


ATDI

SPECTRUM MANAGEMENT & ELECTRONIC WARFARE

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Today's Agenda

- 
- 1** Introducing ATDI
 - 2** Automated Battlespace Spectrum Management Solution
 - 3** HTZ Warfare - key capabilities and demo videos
 - A** Annex 1 – HTZ Warfare technical capabilities
 - A** Annex 2 – Key references

About Us

BATTLESPACE SPECTRUM MANAGEMENT AND ELECTRONIC WARFARE NETWORK PLANNING AND MODELLING SOFTWARE SOLUTIONS

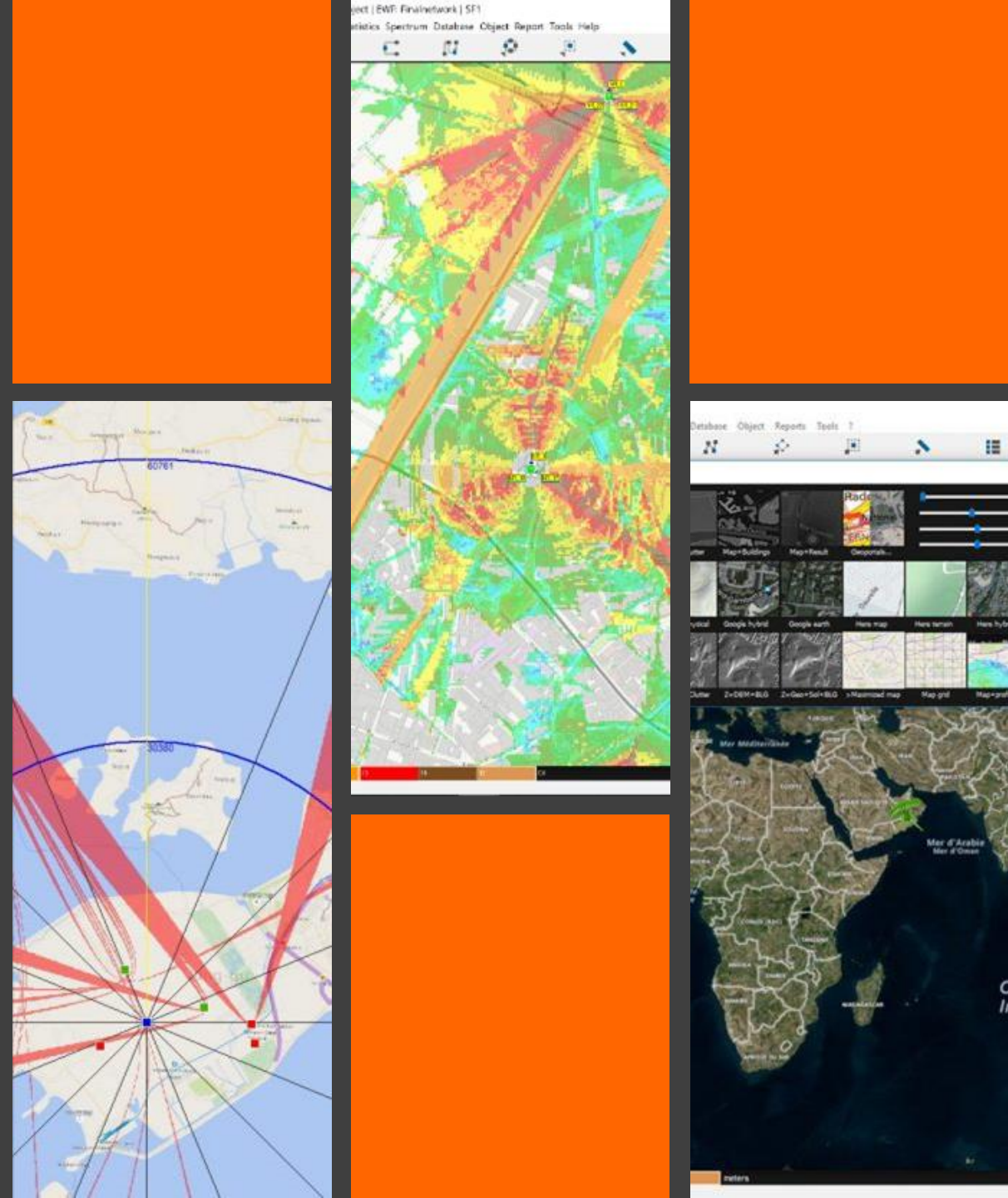
OUR FOCUS IS TO SUCCEED AT EVERY LEVEL OF COMMAND IN ELECTROMAGNETIC SPECTRUM OPERATIONS

ATDI are global leaders in the development and implementation of automated spectrum management solutions.

For over three decades, we have backed over 2,000 civil and defence spectrum agencies, operators and vendors. Our solutions continue to evolve to meet the growing needs of the defence industry.

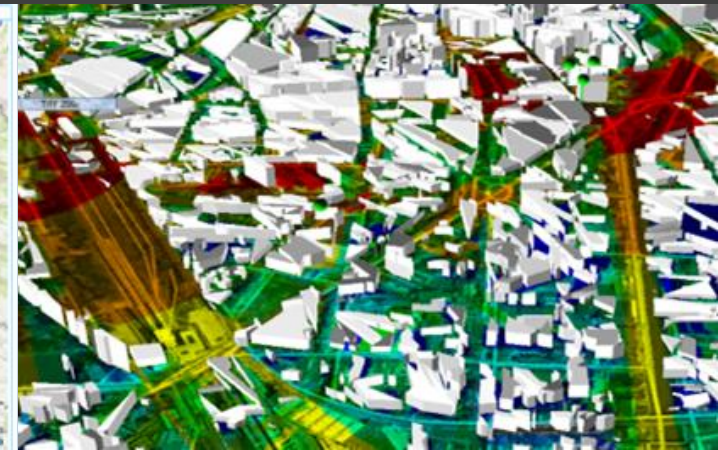
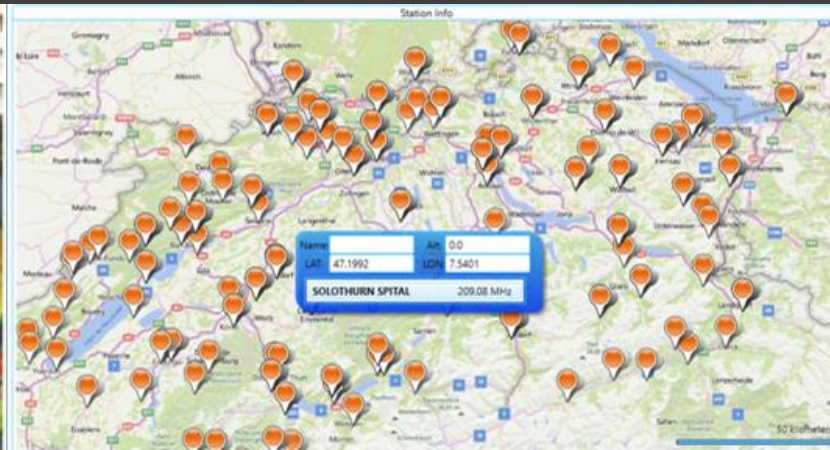
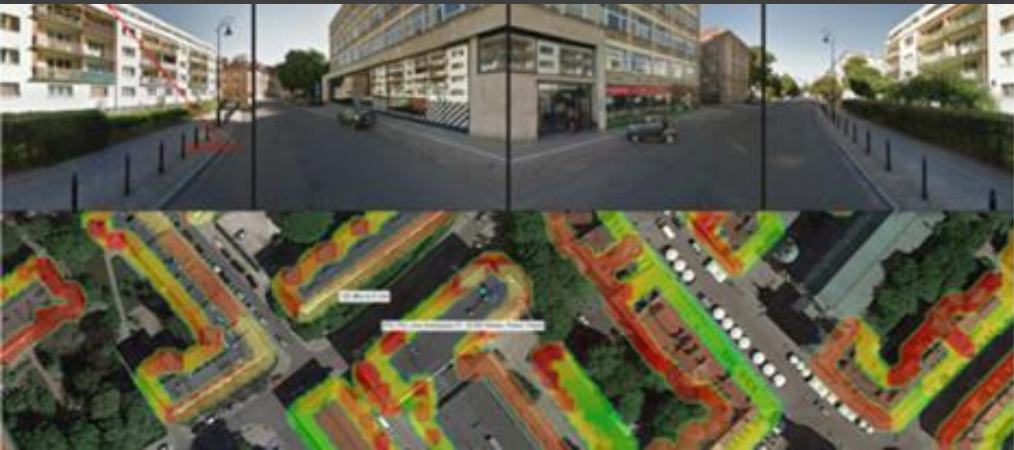
We provide a unique and global solutions for:

- **Radio planning and optimisation:** activities for all communication and transmission systems used by the Ground/Air/Sea/Space forces;
- **Frequency management (FM)**
- **Spectrum management solution (SMS):** for planning, coordinating, and managing joint use of the EMS through operational, engineering and administrative procedures;
- **Electronic Warfare (EW)** management / interception and intelligence



Our Values & Contributions

- Dedicated R&D to ensure we stay ahead of the game
- Solutions compatible with ITU regulations. Contributions to industry organisations including ITU-R and ITU-D, NATO-STCCT, DCI and Old Crows.
- Our team has an excellent understanding of our customers needs – how – discussions/industry experience and a desire to find the best fit (solution) for the end user
- Our team – built from diverse backgrounds enables us to draw from a wealth of knowledge and understanding of the industry and its requirements
- Work in partnership with our end users to ensure both pre-production, throughout project rollout and beyond.



Our Offices Global Footprint

- Allows us to leverage different time zones
- Provide support around the clock
- Fast response times
- Draw resources from across the group to support larger projects ensuring we offer the very best services to our end users
- Shared experiences – combining many man-years experience across the group. At every stage of the project (from project outset to going live) we aim to learn and improve our services. To do that we carry out regular internal project reviews and a group review at handover.



Automated Battlespace Spectrum Management Solution

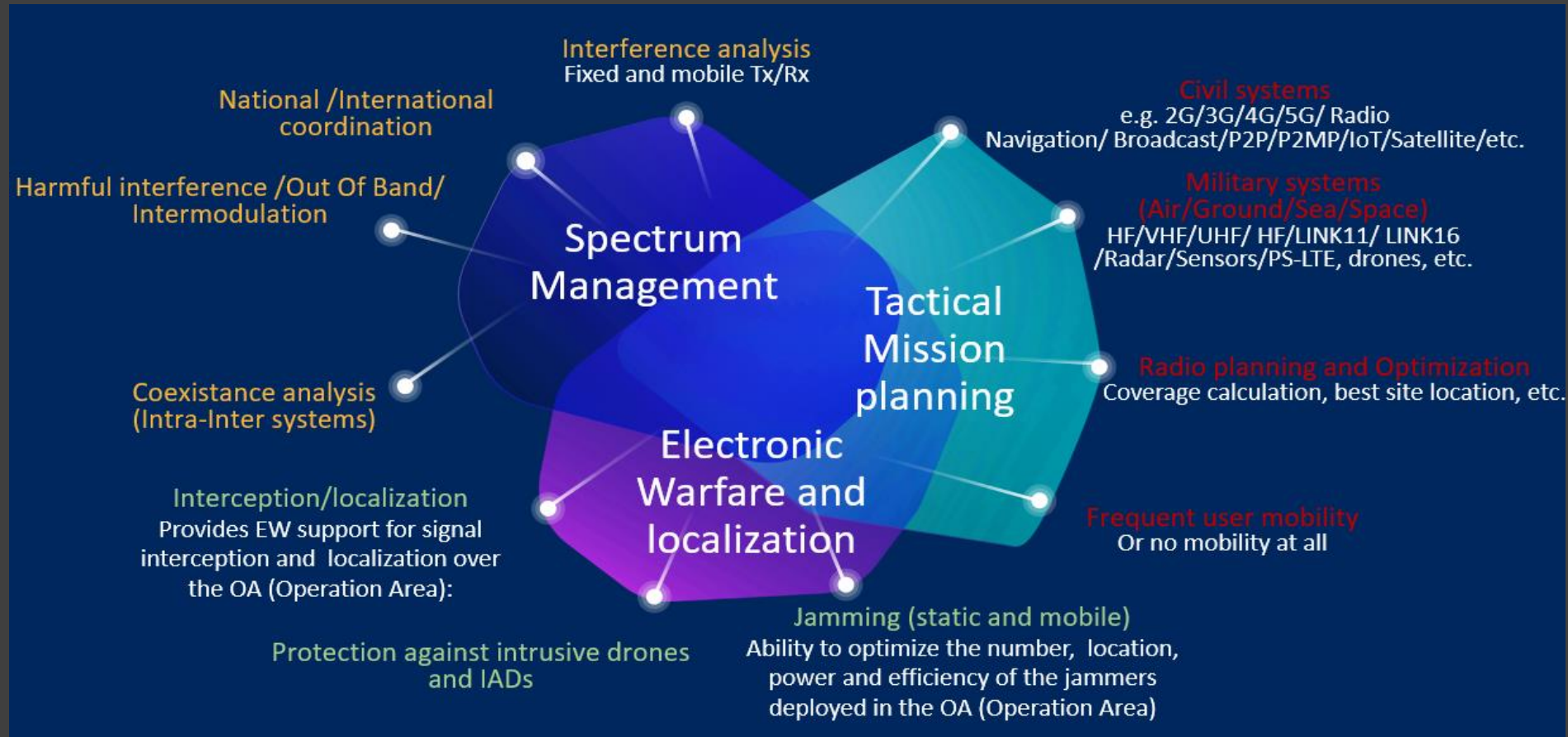
Electromagnetic Spectrum (EMS) is widely used for military operations. Competing demands for radio spectrum means it must be strictly coordinated and controlled. Battlespace spectrum management is the planning, coordination and management of EMS, to enable military systems to perform their functions without causing or suffering from harmful interference.

With over three decades of development, ATDI has developed a leading military network planning, EW modelling tool and frequency management solutions, HTZ Warfare and ICS manager.

