RTUWO '18

Advances in Wireless and Optical Communications

Instituto Politécnico de Castelo Branco
Escola Superior de Tecnologia

Technical University of Riga
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Spectrum Engineering towards 5G: Helping to ensure efficient and interference-free wireless communications

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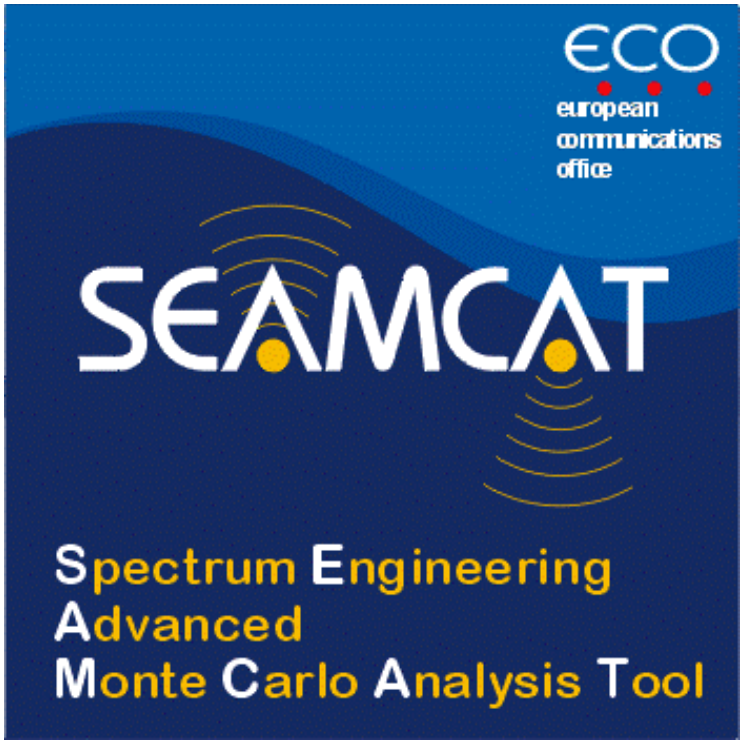
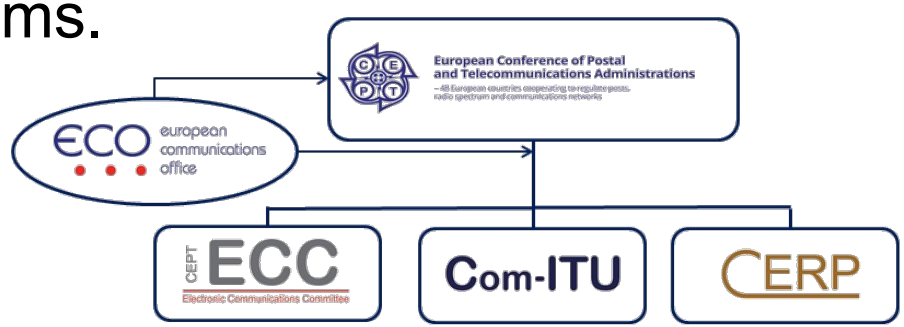
Summary

- What is SEAMCAT?
- Why SEAMCAT?
- SEAMCAT at a glance
- Hand's on Exercises

What is SEAMCAT?

- **Open Source** software tool
- **Free of cost**
- Based on the **Monte Carlo simulation method** for statistical modelling of interference scenarios between radio communication systems.





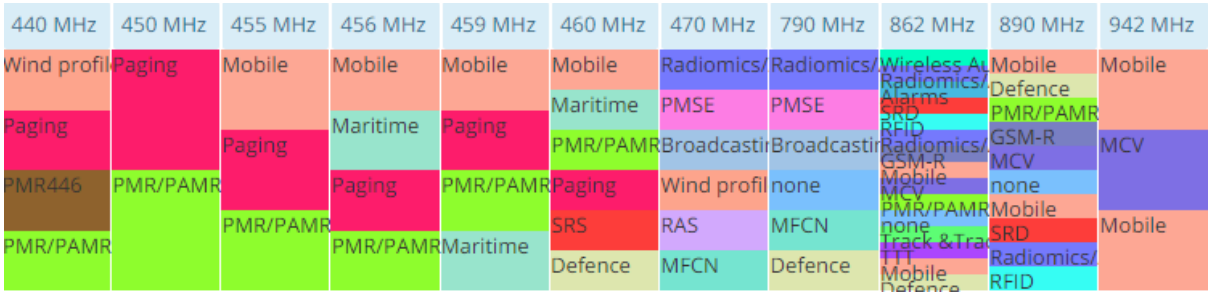
SEAMCAT is intended for:

- **Co-existence studies** between radio communication systems operating in the same or adjacent frequency bands.
- Simulation of systems operating mainly under **terrestrial services** (some scenarios involving satellite systems are also possible).
- Quantification of the **probability of interference** (probability that one system is interfered by one or more other systems).

It is <u>not</u> designed for network planning purposes.

Why SEAMCAT?

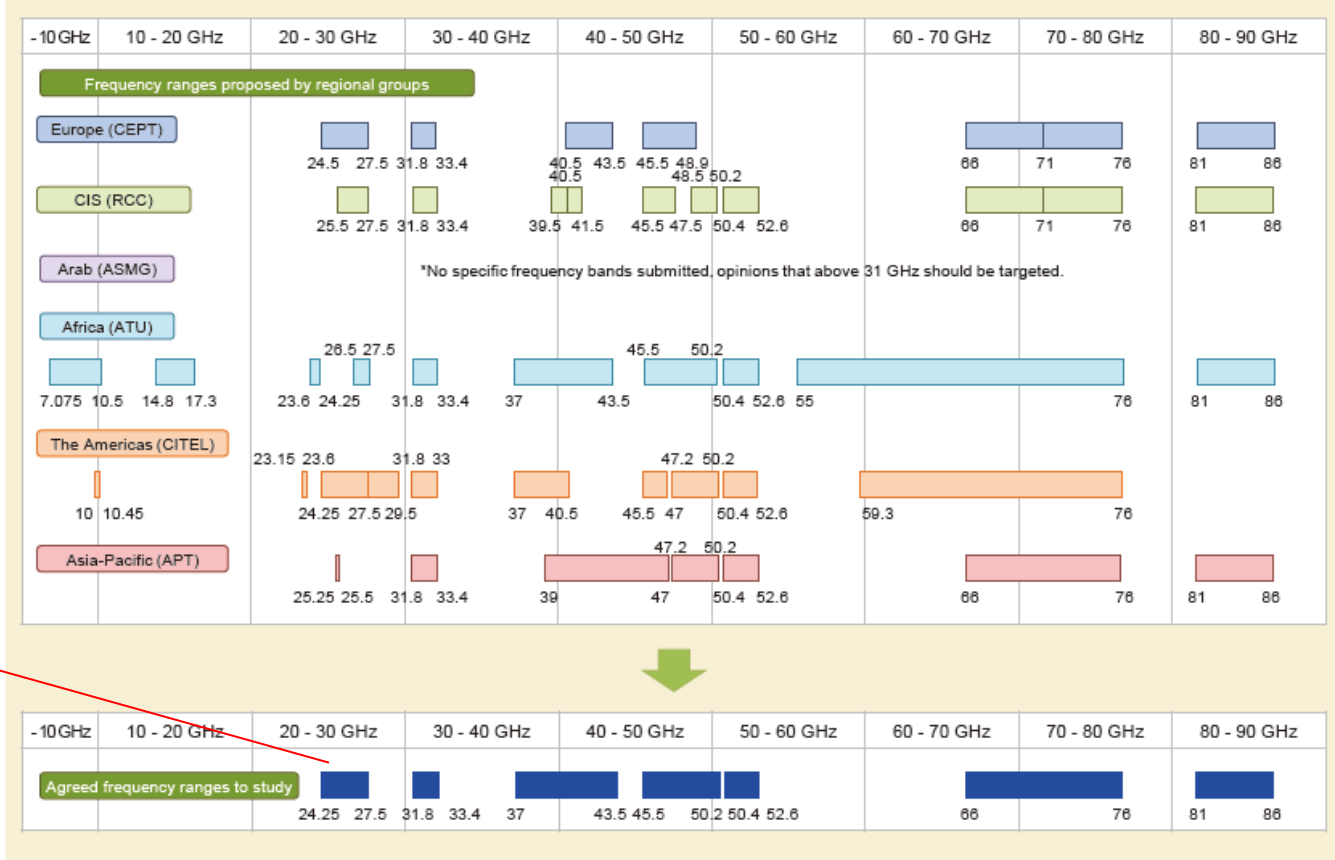
- **Congestion** in the radio spectrum resource.
- Radiocommunication systems need to **share the resources** efficiently.



