INTRODUCTION TO WRAP AND EMC

ALTAIR

Stefan Fors, Lead Software Developer

ALTAIR SOLUTION

ALTAIR

Altair Solution for Electronic System Design

Altair enables the team of specialized engineers required to deliver today's smart, connected devices to collaborate on all aspects of physical, logical, thermal, electrical, and mechanical design

Electronics

More efficient PCB design review, verification, analysis, & manufacture.

Electrical

Simulate and optimize wireless connectivity, EMC and radar electronics.

Altair Feko

Mechanical

Automate structural stress, vibration, & drop test performance.

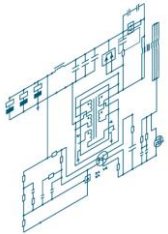
Thermal

Thermal analysis of electronics without advanced CFD knowledge.

Mechatronics

Accelerate the design of motors, power electronics, sensors & actuators with simulation.

Circuit



Circuit simulation with an enhanced proprietary version of SPICE.

Code

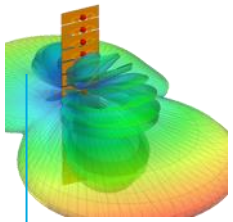
Visual firmware development supporting many common microcontroller families.

Efficient HPC Scheduling & Cloud Accessibility

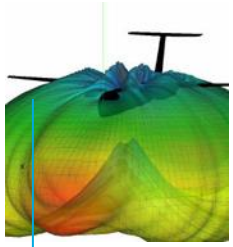
ALTAIR

Wireless Connectivity, EMC and Radar

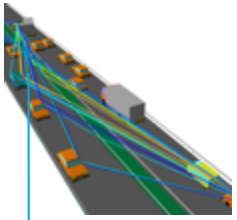
Main Electrical Applications with Altair Feko



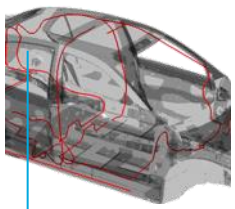
Antenna Design



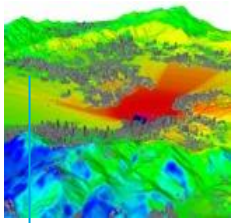
Antenna Placement & Coupling



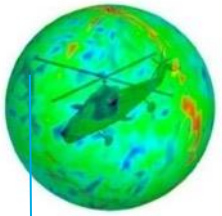
Virtual Drive & Flight Tests for Platform Connectivity & ADAS



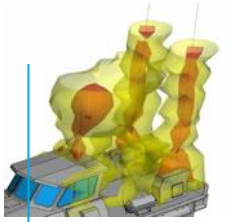
Electromagnetic Compatibility



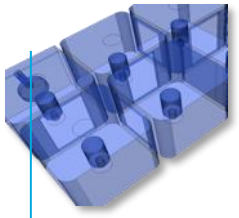
Radio & Radar Coverage & Planning



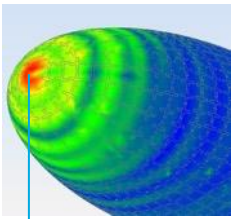
Scattering & RCS



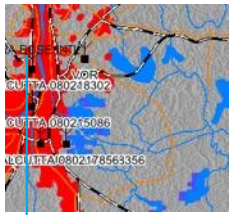
RADHAZ & Bio-Electromagnetics



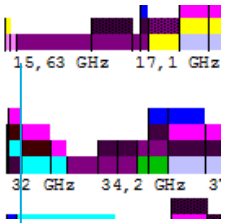
RF Devices



Radomes, including FSS



Radio Frequency Interference



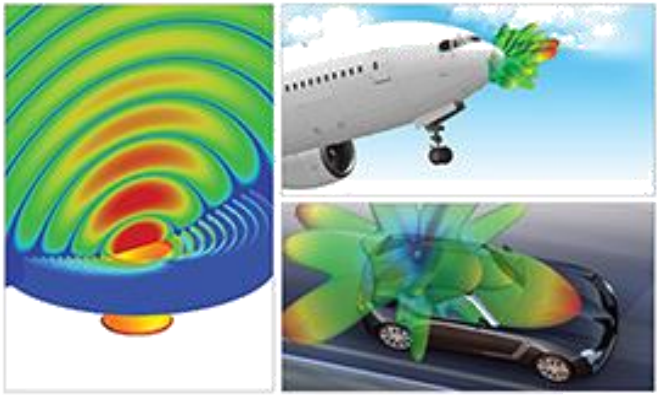
Spectrum Management

ALTAIR

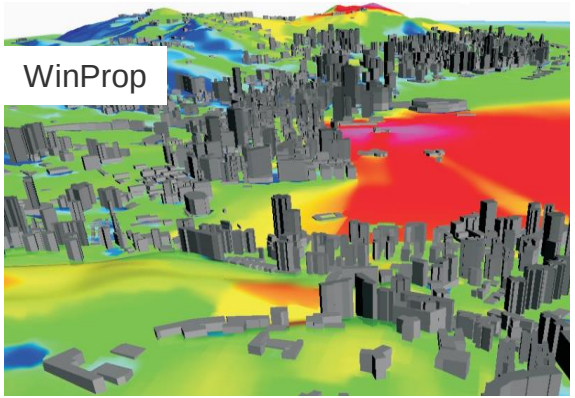
Altair Electromagnetic Simulation Solutions

Altair Feko

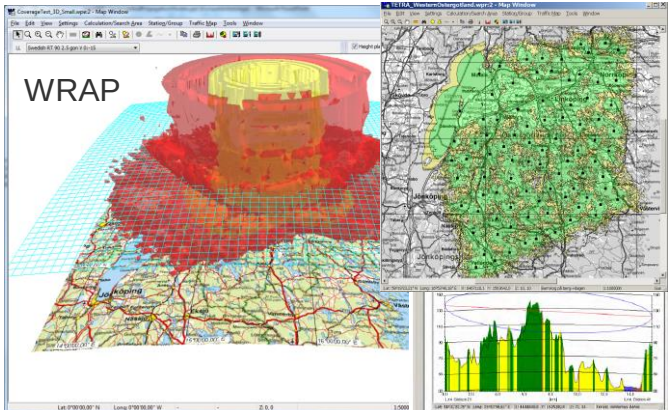
Antenna Design and Antenna Placement



Wave Propagation & Radio Planning



Radar Coverage & Spectrum Management

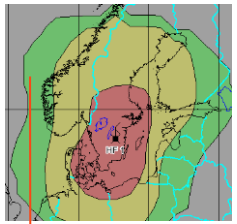


Advanced Simulation Tools for Wireless Networks

ALTAIR

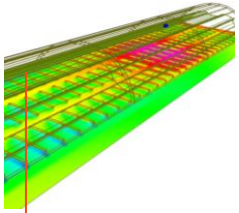
Main Radio Coverage & Planning Applications

