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WRAP for Defence Applications



MAKING RADIO VISIBLE, CONTROLLABLE AND VALUABLE

WRAP 1781_Rev2021

WRAP - more information

- www.altair.com
Brief information
- www.wrap.se
Detailed information
- <https://wrap.se/radio-network-planning/download-video-films/>

View on-line videos on Military applications (and more)

WRAP at central defence spectrum management agency

- Coordination between national/international military and national/international civilian frequency utilisation
- Central management of frequency allocations, allotments and assignments for the national defence forces
- Distribution of coordinated frequency allocations, allotments and assignments to the air force, army, navy and other services
- Design of radio communication, electronic warfare and radar functions and facilities to achieve required capabilities for coverage, performance and electromagnetic protection.

WRAP at regional and service level **ARMY, AIR FORCE, NAVY**

- Long-term planning of the frequency utilisation within the region/service
- Short-term planning of the frequency utilisation for missions, manoeuvres and large exercises
- Planning and design of radio communication, electronic warfare and radar functions and facilities to achieve required capabilities for coverage, performance and electromagnetic protection.

WRAP at local and military unit level

Field users can connect to central servers, and run stand-alone

- Short-term frequency planning for missions
- Planning of radio communication, electronic warfare and radar units to achieve required capabilities for coverage, performance and electromagnetic protection.

Summary: WRAP at central, regional and command unit level

- Central: Strategic, long-term spectrum management. Support in the design and procurement of new systems.
- Regional/Service: Strategic and tactical, long-term and short-term spectrum management within the region/service. Support in detailed planning and design of existing and new systems.
- Local/Unit: Tactical, short-term planning of frequency utilisation and unit deployments to support the current mission with the goal of achieving successful radio communications, EW and radar coverage.

WRAP in a hierarchy

- WRAP supports the hierarchical process of military spectrum management through all levels.
- WRAP can be used at all levels, with efficient exchange of data between the levels and between WRAP systems operating at the same level.

Radio systems typically used in the Army

- HF radio communication
 - Short range tactical ground wave and sky wave
 - Medium-long range strategic sky wave
 - VHF/UHF radio communication
 - Combat Net Radio 30-88 MHz
 - Short-range personal radios
 - Tactical data communication networks
 - UHF links
 - Microwave links
 - Air defence radars
 - Surveillance sensors
 - Electronic warfare systems
- WRAP supports all of these systems*

Radio systems typically used in the Air Force

- VHF/UHF radio communication
 - 118-136 MHz, 225-400 MHz, 960-1215 MHz
- HF radio communication, ground-to-air/ground-to-ground, sky wave
- Ground communication at air bases
- Distress systems: 121.5, 243, 406, 1646 MHz
- NDB, VOR, ILS, DME, MLS navigation systems
- Ground traffic control radars
- Air surveillance radars
- Airborne radars
- Electronic warfare systems

WRAP supports all of these systems

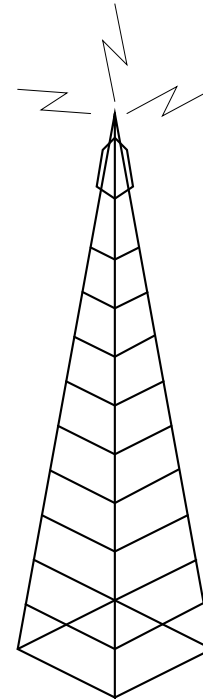
Radio systems typically used in the Navy

- HF radio communication ship-to-shore/ship-to-ship, ground wave
 - HF radio communication, ship-to-shore/ship-to-ship, sky wave
 - VHF radio communication
 - AIS navigation systems (160 MHz)
 - VLF/LF navigation and communication systems
 - Coast surveillance radars
 - Ship-borne radars
 - Electronic warfare systems
- WRAP supports all of these systems*

Main Functions

- Basic Package
- Coverage
- Interference
- Collocation Interference
- Radio Link Performance
- Spectrum View
- Frequency Assignment
- Traffic Capacity
- Radar Coverage
- Earth Station Coordination
- Satellite Network Coordination
- 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
- Map Data Manager

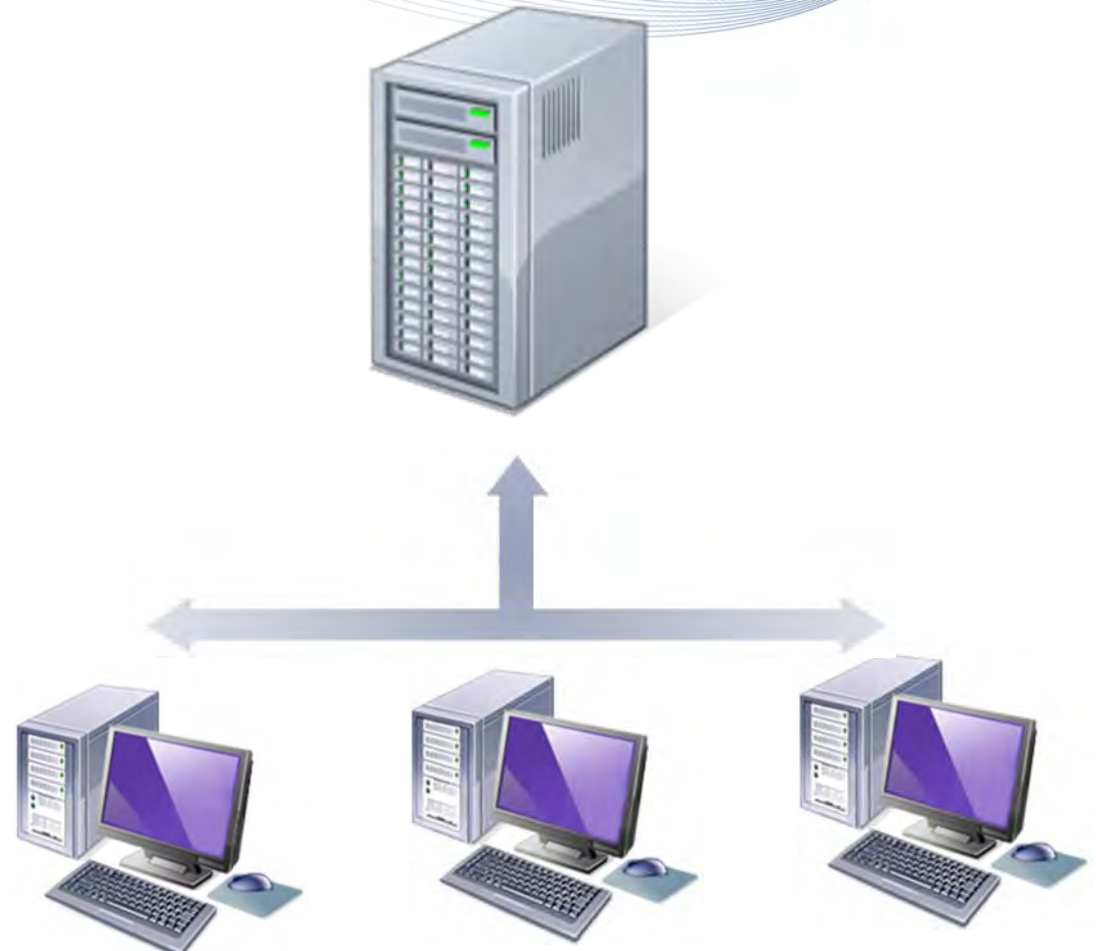
Functions in red are recommended for full military spectrum management capabilities. All functions are included in the Altair WRAP licence.



