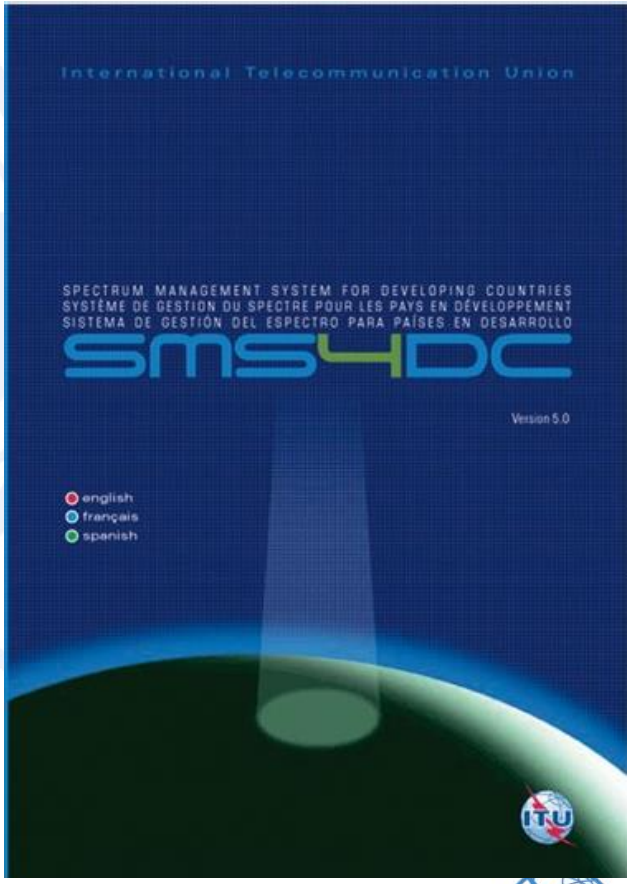
PRIDA Track 1 (T1)

SMS4DC
Overview

Online training, 27 April 2020

ITU Spectrum Management System for Developing Countries (SMS4DC)

- SMS4DC is software designed by ITU based on ITU recommendations
- Developed to assist the administrations of developing countries to undertake their spectrum management responsibilities more effectively;
- SMS4DC covers terrestrial fixed, mobile, sound and television broadcasting services in the bands above 30 MHz, including GE-06 as well as frequency coordination of Earth stations



Computer aided spectrum management

- The use of computers in the spectrum management process has become crucial for most administrations that are faced with the ever-increasing use of the radio frequencies.

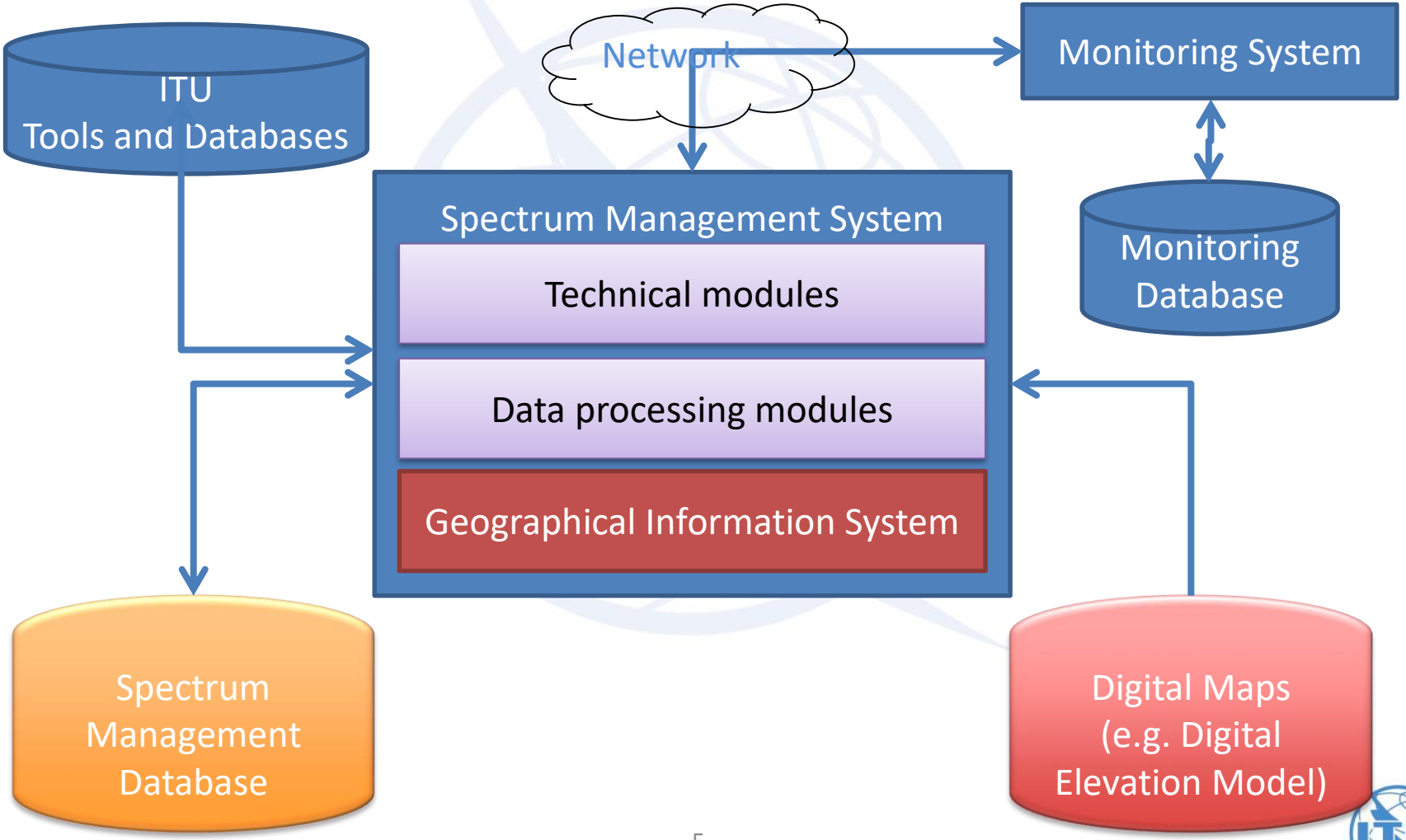
- Several aspects of this process, such as frequency coordination, administrative procedures (registration and issuing of licenses) and notifications of assignments to the ITU according to the Radio Regulations, are crucial in the establishment of a computer-automated process.

- ITU-R Handbook: Computer-aided Techniques for Spectrum Management (CAT) (2015) http://www.itu.int/pub/R-HDB-01

National Spectrum Management

Spectrum management is a combination of administrative and technical activities for efficient utilization of spectrum by users without causing harmful interference in their service area

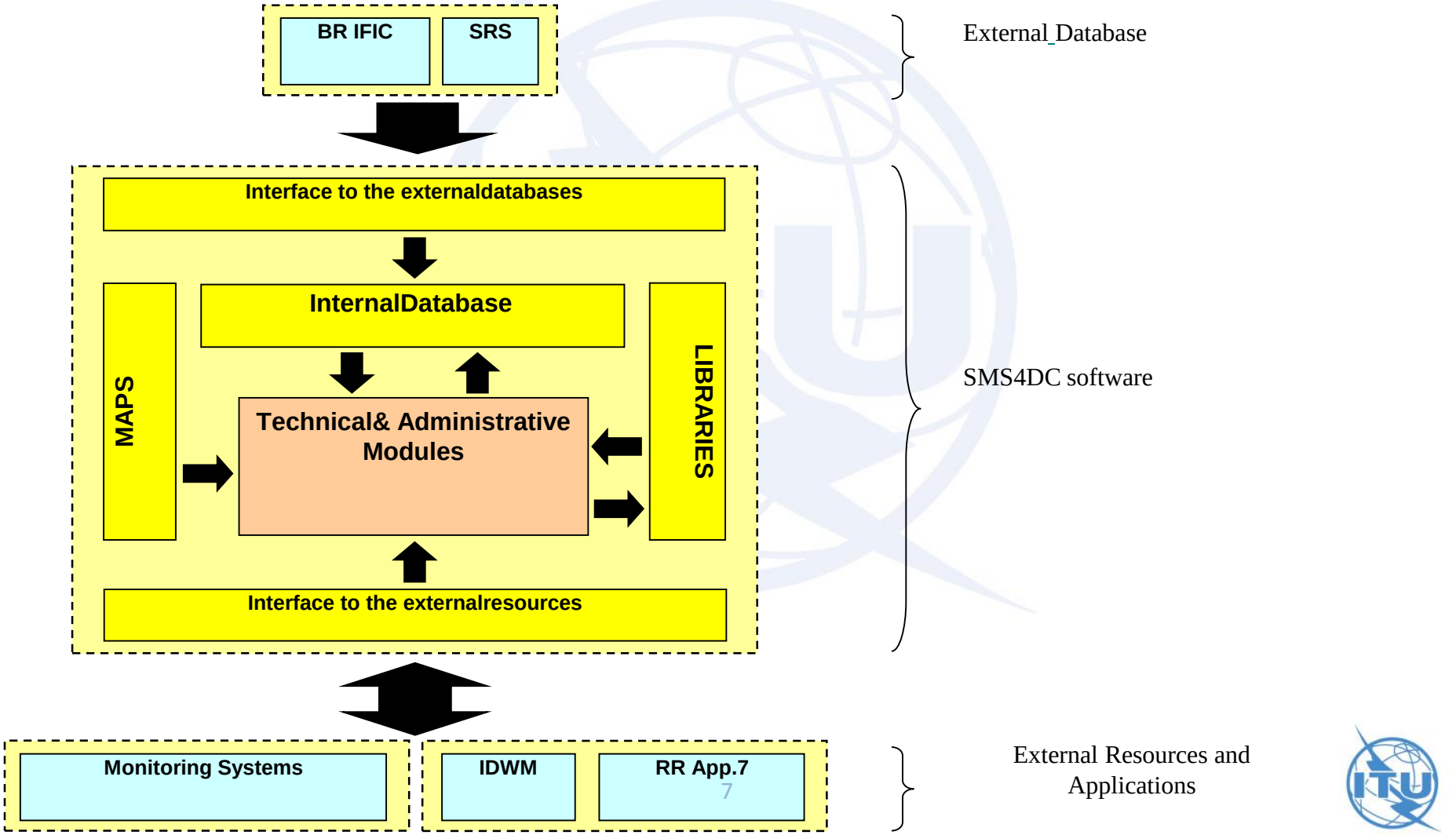
System architecture



SMS4DC Development Cycle

- **2007:** *SMS4DC Version 1.0*
- **2008:** *SMS4DC Version 2.0 (Addition of Digital TV planning tools (GE06))*
- **2009:** *SMS4DC Version 3.0 (Addition of Google Earth and monitoring interface)*
- **2012:** *SMS4DC Version 4.0 (link to ESMERALDA monitoring software of Thales and additional enhancements, French language)*
- **2014:** *SMS4DC Version 4.1 (Update of Article 5 according to WRC12, import from new BRIFIC & interface with appendix 7)*
- **2015:** *SMS4DC Version 5.0 (Revised propagation models based on the latest version of P.452, P.530 and P. 1812, P.1546, Spanish language).*
- **2017:** *SMS4DC Version 5.1 (HCM, results of WRC-15: revision of the Radio Regulations Article 5 module, the international frequency allocation).*
- **2020:** *SMS4DC Version 5.2*

Structure of the SMS4DC



Functions of SMS4DC

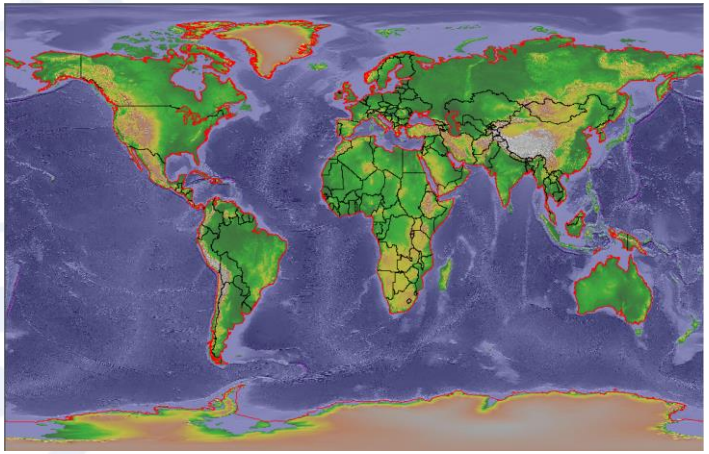
- **Administrative Functions**
- **Graphical User Interface (GIS) Functions** *(including Map Displays)*
- **Engineering Analysis Functions**

Administrative Functions

- Comprehensive database (MS Access) of user/license details, with data fields in accordance with ITU recommendations;
- Provides complete process from: frequency application, frequency assignment, licensing, ITU plans and Bilateral frequency coordination procedures;
- Imports coordination data from ITU BRIFIC & SRS CD-ROM database;
- Producing electronic notices, print license, invoice & spectrum fee
- Security features: *The designated system administrator can define an individual account for each SMS4DC user up to 6 levels of access to the different processes (e.g. licensing, assignment etc). Each user account is named and password protected.*

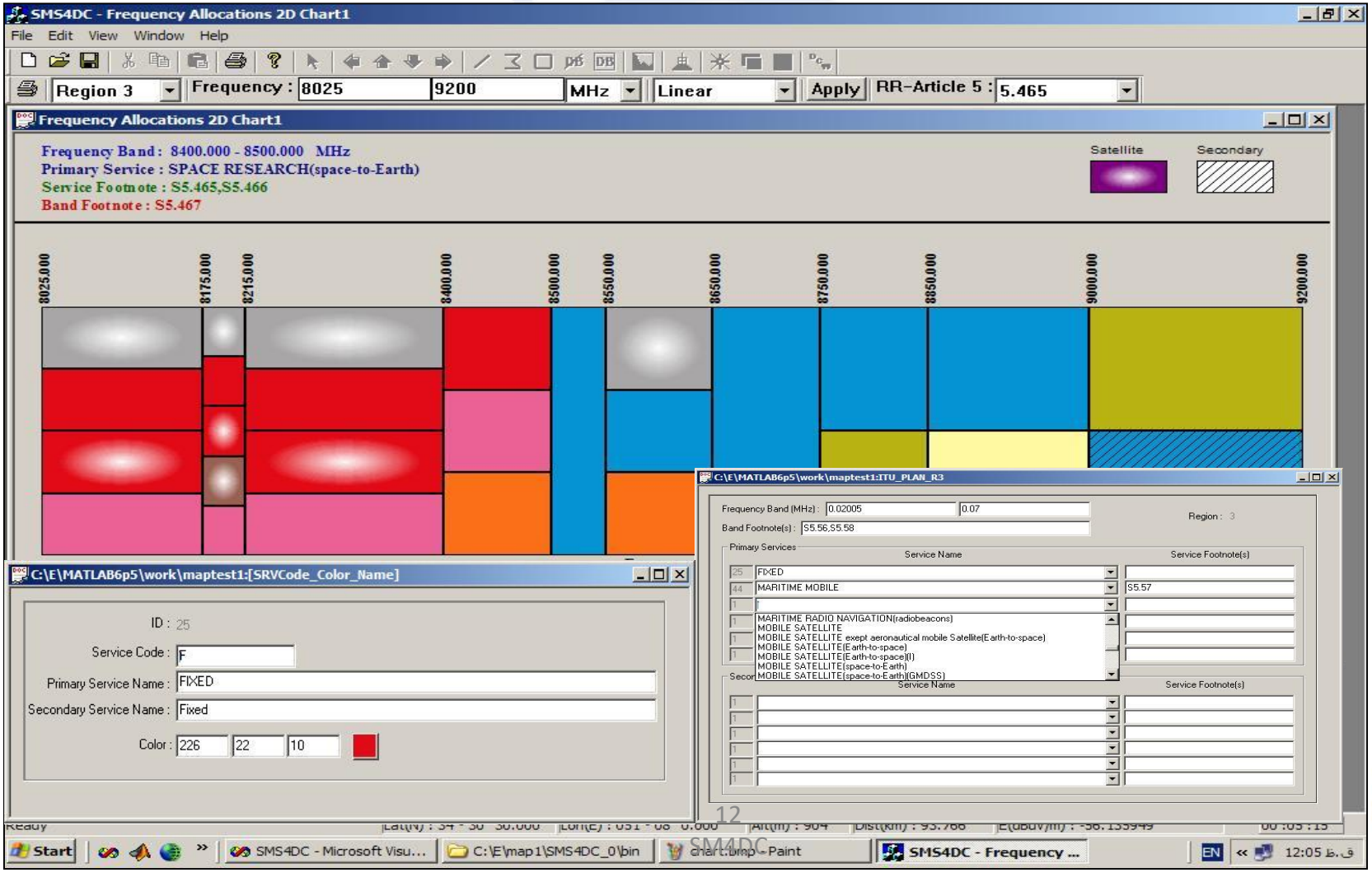
GIS Functions of SMS4DC

- **User friendly interface with text menus and icon-tool bars;**
- **Display views**
  - *International Digital World Map (IDWM)*
  - *Digital Elevation Map (DEM) (2-D and 3-D)*
- **Data entry/Assigning of new stations on DEM by mouse point-and-click**
- **Export of maps, overlays and vectors to Google Earth Searching and displaying stations on DEM**



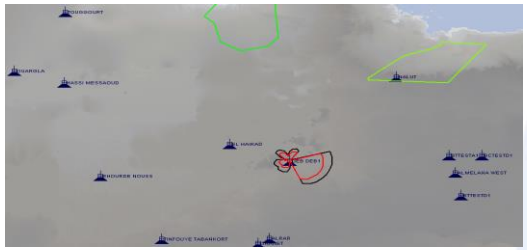
Engineering Functions

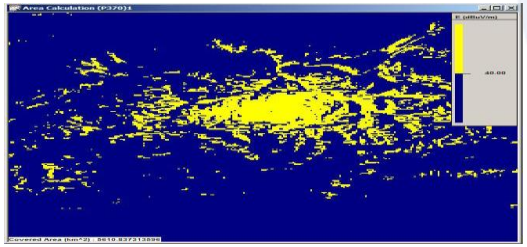
International & National frequency allocations table (chart)



Engineering Analysis Functions

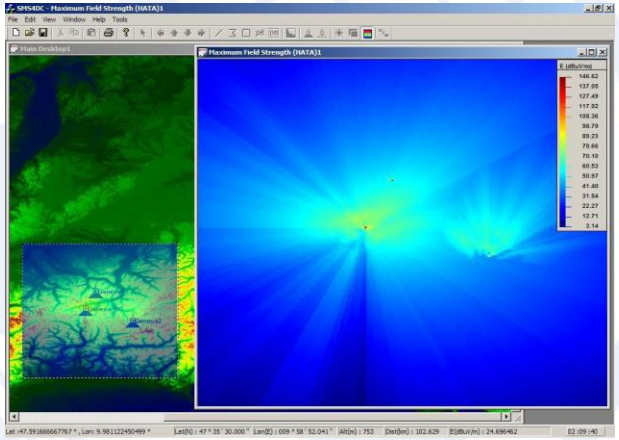
Calculation of coverage area, field strength, field strength contour, network coverage and best server calculations





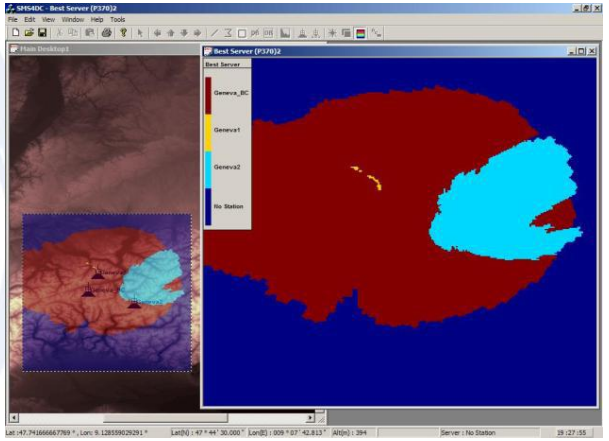
Coverage area

Item to calculate area in km2 Where inside the area, the field strength value is higher than a threshold value.



Maximum Field Strength

Item to calculate and visualize the maximum values produced by more than one transmitting stations at any point inside a predefined rectangular area.



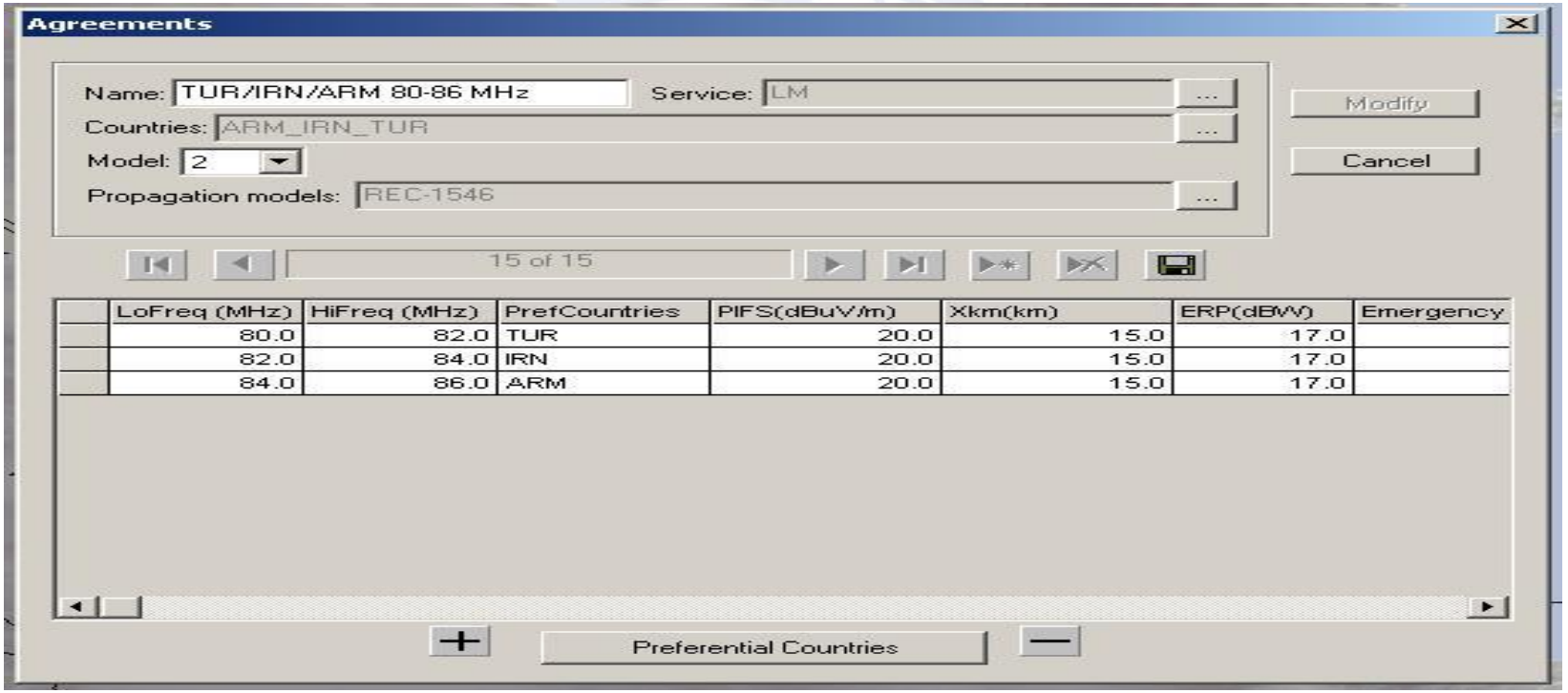
Best Server

Item to calculate and visualize the best serving station at each point among various stations inside a predefined rectangular area.

Broadcasting services

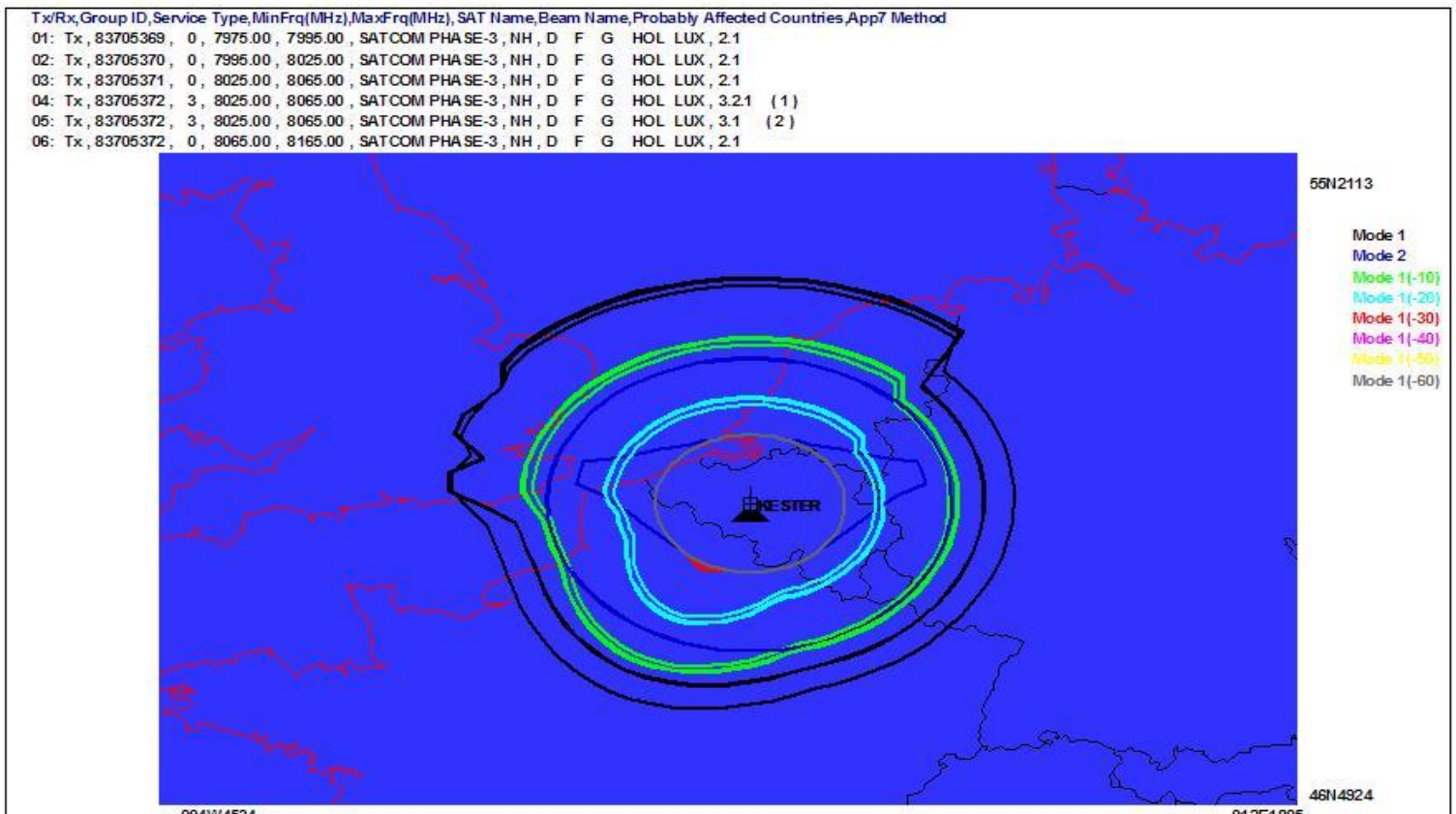
- Co-ordination includes interference analysis and frequency co-ordination tools between Broadcasting Services and between Broadcasting Services and some of the other services (Fixed and Land Mobile only) sharing the frequency bands in the ST61, GE84, GE89, and GE06 Agreements.
- Interference analysis methods are in conformity with the relevant requirements of the Agreements

Example for the Land Mobile service – cross border coordination



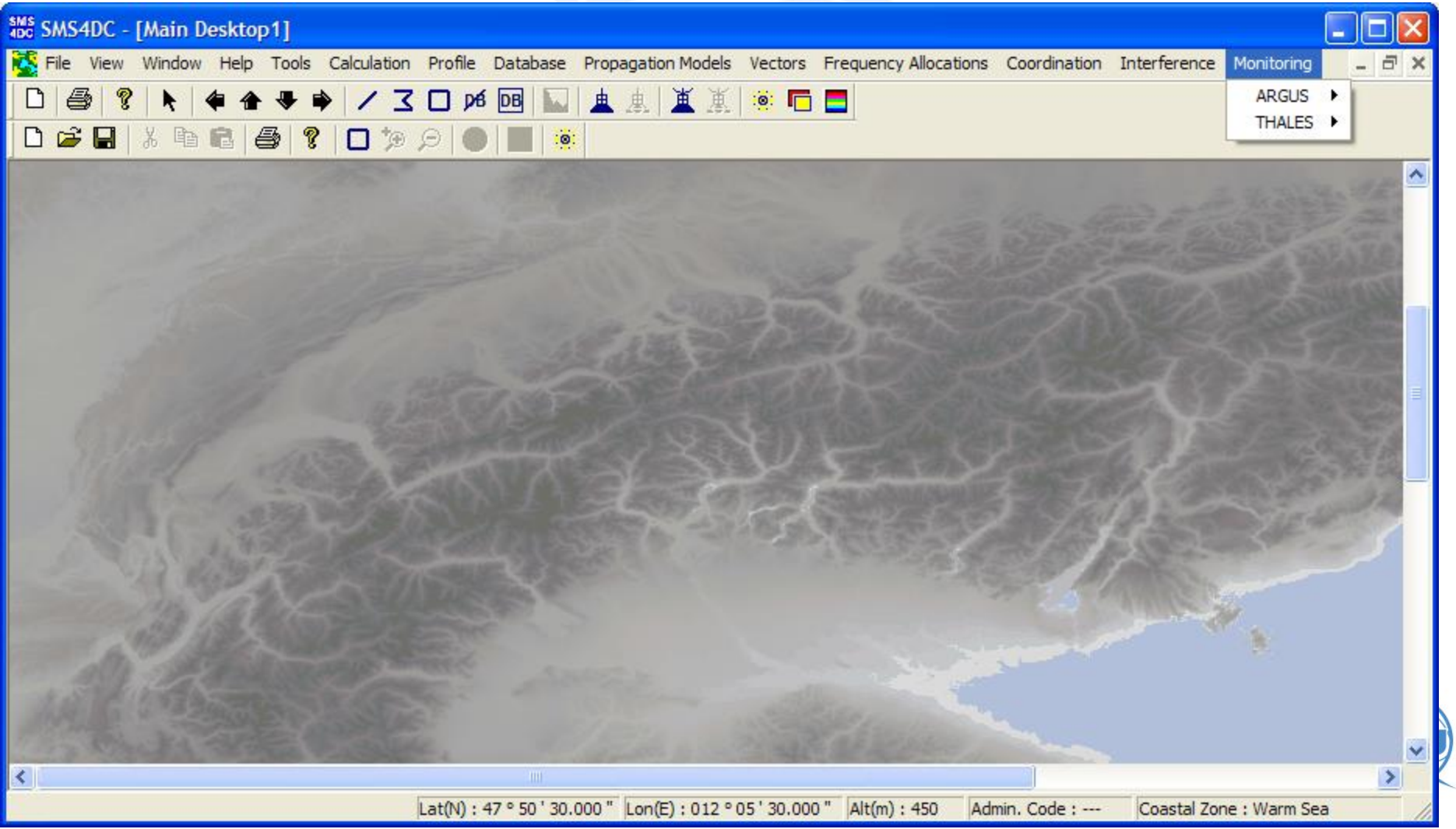
The example shows a cross border coordination agreement for the band 80-86 MHz among three administrations. Three sub-bands are established, one for each country, giving preferential assignment rights. The limits of the preferential rights are 20 dbuV/m measured at 15 km across the border. For coordination of receivers, a reference transmitter with e.r.p. of 17 dBW is used.

