5 Generic module

As mentioned earlier in this manual, virtually all radio interference scenarios on terrestrial paths can be addressed in both co-channel (sharing) and adjacent frequency (compatibility) interference studies. A number of various radiocommunications services can be modelled using the generic module:

- Broadcasting: Terrestrial systems and earth stations (e.g. DTH receivers) of satellite systems;
- Fixed services: Point-to-point and point-to-multipoint fixed systems;
- Mobile Services: Land mobile systems, short range devices and earth based components of satellite systems.

This flexibility is achieved by the way the system parameters are defined as constant values or random variables through their distribution functions. It is therefore possible to model even very complex situations by relatively simple variations of some elementary functions. This section explains the use of these parameters in SEAMCAT calculations, where appropriate.

5.1 Generic system tab

Intro

This tab allows you to update all scenario parameters of for a generic system .

In the upper part of the tab, you have three panels.

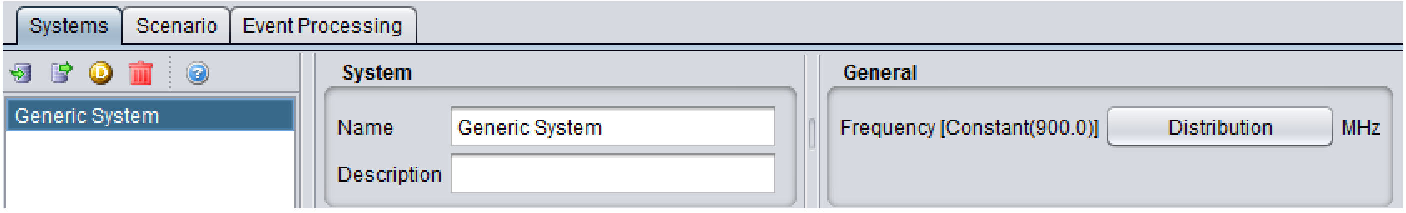

Figure 142: Generic system

5.1.1 System

You can name and write some description of the victim system you want to simulate.

5.1.2 General

The user can enter the frequency. The frequency value is overwritten at the “Scenario” tab level.

Table 8: Generic system – General panel

Description	Symbol	Type	Unit	Comments
Frequency	f	Distribution or Scalar	MHz	Distribution of the centre frequency of the system

You have access to 3 sub tabs to set the generic system:

- Receiver: This will be used either as VLR or ILR;
- Transmitter: This will beused either as VLT or ILT;
- Transmitter to Receiver Path (i.e. either VLT ->VLR or ILT ->ILR).

5.2 Receiver

Introduction

It can be the VLR or the ILR as illustrated in Figure 143.

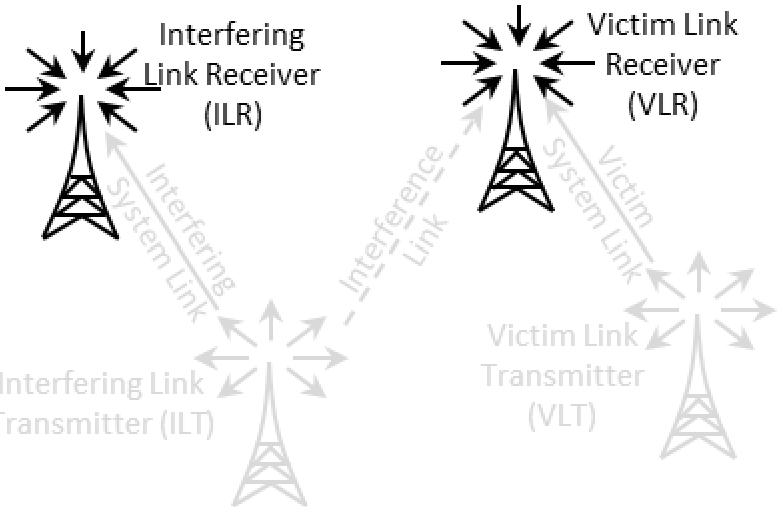

Figure 143: Receiver illustration as VLR or ILR

The receiver consists of 5 panels (Figure 144); Receiver identification, antenna pointing, antenna patterns identification, reception characteristics and interference criteria.