Configurations, general

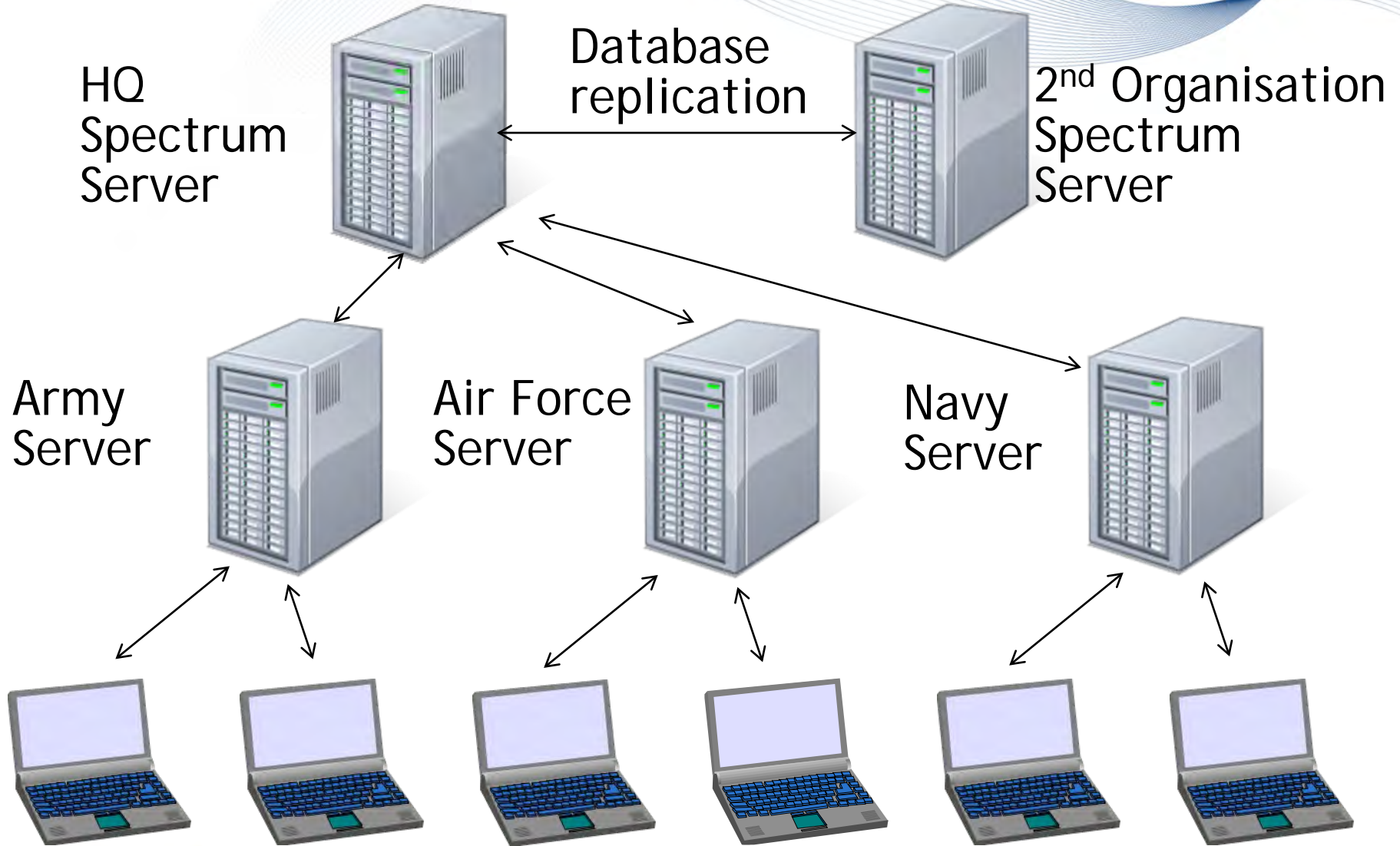
WRAP can be configured as a single-user system

OR
as a client-server application in a larger organisation



CLIENTS

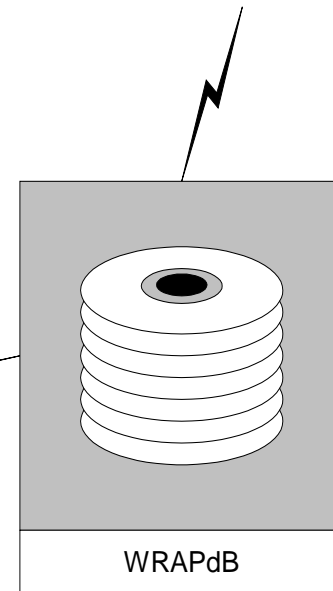
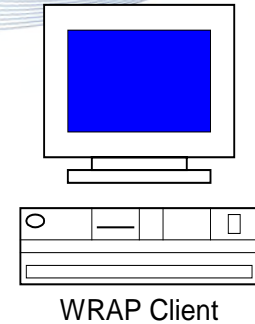
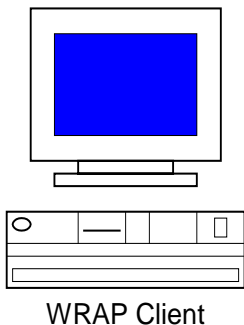
Example of Defence-Type Client-Server Configuration



WRAP Station Database

WRAPdB, a comprehensive database for station and equipment characteristics

- Microsoft SQLLocalDB (only stand-alone)
- Microsoft SQL-Server
- Any ODBC database (e.g. Oracle)
- Import from BRIFIC and other databases



Station databases

WRAP handles several station databases:

- WRAPdB main database(s)
- National Frequency Register (civilian spectrum use)
- ITU BRIFIC
- SMIR

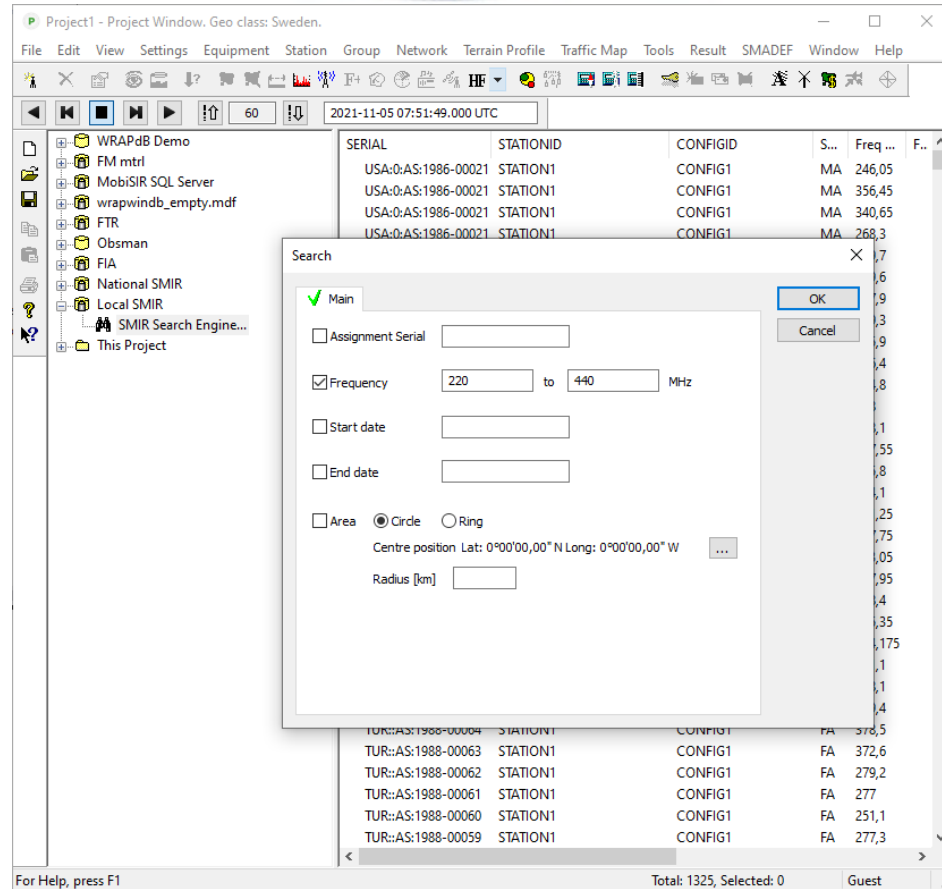
The screenshot displays the WRAP software interface, divided into three main windows:

- Spectrum.WPR:1 - Project Window:** Shows a hierarchical tree view of databases and project files. The tree includes folders for 'WRAP DB Demo 4.5', 'BRIFIC fmv', 'BRIFIC fxm', 'BRIFIC GE06D', 'Stations', 'Groups', 'Networks', 'Satellite networks', 'Equipment', 'Allotment', 'BRIFIC lfmf', 'National Master Register', and 'This Project'. The 'Stations' folder is expanded, showing a list of stations with columns for Latitude, Country, Type, and Remark.
- Spectrum.WPR:2 - Map Window:** Displays a map of a region with a pink polygon highlighting a specific area. Numerous black icons representing stations are scattered across the map, with a higher density within the pink polygon.
- Station Search Engine:** A dialog box with the following fields and options:
 - Buttons: Main, Cell Info, OK, Cancel
 - Search criteria:
 - Name (with a text input field)
 - Tx frequency, Rx frequency (with 'To' and 'MHz' labels)
 - Area, Circle, Polygon
 - Include typical stations
 - Class of Station (dropdown menu showing 'BT - Broadcasting station, TV')
 - Comment (with text input field containing 'GE06D')
 - Country (with a text input field)

SMADEF

(Spectrum Management Allied Data Exchange Format)

- Import of SMADEF Assignment messages
- Connection to a National SMIR (Spectrum Management Information Repository)
- Search for Assignments in SMIR
- Assignments are converted to WRAP Stations when added to project



SFAF

(Spectrum Frequency Action Format, as used by
US SPECTRUM XXI)

- Import / Export of SFAF messages
- Extra pages to fill in SFAF specific data

BaseStations.WPR:1 - Project Window. Geo class: Sweden.