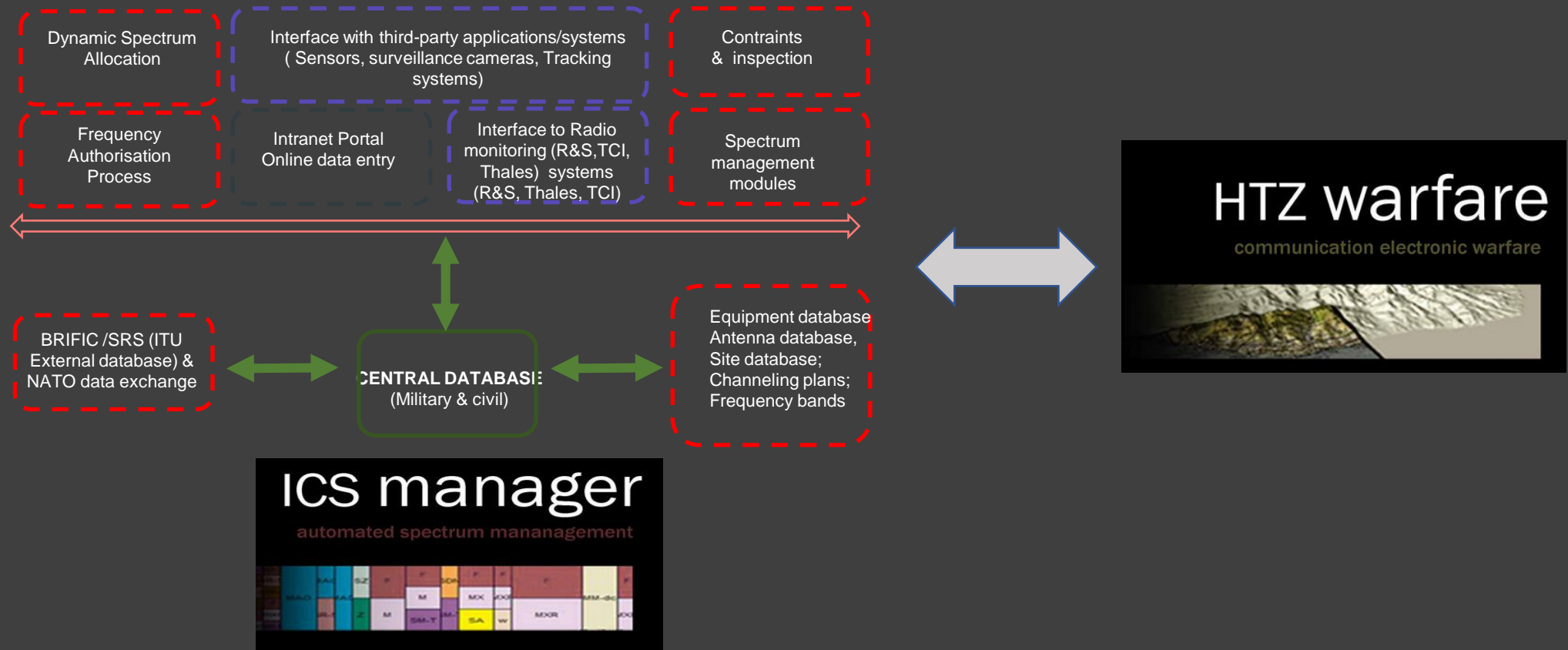
Our solutions allow defence spectrum managers to:

- **Control** the use of spectrum
- **Deconflict** electromagnetic spectrum interference
- **Joint Mission Operation** support standard mission planning data (SFAF, SMEDEF-XML, etc)
- **Tactical Mission Planning** rapid tactical mission network deployment and frequency assignment
- **Convert** private GIS dataset to secure confidential information
- **Automate** complex mission planning workflows to support field operations
- **Share and Control** database to support simultaneous data access

Automated Battlespace Spectrum Management Solution



Automated Battlespace Spectrum Management Solution



HTZ Warfare

All-in-One Multi Technology Capability

HTZ WARFARE SUPPORTS ALL TECHNOLOGIES & FUNCTIONS FOR THE DEFENCE AND SECURITY MARKETS:

- Radio Critical Communication: VHF/UHF, HF, LINK11, LINK16, TETRA, PMR, TETRAPOL, P25, DMR, CDMA, CDMA 2000, TEDS, PR4G, PS-LTE (Public Safety), paging...
- Satellite/Earth station
- Microwave-links & Point to Multi-Points
- Radio cellular technologies: GSM, GPRS, EDGE, EDGE Evolution PMR, Trunked Radio Systems (TETRA, TETRAPOL, APCO-25, MPT 1327), GSM-R, DCS, CDMA EVDO GPRS, Wi-Fi (802.11a/b/g/ac), WiMax (802.16 a/d/e), UMTS, R99, HSDPA, HSUPA, HSPA+, DB-HSDPA, DC-HSDPA, CDMA 2000 1x, CDMA 200 EV-DO, DCS, LTE Advanced (latest 3GPP release), MBSFN-LTE, NB-IoT (3GPP), IoT/LoRA/SigFox, WiFi, Ingenu, LoWPAN, RPMA, Zigbee, Enocean, ISA 100, LTE-M, LTE-R (TDD/FDD), ZWave, Mesh network, Smart Grid, CISCO smart grid technology, 5G-NR (FDD/TDD), SCADA,
- Aeronautical & UAVs : Communications (Ground To Ground/Ground To Air), Radio Navigation (GP, markers, Loc, MLAT, DME, TACAN, NDB, Markers, GBAS RX, MLS AZ, etc.) and Surveillance systems, drones
- Radio-localisation: (DF/Sensors/MLAT, Telemetry, TDOA, RSSI, etc.)
- Jammers (Fixed frequency mode, **wide band – diffusion**, **wide band – adaptive mode**)
- Broadcast : Radio analog and digital (FM, AM, LF/MF, TDAB, etc.), TV analog and digital (DVB, DVB-T2, ISDB-T, DMR, DVB-S, DVBS2, etc.)
- Subscribers and User Equipment

HTZ WARFARE SUPPORTS ALL TECHNOLOGIES & FUNCTIONS FOR THE DEFENCE AND SECURITY MARKETS, INCLUDING:

- **TACTICAL COMMUNICATIONS (ELINT, COMINT)**
- **UAV/UAS MISSION PLANNING**
- **MARITIME COMMUNICATIONS**
- **LMR/PMR/P25/TETRA**
- **PUBLIC SAFETY NETWORK/PPDR**
- **HF COVERAGE ANALYSIS**
- **MICROWAVE LINKS**
- **SATELLITE & EARTH SEGMENT (GSO/NON-GSO) DESIGN**
- **RADAR, INTERCEPTION, JAMMING EFFICIENCY**

HTZ Warfare Propagation models

1. Free Space model
2. Diffraction models
3. Tropo-scattering models
4. Deterministic ITU Recommendations
5. Industry standard models including aeronautical models
6. Specific/external & custom-built models
7. HF conductivity model

The screenshot shows the 'Propagation models' window with the following sections highlighted by numbered callouts:

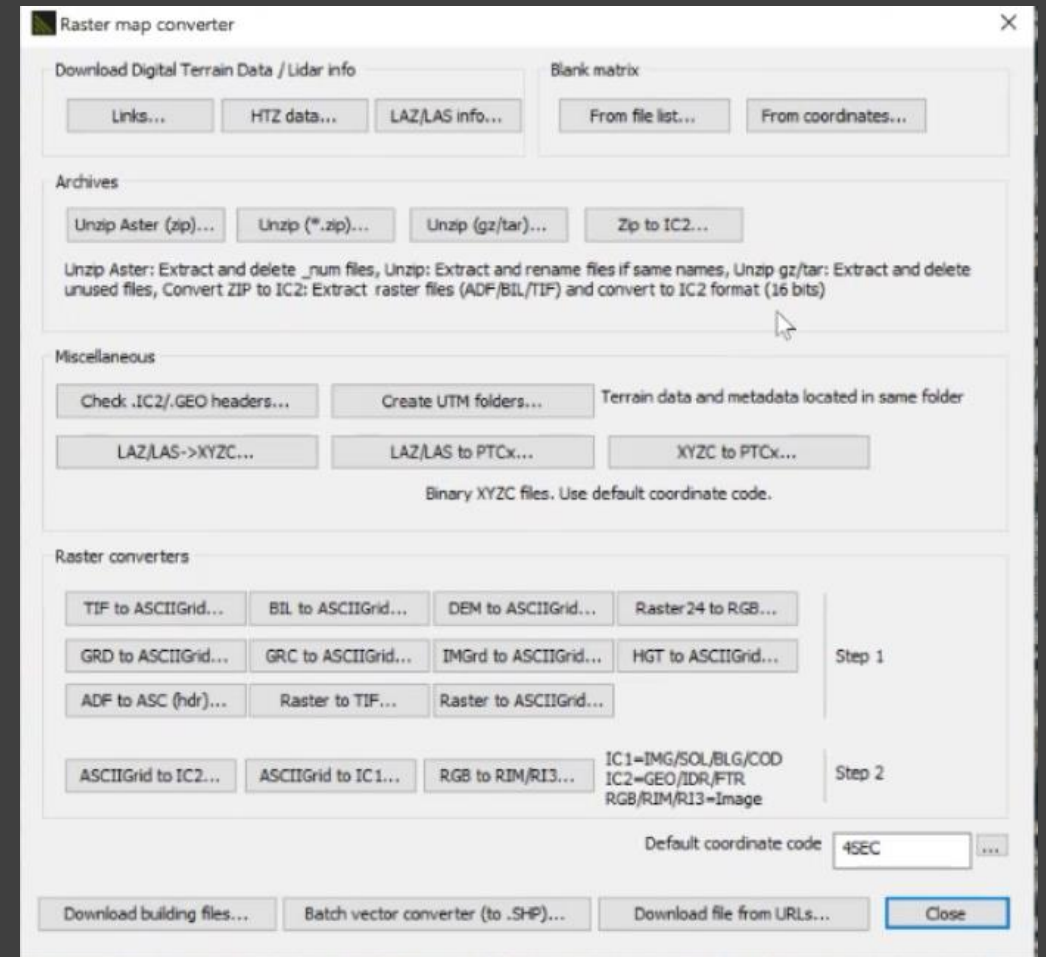
- 1:** 'Free space loss' section under 'Propagation losses ='. It includes a 'Near field calculation' checkbox and a list of models like '20.LOG[(4.PI.D)/wavelength]' and 'ISO'.
- 2:** 'Diffraction geometry' section, listing models such as 'Deygout 94-2', 'Deygout 94-1', 'Deygout 66', 'Deygout 91', 'Bullington', 'Delta Bullington', 'ITU-R 526, round mask', 'ITU-R 526, cylinders', 'Visibility / Indoor', and 'No diffraction loss'.
- 3:** 'Attenuation by atmospheric gases and rain' section, including 'Gases / Fog / Clouds / Sand' (ITU-R 676, ITU-R 1820), 'Rain / Snow' (ITU-R 838/530, Rain Crane global), and 'Rain rate (mm/h)'.
- 4:** 'Propagation methods' section, listing various ITU-R and FCC models like 'ITU-R 370 (30-1000 MHz)', 'ITU-R 525/526-15', 'ITU-R 1546-6 (30-4000 MHz)', etc.
- 5:** '3GPP / COST (empirical)' section, listing models like 'Durkin', '3GPP-LTE urban (0.9-2 GHz)', '3GPP-LTE rural (0.9-2 GHz)', 'SUI method (2.5-2.7 GHz)', 'Okumura-Hata (150-1500 MHz)', 'Hata - Cost 231 (150-2000 MHz)', 'Extended Hata (30-3000 MHz)', 'Cost 231 open...', 'Walfisch-Ikegami (800-2000 MHz)', and 'Modified Hata model by ACMA'.
- 6:** 'Specific / External' section, listing models like 'BR method (uV)', 'Wojnar method (1-1000 MHz)', 'CCIR - MF (550-1700 kHz)', 'Egli (V/UHF)', and 'Ext. model (DLL)'.
- 7:** 'Global parameters' section, including 'Earth radius km land/sea', 'RMS wave height (m)', 'Variability' (Location, Time, P2P unwanted signal), and 'Field strength offset'.

HTZ Warfare

Robust GIS Data Support

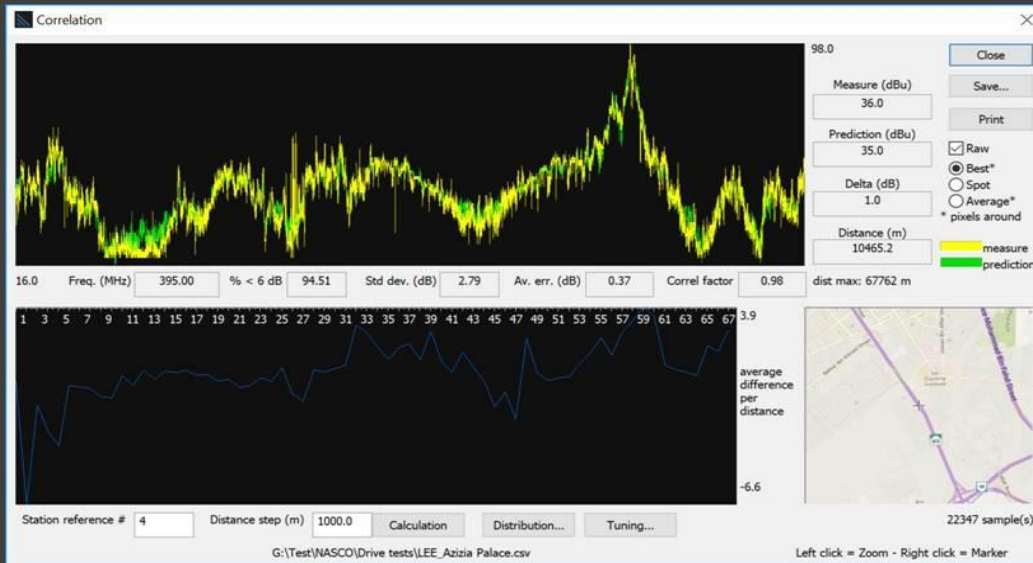
HTZ Warfare has various tools to acquire and manage digital maps including DTM, clutter, image and vector files

- In-built tool to access ATDI GIS database to download medium to high resolution DTM and clutter worldwide. High resolution 3D building layer is also available for some cities;
- 3rd party map image API connection like Google Maps, MS Bing Maps, Geospatial, Open Street Maps, etc.
- Private GIS data conversion using Raster Map Converter in HTZ Warfare. The tool supports generic formats to convert into HTZ formats.
- Data production and development services are also available for any specific project needs.

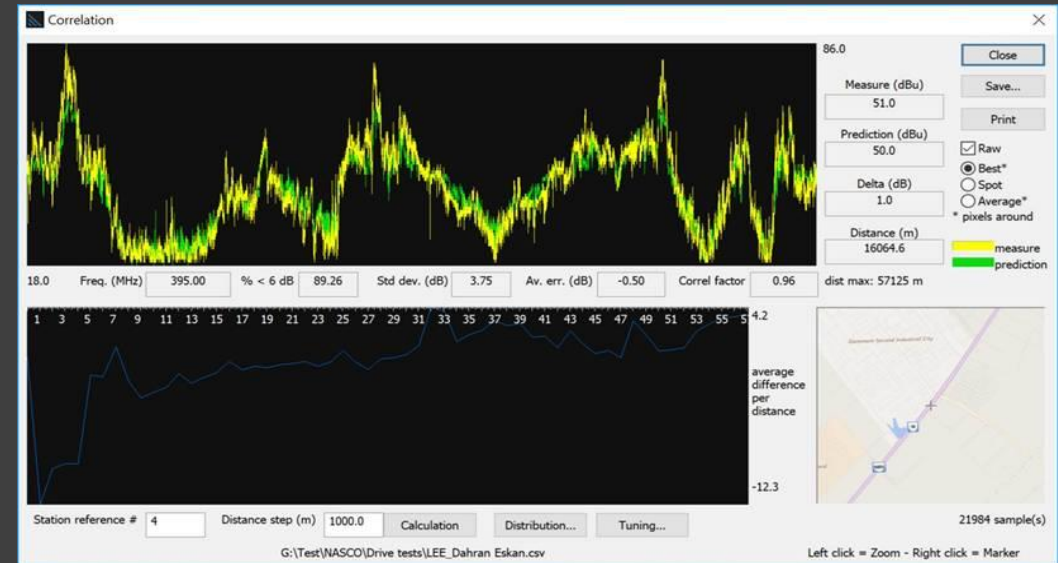


HTZ Warfare

Unprecedented Modelling Accuracy

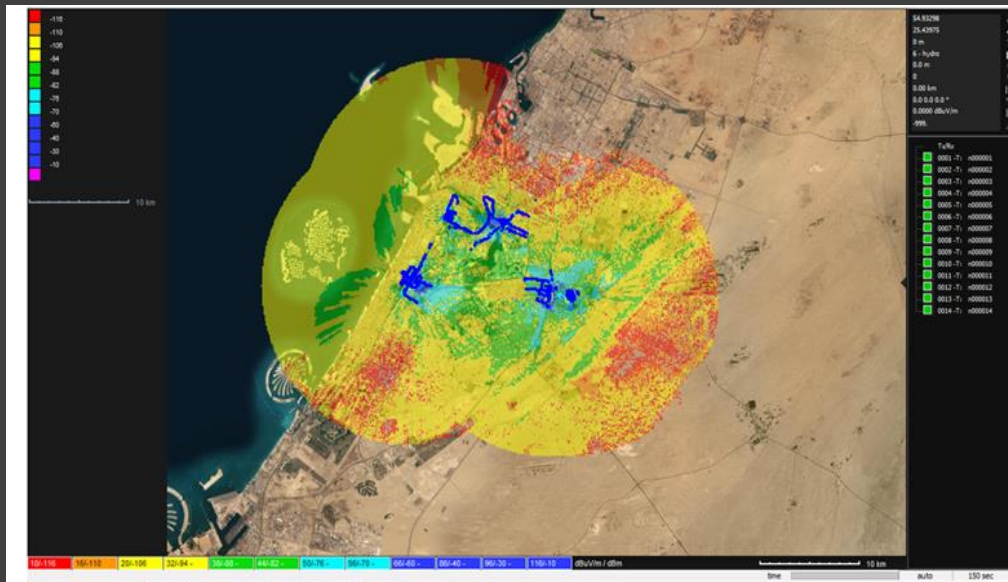


TETRA station located in Dammam KSA (Azizia Palace)
 Standard Deviation Error (dB): 2.79
 Correlation Factor: 0.98
 Sample measurement: 22347