- **Sharing and compatibility studies** are required to assess the possibilities for radio systems to coexist in the same or in adjacent frequency bands.

Why SEAMCAT?

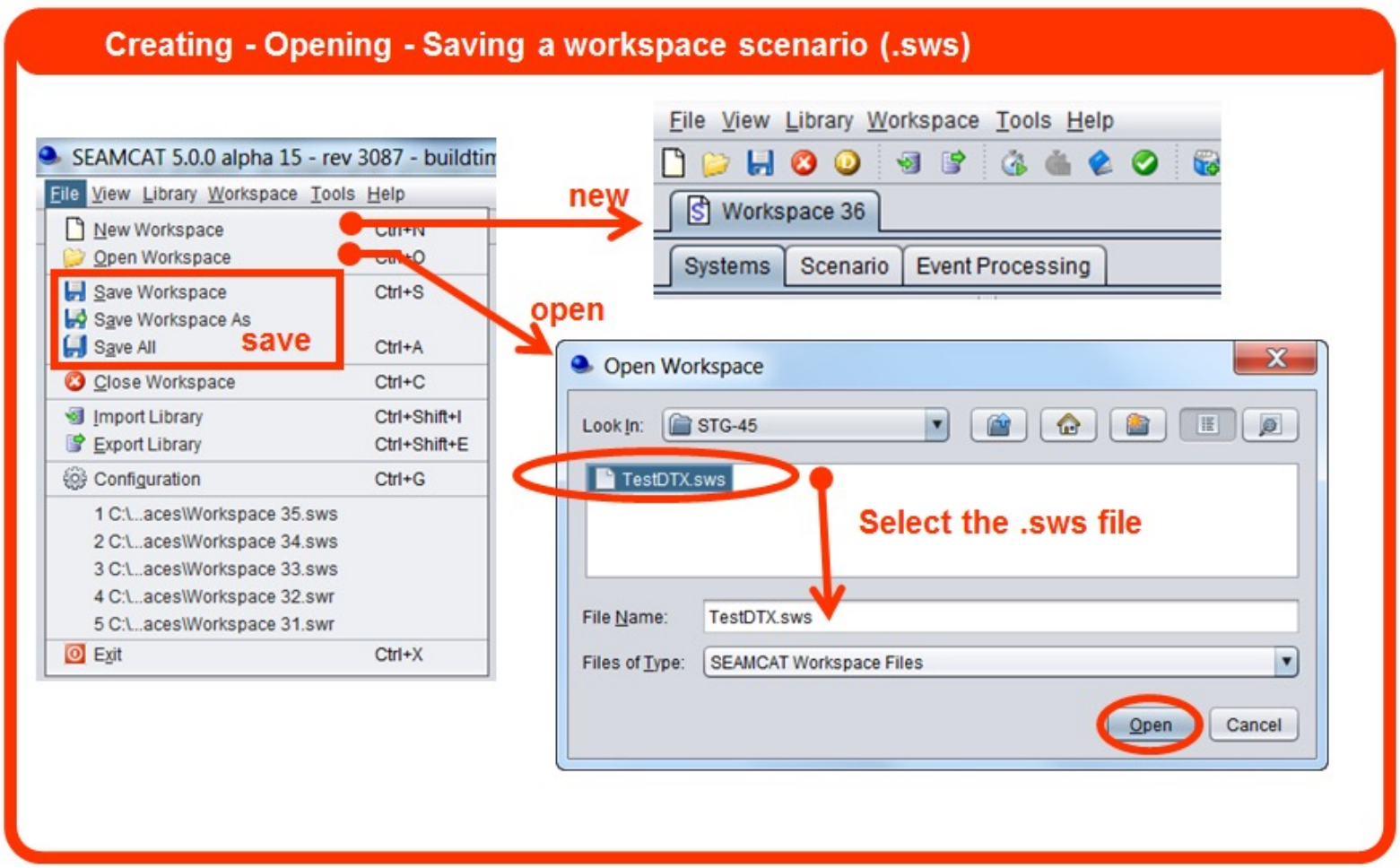
- Frequency ranges for 5G systems (from ITU-WRC15)
- Compatibilty studies are still needed…



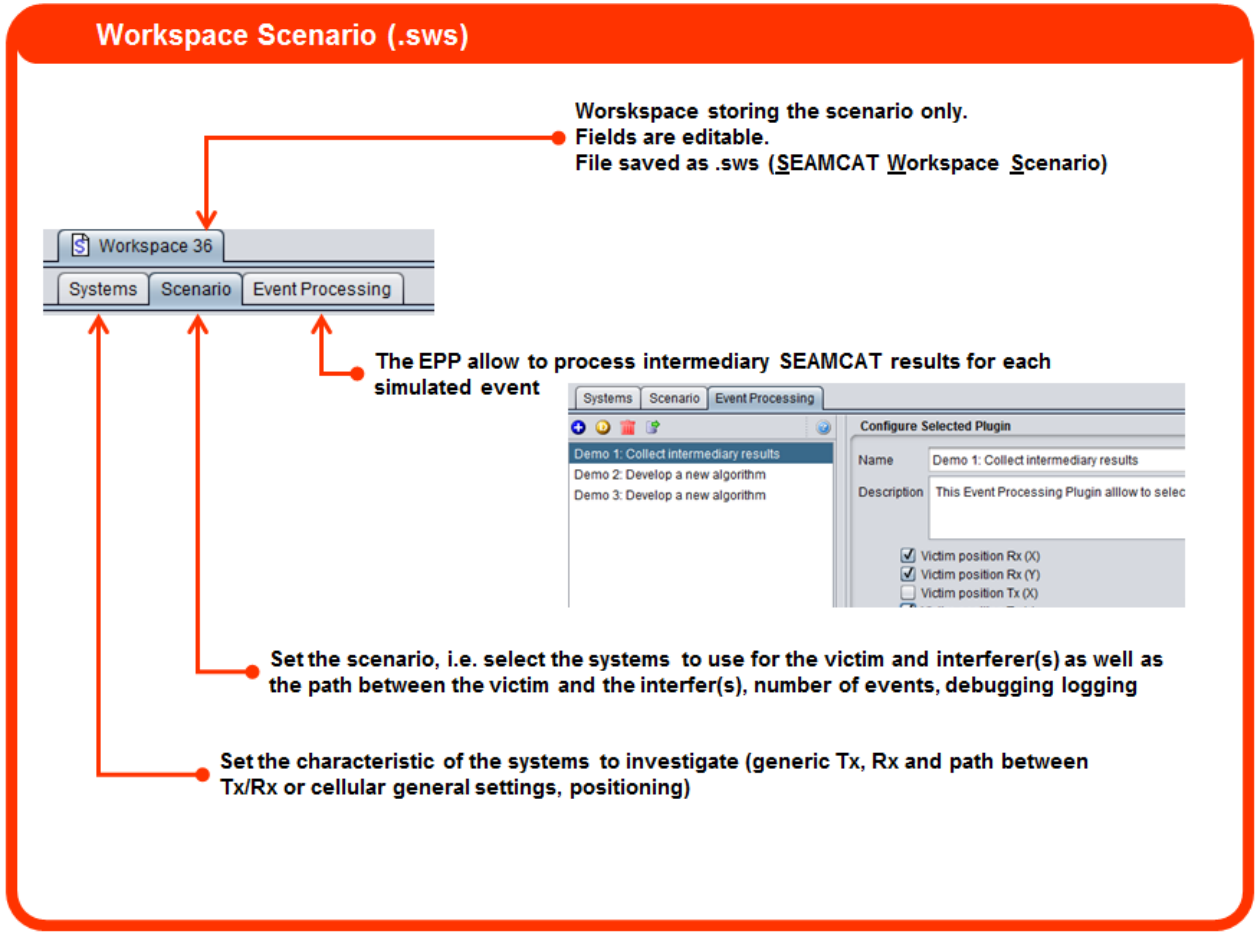
Earth Exploration Satellite Services (EESS)