Coordination contours around an Earth station - BR



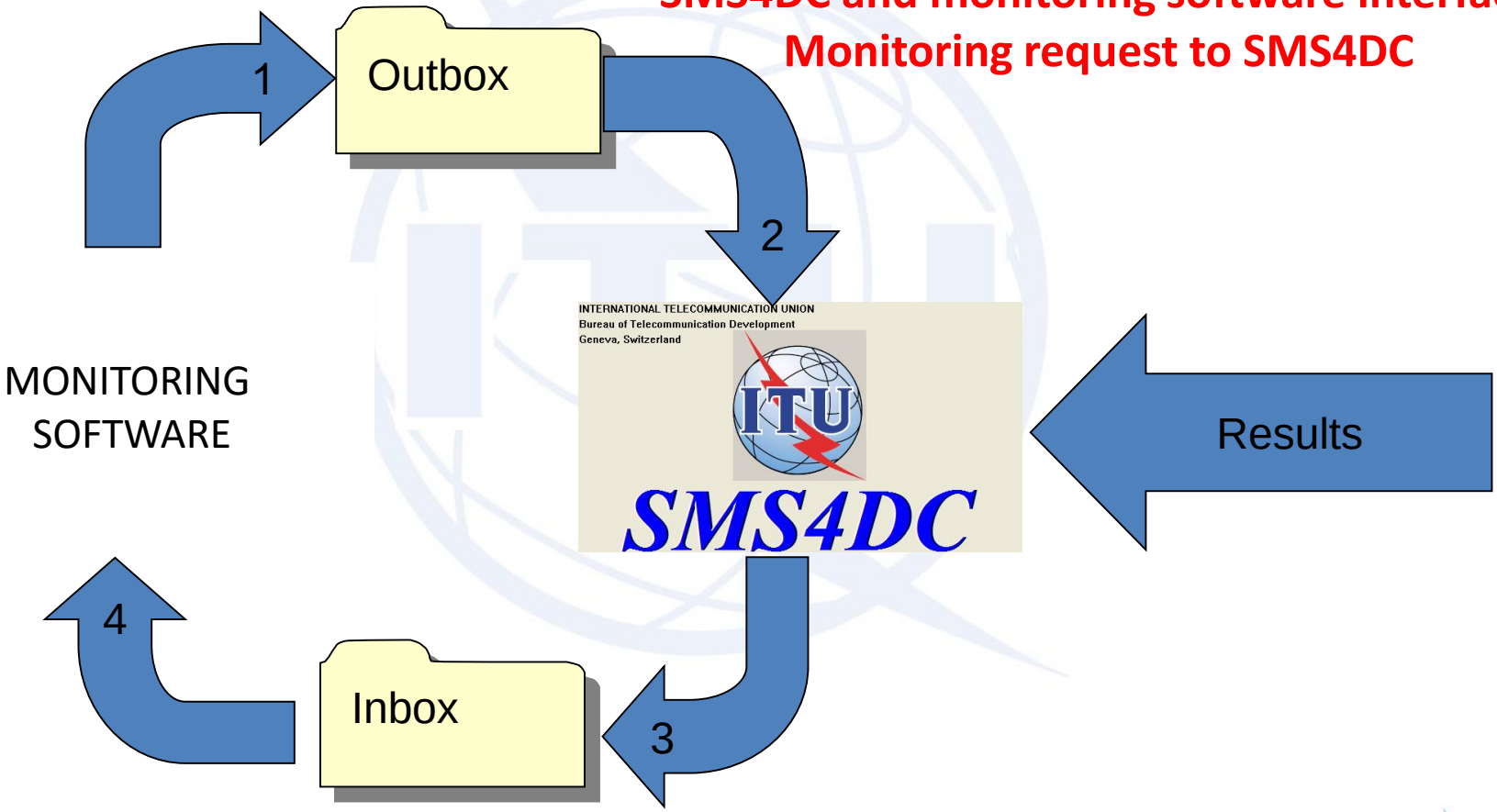
SMS4DC's Engineering Functions

SMS4DC and monitoring software interface



SMS4DC's Engineering Functions

SMS4DC and monitoring software interface
Monitoring request to SMS4DC



MSIP (Republic of Korea) and ITU project

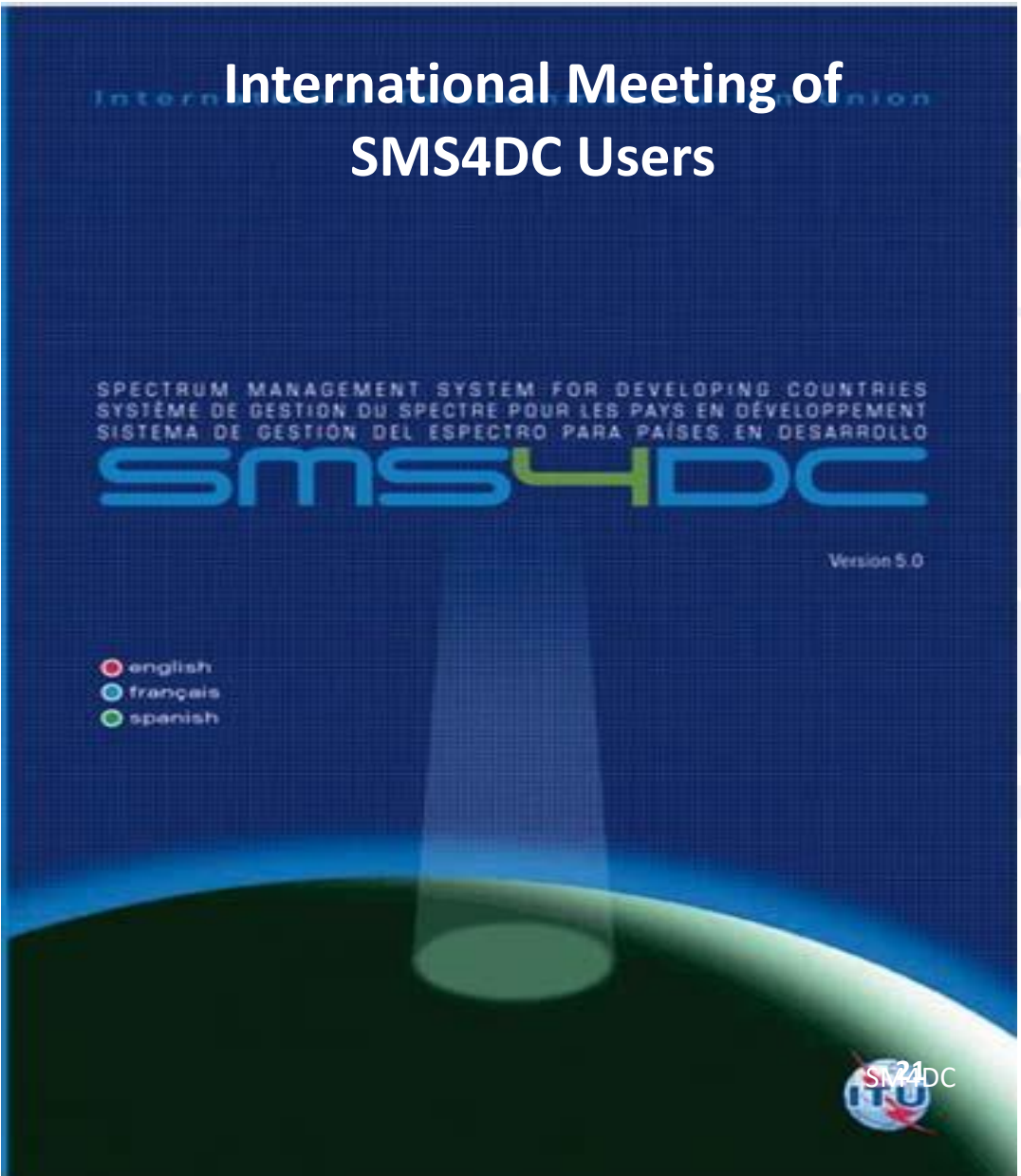
V5 released at the end of 2015

- Adding propagation models based on the latest version of
  - P.452(-16), Prediction procedure for the evaluation of interference between stations on the surface of the Earth at frequencies above about 0.1 GHz
  - P.530(-16), Propagation data and prediction methods required for the design of terrestrial line-of-sight systems
  - P.1546 (-5) (Method for point to area prediction for terrestrial services in frequency range 30 MHz to 3000 MHz)
  - P. 1812 (-4) (A path specific propagation prediction method for point-to-area terrestrial services in VHF and UHF bands);
- Intermodulation: calculating interference caused by intermodulation products up to 7th order by using ITU-R SM1134-1 and other resources
- General interface between SMS4DC and monitoring software (based on the guidelines prepared for and presented to ITU-R WP1C of the SG1)
- Further development of built-in and user specified administrative reports;
- Preparation of a general method to import data to SMS4DC
- Spanish language added
- Preparation of time limited version as a demo tool which can be used for introduction of SMS4DC;
- Preparation of the training material for assisting self-learning training of the software.
- Train-the-trainer workshop 24 November-2 December 2106, Addis, for around 10 new trainers (English, French and Arabic speaking), in close cooperation with the AFR office

HCM in SMS4DC

- V5.1 of SMS4DC released in 2017 (3rd Quarter)
  - HCM calculations included (EUR)
  - WRC-15: Article 5 of the RR
- HCM4A.dll will be developed by the African experts and when ready, it will be added

International Meeting of SMS4DC Users



http://www.itu.int/en/ITU-D/Spectrum-Broadcasting/Pages/International-SMS4DC-Users-Meeting_Geneva_December16.aspx

Overview

In order to further develop the tool, it is necessary to collect the opinions and expectations of users and potential users. To this end, a meeting was be organized for the SMS4DC users with the following aims:

- summarizing why computerized spectrum management is required;
- analysing the main functions of the SMS4DC;
- proposing further developments;
- understanding the needs, proposals and experiences of targeted users in order to meet their requirements.

The meeting focused on:

- highlighting the main functions and structure of spectrum management organization and necessary information for efficient spectrum management;
- the role of computer-aided spectrum management;
- overview of the SMS4DC, including its structure, main features and different functions;
- practical examples;
- country presentations from SMS4DC users: how to use the tool and description of their experiences;
- requirements, needs, proposals and remarks for further developing the tool.

SMS4DC subscriptions before the Workshop

Participants

Around 40 participants (registered 50) from 25 countries.

Presentations: 3 BDT, R&S, ITU Sales, experience of a trainer

Country presentations: Hungary, Switzerland (including HCM), Burundi, Colombia, Myanmar, Sudan

Oral presentations: Timor Leste, Bhutan, Cameroon, PNG, LS

Comments by e-mail: experiences of Pacific Islands

Final conclusions

The participants expressed their view on the usefulness of the software but it can be even better with some improvements. In addition they supported the idea to have this type of meeting once per year and if possible, have also regional meetings of the users.

Proposals for improvements, additions

- Administrative functions
- Engineering
- Graphical
- Training
- Support
- Software
- Promotion

Administrative functions

- Making easier transfer from Anonymus to licensed station
- Improvement of designing license and invoice form
- Using copy function in data entry
- Export to/from Excel and Word for reporting
- Search for stations based on name/ID
- Status of license, step-by-step follow up of the licensing process
- Export/import between SMS4DC-SMS4DC
- Licensing request via web/on-line application form
- Upload printed license/invoice (or at least link to them)
- Reporting on e.g. number of licenses, stations
- Automatic renewal of frequency licenses
- Making microwave link entries easier
- Supporting management information system

Engineering

- Equipment, filter database
- Tower database
- Higher resolution terrain
- Fee calculation

Graphical

- Revise the graphical interface
- Icons to add/move/remove stations
- Frequency allocation chart

Training

- Preliminary questionnaire to participants
- Preparing more training materials
- Background presentations, video on the functions
- More spectrum management training is required
- Training curriculum
- Starting/tutorial/basic information
- Training on You Tube
- Modular trainings (e.g. engineering/data entry/licensing)
- Small demo on the functions for a smaller area

Support

- Ticketing for help request
- Web/online support
- FAQ
- Forum for users and forum for developers

Software

- Checking other operational system than Windows
- Mobile/tablet application
- Pre-defined workflow (like e.g. in the Executive overview)
- Modular utilization
- Checking the possibility of other solution than dongle for authorized utilization

Promotion

- Presentations during workshops
- Web page
- During meetings of Regional Organizations
- Flyers, brochures
- Packing together with other spectrum management assistance
- Distributing information video/tutorial by a BDT Circular
- Using BRIFICs for distribution of information about SMS4DC
- Regional roadshows (1-2 days, back-to-back with other workshops)
- Presentations during WRS and RRS

SMS4DC subscriptions after the Workshop

PIRRC project (Pacific Islands)

While most of the smaller islands are considering or have procured the SMS4DC systems only few have implemented it as their spectrum management system.
The problems include the lack of the basic like:

1) Absence of a national frequency allocation table;
2) Absence of resources for systematic spectrum management;
3) Lack of training.
4) All countries who have responded to the survey indicate that while they will adopt SMS4DC they need additional training and more importantly training material that would allow them to work and learn on the system with limited supervision.

The PIRRC Project will be conducting additional training in the first quarter of 2017 and will include the preparation of training aids for the users.

Direct beneficiaries of PIRRC are FSM; Kiribati; Marshall Islands; PNG; Samoa; Solomon Islands; Tonga; Tuvalu and Vanuatu.
Countries that are not are beneficiaries Cook Islands; Fiji; Nauru; Niue; Tokelau and Palau.

Purchased SMS4DC for 10 users
Provided higher resolution map (in 2018)

Republic of Korea and ITU project

Project activities

To improve **administrative function** and user interface for spectrum management, functions below listed should be newly made or improved:

- Improvement of designing license and invoice of fee form
- Adding copy function in data entry to avoid repeating same data
- Improvement of data export and import function to Excel, Word and other commercial software
- Adding search function for stations based on name or ID
- Export and Import data between SMS4DC – SMS4DC
- To make on-line license application possible, set up sample license web pages and link applicant's data to SMS4DC database
- Upload of printed license or invoice(pdf or jpg format) to SMS4DC database or provide a link function to the documents saved in separate place
- Macro function or simplified process for repeated similar stations' licensing

Republic of Korea and ITU project - new

For better radio communication **engineering** and easy work for **licensing**, functions below listed should be newly made or improved:

- Based on the user country's request, provision of non-commercial higher resolution(around 90 m) map based on freely available data
- Adding new database of filter, tower and other available commercial products database of radio communication equipment
- To calculate licensing fee, adding formula configuration and calculation function for licensing fee or importing formula function from other program i.e. Excel, based on the country's law and regulation
- Improving graphical user interface, i.e. add icon of linking and removing linked stations etc.
- For data protection, adding automatic back up menu to separate storage device

Republic of Korea and ITU project - new

To closely **support users** and **exchange useful information** and experiences of users

- closed on-line forum should be operated and this forum may include FAQ, bulletin board and other necessary functions for users. To facilitate this forum, the developers and experts of SMS4DC should participate in it and timely provide answers for users' questions.

Preparation of additional **training materials**

- Making video with e.g. recording of training classes for SMS4DC software and uploading the videos to You Tube and other sharing site for learners
- Preparation of the training videos as a multimedia DVD and releasing it for assisting self-learning users

Final approval test of the revised version of SMS4DC software package:

- Preparation of a protocol for testing and test the revised version of the SMS4DC software
- Execution of the approval test of the SMS4DC software on the basis of such test protocol, with the participation of the SMS4DC developers, experts and trainers, and ITU staff from BR and BDT

Additional experts for development

- **New experts can be involved in developing stand-alone modules**
- These modules will be added to the software by the existing experts
- Example: HCM module developed by an expert from Lithuania and inserted to the SW by the present experts.

How to order

- ITU Sales

https://www.itu.int/pub/D-STG-SPEC

- Publication notice

https://www.itu.int/dms_pub/itu-d/opb/stg/D-PN-395-17-PDF-E.pdf

- Reduction for Member States, Sector Members, Associates (15%)
- Reduction for LDCs (80%)

For further reading:

- ITU Handbook - Computer-Aided Techniques for Spectrum Management (CAT), 2015
- ITU Handbook on National Spectrum Management, 2015
- SMS4DC 5.0 User Guide
- ITU Handbook on Spectrum Monitoring, 2011
- Recommendation ITU-R SM.1370-2 (08/2013)
  - **Design guidelines for developing automated spectrum management systems**
- Recommendation ITU-R SM.1537 (08/2013)
  - **Automation and integration of spectrum monitoring systems with automated spectrum management**
- Recommendation ITU-R SM.1604 (02/2003)
  - **Guidelines for an upgraded spectrum management system for developing countries**

Thank you!

PRIDA Track 1 (T1)

ON-LINE English capacity building workshop

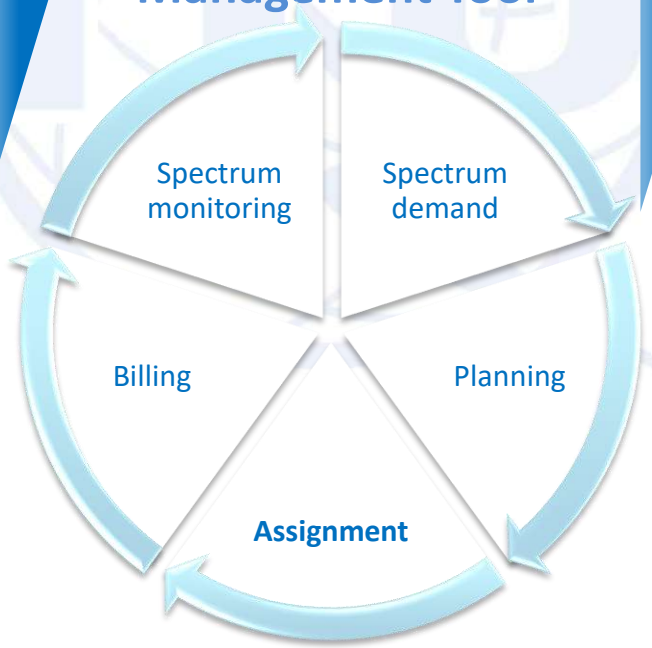
SMS4DC Introduction

April 20 - May 1, 2020

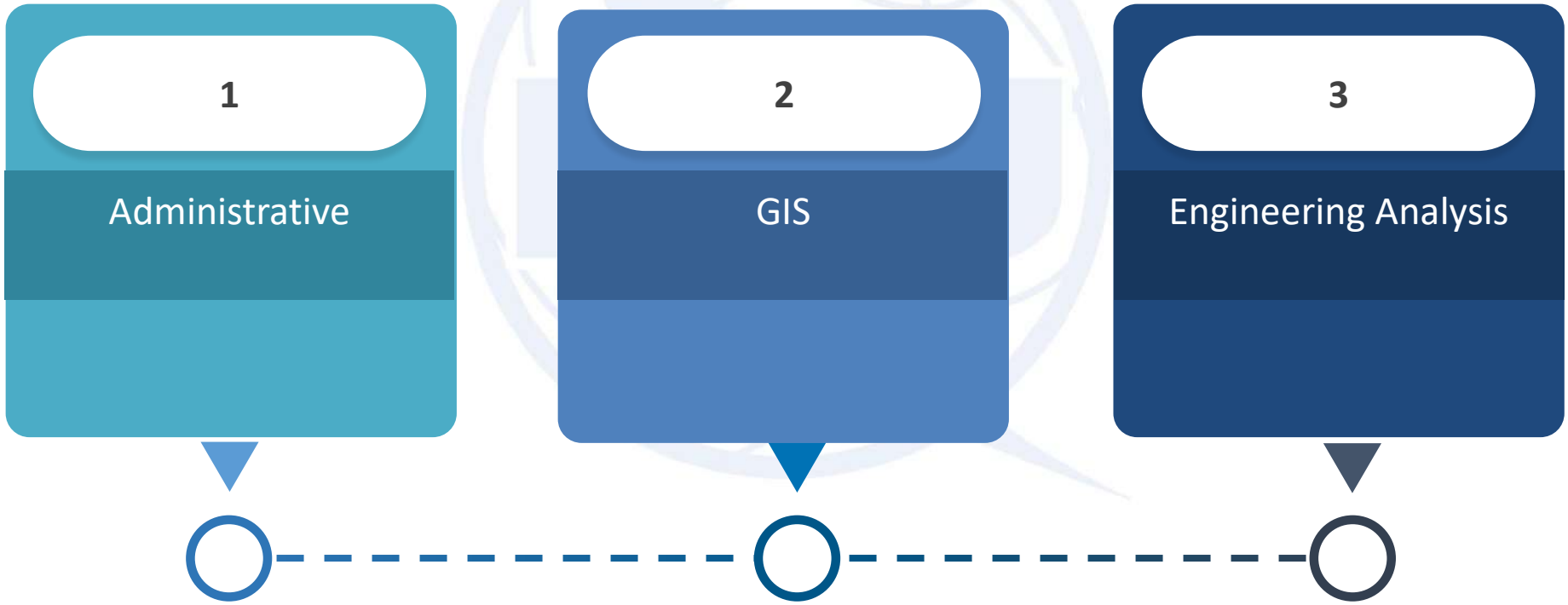
Yasir Ahmed
ITU expert
Email: Yasir192@gmail.com

Why Spectrum Management System

Requirements	Solution	Results
• Thousands of frequency assignments. • Frequency assignment requests. • New services and technologies. • Insure interference free operation. • Apply international regulation and standards. • Develop national regulations. • Efficiency of spectrum utilization.	Automated Spectrum Management Tool	• Provide frequency assignments to all users. • handle different scheduled administrative tasks. • Efficient use of radio spectrum. • Mitigate interference. • Interference resolution • Supporting coordination with other administrations. • Help in providing short and long term strategies. • Records and database. • Connected to remote monitoring stations.