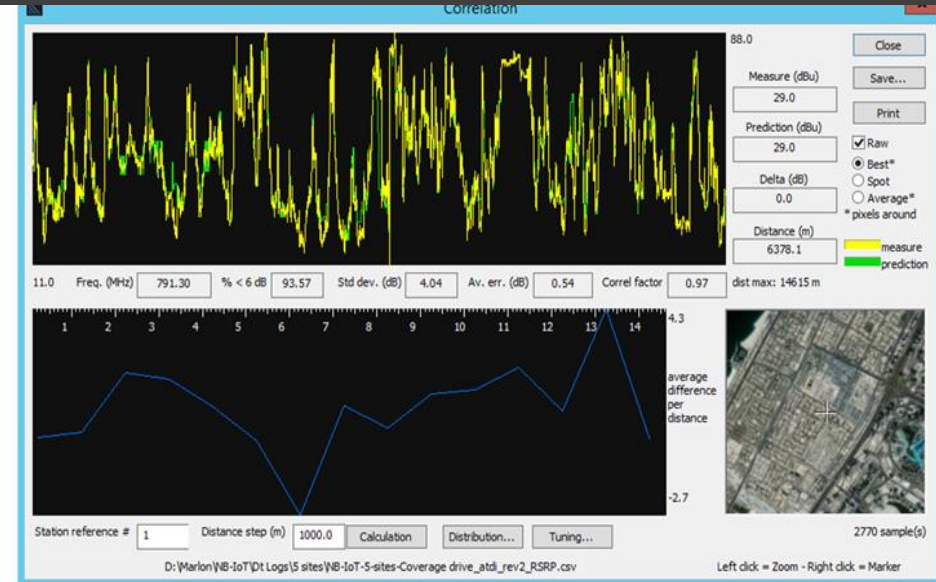


TETRA station located in Dahran Eskan (KSA)
 Standard Deviation Error (dB): 3.75
 Correlation Factor: 0.96
 Sample measurement: 21984

HTZ Warfare Unprecedented Modelling Accuracy



5G-NR coverage prediction (3.5GHz) Dubai city (UAE)



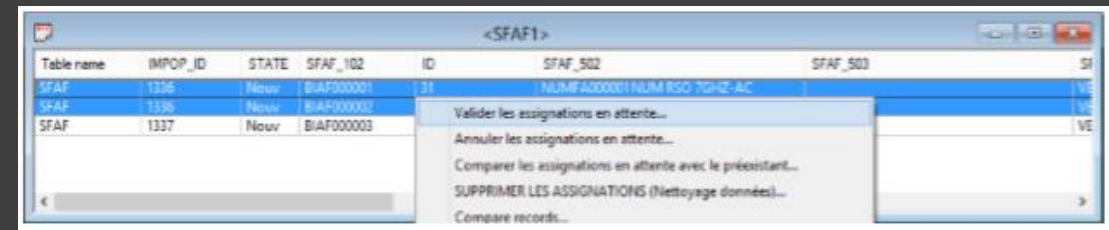
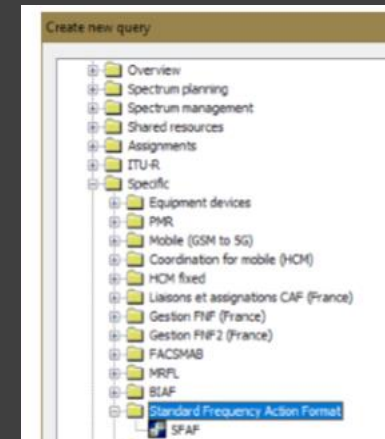
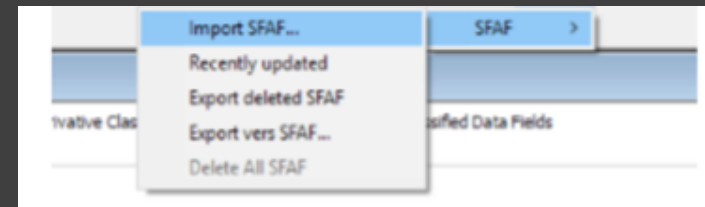
NE501 RSRP coverage prediction vs. Scanner (3.5GHz) Dubai city (UAE)
 Standard Deviation Error (dB): 4.04
 Correlation Factor: 0.97
 Sample measurement: 2770

HTZ Warfare Tactical Mission Planning

In the mission critical environment, access to online and offline operations for rapid network planning and frequency assignment is the key for the mission success. HTZ Warfare supports:

- Examines links between communication assets and assesses the performance of the link in detail. All simulations are based on proven, accurate simulation methods;
- Moves individual sites and analyses communication capabilities virtually instantly;
- Assesses the impact of communication site failures and their impact on the network, so that contingency plans can be included as part of the normal system design process;
- Identifies network capabilities for moving elements, such as convoys, through hostile territory. Suitable locations for talk-through sites can be easily identified;
- Supports the complete design of communication networks, including the ability to minimise interference, assign frequencies and generate alternative communication plans;
- Network changes to any part of a network can be analysed and viewed virtually instantaneously. This includes the ability to assess the effect of failure or enemy action on the network. This supports mitigation planning and reduces the likelihood of communication failures in the field;

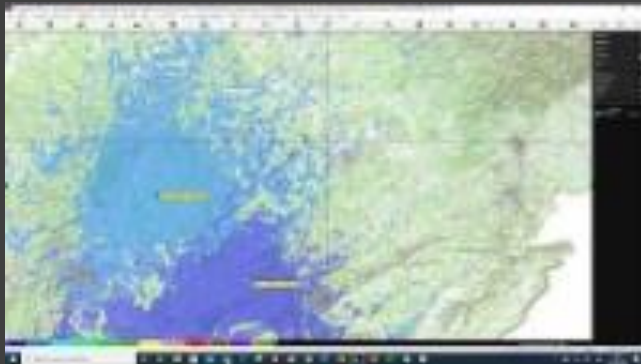
SFAF and SMADEF-XML formats are compatible



HTZ Warfare Tactical Mission Planning demonstration

Part 1: Mission Scenario and Project Set up in HTZ Warfare

<http://www.youtube.com/watch?v=mdKWJaw09GQ>



Part 2_Mission Network Analysis and Frequency Assignment

<http://www.youtube.com/watch?v=chZIWm8ycSE>



Part 3_HTZ Warfare mission planning process summary

http://www.youtube.com/watch?v=S7_2IAkoctM



HTZ Warfare

Electronic Warfare

Battlespace spectrum management is the planning, coordination and management of EMS, to enable military systems to perform their functions without causing or suffering from harmful interference.

Significant importance is placed on the performance of radio intercept receivers, direction finders and communications jamming equipment. Key features that determine the success of a mission is the ability to intercept or jam enemy communications. And similarly, to share information with the command structure without undue interference.

- Assess the risk of interception or jamming by known enemy electronic warfare assets;
- Electronic warfare for communications planning can be included by analysing intercept vulnerability, identifying the possible effects of enemy jamming and developing plans to overcome these factors;
- Plans for the deployment of intercept receivers, including intercept coverage assessment and gap identification, maximising the efficiency of deployed sensors or minimising the assets assigned to a given objective;
- Deploy direction finders with best site searching, DF baseline coverage assessment and communications planning between assets. The system can be integrated with DF systems, so that DF hits can be displayed directly on the planner's screen;
- Plan offensive communication jamming missions, including asset optimisation, communications planning and assessments of jamming effects on own communications systems;
- Determine the vulnerable points in known enemy communications systems and prioritise targets for attack.

HTZ Warfare Electronic Warfare Use Case

UAV/UAS Counter-drone network analysis

Part 1: Mission Scenario and Project Set up in HTZ Warfare

<https://www.youtube.com/watch?v=5EqnNwfG7xw&t=1s>



Part 2 Counter-drone jamming effects analysis in HTZ Warfare

<http://www.youtube.com/watch?v=M3fYDETFNv8>



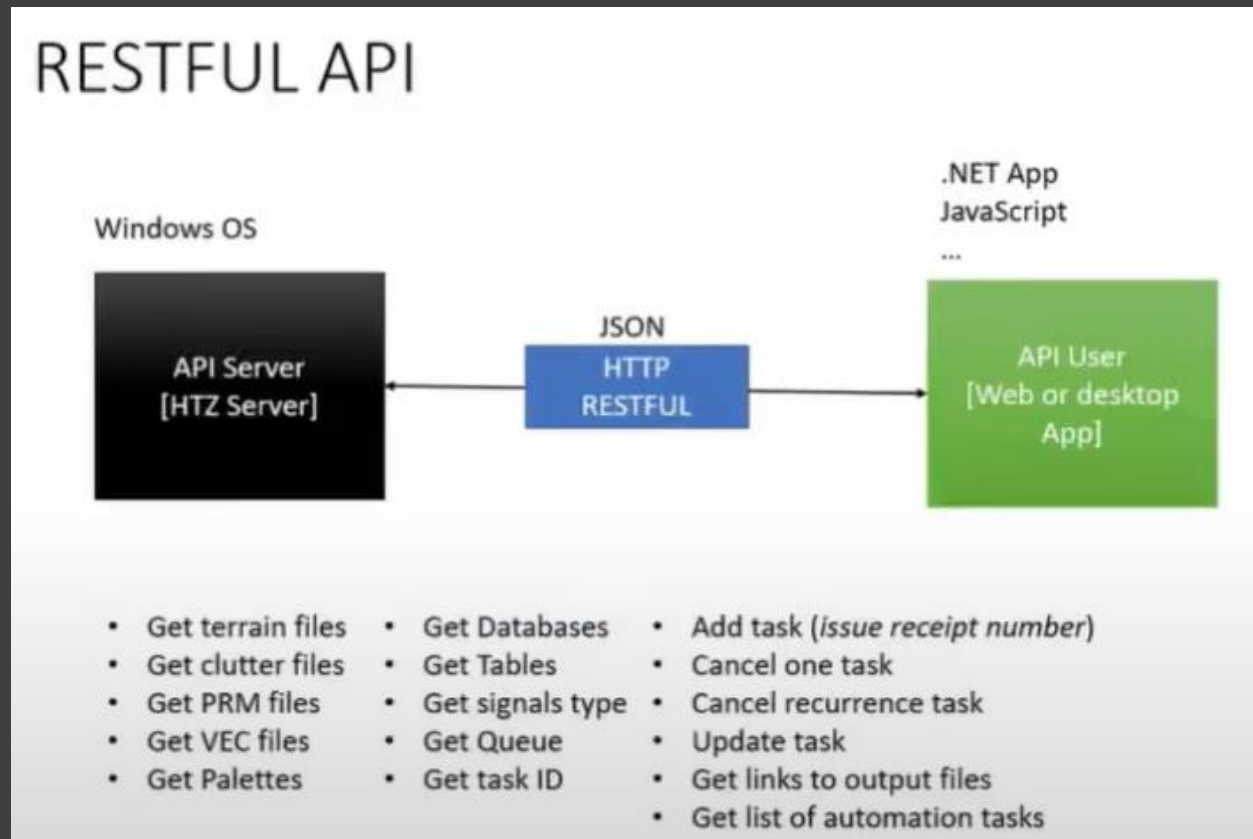
HTZ Warfare Planning Automation

Staying connected to Headquarters while in enemy territory is an essential part of many military missions.

HTZ Warfare provides the ability to custom workflows to support different end-user requirements or system capabilities. This simplifies interfaces for software users who may not have a radio propagation background.

For instance, by identifying the areas with no possible communication with headquarters, routes can be chosen for ground vehicles, helicopters and planes moving at different speeds and using different types of equipment.

The entire planning and problem solving is managed in an automated fashion.



HTZ Warfare Planning Automation use case (videos)

Part 1: MANET concept and introduction
<http://www.youtube.com/watch?v=-NAFafSwwog>



Part 2: Project set up and simulation analysis in HTZ Warfare
<http://www.youtube.com/watch?v=UGrBOjz83CA>



Part 3: Continue Part 2 and Automation in HTZ Warfare (starts at 8:10)
<http://www.youtube.com/watch?v=7bg8HFhT4Sc>



Our Services



Training

Customised training service online or onsite.



Support

24/7 global technical support via phone, email and web-conference



System Customisation

Business analysis, system design, architecture, customisation, integration, and configuration.



Spectrum consulting

Provide professional consulting services in spectrum engineering and management to solve any spectrum issues.



Cartographic data

Medium to High resolution DTM and Clutter library.
Cloud base digital map image streaming and cache support.



System Deployment & Maintenance

Support on Go-Live, Testing, and bug fixing.
On-going maintenance support with software updates.

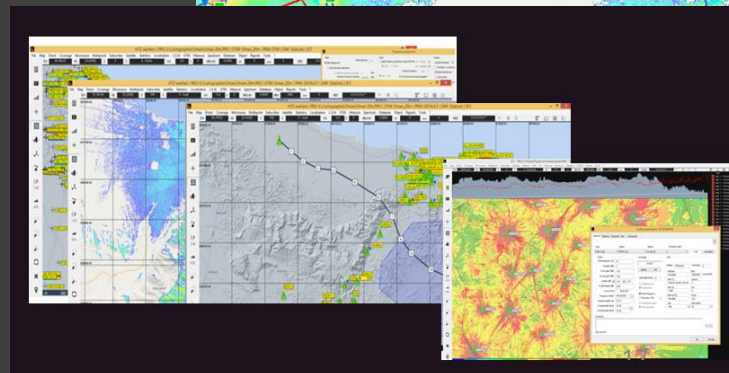
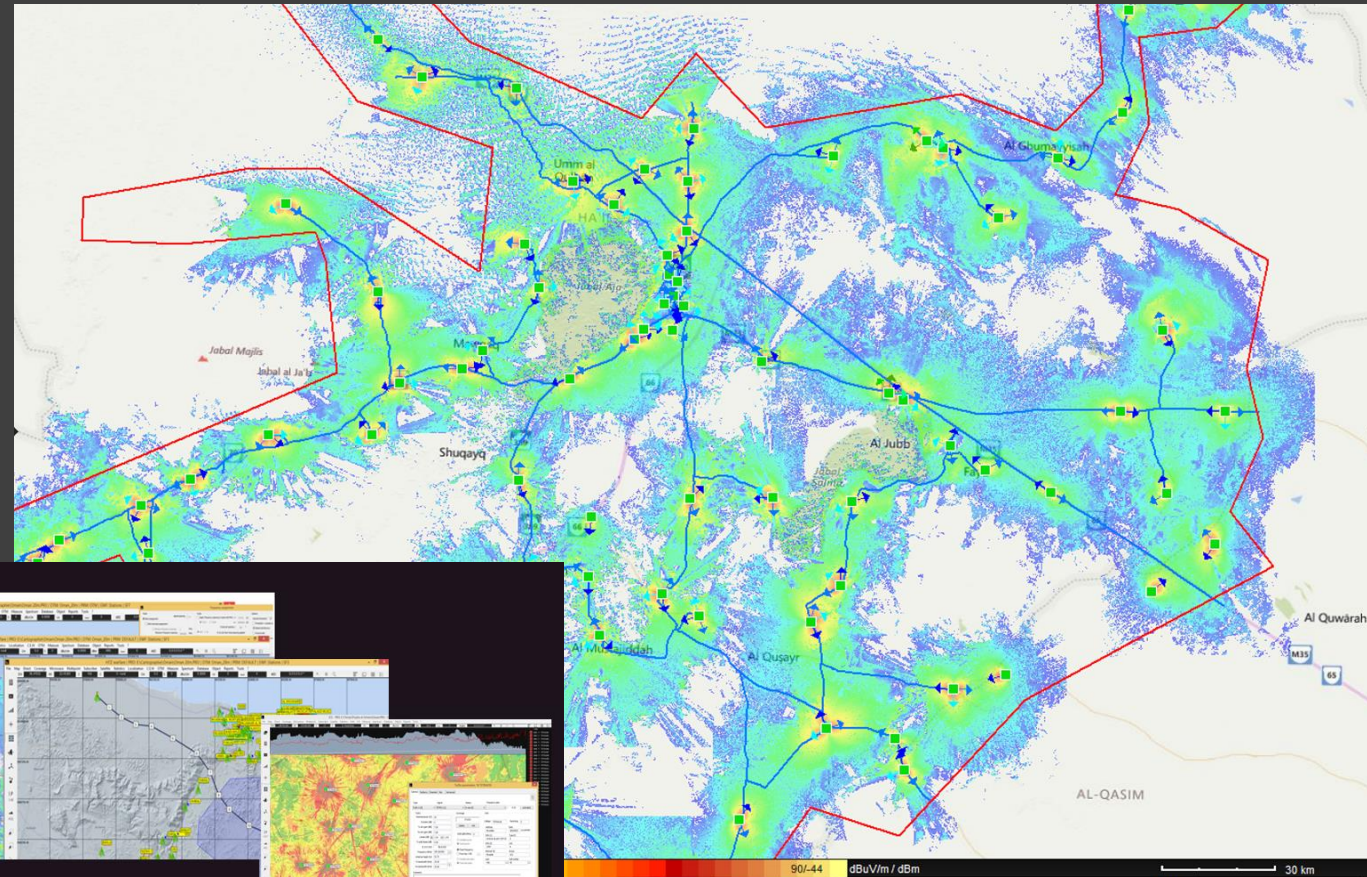
Annex

Technical Analysis Capabilities in HTZ Warfare

HTZ Warfare Critical Comms Network Planning

TETRA, P25, DMR, CDMA, CDMA 2000, TEDS, TETRAPOL, PS-LTE, VHF/UHF...

