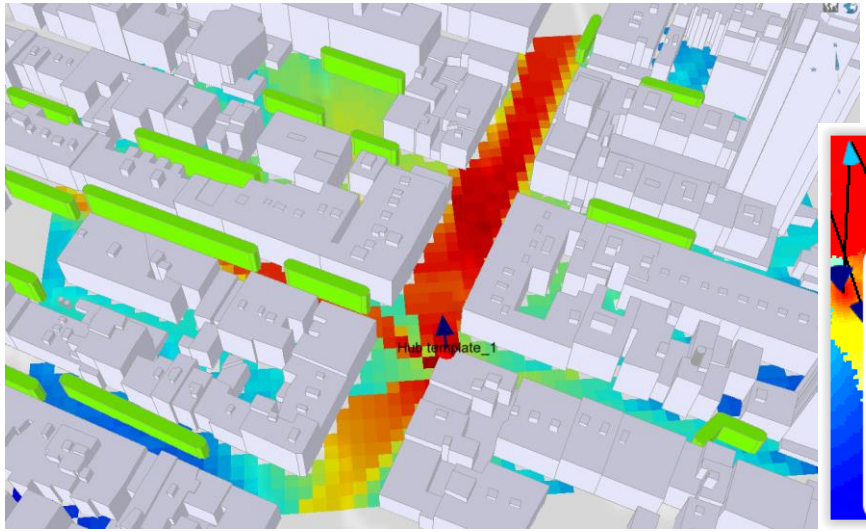
Activate UE template

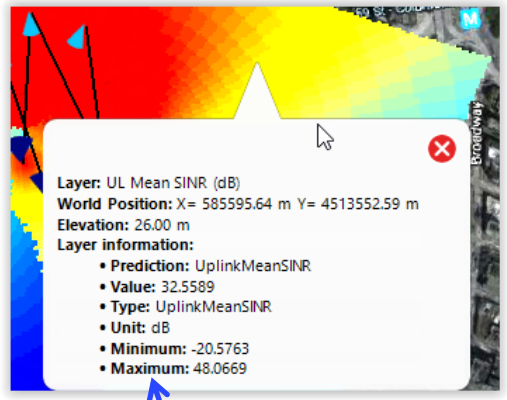
Define computation area (optional)

Start prediction for one or several active Cells

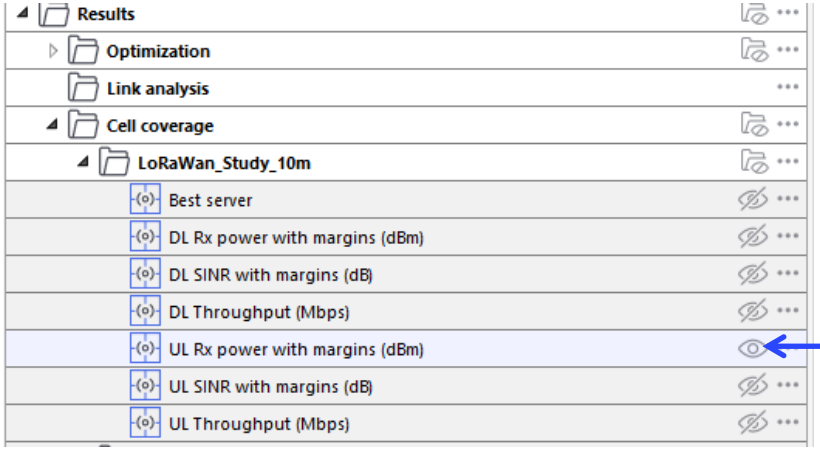
Define resolution and select computation area

Results analysis





Left click + ctrl opens a tooltip to read coverage values at a specific location



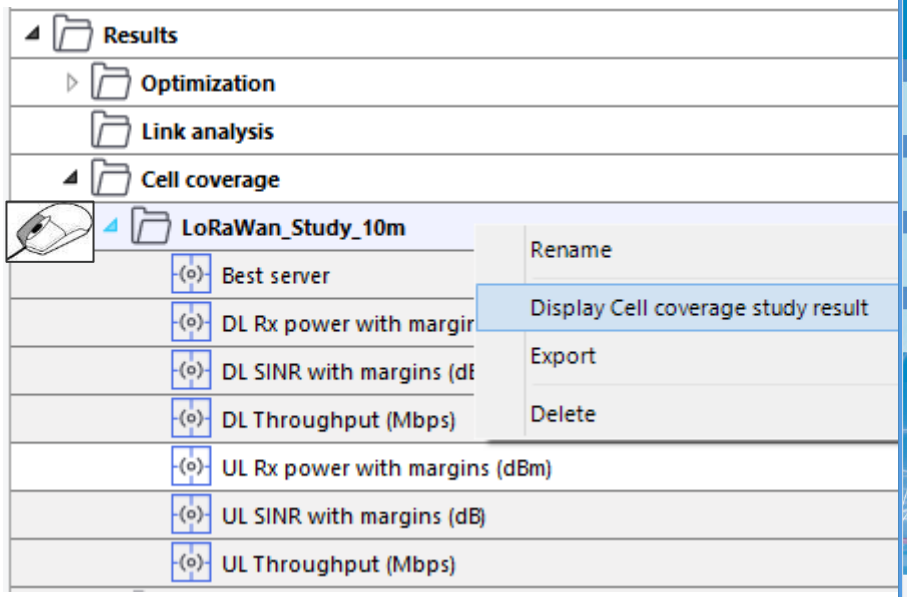
Display/Hide results by clicking on the « Eye »

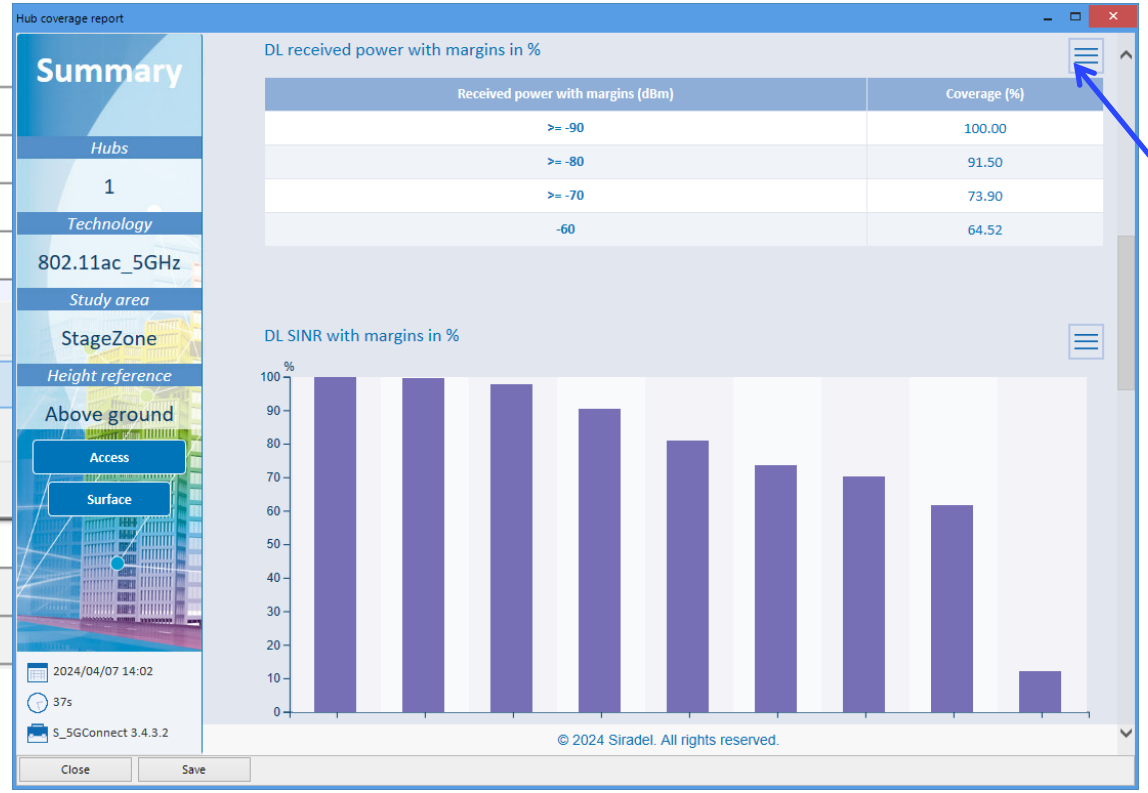
Coverage results available in the Scene manager under **Results**

Coverage Prediction Workflow - Report

The report provides a detailed overview of the simulated metrics (Throughput, SINR, Received power, Best Server, Visibility) as well as a comprehensive summary of the simulation input data.

For indoor or 3D simulation scenario, the coverage report is located at the receiver floor level. **Right-click** "**Results – Cell coverage – (Simulation name) – 2D multi-floor – Height: (receiver height)**" and select "Display Cell coverage study result" option to display the study report.





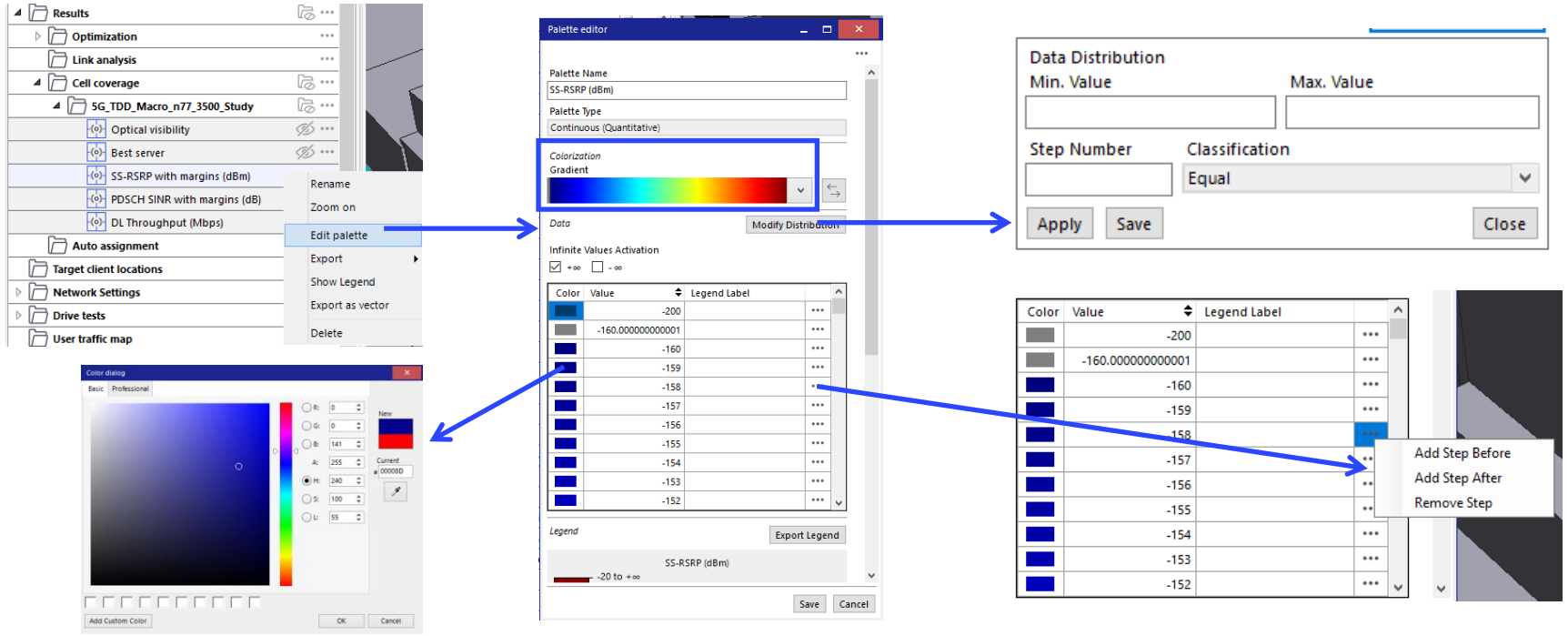
Switch view between chart and table

Coverage map: palette (legend) configuration

To modify the legend of a coverage map, right-click on a coverage map layer, select **Edit palette**.

There are two ways to modify the coverage map palette:

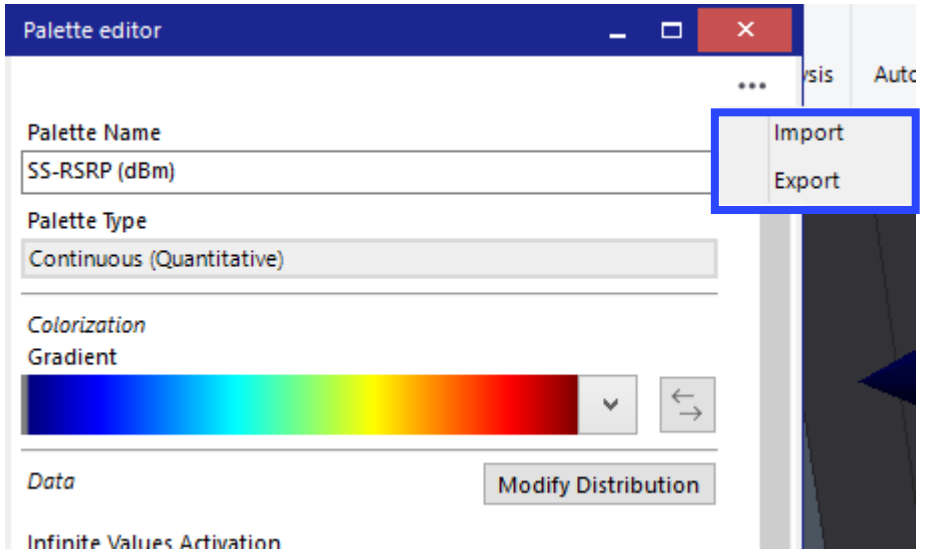
- Use **Gradient** and Modify **Distribution** function, to configure and generate automatically the legend.
- Click the … button to Add or Remove step and click on the color block to change the color of the step.



Coverage map: palette (legend) – Export and Import

Click on the … button on left top of the Palette editor window to export or import palette configuration file.

The palette configuration file is in XML format, which can be edited directly.




```
<ResultPalette xmlns:i="http://www.w3.org/2001/XMLSchema-instance" xmlns="http://schem
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  <ExtendToPositiveInfinity>true</ExtendToPositiveInfinity>
  <Markers>
    <Marker>
      <Color xmlns:d4p1="http://schemas.datacontract.org/2004/07/System.Drawing">
        <d4p1:knownColor>0</d4p1:knownColor>
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    </Marker>
    <Marker>
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    </Marker>
```

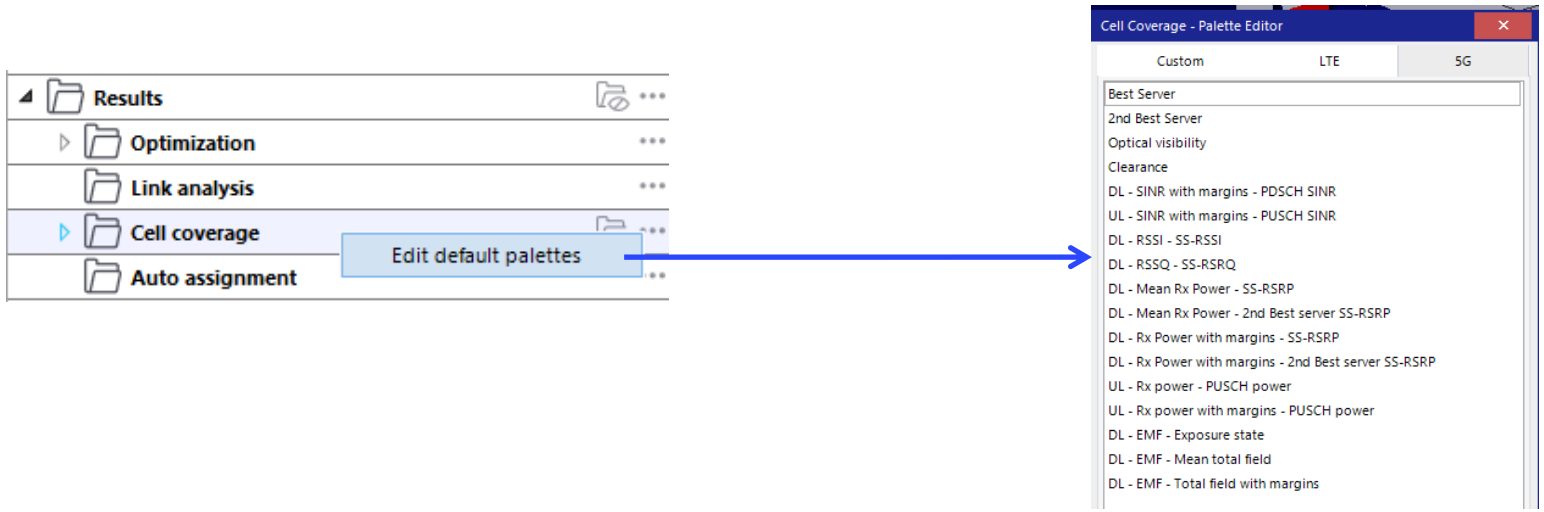
Coverage map: default palette (legend) configuration

Bloonet Planner provides default palettes for different metrics.

There are two levels of default setting modification :

Project level: all users (SaaS and Desktop users) can right-click (or click on the … button at the right) on **Results – Cell coverage**, click on **Edit default palettes** button. Select the metric and click **Edit Palette** button to edit the default palette of selected metric. All simulations run after this will be based on the new palette of this metric. This is limited in the project.

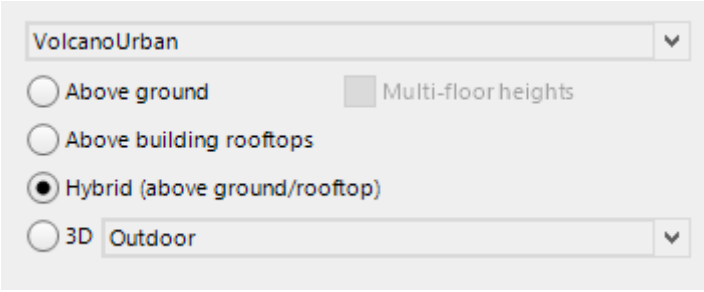
Application level: Desktop users can follow the palette configuration and export steps to create their own palettes. Replace the default palettes that are located at *C:\Program Files\Siradel\SmartCityExplorer\bin\plugins\S_5GConnect\Resources\Palettes* if the default installation path is used. The default palettes will be rewritten upon new version installation. Please ensure the backup before upgrading Bloonet Planner to a new release. (This option is not available for SaaS users.)



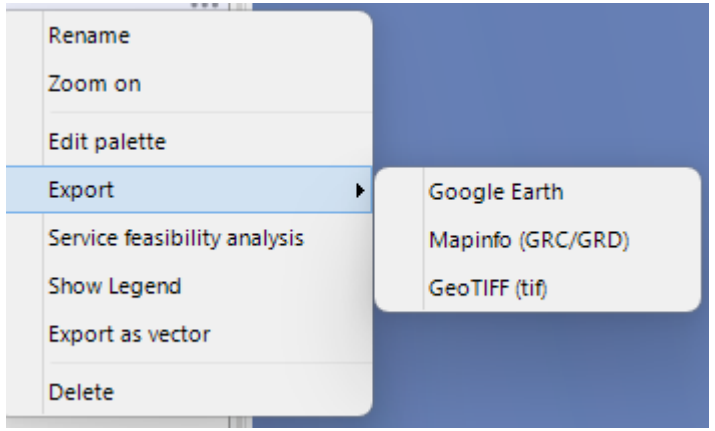
2D Coverage map: export options

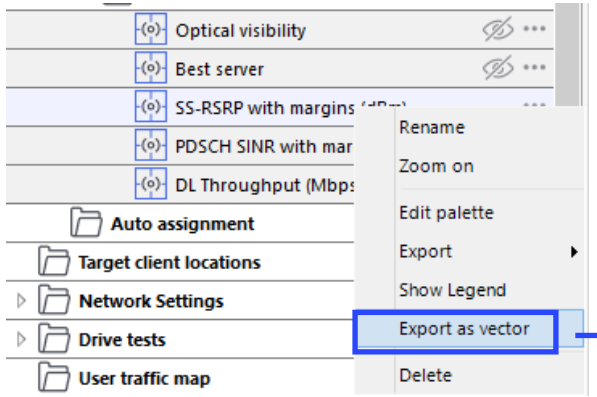
2D coverage map refers to the simulation results when the receiver location is Above ground, Above building rooftops or Hybrid (above ground/rooftop).