File Edit View Settings Equipment Station Group Network Terrain Profile Traffic Map Tools Result SFAF SMADEF

Window Help

Edit Station: Base Station 13

Main Frequencies Tx Equipment Rx Equipment Cell Information SFAF Admin SFAF Equipment

005. Classification UB

010. Type of Action M

130. Time

140. Required Date 2017-03-2

141. Expiration Date 2017-05-3

142. Review Date

144. Approval Authority Indicator

145. ITU BR Registration O

702. Control/Request Number

704. Type of Service B

803. Requestor Data

805. Date Response Required

102. Agency Serial Number S1234

112. Fq Sep Criteria

200. Agency S

201. Unified Command

204. Command

207. Operating Unit

707. PACOM / FMSC

716. Usage Code 3

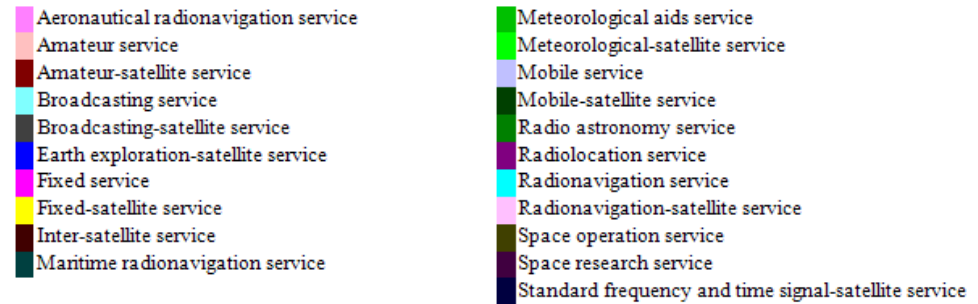
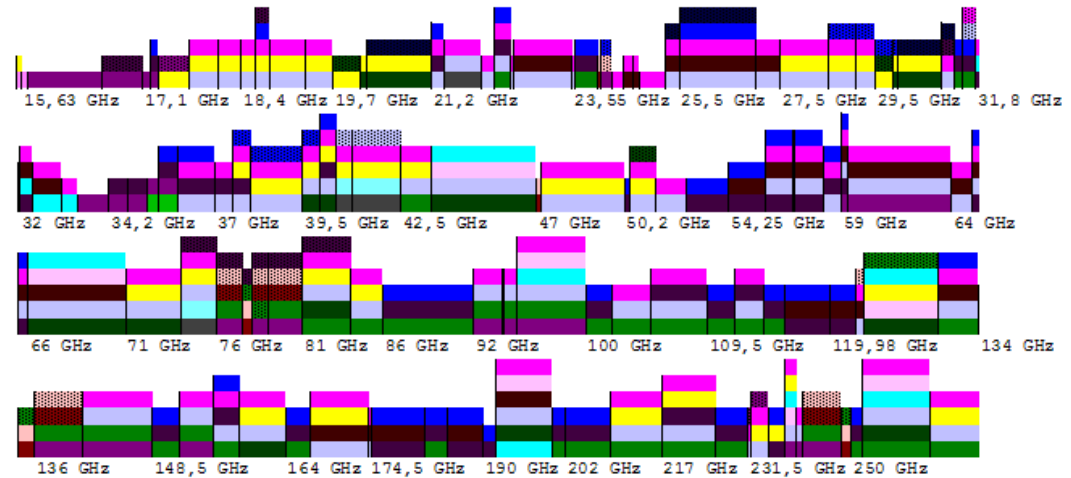
OK Avbryt Hjälp

For Help, press F1 Total: 16, Selected: 1 Guest

Spectrum Allocation Manager

- SAM provides functions for handling Allocations:

- ITU Regions 1, 2 and 3
- National allocations
- Military allocations
- Sub-bands
- Footnotes
- Referenced standards
- Utilisations



- Allotment generation

- Deterministic
- Random
- Considering existing allotments
- Import/Export from/to WRAP

2003-11-09

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Allotments

Create Allotment

Lower band

Min frequency [MHz]: 64

Max frequency [MHz]: 67

Assigned fq Refer

Channel separation [kHz]:

Bandwidth on allotment Fq

No of channels:

Duplex Spacing [MHz]

Channel arrangement

Polarisation independent

Alternated

Co-channel band re-use

Interleaved band re-use

Interleaved polarisation

Frequency Search Result

Show

Only free frequencies

Only occupied with < base 8 bits

Only occupied with >

Only marked frequency

Only blocked frequency

All frequencies in band

Statistics

Total no of free frequencies: 37

Total no of shown bit frequencies inside area: 8

Edit Allotment

Allotment Name:

Owner: WRAP User

Duplex

Band usage at base

Lower band Upper band Don't care

f [MHz]	f' [MHz]	Tx [MHz]	Rx [MHz]	Channel	Comment
890	935	935	890	1	
890,2	935,2	935,2	890,2	2	
890,4	935,4	935,4	890,4	3	
890,6	935,6	935,6	890,6	4	
890,8	935,8	935,8	890,8	5	
891	936	936	891	6	
891,2	936,2	936,2	891,2	7	
891,4	936,4	936,4	891,4	8	
891,6	936,6	936,6	891,6	9	
891,8	936,8	936,8	891,8	10	
892	937	937	892	11	
892,2	937,2	937,2	892,2	12	

f [MHz]:

f' [MHz]:

Channel:

Level:

Comment:

Compatibility

Class of station

Base station

Coast station

Aeronautical station

Fixed station

Radionavigation land station

Radiolocation land station

Max EIRP [dBW]

Class of emission:

Validity

Start date:

End date:

Start time: End time:

Area:

Comment:

Generation of Allotments: The Process

- In SAM (Spectrum Allocation Manager)
 - Generate Total Pool of frequencies based on ITU Table of Frequency Allocations, national allocations and blocked allotments
 - Export to file or save in WRAPdB for direct access by WRAP
- Make congestion check between Total Pool and existing assignments and allotments to be protected. Save Coordinated Allotment of free frequencies.
- Use Coordinated Allotment as top-level source allotment for dividing into specific Services Allotments as may be needed
- Further divide Services Allotments into Network Allotments, considering propagation conditions, link properties, network location and extent etc.

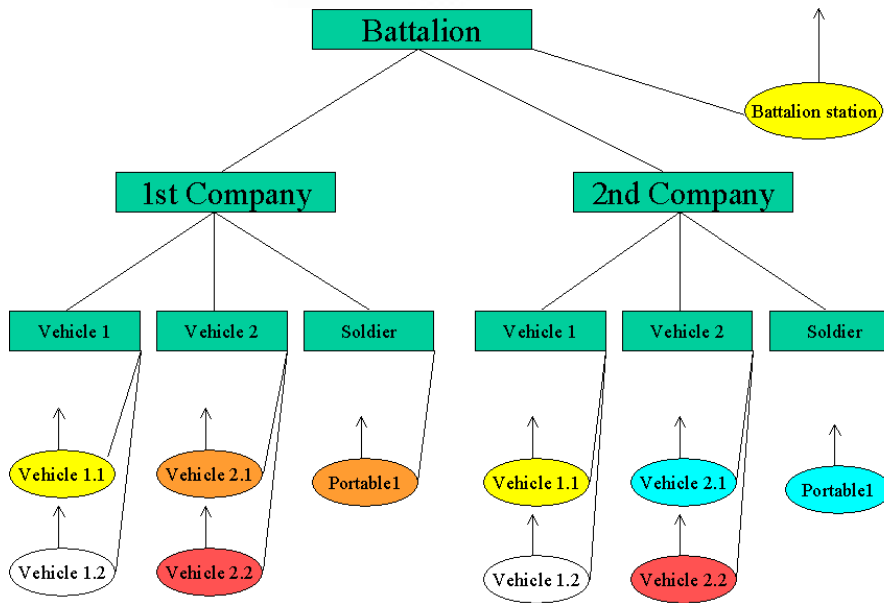
Units, nets and command structure handling

The screenshot displays a software window titled "Networks_FF.wpr:2 - Map Window". The main area is a map showing a terrain with red and blue areas, overlaid with a grid. Several military units are marked with icons and labels: Battalion 133, Brigade 13, Battalion 132, Battalion 131, Division 1, Battalion 113, Brigade 11, Battalion 112, Battalion 111, Battalion 123, Brigade 12, Battalion 122, and Battalion 121. A tree view on the right side of the window shows the command structure:

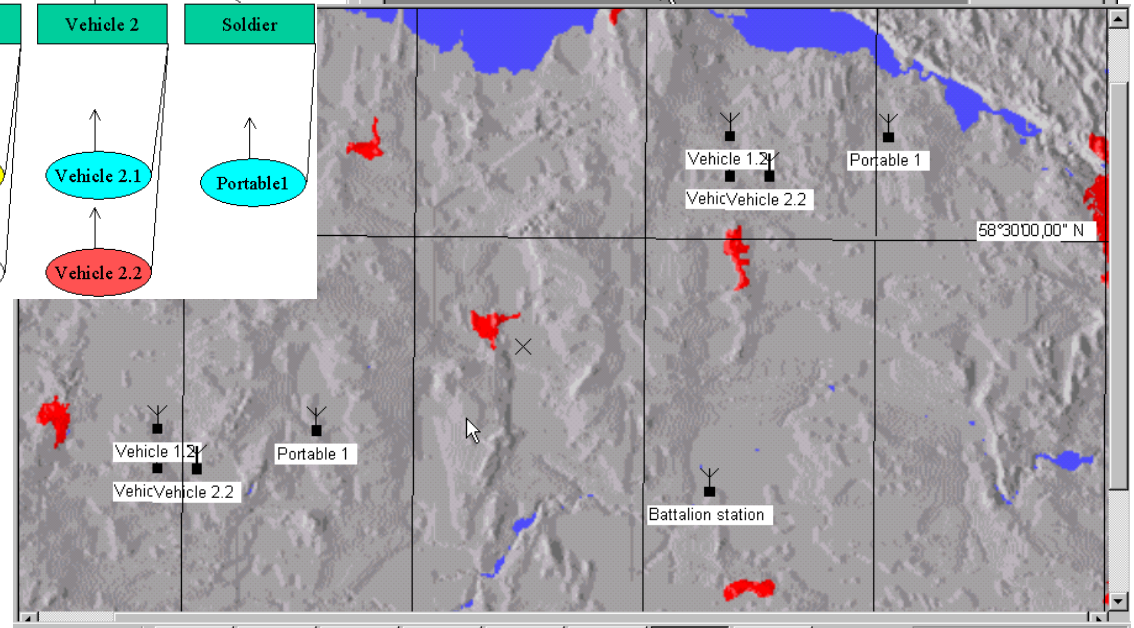
- This Project
 - Stations in Project
 - Groups in Project
 - Sites in Project
 - Units in Project
 - Division 1**
 - Stations
 - Brigade 11
 - Battalion 111
 - Company 1111
 - Platoon 11111
 - Stations
 - Company 1111 HQ
 - Stations
 - Platoon 11112
 - Stations
 - Platoon 11113
 - Stations
 - Battalion 111 HQ

The status bar at the bottom of the window displays the following information: "For Help, press F1", "Lat: 58°29'47,07" N", "Long: 15°28'55,49" E", "X: 6485942,9", "Y: 1480981,1", "Z: 78", "Åkermark", "1:300000", and "Guest".