Wide Range of Scenarios

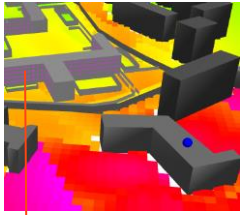


Radio Planning over Large Areas including HF

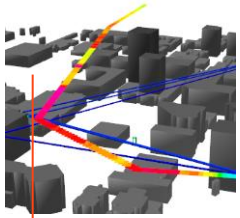
Radio Planning in Built-up Scenarios



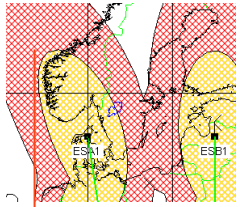
In-Vehicle Radio Coverage



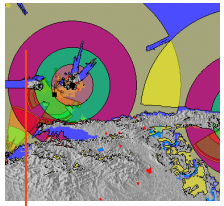
Jamming of Cellular & Satellite Signals



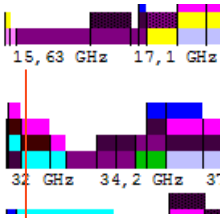
Virtual Drive & Flight Tests



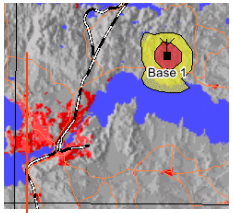
Satellite Radio Coverage



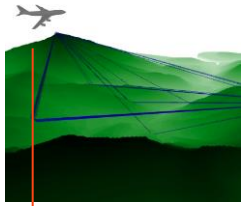
Radar Coverage



Spectrum Management



Cost & Coverage Optimization



Multipath Impairments for Navigation Systems

ALTAIR

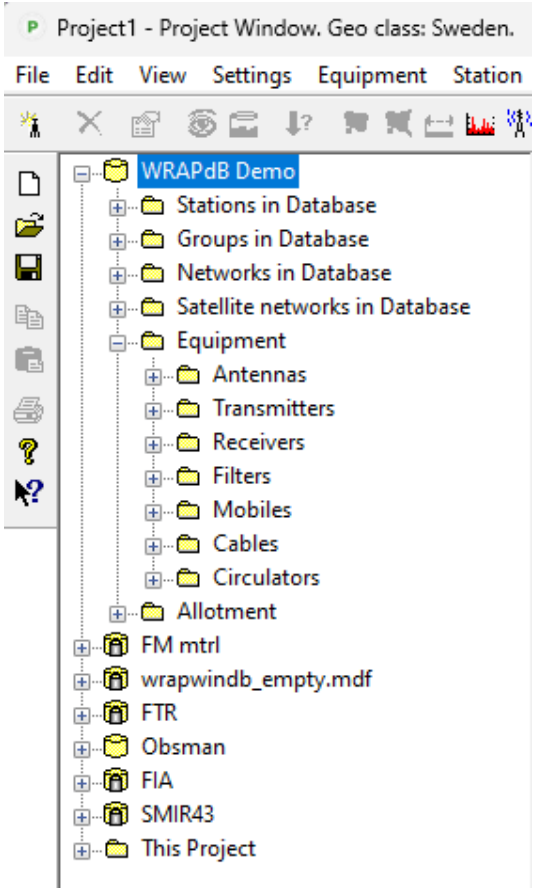
WRAP

ALTAIR

WRAP – a Frequency Management System

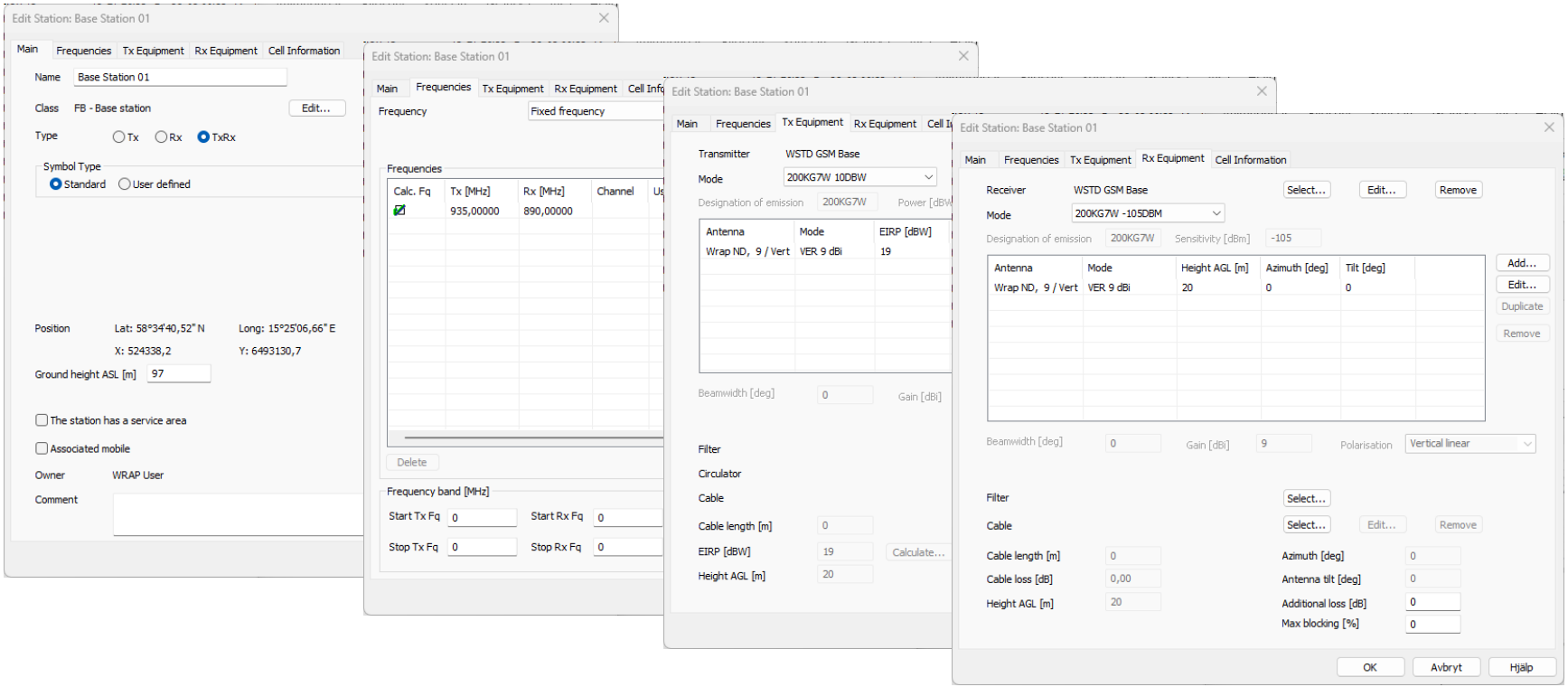
- Create and store
  - stations
  - transmitters
  - receivers
  - antennas
  - filters