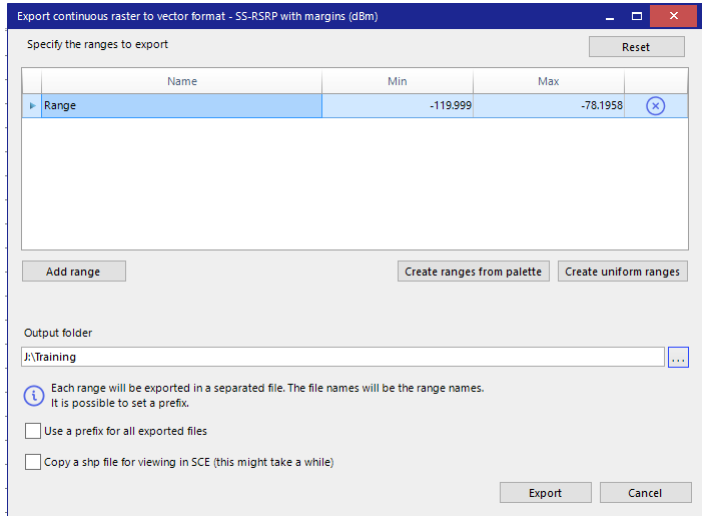
There are 4 options to export 2D coverage simulation results:



- **Google earth (KMZ) :** Right-click a simulation result, select **Export – Google Earth**
- **Mapinfo (GRC/GRD) :** Right-click a simulation result, select **Export – Mapinfo**
- **GeoTIF (tif) :** Right-click a simulation result, select **Export – GeoTIFF**
- **Vector (Shape format) :**Right-click a simulation result, choose **Export as vector**, configure the parameters in the pop-up window, and export the results as a Shapefile vector format. The exported files provide coverage area contours where metric values fall within the specified range.

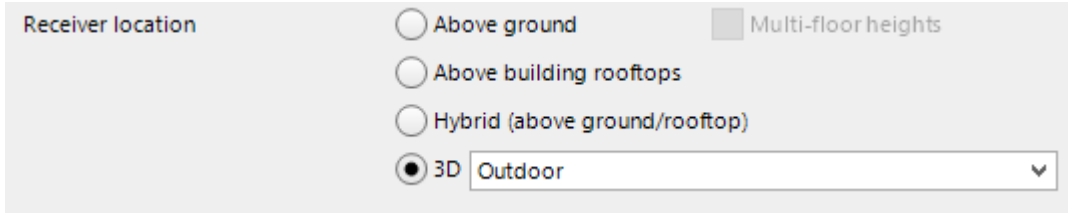






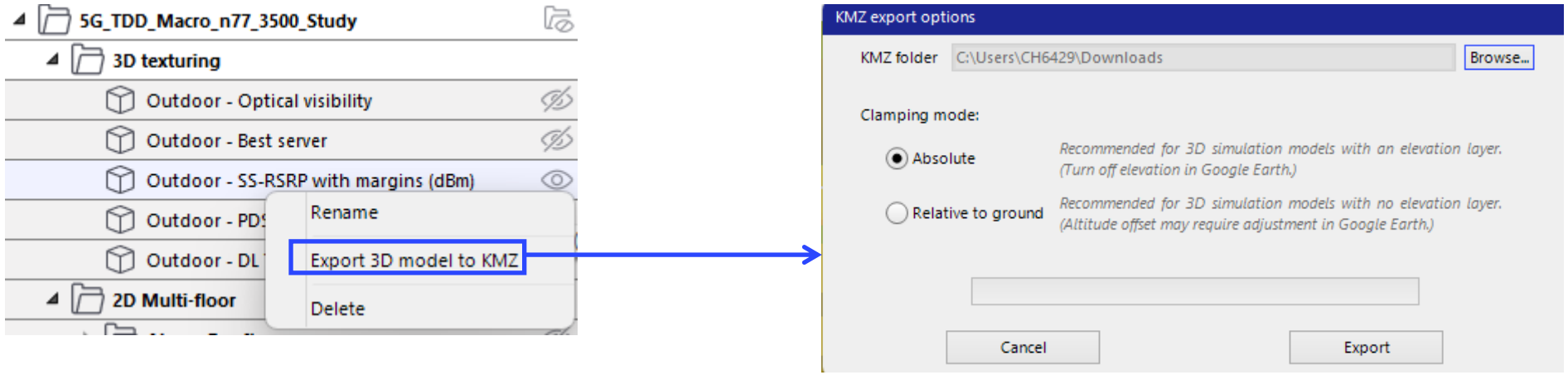
3D Coverage map export

3D coverage map refers to the simulation results when the receiver location is 3D (Outdoor or Indoor).



Right-click a simulation result under 3D texturing and select Export 3D model to KMZ (Google Earth format), two clamping modes are proposed:

- Relative to ground: Recommended mode for 3D coverage map export.
- Absolute: Terrain option in Google Earth Pro needs to be deactivated.



Note: 3D model load and display in Google Earth Pro can take some minutes (from a few minutes to more than 10 minutes depending on file size.

CONTENT

Automatic cell planning - introduction

Automatic cell planning feature is a workflow that helps the users to automate the process of optimizing the cell configurations. It uses optimization algorithms to determine the optimal cell configuration based on given objective.

This workflow can be used either at the network design phase, before the actual deployment of the base stations or gateways, or at the continuous network optimization phase, after the network deployment.

Together with the Automatic Cell Selection workflow, Automatic Cell Planning offers several significant benefits :

- Improvement of network coverage by strategically placing cell sites and proposing the optimal configurations to minimize coverage holes.
- Cost-efficiency as it reduces the need for manual planning, saving both time and resources.
- Enhanced service quality by minimizing interference and optimizing signal strength.

SIRADEL ENGIE

Automatic cell planning – pre-requisites

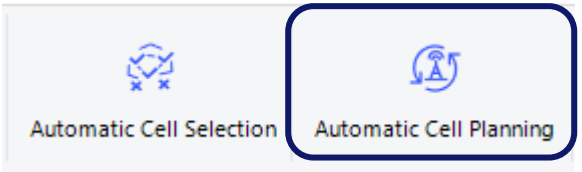
Before starting Automatic cell planning workflow, there are some pre-requisites to respect:

- **Cells** to be optimized have been already created in the project
- **UE equipment** (under “Network settings – Equipments – Radios – Custom/5G/LTE – UEs” in the Scene manager) has been well configured, gathering the target receiver equipment’s characteristics : transmission power, noise figure, mapping tables that translate a given SINR into throughput value through spectrum efficiency, antenna pattern, etc.
- **UE template** (under “Network settings – Templates – Custom/5G/LTE – UEs” in the Scene manager) has been well configured, gathering target UE’s initial configuration information : UE equipment, receiver height, antenna related parameters, additional interference, etc.
- **Study Area** (menu **Tools – Add zone** in the tool bar) has been created. The study area specifies a zone where the simulation will be run.
- **Optimization Area** (menu **Tools – Add zone** in the tool bar) has been created. The optimization area specifies a zone where the candidate cells are to be optimized.

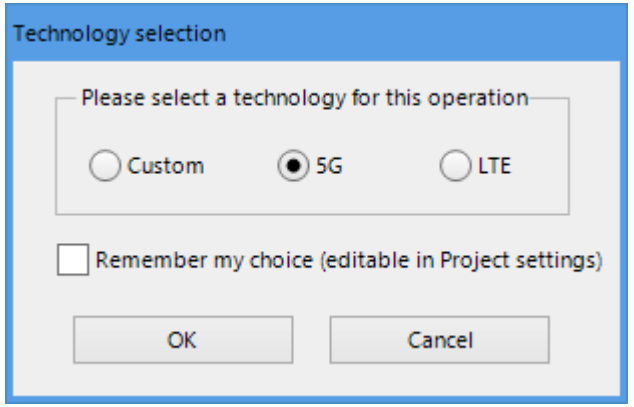
Automatic Cell Planning Workflow : Technology type selection

- **Technology type selection**
- Simulation settings
- Optimization settings
- Live monitoring
- Results

Select the **Automatic Cell Planning** button in the tool bar to launch Automatic Cell Planning workflow.



Select the **Technology Type** in the pop-up window:

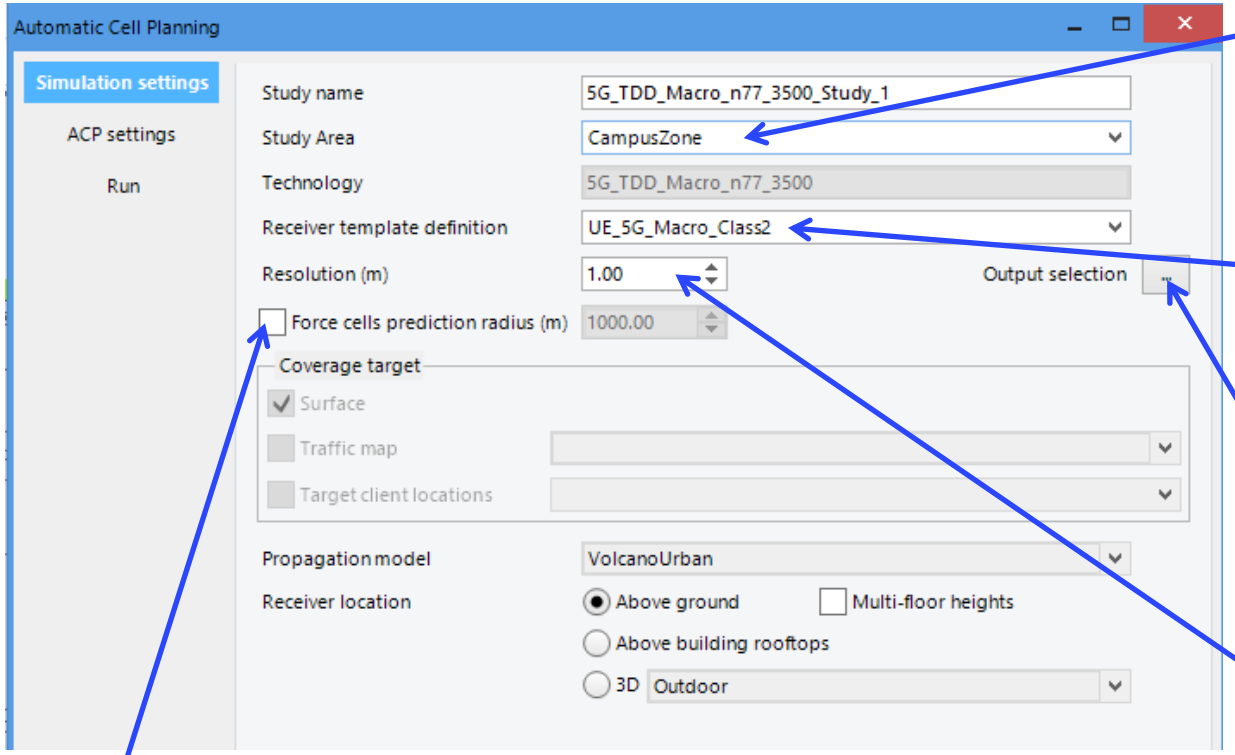


If previously the **Remember my choice** option has been activated, this window will not be shown. You can select the **Project settings** button in the tool bar, then **Technologies** tab to change the **Active technology type**.

Automatic Cell Planning Workflow : Simulation settings

- Technology type selection
- **Simulation settings**
- Optimization settings
- Live monitoring
- Results

This step has similar parameters as in coverage prediction.
It defines prediction related parameters.



Study Area:
Select the Study zone prepared in advance, as stated in the pre-requisites page

Receiver template:
Select the UE template prepared in advance, as stated in the pre-requisites page

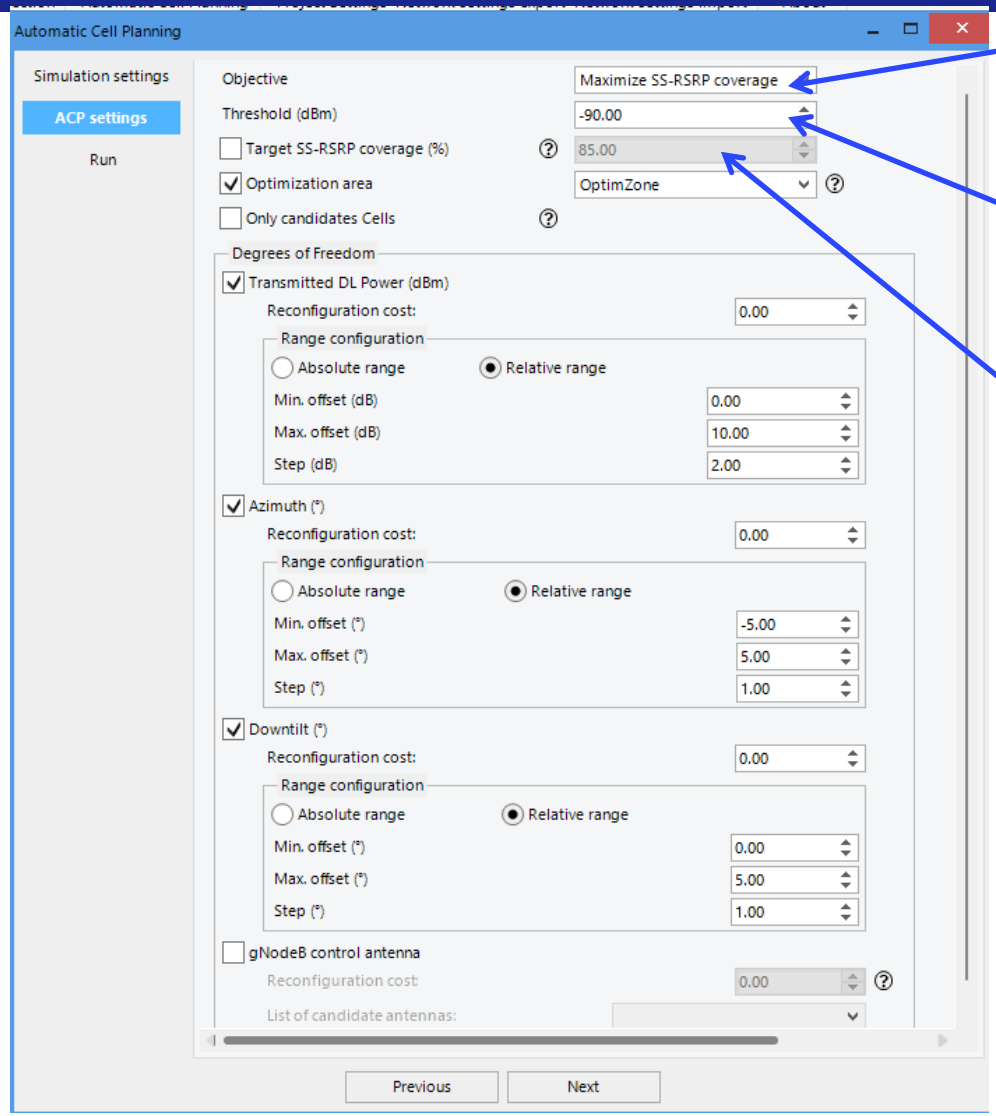
Output selection
Select metrics results to be generated **with the proposed cell configuration**

Resolution (m):
Computation resolution

Override prediction radius defined at the cell level

Automatic Cell Planning Workflow: Optimization settings 1/2

- Technology type selection
- Simulation settings
- **Optimization settings**
- Live monitoring
- Results



Objective: metric that will be utilized to determine the most effective configuration to achieve the objective.

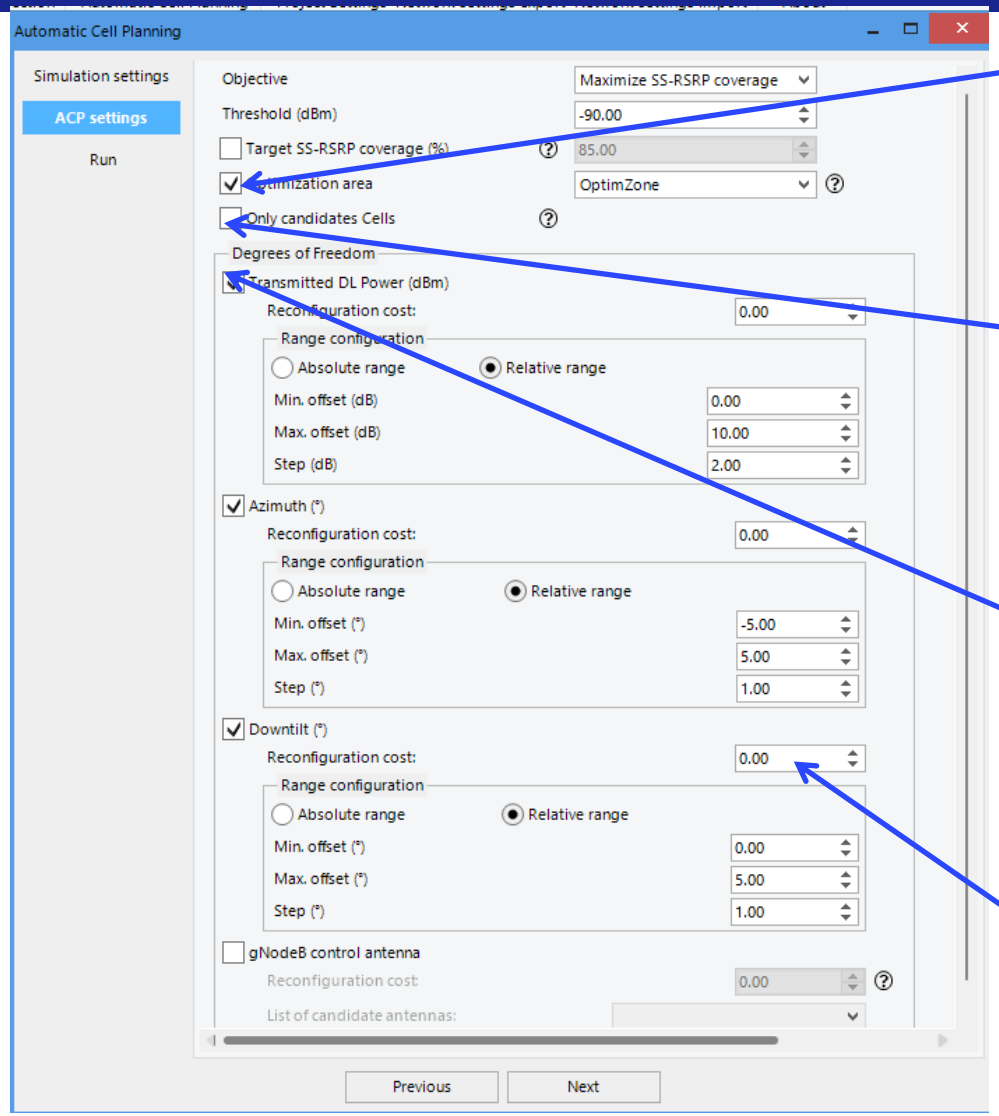
Threshold : minimum value of the chosen metric. Points with results equal or above the threshold will be considered as covered or qualified capacity.

Target:

- **Coverage:** percentage of points that are considered as covered within study area.
- **SINR:** the average SINR of all the points in the study area
- Not selected: the algorithm will try to find the maximum value possible. In this case, it is recommended to set a "**Maximum optimization duration**" value in the live monitoring step.

Automatic Cell Planning Workflow: Optimization settings 1/2

- Technology type selection
- Simulation settings
- **Optimization settings**
- Live monitoring
- Results



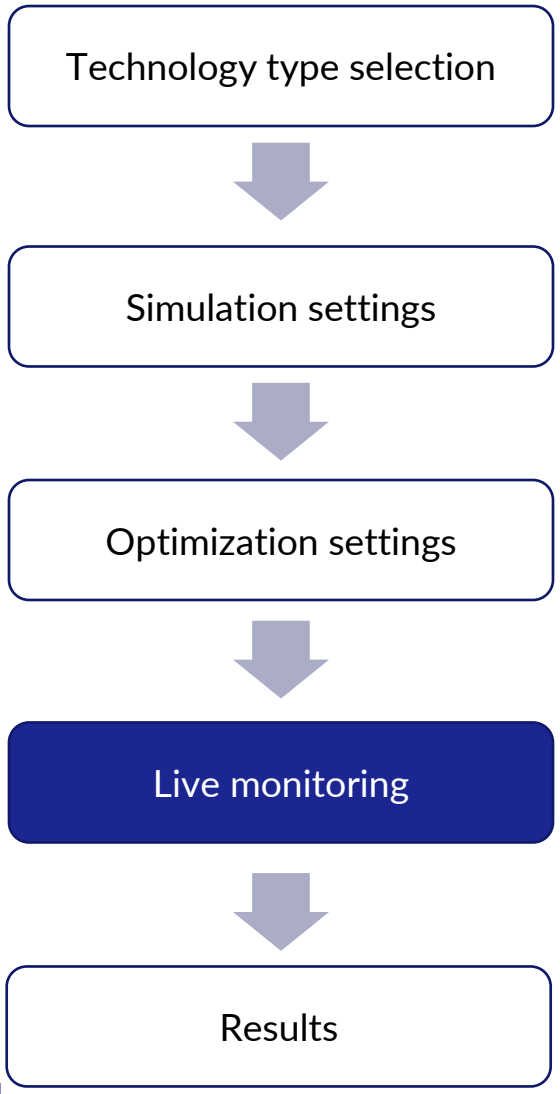
Optimization area : the zone where the candidate cells are to be optimized. If not activated, the study area selected in the simulation settings will be used.