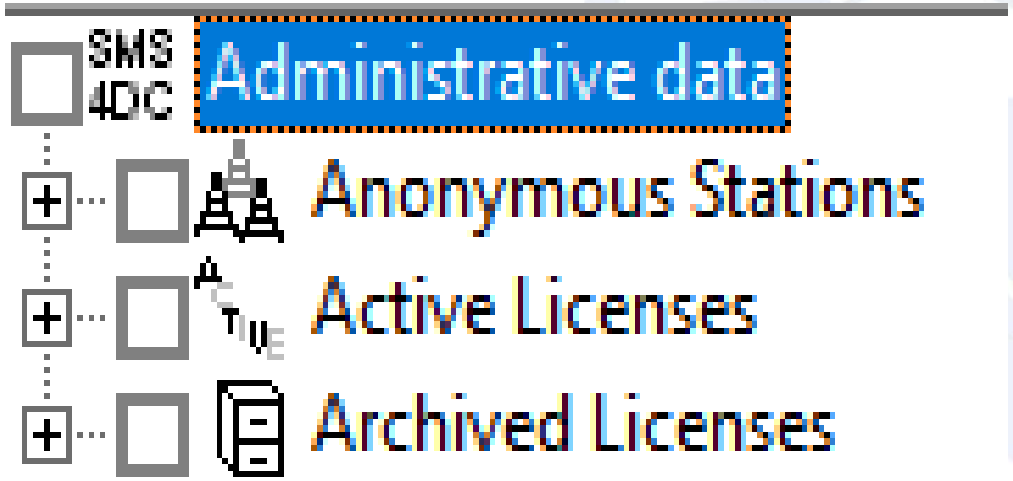


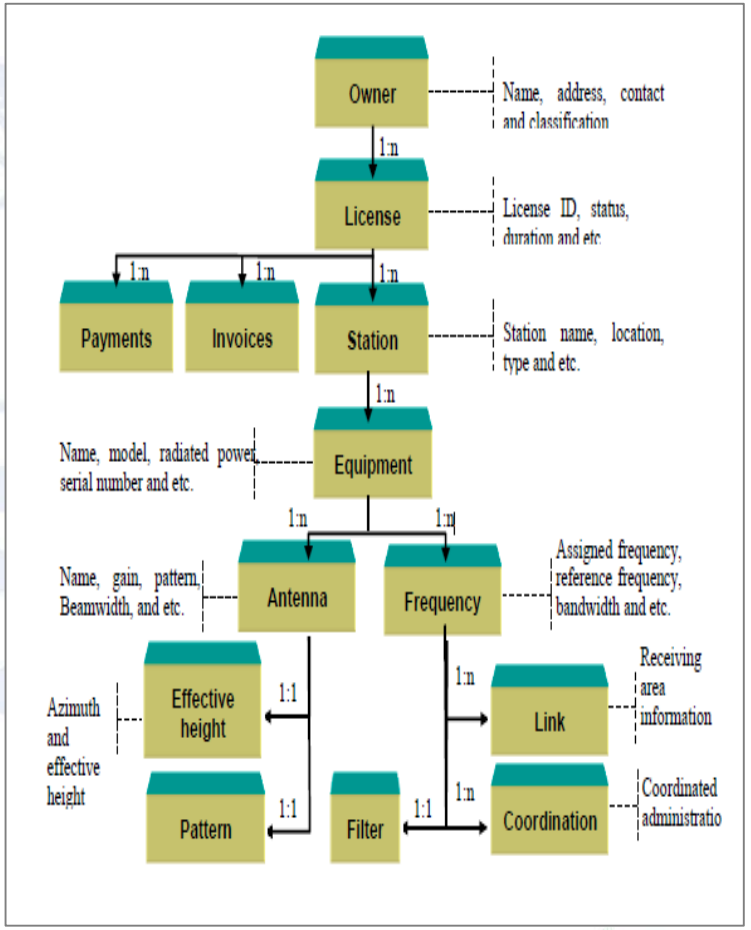
SMS4DC System Functions



SMS4DC Administrative functions

1 **SMS4DC Administrative functions**





SMS4DC Administrative functions

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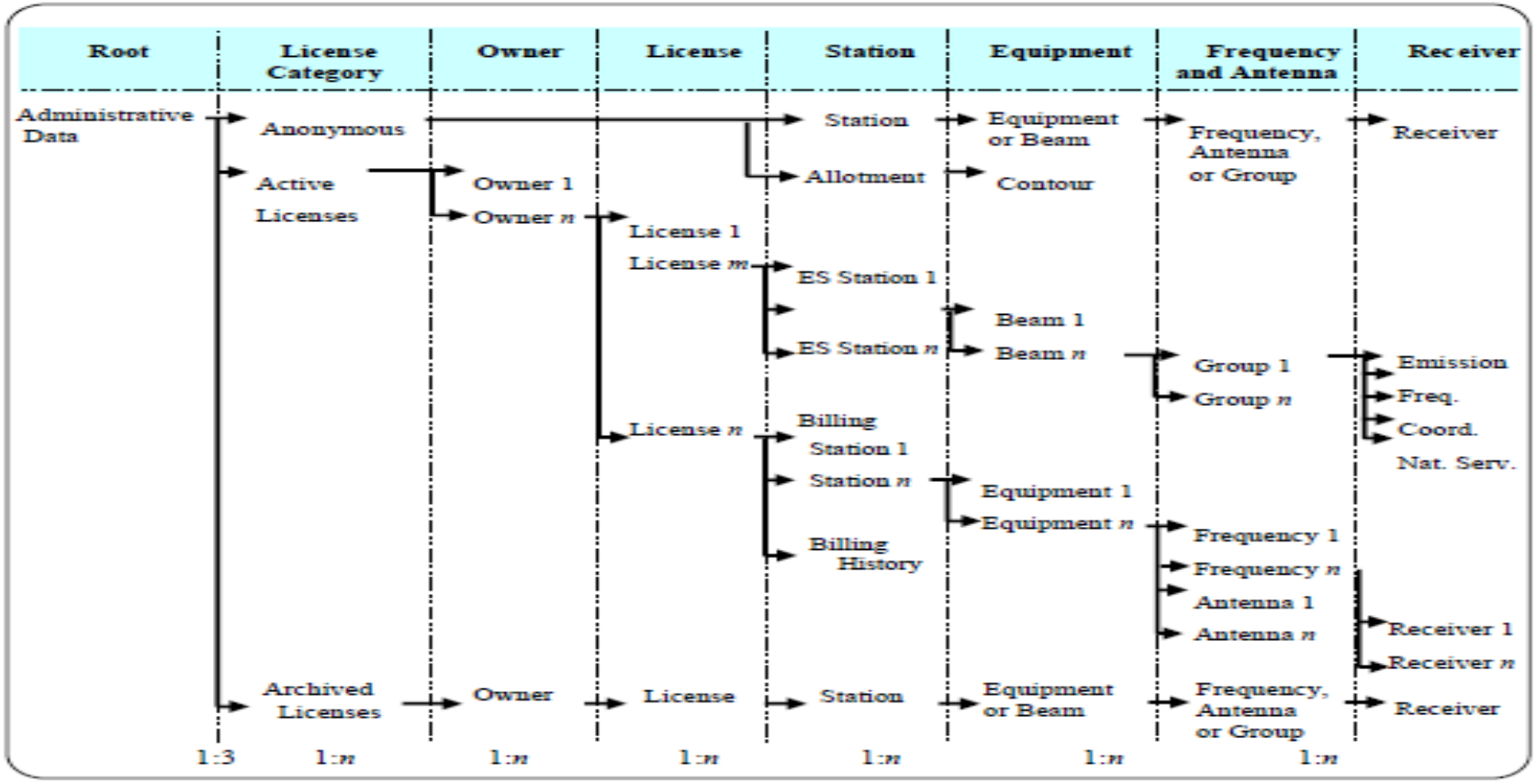
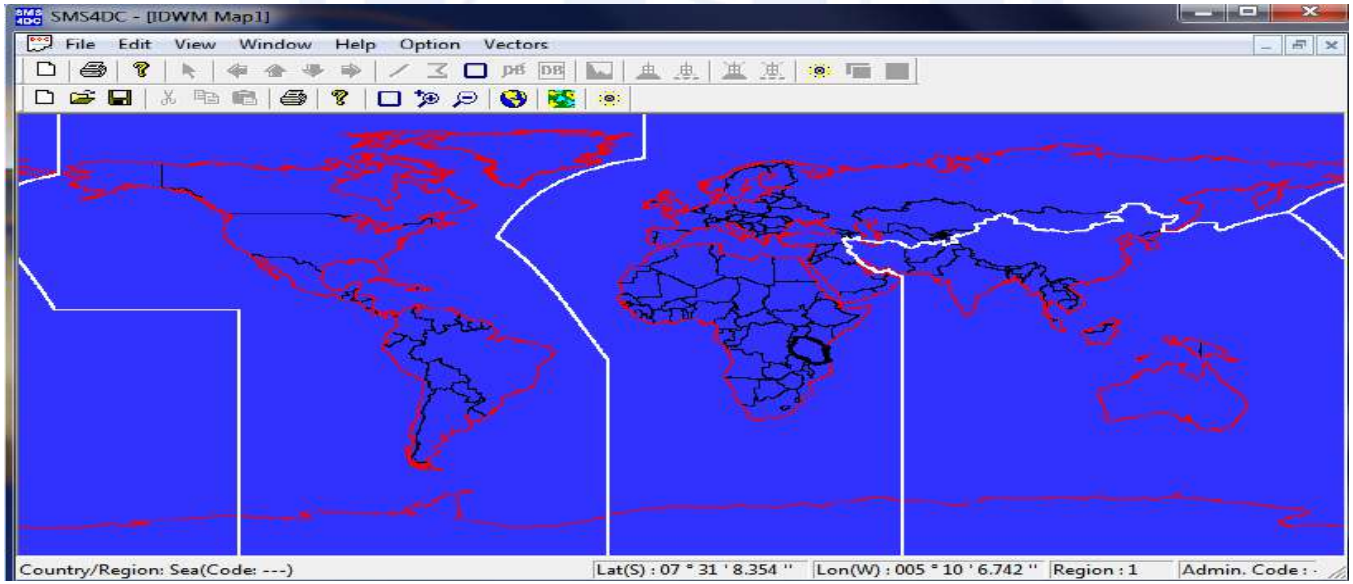


SMS4DC GIS Functions

2 **GIS Functions**

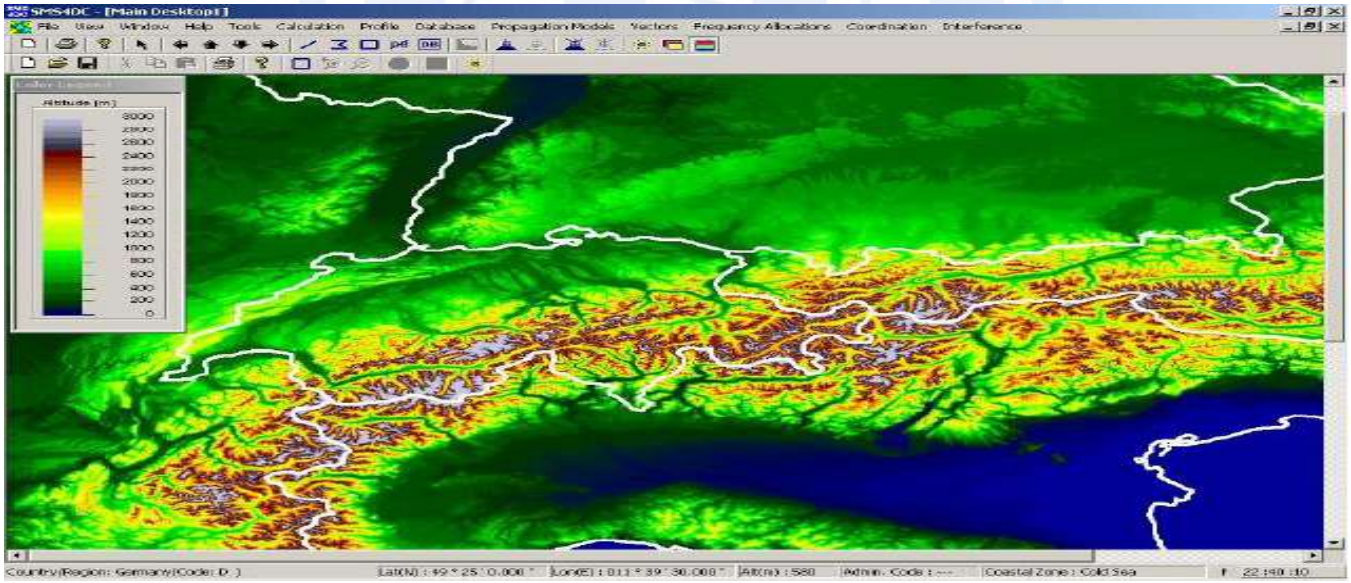
The IDWM is used to draw political borders, coastal lines (P.452), ITU regions, ITU agreements areas.



SMS4DC GIS Functions

2 **GIS Functions**

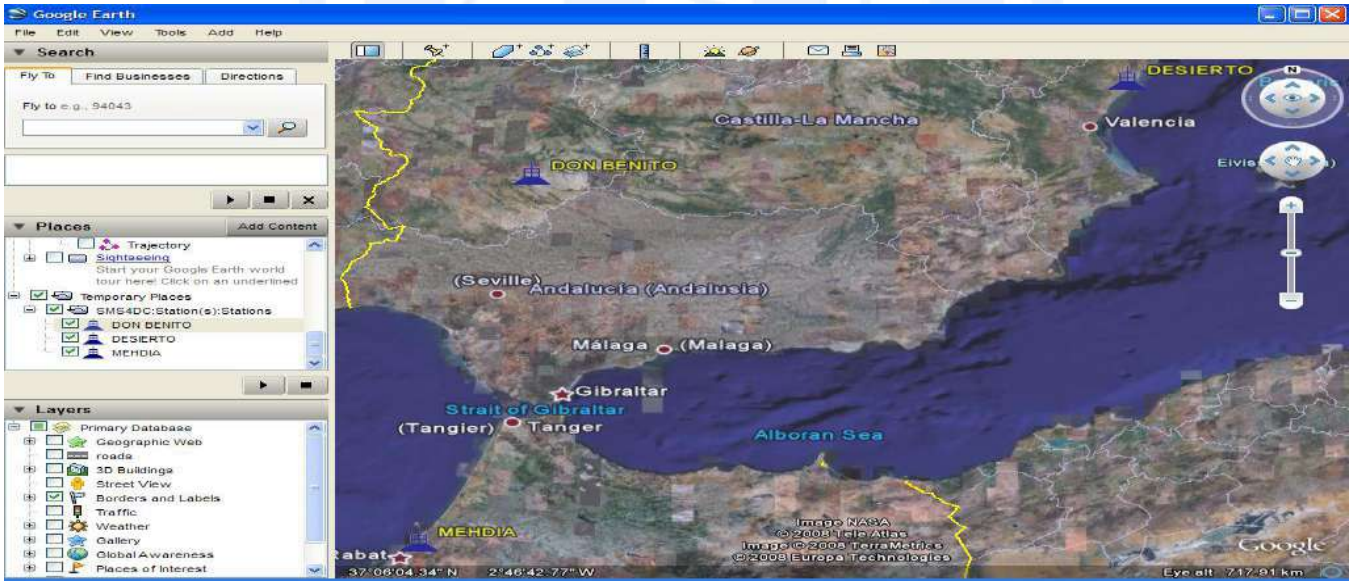
DEM is the Global Land One- kilometer Base Elevation model (GLOBE), however user maps with better resolution can be imported.



SMS4DC GIS Functions

2 **GIS Functions**

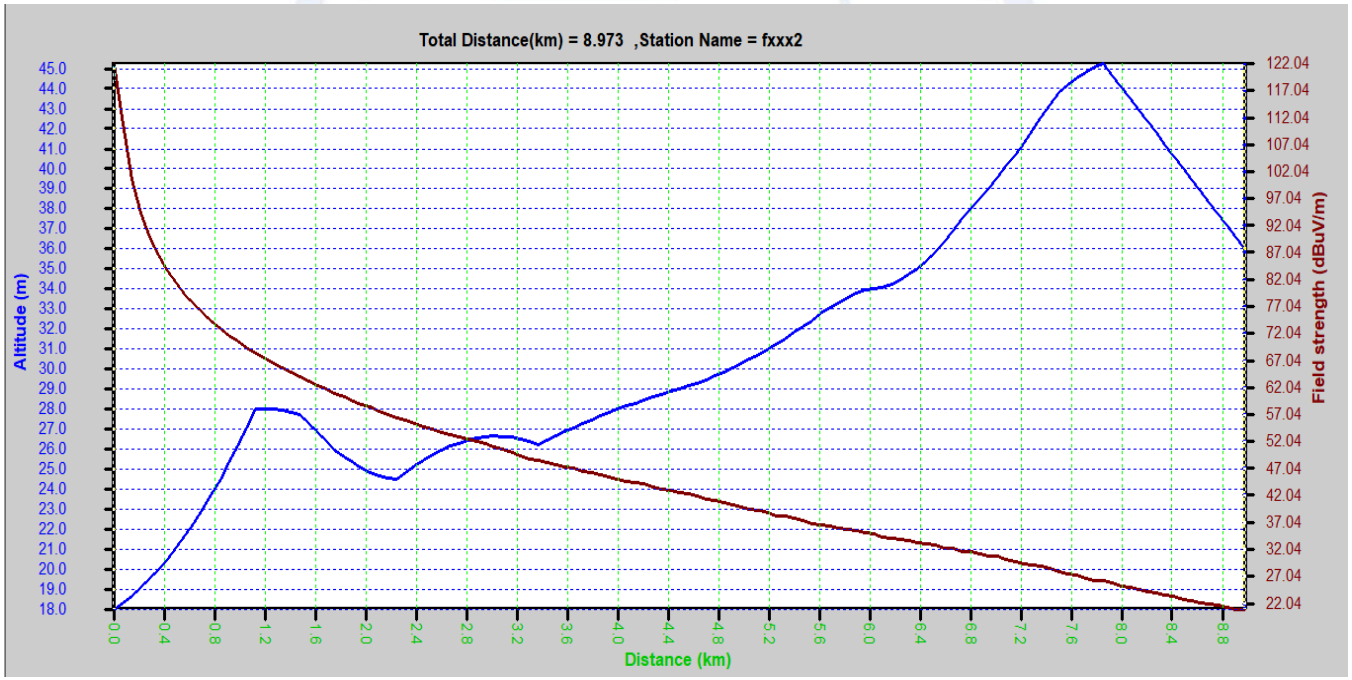
Export and display coverage area and stations, and overlays vectors in Google Earth



Engineering Analysis Functions

3 **Engineering Analysis Functions**
Functions

Calculation along a line for field strength values produced by a station along a path profile at a given receiving height above ground level as well as a visibility analysis.



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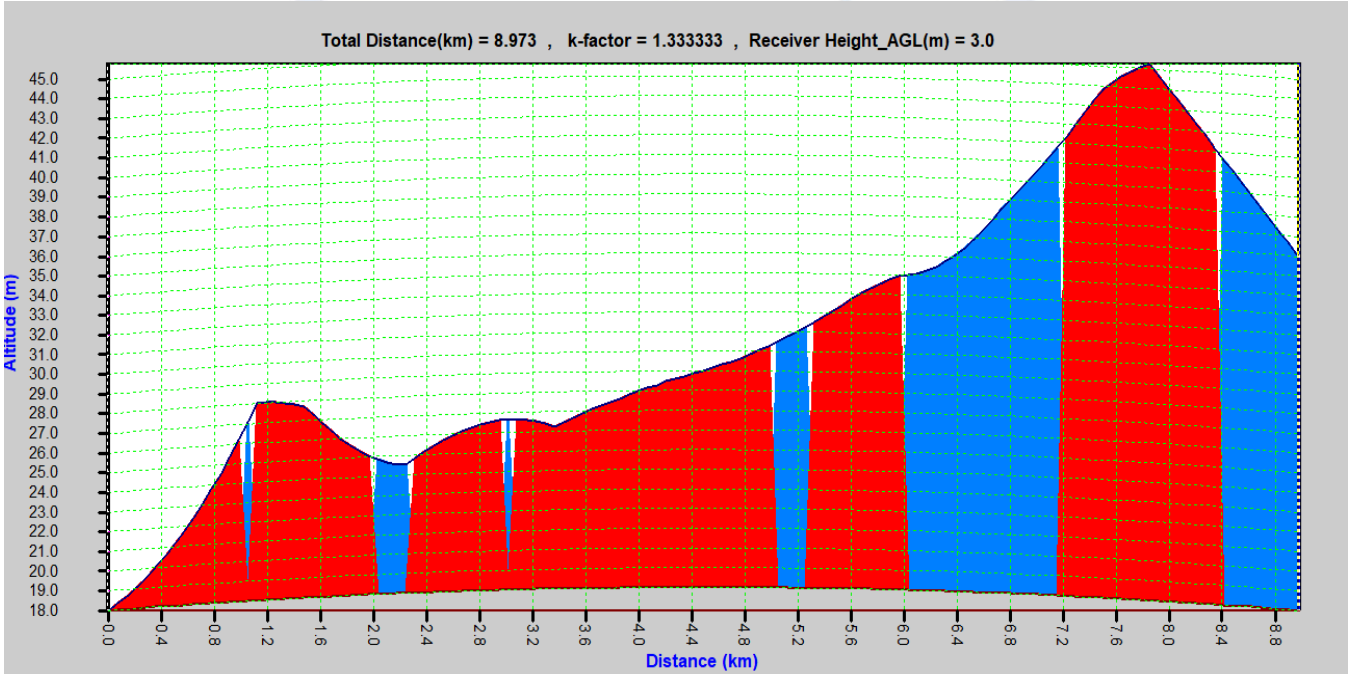
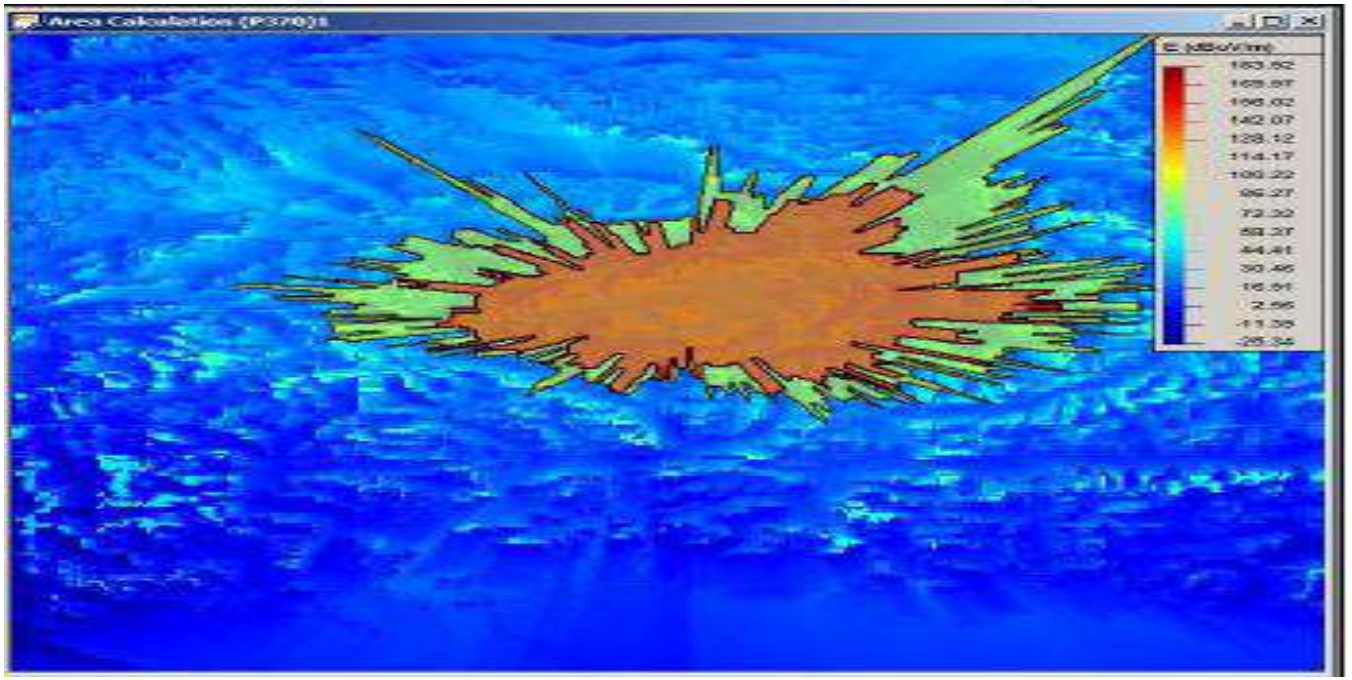


Engineering Analysis Functions

3 **Engineering Analysis Functions Functions**

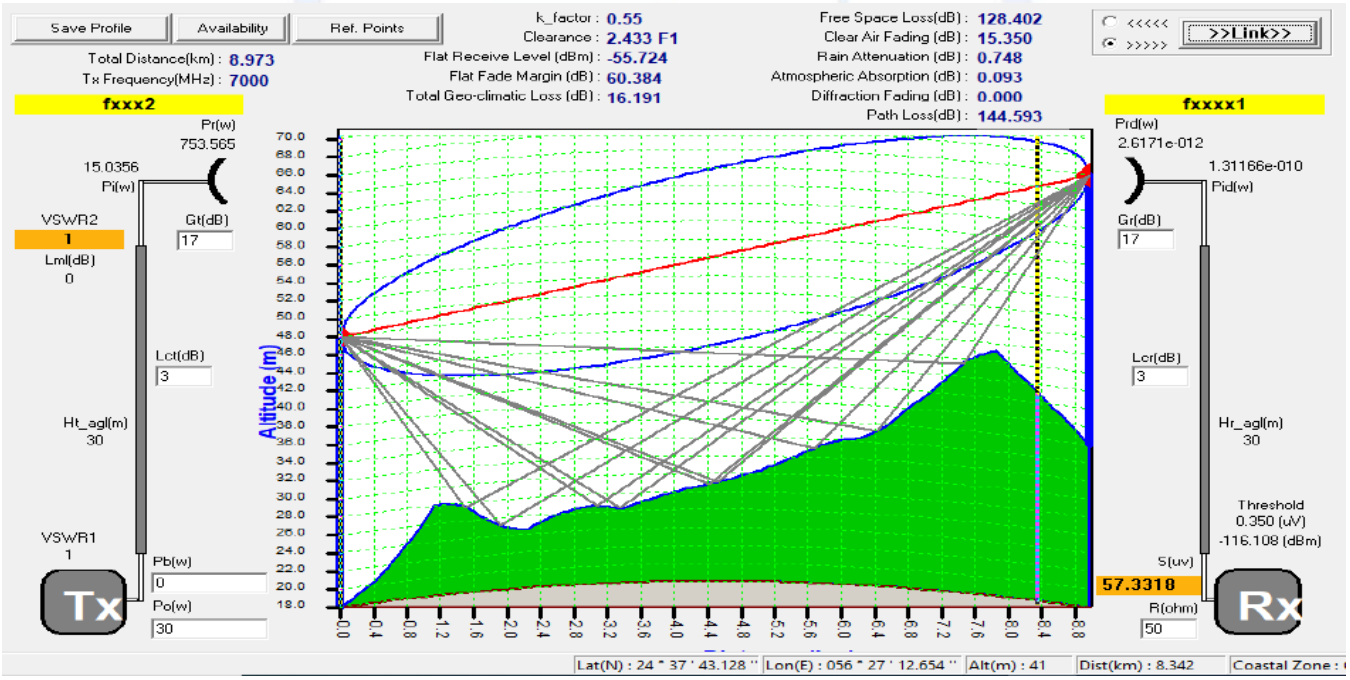
The Area calculation, Draw Contour and coverage area



Engineering Analysis Functions

3 **Engineering Analysis Functions Functions**

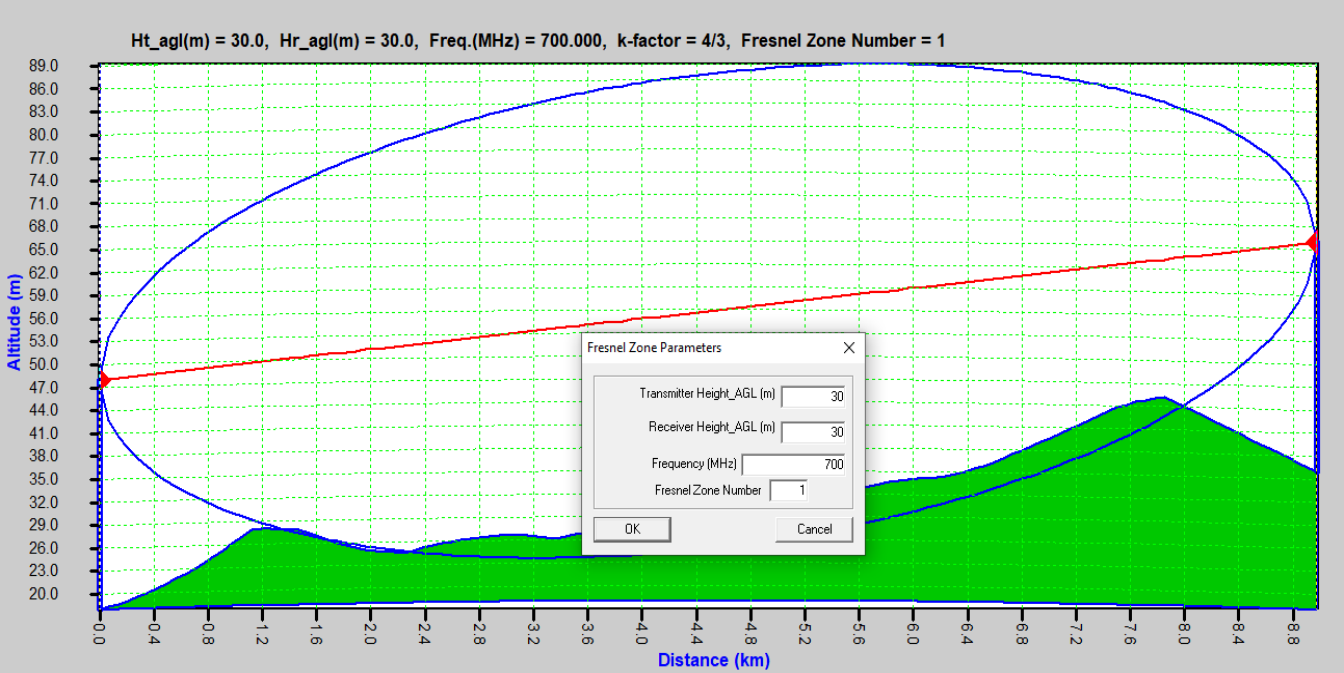
Point-to-point radio links, link budget calculations, link availability, path profiles, Fresnel zone clearance.