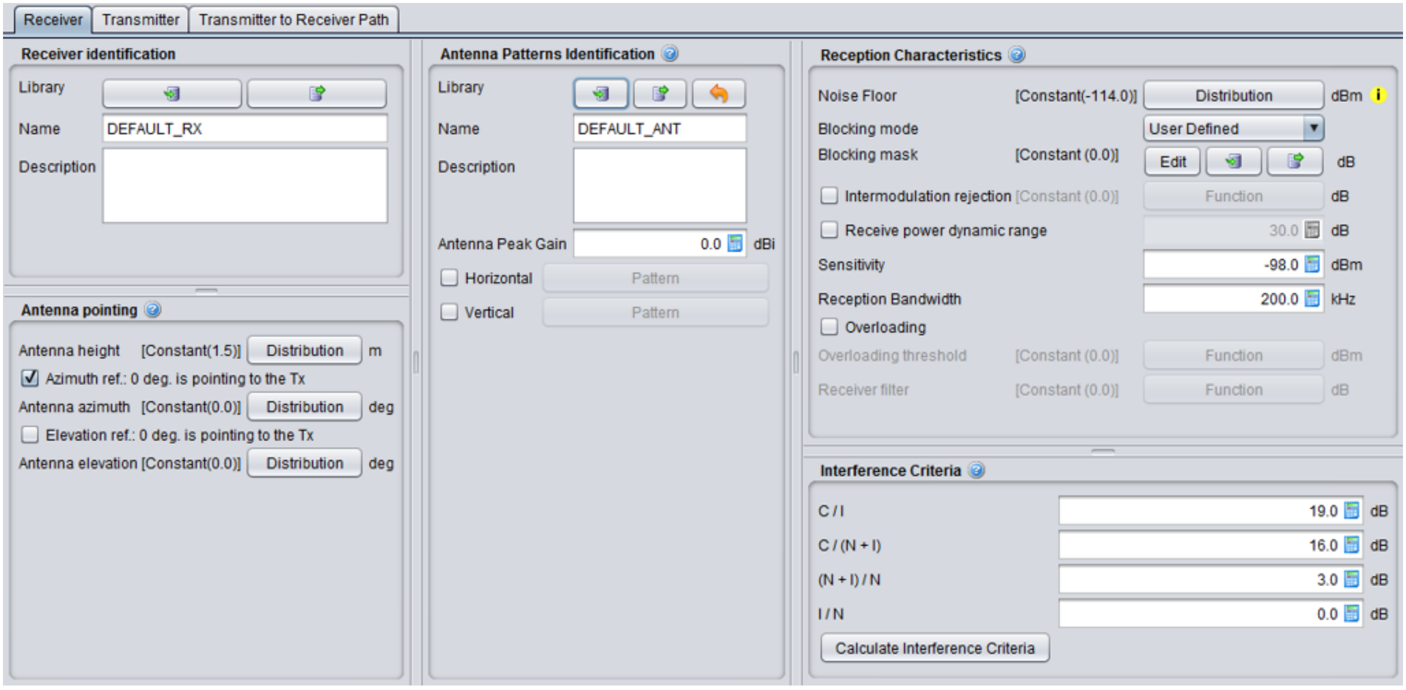

Figure 144: Receiver GUI

5.2.1 Receiver identification

This panel is a common interface that is reused in all other radio system.

Table 9: Receiver identification

<table>
<tr><th>Description</th><th>Symbol</th><th>Type</th><th>Unit</th><th>Comments</th></tr>
<tr><td>Library</td><td>-</td><td>Library</td><td>-</td><td>Allows to import/export the receiver characteristics from/to the library to/from the workspace</td></tr>
<tr><td>Name</td><td>-</td><td>Free text</td><td>-</td><td rowspan="2">Freely chose a name and a description for the receiver. Remember that the settings can be exported to the library, so it is important that the description is accurate enough when reusing or sharing it.</td></tr>
<tr><td>Description</td><td>-</td><td>Free text</td><td>-</td></tr>
</table>

5.2.2 Antenna pointing

This panel is a common interface that is reused in other radio system. It contains all information relative to the antenna other than the radiation pattern.

Table 10: Receiver antenna pointing GUI

Description	Symbol	Type	Unit	Comments
Antenna height	*h*	Distribution or Scalar	m	See ANNEX 11:.
Azimuth ref. 0 deg is pointing to the Tx	-	Boolean	-	When selected, the antenna (i.e. for an antenna azimuth distribution of 0°) is pointing by default at the VLT. If not selected, it looks EAST.
Antenna azimuth: Antenna alignment horizontal tolerance	d^H	Distribution or Scalar	degree	This is the angle between the Rx main beam and the direction to Tx. E.g. if antenna azimuth=0, the Rx and Tx antennas are strictly aligned in the horizontal plane, see ANNEX 11:.
Elevation ref. 0 is pointing to the Tx	-	Boolean	-	When selected, the antenna (i.e. for an antenna elevation distribution of 0°) is tilted by default towards the VLT. If not selected, it is set horizontal.

Antenna elevation: Antenna alignment vertical tolerance	d^V	Distribution or Scalar	degree	This is the vertical angle between the Rx main beam and the direction towards Tx. E.g. if antenna elevation=0, the Rx and Tx antennas are strictly aligned in the vertical plane, see ANNEX 11: on p. 312.

5.2.3 Antenna patterns identification

This panel is a common interface that is reused in all other radio system. It contains all information relative to the antenna radiation pattern:

Table 11: Antenna pattern identification

Description	Symbol	Type	Unit	Comments
Library	-	Library	-	Allows to import/export the antenna pattern from/to the library to/from the workspace.
Name	-	Free text	-	
Description	-	Free text	-	
Antenna peak gain	G	Scalar	dBi	Antennae are implemented as plugins, therefore see ANNEX 11: as separate guidance on the the radiation pattern.
Horizontal	-	Pattern	-	Pattern selection. See working range in ANNEX 11:.
Vertical	-	Pattern	-	Pattern selection. See working range in ANNEX 11:.

5.2.4 Reception characteristics

This panel consists in setting of the receiver characteristics of the generic system:

Table 12: Reception characteristics GUI

Description	Symbol	Type	Unit	Comments
Noise floor: define a distribution of the noise floor	*N*	Distribution or Scalar	dBm	See section 1.2.3 for further details
Blocking mode	-	Boolean	-	Blocking mode and associated blocking mask
Blocking response: Receiver frequency response (receiver blocking performance)	*blocking*	Function (X,Y) (MHz)	dBm or dB depend. on mode	Receiver mask attenuation (positive or negative values depending on the chosen blocking mode, see below) versus frequency, see ANNEX 8:
Intermodulation rejection: Intermodulation response (intermodulation interference)	*intermod*	Function (X,Y) (MHz)	dB	Receiver mask at the intermodulation frequency. (see Annex A5.3 for further details)

Receive power dynamic range	Pc_{max}	Scalar	dB	Used in the calculation of the dRSS. It is the maximum range of the received power that the VLR can accept, in terms of the maximum receive power over the VLR's sensitivity threshold. If the trialled dRSS value exceeds $sens+Pc_{max}$, the dRSS is set to the latter value. See ANNEX 14:.
Sensitivity	*sens*	Scalar	dBm/VLR reception bandwidth	Sensitivity of the receiver. See Section 1.2.4
Reception bandwidth: Operating bandwidth	*B*	Scalar	kHz	Bandwidth of the receiver.
Overloading	-	Boolean	-	When selected, the overloading calclulation is performed. See Annex A5.4 for further details.
Overloading threshold	*Oth*	Function (X,Y) (MHz)	dBm	It is the maximum interfering signal level close to which the receiver loses its ability to discriminate against interfering signals at frequencies differing from that of the wanted signal
Receiver filter	*Rx_filter*	Function (X,Y) (MHz)	dB	Filtering of the receiver (if any). The filtering of the receiver is by default 0 dB (similarly to the default blocking filtering value). It is used in connection with the overloading calculation.