Only candidate cells : if this option is activated, only the cells configured in the cell properties as **Candidate cell for Optimization Cell Planning** will be optimized.

Degrees of freedom: the cell parameters that are subject to optimization. The range of optimization can be set as absolute value or relative range to the initial value.

Reconfiguration cost: the total reconfiguration cost will appear in the ACP report.

Automatic Cell Planning Workflow



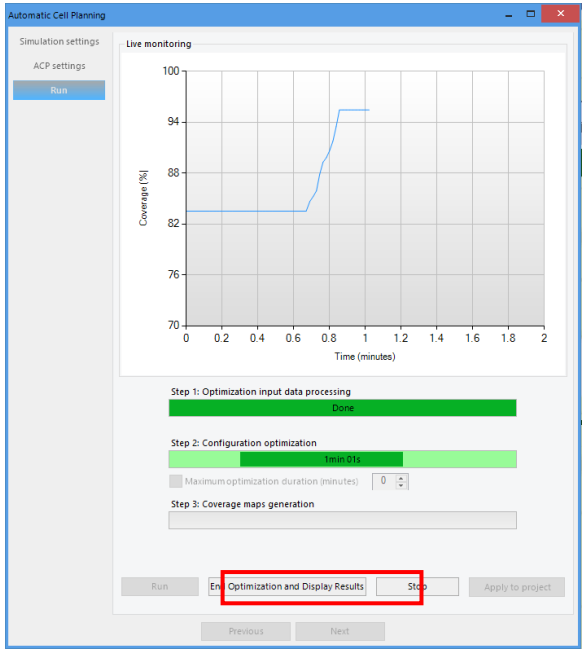
During the Run phase, live monitoring is shown to actively track the optimization process. This allows users to be informed of the current status and make decisions about when to halt the optimization, particularly as the results begin to converge.

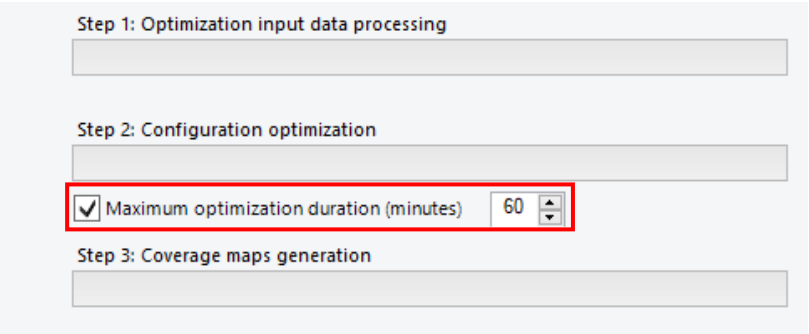
There are 3 triggers to stop the optimization process and show the results:

1, **End Optimization and Display Results** button is pressed by the user: this button can be used by users to end the optimization process if they believe the result is satisfactory.

2, **Maximum optimization duration** is reached: this setting allows users to specify a limit for the optimization duration. In networks with a large number of cells and several configuration parameters (Degrees of freedom), the number of possible combinations can be vast. As a result, the optimization could continue for an extended period, often yielding marginal improvements after a certain threshold. By setting the Maximum optimization duration, users can ensure they achieve an optimal configuration within a desired timeframe.

3, The objective that was set in the previous step has been achieved.

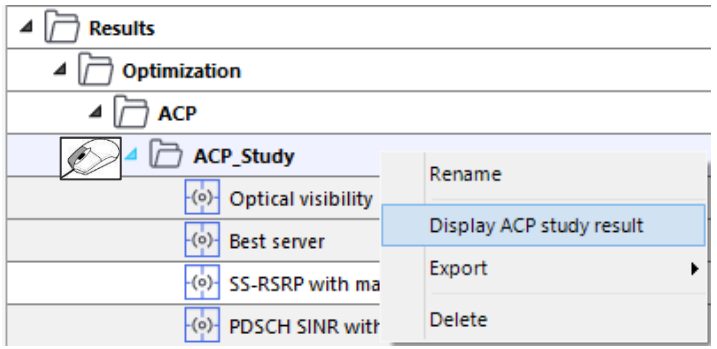


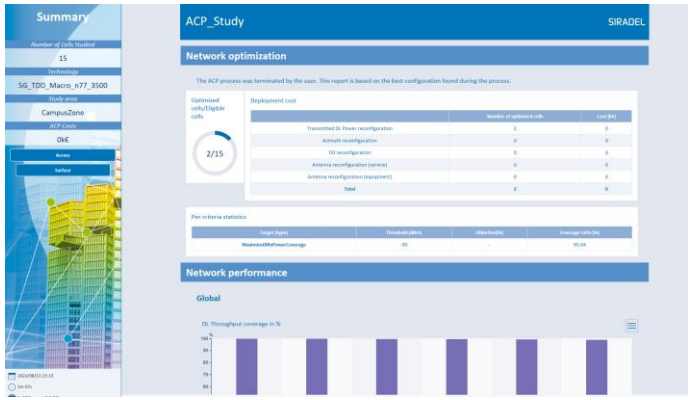


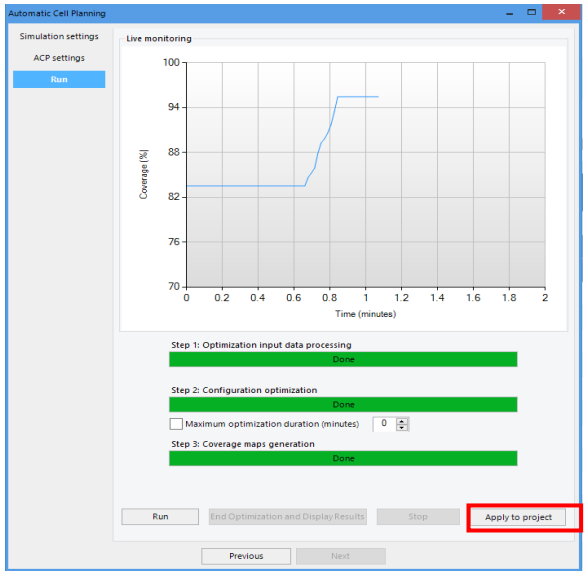
Automatic Cell Planning Workflow

- Technology type selection
- Simulation settings
- Optimization settings
- Live monitoring
- Results

Upon completion of the ACP process, an ACP report will be generated, summarizing the results. Users may then click the **Apply to Project** button to implement the suggested configuration within the project.







CONTENT

Access Auto Assignment

The Access Auto Assignment aims at automatically assigning UEs (or CPE : Customer Premises Equipment) to Cells. The feature simplifies the process of assigning Cells and UEs for users designing a Fixed Wireless Access network.

Access Auto Assignment

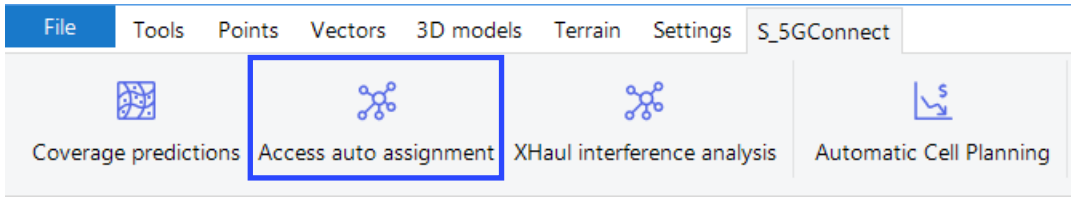
Start Access Auto Assignment

General settings

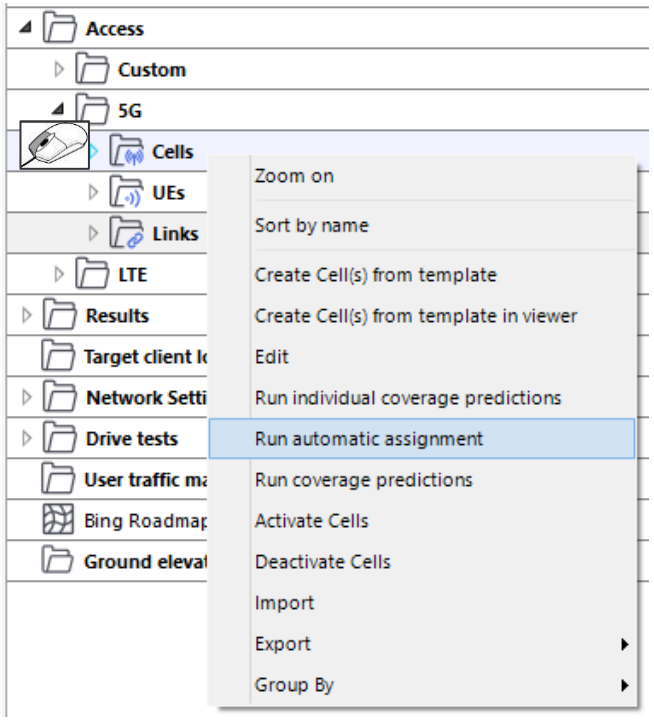
Manually adjust study configuration (optional)

Run

Visualize report and network topology



Or



Access Auto Assignment

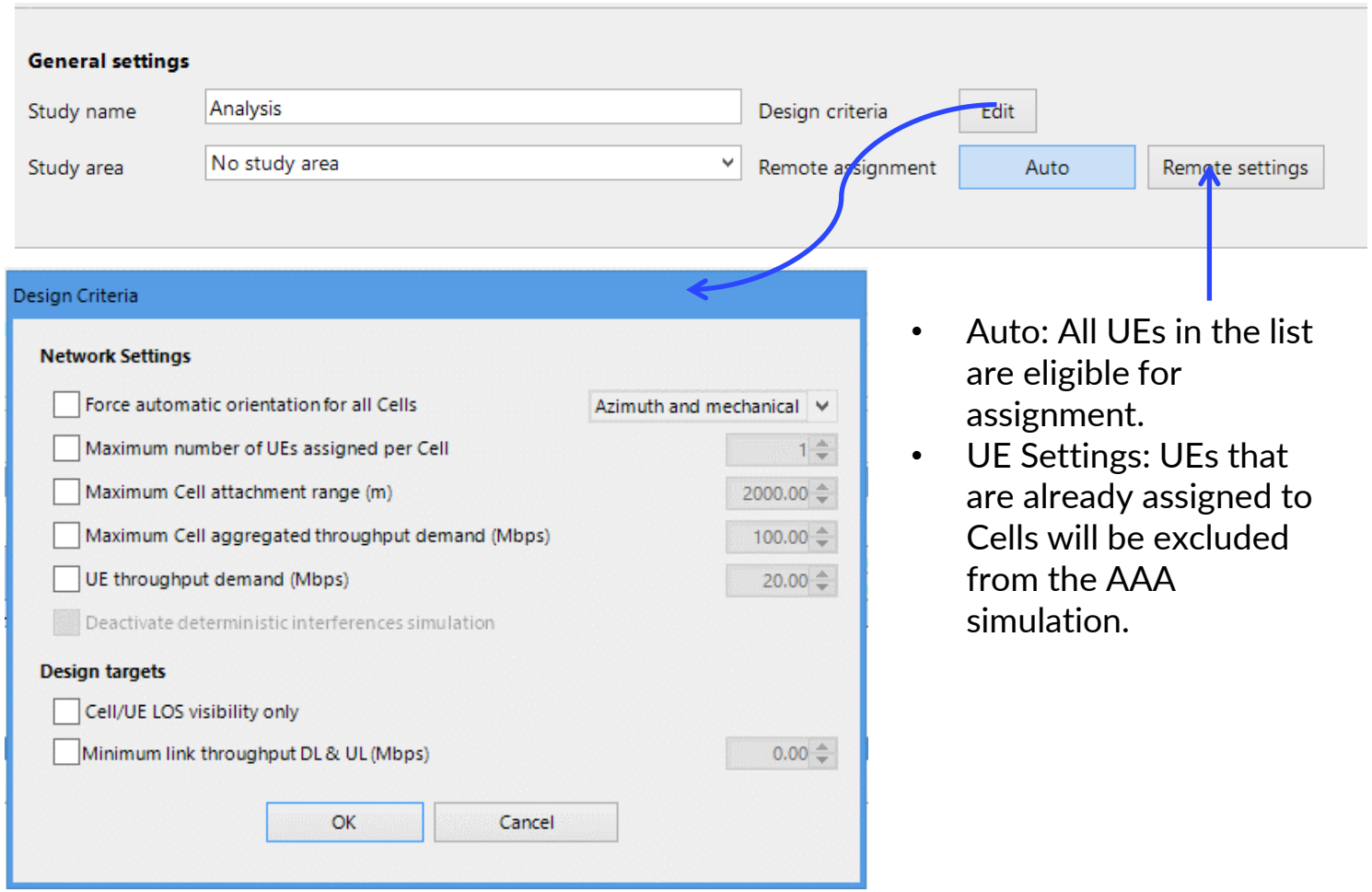
Start Access Auto Assignment

General settings

Manually adjust study configuration (optional)

Run

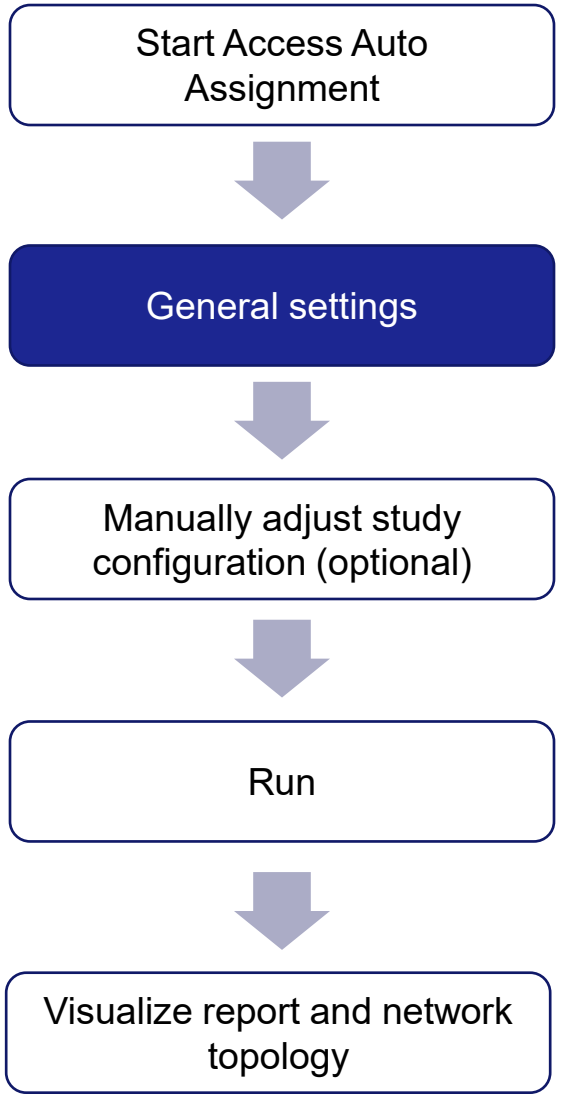
Visualize report and network topology

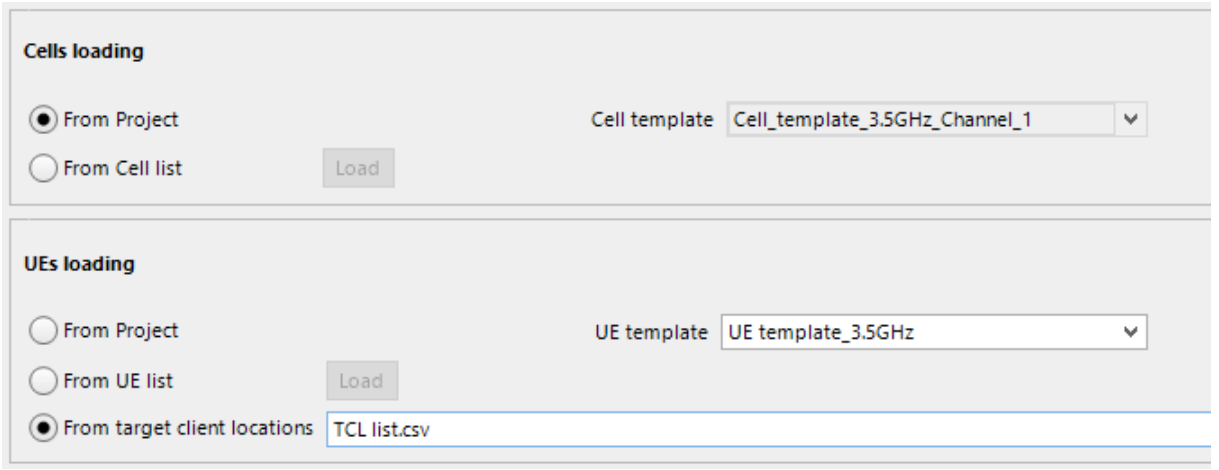


- Auto: All UEs in the list are eligible for assignment.
- UE Settings: UEs that are already assigned to Cells will be excluded from the AAA simulation.

Design Criteria enables to easily overwrite network settings for quick evaluation of different deployment scenarios.

Access Auto Assignment





- Cells loading:
  - **From Project:** the active cells of the corresponding technology in the project will be considered for the AAA simulation.
  - **From Cell list**: users need to select a csv format file which contains the available Cells for the AAA simulation.
- UEs loading:
  - **From Project**: the active UEs of the corresponding technology in the project will be considered for the AAA simulation.
  - **From UE list**: users need to select a csv format file which contains the UEs for the AAA simulation. If a study area is selected, only the UEs within the study area will be considered.
  - **From target client locations**: the dropdown list include all target client location lists imported under Target client locations in the Scene manager. The target client location file includes at least 4 columns: Name;X;Y;Height

Access Auto Assignment

Start Access Auto Assignment

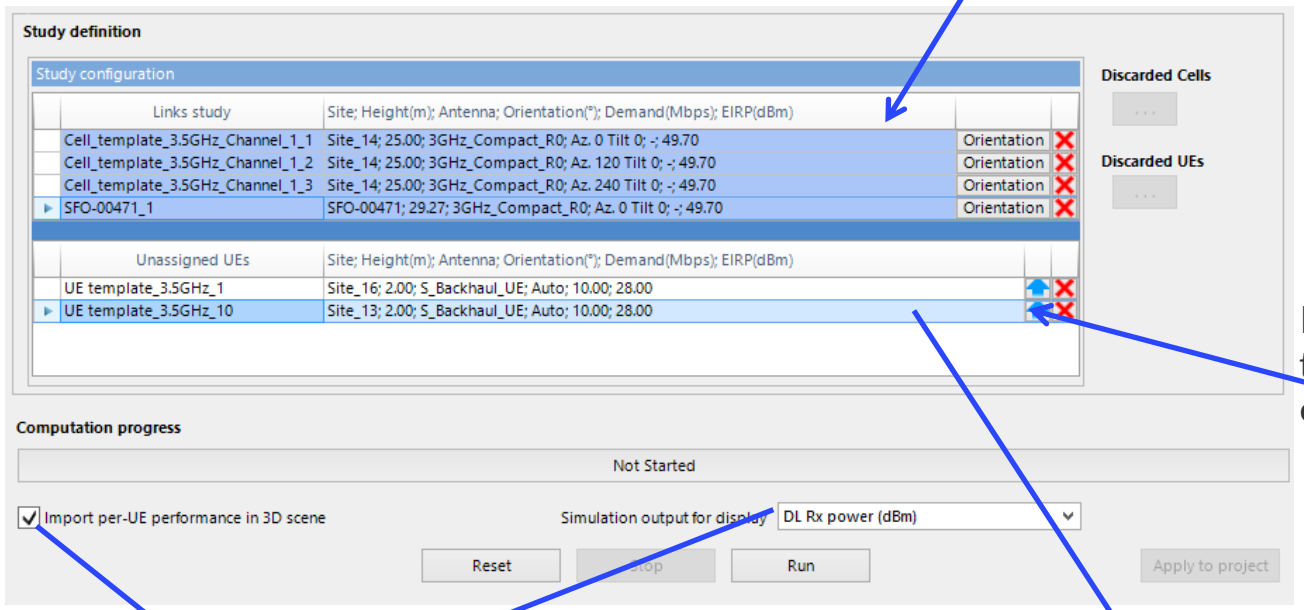
General settings

Manually adjust study configuration (optional)

Run

Visualize report and network topology

List of Cells to be considered in the study as potential donors



Force manually the attachment of some UEs to specific Cells

Import per-UE performance in 3D scene:
When this option is enabled, a 3D point layer representing the selected simulation output per point will be generated and displayed in the Scene window. The 3D display of the point layer requires that height information is included in the target client location file.