SEAMCAT
at a glance

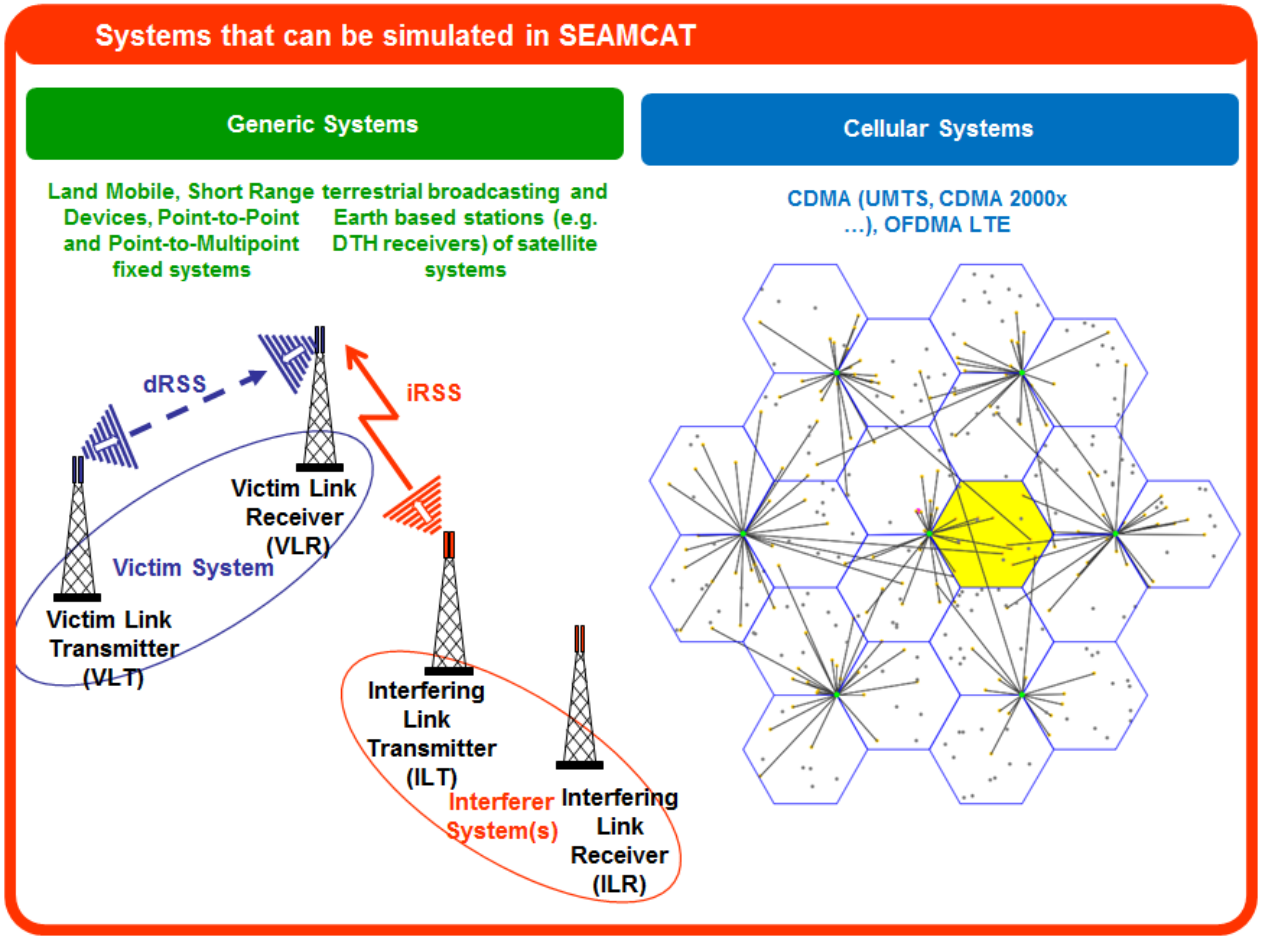
Creating – Opening and Saving a Workspace