5.2.5 Interference criteria

Section 1.4 presented the concept of interference criteria (C/I, C/(N+I), (N+I)/N, I/N) when the victim is a generic system. The consistency between these values falls under the responsibility of the user. It should be noted that only one criterion is used at a time in the final interference calculation.

It is important to remember that these parameters are also used in the evaluation of the two blocking modes (Protection ratio and Sensitivity) as presented in See section 1.4.5.

SEAMCAT performs a consistency checking between the interference criteria as explained in ANNEX 3:.

Table 13: Interference criteria panel GUI

Description	**Symbol**	**Type**	**Unit**	**Comments**
Interference criteria	*C/I* *C/(N+I)* *(N+I)/N* *I/N*	Scalar	dB	At least one of these criteria should be defined: (C/I, C/(N+I), (N+I)/N, I/N). Then, one of these criteria is chosen for each interference probability calculation.
Calculate interference criteria	-	calculator	-	This feature allows the evaluation of the consistency between the entered interference criteria (C/I, C/(N+I), (N+I)/N, I/N) and proposes alternative values that can be selected to ensure consistency between them.

The “calculate interference criteria” is a user friendly calculator for the interference criteria. It avoids conspicuous calculations, increases the transparency and avoids consistency check warnings because of the use of inconsistent sets of values.

The calculation and selection of a consistent set of interference criteria is implemented. The calculator opens with the existing values in the interference criteria fields of the workspace. A checkbox (default: ON) allows to force the consistency of the C/(N+I) value with the workspace, i.e. the values ‘Noise floor’ and ‘Sensitivity’. The relation between the values is given in the formula C/(N+I) [dB] = Sensitivity [dBm] – Noise floor [dBm]

The Interference Criteria Calculator displays all possible sets of consistent interference criteria rounded to two decimals. The same set is displayed only once. As a consequence of rounding, the displayed sets are differ at least 0.01 dB in one of the four values.

When you select the column of values you want and click ok, the values are copy/pasted to the “Interference criteria” panel.

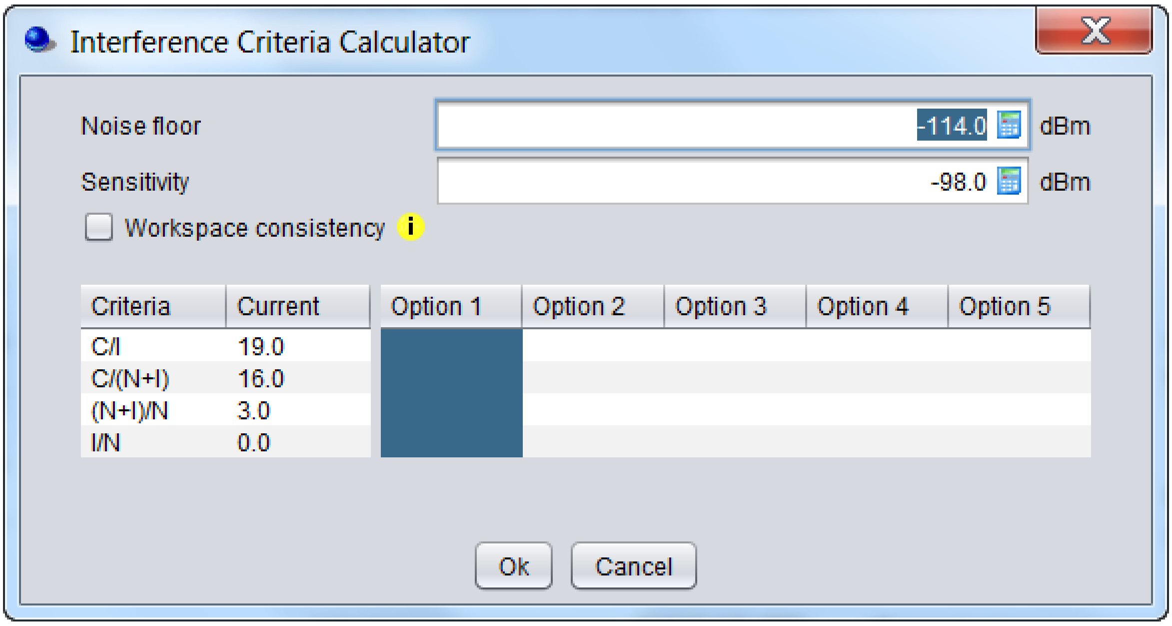

Figure 145: Interference criteria calculator GUI

5.3 Transmitter

Introduction

It can be the ILT or the VLT as illustrated in Figure 146.

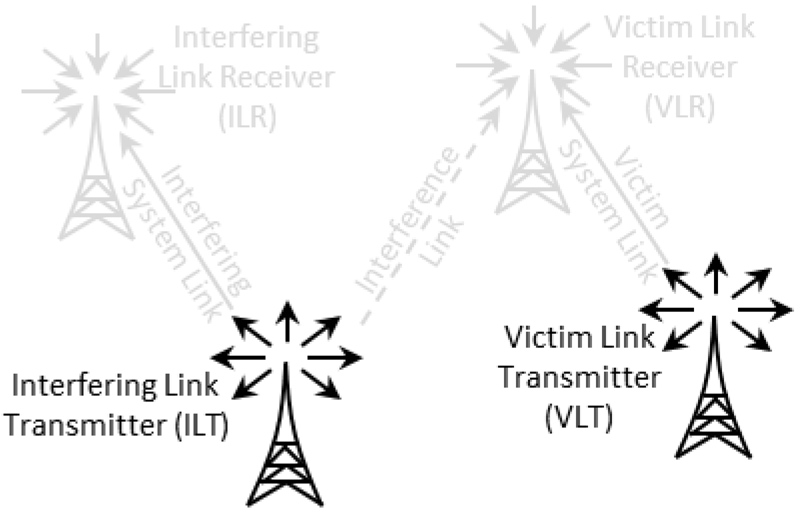

Figure 146: Transmitter illustration as ILT or VLT

It consists in 4 panels (Figure 147); Transmitter identification, antenna pointing, antenna patterns identification, emission characteristics.