List of UEs to be assigned to the potential donors (Cells)
(The UE list is visible if **From target client locations** option is selected for Ues loading.)

Access Auto Assignment

Start Access Auto Assignment

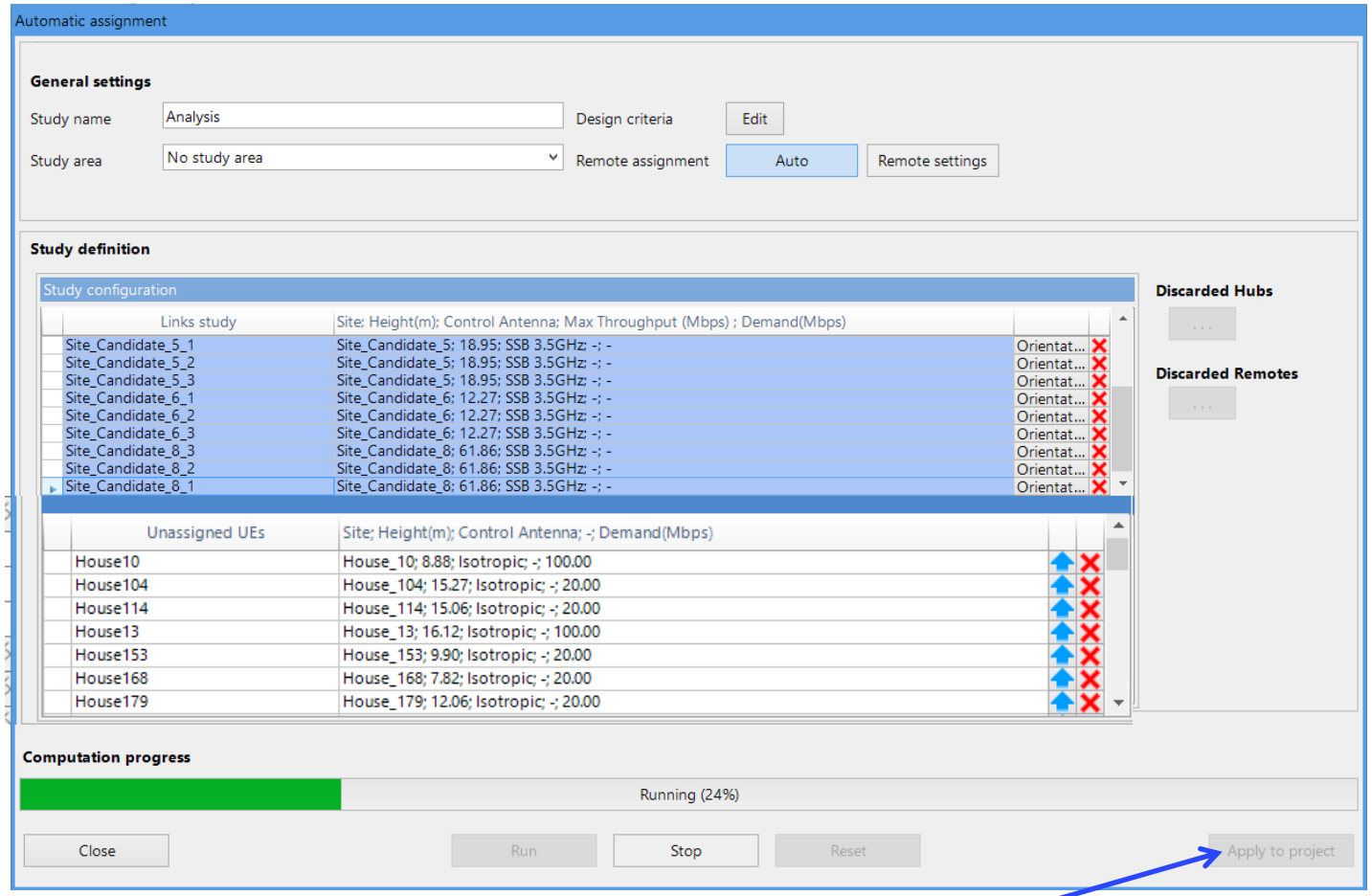
General settings

Manually adjust study configuration (optional)

Run

Visualize report and network topology

Click the **Run** button to launch the AAA simulation.



The « **Apply to project** » button will be available after the computation. Clicking on it will enable the automatic generation of the assignment links in the report.

Access Auto Assignment

Start Access Auto Assignment

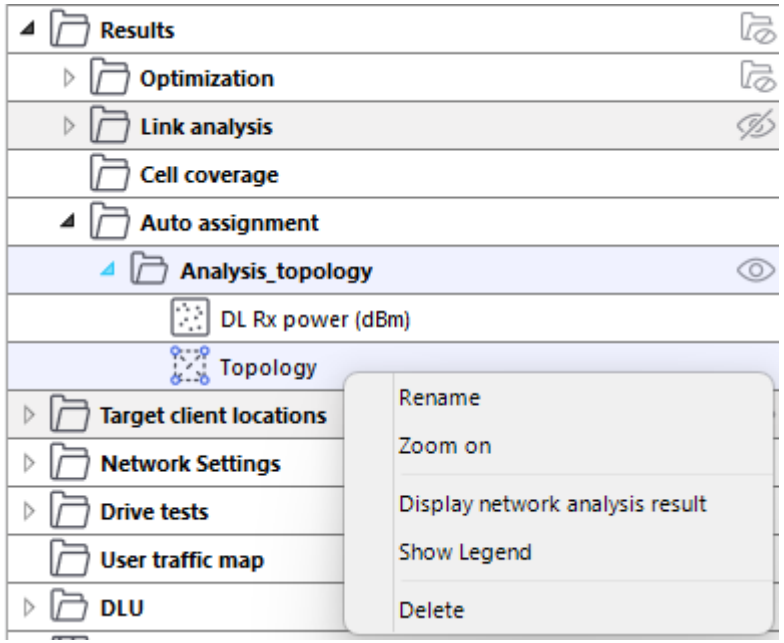
General settings

Manually adjust study configuration (optional)

Run

Visualize report and network topology

Right-click the **Topology** layer under the AAA result folder to display the AAA report.



If **Import per-UE performance in 3D scene** option on the Automatic assignment GUI is selected, a point layer will be also generated under the AAA result folder with the simulation output as the layer name (e.g. DL Rx power with margins (dBm)).

Access Auto Assignment

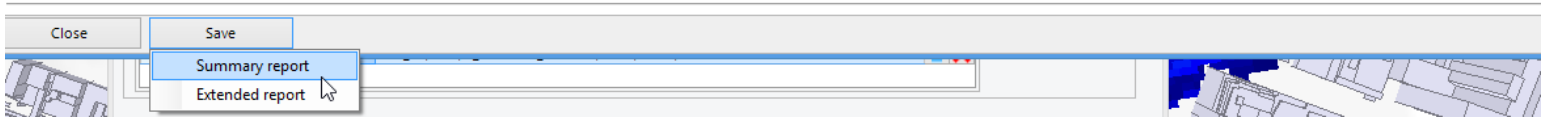
Two reports are available :

Summary report (HTML): The report provides the optimal network configuration connecting each UE to Cells and respecting the constraints set by the user

Extended report : The extended report provides the complete list of Cells that can possibly connect to each UE, available in two formats: CSV and Excel formats. The extended report menu will not be accessible if the **Maximum number of attached UEs option** is deactivated (not checked) for all Cells.

Per-Remote Performance

Remote	Hub	LOS/NLOS	Distance (m)	DL SINR (dB)	UL SINR (dB)	DL Throughput (Mbps)	UL Throughput (Mbps)	Hi-Res GIS	Azimuth (deg)	Downtilt (deg)
5GHz Remote_1	5GHz Hub_1	NLOS	36.82	32.63	32.63	104	104	True	14.42	-7.12
5GHz Remote_2	5GHz Hub_4	LOS	194.68	19.42	19.42	96	96	True	36.24	-4.87
5GHz Remote_3	5GHz Hub	NLOS	219.6	3.43	3.43	22	22	True	170.45	-44.87
5GHz Remote_4	5GHz Hub_2	NLOS	126.29	4.94	4.94	22	22	True	101.86	-14.38
5GHz Remote_5	5GHz Hub_3	NLOS	108.45	15.43	15.43	72	72	True	269.49	-5.17



Information about best server ranking is available if Cell orientation is fixed and interferences inactive

Extended report

Remote	Hub	Distance	Optical vis	DL SINR (d	UL SINR (d	DL Throug	UL Throug	DL Rx Pow	UL Rx Pow	3D GIS	Remote A	Remote D	Hub Az (d	Hub Dow	Direct Pat	Direct Pat	Algorithm	Server ranking
UE_1	Hubs_33_0	837.4081	NLOS Veg	4.848767	37.62877	55.47675	0.059991	-122.128	-86.3475	LR	336.564	-2.403	0	0	156.564	-2.403	1	4
UE_1	Hubs_33_120	837.4081	NLOS Veg	26.03142	58.81142	299.9535	0.059991	-100.945	-65.1649	LR	336.564	-2.403	0	0	156.564	-2.403	0	1
UE_1	Hubs_33_240	837.4081	NLOS Veg	6.317235	39.09724	71.613	0.059991	-120.659	-84.8791	LR	336.564	-2.403	0	0	156.564	-2.403	0	3
UE_1	Hubs_46_120	1346.295	NLOS Veg	18.31799	51.09799	194.9063	0.059991	-108.658	-72.8783	LR	336.564	-2.403	0	0	79.063	-1.495	0	2

CONTENT

Link Analysis Workflow

Select Cell

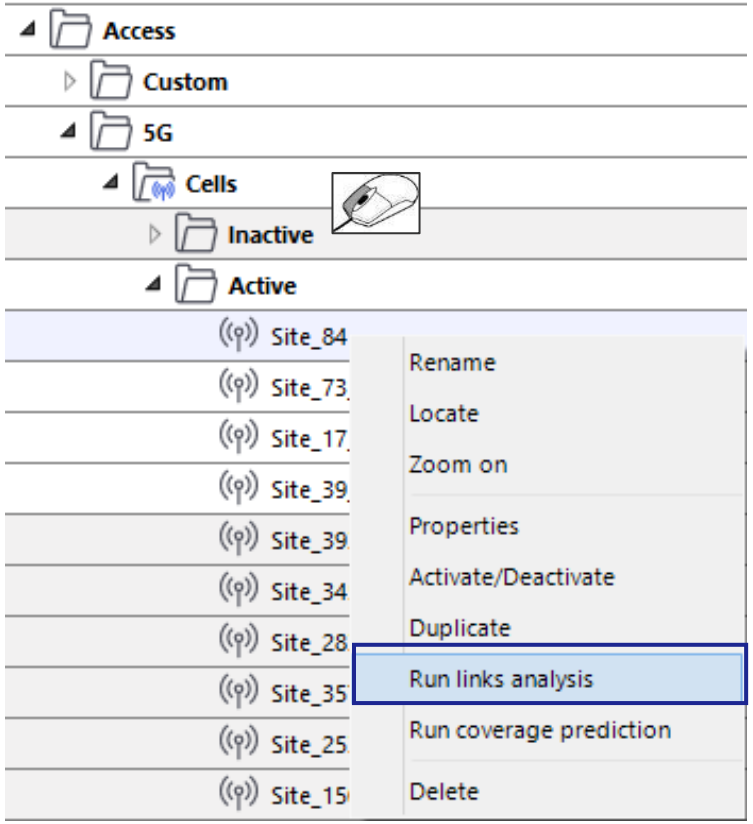
Select UEs to be simulated

Define Cell antenna orientation strategy

Run simulations and analyze results

Apply modifications to project (Optional)

Link analysis simulation refers to **Point-to-Point** or **Point-to-Multiple Points** simulations.
Right-click a Cell and select the **Run links analysis** action to launch the link analysis simulation.



Link Analysis Workflow

Select Cell

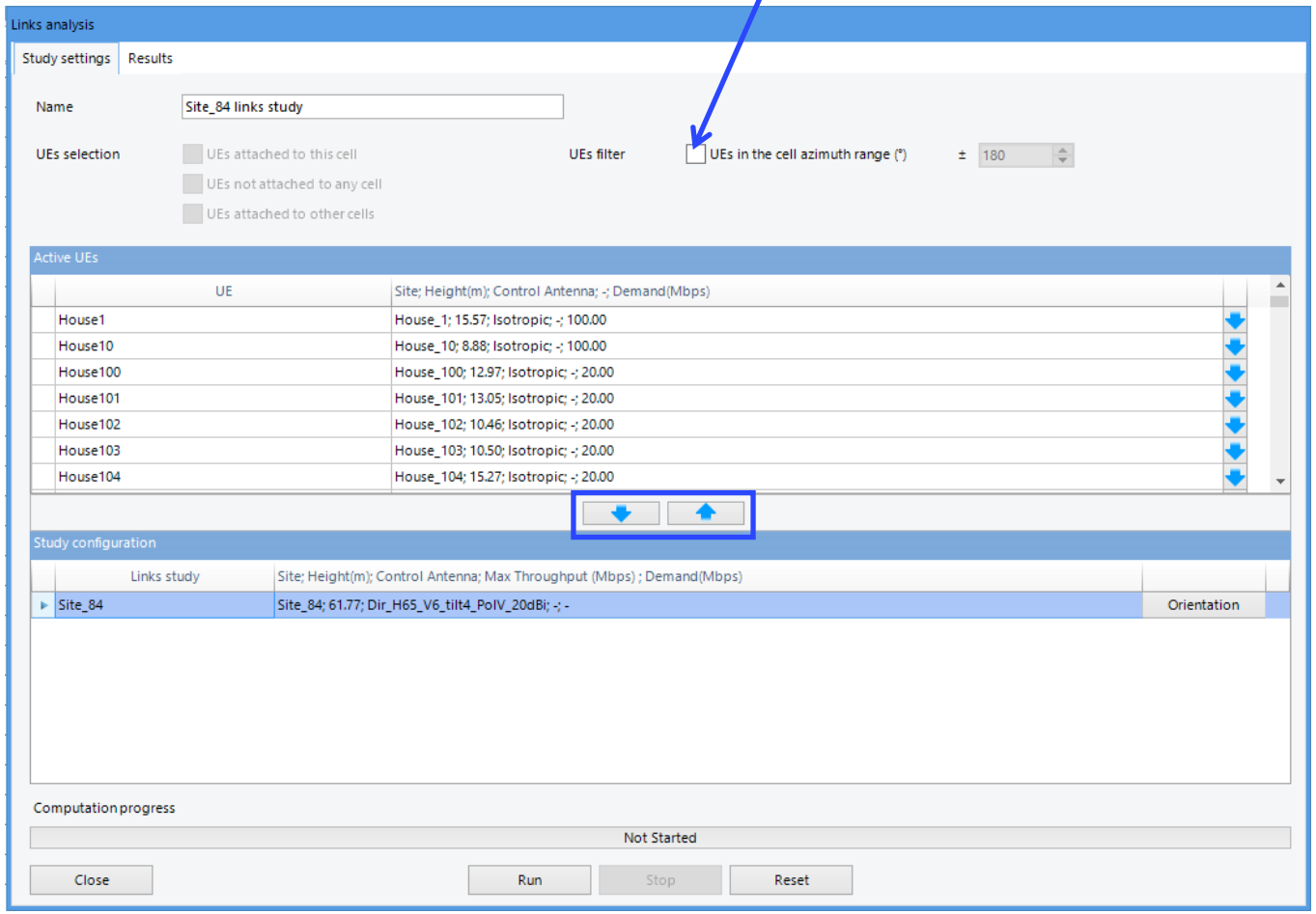
Select UEs to be simulated

Define Cell antenna orientation strategy

Run simulations and analyze results

Apply modifications to project (Optional)

Filter UE list based on azimuth range criteria



- Up\Down arrows to select UEs to be simulated
- Select one UE for Point-to-Point or several UEs for Point-to-MultiPoint simulations

Link Analysis Workflow

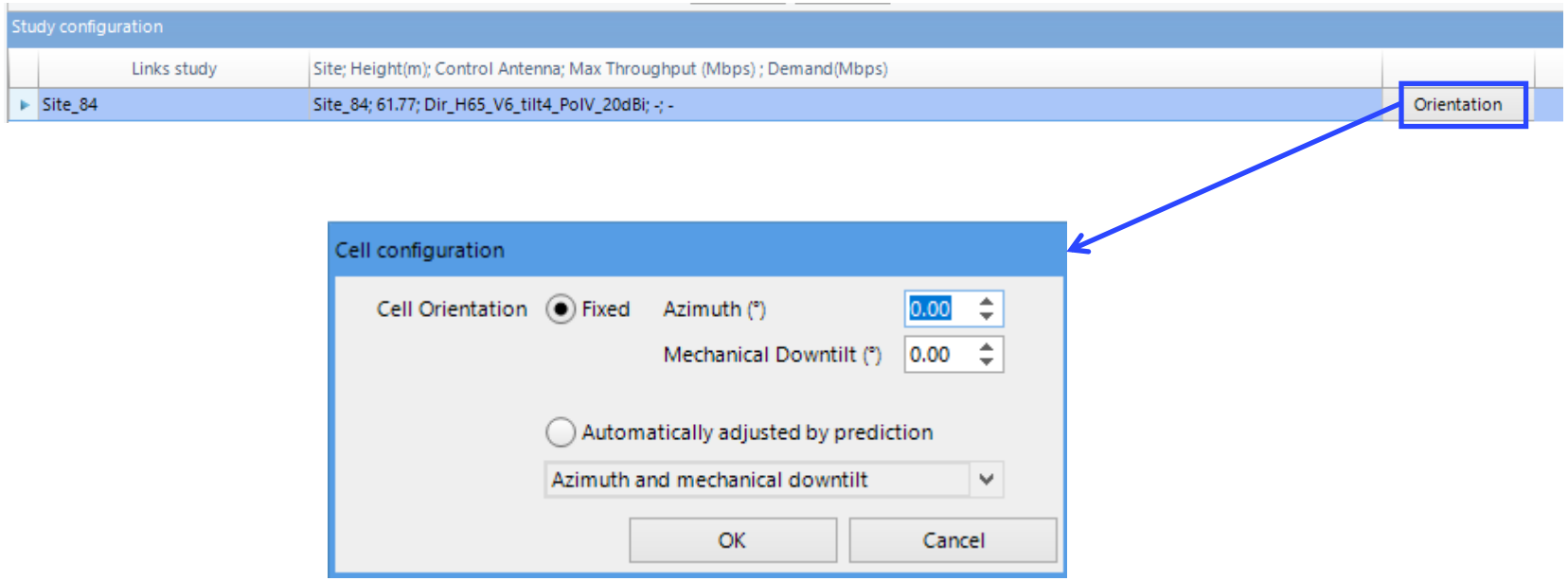
Select Cell

Select UEs to be simulated

Define Cell antenna orientation strategy

Run simulations and analyze results

Apply modifications to project (Optional)



4 modes*

- Fixed (Consider Azimuth\Tilt defined in the project)
- Automatic Azimuth orientation
- Automatic Mechanical tilt orientation
- Automatic Azimuth\Tilt orientation

Important: This step is only relevant for backhaul design and is supported exclusively with **Custom** technology type.