Network Management

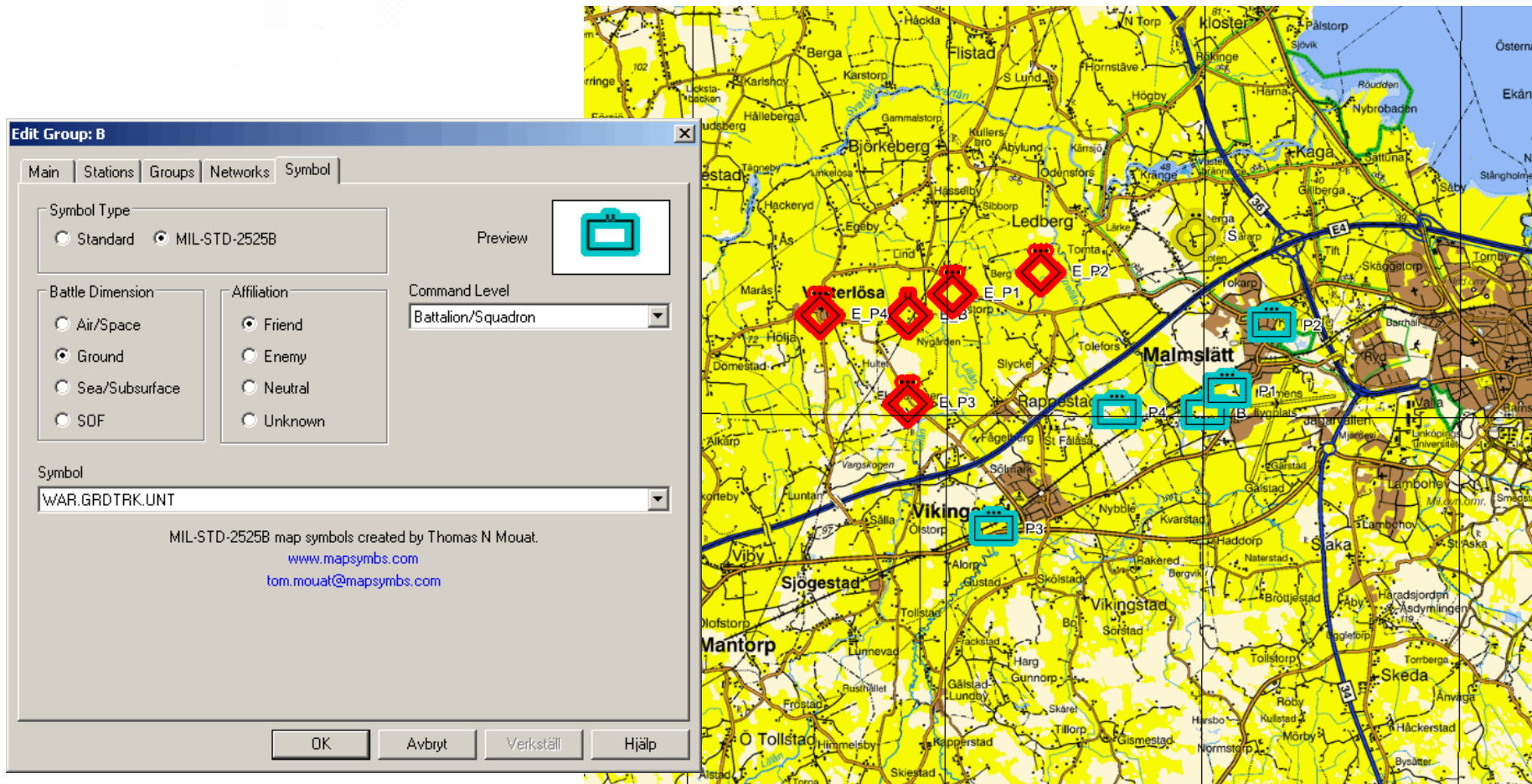


Group/Network	Bat Net	1st Comp Net	2nd Comp Net	Company
Battalion	Battalion st...			
1st Company				
Vehicle 1	Vehicle 1.1			
Vehicle 2		Vehicle 2.1		Vehicle 2
Soldier		Portable 1		
2nd Company				
Vehicle 1	Vehicle 1.1			
Vehicle 2			Vehicle 2.1	Vehicle 2
Soldier			Portable 1	