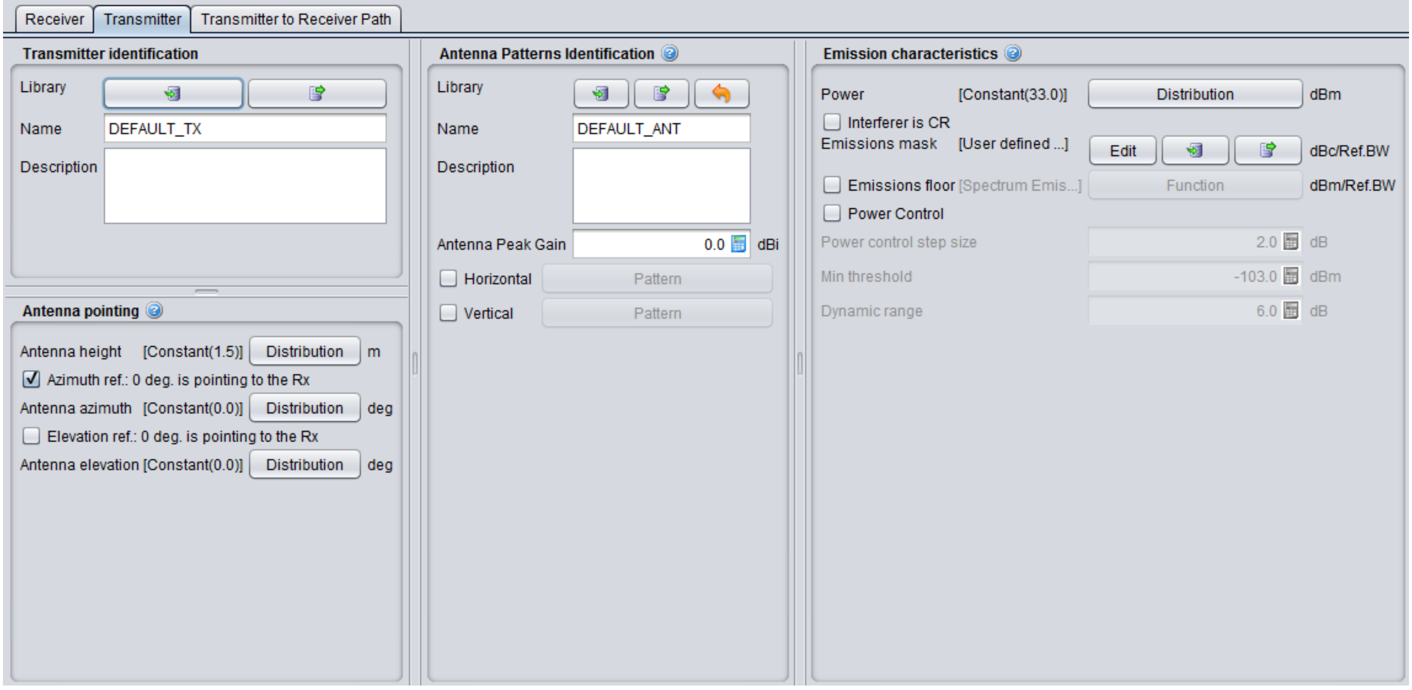

Figure 147: Transmitter GUI

5.3.1 Transmitter identification

This is the same panel as in section 5.2.1 so that transmitter characteristics can be imported/exported from/to the library to/from the workspace and you can freely chose a name and a description.

5.3.2 Transmitter power

In SEAMCAT, the transmitter power (P) is expressed as conducted power in dBm, including feeder loss. The antenna peak gain (G) is expressed in dBi.

Consequently, the power calculated by SEAMCAT at the antenna output is the effective isotropic radiated power (e.i.r.p.) expressed in dBm:

e.i.r.p (dBm) = P (dBm)+G (dBi)

If the transmitter power is defined as e.i.r.p (dBm) or e.r.p (dBm), the conducted power (P), including feeder loss, can be calculated as follows:
P (dBm)= e.i.r.p (dBm)-G (dBi);
P (dBm)= e.r.p (dBm)-G (dBi)+2.15.

If the antenna gain is not known, it should be assumed zero, then:
P (dBm)= e.i.r.p (dBm);
P (dBm)= e.r.p (dBm)+2.15.
Note that G (dBi)= G (dBd)+2.15.

Example 1: P_t= 50 dBm (conducted transmitter power), L_f (feeder loss) = 2 dB, G_{ant} (antenna gain) = 15 dBi
SEAMCAT settings should be: Power (dBm) = 50 - 2 = 48, Antenna Peak Gain (dBi) = 15
e.i.r.p (dBm) calculated by SEAMCAT= P (dBm)+G (dBi) = 48 + 15 = 63 dBm

Example 2: e.i.r.p = 63 dBm, G_{ant} = 15 dBi, feeder loss in not needed
SEAMCAT settings should be: Power (dBm) = 63 - 15 = 48, Antenna Peak Gain (dBi) = 15
e.i.r.p (dBm) calculated by SEAMCAT= P (dBm)+G (dBi) = 48 + 15 = 63 dBm

Example 3: e.r.p = 60.85 dBm, G_{ant} = 12.85 dBd, feeder loss in not needed
SEAMCAT settings should be: Power (dBm)= 60.85 - 12.85 = 48, Antenna Peak Gain (dBi) = 12.85 + 2.15 = 15
e.i.r.p (dBm) calculated by SEAMCAT= P (dBm)+G (dBi) = 48 + 15 = 63 dBm

Example 4: e.i.r.p = 63 dBm, no other information available
SEAMCAT settings should be: Power (dBm) = 63, Antenna Peak Gain (dBi) = 0
e.i.r.p (dBm) calculated by SEAMCAT= P (dBm)+G (dBi) = 63 + 0 = 63 dBm

Example 5: e.r.p = 60.85 dBm, no other information available
SEAMCAT settings should be: Power (dBm) = 60.85, Antenna Peak Gain (dBi) = 2.15
e.i.r.p (dBm) calculated by SEAMCAT= P (dBm)+G (dBi) = 60.85 + 2.15 = 63 dBm

5.3.3 Transmitter antenna pointing

This is the same panel as in section 5.2.1 so that transmitter characteristics can be imported/exported from/to the library to/from the workspace and you can freely chose a name and a description.