Link Analysis Workflow

Select Cell

Select UEs to be simulated

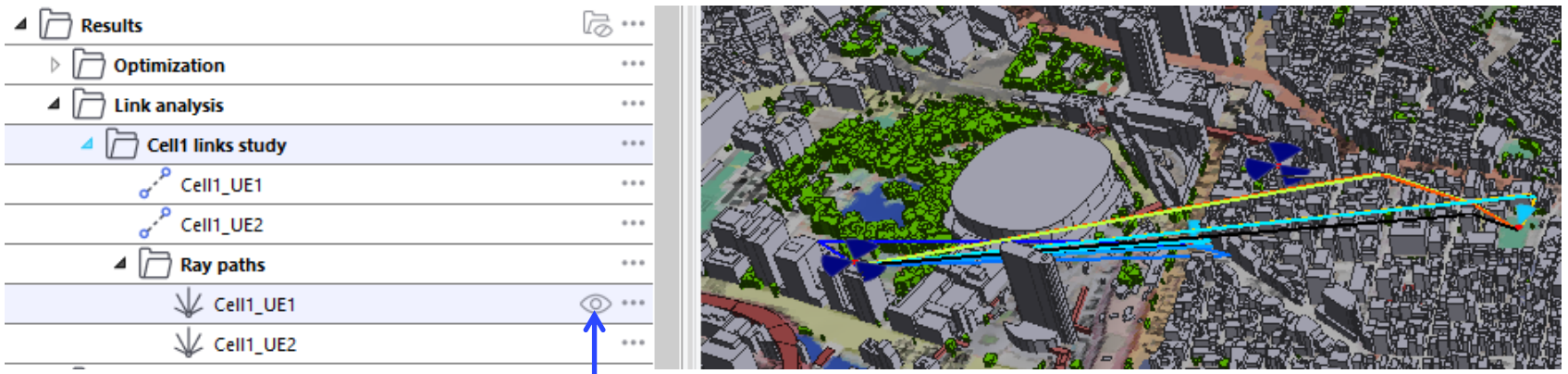
Define Cell antenna orientation strategy

Run simulations and analyze results

Apply modifications to project (Optional)

After running the simulation, a link analysis result section is created under **Results - Link analysis – Link study name** in the **Scene manger,** providing :

- a P2P simulation result per link, and
- a **Ray paths** sub-section, with detailed ray tracing visualization, which is only relevant when there are vector map data layers in the project. By default, the Ray paths sub-section is hidden, click on the Eye icon to display the ray paths.



Ray-paths visualization

Link Analysis Workflow – Point-to-Point (P2P) report

Select Cell

Select UEs to be simulated

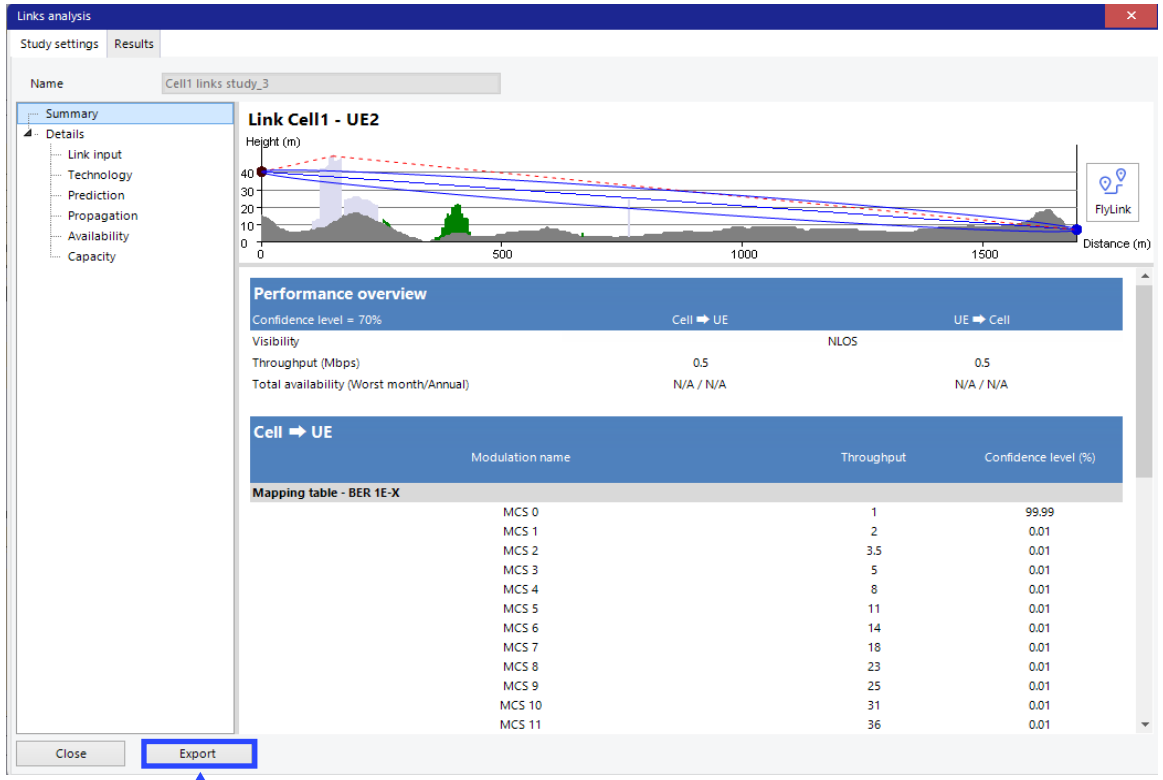
Define Cell antenna orientation strategy

Run simulations and analyze results

Apply modifications to project (Optional)

After running the simulation, a **Results** tab appears. For **P2P** simulation, the report is divided into two sections :

- Summary: provides a vertical profile of the P2P link, an overall performance overview, and a mapping of modulation schemes to throughput and confidence levels.
- Details: presents comprehensive information on inputs, propagation characteristics, availability, and capacity.



XLS Export

Link Analysis Workflow – Point-to-MultiPoint (P2MP) report

Select Cell

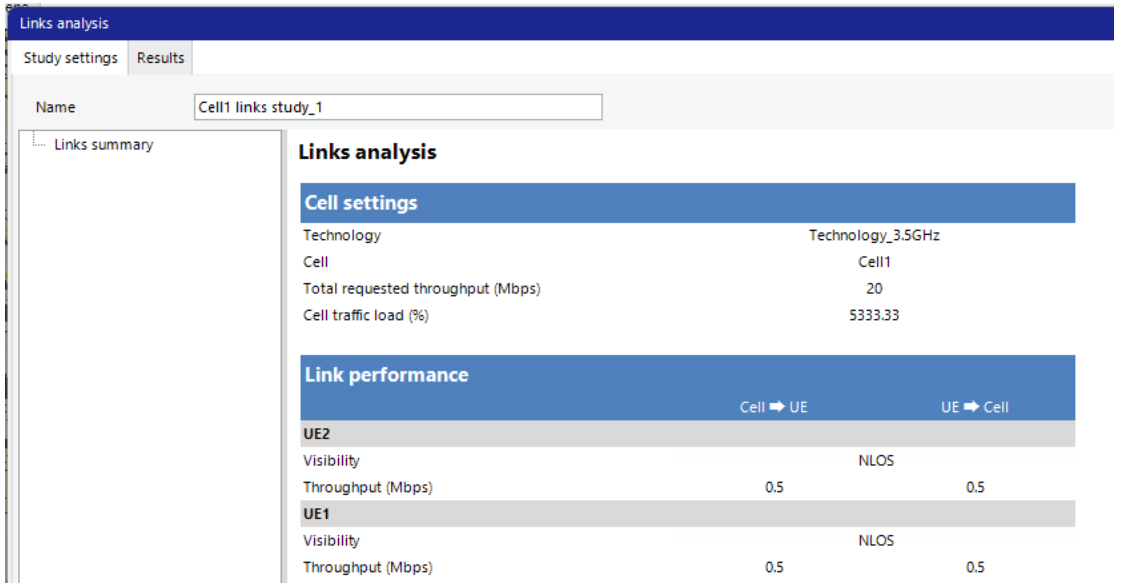
Select UEs to be simulated

Define Cell antenna orientation strategy

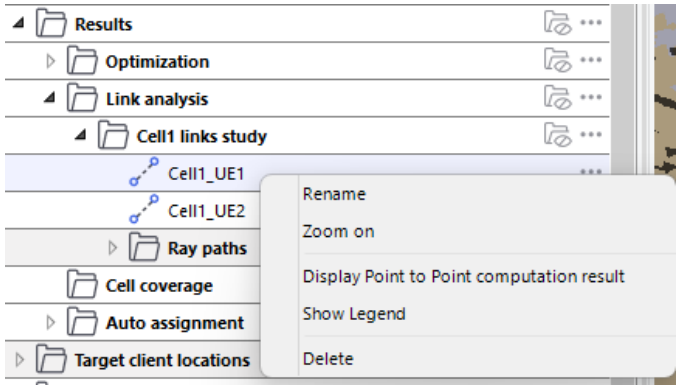
Run simulations and analyze results

Apply modifications to project (Optional)

After running the simulation, a **Results** tab appears. For **P2MP** simulation, the report includes the Summary sections providing the Cell settings and Link performance information.



To view the detailed report of each P2P link, right-click the P2P link under **Results - Link analysis – Link study name** in the **Scene manger** and select **Display Point to Point computation result** action.



Link Analysis Workflow

Select Cell

Select UEs to be simulated

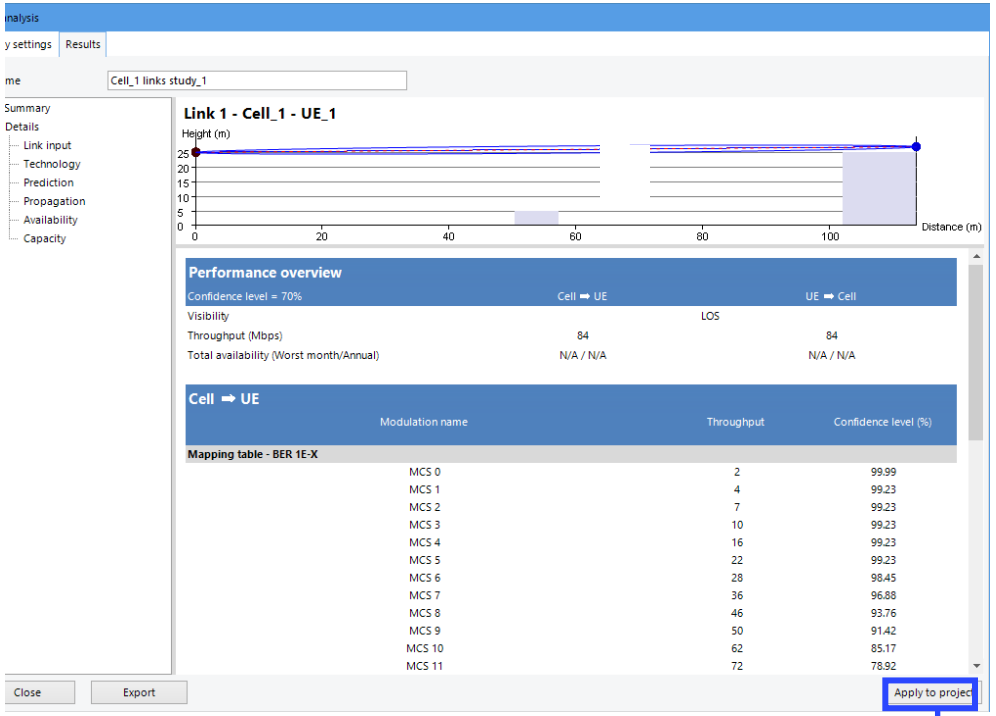
Define Cell antenna orientation strategy

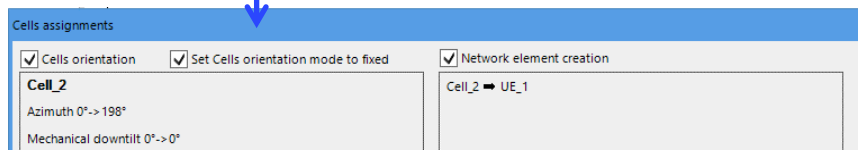
Run simulations and analyze results

Apply modifications to project (Optional)

For **Customer technology type**, users have the option to apply modifications to project so that parameters automatically set during the predictions are set in the project properties:

- Cell azimuth
- Cell mechanical Tilt
- Cell assignment list for link creation





Link Analysis Workflow

Select Cell

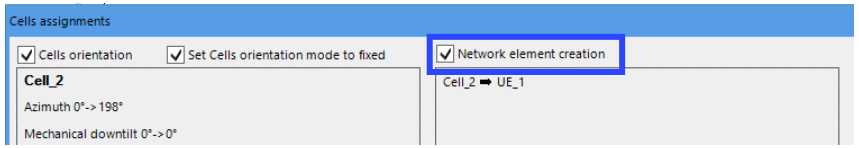
Select UEs to be simulated

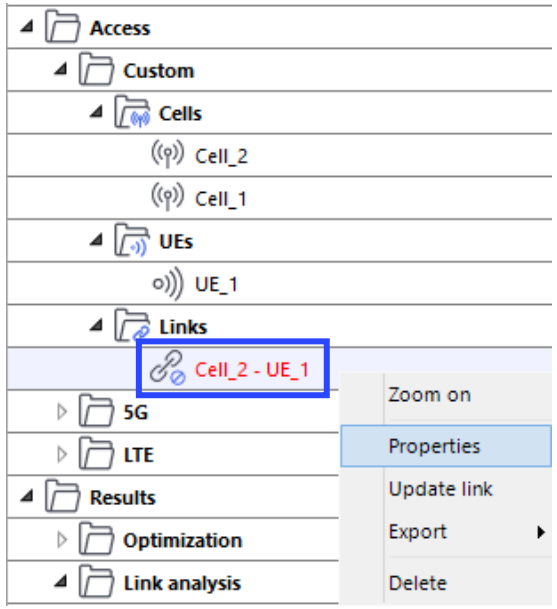
Define Cell antenna orientation strategy

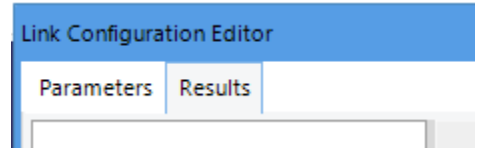
Run simulations and analyze results

Apply modifications to project (Optional)

If a link is created when applying the modifications, then link results are also available under **Access – Custom/5G/LTE – Links** in the **Scene manger**







Detailed Link report

The link report provides a detailed description of the link performance.

Link input section summarizes computation input data.

Link	Cell	UE
Longitude (°)	139.74510613	139.74457648
Latitude (°)	35.65961432	35.65781015
Height above ground (m)	25.07	26.91
Radio equipment	BaseStation_5GHz_Access	UE_5GHz_Access
Antenna	S_Backhaul_Hub	S_Backhaul_Remote
Antenna gain (dBi)	12	8
Cable loss (dB)	0	0
Connector loss (dB)	0	0
Orientation	Az. And Tilt set by prediction	Automatically adjusted
Azimuth (°)	198	14.2
Mechanical downtilt (°)	0	0
Transmitter		
Number of active antenna ports	2	2
Total transmit power (dBm)	20	20
EIRP (dBm)	32	28
Receiver		
Number of active antenna ports	2	2
Noise figure (dB)	4	4

Point to Point equipment settings		
Channel Bandwidth (MHz)	20	
Channel	1	
Central Frequency (MHz)	5810	5790
Polarization	Vertical	

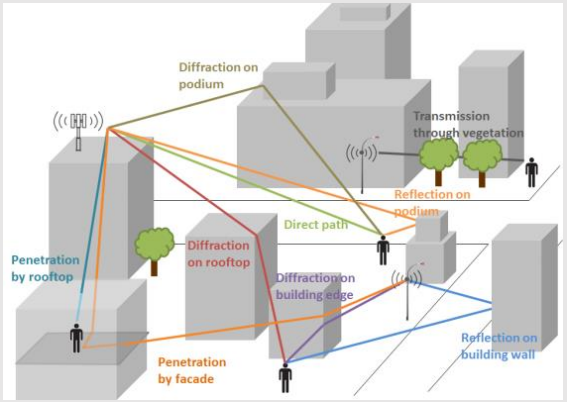
Capacity	Cell ➡ UE	UE ➡ Cell
Inputs		
Number of Tx antennas	2	2
Number of Rx antennas	2	2
Intra-system interference	Disabled	Disabled
Average background interference (dBm)	Disabled	Disabled
Results		
Rx power (dBm)	-61.39	-61.39
Rx power with margins (dBm)	-63.49	-63.49
Interference (dBm)	-	-
Mean SINR (dB)	38.58	38.58
SINR with margins (dB)	34.91	36.48
Transmission mode	Mapping table	Mapping table
MCS	MCS 14	MCS 14
Throughput (Mbps)	104	104

CONTENT

Volcano Urban & Flex

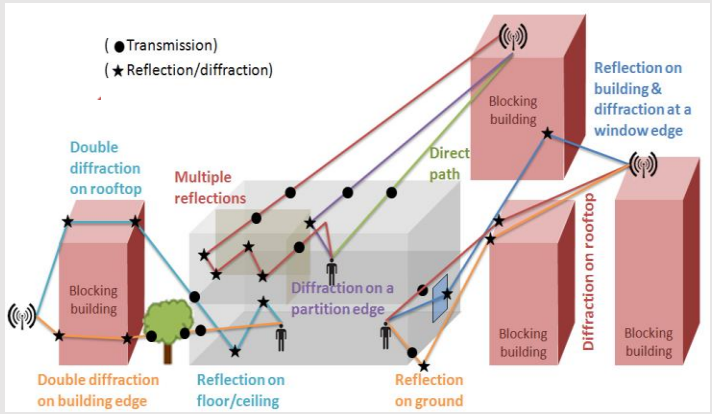
In Siradel Planner, two propagation models are available, each corresponding to specific data model formats :
- Volcano Urban : Designed for outdoor environments using LOD1 (Level of Detail 1) map data.
- Volcano Flex : Supports the **DXF** format data model, enabling the modeling of indoor environments with LOD4 map data, as well as hybrid configurations that combine LOD1 and LOD4.

URBAN



- **Large-scale scenarios**: 3D propagation, Large multi-BS coverage maps
- **Environments:** Outdoor, Outoor-to-Indoor (statistical)
- **Geo data:** 3D City (LOD1), LiDAR point cloud
- **Multi-paths:** Reflection, Diffraction, Scattering, Penetration Loss

FLEX

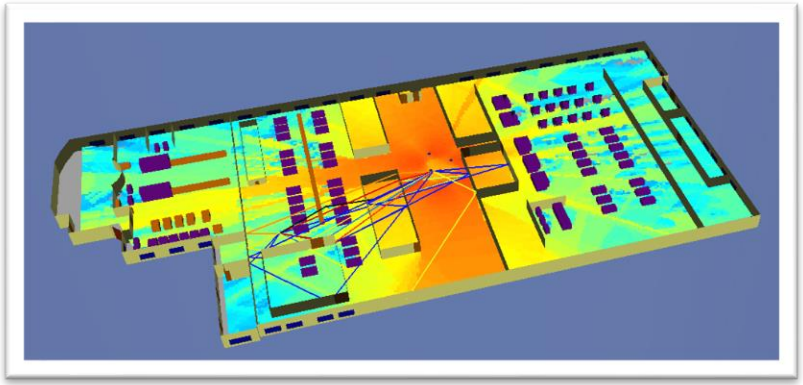


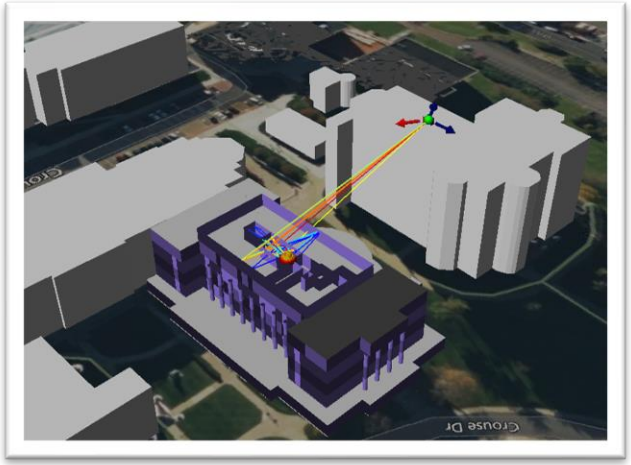
- **Small-scale scenarios**: 3D propagation, From indoor to small district areas
- **Environments:** Indoor, O2I , Outdoor
- **Geo data:** 3D building model in LOD4 (DXF format), possibly completed with 3D City LOD1
- **Multi-paths:** Reflection, Diffraction, Scattering, Penetration Loss

Volcano Flex – Geo Data Modeling

Volcano Flex supports two types of geographical data to address various propagation scenarios including outdoor, indoor and outdoor-indoor:

- Outdoor (LoD1 – Level of Detail 1): Buildings and vegetation could be represented in LOD1 data, i.e. described by their footprint and height. The top of LOD1 buildings and vegetation blocks is plane. This representation is regularly employed to model a group of buildings or a district.
  - Volcano Flex considers LOD1 buildings as opaque obstacles, without any possible transmission.
  - Transmission through LOD1 vegetation is permitted with a loss depending on the in-vegetation distance of propagation.
- Indoor (LoD4 – Level of Detail 4) Modelling of detailed building is obtained from a group of surfaces that describe walls, windows, doors, floors, etc. Some objects can also be represented, e.g. metallic armchairs, machines, when significant impact on propagation is expected.