Engineering Analysis Functions

3 **Engineering Analysis Functions Functions**

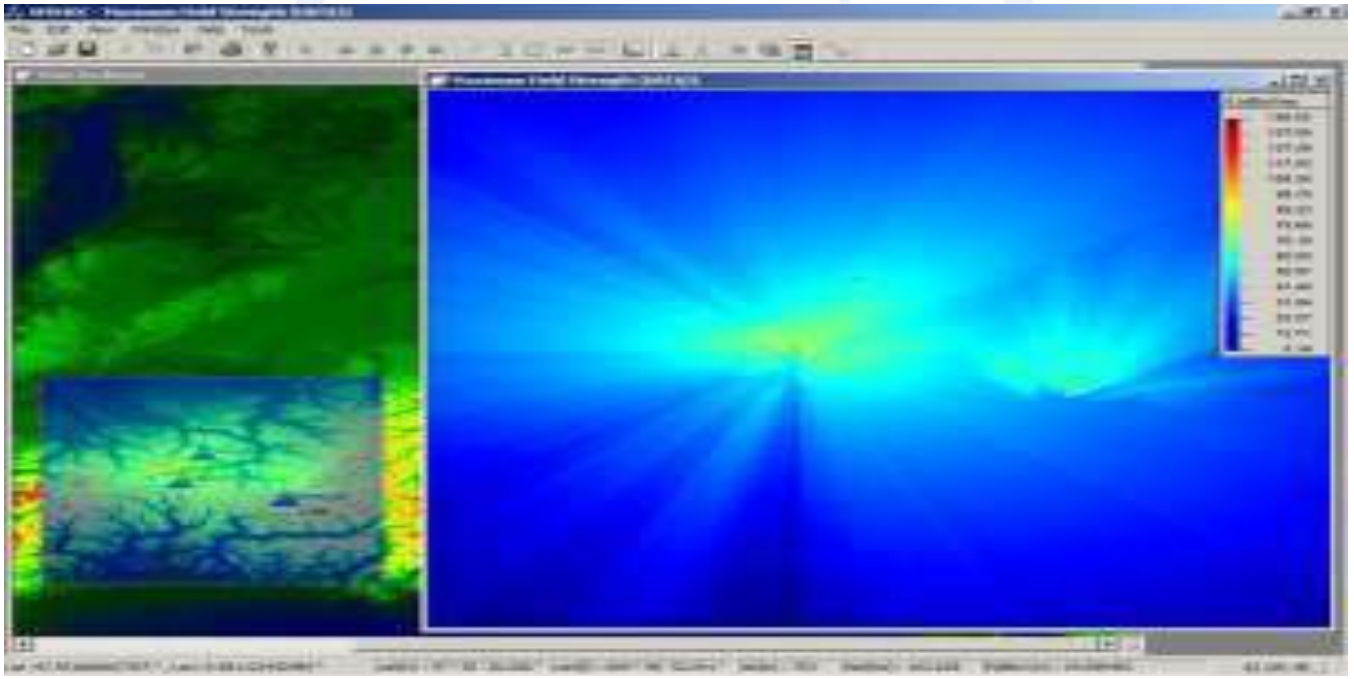
Fresnel Zone: Plots a path profile and the corresponding nth Fresnel Zone with the values of left site antenna, right site antenna, frequency, k-factor and Fresnel Zone number.



Engineering Analysis Functions

3 **Engineering Analysis Functions Functions**

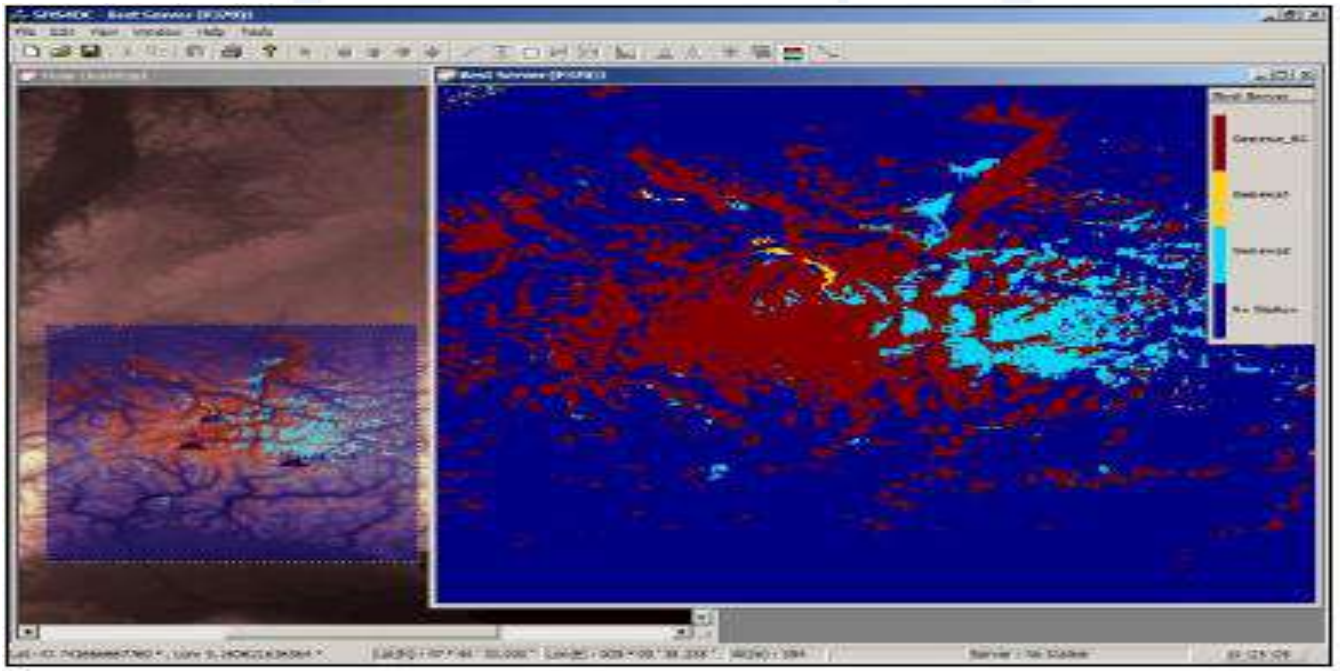
Maximum Field Strength, Calculate and visualize the maximum values produced by more than one transmitting stations at any point inside a predefined rectangular area.



Engineering Analysis Functions

3 **Engineering Analysis Functions Functions**

Best Server, calculate and visualize the best serving station at each point among various stations inside a predefined rectangular area

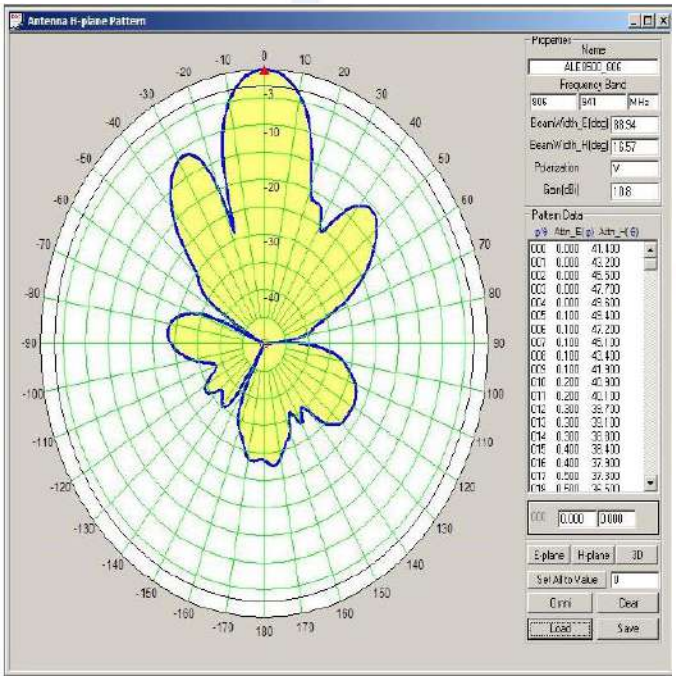


Engineering Analysis Functions

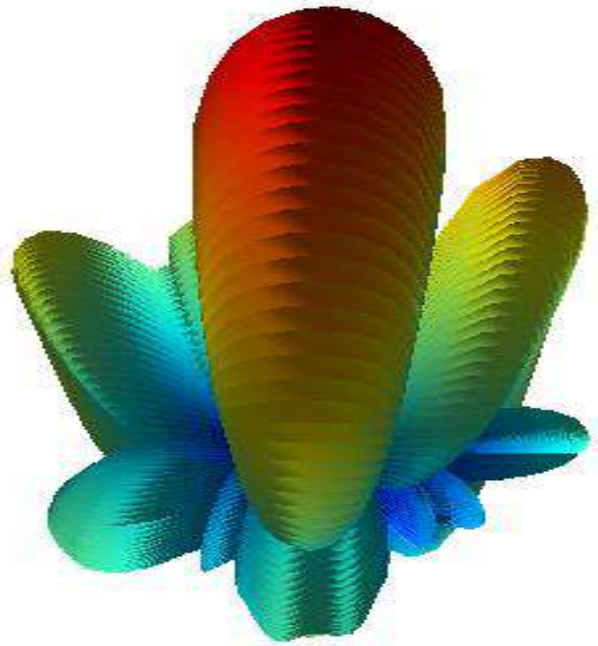
3 **Engineering Analysis Functions Functions**

Antenna Editor :Load, modify, visualize (2D and 3D), define and print antenna radiation pattern.

E-plane or H-plane



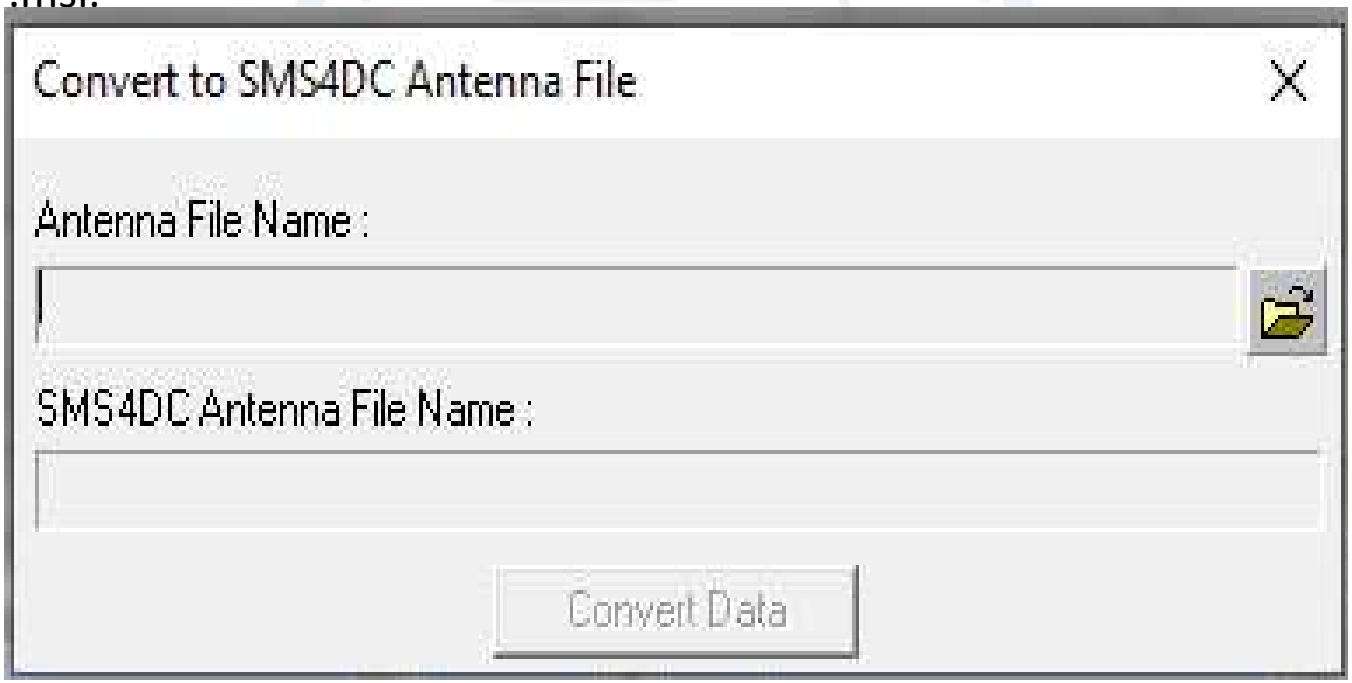
3D view of antenna pattern



Engineering Analysis Functions

3 **Engineering Analysis Functions Functions**

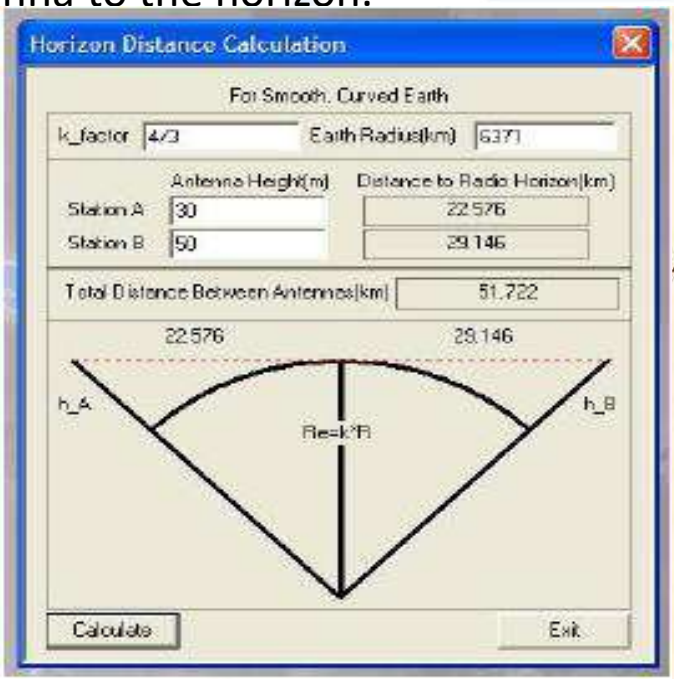
Convert Antenna File from other format to SMS4DC format: Antenna file in SMS4DC has format ant_*.ant , Most of antenna have Andrew format - *.adf or *.dat or Kathrein format - *.msi.

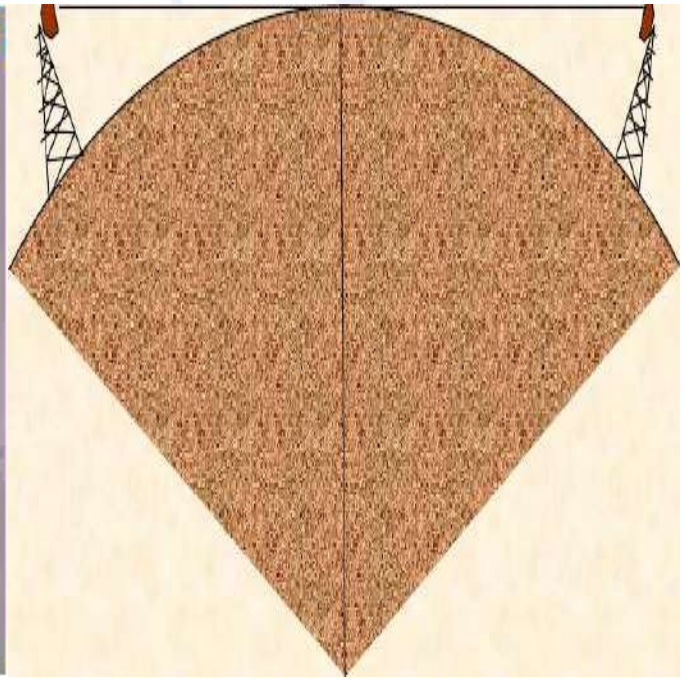


Engineering Analysis Functions

3 **Engineering Analysis Functions Functions**

Horizon Distance: This item provides a multi-entry calculator to calculate point to point distance between antennas over a smooth Earth path and the individual distance from each antenna to the horizon.

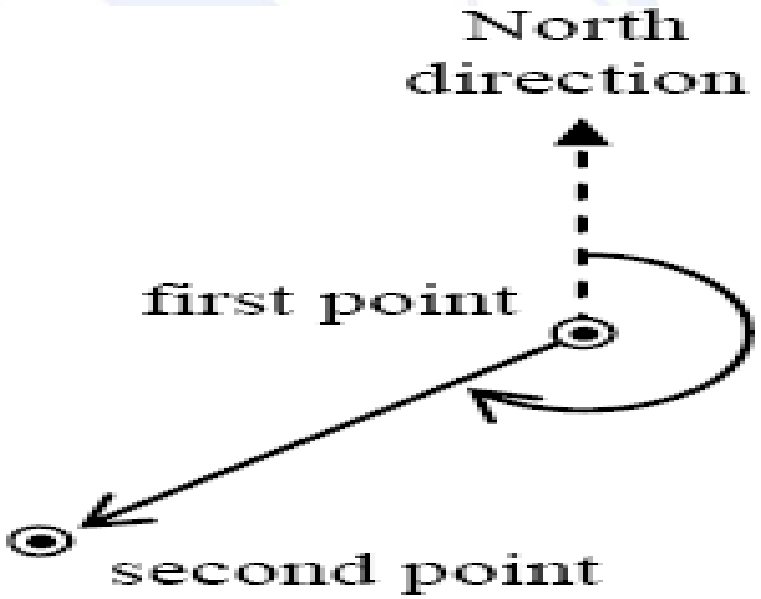




Engineering Analysis Functions

3 **Engineering Analysis Functions Functions**

Azimuth (Deg.): Calculation of azimuth angle of first point in respect to the second point in degrees

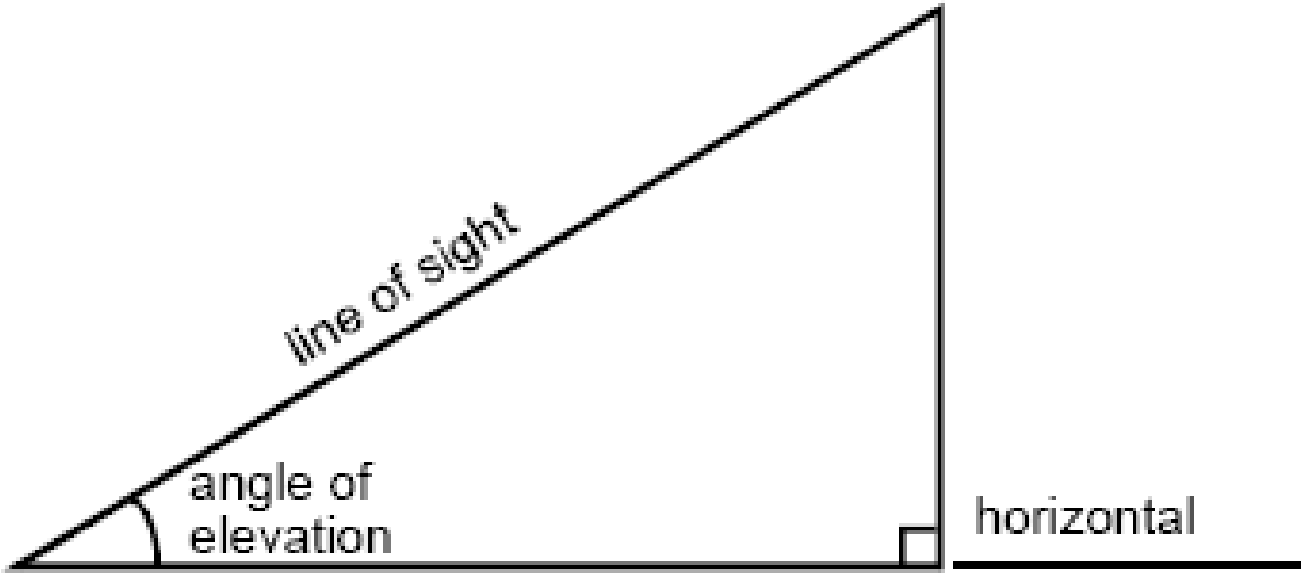


Azimuth 270 Deg

Engineering Analysis Functions

3 **Engineering Analysis Functions**
Functions

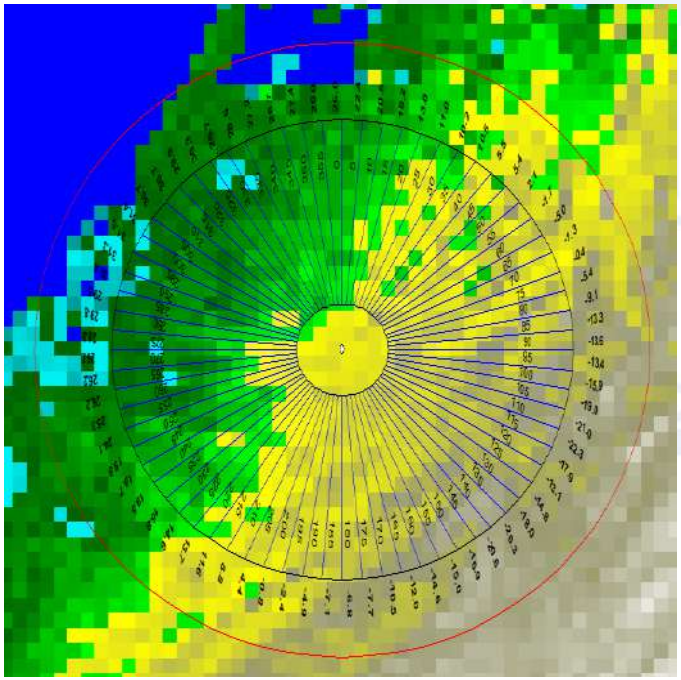
Elevation (Deg): Calculation of elevation angle of path from horizon distance to the line of sight

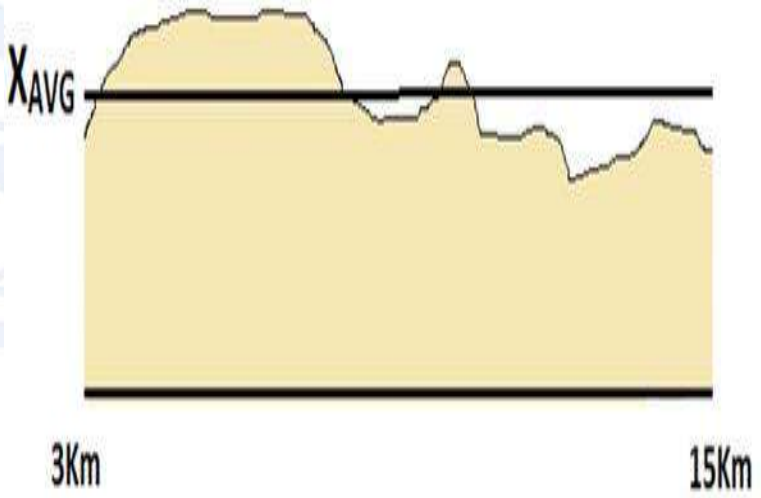


Engineering Analysis Functions

3 **Engineering Analysis Functions Functions**

Effective Height of antenna: is a function of surrounding terrain height, is average level of the ground between distances of 3 km and 15 km from the transmitter in the direction of the receiver.





SMS4DC System Security Mechanisms

Security Mechanisms in SMS4DC

- Supervisor
- Senior operator
- Engineers
- Licensing
- Data entry
- Read-only

Administrative data	Technical data	Manage user IDs and passwords
Read + write	Read + write	Read + write
Read + write	Read + write	Read + write
	Read + write	
Read + write		
Read + write		
Read	Read	

SMS4DC System Configuration

Single user

Workstation

-Main application
-Database
-Reports
-Maps

Multi user

-Database
-Reports
-Maps

Server

Workstation B

-Main application

Workstation A

-Main application

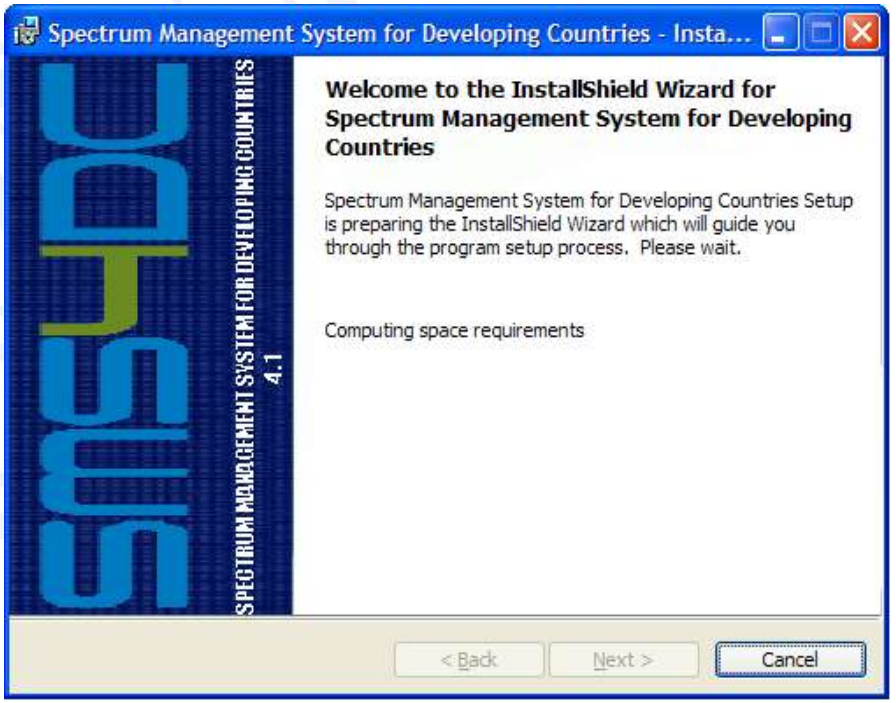
Setup for a single-user

Single user

Workstation

-Main application
-Database
-Reports
-Maps

1 Insert the SMS4DC CD in the CD-drive of the stand-alone PC. The SMS4DC CD is auto-run, therefore Windows installShield wizard will launch automatically.



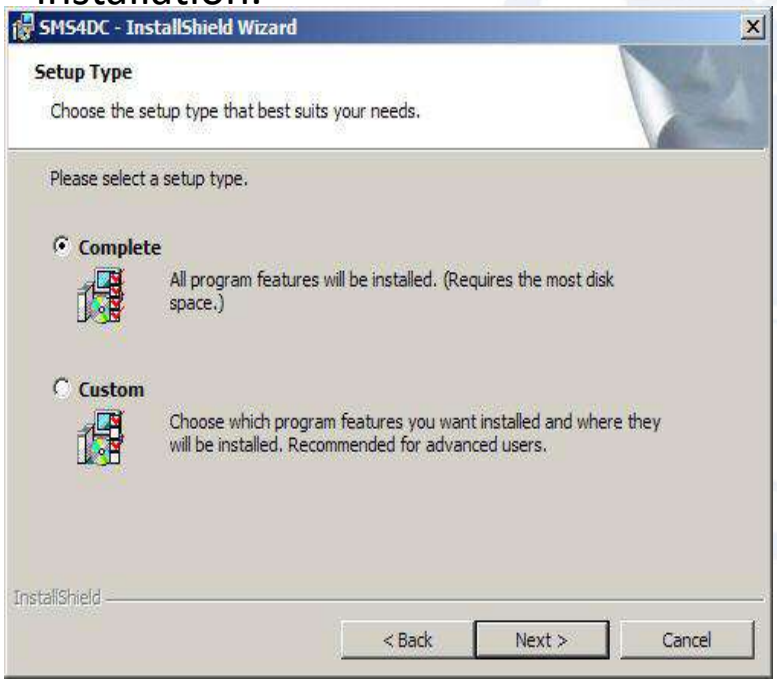
Setup for a single-user

2 Choose the installation language from the list of available languages that are displayed.

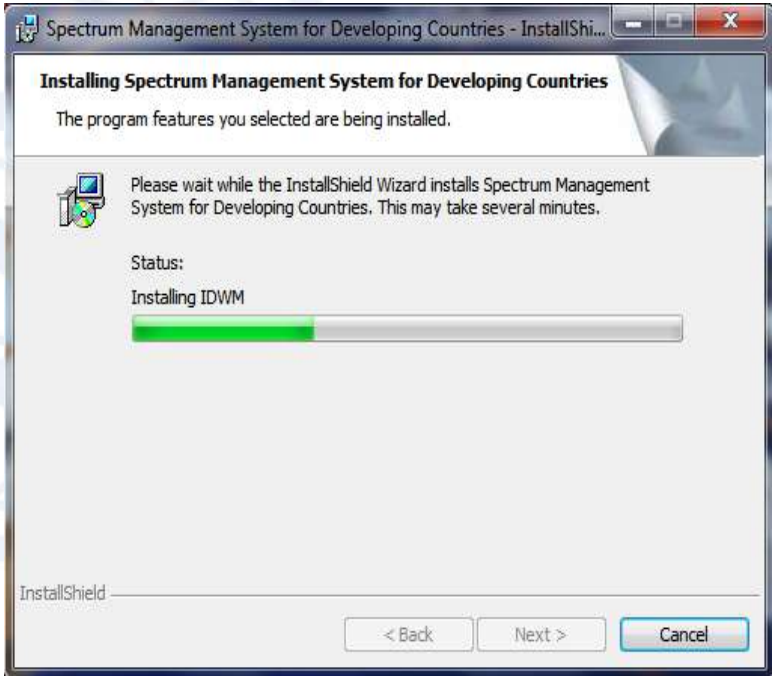
3 Accept the license agreement and enter the user information. Go to the next page.