- DL/UL Coverage planning (outdoor, indoor, in car)
- DL/UL link budget calculator
- Automatic best site selection candidates according to coverage objective
- Automatic site planning
- Automatic site optimization (azimuth, power, tilt, antenna model...)
- Interference calculations
- Automatic Frequency assignment
- Traffic & mobility profile editor (UE)
- Capacity planning (Erlang, data)
- Automated handover, neighbor list planning
- Monte Carlo simulations



HTZ Warfare Critical Comms Network Planning

Ground to Ground Communications



VHF AM radio base station JOTRON (TR-7550)

- Portable Radios (ICOM)
- Mobile Radios (ICOM)

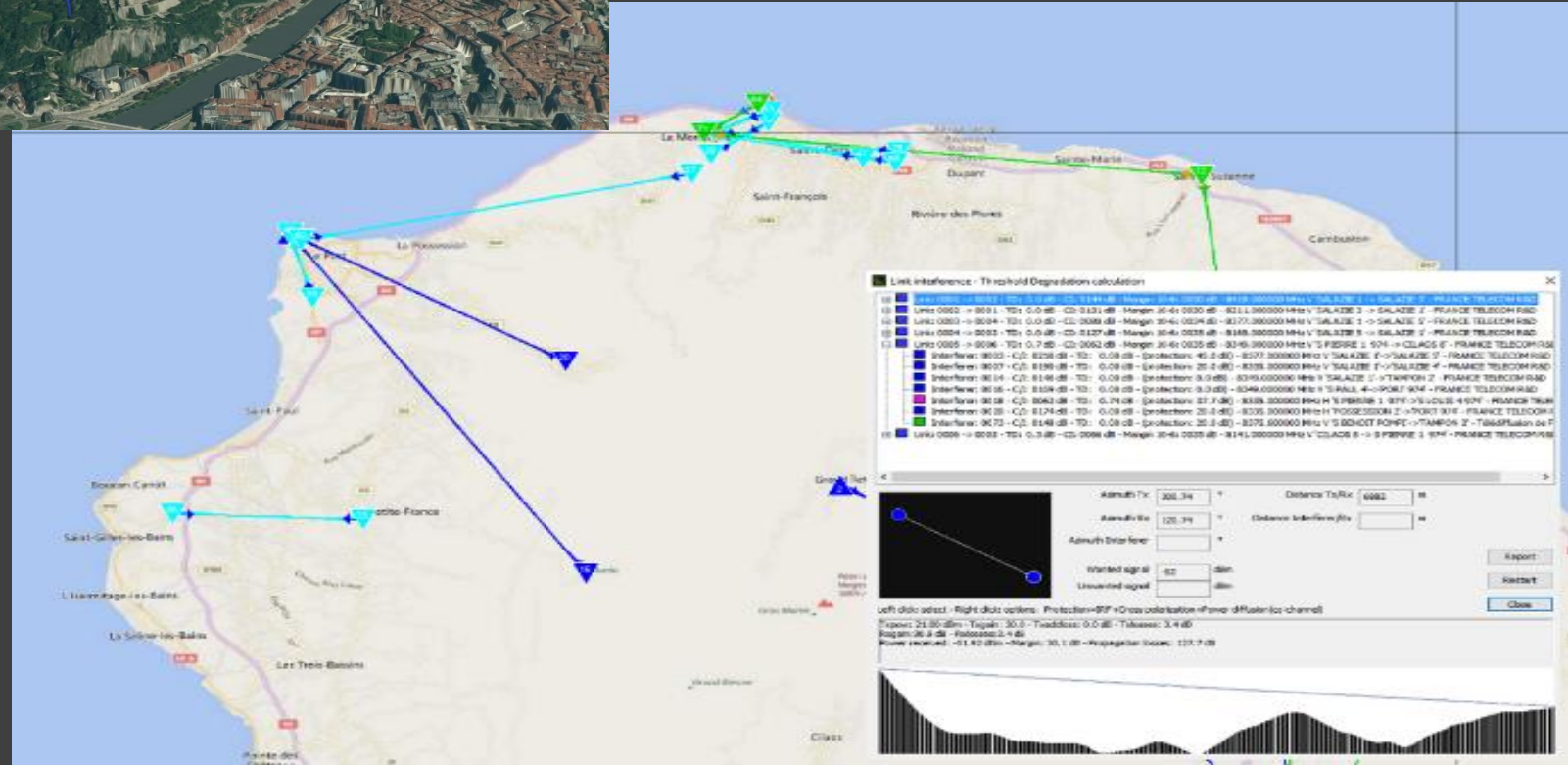
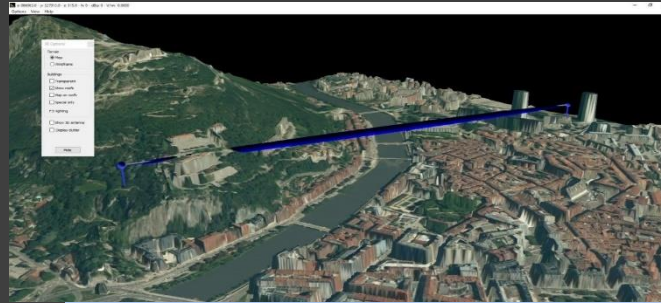


ITEM	CH FREQ. (MHZ)	USE
1	CH 1: 133.500	Ground to Ground communication
2	CH 2: 121.700	Operation room to Tower communication
3	CH 3: 118.100	Monitor in operation room from Air to Ground communication

HTZ Warfare

Microwave, P2MP, Backhaul, mm Wave bands

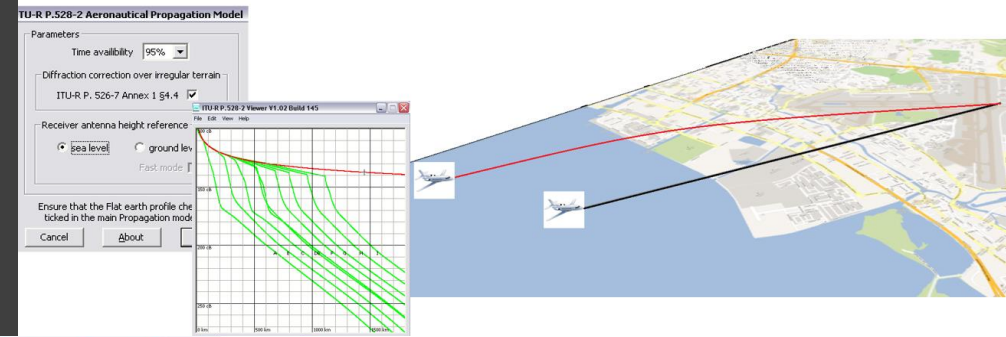
- Profile budget calculations
- Frequency and space diversity
- Multi-K factor calculations
- Climate and rain parameters
- Reliability calculations
- Automatic antenna orientation
- Link optimization
- Automated frequency planning
- Interference calculations
- Quality objectives calculations (ITU-R F. 1703 and ITU-T G.827)
- MIMO Antenna systems
- M2M, D2D, SCADA, CDMA 450, MMDS, WiMAX, LMDS, etc.



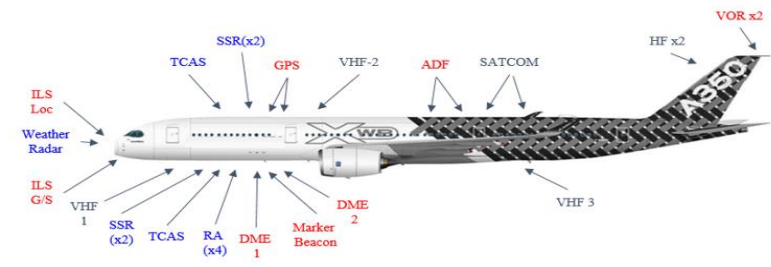
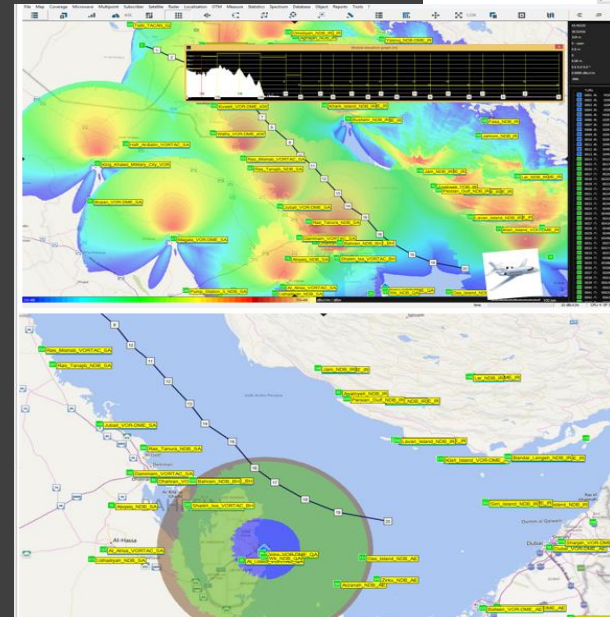
HTZ Warfare Aeronautical Services

- Aeronautical Communication Systems (VHF/UHF Ground To Air, Air to Ground, Broadband LTE A2G (Air To Ground)),
- Radio navigation systems: GP, markers, Loc, MLAT, DME, TACAN, NDB, Markers, GBAS RX, MLS AZ, etc.
- Surveillance system: Radar (PSR, SSR, etc.) including coverage, interference and coexistence analysis
- Multi-lateration (Time Sum of arrival – TSOA / Time Difference of arrival (TDOA))
- Building restricted area ICAO recommendations
- Coexistence between aeronautical services and FM network (ITU-R/ SM1009)
- Coexistence between radar and LTE network (from OFCOM recommendations)
- Traffic/Interference analysis and Automatic Frequency Assignment

ITU-R P. 528-2 + ITU-R P.526-7 (diffraction)



Modeling aircrafts with all radio navigation equipments with HTZ warfare



- | | | | |
|-------|------------------------------|----------|------------------------------------|
| ADF : | Automatic Direction Finder | Loc | Localizer |
| DME : | Distance Measuring Equipment | RA : | Radio Altimeter |
| GPS : | Global Positioning System | SATCOM : | Satellite Communication |
| G/S : | Glide Slope | SSR : | Secondary Surveillance Radar |
| HF : | High Frequency | TCAS : | Traffic Collision Avoidance System |
| ILS : | Instrument Landing System | VOR : | VHF Omni ranging |

HTZ Warfare Radar - Parameters

Radar parameters: 1 MS006717

General Patterns Channels Site Advanced Radar

Type: Radar allied (4) Bistatic

Peak power (kW): 25.00000 IF bandwidth (Hz): 18000000 Energy (Joule): 0.00

Antenna gain (dBi) Tx/Rx: 31.00 / 31.00 Pulse width (us): 0.07 Effective surface (m2): 0.10

Losses (dB) Tx/Rx: 0.00 / 0.00 Noise (dB): 6.00 N.K.T: 1.636221e-20

Radiated power (W): 3.147314e+07 Detection PD: 0.50 NKTB (dBm): -95.31

Mean power (W): 0.001666667 RCS (m2): 2.00000 R/R0 (km): 20

Antenna height (m): 4.00 PRF (Hz): 1.00

Frequency (MHz): 9410.000000 Unambiguous range: 149895.0 km Radar limit - R/R0 (km): 19.28

Threshold (dBU): 124

Load... Save... Constraints... Pattern... Use distance pattern for R0 computing Convert to Tx/Rx

IF BW (Hz) = 1.2 / pulse width (sec) 1.0 / pulse width (sec) PRF = Pulse repetition frequency