5.3.4 Antenna patterns identification

It contains all information relative to the antenna radiation pattern. It is similar to the receiver antenna patterns identification (Section 5.2.3).

5.3.5 Emission characteristics

This panel consists in setting of the emission characteristics of your generic system.

Table 14: Emission characteristics GUI

Description	Symbol	Type	Unit	Comments
Power	P	Scalar or Distribution	dBm	This is the transmitter power supplied to the antenna of the generic system, including feeder loss.
Interfere is CR:		Boolean		When the CR button is checked then it allows to set the emission characteristics of the VLT and ILT (used for the sRSS calculation only. See Section 6)
Emission mask:	emission_rel(f)	Function (X,Y) (kHz)	dBc/ reference bandw. (kHz)	Define the mask of the transmitter, in the emission bandwidth and out of the emission bandwidth. It is the unwanted signal level from the ILT. (See ANNEX 7:)

Unwanted emissions floor: Noise floor signal level	emission_floor(f)	Function (X,Y) (kHz)	dBm/ reference bandw. (kHz)	Define the minimum strength of the unwanted emissions. So the unwanted emissions equal to Max(P_{Tx} + Unwanted emission, Unwanted emissions floor) (see Annex A7.4)
Power control				If Power control is checked, the 3 following parameters have to be defined. This Power control is used to limit the output power of the transmitter (see ANNEX 14:)
Power control step size	PC_{step}	Scalar	dB	
Min threshold	$PC_{threshold}$	Scalar	dBm/ emission bandw	If the received power is lower than this threshold, then no power control takes place
Dynamic range	PC_{dyn}	Scalar	dB	If the received power is higher than $Pc_{treshold}$ + Pc_{dyn} then the full power control takes place, i.e. the power is decreased by Pc_{dyn}

5.4 Transmitter to Receiver Path

Introduction

3 elements form the path between the VLR and the VLT or the ILR and ILT as illustrated in Figure 148.