Setup for a single-user

4 Choose the option Complete for the type of installation and allow the InstallShield wizard to complete the installation.

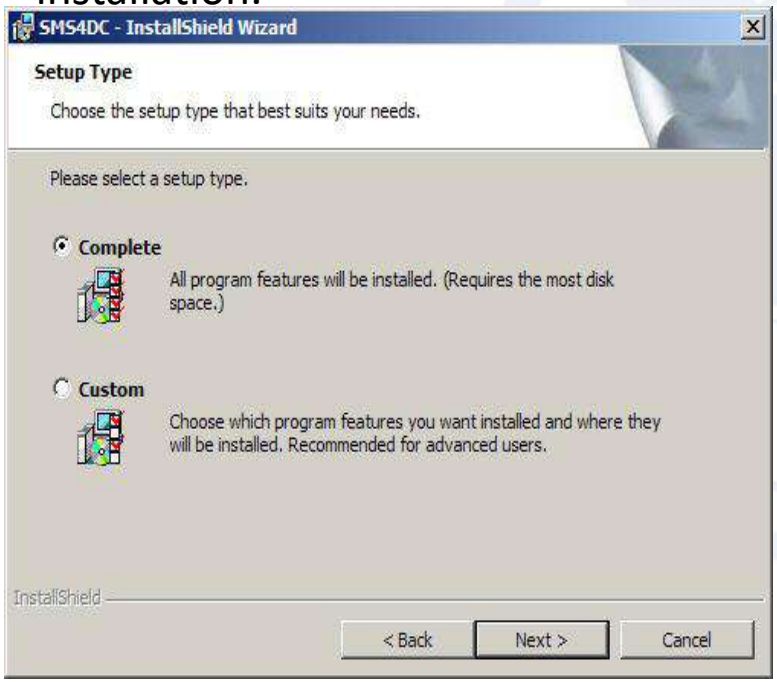


5 SMS4DC will start installation.

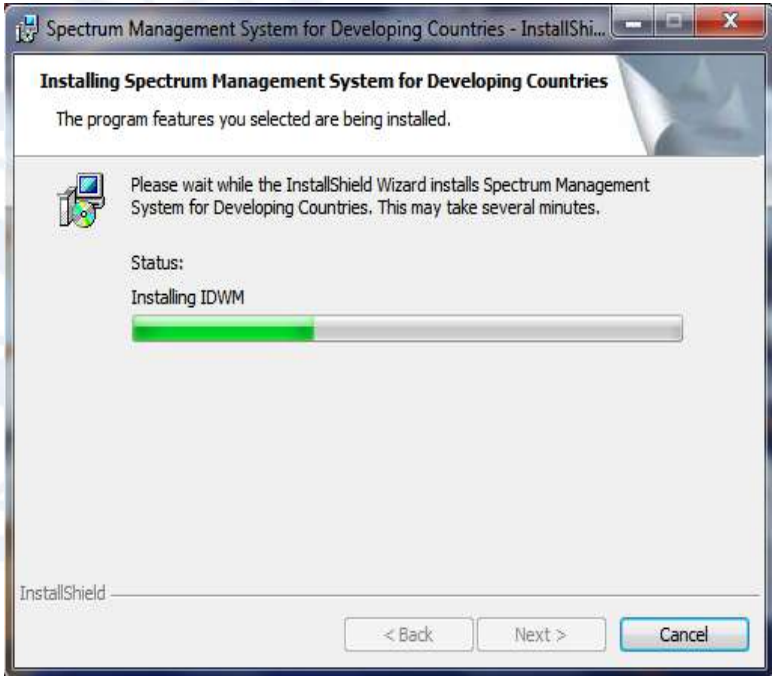


Setup for a single-user

4 Choose the option Complete for the type of installation and allow the InstallShield wizard to complete the installation.



5 SMS4DC will start installation.

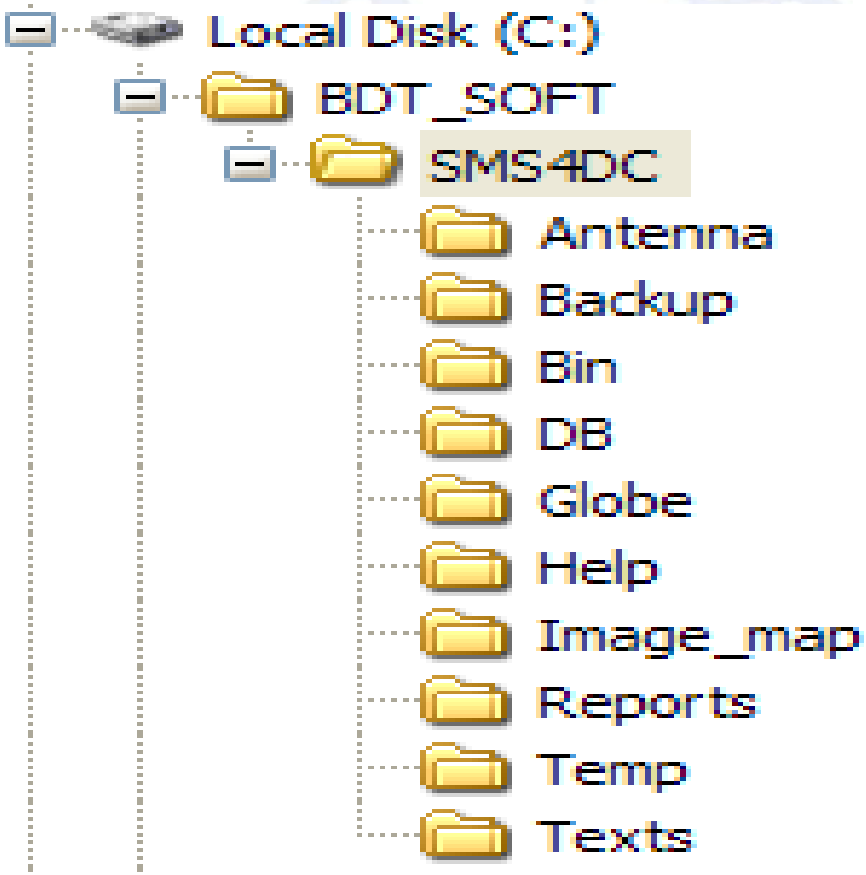


Setup for a single-user

6 The USB hard lock driver program is normally installed automatically during the main SMS4DC installation. The dongle should be plugged in to an active USB port of the computer ONLY after the installation is finished.

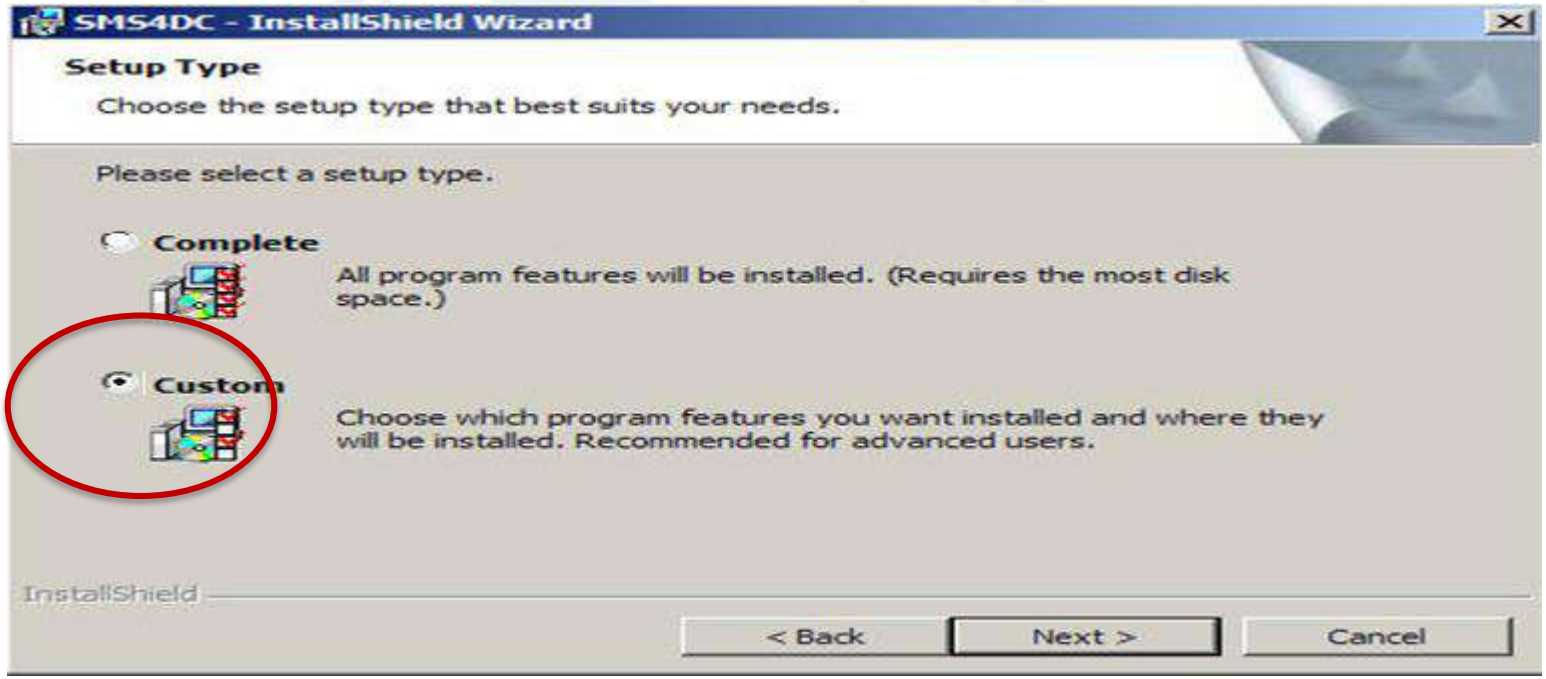
Setup for a single-user

7 The directory structure of the SMS4DC software in the case of a single-user setup



Setup for multiple user

- GLOBE and SMSDB-NEW installed on server and SMS4DC core installed on the client PCs.
- Choose the option Custom for a network installation and follow the instruction from SMS4DC installation guide.



Thank you!

PRIDA Track 1 (T1)

ON-LINE English capacity building workshop

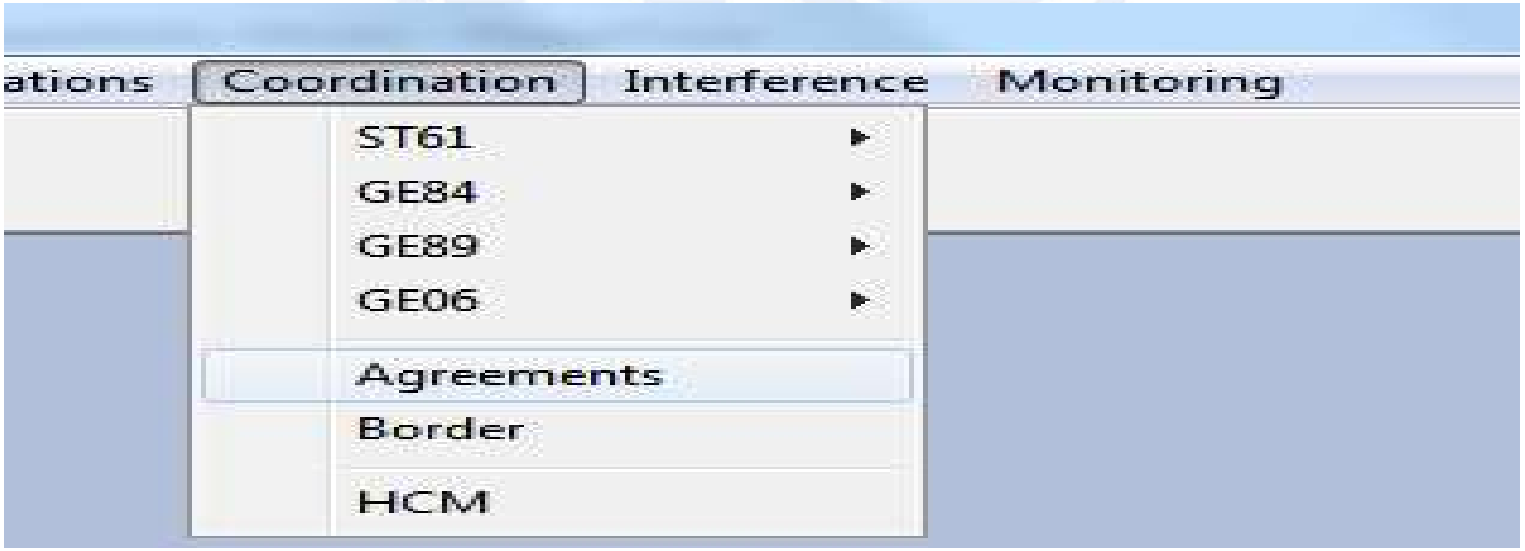
Border Coordination- User defined agreements

April 20 - May 1, 2020

Yasir Ahmed
ITU expert
Email: Yasir192@gmail.com

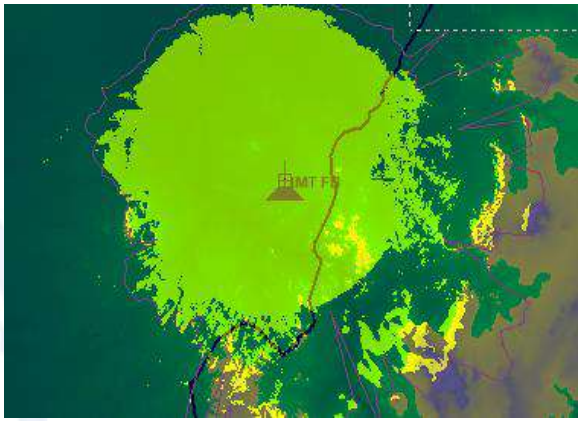
Why Border coordination

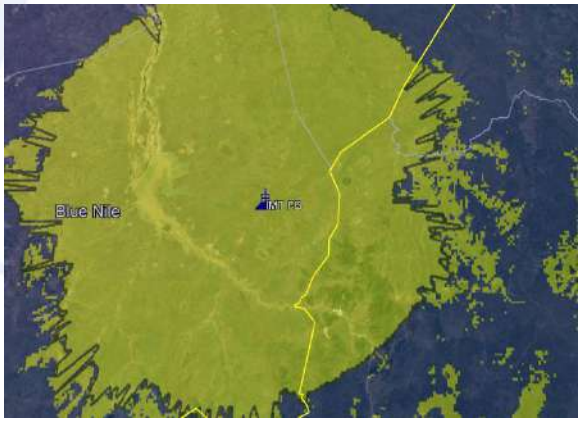
- Developing effective bilateral or multilateral agreements on frequency use in border areas will aid long-term strategic planning, promote efficient spectrum utilisation and help avoid interference
- The item “Agreement” in Coordination menu enables the entry of user-defined agreements which may be used for border coordination through the “Border” item in same Menu.
- Each agreement consists of two parts; header and technical characteristics.



Why Border coordination

- Radiowaves do not stop at the border of the country.
- To avoid harmful interference from the stations of one country into the territory and stations of neighbor countries.
- Bilateral or multilateral agreements on frequency use in border areas will aid long-term strategic planning, promote efficient spectrum utilization.
- Agree on allowed interference range and distance
- Coordinating frequencies among administrations before assigning them.
- Quick assessment of interference through agreed criteria.





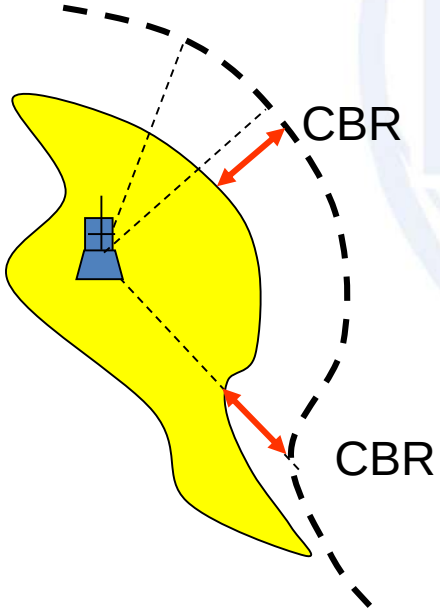
SMS4DC border agreements

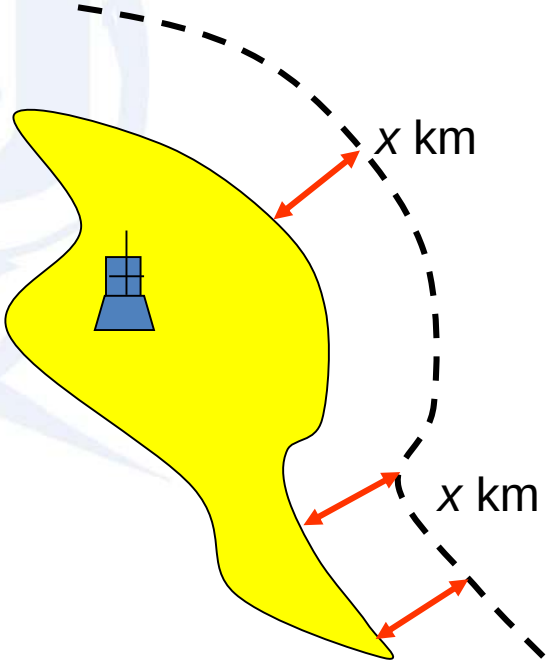
- The item “Agreement” in Coordination menu enables the entry of user-defined agreements which may be used for border coordination through the “Border” item in same Menu.
- Each agreement consists of two cparts; header and technical characteristics.

Header part	**Technical part**
• Name of agreement • Member countries • incorporated radio communication services • Propagation models used in the agreements (free space and P.1546) • Agreement category	• Frequency bands • Preferential countries in any frequency band • Cross Border Range(CBR), x-km or coordination distance. • Effective radiated power and permissible interference field strength(PIFS)

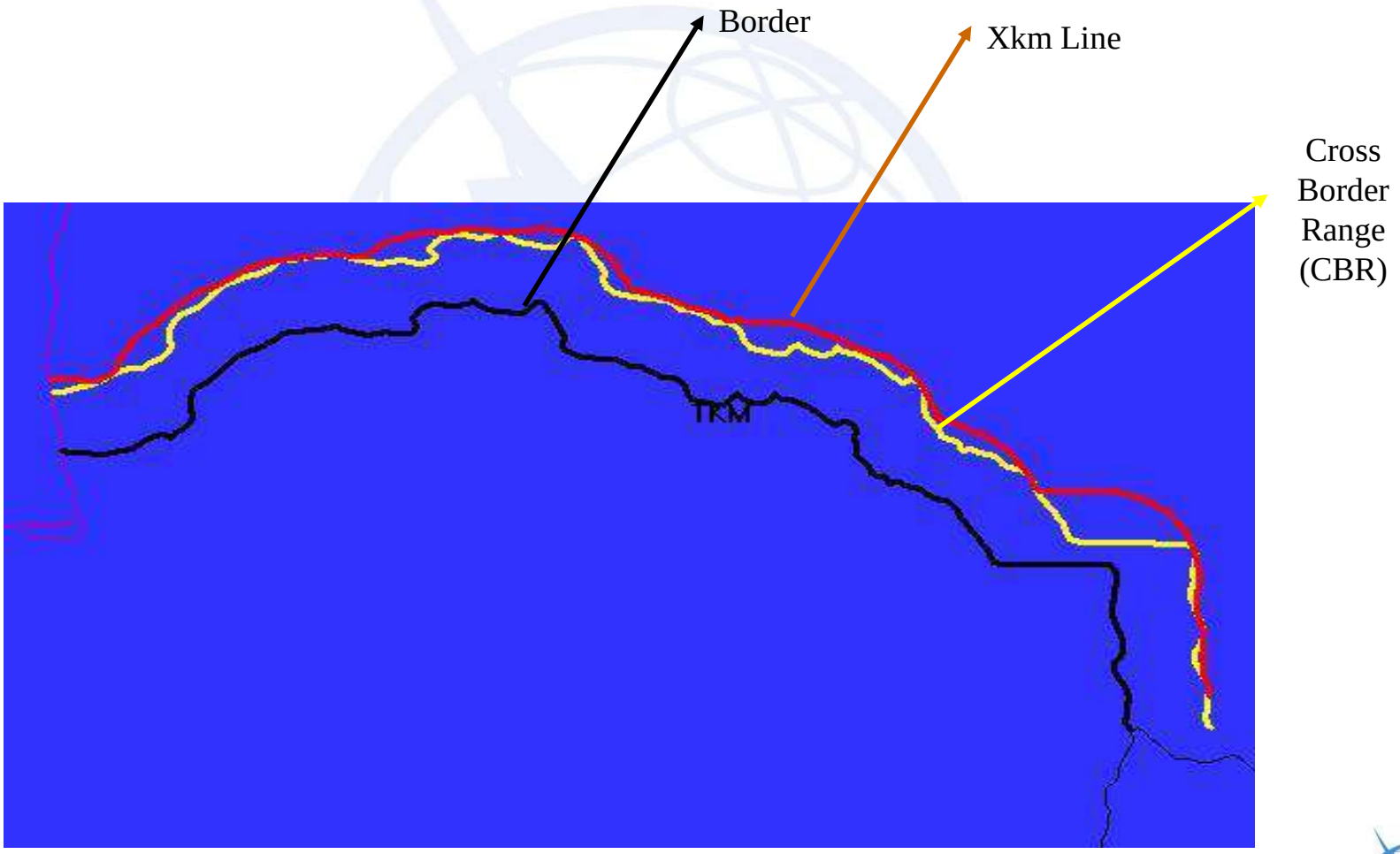
Contour categories

Cross Border Range(CBR)	The x-km contour
• is the locus of points where their distances to the border, along the line connecting points to the concerned station, are identical	• is the locus of points where their nearest distance to the border is set at an agreed value of x km.





Contour categories

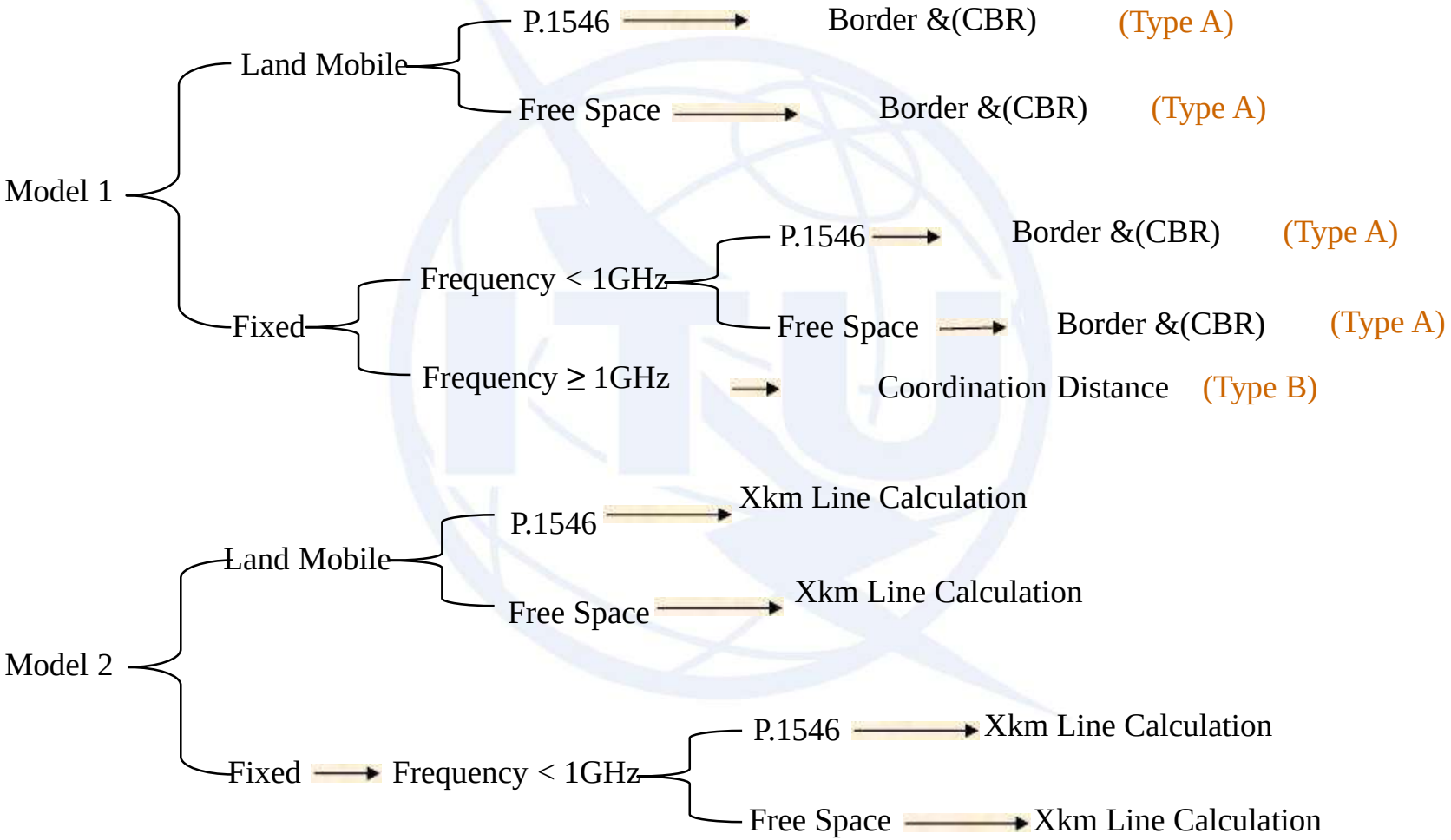


Agreements types

- **Frequencies requiring co-ordination** :Frequencies which Administrations are required to co-ordinate with the other Administrations affected before a station is put into service.
  - Model 1 (Type A) Land Mobile service (all frequencies) & Fixed service(below 1 GHz) Coordination of selected station is required if field strength on border of concerned administrations exceeds permissible interference level. Also field strength on CBR shall not exceed permissible interference level.
  - Model 1 (Type B) Fixed service above 1 GHz Coordination of selected station is required if distance of the station to border is less than coordination distance