OK Annuler

Distance / elevation pattern

°	km/M	°	km/M	°	km/M	°	km/M	°	km/M	°	km/M	°	km/M
-89	10.00	-69	15.82	-49	21.64	-29	27.46	-9	33.28	11	40.31	31	32.54
	10.29		16.11		21.93		27.75		33.57		39.92		32.15
	10.58		16.40		22.22		28.04		33.86		39.53		31.76
	10.87		16.69		22.51		28.33		34.15		39.15		31.37
	11.16		16.98		22.80	-25	28.62	-5	34.44	15	38.76		30.98
	11.46		17.28		23.10		28.92		34.74		38.37		30.60
	11.75		17.57		23.39		29.21		35.03		37.98		30.21
	12.04		17.86		23.68		29.50		35.32		37.59		29.82
	12.33		18.15		23.97		29.79		35.61		37.20		29.43
-80	12.62	-60	18.44	-40	24.26	-20	30.08	0	35.90	20	36.81	40	29.04
	12.91		18.73		24.55		30.37		35.80		36.43		28.65
	13.20		19.02		24.84		30.66		70.30		36.04		28.26
	13.49		19.31		25.13		30.95		79.60		35.65		27.88
	13.78		19.60		25.42		31.24		76.00		35.26		27.49
	14.07		19.89		25.71	-15	31.53	5	61.00	25	34.87		27.10
	14.37		20.19		26.01		31.83		50.50		34.48		26.71
	14.66		20.48		26.30		32.12		50.80		34.09		26.32
	14.95		20.77		26.59		32.41		49.20		33.71		25.93
	15.24		21.06		26.88		32.70		41.60		33.32		25.54
												89	10.00
													25.16
													17.38

converted diagram preview

km statute mile international nautical mile geographical nautical mile

R/R0: 367.90 miles

reset interpolate

Close Cancel

Radar constraints

Radar type

High/medium altitude

Low altitude

Others

Landing

User defined

First sector constraints

Begin (°): 0.0

End (°): 0.0

Distance (km): 0.00

Area constraints

Max radius (km): 30.00

Intermediate radius (km): 20.00

1st radius (km): 5.00

Slope (°): 0.00

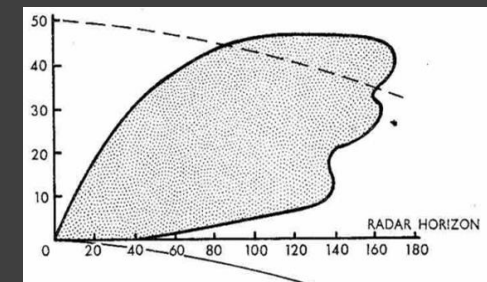
Second sector constraints

Begin (°): 0.0

End (°): 0.0

Distance (km): 0.00

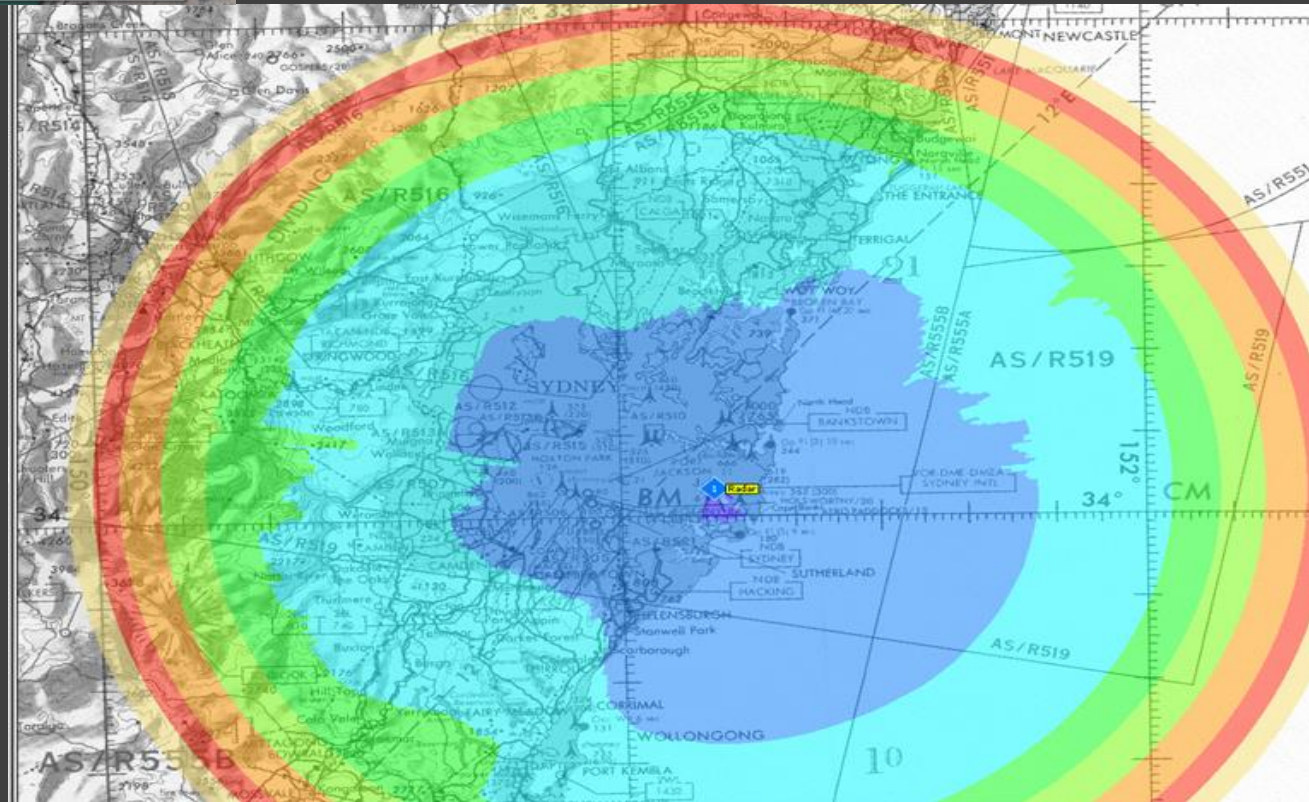
OK Cancel



HTZ Warfare

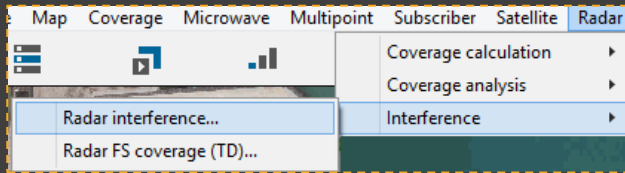
Radar Minimum Detection Height

Point	Subscriber	Satellite	Radar	Localization	OTM	Measure	Statistics	Spectrum
			Coverage calculation					
			Coverage analysis					
			Interference					
				Radar coverage...				
				Radar FS coverage...				
				Radar coverage (min detection)...				

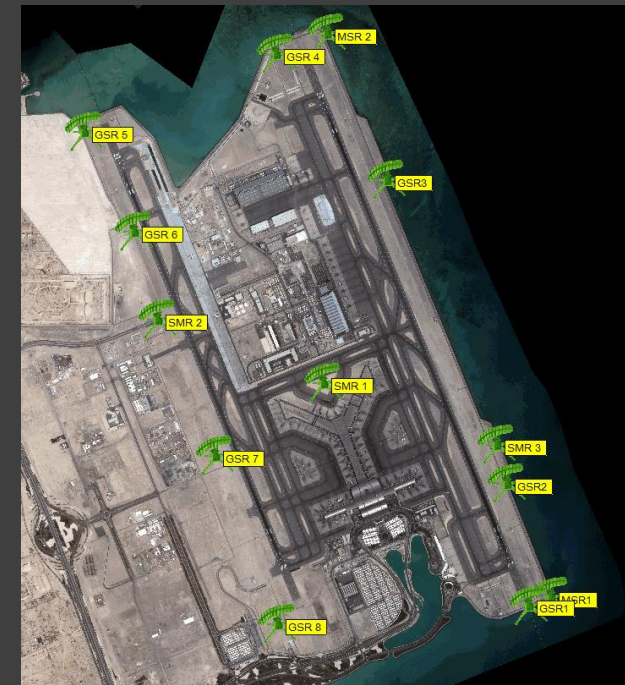
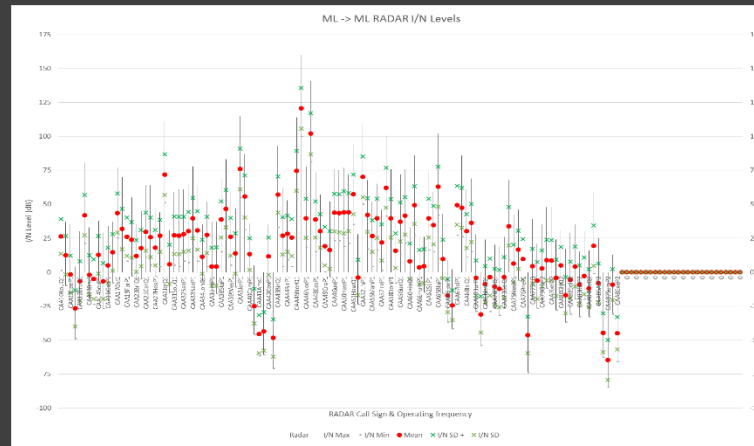
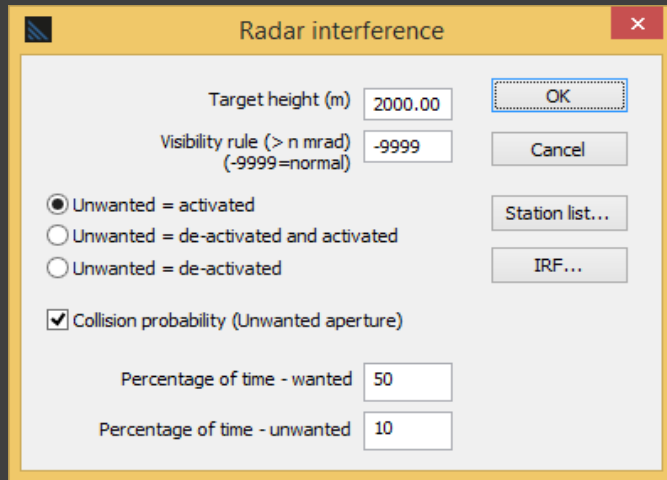


Label	Color
Target detected	Dark Blue
150 feet ASL min	Light Blue
300 feet ASL min	Light Green
450 feet ASL min	Green
600 feet ASL min	Yellow-Green
750 feet ASL min	Yellow
900 feet ASL min	Orange
1050 feet ASL min	Light Red
1200 feet ASL min	Red
1350 feet ASL min	Dark Red

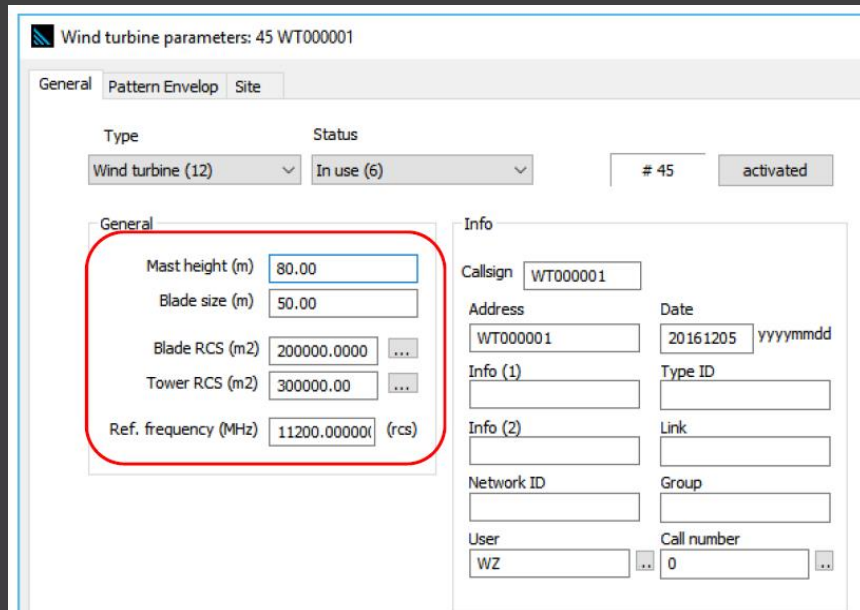
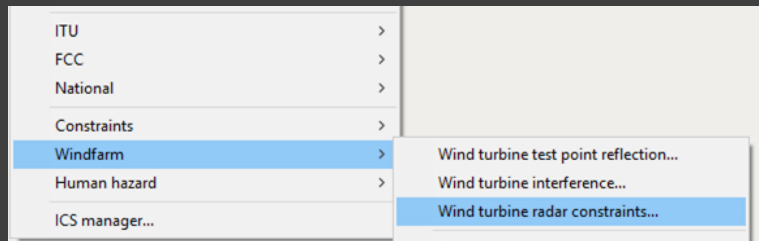
HTZ Warfare Radar Interference Analysis



This function rotates the radar horizontal antenna pattern in 1-degree intervals and calculates the I/N and Threshold degradation. The radar coverage is then calculated using the threshold degradation and then calculates the radar coverage for the given probability of detection and radar cross section.



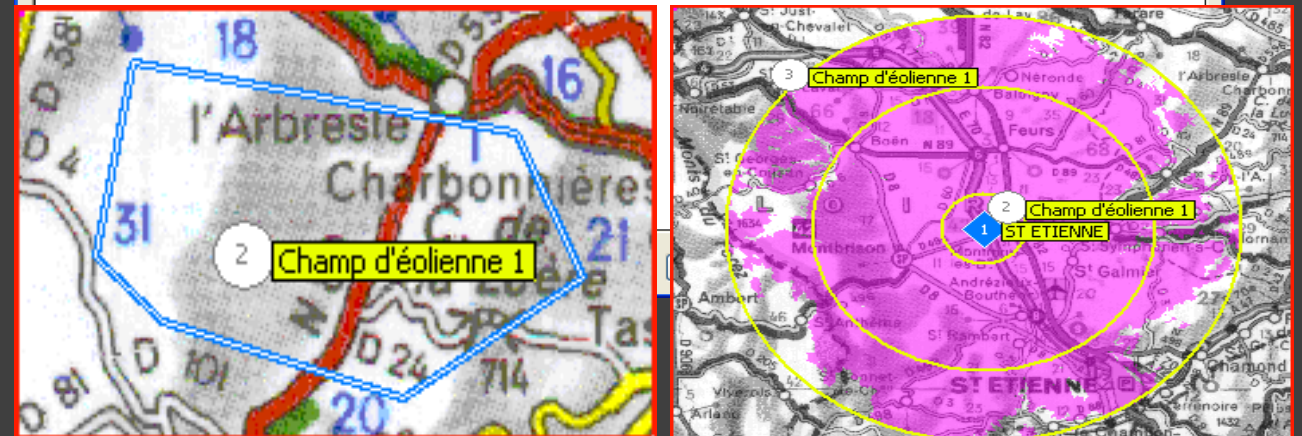
HTZ Warfare Radar Coexistence; Radar Vs Windfarm



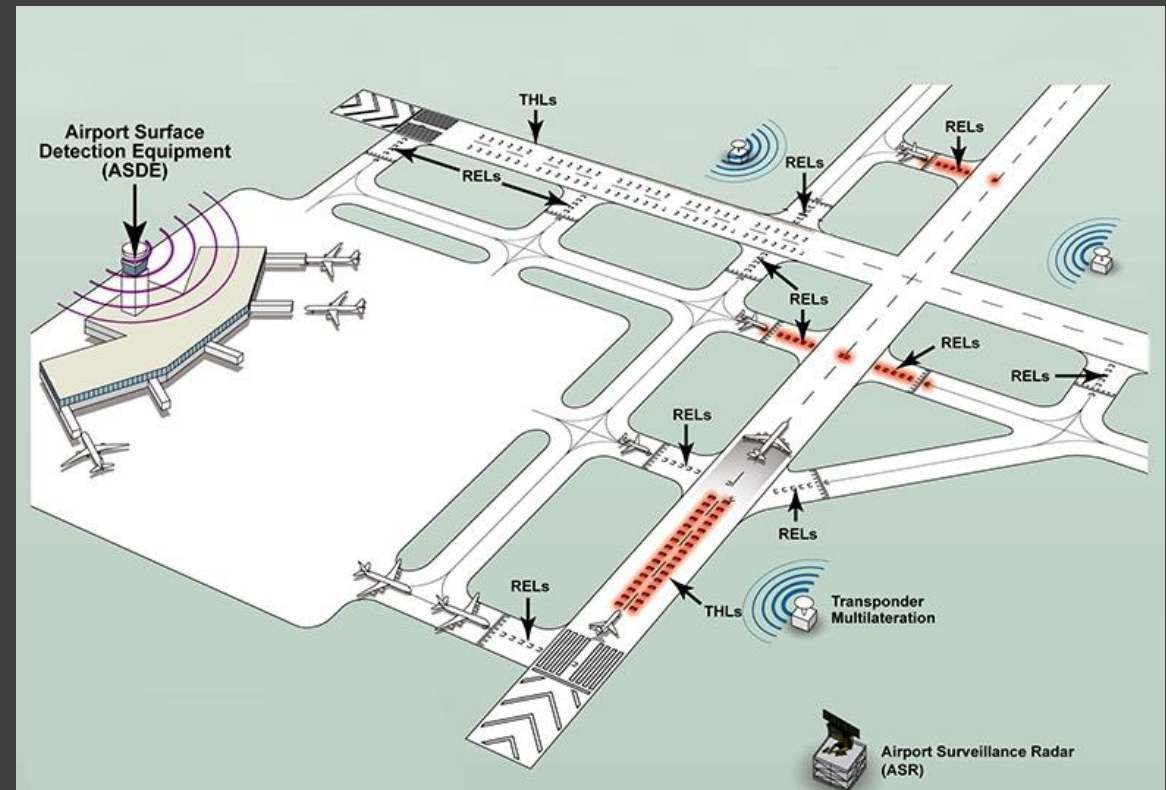
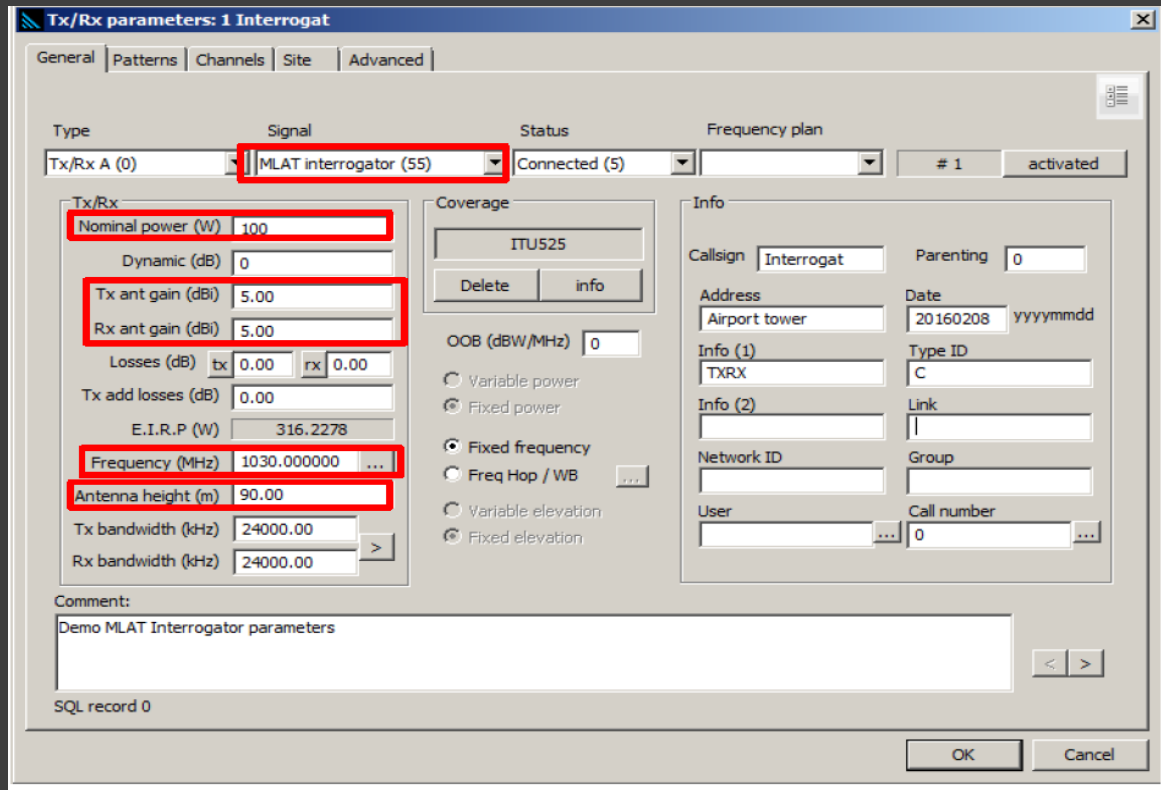
Report