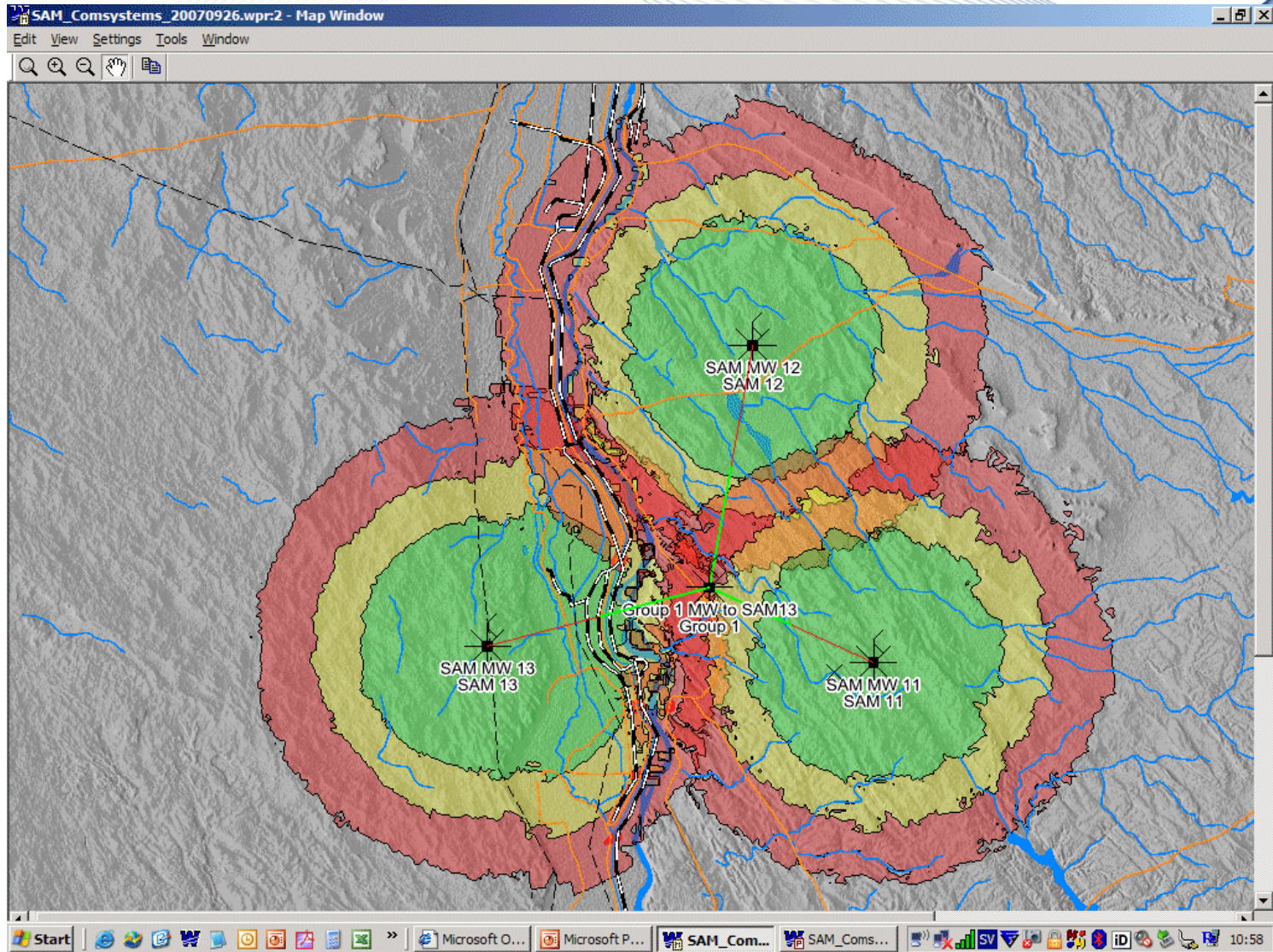


Network Management

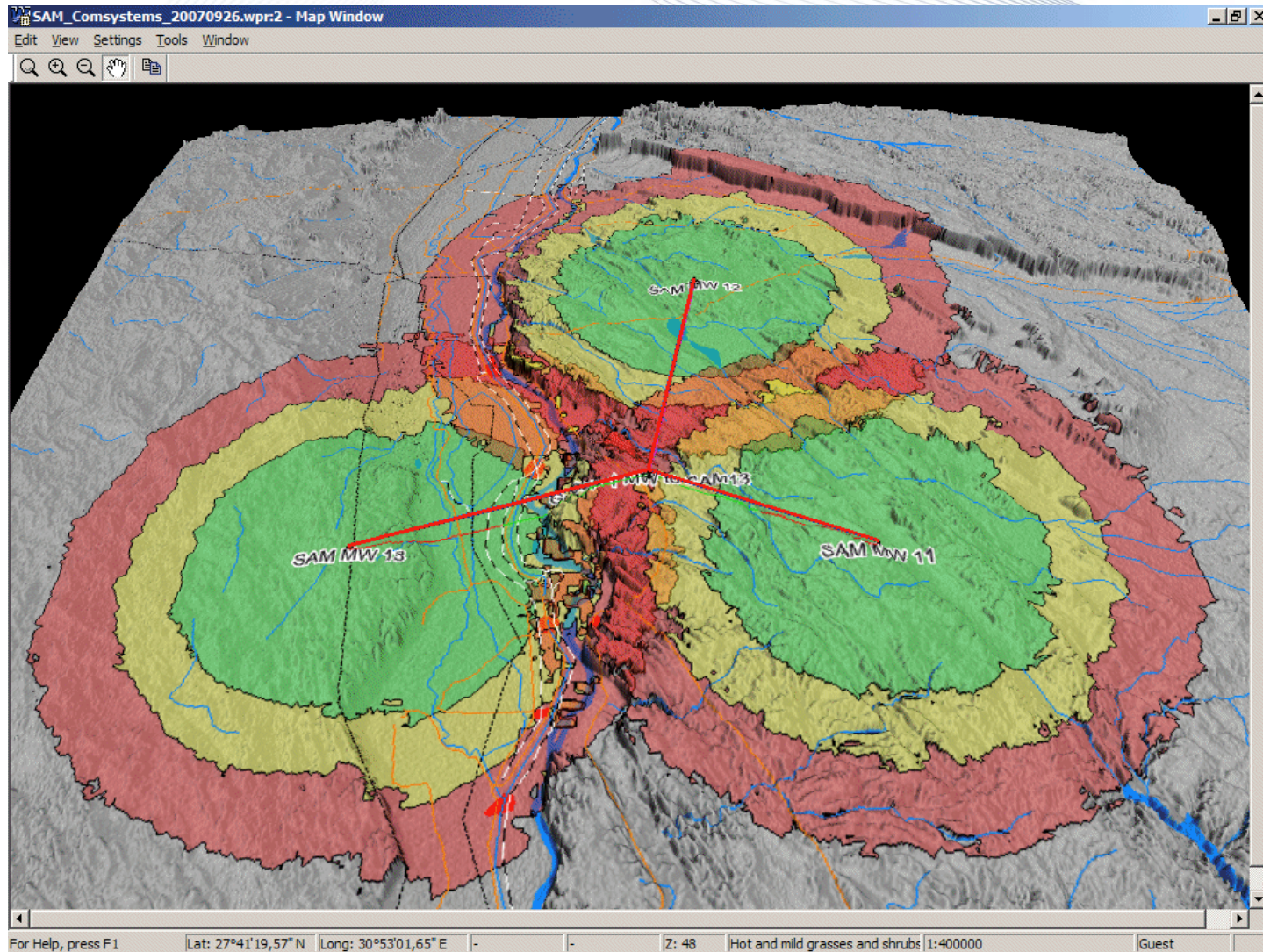
- Support for symbols according to MIL-STD 2525B.



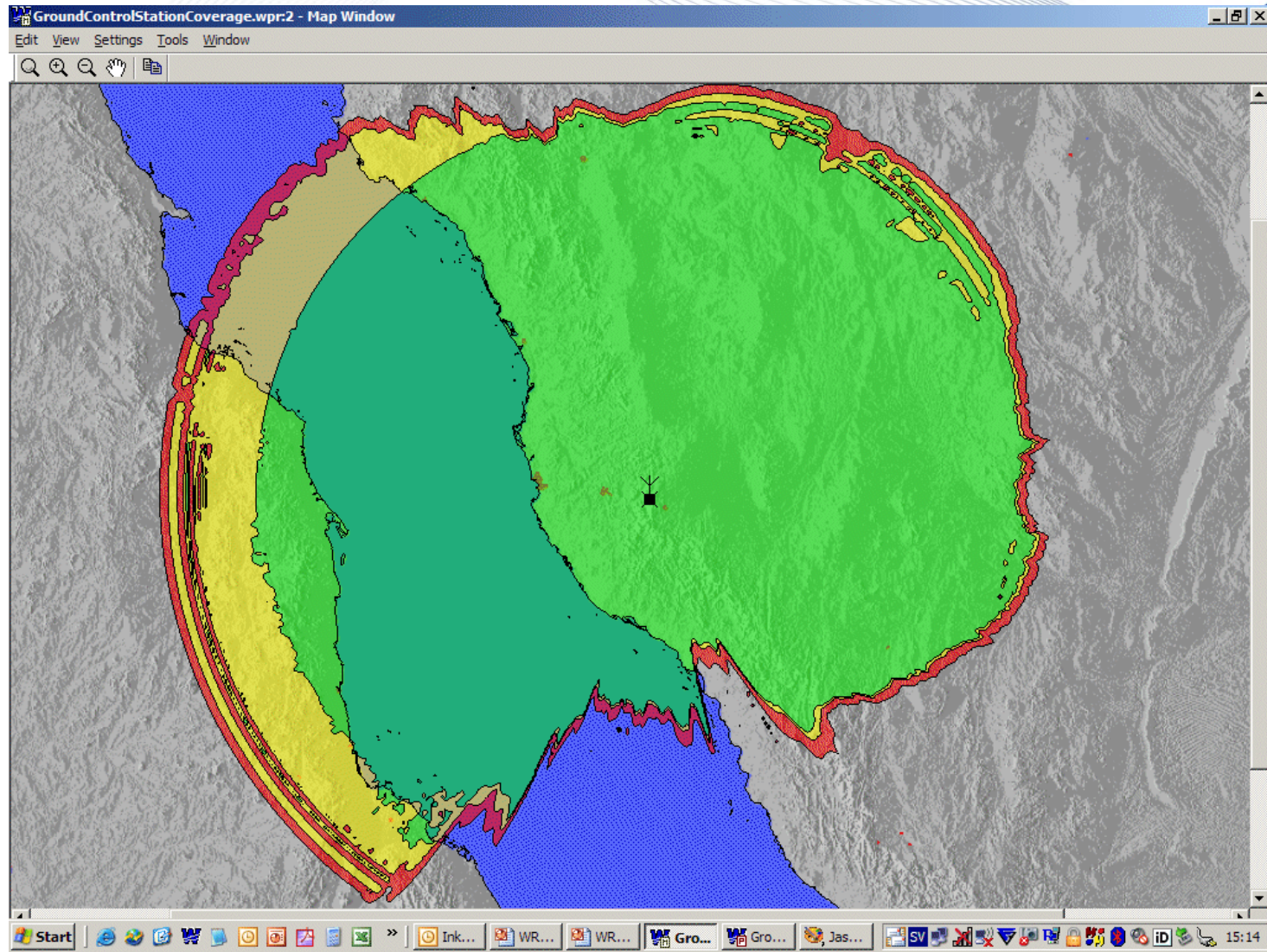
Coverage for CNR stations in air defence system