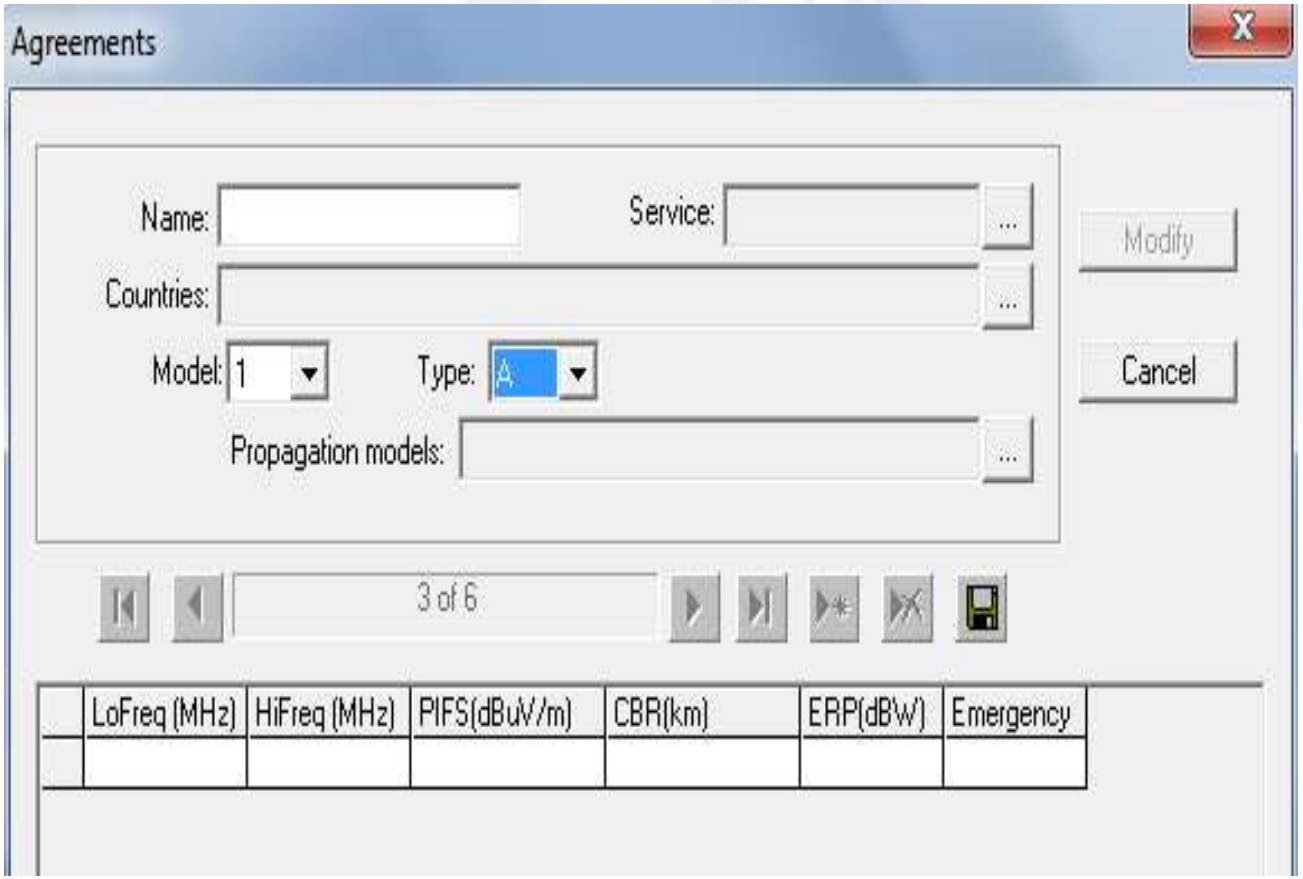
- **Preferential Frequencies** :Frequencies which the Administrations concerned may assign, without prior co-ordination, on the basis of bi- or multilateral agreements.
  - Model 2 : Land Mobile service (all frequencies) and fixed service below 1 GHz Prior co-ordination is not required if field strength of selected station on X-km is less than permissible interference level

Agreements types



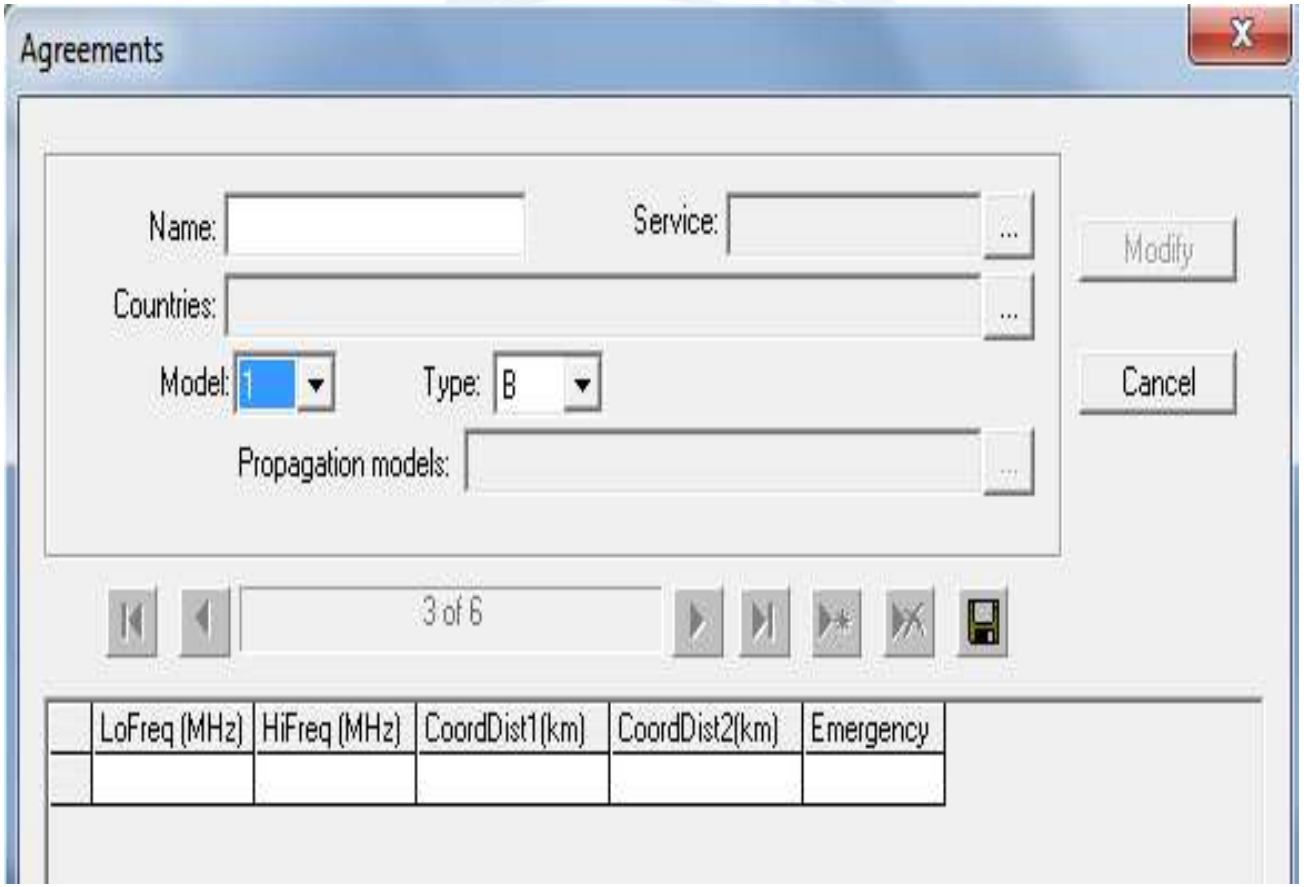
Agreements types

Model 1 Type A



Agreements types

Model 1 Type B



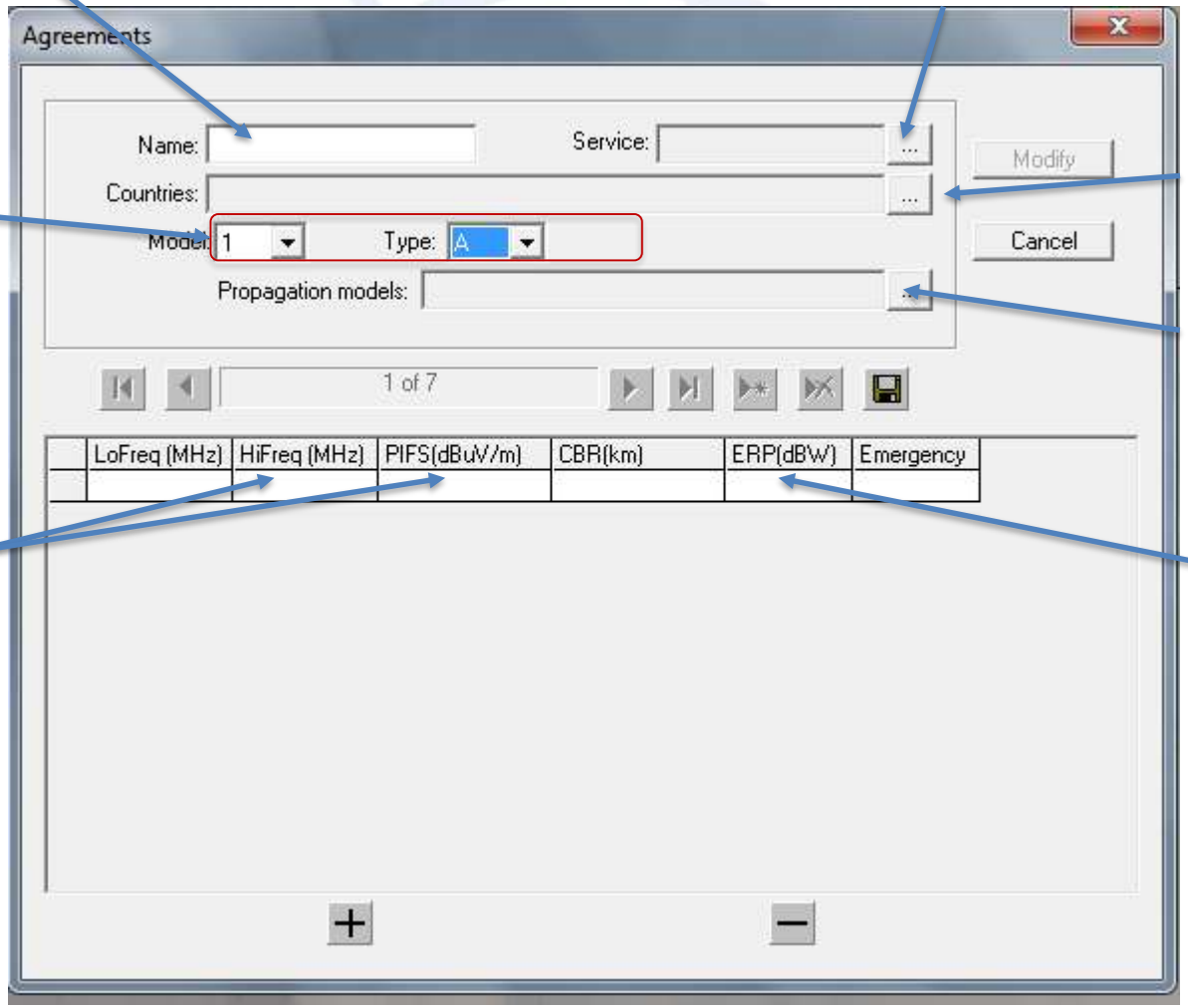
Agreement- Fields

Field name	Description	Category	
		Mode	Type
AgID	The ID number of an agreement in the database.	All	All
LoFreq,HiFreq	The lower and upper edge of the applicable frequency range (MHz).	All	All
PrefCountries	The list of preferential countries. If this cell in relevant row or the row is selected, the "Preferential Countries" push button can be used for choosing and inserting data in this cell.	2	---
PIFS	Permissible Interference Field Strength. This value (in dBμV/m) is compared with the calculated field strength value to determine whether or not coordination is necessary.	All	A
CBR	The CBR (Cross Border Range), in km, is the distance beyond the national border used to establish a contour of points. The distance of any point on this contour to the border, along the line connecting to the concerned station, will be identical and equal to CBR (see Figure 3.175).	1	A
X-km	The X-km, in km, is the distance beyond national border used to establish a contour of points. The nearest distance of any point on this contour to the border will be identical and equal to X-km (see Figure 3.175).	2	
CoordDist1	The coordination distance used where the summation of station height, above sea level, and antenna height, above ground level, is less than β00 metres.	1	B
CoordDist2	The coordination distance used where the summation of station height, above sea level, and antenna height, above ground level, is over 300 metres.	1	B
ERP	The Effective Radiated Power (ERP), in dBW, of reference transmitter, used for field strength calculations (except in type B, mode 1).	All	A
Emergency	The code indicating the operation type for the frequency band, 1 for emergency and 0 for normal operation modes. This field is available for all categories of agreement.	All	All

Agreement- Fields

Agreement name

Services considered



Category of agreements

Member countries

Propagation models used in the agreements

Frequency band definition

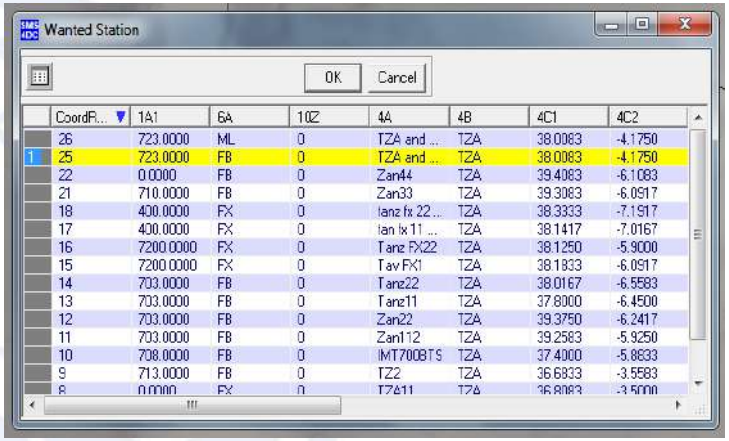
ERP of reference transmitter

Border coordination calculations

Select border under coordination menu

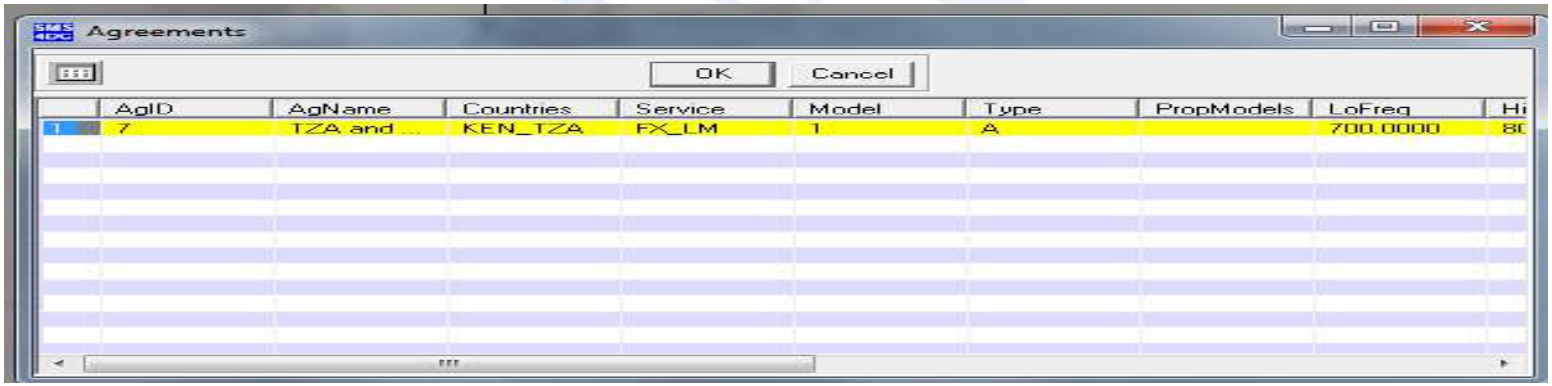
1

Choose wanted station



Applicable agreement (or agreements) will be displayed, The applicability of agreements will depend on the frequency, country and service type of the selected station.

2

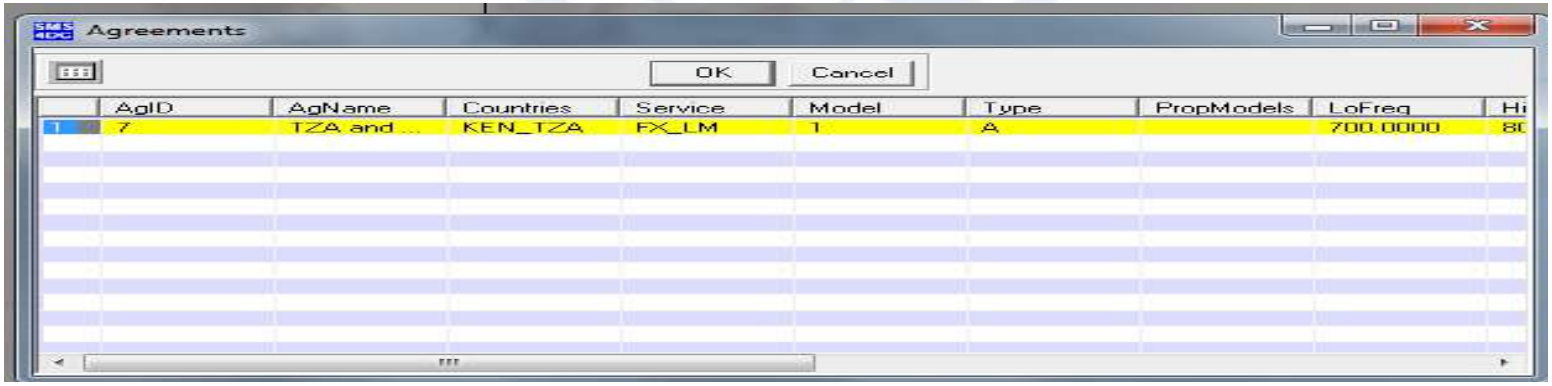


Border coordination calculations

1. After choosing one of the presented applicable agreements, the search radius will be requested as additional criteria.

Applicable agreement (or agreements) will be displayed, The applicability of agreements will depend on the frequency, country and service type of the selected station.

2.

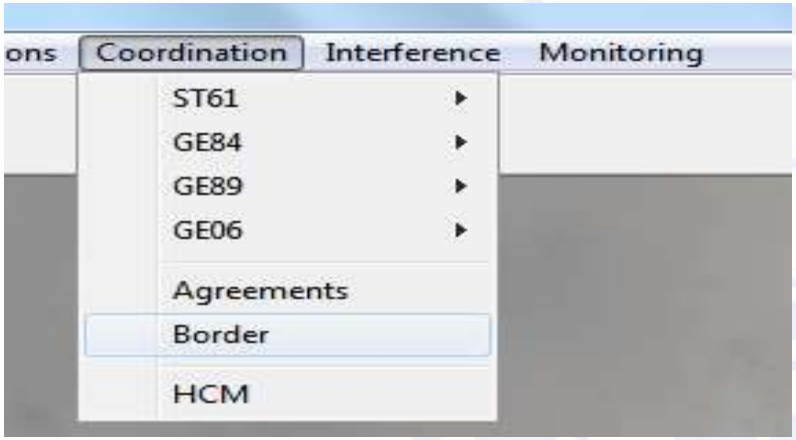


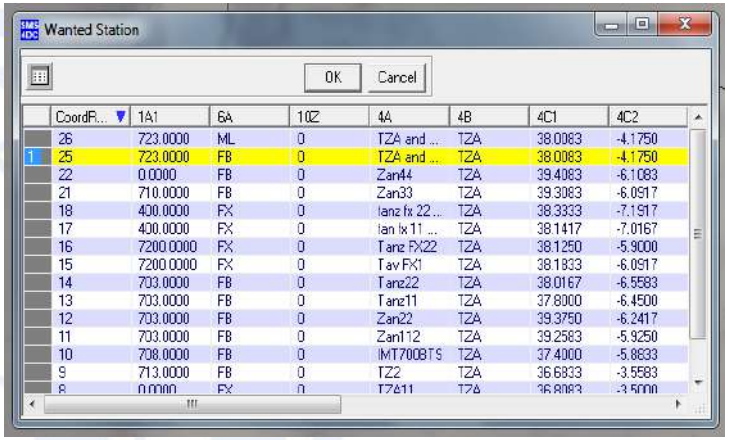
Border coordination calculations

Select border under coordination menu

Choose wanted station

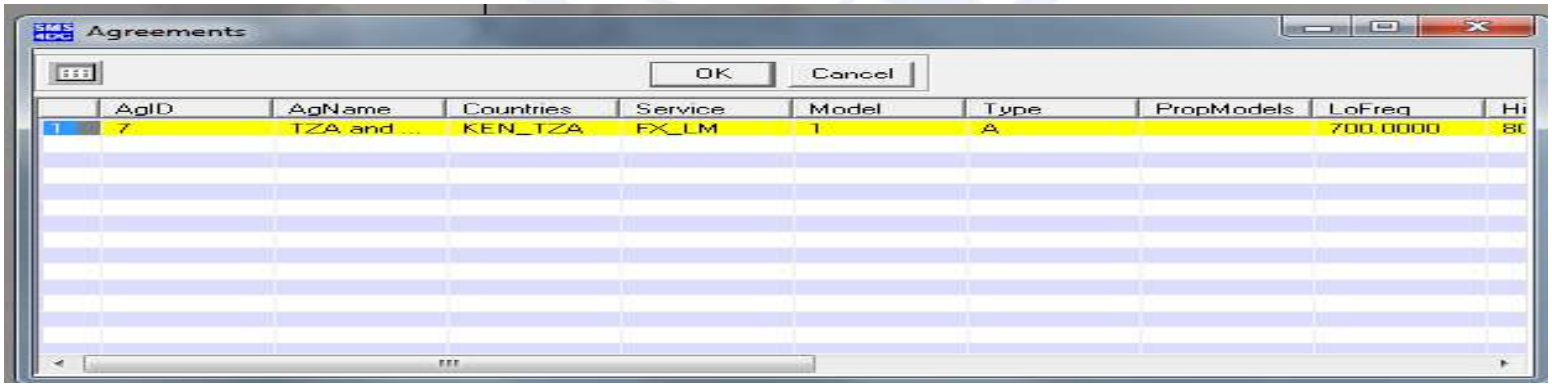
1





Applicable agreement (or agreements) will be displayed, The applicability of agreements will depend on the frequency, country and service type of the selected station.