Wind turbine - Radar constraints

Radar type	Wind turbine #	Callsign	Height	Agreement	Max Height
ZIT	2	Eolienne 1	150.00	NOK	0
ZIT	3	Eolienne 1	150.00	OK	150
Landing	2	Eolienne 1	150.00	OK	150
Landing	3	Eolienne 1	150.00	OK	150
Other	2	Eolienne 1	150.00	OK	150
Other	3	Eolienne 1	150.00	OK	150
H/L altitude	2	Eolienne 1	150.00	NOK	0
H/L altitude	3	Eolienne 1	150.00	OK	150



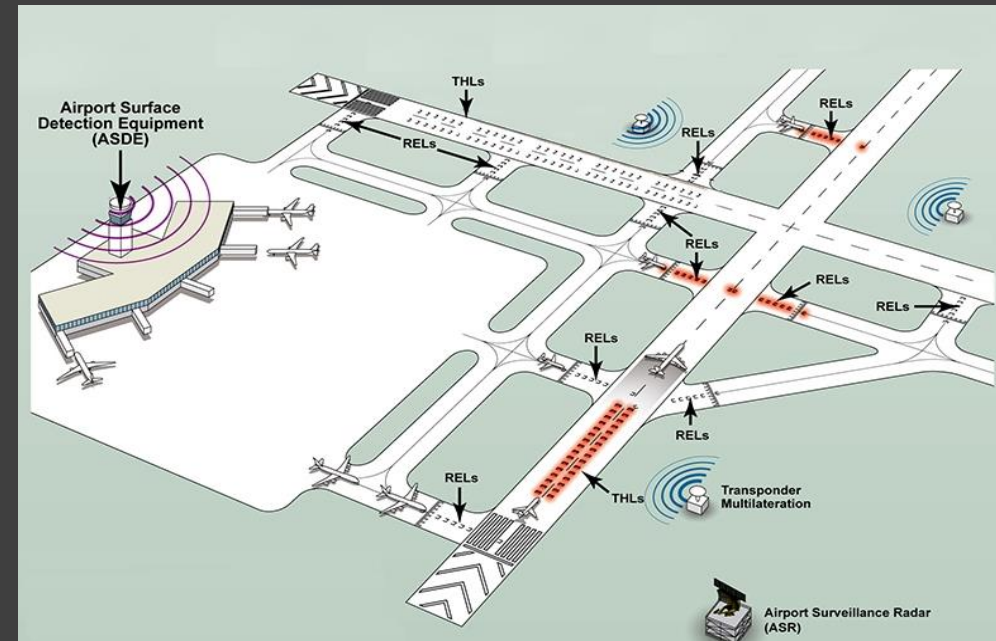
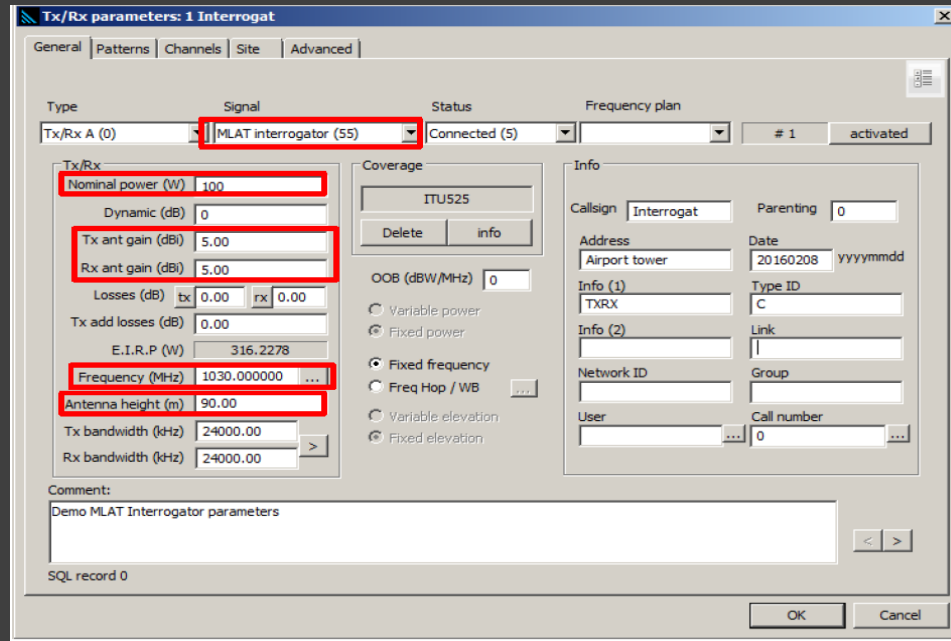
HTZ Warfare Multi-lateration- Airport surface



HTZ Warfare

Multi-lateration- Airport surface

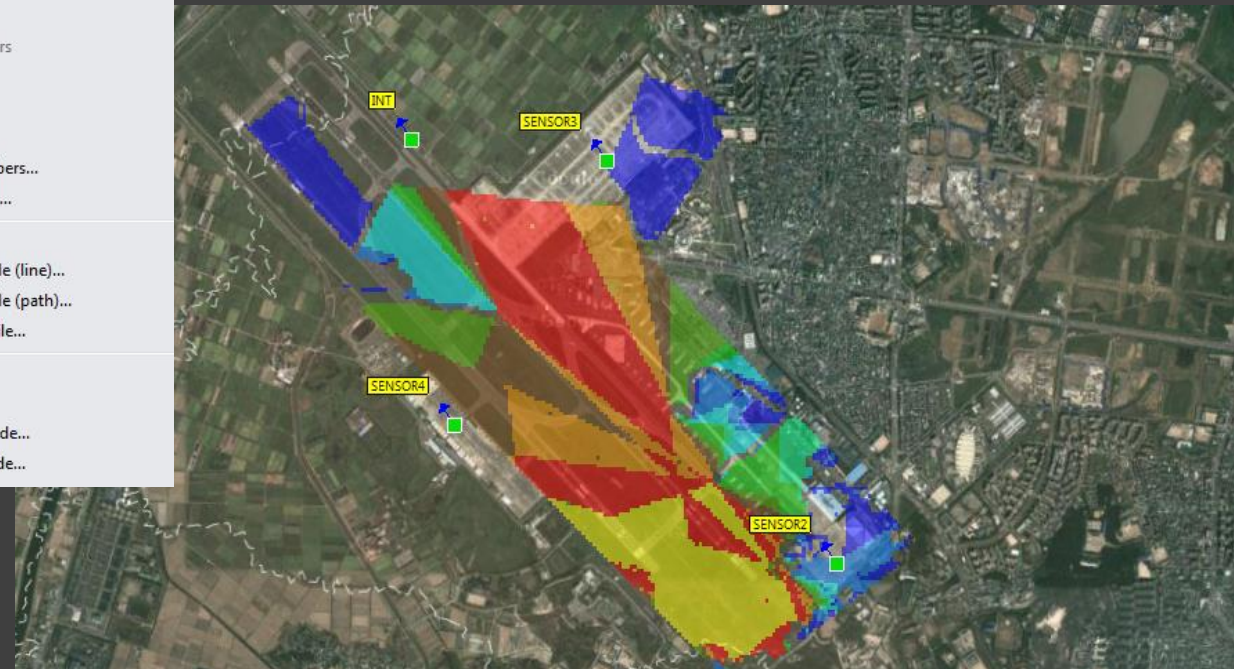
- Planning where to put the sensors
- Planning best spot to put the interrogator
- Evaluate the accuracy/range of the sensor network



HTZ Warfare Multi-lateration- Airport surface



- Move stations
- Duplicate stations...
- Rotate station antenna...
- Assign last polygon to station...
- Assign Tx/Rx sector and distance
- Microwave link list...
- Search site...**
- Assign subscribers to...
- Isolate subscribers
- Isolate orphan subscribers
- Mask subscribers
- Subscribers counter
- Generate subscribers...
- Search site from subscribers...
- Search site from clusters...
- Vector info...**
- Add polyline to vector file (line)...
- Add polyline to vector file (path)...
- Add polygon to vector file...
- Change clutter code...
- Modify clutter code...
- Change dtm / indoor code...
- Modify dtm / indoor code...



HTZ Warfare Broadband LTE A2G

LTE configuration:

- Freq: 2325 MHz
- Bandwidth: 5MHz
- TDD mode (config 1/ Subframe format 7)
- MIMO 4x2 system

Throughput Target:

- DL/UL : 2Mbps
- Coverage probability: 87,5%
- Aircraft Altitude: 8000 ft.

Output

#RE/PRB/subframe	16
Number of OFDM symbols per subframe	14
Total Number of PRBs per TTI	25
Reference signal	13.095
Primary synchronization signal (PSS)	0.000
Secondary synchronization signal (SSS)	0.632
PBCH / PRACH	1.210
PDCCH (incl. PCFICH, PHICH) / PUCCH	6.578
PDSCH	78.484



Input

FDD TDD

Cyclic prefix

Normal Extended

Antenna configuration

No. arrays T/R 4 / 2

TDD

DL-to-UL configuration

DL-to-UL config 1

Special subframe format type

Subframe Format 7

Regural DL/UL subframes 4

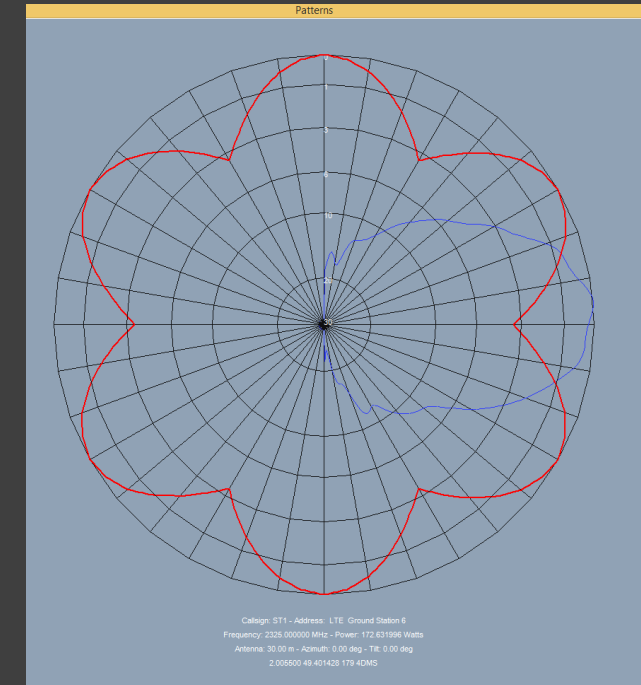
Special subframes 2

DL/UL ratio 54.29

Bandwidth (kHz) 5000.00

PDCCH symbol(s) 1

Max power (W) 30.000000



Antenna patterns (H/V)

HTZ Warfare Broadband LTE A2G

E-Node B parameters:

Type	Signal
Tx/Rx A (0)	LTE TDD (57)
Tx/Rx	
Nominal power (W)	30
Dynamic (dB)	0
Tx ant gain (dBi)	9.60
Rx ant gain (dBi)	9.60
Losses (dB)	tx 0.50 rx 0.50
Tx add losses (dB)	1.50
E.I.R.P (W)	172.632
Frequency (MHz)	2325.000000
Antenna height (m)	30.00
Tx bandwidth (kHz)	5000.00
Rx bandwidth (kHz)	5000.00

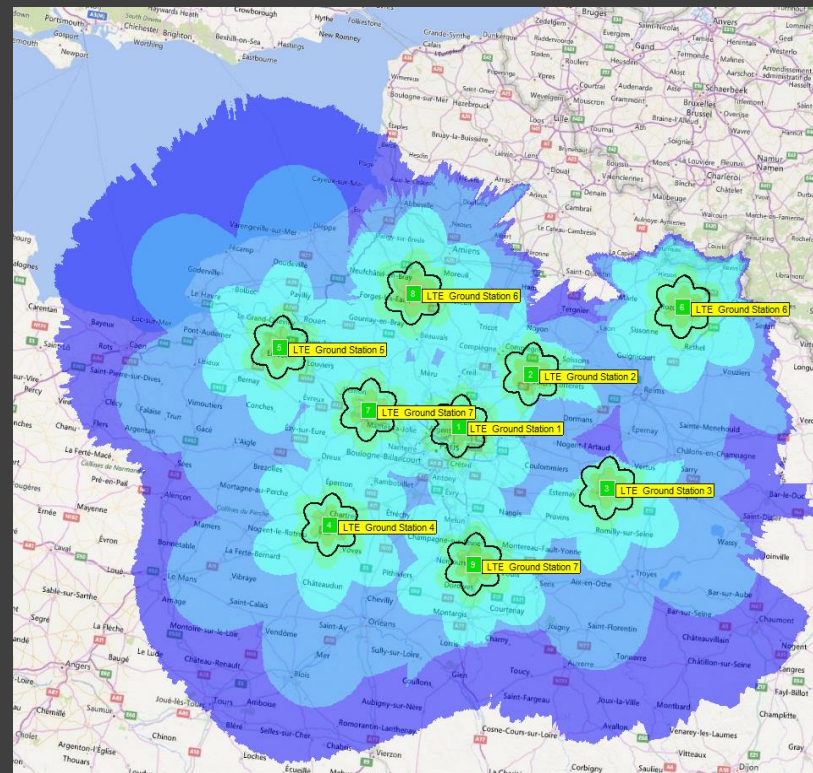


Fig 1: RSRP coverage (Aircraft altitude: 8000 ft)