- Connect reference database
  - National Master registry
  - BRIFIC



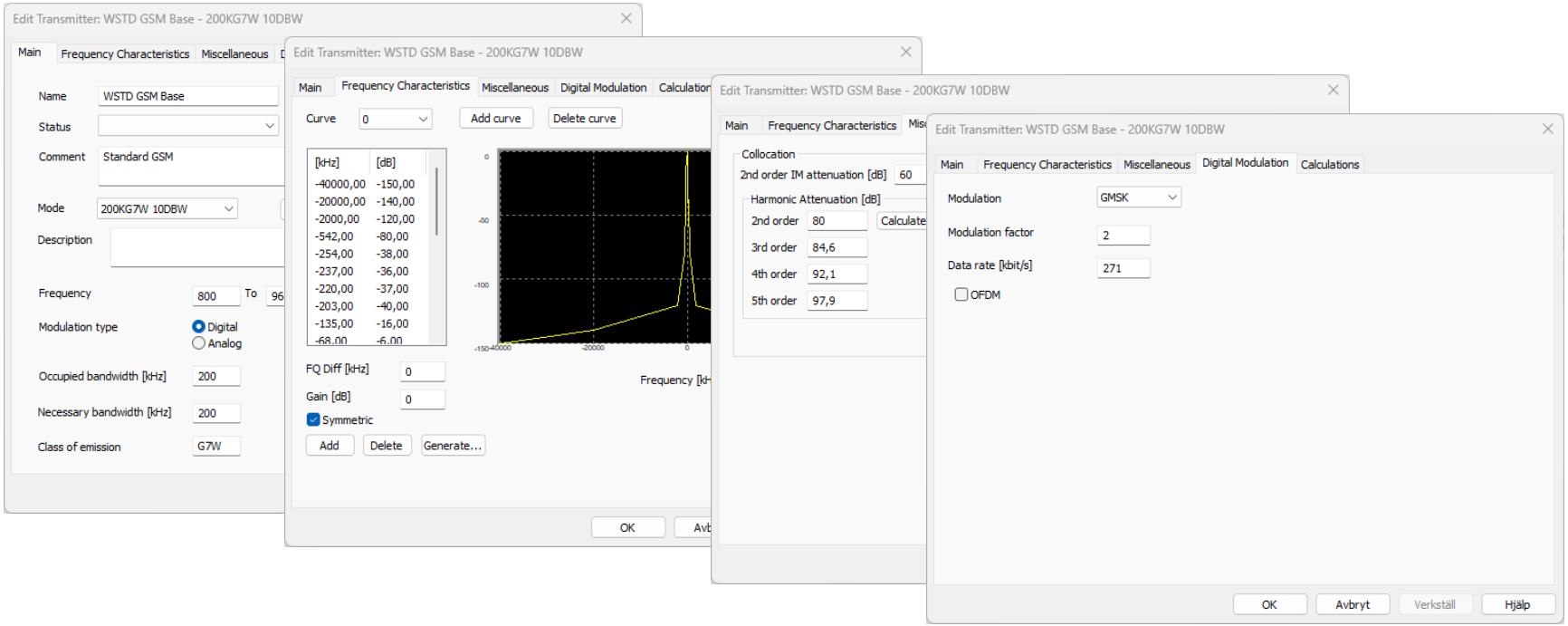
ALTAIR

Radio Stations

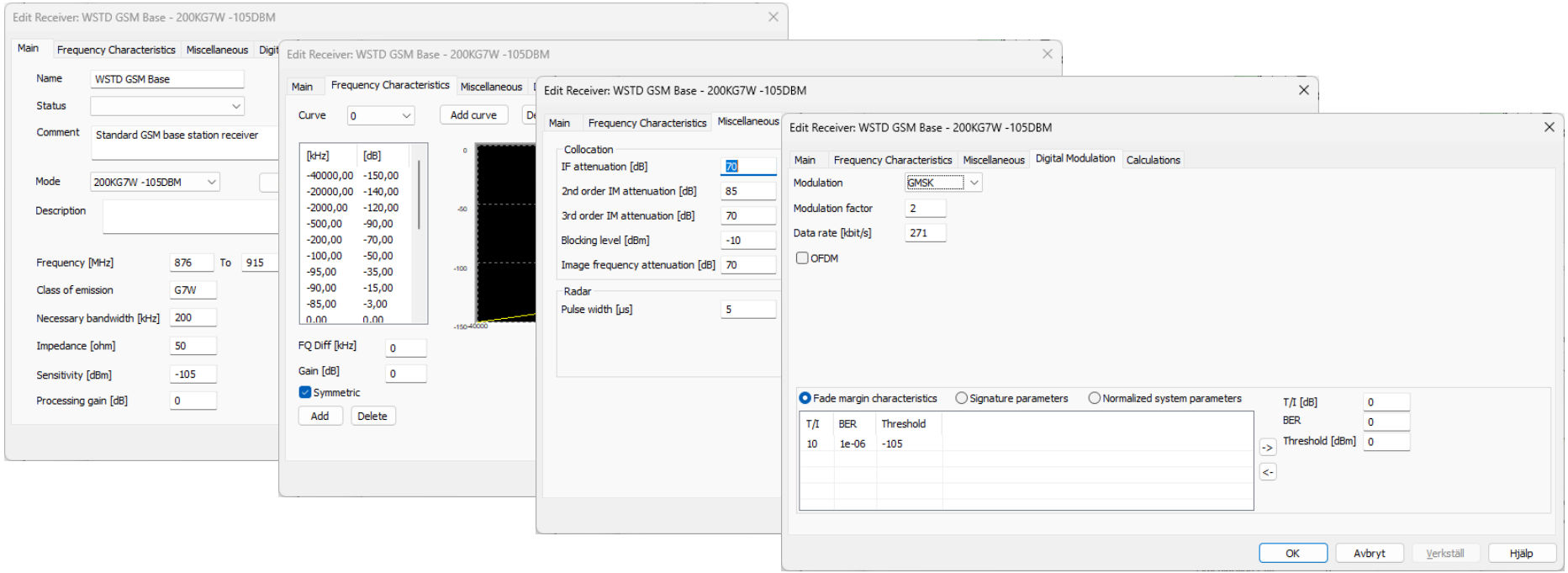


ALTAIR

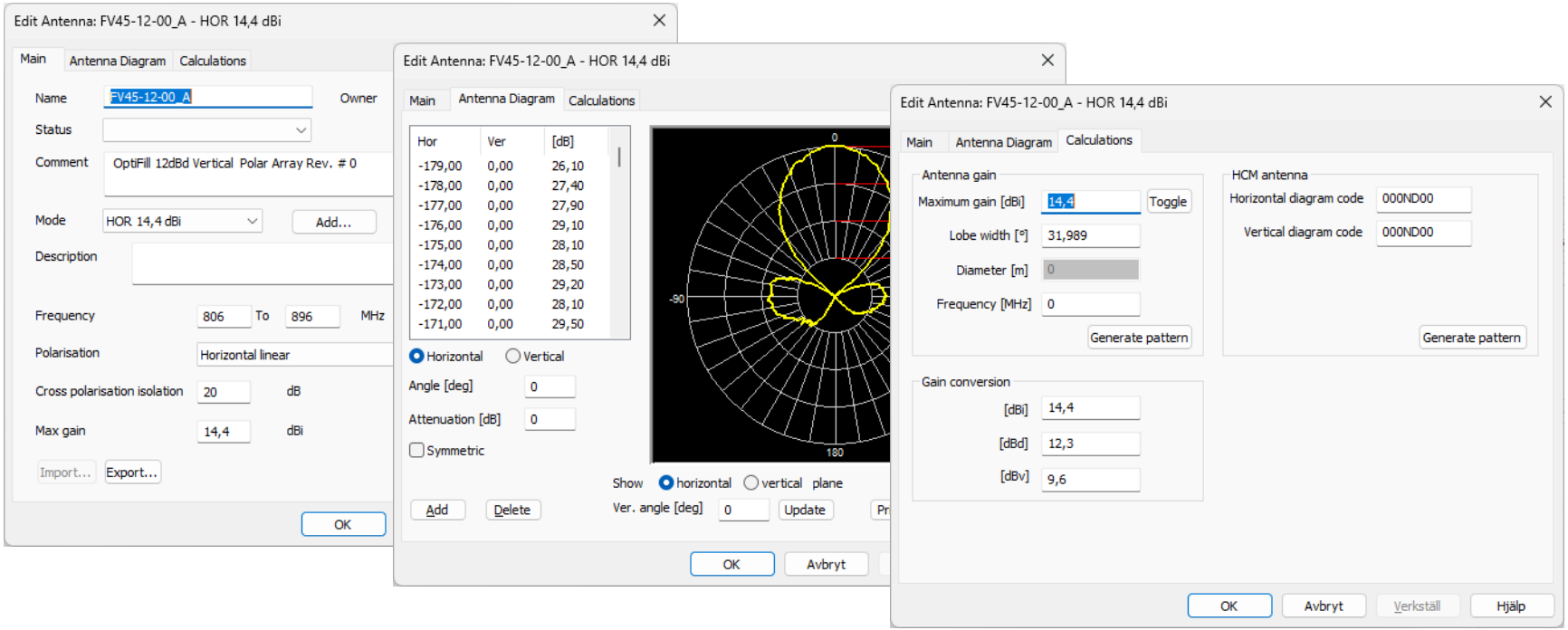
Equipment: Transmitter



Equipment: Receiver

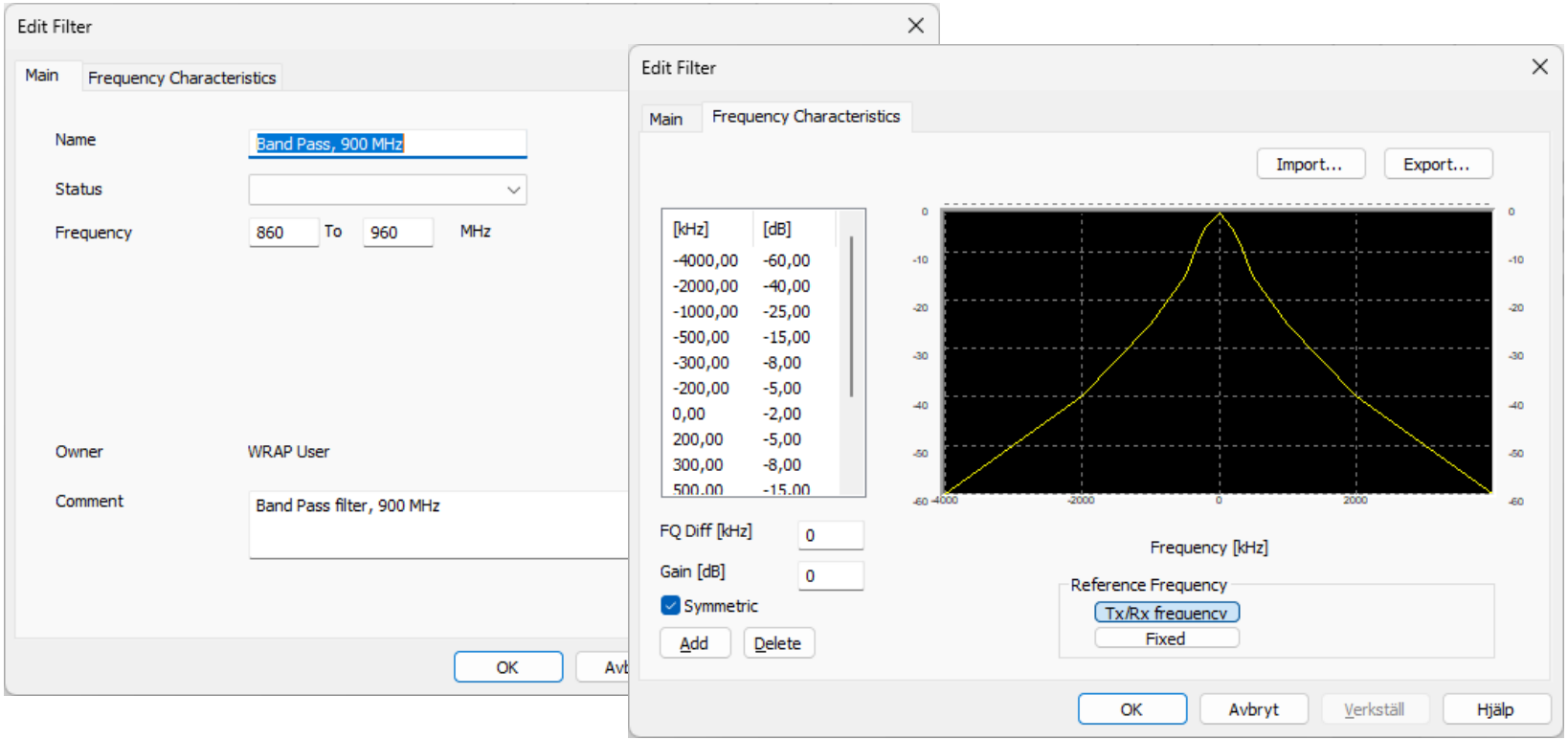


Equipment: Antenna



ALTAIR

Equipment: Filter



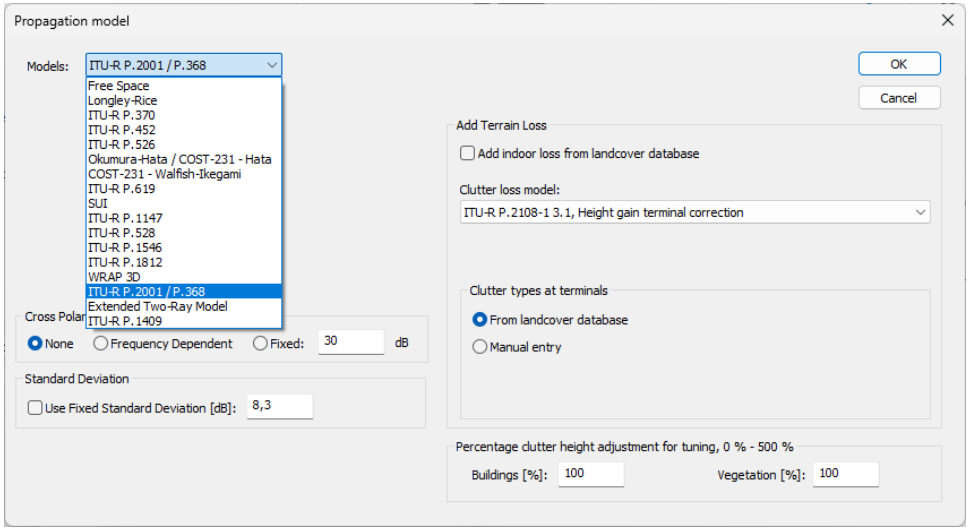
Main functions

- Coverage
- Radar Coverage
- Interference
- Collocation Interference
- Radio Link Performance
- Spectrum View
- Frequency Assignment
- Traffic Capacity
- Earth Station Coordination
- Satellite Network Coordination
- Dynamic Satellite calculations

- Coverage Comparison
- Broadcast
- Radio Network Management
- Point-to-Multipoint
- HF Planning
- Cost and Coverage Optimiser
- Aeronautical Interference
- Obstruction Manager
- Spectrum Allocation Manager
- Licensing and Coordination Manager
- Application Programming Interfaces
- Calculators

Supported Propagation Models