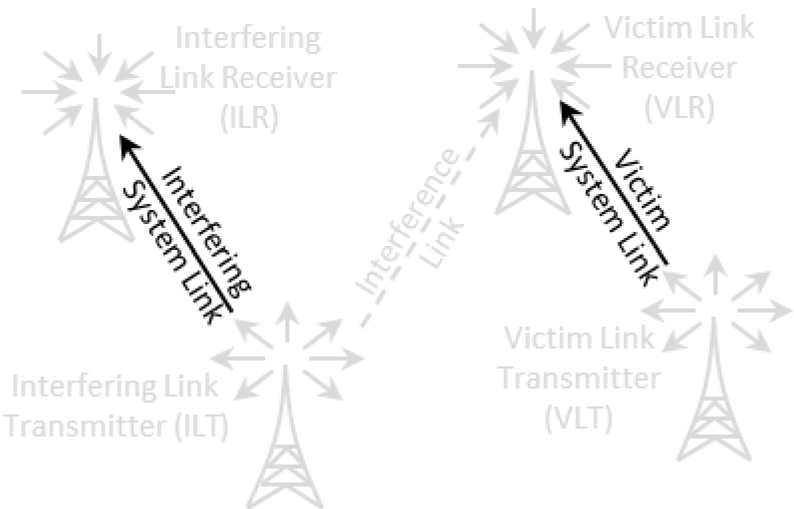

Figure 148: Transmitter to Receiver Path illustration

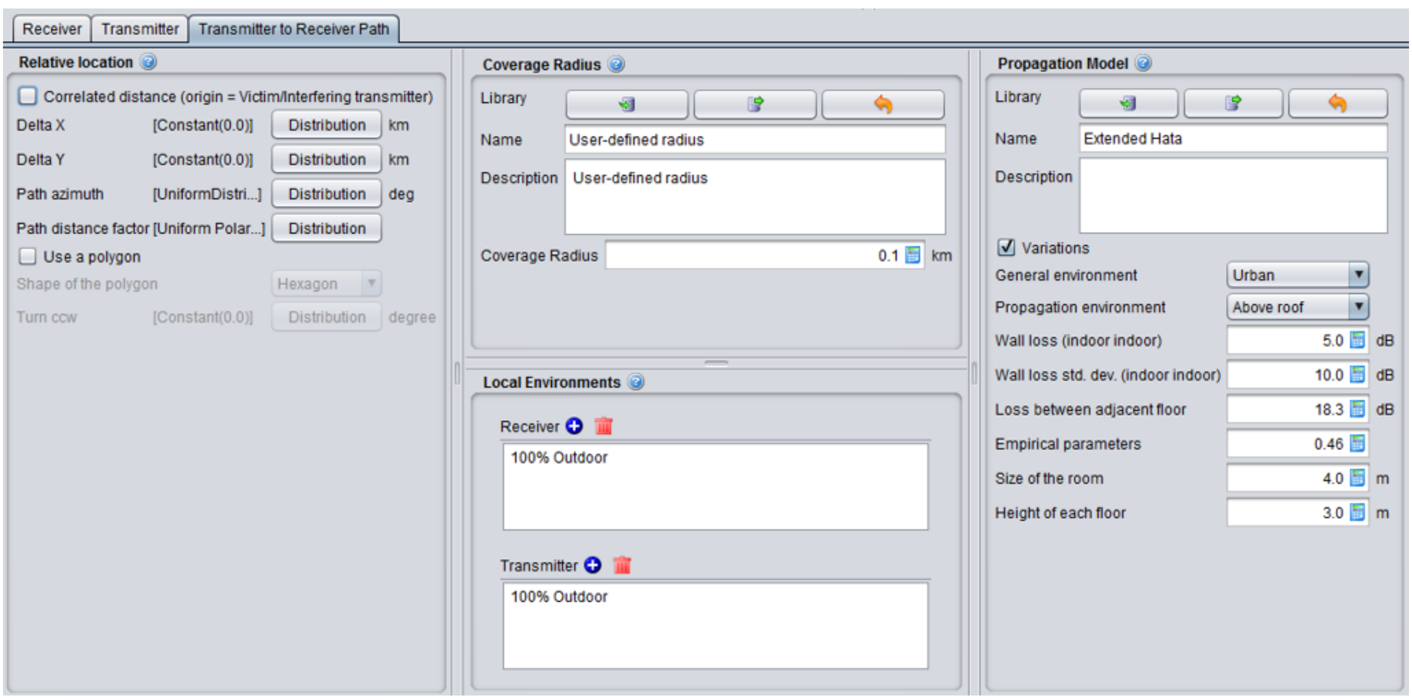

Figure 149: Transmitter to Receiver Path GUI

5.4.1 Relative location

- When the Correlated distance option is checked, the positions of the receiver and transmitter are geographically fixed with respect to each other (e.g. co-located or constantly spaced base stations). The transmitter is considered a reference centre.
- When the correlated distance is unchecked, the receiver is randomly moving around the transmitter. There are 2 primary options to define type of mutual placement of VLR with respect to VLT.

See ANNEX 12: for further details on the algorithm and conventions.

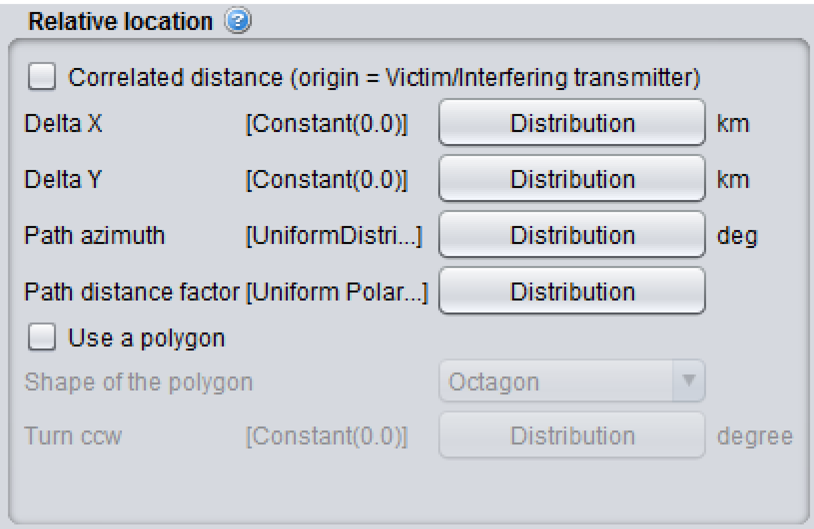

Figure 150: Relative location panel

Table 15: Relative location GUI

Description	Symbol	Type	Unit	Comments

Correlation distance	-	Boolean	-	When checked, the only the Delta X and Y are editable.
Delta X	X	Distribution	Km	Horizontal distance between the transmitter and receiver. It can be used to shift horizontally the distributed receivers.
Delta Y	Y	Distribution	Km	Vertical distance between the transmitter and receiver. It can be used to shift vertically the distributed receivers.
Path azimuth	-	Distribution	Degree	Horizontal angle for the location of the Rx respect to the Tx. If constant, the Rx's location will be on a straight line. If not, the location of the Rx will be on an angular area. (See Annex A12.3)
Path distance factor	-	Distribution	-	Distance factor to describe path length between the Tx and the Rx. If the path factor is constant, the Rx will be located on a circle around the Tx. (See Annex A12.2)
Use of polygon	-	Boolean	-	When this is checked, you can select other shape of deployement than the default circle
Shape of the polygon	-	Boolean	-	You can select between hexagon (6 sides), heptagon (7 sides), Octagon (8 sides), Pentagon (5 sides), Rectangle (4 sides) and Triangle (3 sides)

Turn CCW	-	Distribution	Degree	Allows to rotate counter clock wise the selected polygon

5.4.2 Coverage radius

A coverage radius is calculated for both the victim link and the interfering link. It is the R_{max}^{VLT} for the victim link (VLR-VLT) and the R_{max}^{ILT} for the interfering link (ILR-ILT) (see Annex A13.1). The receivers will be randomly deployed within the area centred on the transmitter and delimited by the coverage radius if the non-correlated option is selected.

Three different modes are available for calculating the maximum radius .

- **User-defined radius** allows directly entering the maximum radius (See Annex A13.1.1);

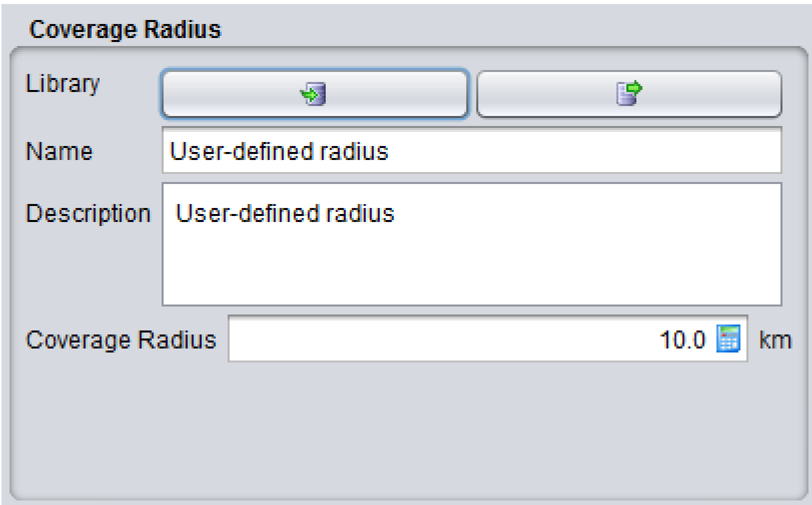

Figure 151: User-defined coverage radius dialog box

Table 16: Description on User-defined coverage radius

Description	Symbol	Type	Unit	Comments

Coverage radius	R_{max}	Scalar	km	The coverage radius defines the coverage of the system, i.e. the maximum distance between an ILT and a ILR or between a VLT and a VLR. The origin point of the coverage radius is logically the VLT or the ILT.