Volcano Flex for Indoor or Hybrid Simulations

For Volcano Flex to operate, two file components are required :

1.DXF File – Represents the 3D geographical environment of the target area.

- To create a DXF 3D model, it is recommended to use third-party tools such as **Blender** – an open-source software for 3D modeling, animation, and rendering.
- Siradel provides a series of tutorials to help users create **Siradel Planner-compliant** 3D models using Blender.

2.DBM File – An XML file containing information about different layers, including materials, propagation types, and other parameters.

- The **DBM file** is generated using the Siradel tool **Building Creator**, which allows you to configure the necessary parameters and automatically create the file.
- Ensure that the DXF file path defined in the DBM XML file is expressed as a relative path, based on the location of the DBM XML file. This practice guarantees file portability and usability when the project is shared.

Importing into Siradel Planner:
The 3D model can be imported into Siradel Planner by either:

•Dragging and dropping the DXF file into the 3D scene, or

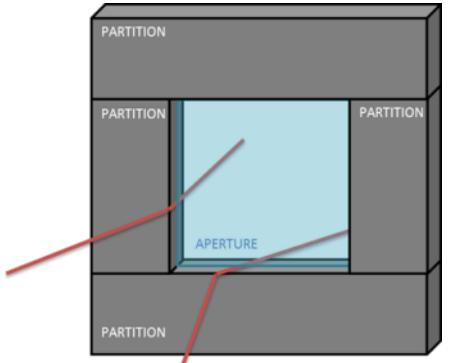
•Using the **File → Import** option from the menu to import the DXF file.

Volcano Flex – Multi path prediction

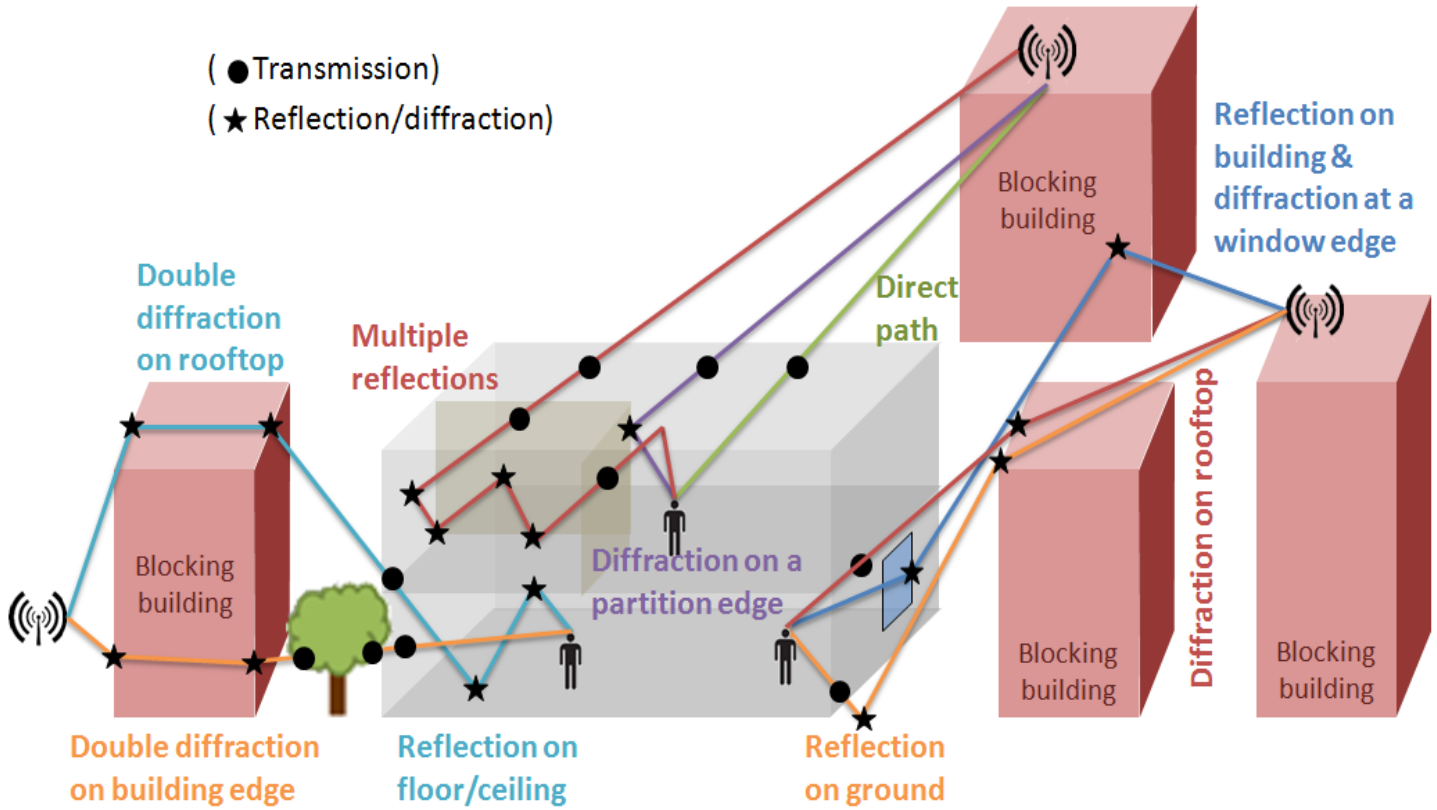
Volcano Flex can simulate in-building coverage with detailed map (CAD map)

- Reflections
- Diffractions
- Transmissions through walls and floors
- Transmissions through objects (e.g., tables)

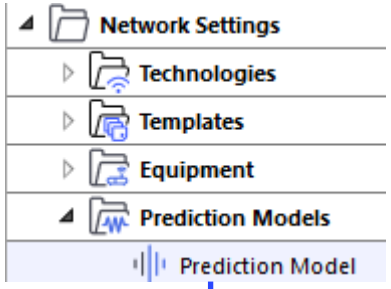
***Diffraction at the window vertical and horizontal edges:**
- Leading to fine simulation of the outdoor-indoor propagation mechanisms

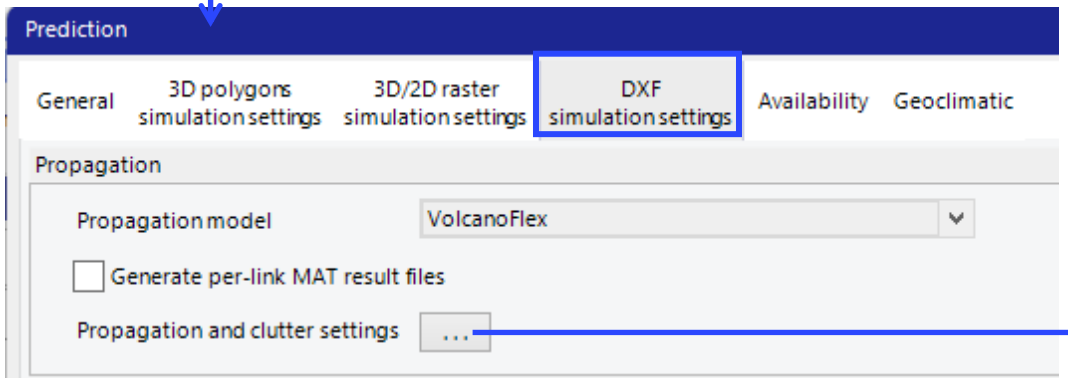


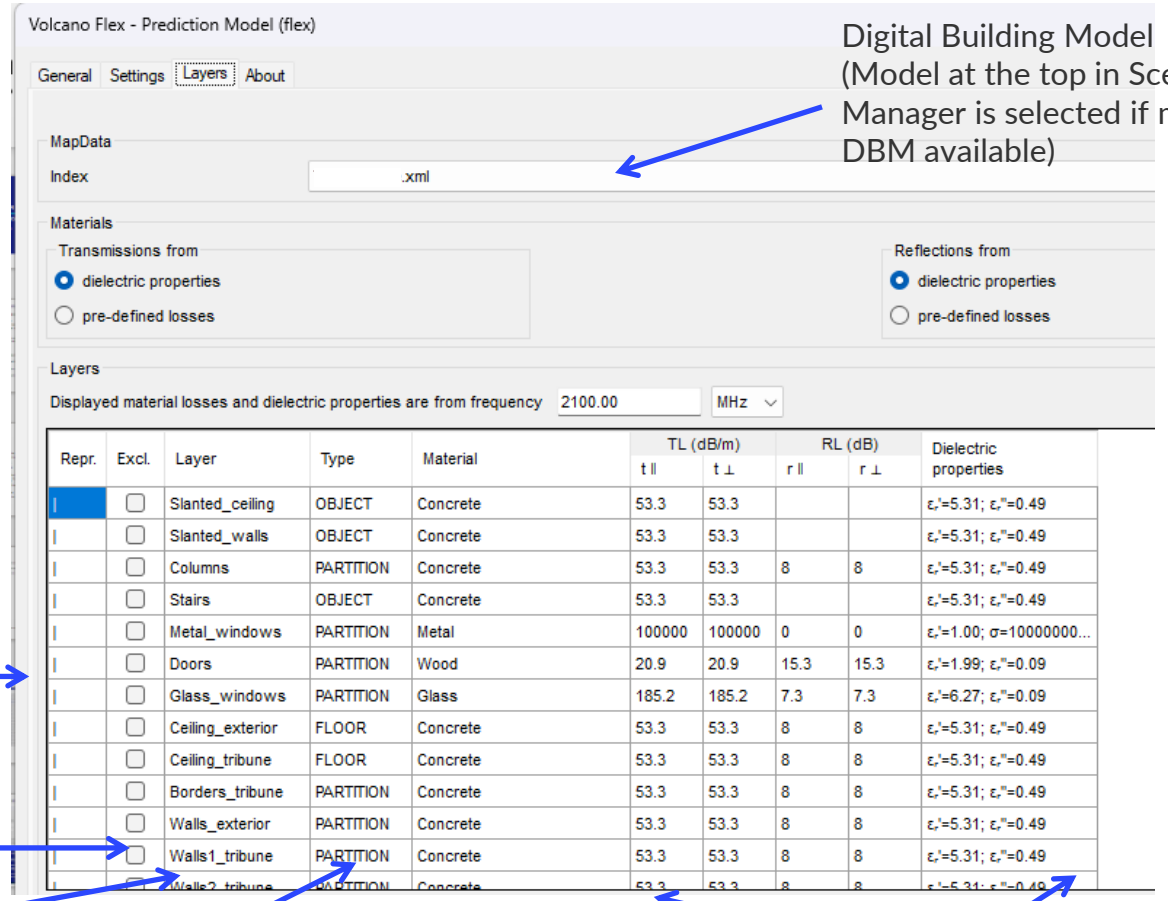
Diffractions by window/wall edge



Volcano Flex - Layers settings







Digital Building Model (Model at the top in Scene Manager is selected if multiple DBM available)

Layer Exclusion from prediction

3D model layers

Types: See next page

Dielectric properties are selected according to material and frequency. Materials and properties can be edited at installation folder for desktop users (By default: C:\Program Files\Siradel\SmartCityExplorer\bin\plugins\S_5GConnect\data\core_data\building_materials.xml).

Volcano Flex - Layer Type Properties

Type / Category	Description	Geometry	Propagation
#BUILDING	LOD1 B-buildings (no indoor modeling)	Cuboid	Reflections, diffractions and diffuse scattering. No indoor penetration.
#GROUND	Outdoor ground floor	Horizontal or slightly slanted faces	Reflections and diffuse scattering
#FOLIAGE	Foliage	Cuboid	Transmission and diffraction on top/bottom.
#OBJECT	Any indoor and outdoor objects or transmission-only layers	Any geometry	Transmissions
#PARTITION	D-building indoor walls	Vertical faces	Reflections, diffractions, diffuse scattering and transmissions
#APERTURE	D-building windows and doors	Vertical faces	Reflections, diffuse scattering, diffraction on the aperture edges and transmissions
#FLOOR	D-building floors/ceilings	Horizontal or slightly slanted faces	Reflections, diffuse scattering and transmissions

If technically relevant, the layer type (Category) can be adjusted in the DBM XML file.

```
106    <layer>
107      <name>Ceiling_tribune</name>
108      <representation>face</representation>
109      <material>Concrete</material>
110      <category>FLOOR</category>
111      <width>0.100</width>
112    </layer>
113    <layer>
114      <name>Borders_tribune</name>
115      <representation>face</representation>
116      <material>Concrete</material>
117      <category>PARTITION</category>
118      <width>0.100</width>
119    </layer>
120    <layer>
121      <name>Walls_exterior</name>
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123      <material>Concrete</material>
124      <category>PARTITION</category>
125      <width>0.100</width>
126    </layer>
127    <layer>
128      <name>Walls1_tribune</name>
129      <representation>face</representation>
130      <material>Concrete</material>
131      <category>PARTITION</category>
132      <width>0.100</width>
133    </layer>
134    <layer>
135      <name>Walls2_tribune</name>
136      <representation>face</representation>
137      <material>Concrete</material>
138      <category>PARTITION</category>
139      <width>0.100</width>
140    </layer>
141    <layer>
142      <name>Walls3_tribune</name>
143      <representation>face</representation>
144      <material>Concrete</material>
145      <category>PARTITION</category>
146      <width>0.100</width>
147    </layer>
```
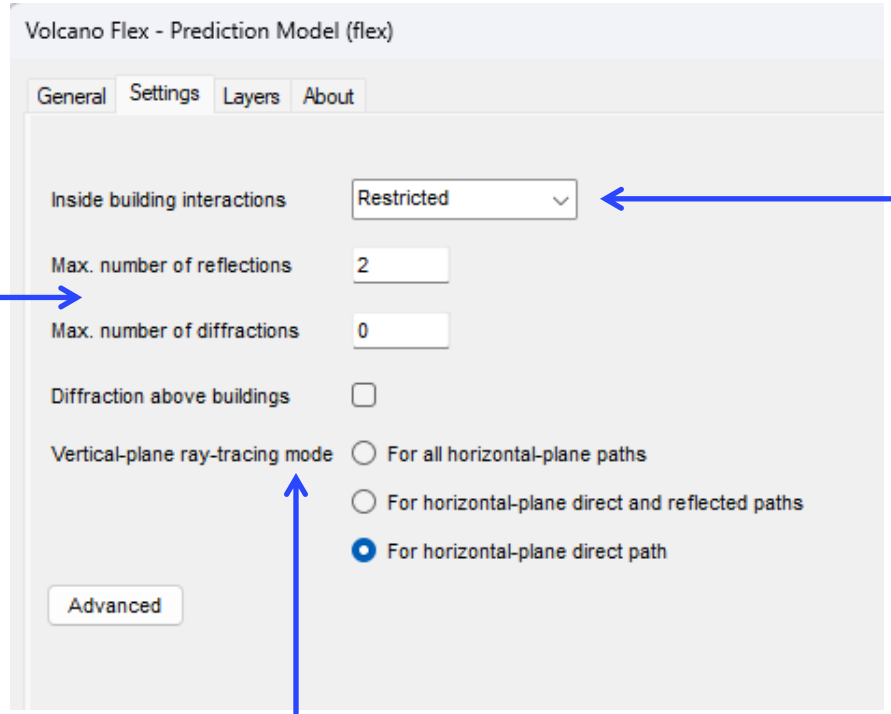

SIRADEL ENGIE

Propagation Parameters Settings

The **Max. number of reflections** and **Max. number of diffractions** parameters set the maximum number of specular lateral interactions allowed along a ray-path.

Maximum number of reflections and diffractions are respectively 4 and 2. Diffraction above buildings can be activated independently.



The **Inside building interactions** parameter allows to reduce calculation time by filtering some ray interactions.

This setting option only applies for outdoor base stations. It can be set to 'Restricted' or 'Full' :

- **Restricted** -> Some interactions are not considered in the calculation to drastically reduce the calculation time. This causes a slight loss of precision in received power results as only transmissions (+ diffractions on the edges of outside windows) are authorized inside the DXF building.
- **Full** -> No ray filtering

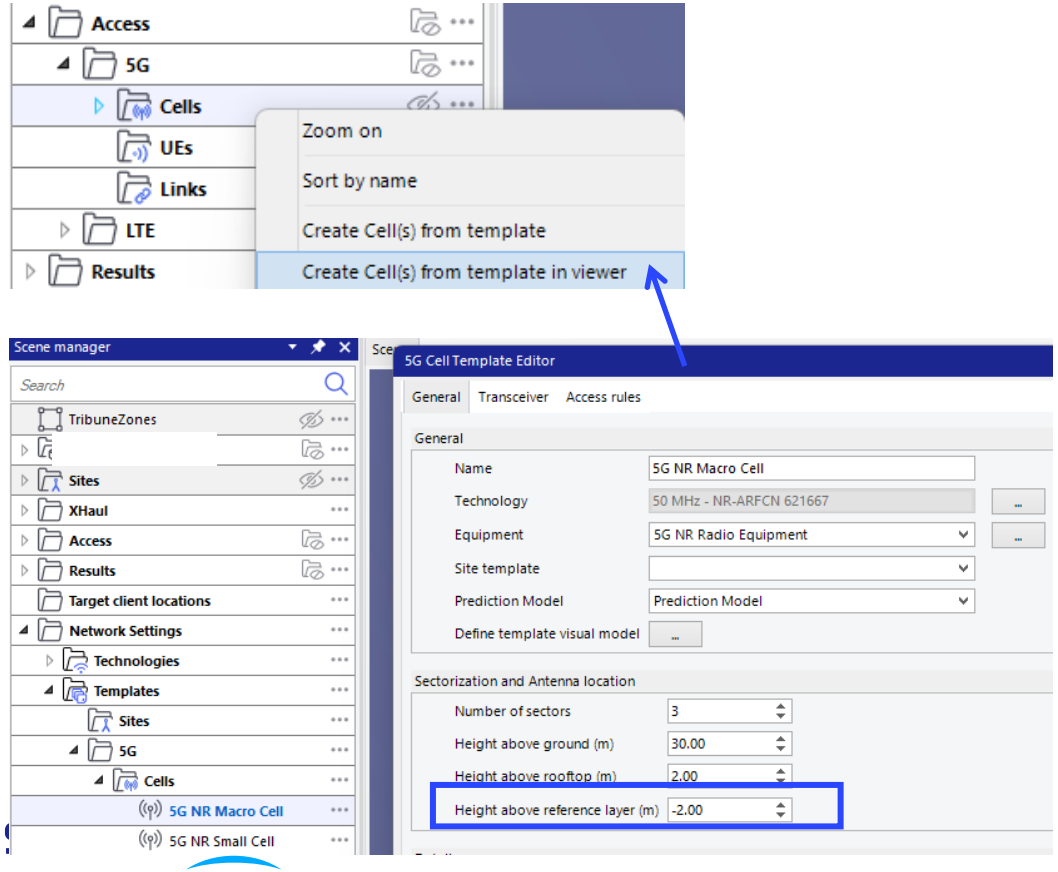
The **Vertical-plane ray-tracing mode** parameter offers a trade-off between computation time and prediction accuracy by limiting the combinations of interactions in the horizontal plane and interactions in the vertical plane.
3 levels of algorithm complexity exist:

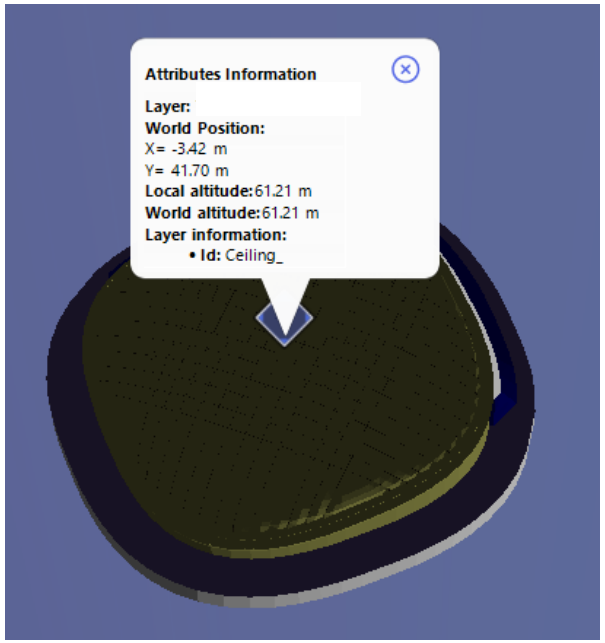
- **For all horizontal-plane paths:** ray-launching in vertical plane is performed for all propagation paths found in horizontal plane.
- **For horizontal-plane direct and reflected paths** -> ray-launching in the vertical plane is performed for only direct and reflected paths found in the horizontal plane.
- **For horizontal-plane direct path** -> ray-launching in the vertical plane is performed for only the direct-path between the terminal antennas, delivering an approximate received power for outdoor-only and indoor-only pre-design scenarios with about 90% gain in computation time.