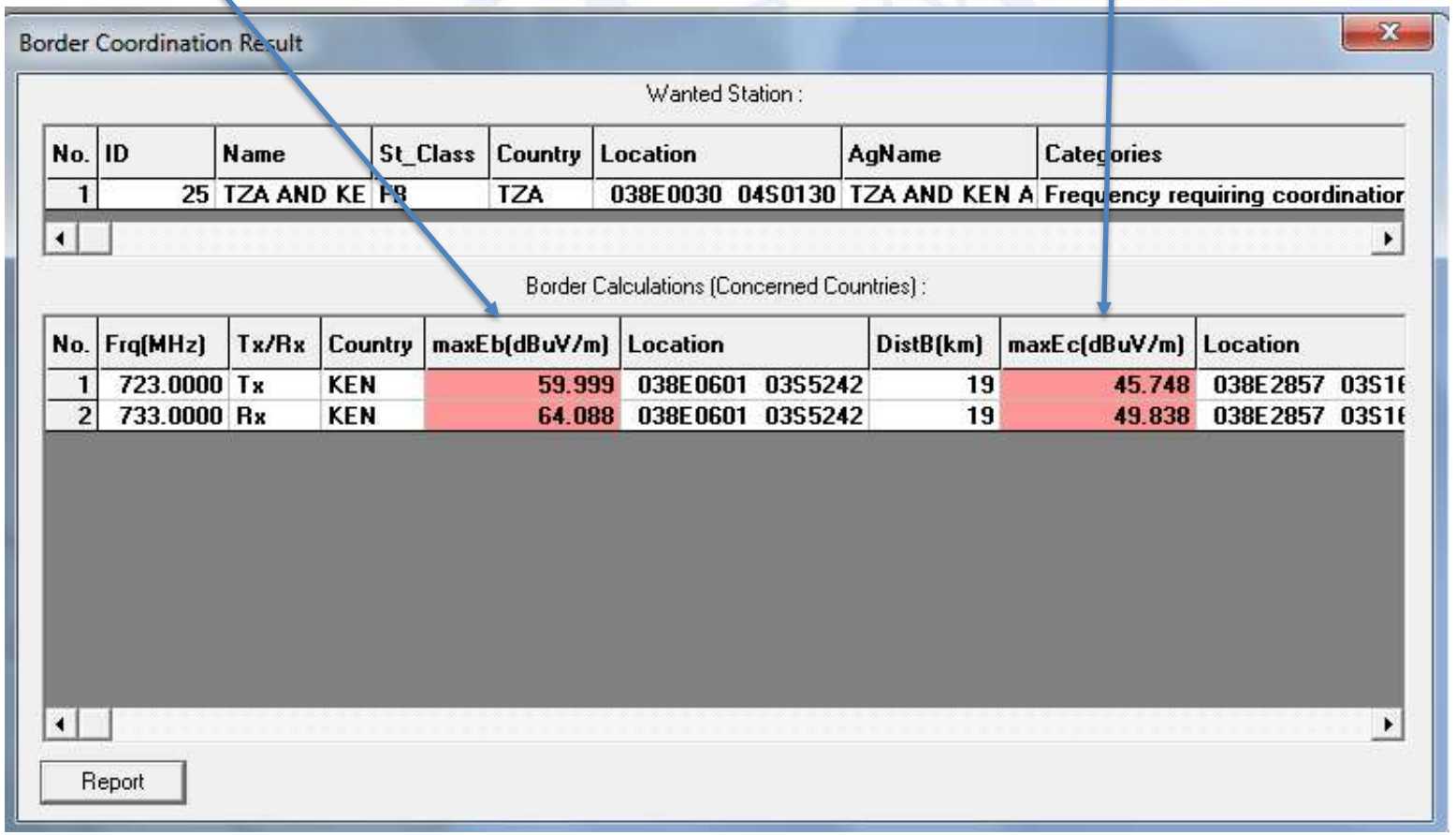
2



Calculations results Model 1 Type A

Maximum field strength on border line

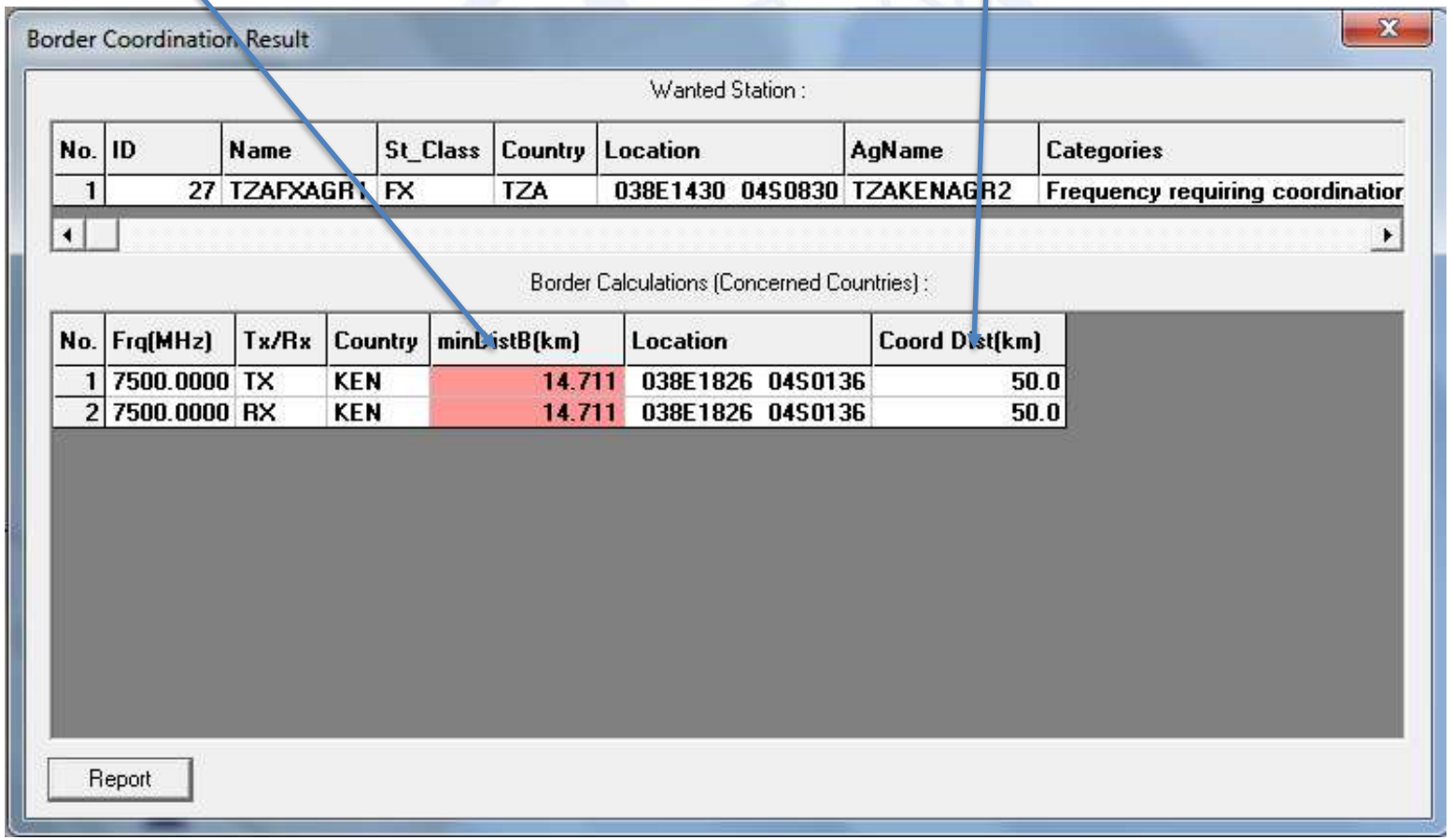
Maximum field strength on CBR



Calculations results Model 1 Type B

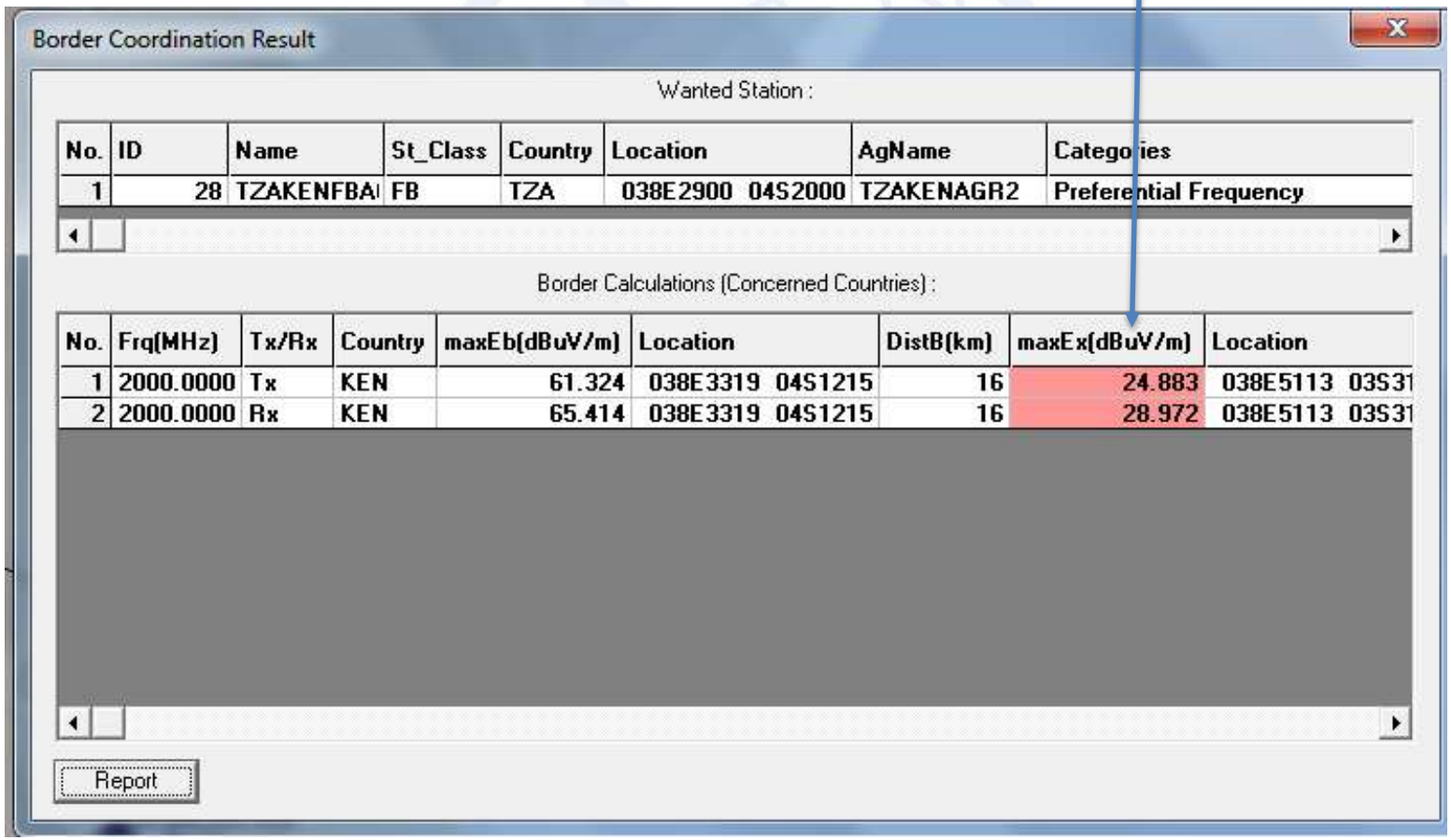
Minimum distance to the border

Coordination distance



Calculations results Model 2

Maximum field strength on X-km contour



Border Coordination Result

Wanted Station :

No.	ID	Name	St_Class	Country	Location	AgName	Categories
1	28	TZAKENFBA	FB	TZA	038E2900 04S2000	TZAKENAGR2	Preferential Frequency

Border Calculations (Concerned Countries) :

No.	Frq(MHz)	Tx/Rx	Country	maxEb(dBuV/m)	Location	DistB(km)	maxEx(dBuV/m)	Location
1	2000.0000	Tx	KEN	61.324	038E3319 04S1215	16	24.883	038E5113 03S31
2	2000.0000	Rx	KEN	65.414	038E3319 04S1215	16	28.972	038E5113 03S31

Report

Border coordination results parameters

Field	Description	Type of Agreement		
		Frequency Requiring coordination		Preferential Frequency
		Type A: LM in all frequency and FX below 1GHz	Type B: FX above 1GHz	LM in all frequency and FX below 1GHz
Frequency	Frequency under investigation	X	X	X
TX or RX	Mode of frequency under investigation	X	X	X
Concerned countries	Countries likely to be affected by a station in another country	X	X	X
Max. Eb	Maximum field strength on border line	X		X
Max. Eb location	The location of maximum Eb	X		X
DistB	Distance of wanted station to the maximum Eb location	X		X
Max Ec	Maximum field strength on CBR (Figure 3.175)	X		
Max. Ec location	The location of maximum Ec	X		
DistC	Distance of wanted station to the maximum Ec location	X		
Max Ex	Maximum field strength on X-km contour (Figure 3.175)			X
Max. Ex location	The location of maximum Ex			X
DistX	Distance of wanted station to the maximum Ex location			X
PIFS	Permissible Interference Field Strength in accordance with agreement	X		X
CBR	Cross Border Range in accordance with agreement	X		
X-km	Contour of X km beyond wanted country border line			X
Min. DistB	Minimum distance of wanted station to the border line		X	
Min DistB location	The location of maximum Eb		X	
Coord. Dist.	Minimum permitted distance to the border (from agreement) for comparison with MinDistB		X	

Thank you!

PRIDA Track 1 (T1)

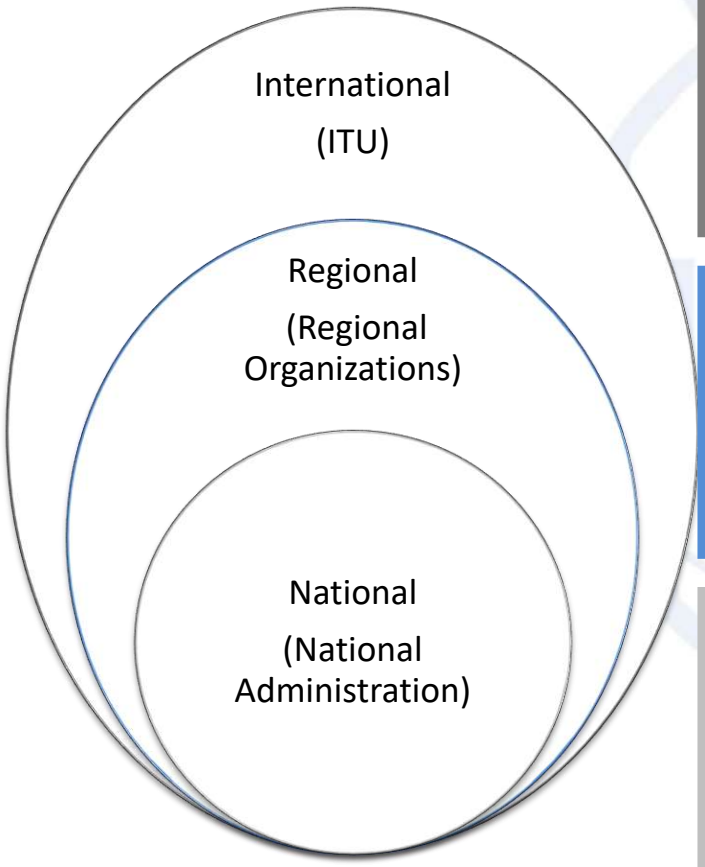
ON-LINE English capacity building workshop

Creating the national frequency allocation table

April 20 - May 1, 2020

Yasir Ahmed
ITU expert
Email: Yasir192@gmail.com

Spectrum management framework



- Set out in a treaty – the Radio Regulations
- Article 5 contains the International Table of Frequency Allocations.
- WRC to review, and, if necessary, revise the Radio Regulations.

- Harmonization of frequency use across the region.
- Provide a common technical requirements and standards.
- Preparation of common proposals to ITU world radio conferences.

- Discussions with different spectrum users.
- National regulations, and polices.
- Establish a National Table of Frequency Allocations (NTFA). Regularly reviewed based on technological developments, national context, and results of WRCs.

National Table of Frequency Allocations - NTFA

Importance

National Table of Frequency Allocations is the foundation for an effective spectrum management process because it provides

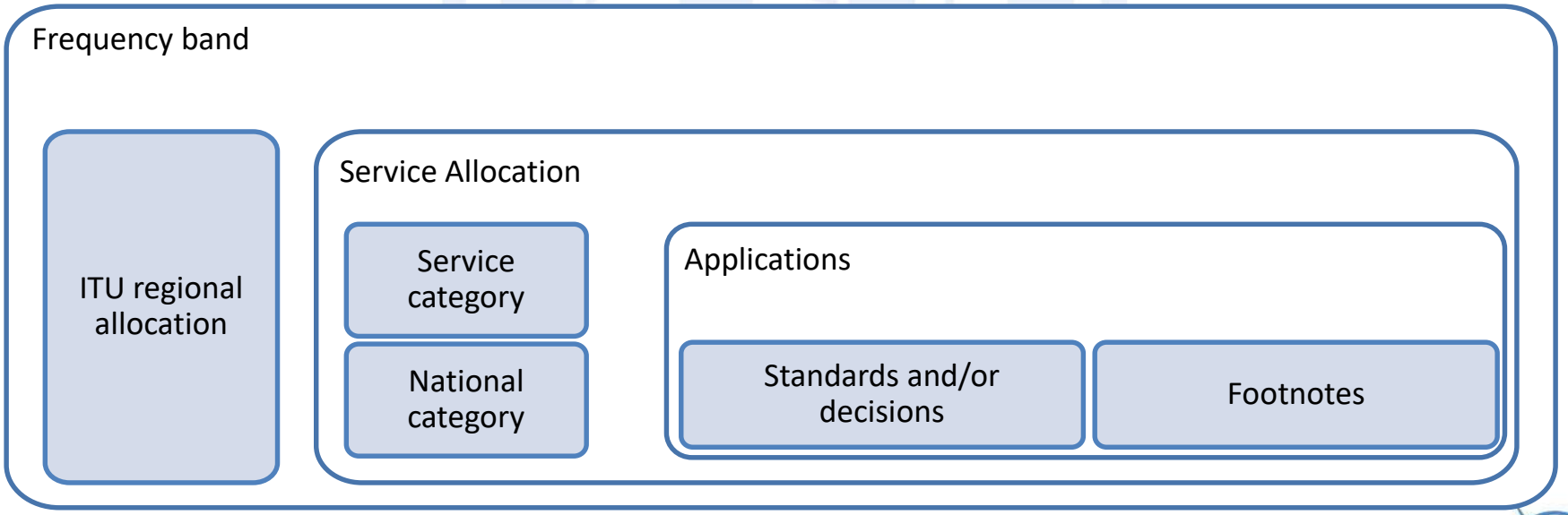
- A general plan for spectrum use
- The basic structure to ensure effective use of the spectrum and the prevention of interference between services
- Advice to
  - manufacturers as to where in the spectrum to design and build equipment;
  - users on what frequencies are available to plan their systems.

Steps

- Adopt or modify the Regional table to restrict the bands to only one service or to compatible services;
- Subdividing the bands for specific services, or to allocate bands to specific parts of the user community;
- Showing and describing specific national use through National Footnotes. For example, some countries divide their national table into bands allocated to the government and to those allocated to private users.

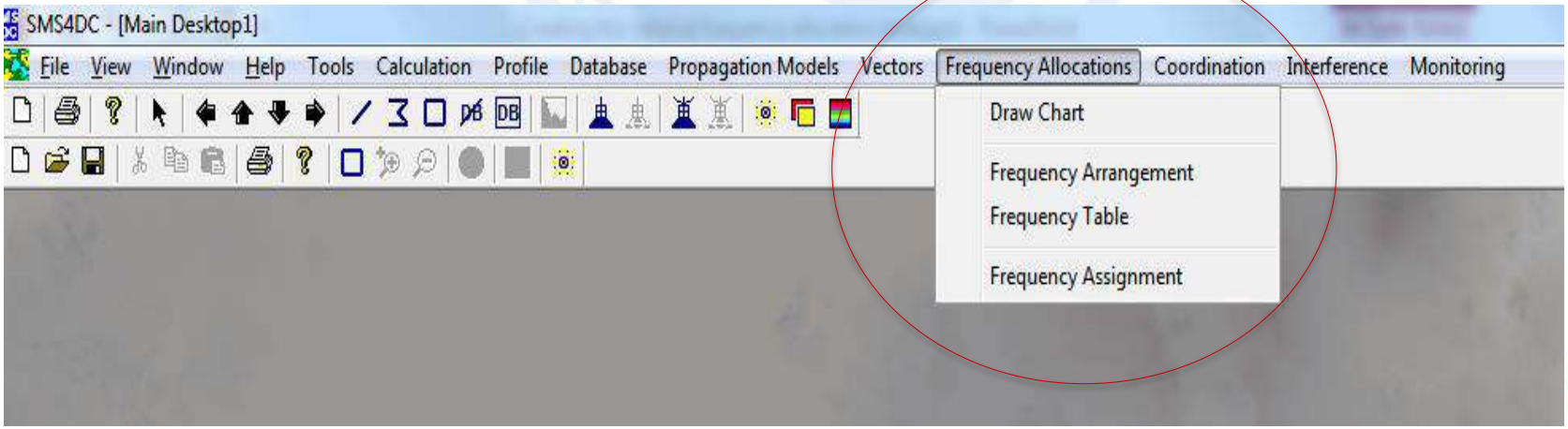
Structure of NTFA

Content of NTFA	Additional categories
• Terms and definitions • NTFA • Applicable international footnotes • National footnotes	• Civil and governmental use of frequency bands • Licensing regime • Frequencies for SRD, ISM applications, …etc.



SMS4DC frequency allocations

- Frequency Allocations menu of DEM view
  - Draw chart
    - National frequency allocations
    - Regional frequency allocations
  - Frequency arrangement
  - Frequency Table
  - Frequency assignment



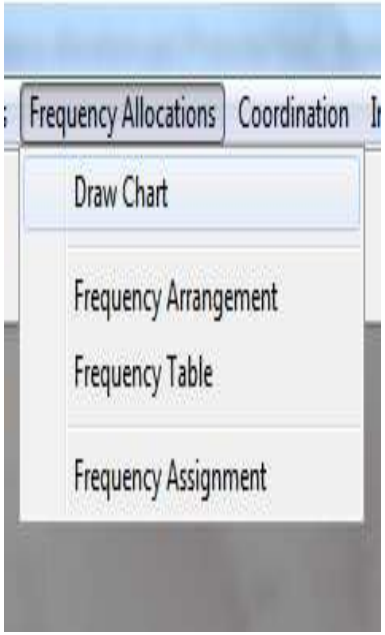
SMS4DC frequency allocation chart

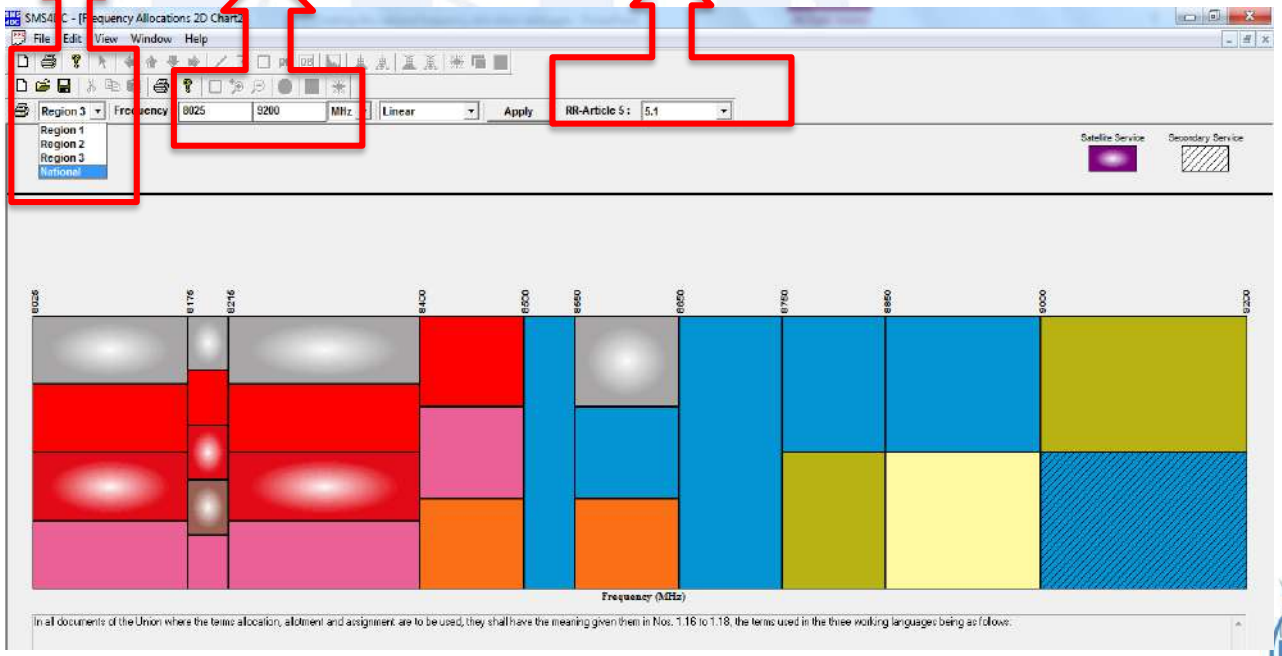
- Draw Chart: Item to depict a section of regional or national FAT in strip format.
- Each segment in the frequency allocations strip denotes a frequency allocation to a radiocommunication service with its service priority .

ITU Regions or national frequency allocations table

Frequency range

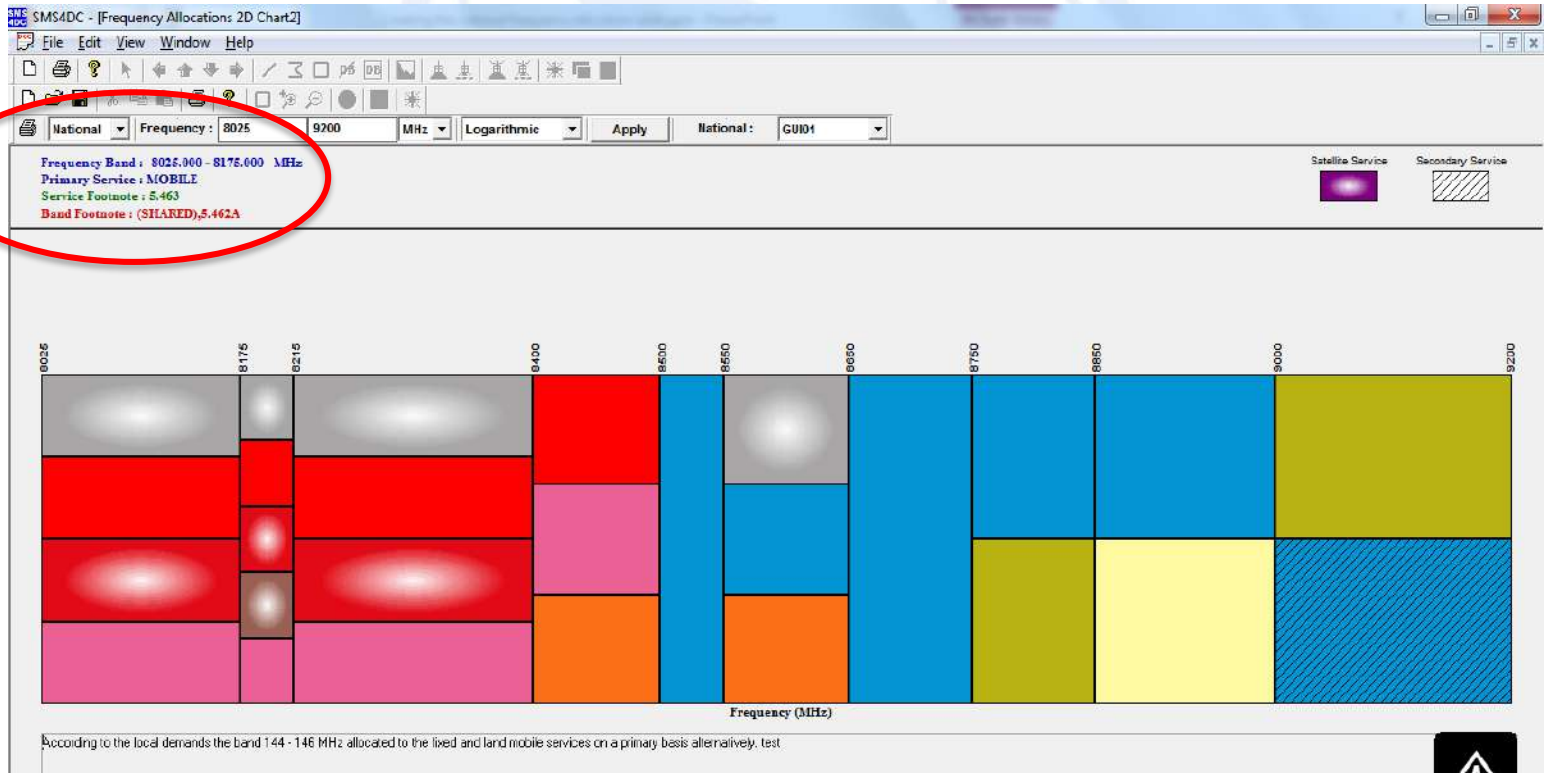
RR Article 5 and national footnotes





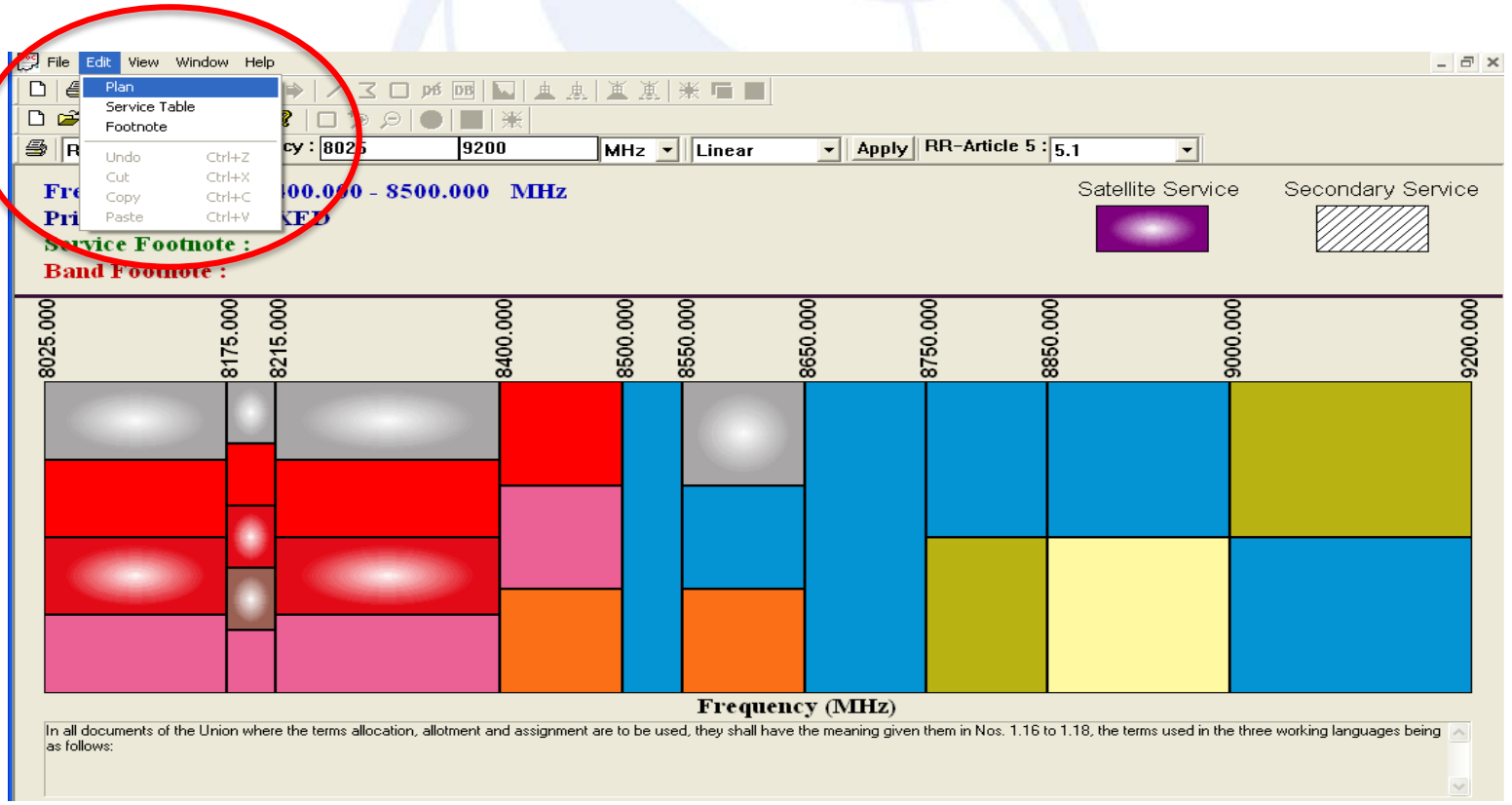
SMS4DC frequency allocation chart

- The mouse cursor shape on the strip is changed to a cross (+) and a left-click on a colored patch shows its characteristics, including: frequency band, service name, service priority, service footnotes and frequency band footnotes at the top-left corner of chart.