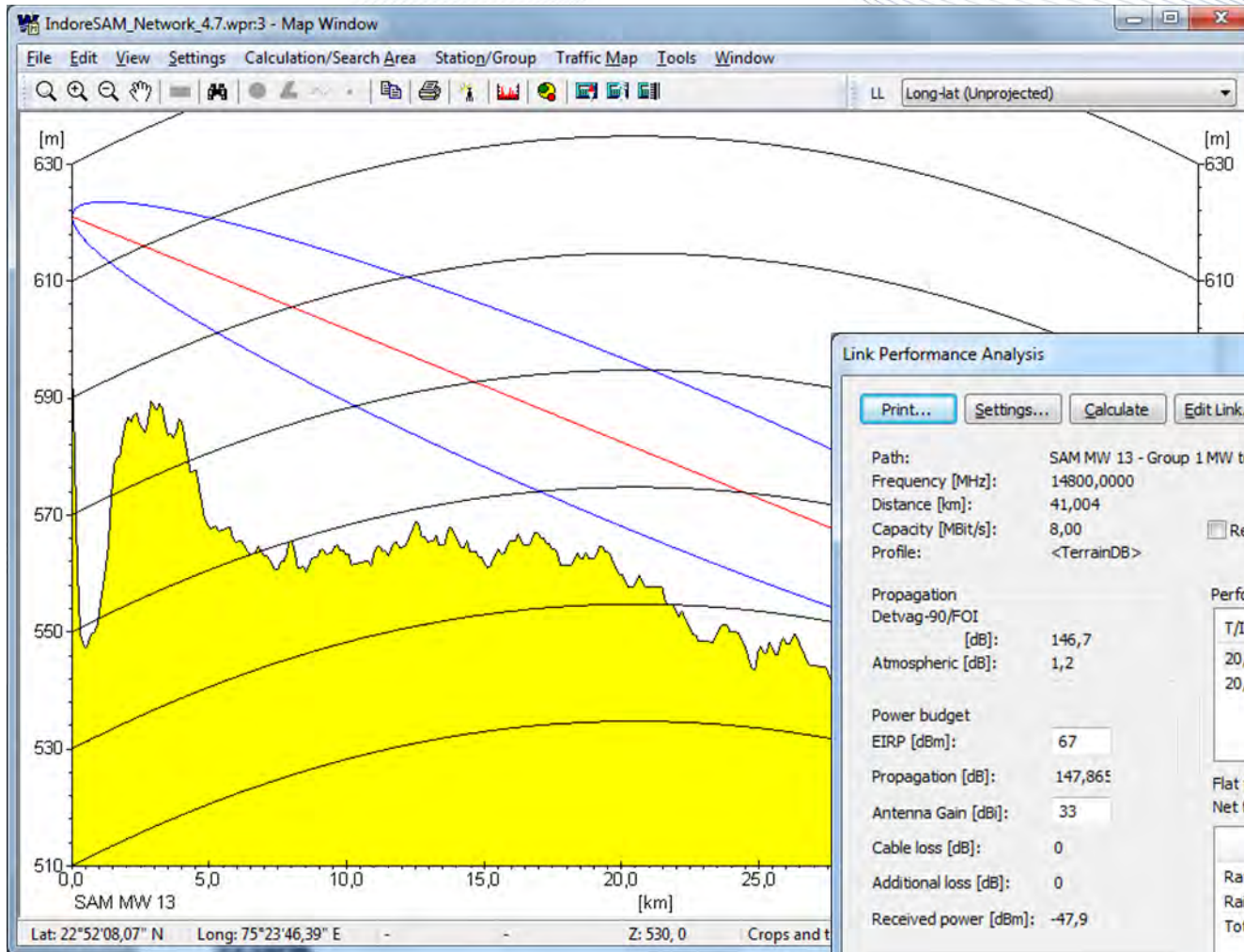
CNR coverage, 3D



Ground control station coverage to aircraft



Point-to-point planning



Link Performance Analysis

Print... Settings... Calculate Edit Link... OK

Path: SAM MW 13 - Group 1 MW to SAM13
 Frequency [MHz]: 14800,0000
 Distance [km]: 41,004
 Capacity [MBit/s]: 8,00 Reverse calculation
 Profile: <TerrainDB>

Propagation
 Detvag-90/FOI [dB]: 146,7
 Atmospheric [dB]: 1,2

Power budget
 EIRP [dBm]: 67
 Propagation [dB]: 147,865
 Antenna Gain [dBi]: 33
 Cable loss [dB]: 0
 Additional loss [dB]: 0
 Received power [dBm]: -47,9

Performance

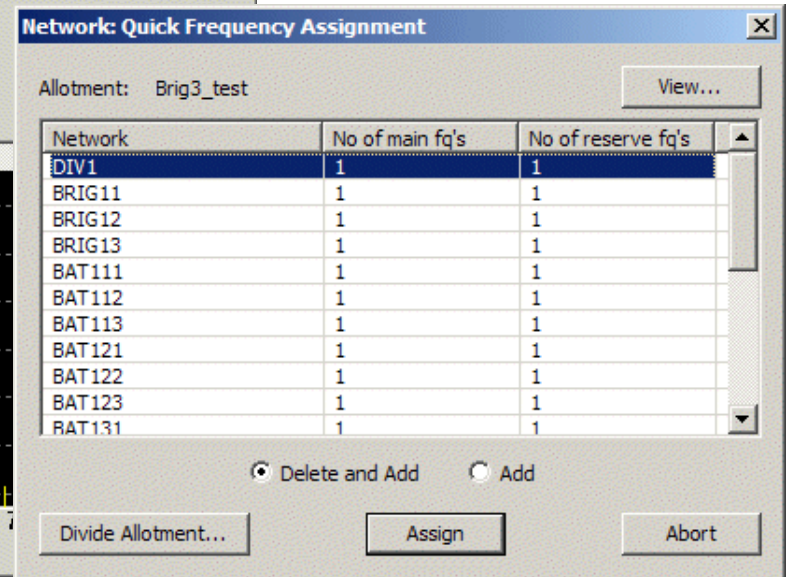
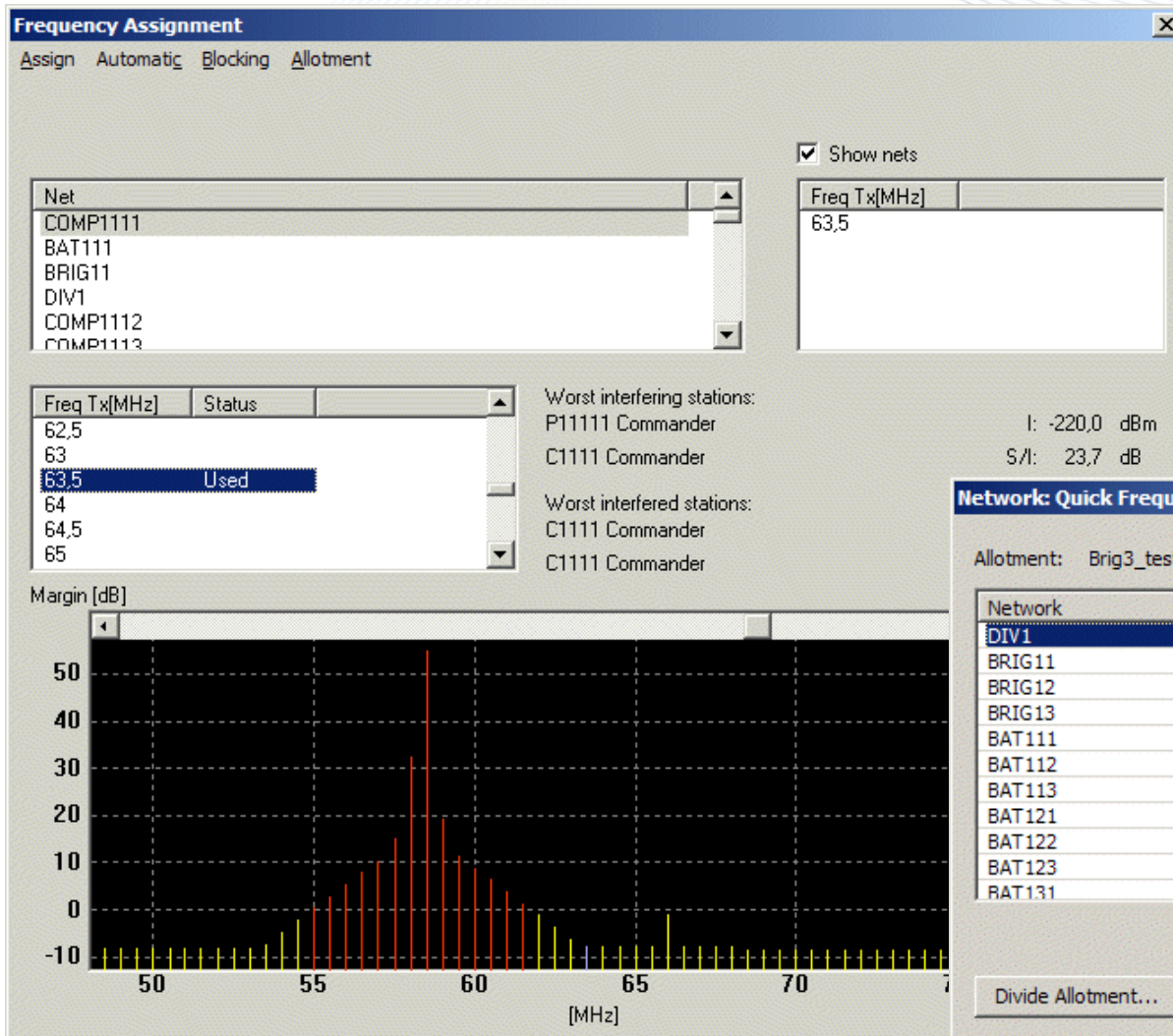
T/I	BER	Threshold
20,0	0,001	-85,0
20,0	1e-006	-82,0

Flat fading margin [dB]: 37,1
 Net fading margin [dB]: 37,1

	Unavailability	Per year	Availability
Rayleigh	1,94e-005	0h10m12s	99,9981 %
Rain	7,23e-005	0h37m58s	99,9928 %
Total	9,17e-005	0h48m11s	99,9908 %

DM: 3,80e-005
 SES: 1,94e-005

Quick and Advanced Frequency assignment



HF Frequency management



Allocations for Adaptive HF Systems



Create Allotment

Min frequency [MHz]:

Max frequency [MHz]:

Channel separation [kHz]:

Bandwidth on allotment frequency [kHz]:

No of channels:

Duplex

Channel arrangement

Polarisation independent

Alternated

Co-channel band re-use

Interleaved band re-use

Interleaved polarisation independ

Divide Allotment: Setup

Frequencies from allotment: Adaptive HF, 2-12 MHz, Region 1, 3 kHz, checked

Destination: WRAP DB

Allotment	None	Division	Brigade
ALE 01	6 (0)	0 (0)	0 (0)
ALE 02	6 (0)	0 (0)	0 (0)
ALE 03	5 (0)	0 (0)	0 (0)
ALE 04	5 (0)	0 (0)	0 (0)
ALE 05	6 (0)	0 (0)	0 (0)
ALE 06	6 (0)	0 (0)	0 (0)

Existing allotments: HF 2-12 MHz, No BC; Total Pool HF 2-30 MHz; HF-plan 2-12 MHz, 5 kHz; CE05_Rumanien

Buttons: New..., Edit..., Calculate...