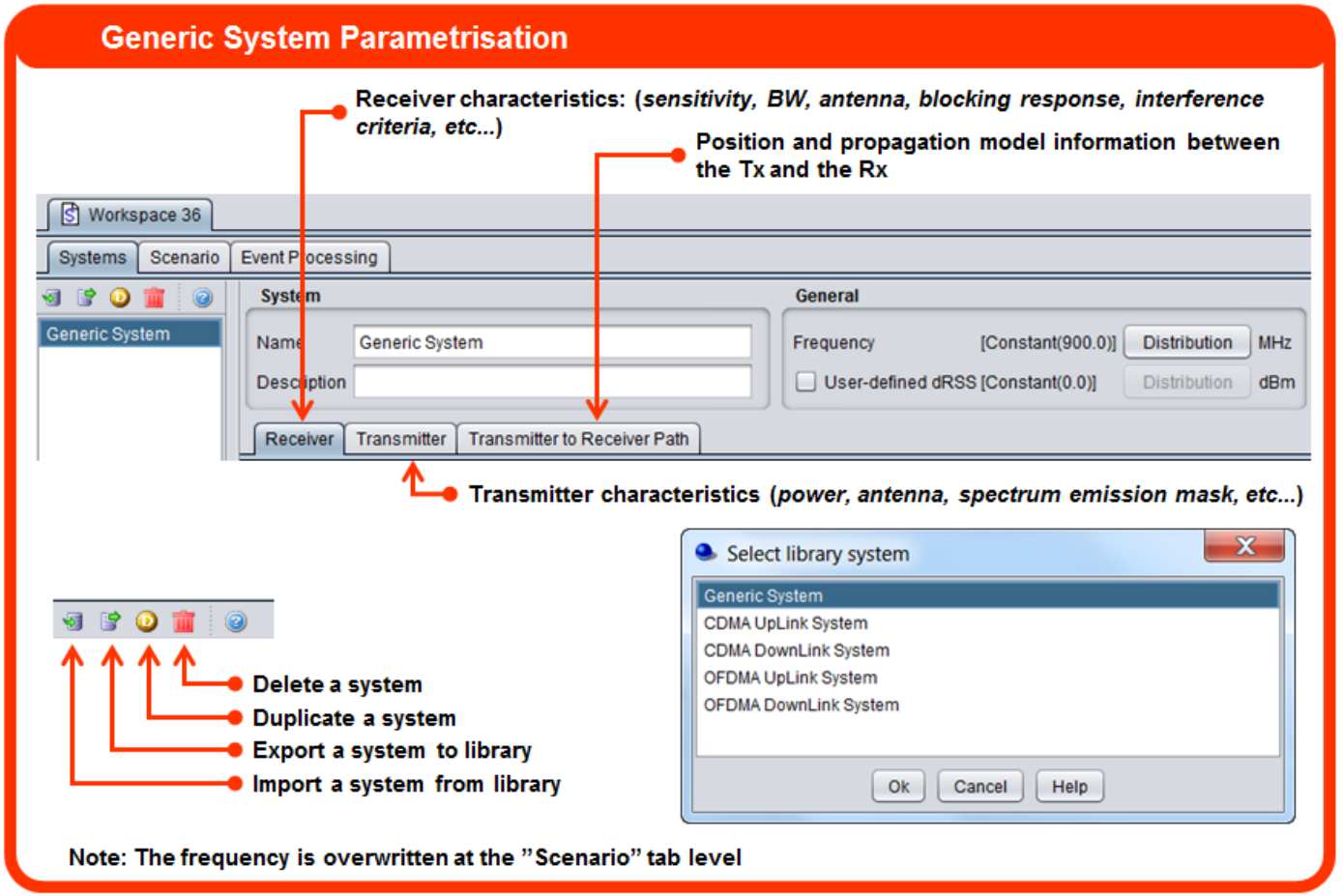
Workspace


Workspace Scenario (.sws)
Worskspace storing the scenario only.
Fields are editable.
File saved as .sws (SEAMCAT Workspace Scenario)
Workspace 36
Systems
Scenario
Event Processing
The EPP allow to process intermediary SEAMCAT results for each simulated event
Systems
Scenario
Event Processing
Configure Selected Plugin
Demo 1: Collect intermediary results
Demo 2: Develop a new algorithm
Demo 3: Develop a new algorithm
Name
Demo 1: Collect intermediary results
Description
This Event Processing Plugin alllow to selec
Victim position Rx (X)
Victim position Rx (Y)
Victim position Tx (X)
Set the scenario, i.e. select the systems to use for the victim and interferer(s) as well as the path between the victim and the interfer(s), number of events, debugging logging
Set the characteristic of the systems to investigate (generic Tx, Rx and path between Tx/Rx or cellular general settings, positioning)

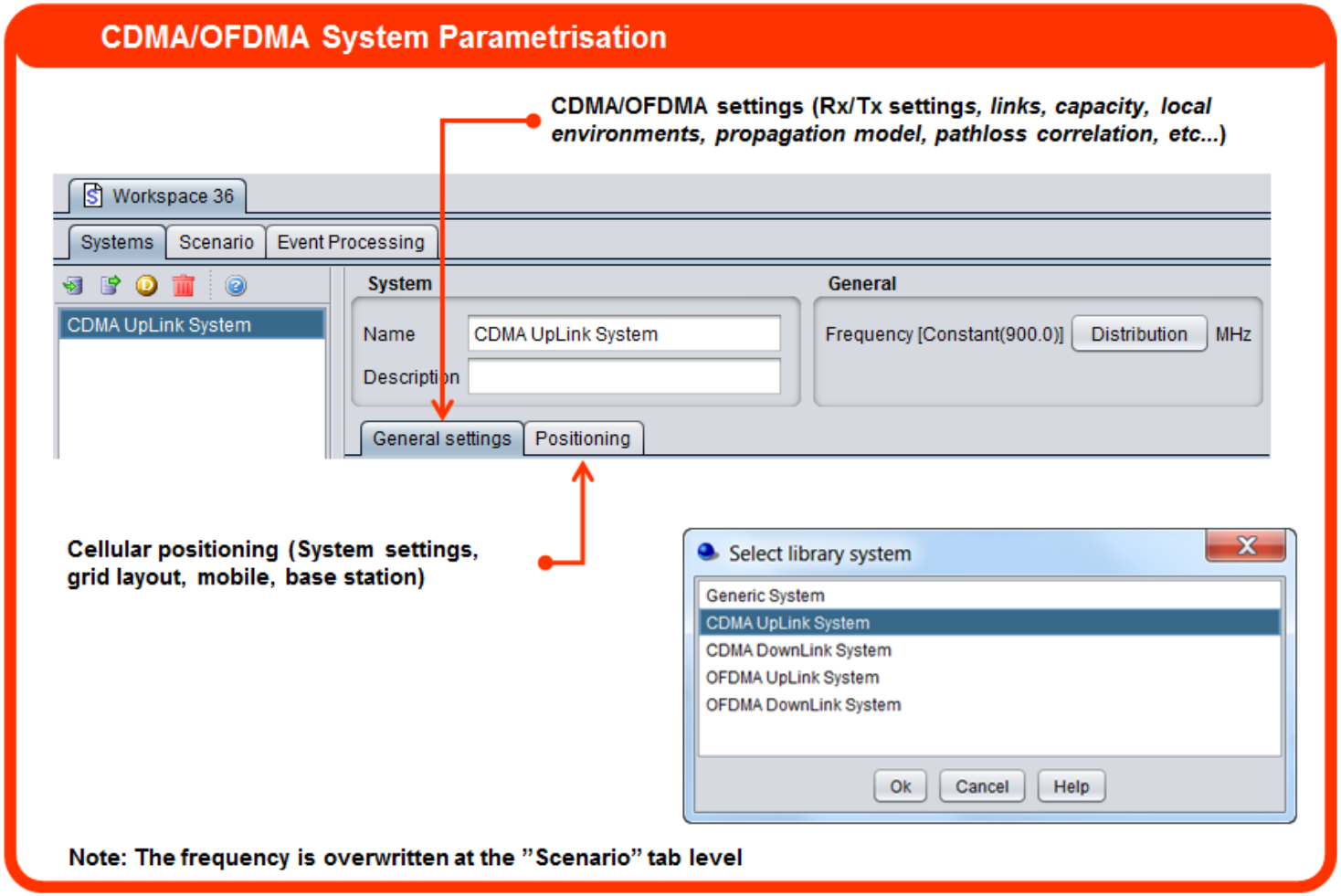
Systems that can be simulated in SEAMCAT