Network Element Creation in 3D Scene

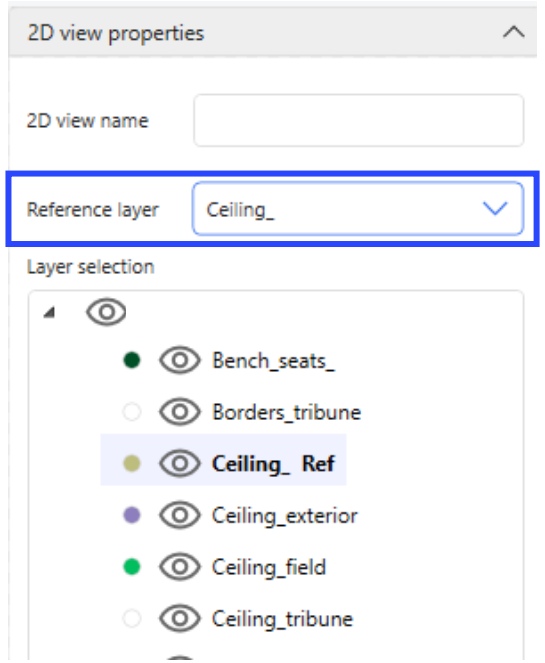
When creating a new network element (Cell or UE) **from template in viewer**, the **Height above reference layer** value defined in Cell/UE template will be used to determine the antenna installation height of the network element :

- In 3D Scene: installation height = layer height at the click point + **Height above reference layer** value.
- In 2D View: installation height = height of the selected reference layer at the click point + **Height above reference layer** value.





3D Scene



2D View

Above layer: Coverage Prediction Configuration

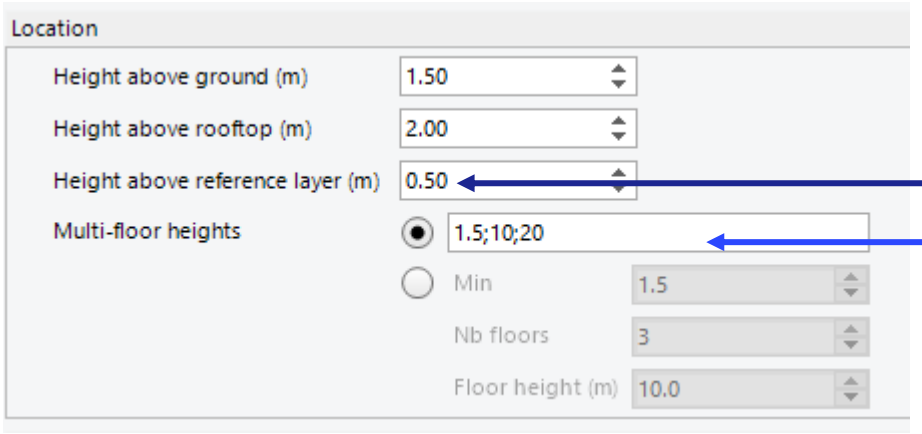
There are three options for the *Receiver Location* parameter in the **Coverage Predictions** window:

1.Layer – The receiver height is defined relative to the selected layer(s). The relative height value is set by the *Height Above Reference Layer* parameter. Multiple layers can be selected, and each selected layer will produce a separate simulation result displayed in the results section.

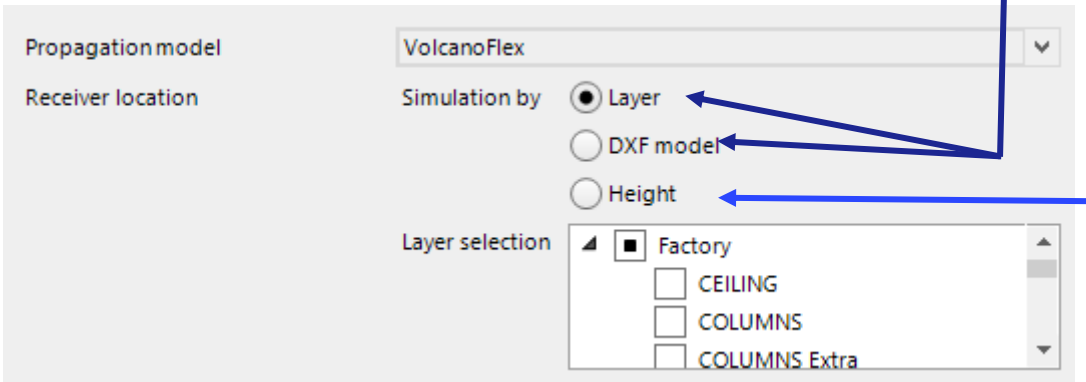
2.DXF Model – Works similarly to the *Layer* option, but the simulation results are generated per DXF model. For the receiver height of a given point, if multiple layers share the same horizontal coordinates (same X, Y), the highest Z value among those layers will be used.

3.Height – Uses fixed receiver heights, defined in the *Multi-Floor Heights* parameter. Multiple heights can be specified, with each height generating a separate simulation result displayed in the results section.

Part of **Active remote template** GUI

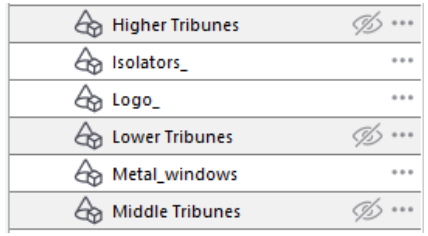


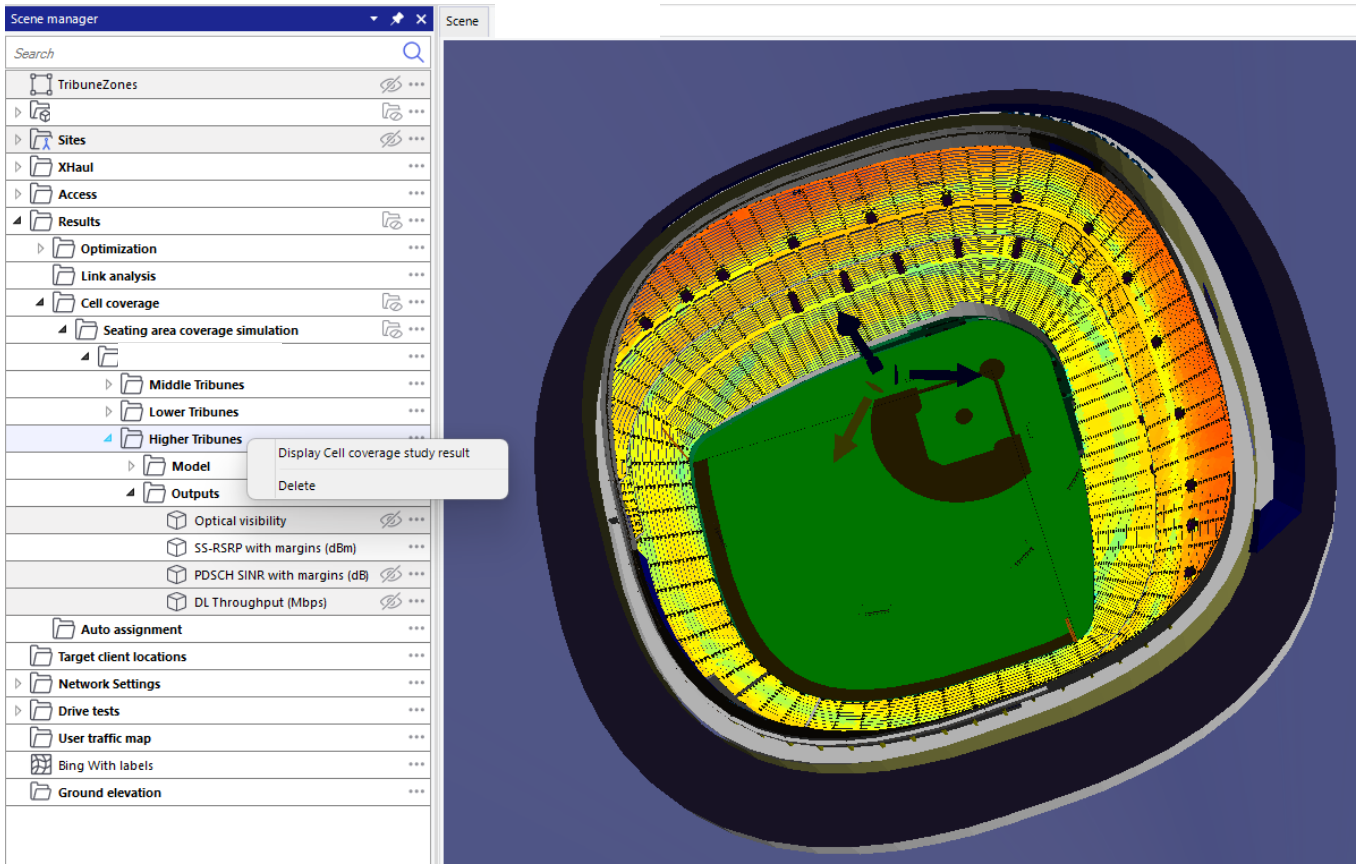
Part of **Coverage predictions (Cell coverage)** GUI



Above layer: Simulation Results

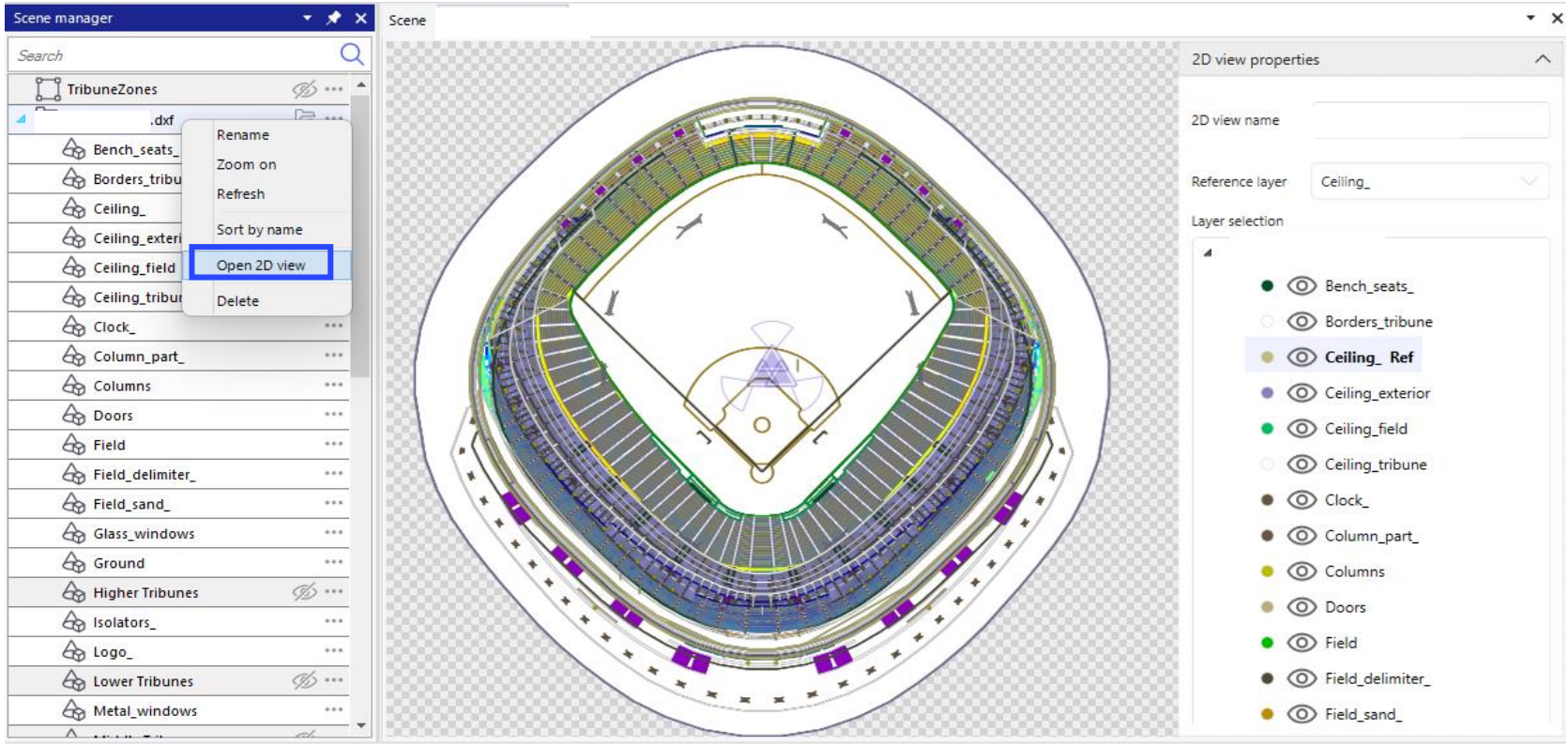
- The **Above Layer** simulation results are organized by Layer or DXF model depending on the user's selection in *Coverage predictions* GUI.
- **To view the simulation report:** right-click the Layer name node and select **Display Cell coverage study result.**
- The simulation results can have conflicts in visualization with the DXF data layers, hide data layer in DXF model to show simulation results.
- **To show or hide a result or a data layer:** click the **Eye** icon.
- **To adjust palettes:** the simulation result palette can be modified, exported, or imported. Desktop users can also replace the default palettes located in the installation directory (*C:\Program Files\Siradel\SmartCityExplorer\bin\plugins\S_5GConnect\Resources\Palettes)*.
- **To access GeoTIFF output:** right-click simulation result and select GeoTIFF export action.





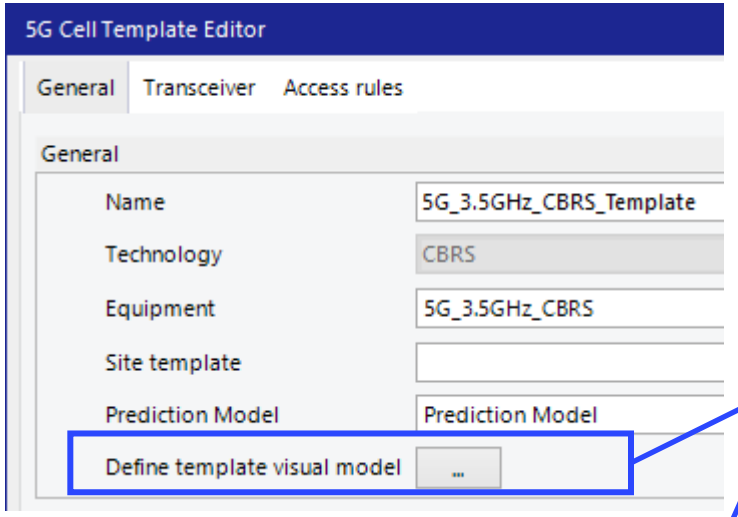
2D View

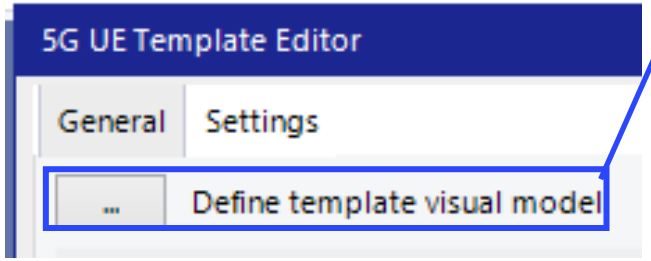
- Right-click the DXF model and select **Open 2D view** to open it in a new Scene tab.
- The **Eye** icons for DXF model layers in the Scene Manager are synchronized with the **Eye** icons in the **Layer selection** panel of the 2D view.
- Network elements can be added directly in the 2D view.
- Coverage maps are displayed in the 2D view associated with the corresponding DXF model.

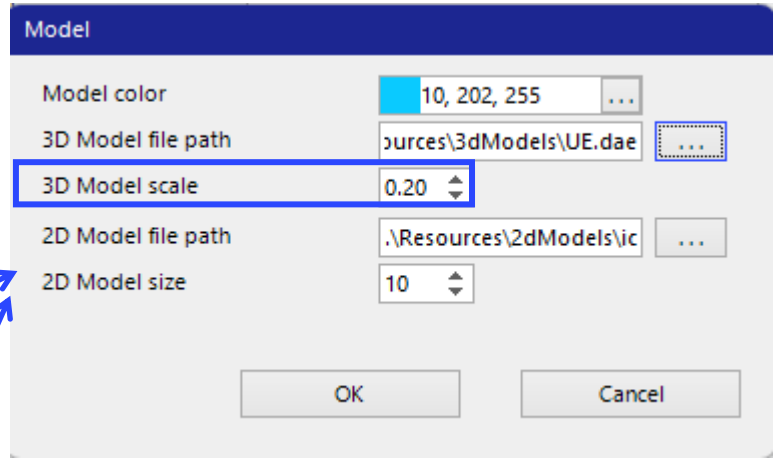


Some recommendations for Indoor simulation

Adjust the Cell/UE icon size for in-building configuration. Default template visual model can be edited. Recommendation is to use 3D model scale at 0.1-0.25 for in-building configurations.

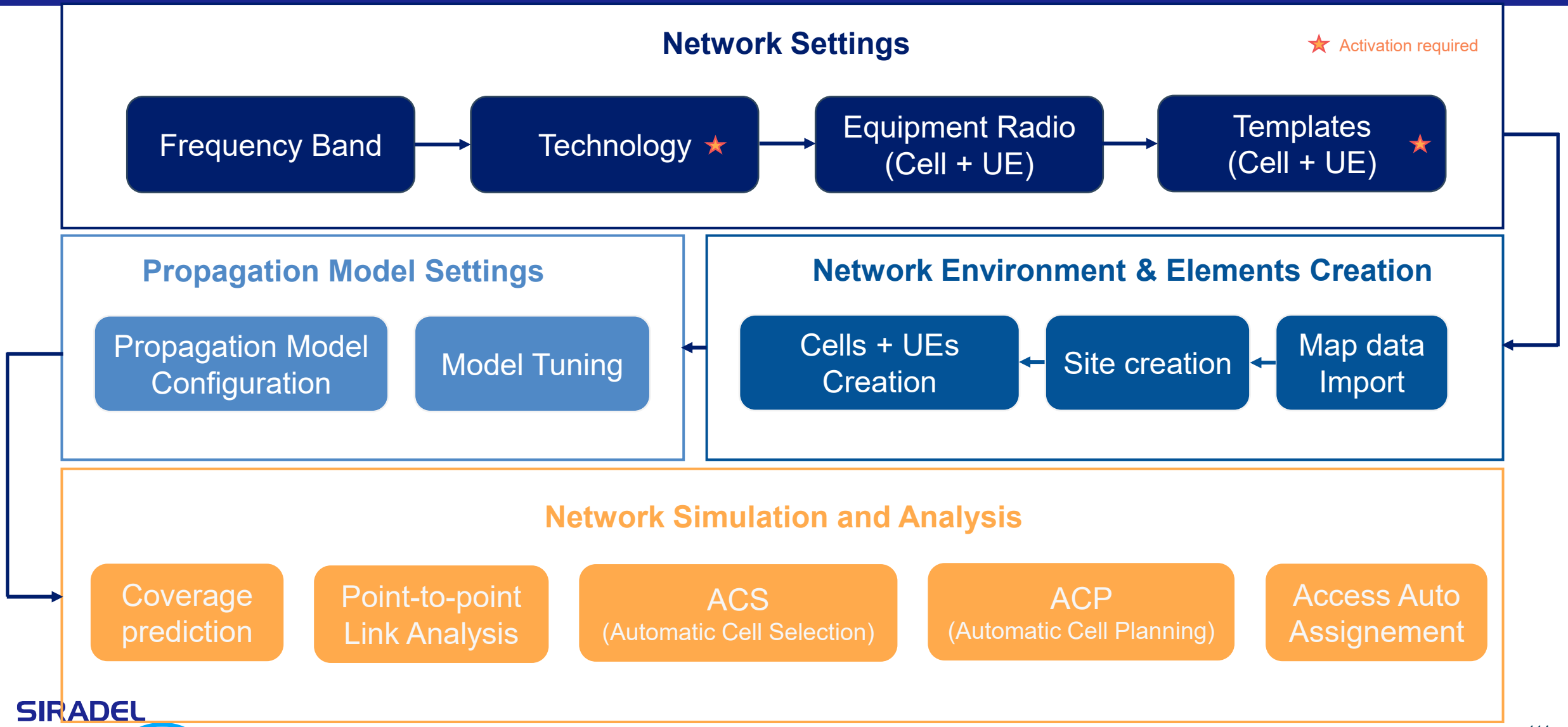






CONTENT

Siradel Planner Workflow Overview



Key Terminology in Siradel Planner

- **Cell** represents Base Stations, transmitter, GateWay, Access Point, ...
- **UE** represents User equipment or End point in IOT scenario
- 3 **Technology types** are defined in the tool: 5G, LTE, and custom. The custom technology type provides high flexibility for users to mobilize different elements, and can be used for all technologies other than 5G and LTE.
- **Technology** defines parameters like bandwidth, DL/UL ratio, etc
- **Radio equipment** defines parameters that are strongly associated with the base station equipment or UE (user equipment or device), including mapping tables that translate a given SINR into throughput value through spectrum efficiency.
- **Template** defines element characteristics to be used for the creation of Sites, Cells and UEs. Refer to Zoom on Templates for more detailed information.
- **Propagation models** gather the various simulation and propagation settings considered during a computation. Each Cell can be associated to a propagation model.