- Many Propagation Models are supported
  - Detailed terrain
  - Statistical
  - Troposcatter
- Attenuation due to atmospheric gases can be included
- Clutter loss (incl. ITU-R P.2108-0) and building penetration loss can be added
- HF Planning with ITS HF software:
  - VOACAP/ICEPAC/REC533 (point-to-point)
  - VOAAREA/ICEAREA/RECAREA (point-to-area)
- Possibility to connect user-defined propagation models through a CDll interface



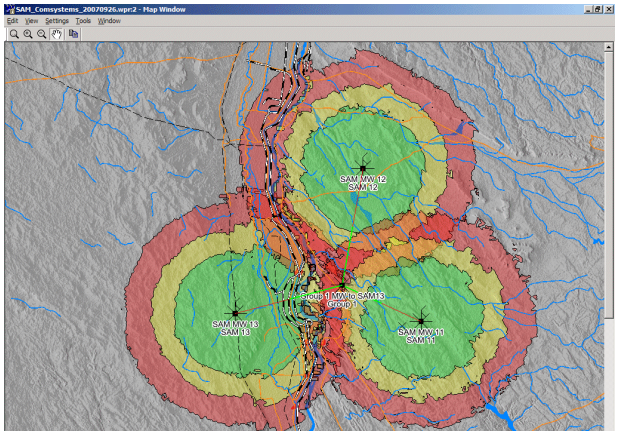
RADAR PLANNING & RADIO COVERAGE

ALTAIR

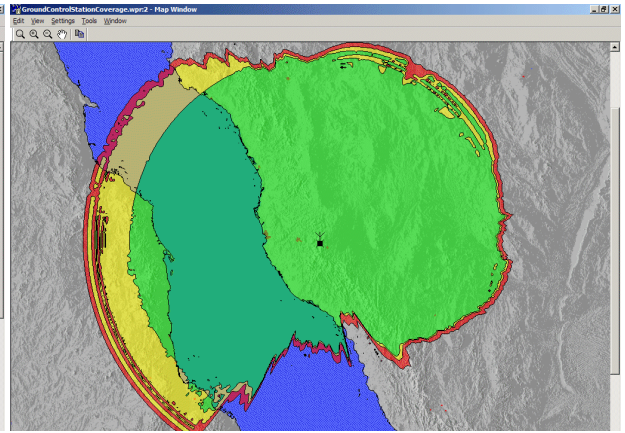
Radar & Radio Coverage

Propagation Models, Air Interfaces and Some Relevant Scenarios

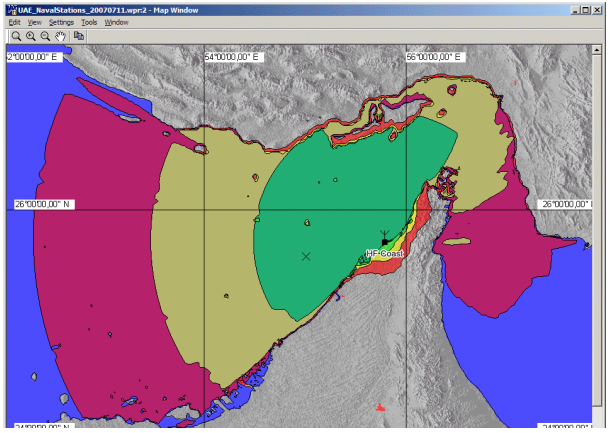
- Comprehensive set of propagation models (empirical, semi-empirical and deterministic ones) (including a wide collection of ITU-based models) for nation-wide, rural, urban and indoor scenarios
- Air interfaces available for all major military and civilian radio systems, from HF through 5G to radar and microwave links