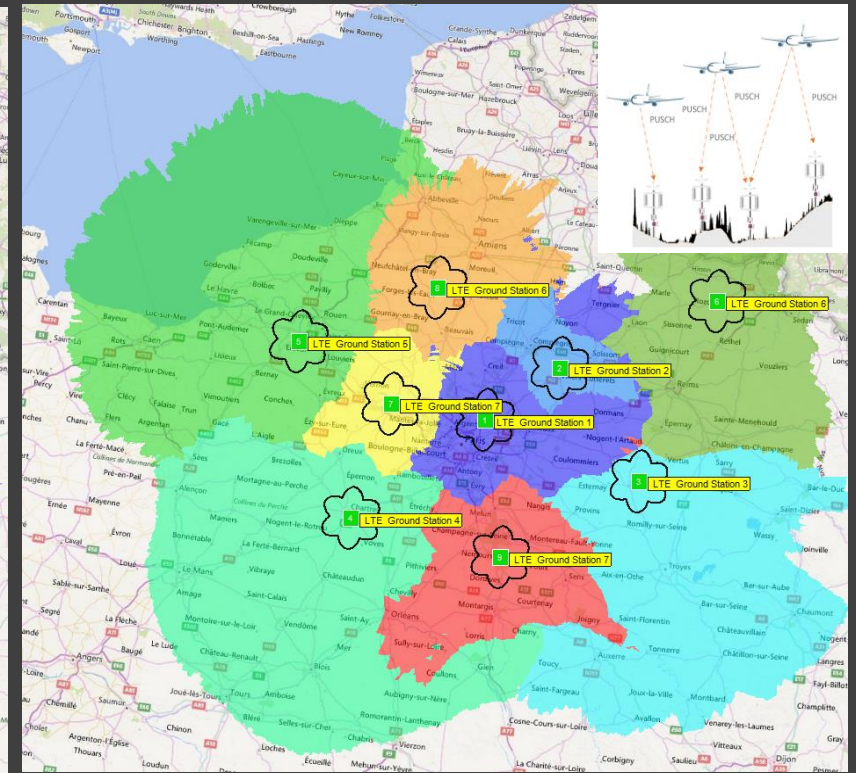
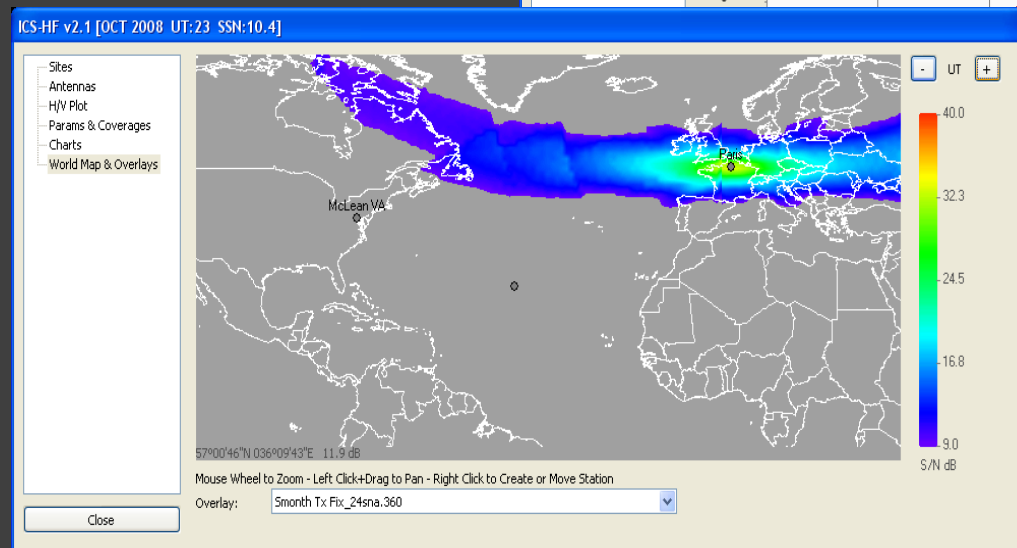
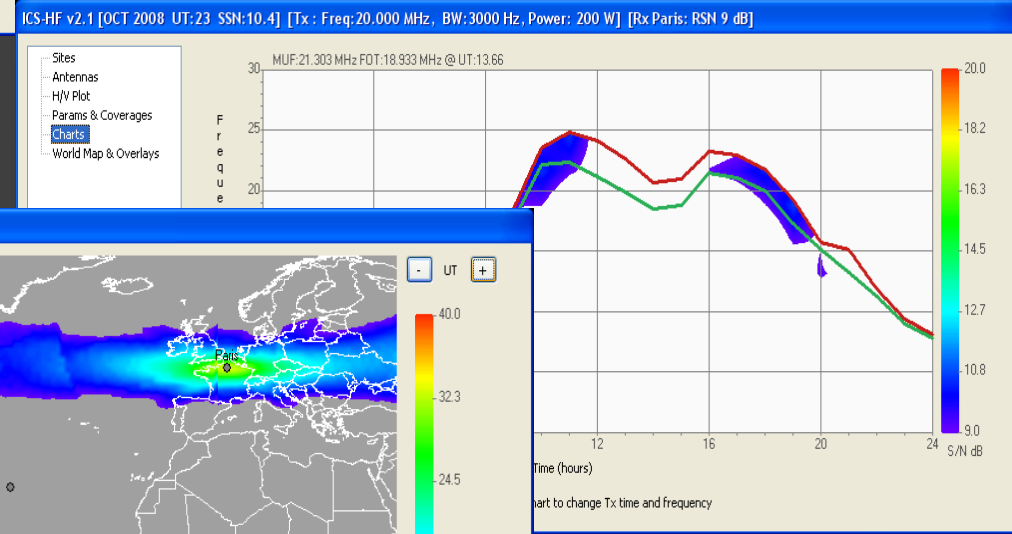
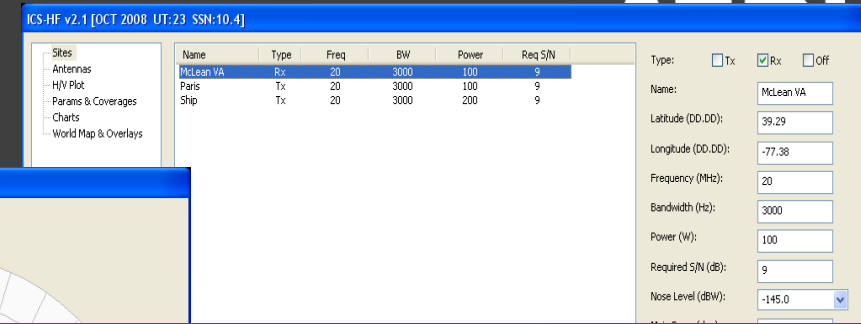
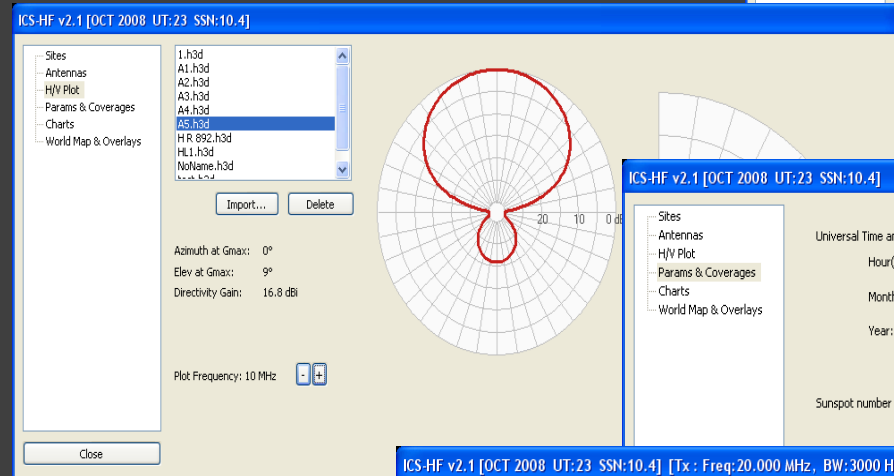


Fig 2: Best server RSRP map (Aircraft altitude: 8000 ft)

HTZ Warfare HF Planning

MODE	EQUIPMENT
SINGLE HOUR COVERAGE	FIXED TRANSMITTER
	MOBILE TRANSMITTER
SINGLE MONTH 24h COVERAGE	FIXED TRANSMITTER
	MOBILE TRANSMITTER

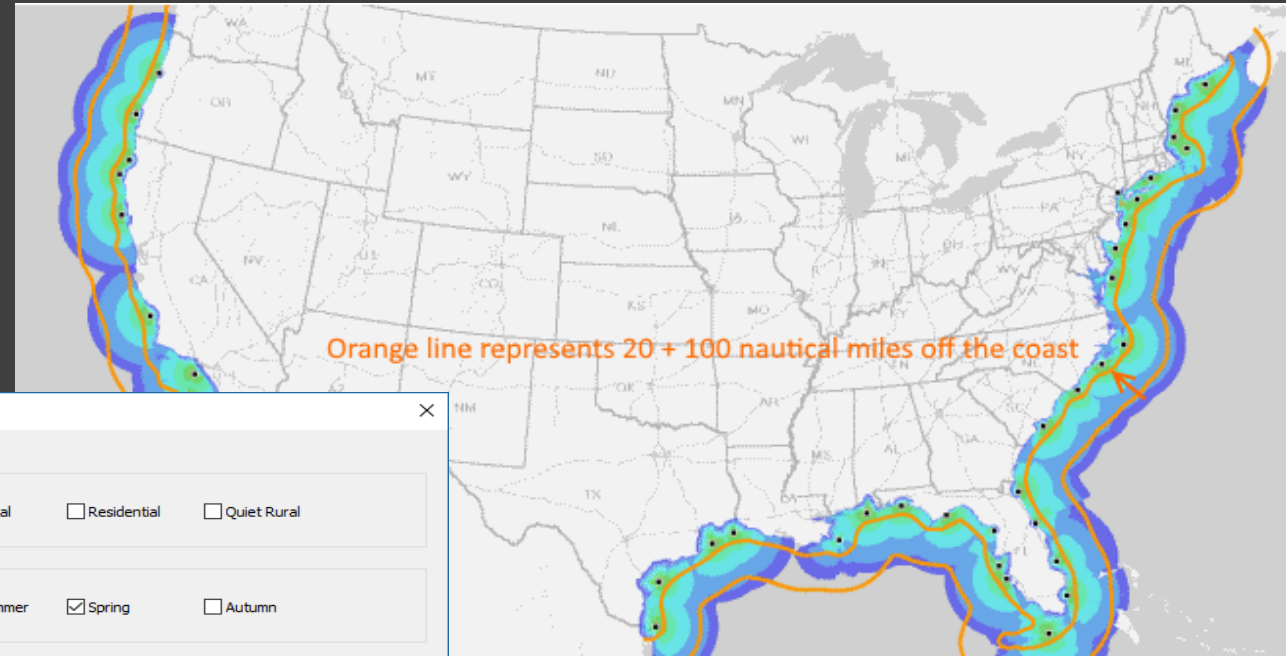
CHART ANALYSIS
MUF (Maximum Usable Frequency)
FOT (Frequency of Optimal Transmission)



HTZ Warfare HF Planning – Maritime Groundwave

In order to properly model the radio wave propagation of MF signals, HTZ warfare integrates the latest ITU recommendations specific to MF Groundwave propagation: ITU-R P.368-9 and ITU-R M.1467-1.

Calculation feature used to generate the field strength received predictions for each pixel on the map is based on the integration of ITU-R P.368-9 into HTZ's propagation engine.



NOISEDAT Calculator

Freq (MHz):
 Bandwidth (Hz):
 S/N (dB):
 Dt+(dB) (0->90%
3->95%):
 Emrp (W):
 Latitude (dd.ddd):
 Longitude (dd.ddd):

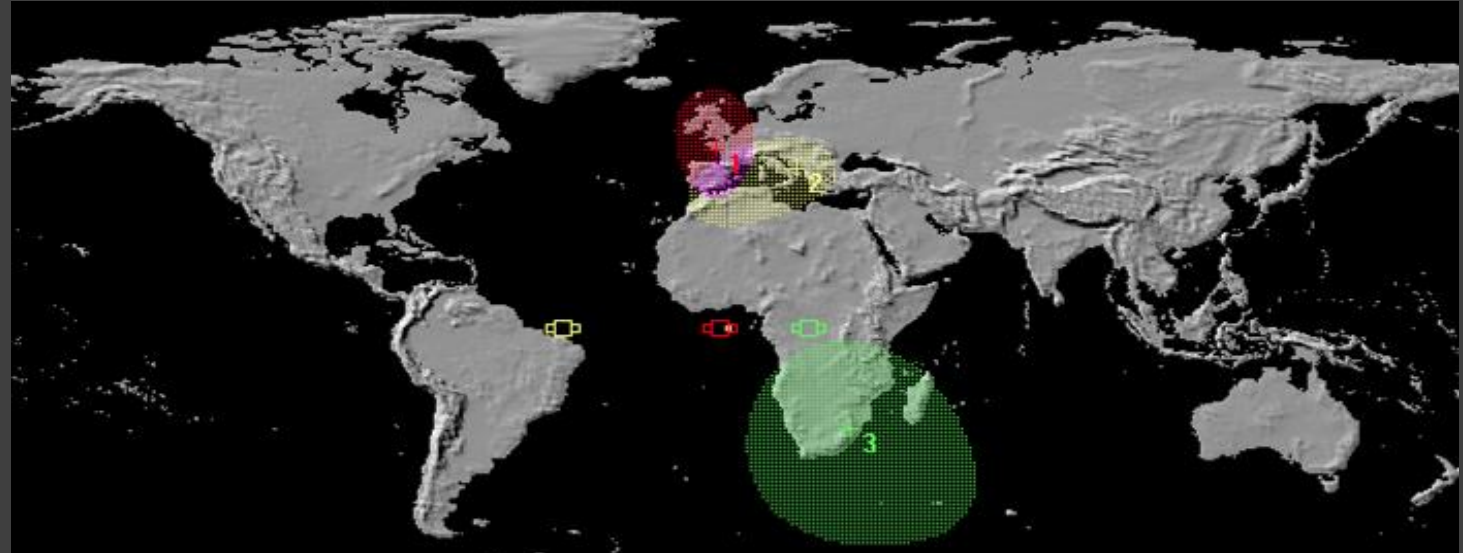
Rx Environment
 Business Rural Residential Quiet Rural

Season
 Winter Summer Spring Autumn

TIME	FA	THRESH	ATMO	GAL	MANMADE	OVERALL	DL	DU	SL
0000-0400	92.6	-46.4	80.4	58.6	75.1	82.0	9.5	10.1	2.2
0400-0800	84.3	-54.7	60.9	58.6	75.1	70.2	10.6	13.8	11.1
0800-1200	85.4	-53.6	47.4	58.6	75.1	75.2	5.9	9.7	1.5
1200-1600	81.7	-57.3	55.8	58.6	75.1	65.4	8.3	16.1	22.9
1600-2000	88.5	-50.5	69.0	58.6	75.1	69.5	15.4	18.7	18.0
2000-2400	92.2	-46.8	80.2	58.6	75.1	82.1	8.8	9.7	2.4

HTZ Warfare Satellites

- GSO/non-GSO satellite coverage planning and link budget (EIRP, G/T, C/N)
- Wide-beam and HTS beam planning across all satellite frequency bands
- Automated frequency planning
- GSO vs GSO and GSO vs non-GSO interference analysis ($\Delta T/T$, C/I, PFD and EPFD masks)
- Satellite vs terrestrial co-existence analysis /Earth station coordination (ITU APP 7)
- DTH network planning /SAT network planning and optimization
- Covers all satellite services: FSS, BSS, MSS, Earth exploration, meteorological and more