Radio buttons: Delete and Add, Add

Site:

Calculate propagating frequencies

Name	Net	Time [UT]	Frequency
HF 1	Net 1	From: 0	2
HF 2	Net 1	To: 24	7,02
HF 3	Net 1		
HF 4	Net 1		
HF 5	Net 1		
HF 6	Net 1		

Buttons: Calculate..., OK, Cancel

Silent calculation

Get frequencies:

All frequencies shall propagate

Date:

SSN:

QIndex (Qe):

Req Rel (LUF) [%]:



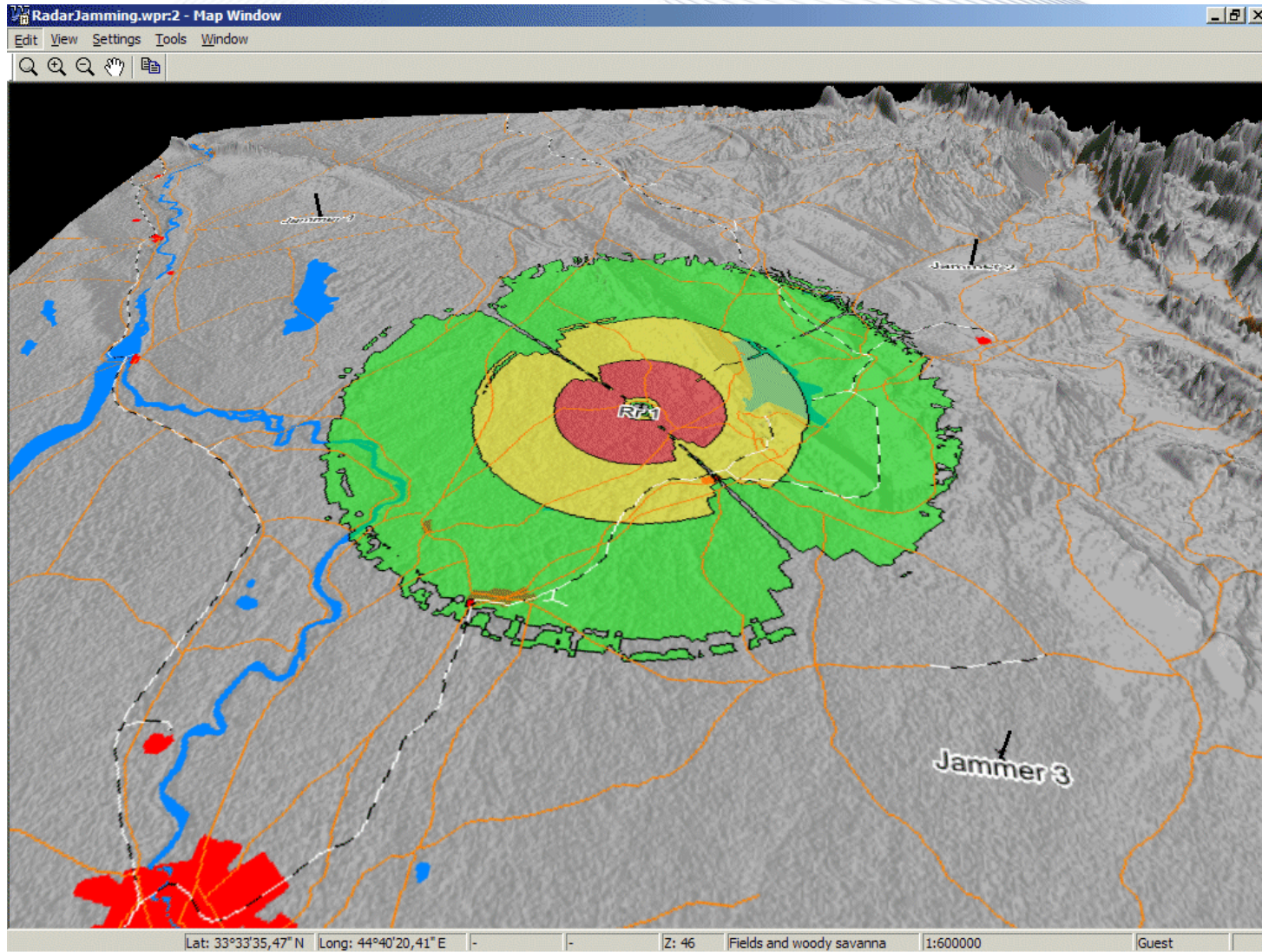
Use of Coverage Optimiser for Electronic Warfare

The screenshot displays the 'Coverage Optimiser' dialog box over a map window titled 'Jamming_DF_Motala.wpr2 - Map Window'. The dialog box is divided into several sections:

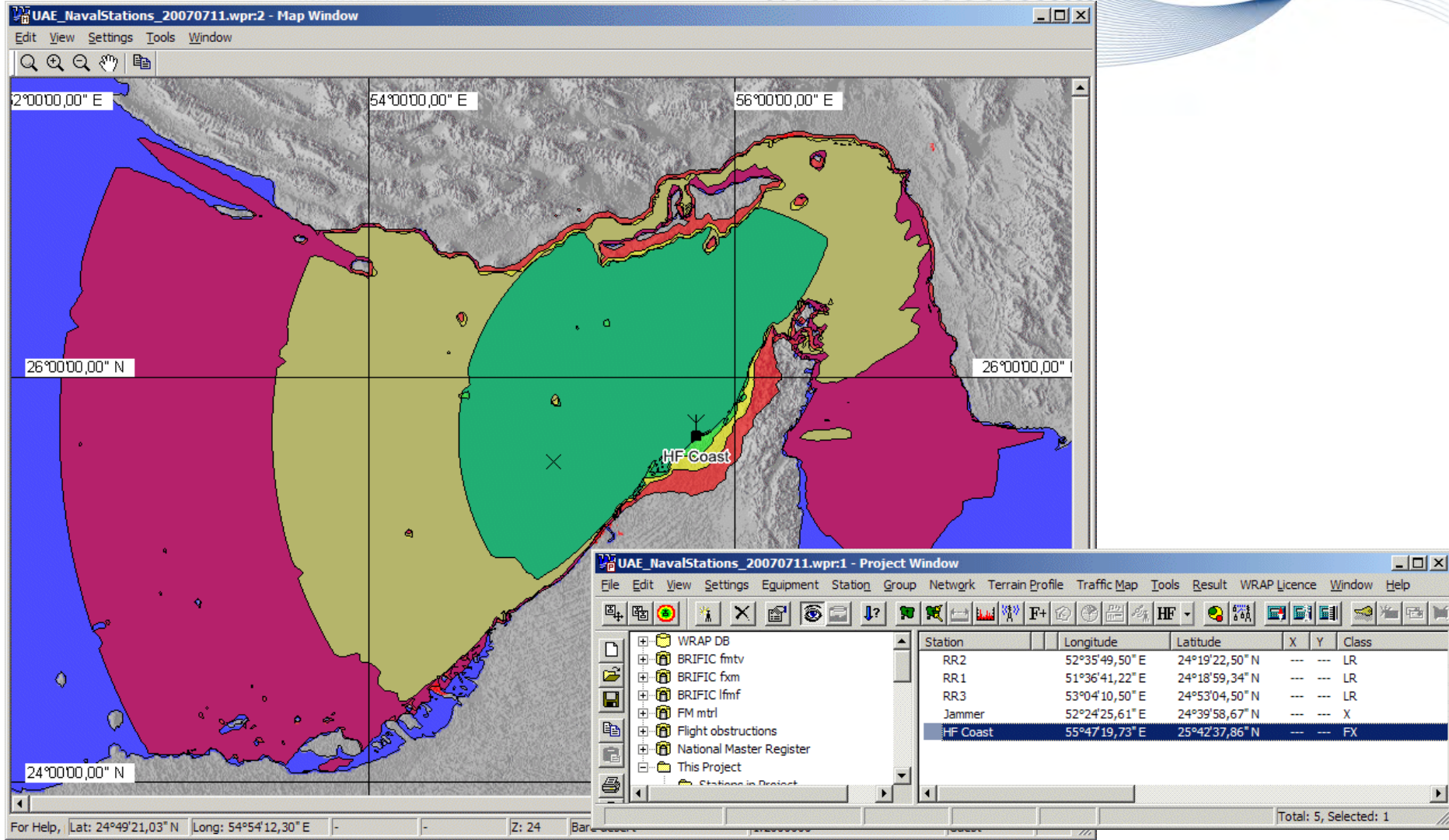
- Existing stations**: Placement, Coverage, Evaluation (selected), Cost
- Propagation model**: Detvag-90/FOI (with a 'Select...' button)
- Calculation direction**: Uplink, Downlink
- Maximum server range**: 30 km
- Limit number of stations**: 2 (checkbox unchecked)
- Resolution**: Average (dropdown menu)
- Show progress during calculation**: (checkbox checked)
- Description**: Coverage optimisation, 30 dB, jammer 30 dBW, 2007-07
- Calculation**:
 - Received power: 30 dB
 - Clearance: 0 %
- Population data**:
 - Provided by vector theme
 - Use landcover subscriber data
 - A Subscribers
 - B Subscribers
 - C Subscribers
 - None
- Solution criteria**:
 - Maximum cost: 0
 - Minimum coverage: 95 %

Buttons at the bottom of the dialog box include 'Load settings', 'Save settings', 'Cancel', and 'OK'. The map background shows a geographical area with two jammer bases labeled 'Base 1' and 'Base 2' (highlighted in yellow), and two VHF jammers labeled 'Jammer VHF 1' and 'Jammer VHF 2'. The map also displays red and blue shaded regions representing coverage areas. The status bar at the bottom of the map window shows coordinates (Lat: 58°28'14,64" N, Long: 15°00'14,51" E), X: 6483317,9, Y: 1453074,8, Z: 114, Åkermark, 1:200000, and Guest.