- The **noise-limited network** option will calculate the coverage radius based on the formula for noise-limited network. If this option is chosen, a set of input boxes will appear below allowing the user to enter specific parameters required for this calculation. In this case it is considered that the coverage of the transmitter is limited only by propagation losses and other elements in thelink budget, with received signal operating at the sensitivity limit. The details of the calculation are given in Annex A13.1.2.

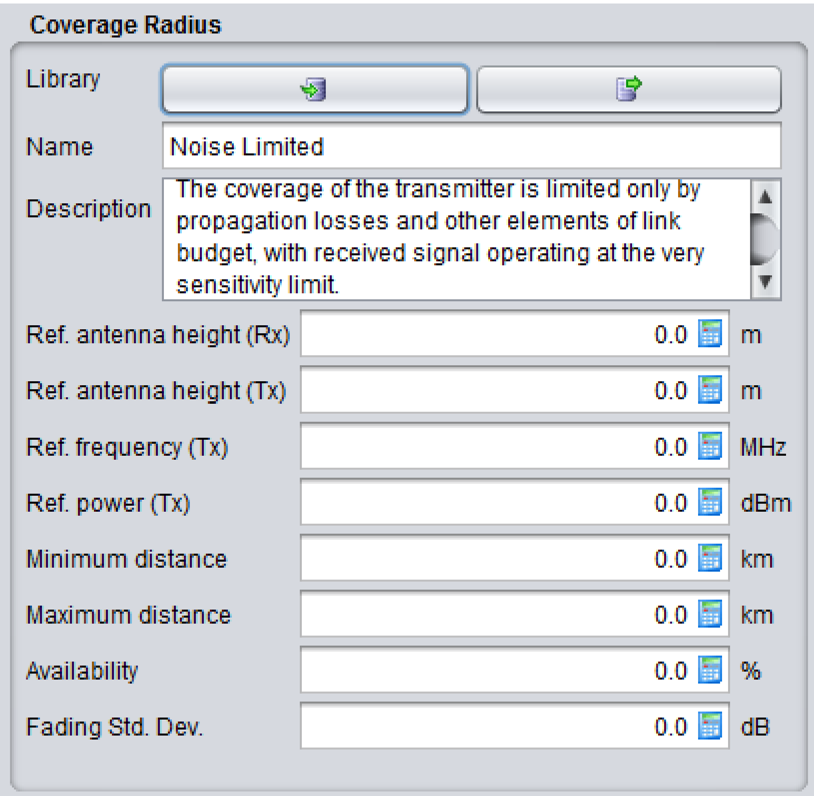

Figure 152: Noise limited network coverage radius dialog box

The coverage radius in the noise-limited network is defined by the parameters of Table 17. Note that the input parameters for the Noise-limited network interface are set to zero by default in order to independently define the radius from some parameters set elsewhere in the link.

Table 17: Description of the Noise limited network coverage radius user interface

Description	**Symbol**	**Type**	**Unit**	**Comments**
Reference antenna height (receiver):	h^0	Scalar	m	The height used for coverage radius calculations. If a distribution is used to define the real height, the coverage radius would be different in each trial, here the value may be fixed.
Reference antenna height (transmitter):	h^0	Scalar	m	The height used for coverage radius calculations.
Reference frequency	fVLR	Scalar	MHz	
Reference power	P_{VLT}	Scalar	dBm	
Minimum distance			km	
Maximum distance			km	
Availability			%	
Fading standard deviation			dB	
Reference percentage of time			%	

Traffic-limited network option will calculate the coverage radius, based on the formula for traffic-limited network. If this option is chosen, a set of input boxes will appear below allowing user to enter specific parameters required for this calculation (See Annex A13.1.3).

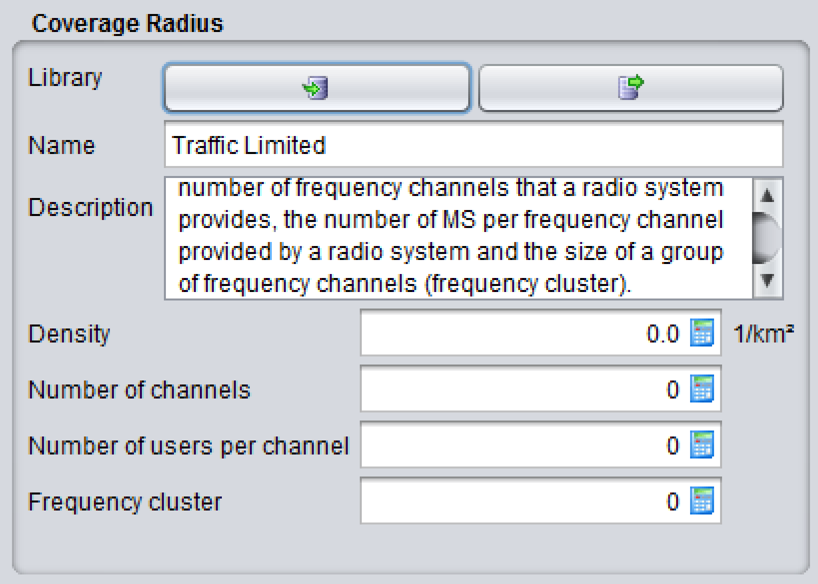

Figure 153: Traffic limited network coverage radius dialog box

Table 18: Description of the traffic limited network coverage radius user interface

Description	Symbol	Type	Unit	Comments
Density		Scalar	$1/km^2$	Maximum number of active transmitters per km2
Number of channels		Scalar		Number of frequency channels of the system
Number of users per channel		Scalar		Number of MS per frequency channel
Frequency cluster		Scalar		Size of a group of frequency channels. See Figure 180 for illustrative details.