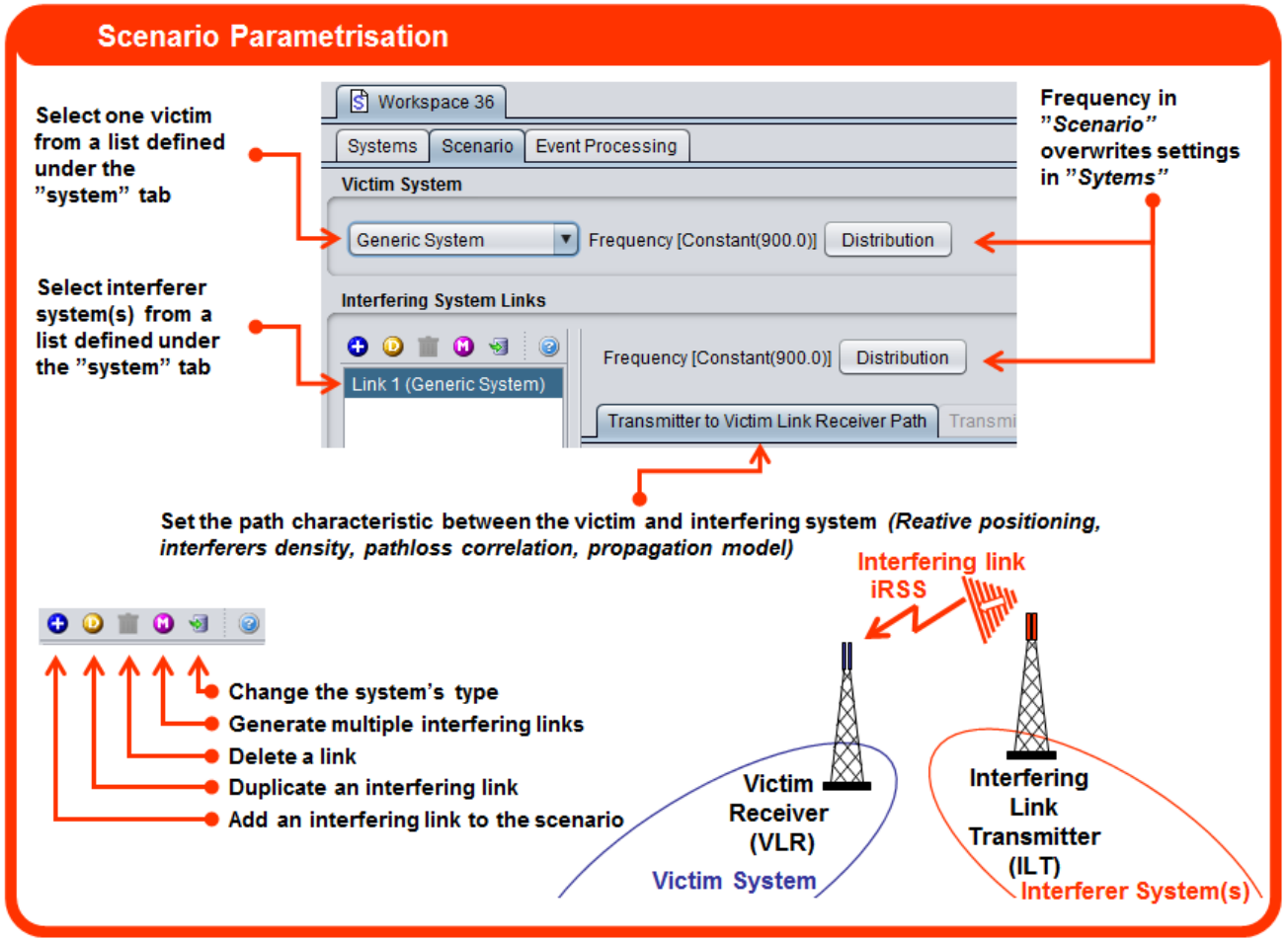
Generic System Parametrization



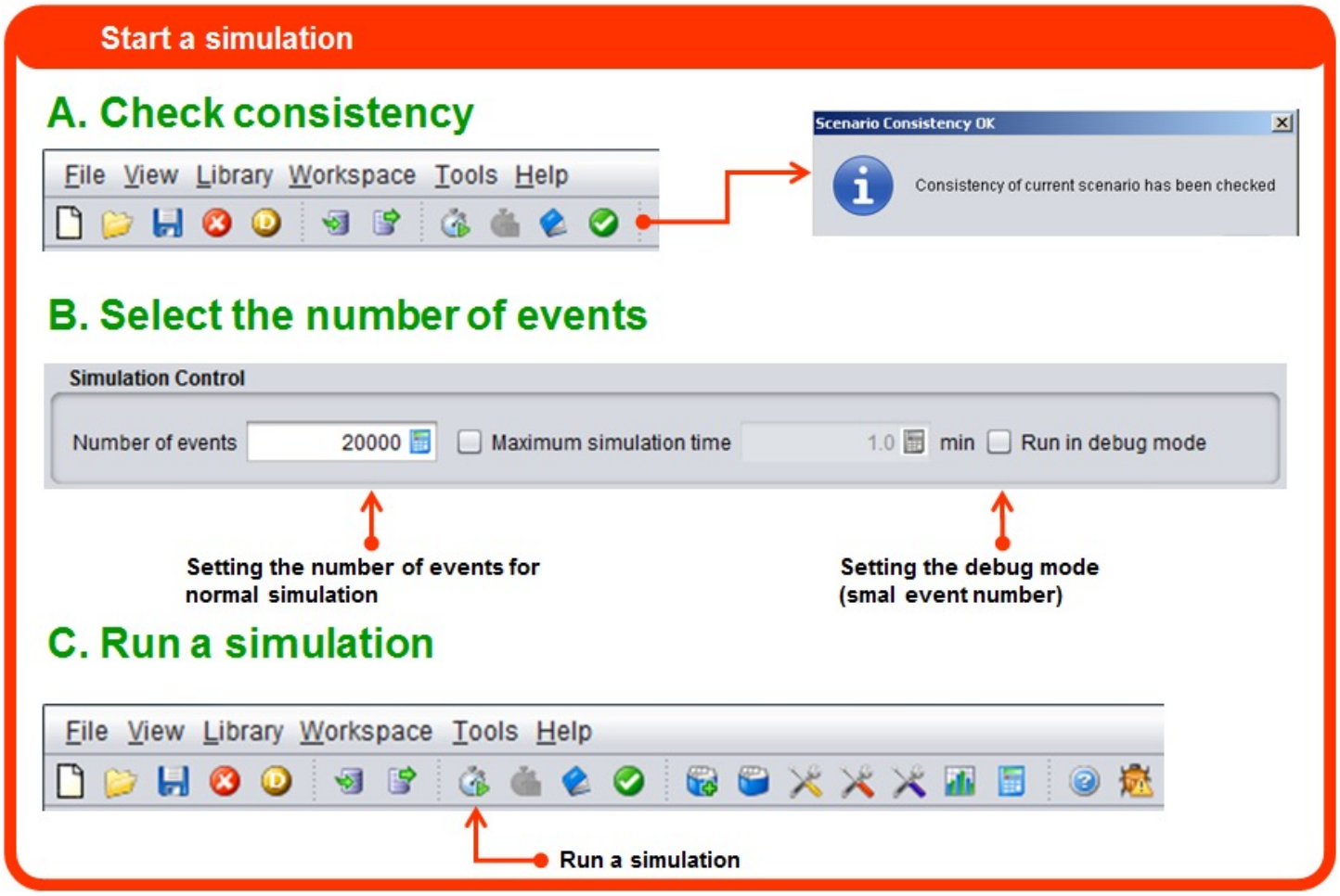
CDMA / OFDMA system parametrization



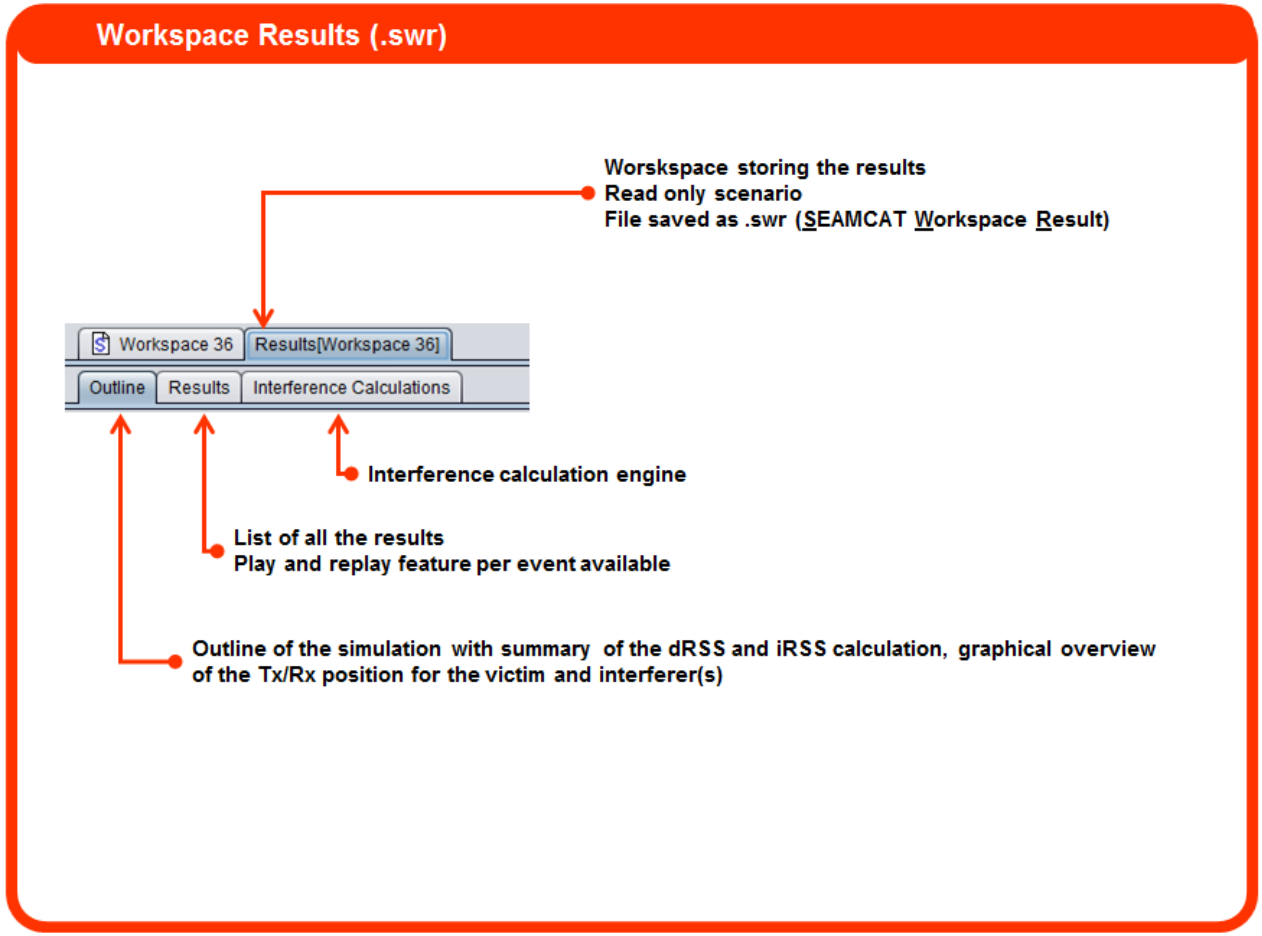
Scenario parametrisation