Ground-to-ground coverage of combat net radios



Ground control station coverage to aircraft

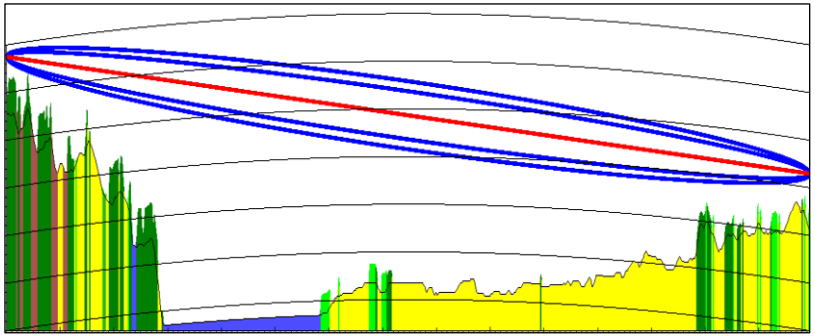


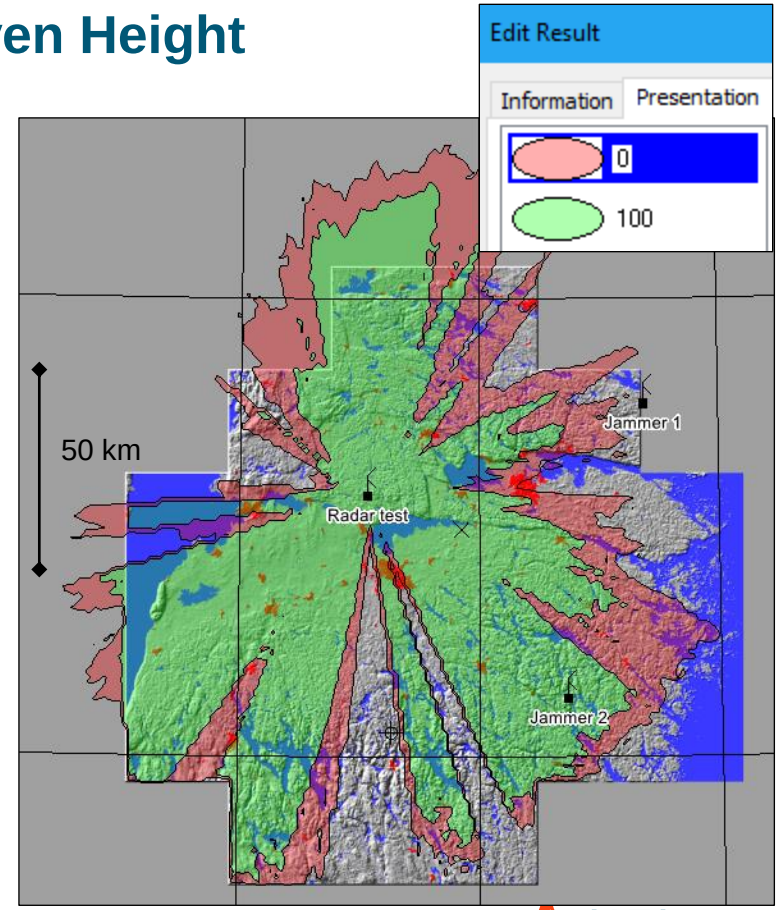
Coast station ground wave coverage

ALTAIR

Radar Coverage: Target Visibility at Given Height

- *Radio* Coverage analysis calculates received signal.
- For *Radar* Coverage you're interested in detection.
- Example: Radar station in hilly landscape.
  Three types of calculations are possible.
- Type 1: target visibility, regardless of RCS.