The consistency of this parameter should be verified against the sensitivity, so that if a receiver is placed at given distance (e.g. at the maximum coverage radius) the received power is higher than the sensitivity for a reasonable percentage of occurrences (availability).

5.4.3 Local environment

The percentage of transceivers being indoor and outdoor can be selected thanks to this panel. It will work in combination with the chosen propagation model that you will select. By default the transmitter and receiver are located outdoor. For each elements of the link, it is possible to add or remove a probability of indoor.

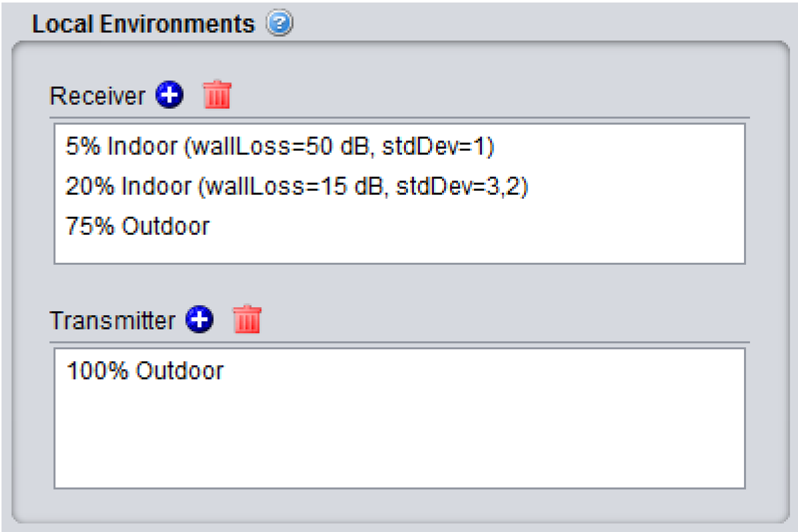

Figure 154: Example of setting up the outdoor/indoor ratio

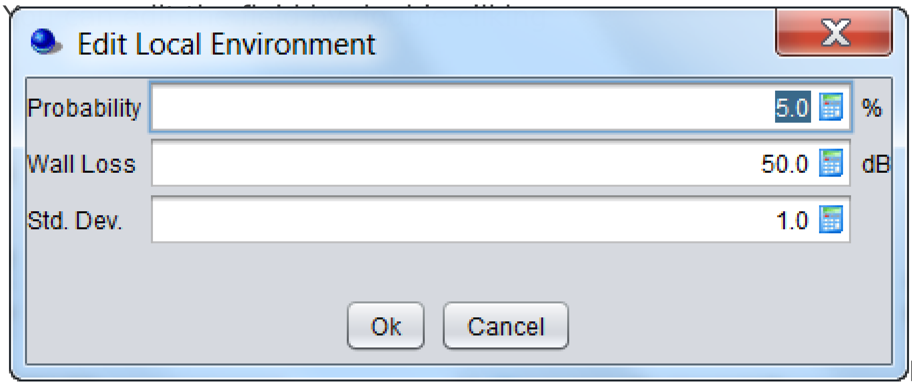

Figure 155: Graphical interface to edit the probability, wall loss and associated standard deviation

Table 19: Local environment and wall loss

Description	Symbol	Type	Unit	Comments
Local environment: Receiver	Indoor/ outdoor	-	-	Environment of the receiver antenna: outdoor, indoor It is used for both VLR and ILR.
Local environment: Transmitter	Indoor/ outdoor	-	-	Environment of the transmitter antenna: outdoor, indoor It is used for both VLT and ILT.
Probability	-	Scalar	%	Probability that a Tx or Rx is located indoors or outdoors.
Wall loss	or	Scalar	dB	Attenuation of external walls separating indoor and outdoor propagation environments. This parameter is associated to the selected propagation model.
Std. dev.	or	Scalar	dB	Wall loss stdandard deviation (indoor - outdoor) Wall loss standard deviation associated to the selected propagation model.

Note that when opening a workspace created prior to SEAMCAT version 5, all settings are mapped to the current SEAMCAT version running on your machine. As the parameter local environment didn't exist before version 5, a warning may appear indicating that "local environments are skipped for multiple interfering links". This means that SEAMCAT was not able to automatically set the parameters of the local environments (most likely due to a scenario with multiple interferers). Therefore, there is a need to edit the local environment manually.

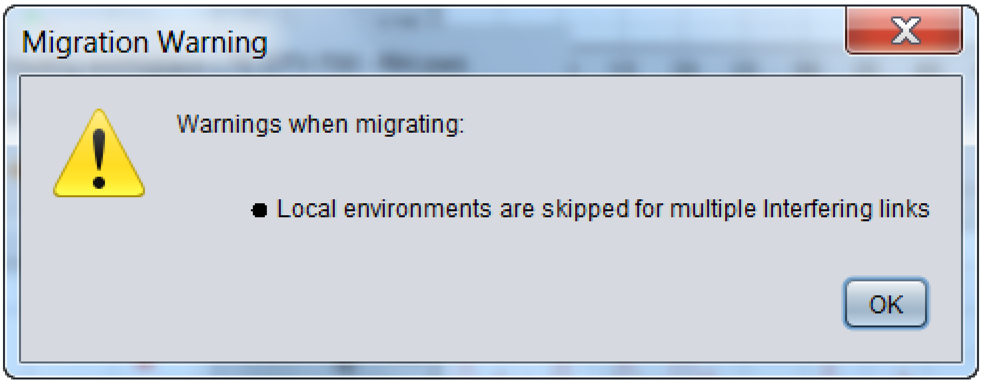

Figure 156: Migration warning on the local environment

5.4.4 Propagation Model

A suitable propagation model can be selected to be applied when calculating signal loss along the path between transmitters and receivers. Further information on propagation models are presented in detail in ANNEX 17.