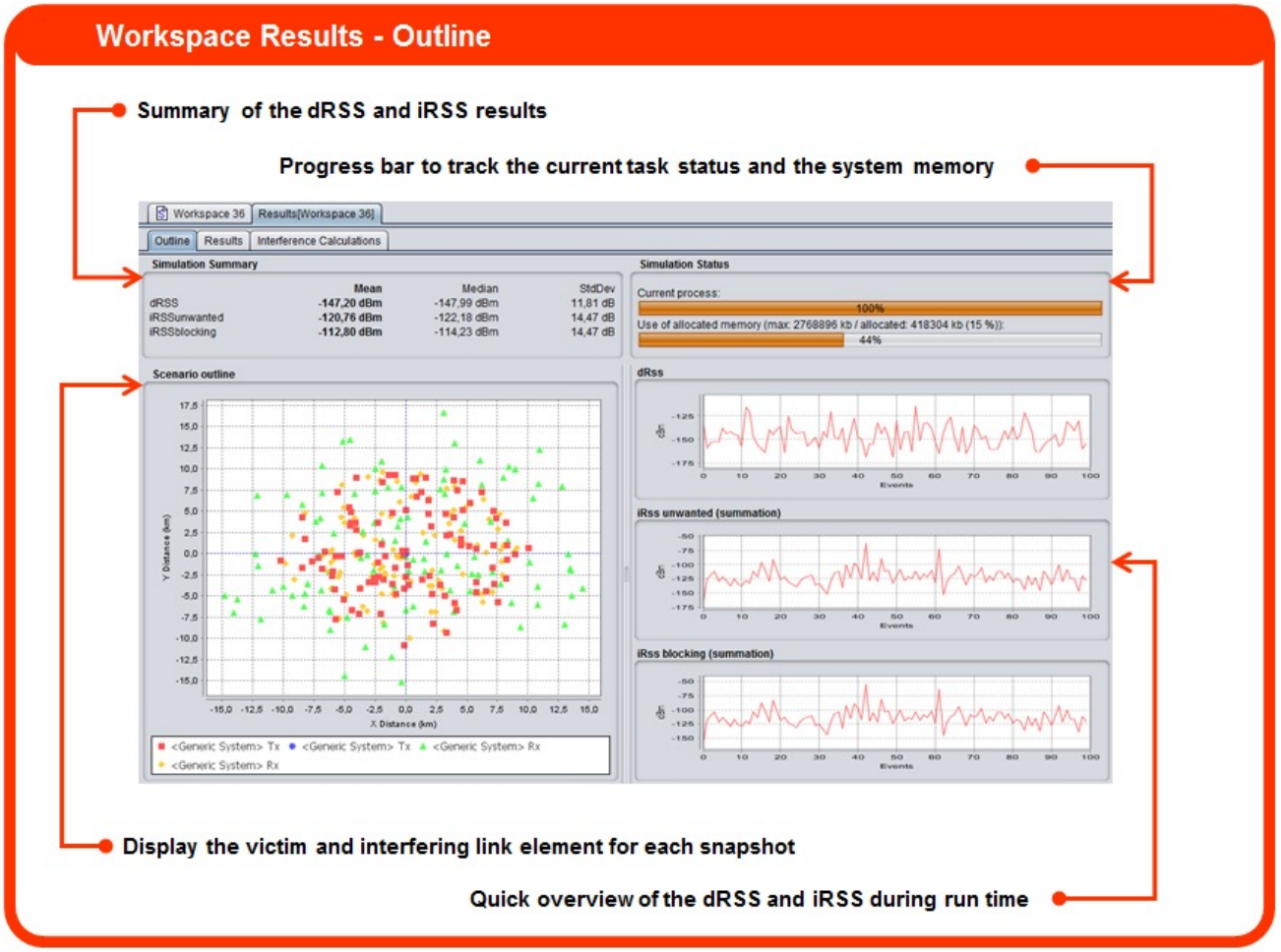
Start a simulation



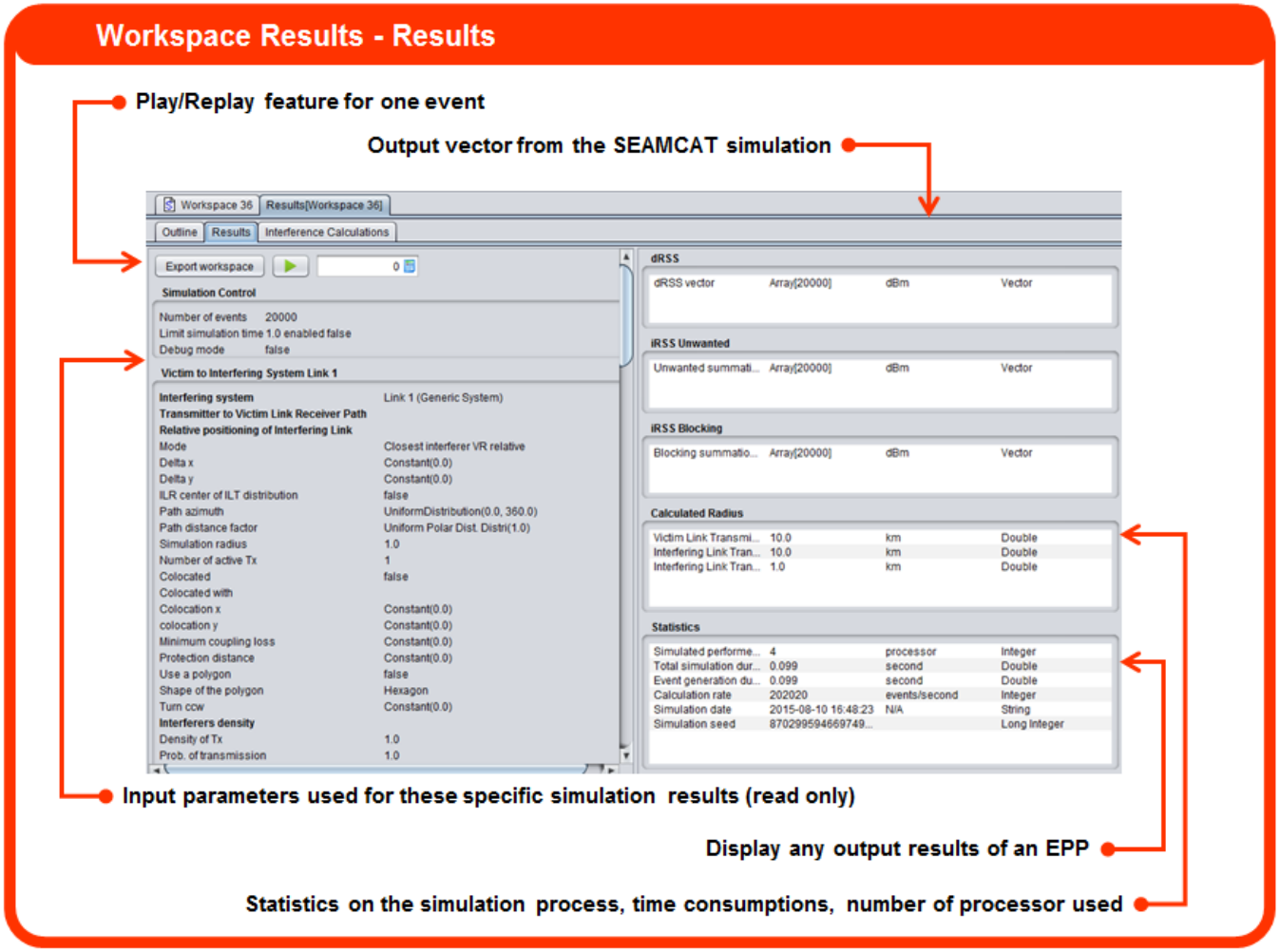
Workspace results



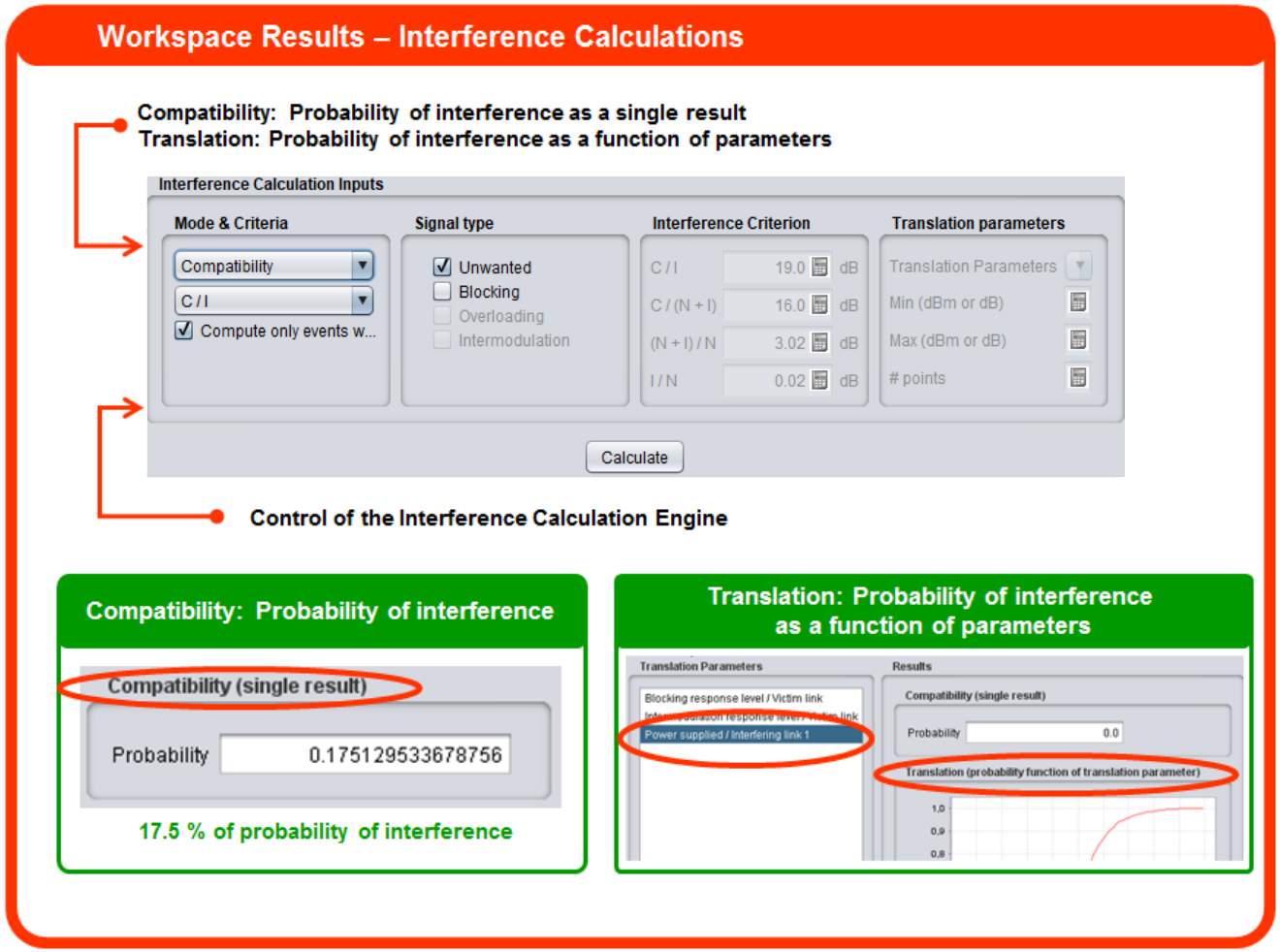
Workspace results - Outline



Workspace results - Results