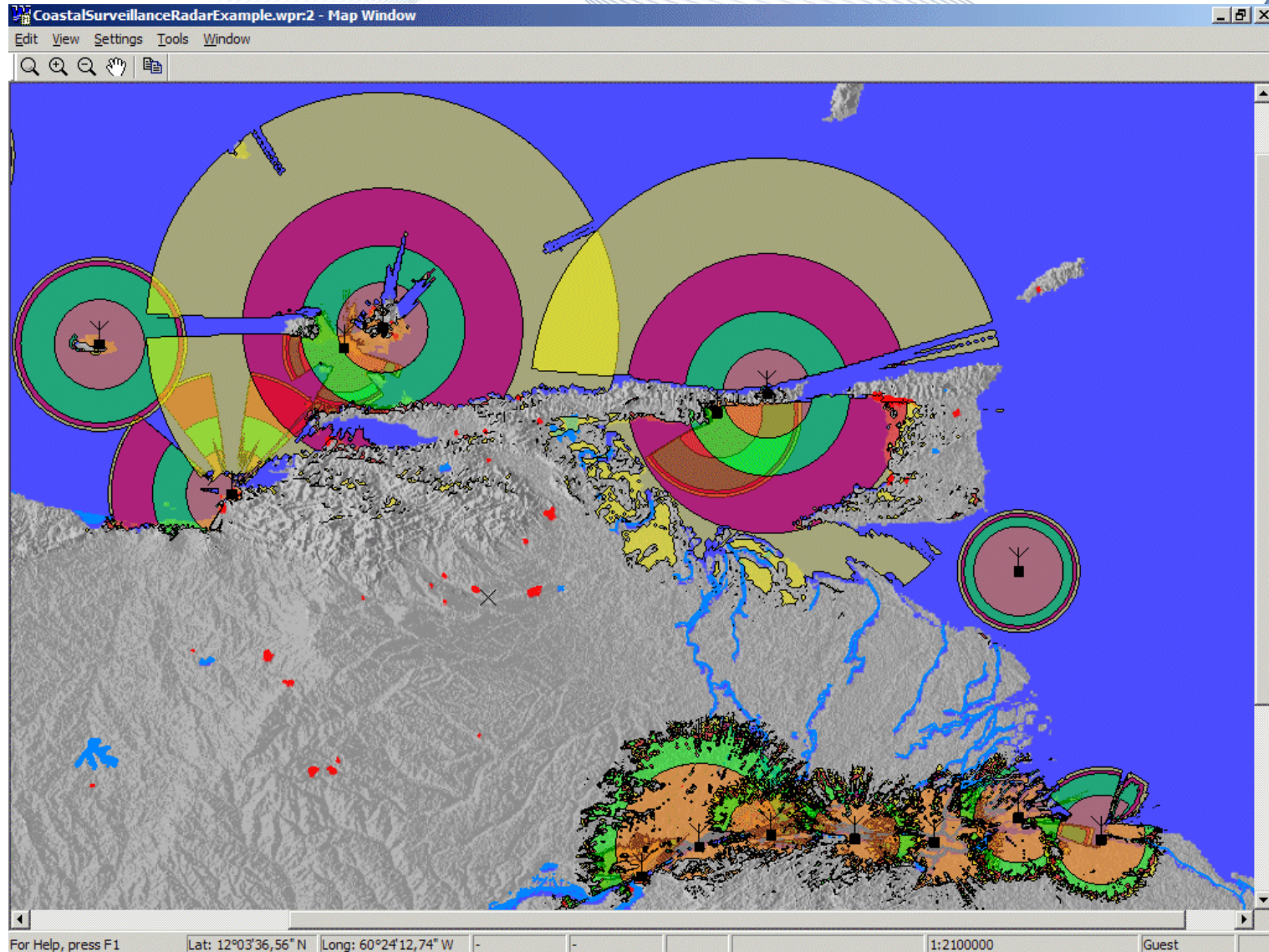
Air surveillance radar coverage with jammers



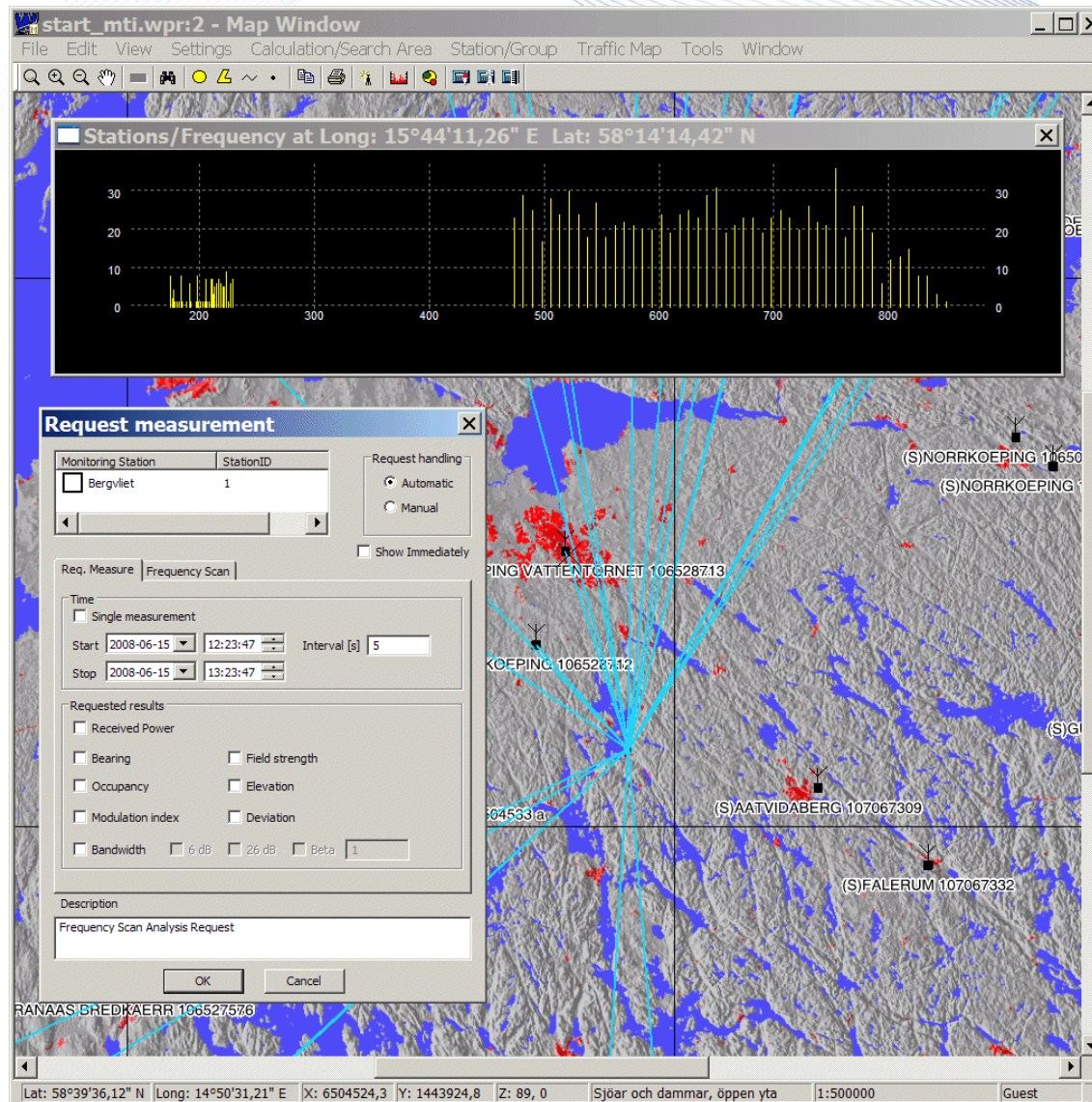
Coast station ground wave coverage



Coast surveillance radar coverage



Integration with monitoring systems





WRAP[®]

ALL YOU NEED FOR SPECTRUM MANAGEMENT



MAKING RADIO VISIBLE, CONTROLLABLE AND VALUABLE