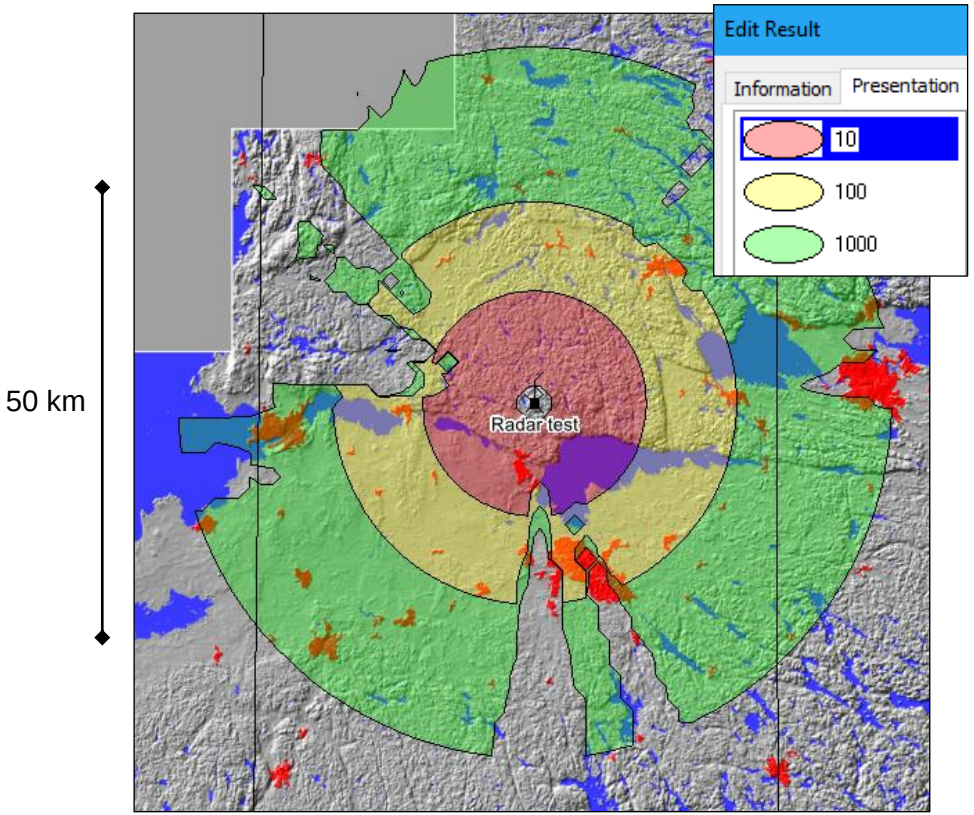




ALTAIR

Radar Coverage: Target Detection at Given Height

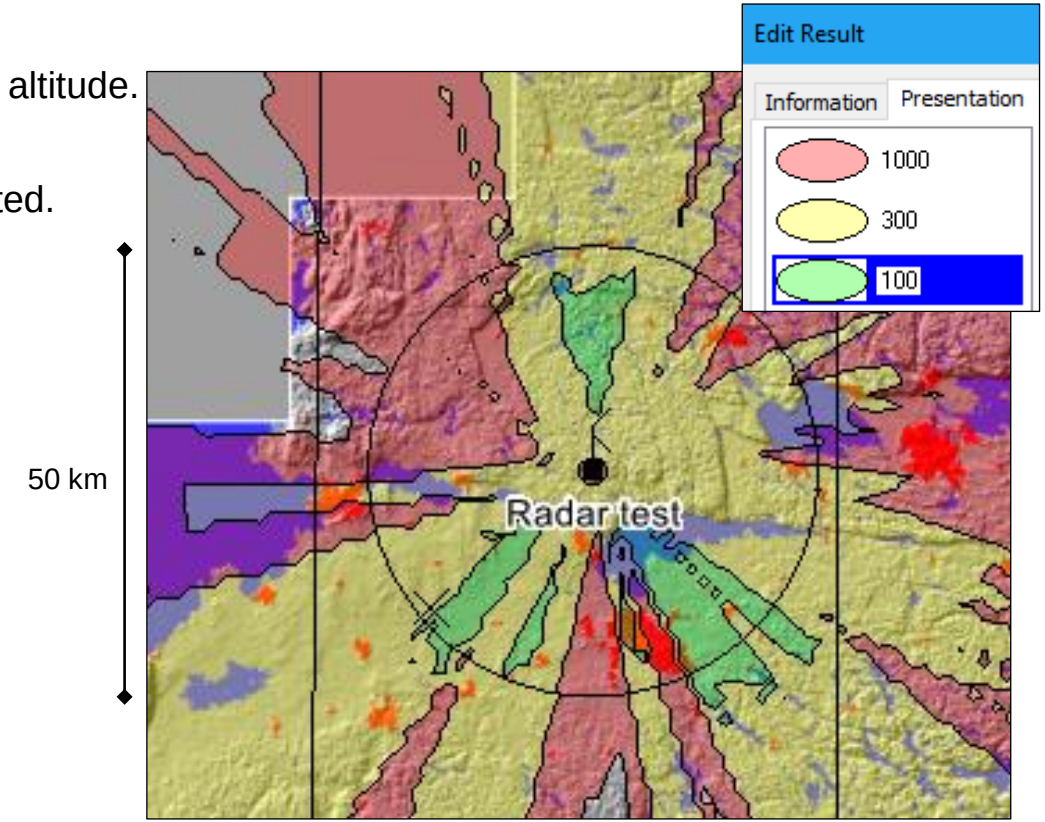
- Type 2: Target detection depending on RCS.
- Plot shows for a given flight altitude (300 m) the minimum RCS that can be detected.



ALTAIR

Radar Coverage: Target Detection of Given RCS

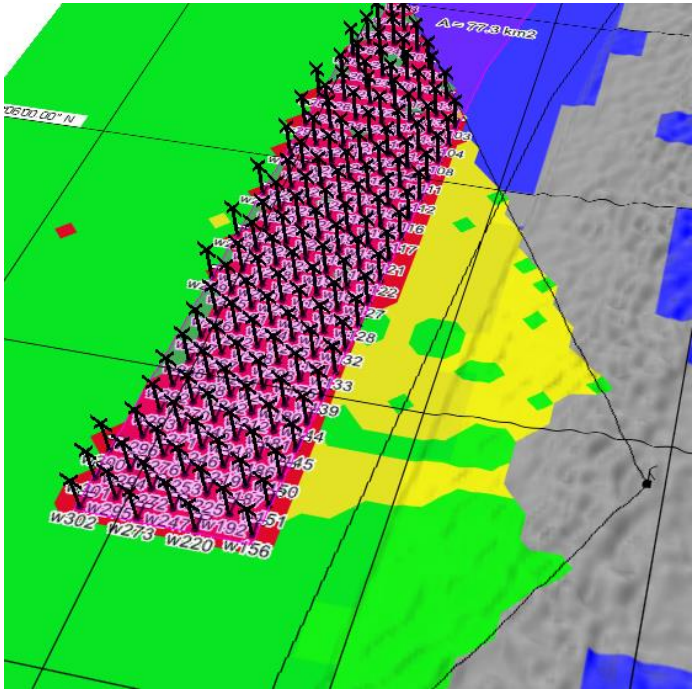
- Type 3: Target detection depending on altitude.
- Plot shows for a given target (100 m2) the minimum flight altitude to be detected.

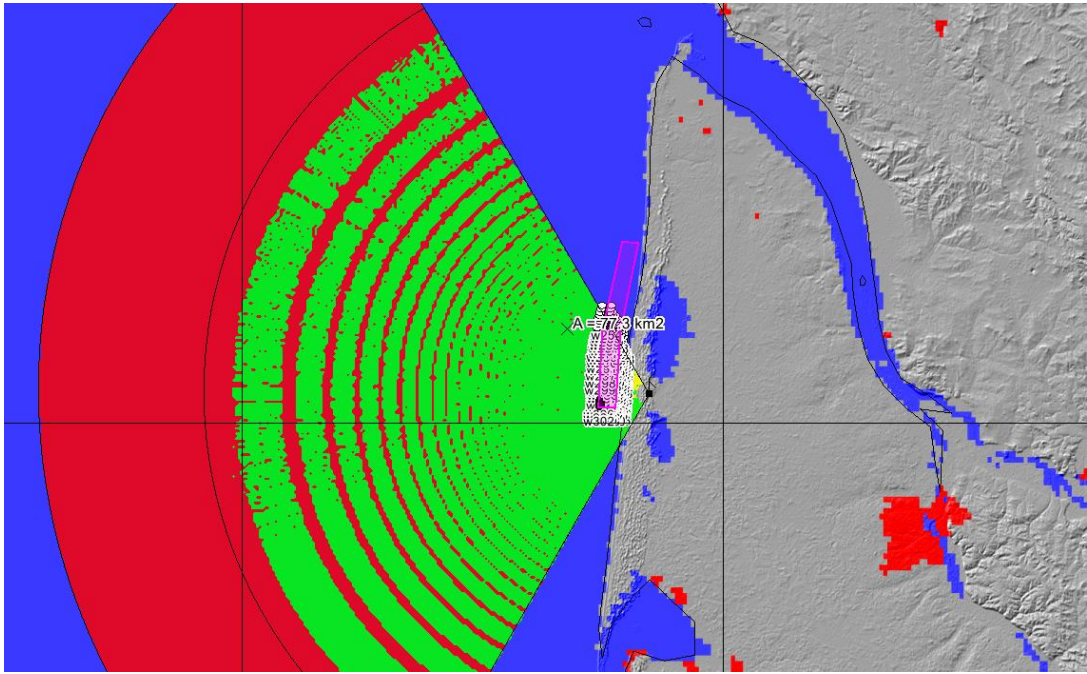


ALTAIR

Impact of Windmills on Radar Coverage

- Windmills can be included.
- The wind farm has a visible effect on detection and produces ghost targets.