Workspace results – Interference calculations



Hand's on SEAMCAT

Example 1

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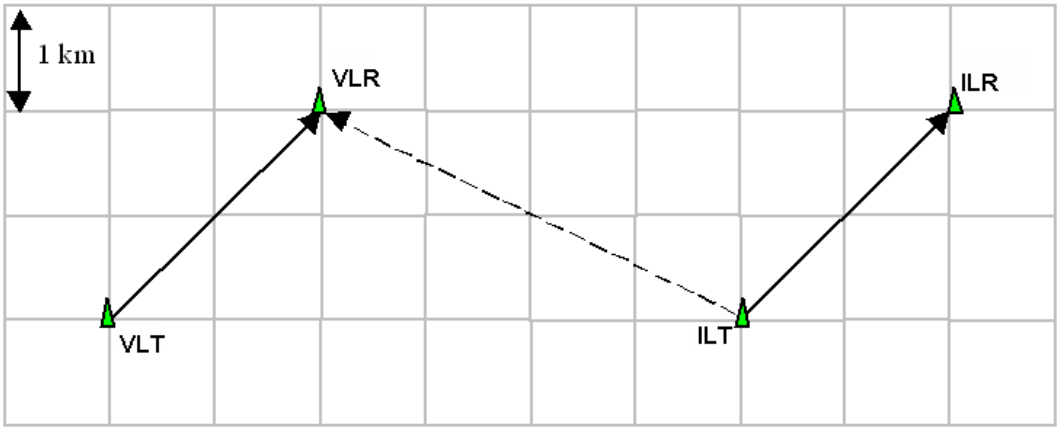
Modelling interference between fixed links