Satellite parameters

Call-sign: SAT 3 Color: [black] Type: NGSO description: Satellite 3

Info Press CTRL+Enter to change line

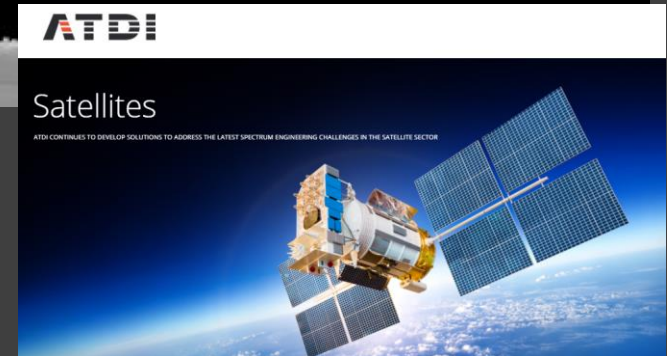
Altitude Longitude * 19.0000 Latitude * 0.0000 StationKeepingError * 1.00 distance to earth centre km 42164 Bore sight coord: Earth bore sight coord Bore sight longitude * 19.0000 Bore sight latitude * 48.0000 Bore sight/earth centre (dist) 6378 Bore sight orientation * 0.0000 Bore sight Euler angle phi * 0.0000 Bore sight Euler angle theta * 0.0000 Bore sight Euler angle psi * 0.0000		Tx/Rx parameters Nominal power (W) 10000.0000 Max power (W) 10000.00 Tx gain (dB) 0.00 Rx gain (dB) 0.00 Tx losses (dB) 0.00 Rx losses (dB) 0.00 ISO <input checked="" type="checkbox"/> Tx frequency (GHz) 11.00000 Tx bandwidth (MHz) 40.00000 Rx frequency (GHz) 1.50000 Rx bandwidth (MHz) 500.00000 Rx antenna noise K 2.00 G/T (dB/K) -3.01		Antenna Max pointing error (roll+pitch) * 1.50 Max pointing error (rotation yaw) * 0.50 <input checked="" type="radio"/> Circular pattern <input type="radio"/> Elliptical <input type="radio"/> Other Pattern type: rec. 672-4, LN=-20 dB (side lobe level) 1/2 power beamwidth 3 dB * 2.0000 1/2 power beamwidth 3 dB (major axis) * 2.0000 1/2 power beamwidth 3 dB (minor axis) * 1.0000 <input type="radio"/> Add 2 x Pointing Error to beamwidth <input checked="" type="radio"/> No error	
--	--	---	--	---	--

Polarization
 Clockwise
 Polar axial ratio (Emin/Emax 1=circular) 1.00
 Angle of polarisation (rotation yaw) * 0.0000

Circular orbit
 Inclination (+180°) 20.0 Anomaly at T0 (0 to 360°) 1.0 Relative time T-T0 (sec) 20000

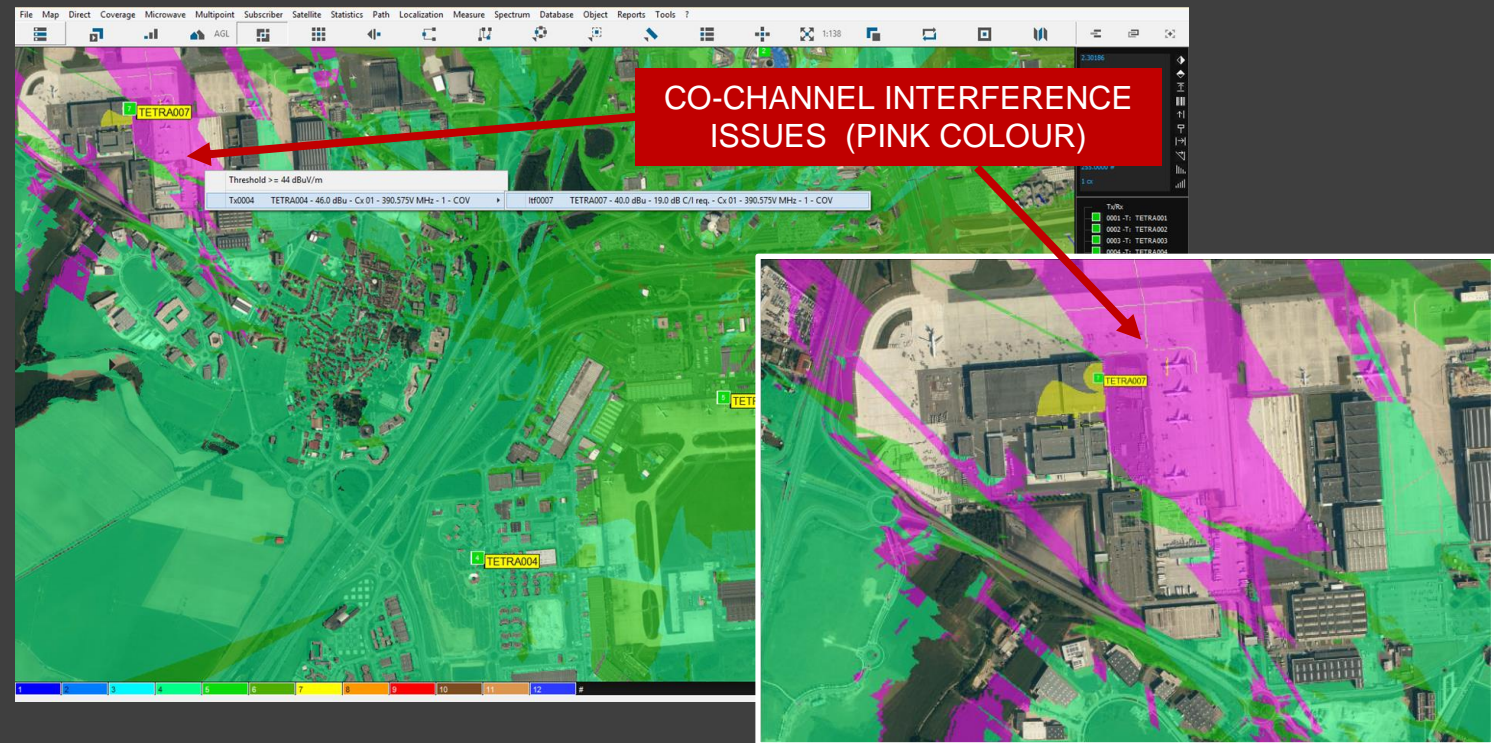
Model atten -1 = R.618 (dB) -1.0 Nb subscribers 0 BW occupancy MHz 0.00000 Loss dB 0.0 OK Cancel

*none = not selectable



HTZ Warfare Interference Analysis

- Provides all capacities for frequency interference analyses (co-, interstitial and adjacent channel interference) based on propagation conditions and the scenario of existing stations.
- Procedures are implemented for all services and consider the special behavior of different service types with regards to bandwidth, spectral distribution or filter curve of the receiver. Interference analysis can be performed using a general analysis function delivering a fast result.
- Comprehensive report that summarizes all technical and operational details of the performed interference analysis can be generated. This includes for example the operational characteristics of the transmitters/receivers, their locations, the utilized propagation model, etc. All identified interference cases are presented on the produced interference reports. In addition, all interference cases may also be visualized graphically on the GIS.

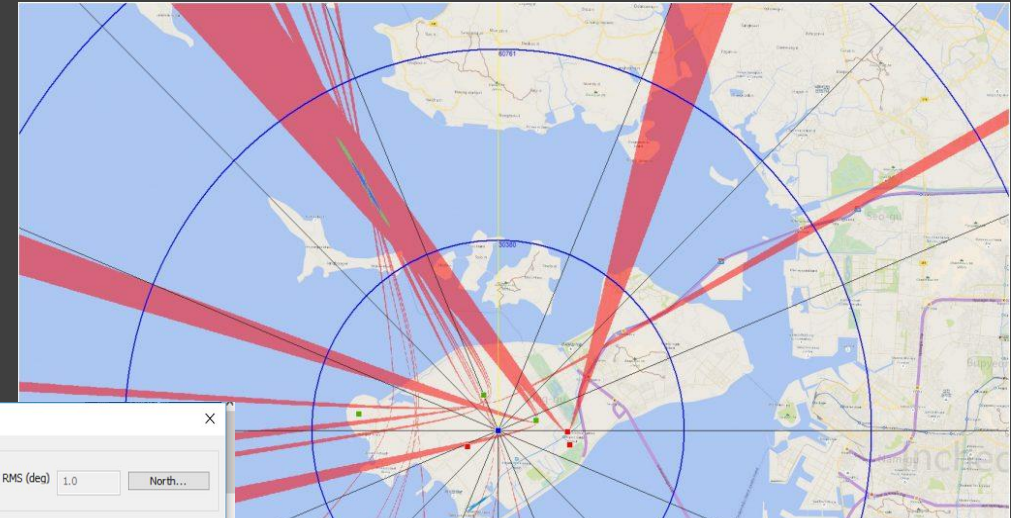


HTZ Warfare

Hybrid Localisation from Measurement

This function is drawing a map of the possible locations of the reference station that has been measured (Target transmitter). It will localize the “target transmitter”, based on the measurement file imported, containing for each coordinate point, either:

- Field strength received (RSSI) measured, or
- Angle of arrival (AOA) of the signal received, or
- Angle of arrival (AOA) of the signal received and Field strength received (RSSI) measured,
- Field strength received (RSSI) measured and measurement azimuth



Hybrid localization from measurements

Measurement file name:

Preview:

Generic format: X[separator]Y[separator]FS[separator]AOA (deg)<CR>

Measurement file settings

Separator: X and Y are inverted

Coordinate code:

Number of values:

Move measurements on vector line

Use vector polygon(s) as mask

Set clutter to 0 on measurement point

Add measurement to vector layer

Processing

RSSI only

AOA only

AOA + RSSI / AOA or RSSI

Homing (Direction + RSSI)

Tolerance margin (max -n) (dB):

Distance discrimination (meas. pts) (m):

Clutter filter (target transmitter location)

0 <input checked="" type="checkbox"/> open	10 <input checked="" type="checkbox"/> rail
1 <input checked="" type="checkbox"/> village	11 <input checked="" type="checkbox"/> road
2 <input checked="" type="checkbox"/> suburban	12 <input checked="" type="checkbox"/> airport
3 <input checked="" type="checkbox"/> urban	13 <input checked="" type="checkbox"/> Tunnel
4 <input checked="" type="checkbox"/> dense urban	14 <input checked="" type="checkbox"/> open rural
5 <input checked="" type="checkbox"/> forest	15 <input checked="" type="checkbox"/> b-plaster
6 <input checked="" type="checkbox"/> hydro	16 <input checked="" type="checkbox"/> b-brick
7 <input checked="" type="checkbox"/> high urban	17 <input checked="" type="checkbox"/> b-glass
8 <input checked="" type="checkbox"/> park/wood	18 <input checked="" type="checkbox"/> b-wood
9 <input checked="" type="checkbox"/> roof - building	19 <input checked="" type="checkbox"/> route

Bearing measurement

RMS (deg):

RSSI measurement

Conversion to dBu (+dB):

Min range (measurement):

Max range (measurement):

Tolerance (measure - prediction) (dB):

Threshold (dBu/m):

Meas. Rx antenna (m): AGL ASL

LOS calculation only

Measurement file cases:

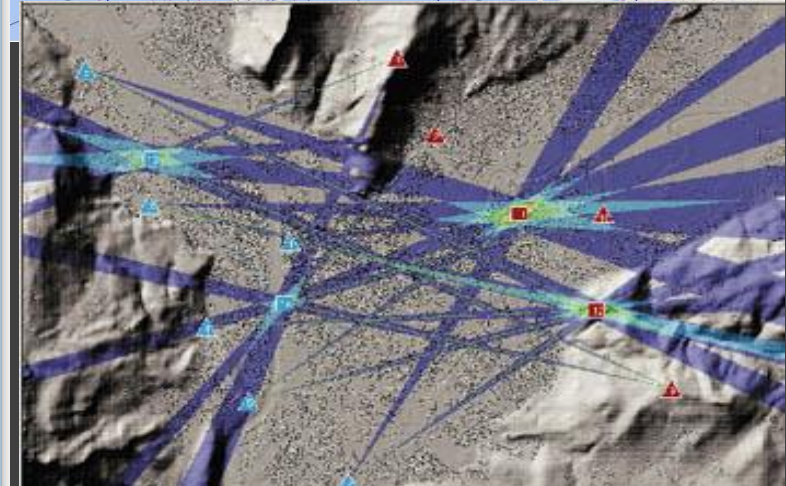
If FS, RSSI localization will be performed

If AOA and FS, RSSI localization sector limited (AOA+RMS)

If AOA only, DF localization (AOA+RMS)

If Homing, AOA = measurement azimuth+RMS

Add localized point(s) on the map



Annex

References

References

Military, Defence administrations

APCO AFC

US Army Spectrum Management Office

JSC, Joint Spectrum Center

FAA, Federal Aviation Administration

DOE, Dept. of Energy HQ Spectrum Management Office

Bonneville Power Authority

Western Area Power Authority

National Nuclear Security Administration

DOI, Dept. of Interior Wireless Management Office

FCC, Federal Communications Commission

USAF, United States Air Force

NASA, National Aeronautical Space Administration



National Security Agency

DHS, Dept. of Homeland Security Wireless Management

US Coast Guard HQ/LANT/PAC

US Customs and Border Patrol

Immigration and Customs Enforcement

DOJ, Dept. of Justice Wireless Management Office

FBI, DEA

INEL, Idaho National Engineering Laboratory

SPAWAR, Space and Naval Warfare Systems Command

NTIA, National Telecommunications Information Administration

References

Military, Defence administrations

France:

French National Air Operation center / CNOA (centre national des opérations aériennes française)
 Signal Corps / CNGF (Centre nationale des Gestions des Fréquences)
 DGA MI (Direction Générale de l'armement)
 STAT (Section Technique de l'Armée de Terre)
 DCI (Défense Conseil International)

Europe:

NARFA (National Allied Radio Frequency Agency) – Norway
 DSTL - Defense Science and Technology Laboratory (UK)
 Royal Air Force Henlow (UK)
 HMGCC – Her Majesty's Government Communications Centre (UK)
 Ministry of Defense (Belarus, Kazakhstan, Serbia, Poland, Romania, etc)
 RUAG Electronics (Switzerland)
 Armasuisse (Switzerland);
 FUB (frequency management department/Frequenzmanagement, Switzerland)
 Finnish Army;
 British Army;
 Portuguese Air Force;
 Norwegian Navy;
 Forsvarets forskningsinstitutt (FFI);

MENA:

UAE Air Force (Abu Dhabi)
 UAE Electronic warfare (Abu Dhabi)
 Border Guards of KSA
 Direction Centrale des Transmissions et de Guerre Electronique (Algéria)
 QESC (Qatari Electronic Signal Corps)
 Minister of Defense (Bahrein) - BHQ (Bahrein Headquarter)
 Minister of defense of Morocco (Royal Marine)
 Ministry of Defense (Oman, Egypt);
 Egyptian Air Force (EAF)
 PSDARC (KSA)

Asia Pacific:

Minister of defense of Bangladesh
 Minister of defense of China
 Korean Army Signal School (South Korea)
 Agency of Defence Development (South Korea)
 Joint Chiefs of Staff (South Korea)
 DSO & DSTG (Australia)
 DSTA (Singapore)
 PLPE (Malaysia)
 Land Engineering Agency, ADF (Australia)
 Indian Air force Army;
 DLRL (India);
 Taiwanese Army, Thai Army;...

References Vendors

NOKIA Portugal

Motorola solution (UK, Poland, Norway, Oman, Duba, Pakistan,...)

Thales

Airbus (Germany, Romania, France, Qatar...)

Teltronic (Spain)

Ericsson (France)

KAPSCH (France, Austria, Bulgaria)

Marconi (UK)

Philips (Netherlands)

Raytheon (US)

Sepura (Malaysia)

SELEX (Finmeccanica, Italy)

Boeing (USA)

Rhode and Schwartz (Germany)

Lockheed Martin (USA, UK)

Hytera (Austria, Germany)

Etc...



Thank you!



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End of Document