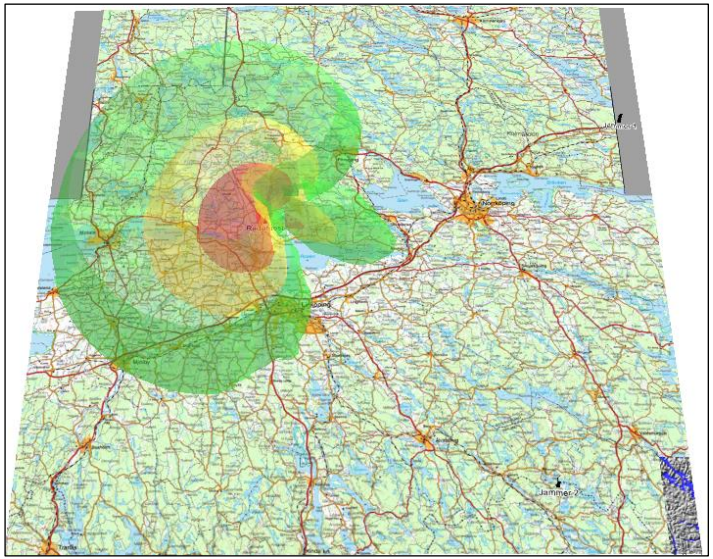


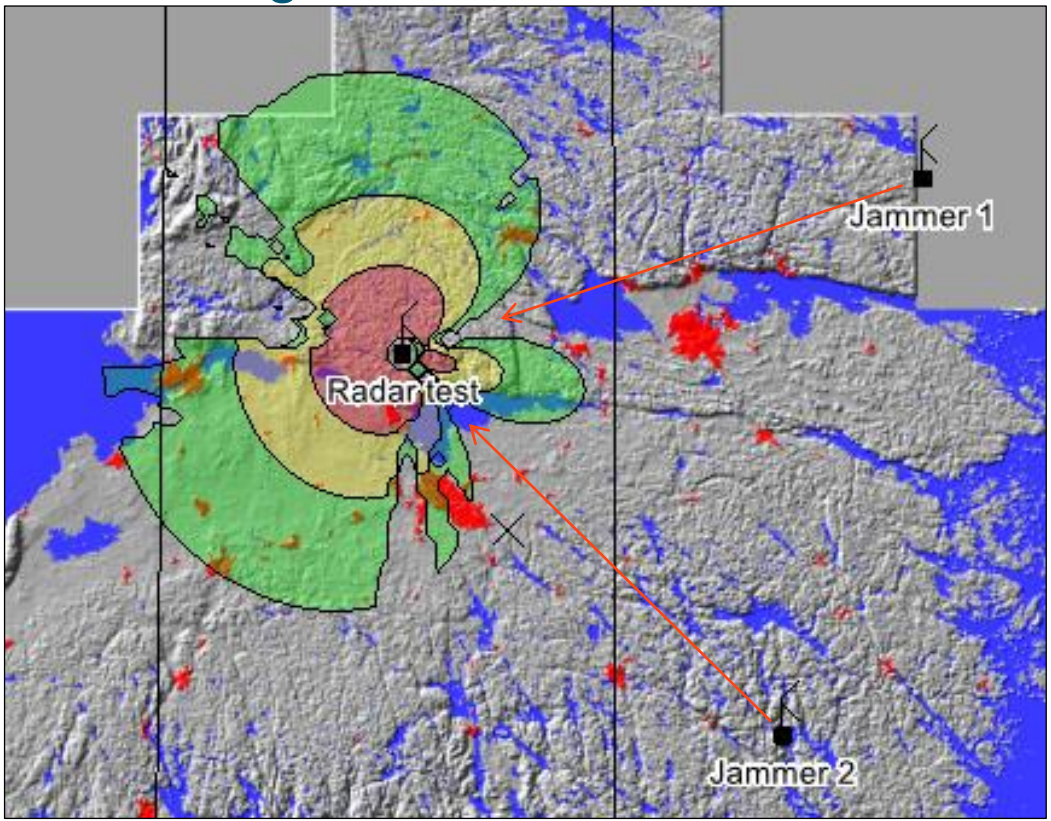


ALTAIR

Impact of Jammers on Radar Coverage

- Jammers have a disproportionate impact:
  Jammer power ~ $1/R^2$
  Radar detection ~ $1/R^4$

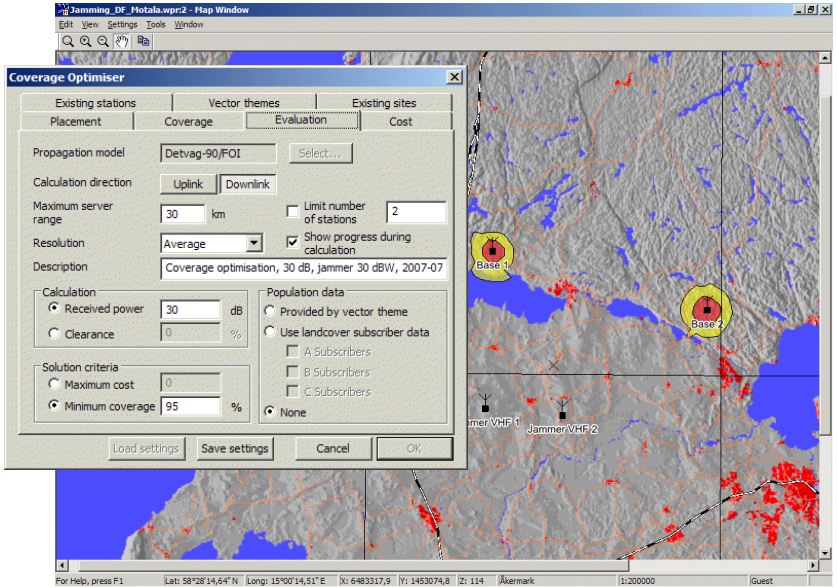




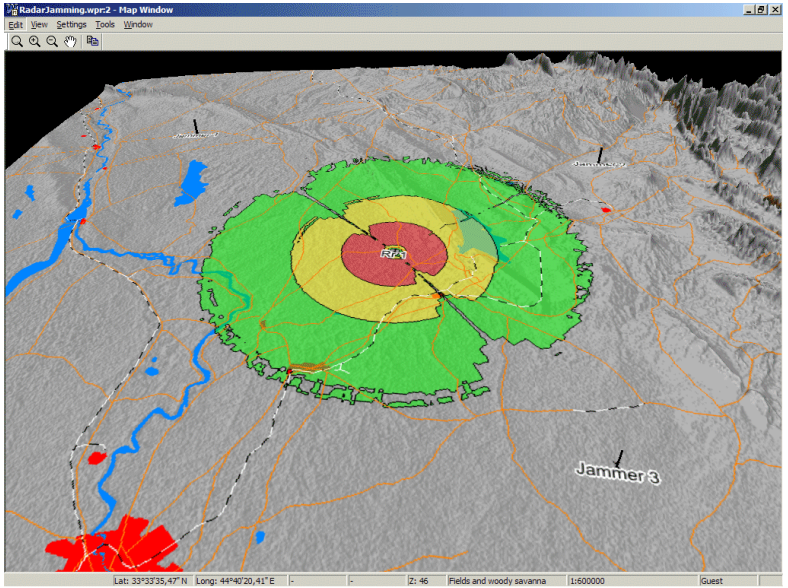
ALTAIR

Radar & Radio Coverage

Coverage Optimizer and Jamming



Use of Coverage Optimiser for Radar Planning



Air Surveillance Radar Coverage with Jammers

ALTAIR

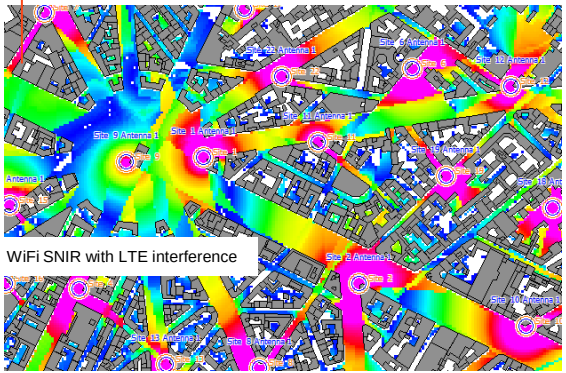
RADIO FREQUENCY INTERFERENCE AND SPECTRUM MANAGEMENT

ALTAIR

Predicting Radio Frequency Interference

Scenarios

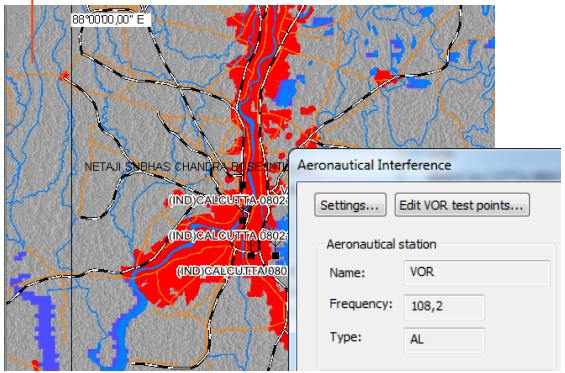
Wireless Networks Co-Existence



WiFi SNIR with LTE interference

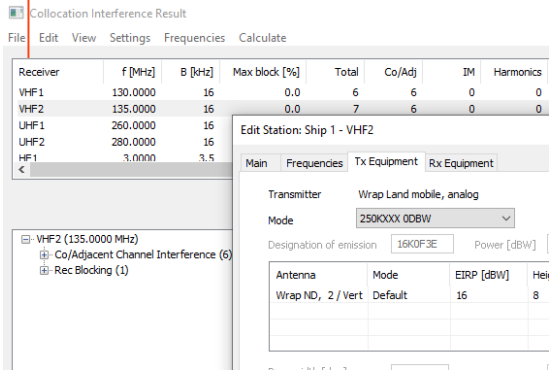
Analysis of interferences between radio technologies in multiple scenarios (including indoor, urban and nation-wide)