Network settings: zoom on Templates

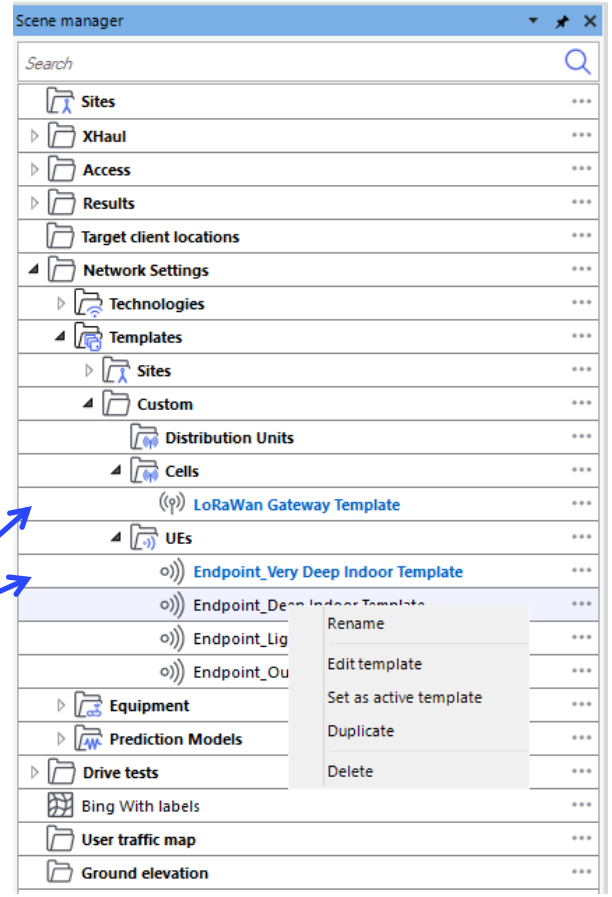
Active templates aim at defining element characteristics to be used for the creation of Sites, Cells and UEs.

Template-specific parameters

- Number of sectors enables to automatically create multi-sectorized Cells
- Height in street (m) aims at defining the default height for element creation in the street
- Height above rooftop (m) aims at defining the default height for element creation on rooftops

The active UE template is also used to determine the characteristics of the user equipment when running coverage predictions

All templates have been already properly configured for the UX/UI exploration.



- Active templates are highlighted in Blue
- Right-click a template and select "Set as active template" to activate it

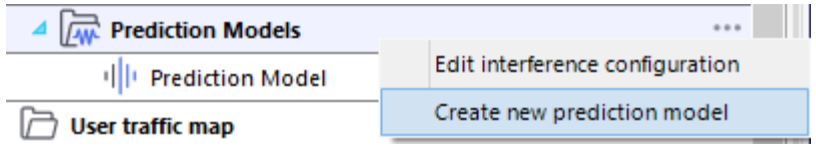
Volcano Propagation Model

- The prediction models aim at defining the propagation parameters as well as the reliability and availability parameters considered for margins and link performance evaluation.

- A standard prediction model is available with any new project and embeds Siradel recommended parameters when no measurements are available to perform a model tuning

    - Model tuning is possible in Siradel Planner

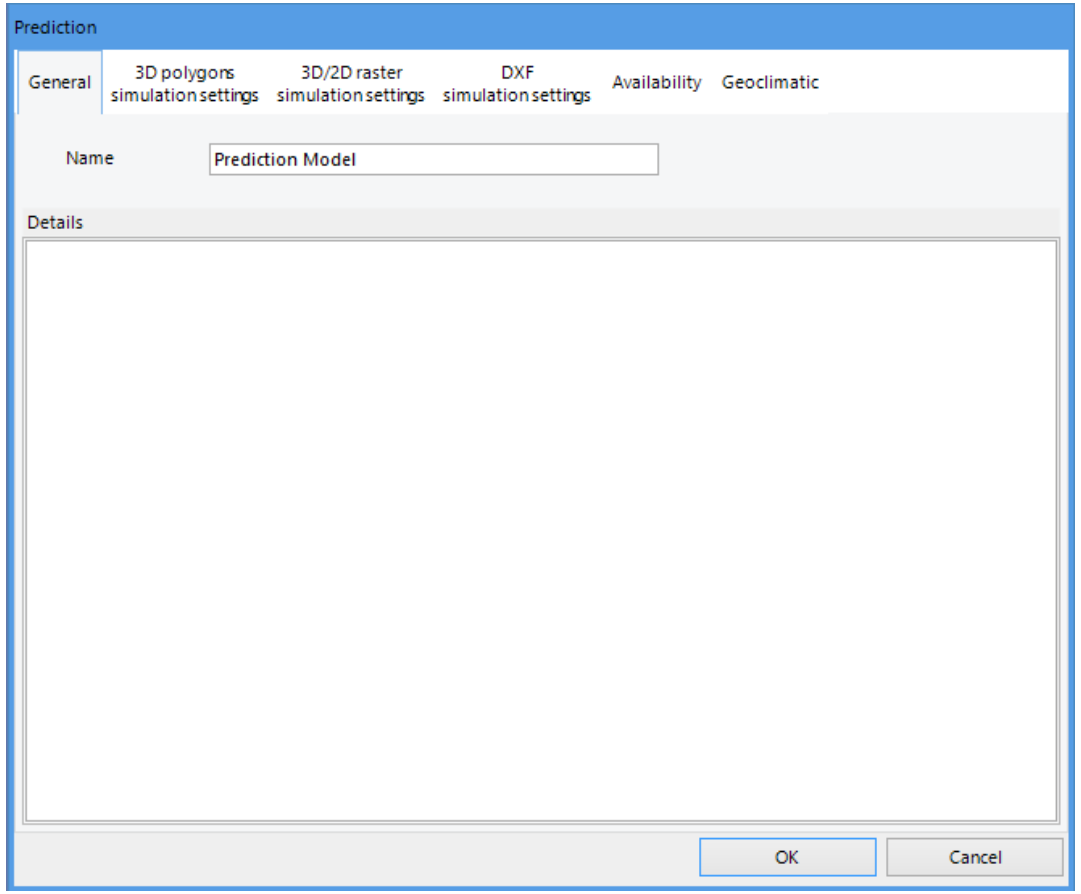
- New prediction models can be created and edited by the user



Volcano Propagation Model: 3 Mapdata Types

- **3D polygons simulation settings**

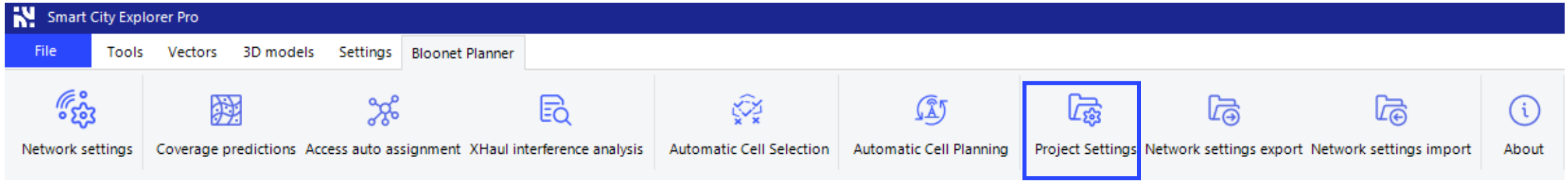
  Outdoor environment simulations with HR (High-Resolution) map data (3D Vector layer)
- **3D/2D raster simulation settings**
  - Outdoor environment simulations with 3D raster map data (DTM+DLU+DHM)
  - Outdoor environment simulations with 2D raster map data (DTM+DLU)
- **DXF simulation settings**
  - Indoor or Outdoor+Indoor environment simulations with DXF format map data
- Mapdata priority level: 3D polygons > 3D/2D raster > DXF
  - Siradel Planner selects automatically the mapdata layer and its related propagation model according to this order.

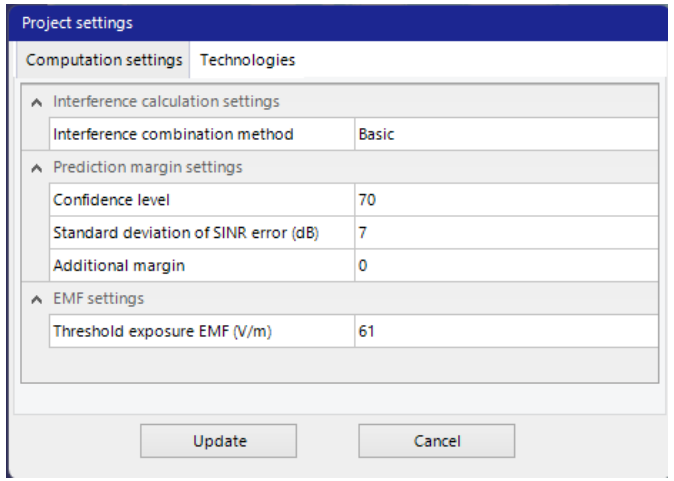


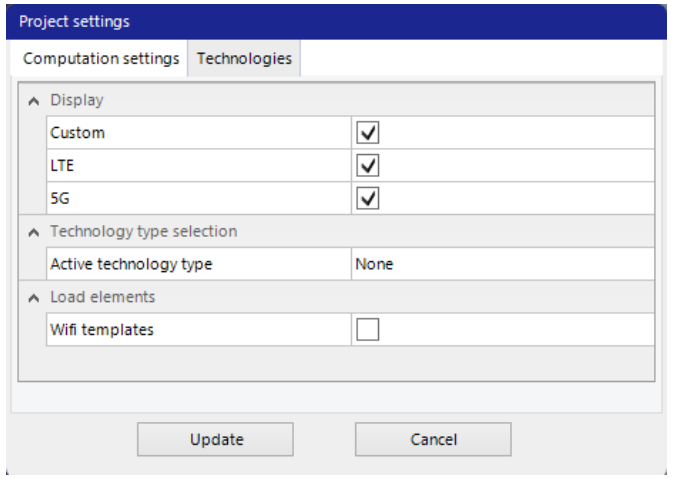
Project Settings

Project Settings allows to set some project level parameters. It includes two types of settings:

- Computation settings: computation related parameters can be set here.
- Technologies:
  - Custom is by default selected
  - LTE/5G can be activated if the licenses are granted.
  - When Wifi templates option is checked, Wifi related templates will be imported into the project.



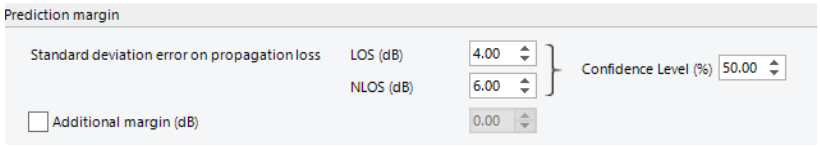


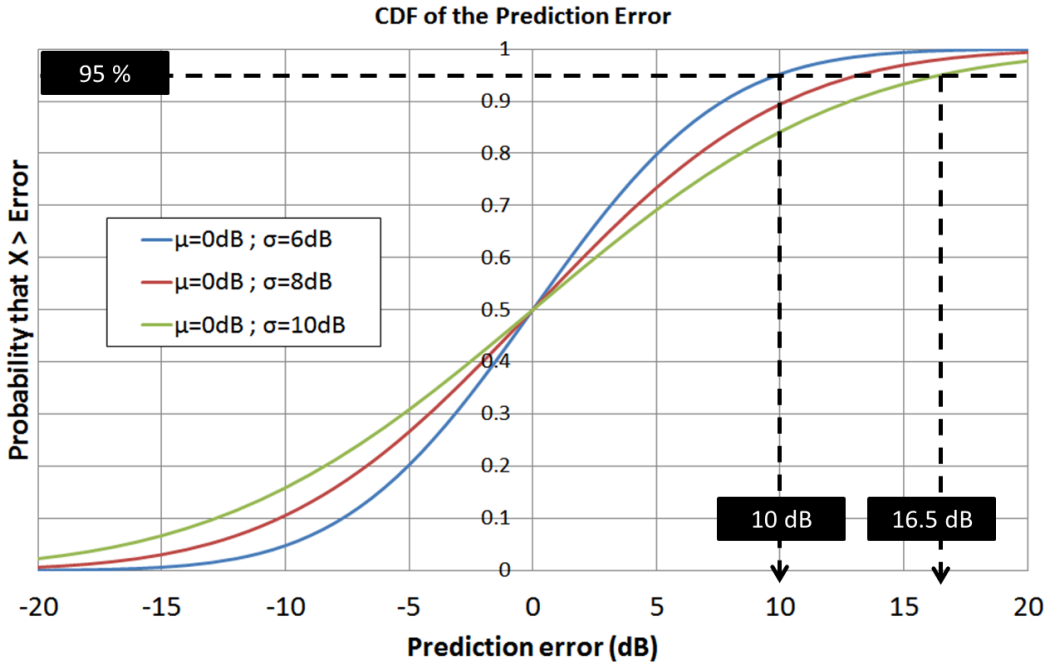


Shadowing margin vs Confidence level

- The prediction error is characterized by a lognormal distribution with a standard deviation σ. A margin is defined to guarantee that the predicted signal with margins is achieved with a confidence level of X%

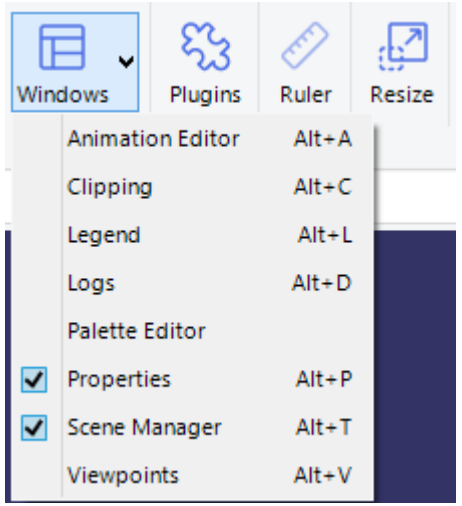
- For instance, for a link between a Cell and a UE, a margin of 10dB will enable to achieve 95% level of confidence for a model standard deviation of 6dB

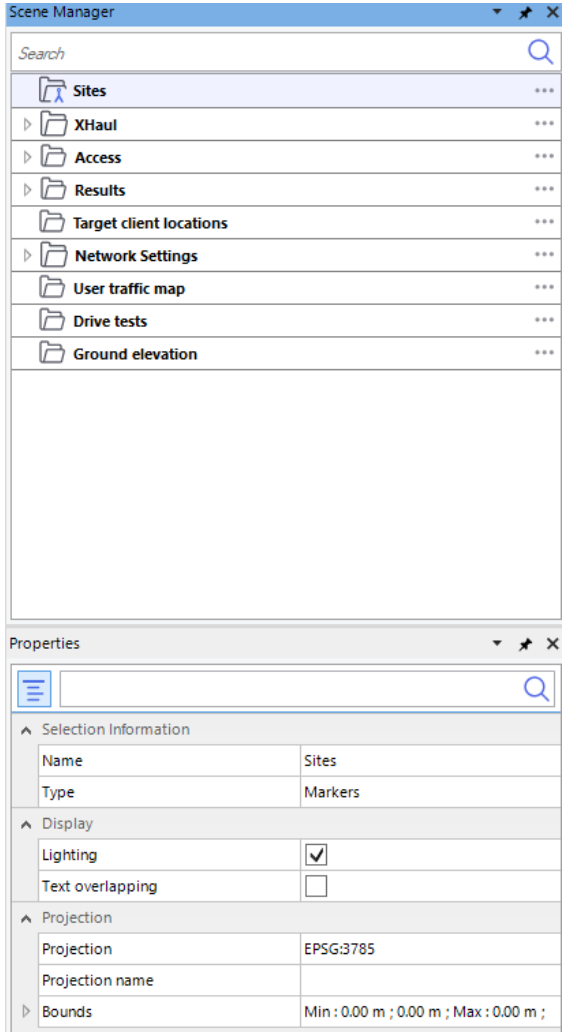




Visual properties

- Properties window (Alt+P) allows the user to modify the visual properties of elements imported in the tool (text, color, 3D/2D model, etc.)

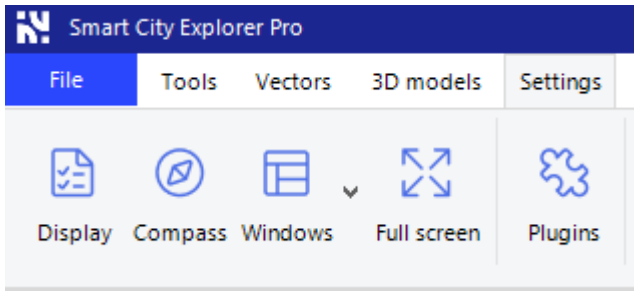


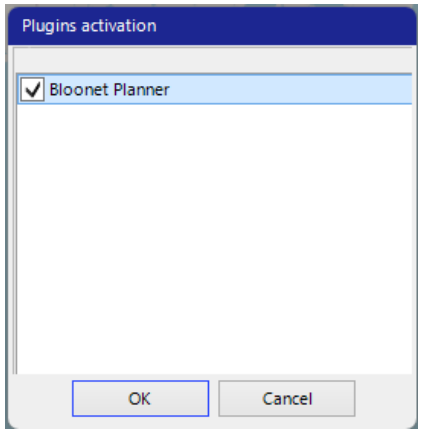


Register Plugins

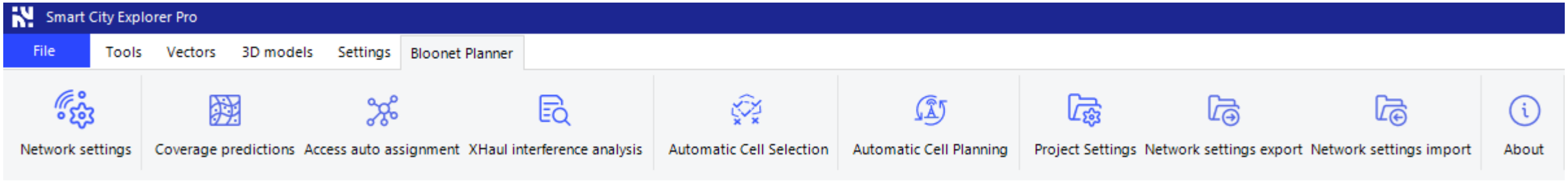
- Bloonet Planner is a plugin integrated in Smart City Explorer Pro. The plugin is automatically activated when Bloonet Planner is installed.
- If the plugin is unregistered at some point (usual Bloonet Planner related folders and the “Bloonet Planner” tab do not appear anymore), the plugin can be activated with the **Plugins activation** option.

Without plugin activated





With Bloonet Planner plugin activated :



THANKS

SIRADEL
ENGIE