System parameters

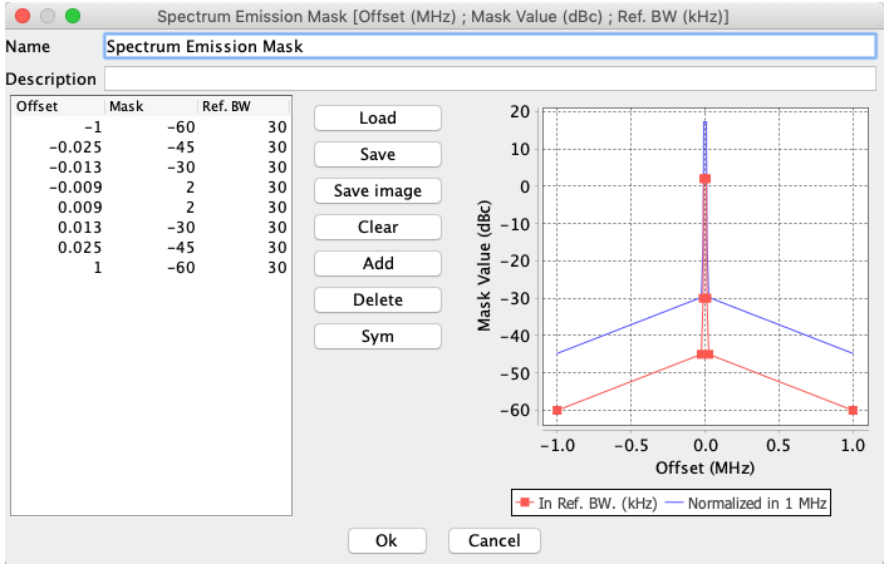
Transmitter

Parameter	Value
Frequency	1 GHz
e.i.r.p.	30 dBm
antenna peak gain	9 dBi
Antenna	omnidirectional
Antenna height above ground	1.5 m
Spectral Mask	See Figure below

Receiver

Parameter	Value
Frequency	1 GHz
Receiver bandwidth	25 kHz
antenna peak gain	9 dBi
Antenna	omnidirectional
Antenna height above ground	1.5 m
Noise Floor	-114 dBm
Sensitivity	-103 dBm
Interference criteria	C/I = 19 dB

Spectrum Emission Mask



Example 2

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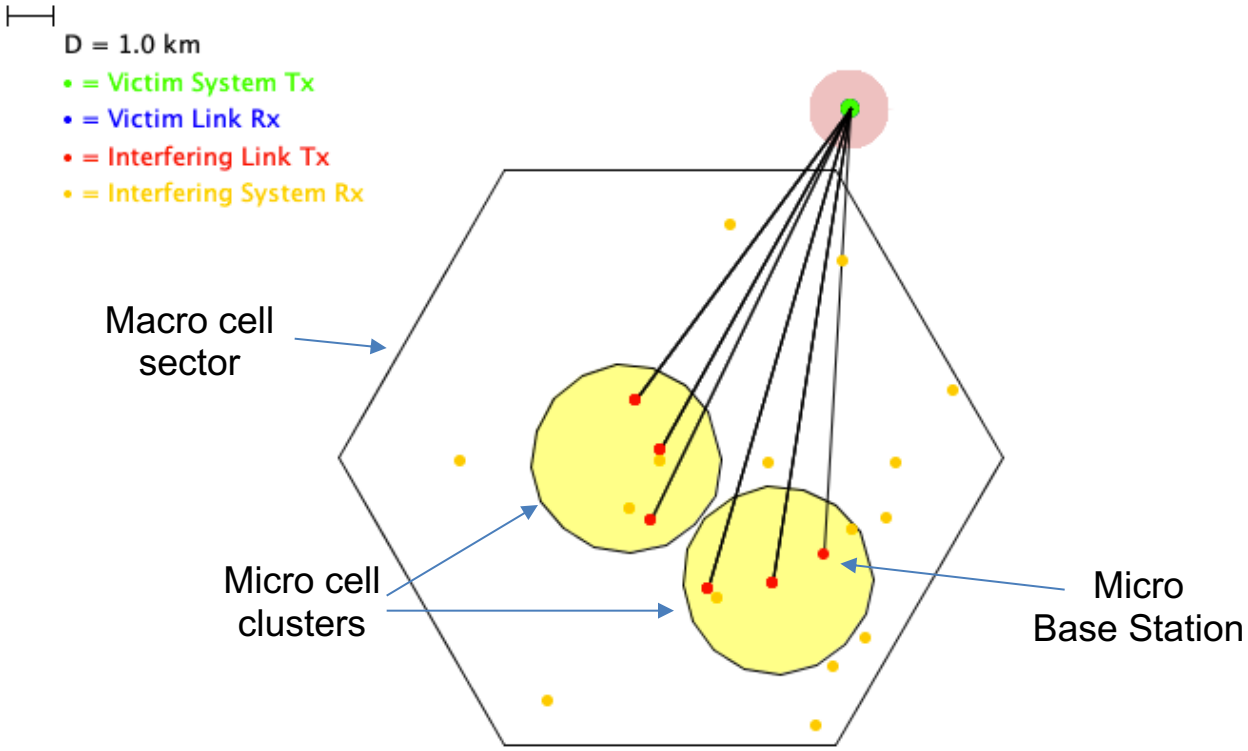
Modelling interference between IMT-2020 microcell and Earth Exploration Satellite Service (EESS)



IMT-2020 parameters

Micro Base station (Downlink)

Parameter	Value
Frequency	26 GHz
Channel bandwidth	200 MHz
Antenna array	8x8 elements
Element gain	5 dBi
Main beam antenna gain	23 dBi
Total output power (after ohmic loss)	25 dBm
e.i.r.p.	48 dBm
Antenna height above ground	6 m
Antenna panel mechanical down tilt	10 degrees
Antenna panel boresight azimuth	Uniform distribution 0° - 360°
Antenna electrical steering (elevation)	Directed towards the UE
Antenna pattern	Recommendation ITU-R M.2101
Relative antenna gain from peak towards horizon	-0.2 dB -
e.i.r.p. density towards horizon	17.8 dBW/200 MHz (-5.2 dBW/MHz) -

Mobile equipment

Parameter	Value
Frequency	26 GHz
Channel bandwidth	200 MHz
Antenna array	4x4 elements
Element gain	5 dBi
Main beam antenna gain	17 dBi
Antenna height above ground	1.5 m
Antenna panel boresight azimuth	Uniform distribution between 0° and 180° (one beam)
Antenna panel tilt	Uniform distribution 0° to -90°
Antenna electrical steering	Directed towards BS
Antenna pattern	Recommendation ITU-R M.2101
Antenna relative gain towards horizon	0 dB
Body loss	4 dB

EESS (s-E) data relay earth station parameters

Earth Exploration Satellite Service

Parameter	Value	Reference
Frequency	26 GHz	
Antenna diameter	6.8 m	
Antenna centre height above ground	6 m	
Antenna Gain	61.8 dBi	
Antenna pattern	RR Appendix 8, Annex III	
Earth station location	51.57775 N, -1.30478 E	
Satellite GSO location	9^{o} East	
I_0/N_0 (0.1% of time)	-6 dB	Recommendation ITU-R SA.1155-2
System noise temperature	300 K	Recommendation ITU-R SA.1414-2
Receiver system noise	-143.8 dBW/MHz	
Interference criteria (0.1% of time)	-149.8 dBW/MHz	

More information...

Handbook:

https://www.ecodocdb.dk/download/5b8f9726-04a6/ECCRep252.pdf

WiKi:

http://confluence.seamcat.org/display/SH/SEAMCAT+Handbook

Thank you for your attention!

Questions?

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