Aeronautical Interference



Calculates interferences between sound broadcasting stations (87 – 108 MHz) and the ILS localizer, VOR and the VHF communications equipment in the 108 – 137 MHz frequency band

Collocation Interference

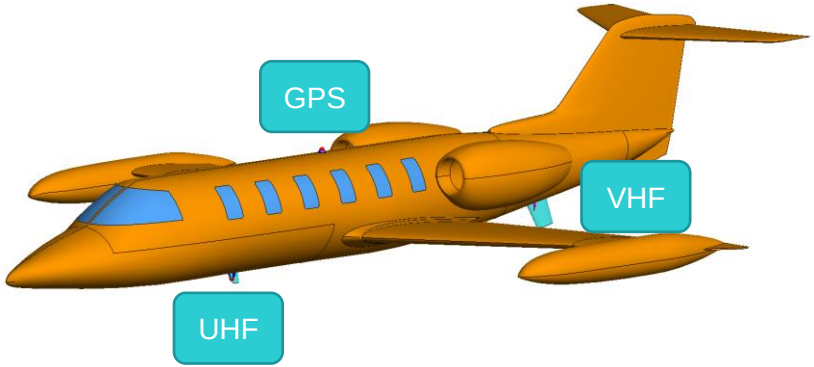


Analysis and mitigation of interferences in site with multiple transmitters and receivers

ALTAIR

Collocation Interference Example

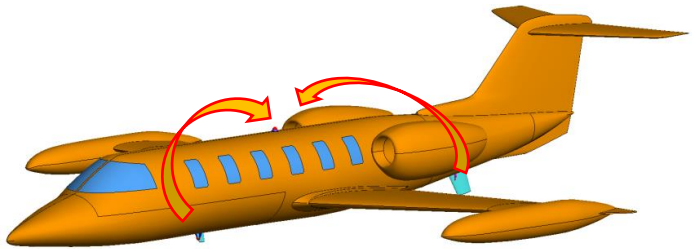
- Antennas not far apart: different services on the same site/mast, multiple systems on an aircraft, ship or vehicle.
- Many more effects need to be included:
  - Intermodulation
  - IF breakthrough
  - Image frequency
  - Harmonics
  - Transmitter spectrum
  - Receiver selectivity
  - Receiver blocking



- WRAP calculates all dangerous frequencies.
- WRAP reports interference levels and their reasons.
- Spread-spectrum (frequency hopping and direct sequence spreading) is supported.

Collocation Interference Result Reporting

- Very detailed report makes obvious what the reasons for the problems are.
- To solve the problems add filters on the equipment in WRAP or move stations or adjust frequencies.



Collocation Interference Result

File Edit View Settings Frequencies Calculate

Receiver	f [MHz]	B [kHz]	Max block [%]	Total	Co/Adj
Blade_VHF	131.2850	250	0.0	1	1
Blade_UHF	315.0840	500	0.0	1	1
GPS_L1_Receiver	1575.4200	500	0.0	4	2

- GPS_L1_Receiver (1575.4200 MHz)
  - Co/Adjacent Channel Interference (2)
  - Harmonic Interference (2)

Transmitter	f [MHz]	B [kHz]	EIRP [dBW]	Margin [dB]
Blade_VHF	131.2850	250	15.0	-18.4
Blade_UHF	315.0840	500	15.0	-2.4

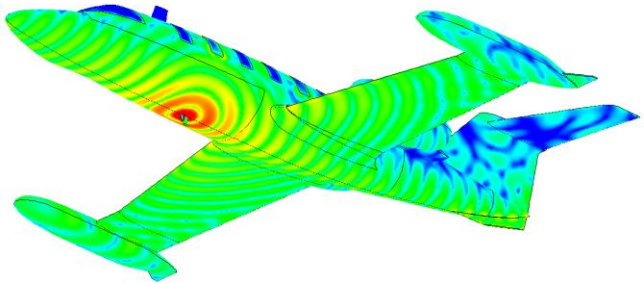
- GPS_L1_Receiver (1575.4200 MHz)
  - Co/Adjacent Channel Interference (2)
  - Harmonic Interference (2)

Transmitter	f [MHz]	B [kHz]	EIRP [dBW]	Margin [dB]
Blade_UHF	315.0840	500	15.0	-19.9
Blade_VHF	131.2850	250	15.0	-4.2

ALTAIR

Isolation between Stations

- Interfering signal level
  - $I = P_{Tx} - L_b + G_{Rx} - L_{cable} - L_{add} - L_{spectrum}$
- Isolation between stations
  - Coupling loss matrix



Main | Stations | Coupling Loss Matrix | Groups | Networks

Clear all

A\B	Frequency	Test TX1	Test TX2	Test TX3
Test TX1	100,0000 MHz	---	*32,3 **	*35,3 **
Test TX2	100,1000 MHz	*32,3 **	---	*32,3 **
Test TX3	10,7000 MHz	*16,8 **	*13,8 **	---
Test RX4	100,2000 MHz	40,0	*35,3 **	*32,3 **
Test RX5	200,0000 MHz	45,0	*38,3 **	*41,3 **
Test RX6	300,0000 MHz	50,0	*49,0 **	*45,0 **
Test RX7	78,6000 MHz	*39,2 **	*37,2 **	*33,2 **
Test RX8	200,1000 MHz	*45,5 **	*41,3 **	*38,3 **
Test RX9	700,0000 MHz	*56,3 **	*55,4 **	*49,4 **
XB	1,0000 kHz	---	---	---

Coupling loss [dB] A to B at A-frequency. *Denotes an automatically calculated system loss (Ls).

Important: default values from propagation calculation can be replaced by results from measurements, Feko or other tools.

ALTAIR

Spectrum Management via WRAP

Main Applications

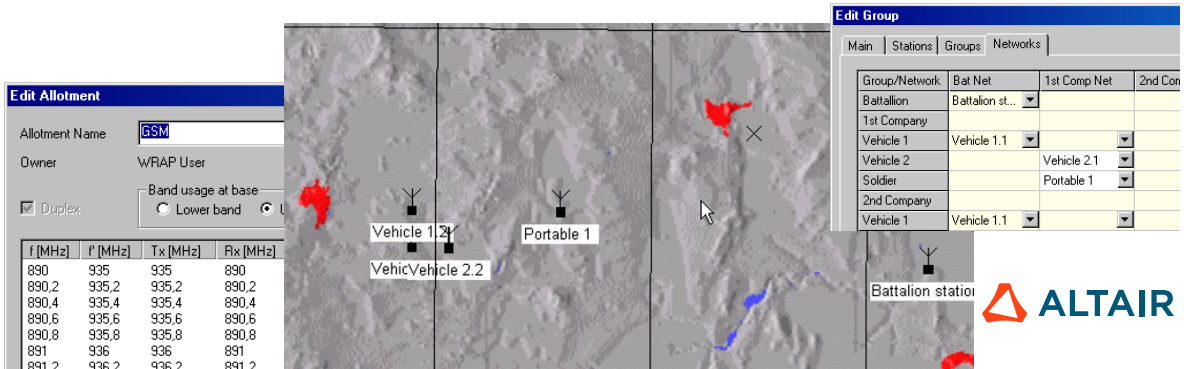
- Coordination between national/international civilian and national/international military frequency utilisation
- Central management and coordination distribution of frequency allocations, allotments and assignments
- Long-term planning of the frequency utilisation within the region/service
- Short-term planning of the frequency utilisation for missions, manoeuvres and large exercises

Levels of Implementation

- Central telecom or defence spectrum management agency
- Regional and service level (e.g. Army, Air Force, Navy)
- Local unit level
- Single-user and client-server configurations with the possibility to handle several station databases

Radio Network Design

- Planning and design of radio communication and radar systems to achieve required capabilities for coverage, performance and electromagnetic protection.



LIVE DEMONSTRATION

THANK YOU

altair.com

#ONLYFORWARD

ALTAIR