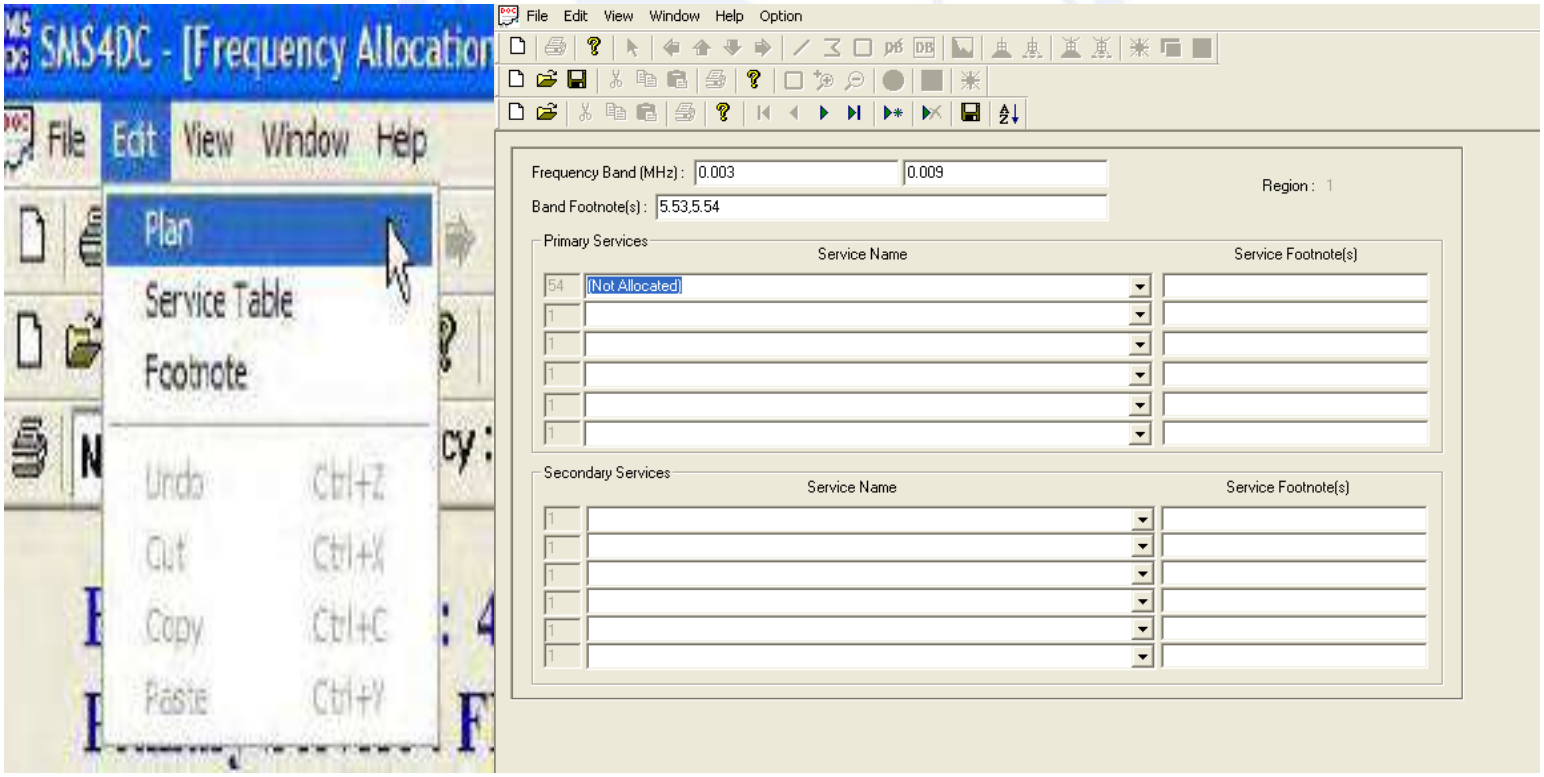
Edit menu under the frequency allocations chart

- The Edit menu under the frequency allocations chart provides three powerful items: “Plan”, “Service Table” and “Footnotes” to edit the content of the frequency allocations table and chart color.



Edit menu under the frequency allocations chart

- Users may browse and edit the content of integrated FATs, inserting up to six primary services and up to six secondary services



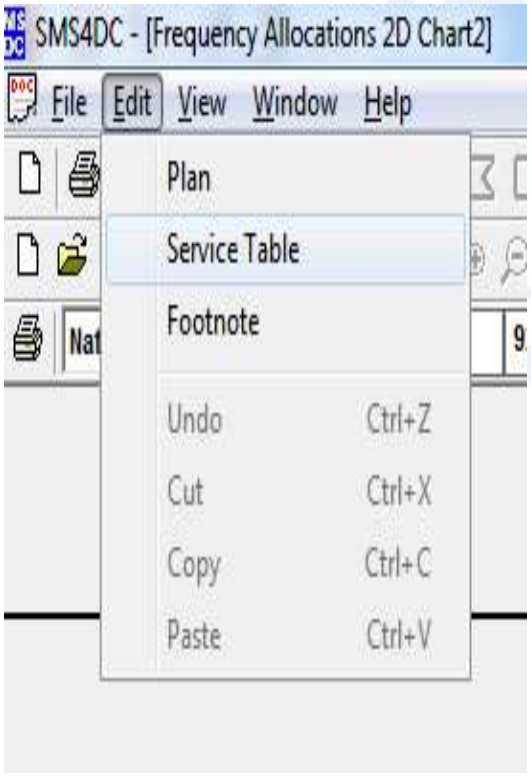
Edit menu under the frequency allocations chart

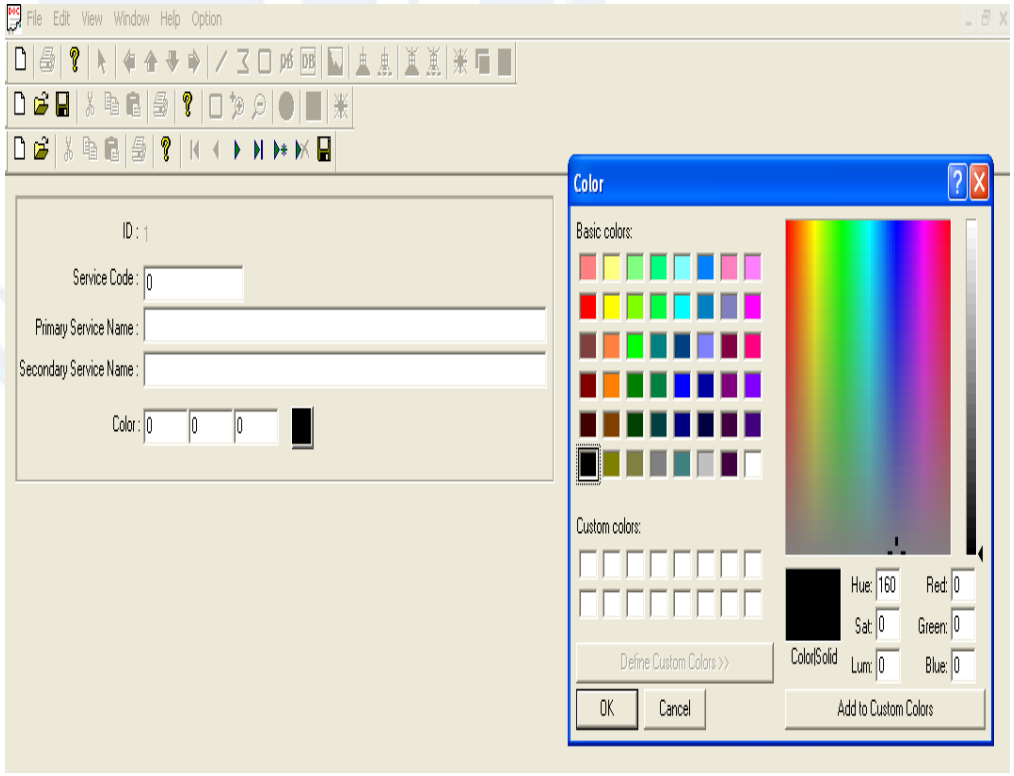
- Push buttons in FAT browsing toolbar in the item “Frequency Allocations->Edit->Plan

Toolbar Buttons	Name	Description
	Move to the first record	Push button to load the allocation that has been made in the first (lowest) frequency band of the active FAT.
	Go to the previous record	Push button to load the allocation that has been made in the previous (lower) frequency band of the active FAT with respect to the displayed frequency allocation on the dialogue box. Also, pressing Page Up key while the cursor is in the Frequency Band text boxes, does the same task.
	Go to the next record	Push button to load the allocation that has been made in the next (higher) frequency band of the active FAT with respect to the displayed frequency allocation on dialogue box. Also, pressing Page Down key while the cursor is in the Frequency Band text boxes, does the same task.
	Move to the last record	Push buttons to load the allocation that has been made in the last (highest) frequency band of active FAT.
	Add record	Push buttons to add, to the active FAT, a new frequency band and relevant frequency allocations.
	Delete current record	Push buttons to delete, from the active FAT, the current record (a frequency band and all relevant frequency allocations).
	Save current record	Push buttons to save a modified allocation in the active FAT.
	Sort	To sort the contents of a frequency allocations table (FAT) with respect to the frequency band (i.e. lowest frequency to highest frequency or *vice versa*). Normally, after the addition of a new frequency band to the FAT it will be appended to the database of FAT. By using this toolbar push button the new frequency band will take its correct position in a sorted FAT.

Edit menu under the frequency allocations chart

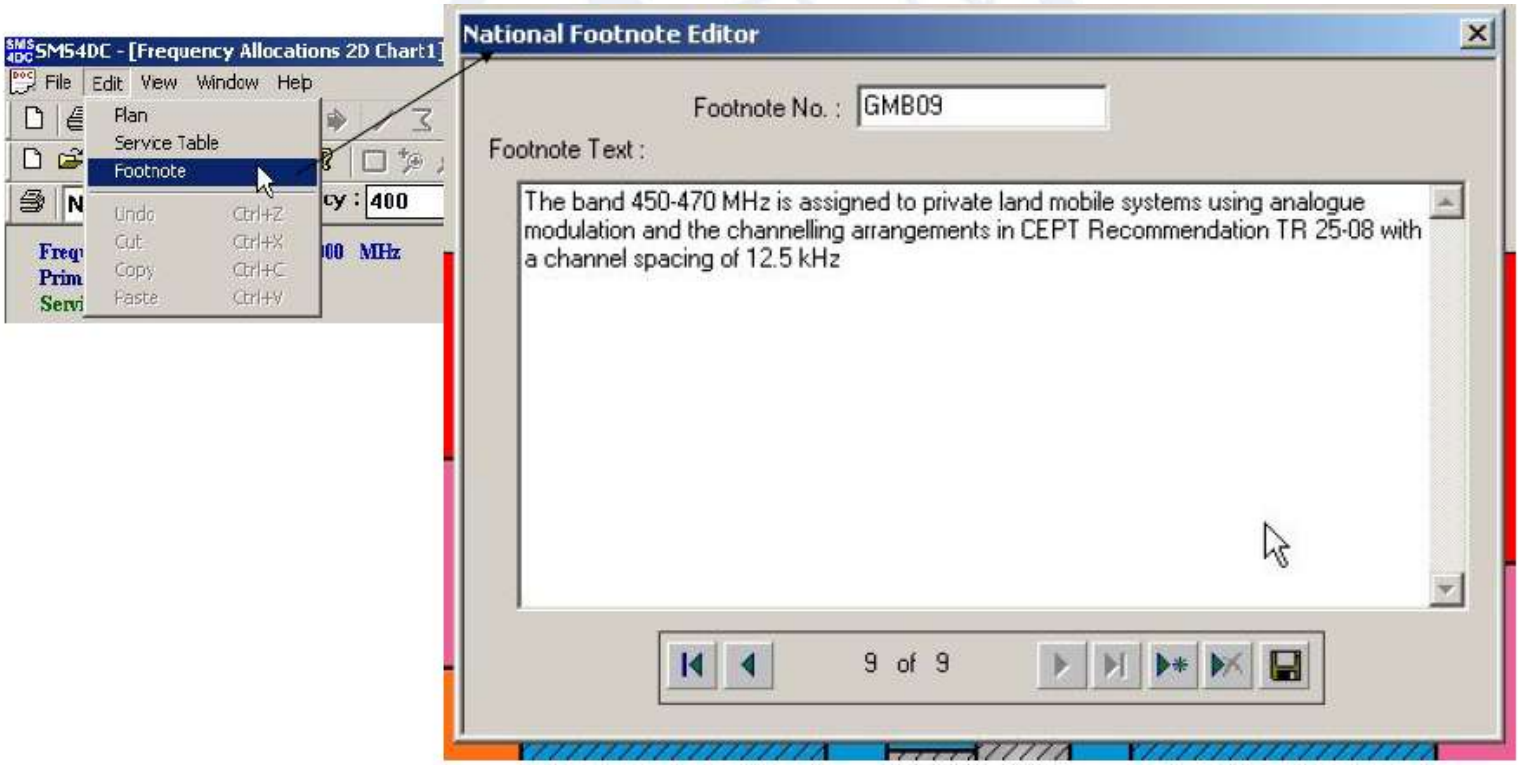
- Service table” item in menu enables user to browse and modify radiocommunication service name and color used in the frequency allocations chart.
- New service can be defined by selecting(( ) and fill the service code, primary and secondary service name and select color.





Edit menu under the frequency allocations chart

- Footnote provide ability for modification existing footnotes or definition of new footnotes using Buttom.



Thank you!

PRIDA Track 1 (T1)

ON-LINE English capacity building workshop

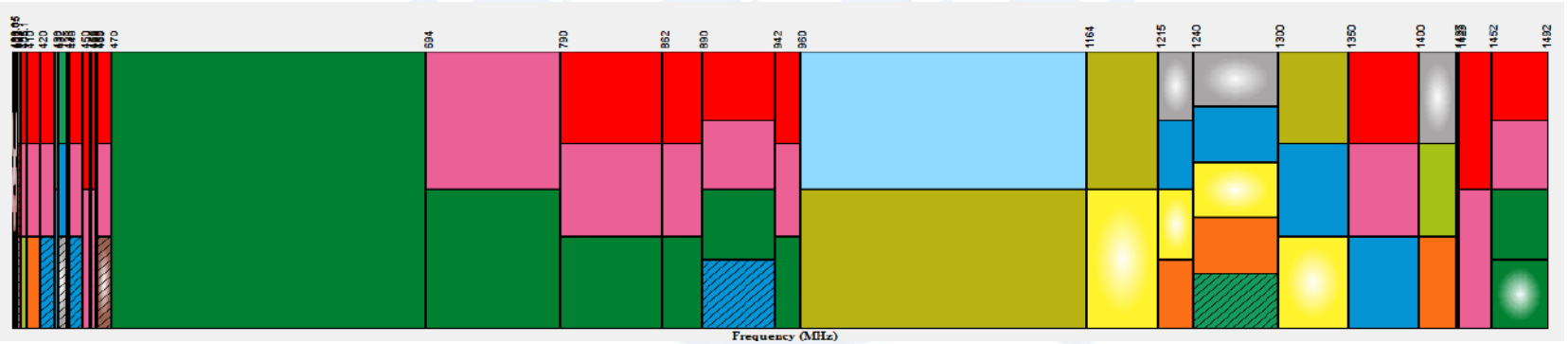
Frequency Arrangement

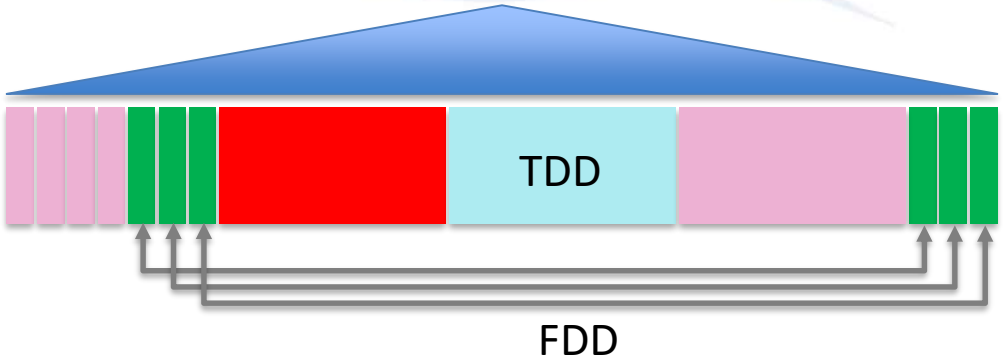
April 20 - May 1, 2020

Yasir Ahmed
ITU expert
Email: Yasir192@gmail.com

Why Spectrum Management System

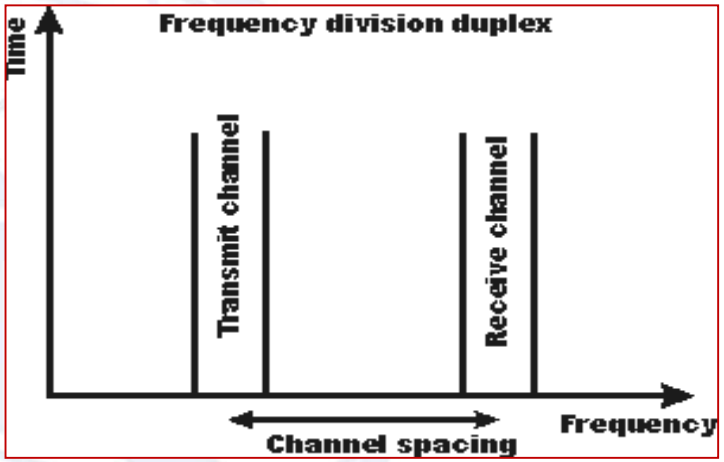
- Frequency arrangements is to develop provisions for systems and users to access the frequencies in an orderly manner by dividing the spectrum available into a number of channels.
- The bandwidth of the channels depends on the technology to be used and the required traffic capacity of the systems that will use the channel.
- Helps in providing harmonization of frequency use, for example to aid cross border frequency coordination, ITU-R has developed recommended channeling arrangements for bands allocated to some services e.g. FIXED and MOBILE. For the same reason, some regional organizations have developed arrangements for some services.



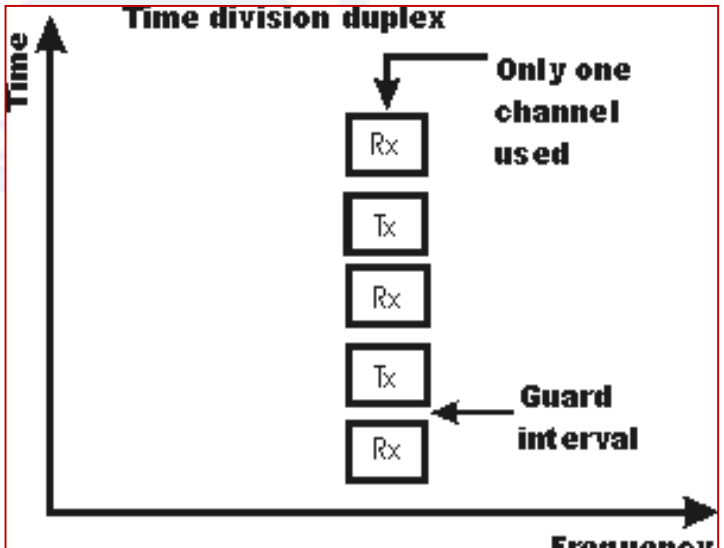


Frequency arrangements

Frequency division duplex (FDD): is a technique where separate frequency bands are used at the transmitter and receiver side



Time division duplex (TDD): refers to duplex communication links where uplink is separated from downlink by the allocation of different time slots in the same frequency band.



SMS4DC Frequency arrangement

- Frequency arrangement item in the “Frequency Allocation ” menu of SMS4DC.
- There are three possible types of frequency arrangement in SMS4DC:
  - Homogenous, same as of FDD
  - Uniform, and, same as of TDD
  - Non-uniform
- Any frequency plan shall be in conformity with frequency allocation table.
- There are already list of planned assignable frequencies could be browsed from item “Frequency table” of “Frequency Allocation ” menu .

Frequency arrangement-Homogenous

- Homogeneous channel arrangement(FDD):

  lower half of the band: $fn = f0 + foffset + n.XS\ MHz$

  n=0,1,2,…

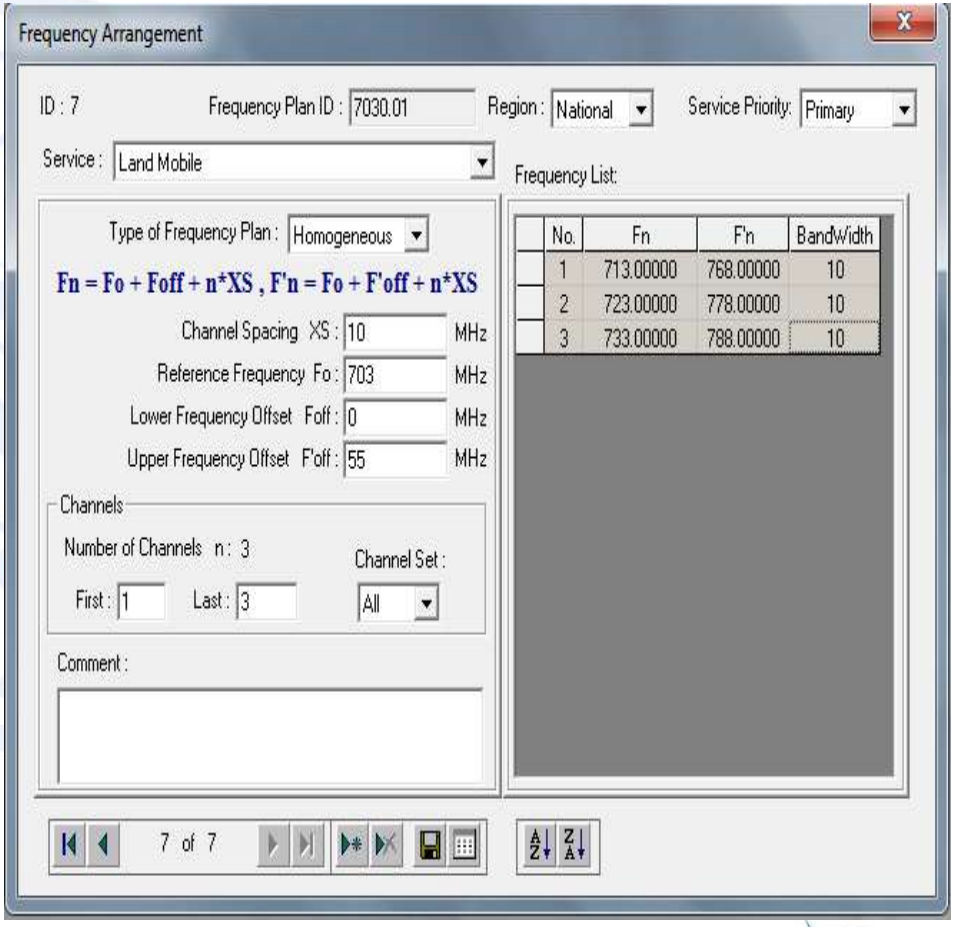
  upper half of the band: $fn' = f0 + foffset' + n.XS\ MHz$

  n=0,1,2,…

- **Reference Frequency ($f0$)**: Frequency used as a reference to calculate centre frequencies.
- **Channel Spacing (XS)**: Frequency distance XS between center frequencies of two adjacent channels.
- **Lower and Upper Frequency Offsets ($foffset$, $foffset'$)** : Frequency offsets to calculate “go” and “return” centre frequencies.
- **Number of Channels (n)** :Number of duplex paired or simplex channels defined in plan

Frequency arrangement-Homogenous

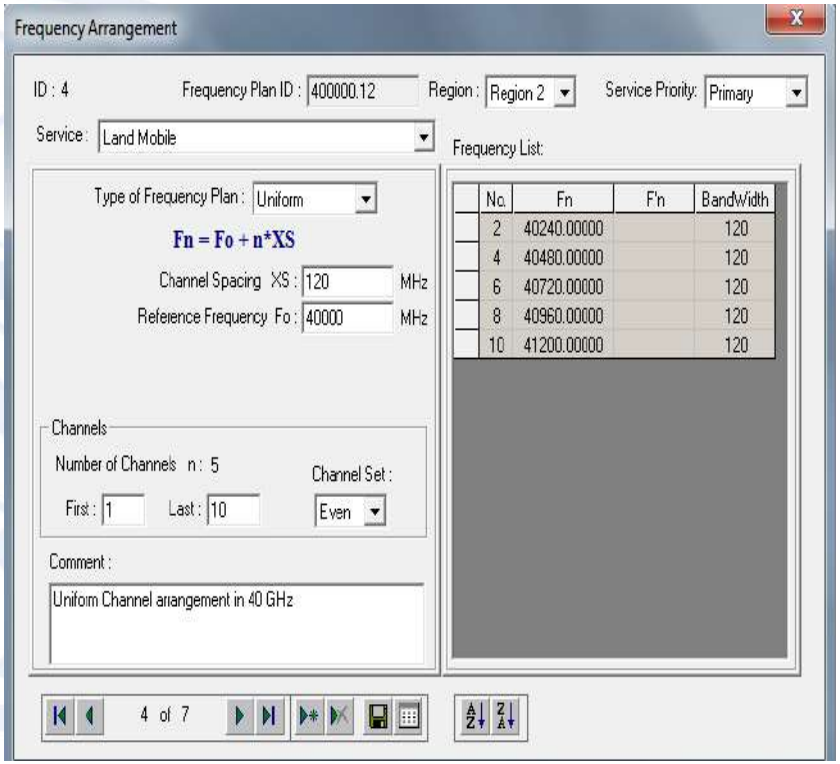
- **Service Priority:** Priority of service in which frequency assignment plan is defined.
- **Type of Frequency Plan**: select one of three available frequency arrangement formats.
- **Channel Spacing**: Frequency distance XS between centre frequencies of two adjacent channels.
- **Reference Frequency**: Frequency used as a reference to calculate centre frequencies.
- **Lower and Upper Frequency Offsets**: Frequency offsets to calculate “go” and “return” centre frequencies.
- **First and Last:** The first and the last channel numbers in a plan.



Frequency arrangement-Uniform

- Uniform channel arrangement:

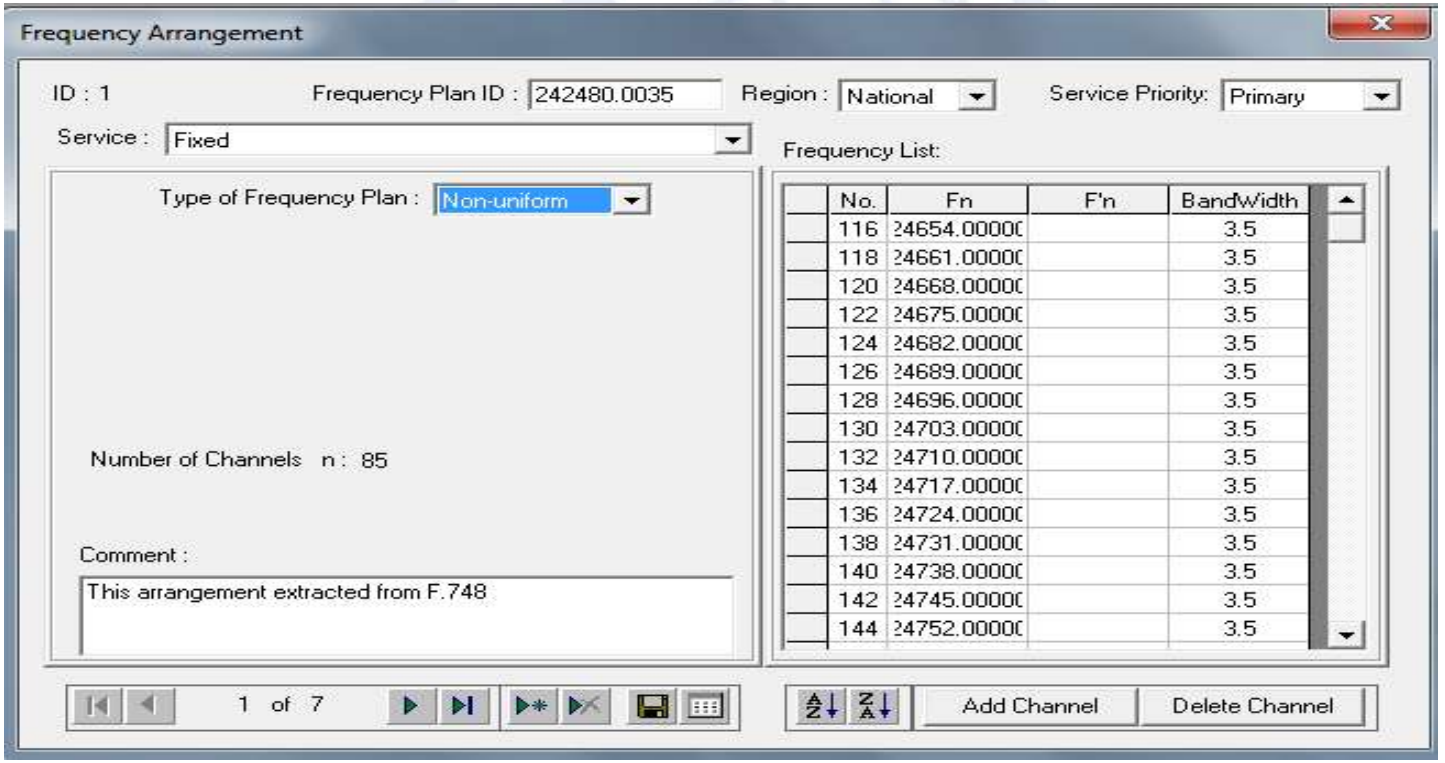
$$fn = f0 + n.XS\ MHz, \qquad n = 0,1,2,\ldots$$



- **Service Priority:** Priority of service in which frequency assignment plan is defined.
- **Type of Frequency Plan**: select one of three available frequency arrangement formats.
- **Channel Spacing**: Frequency distance XS between centre frequencies of two adjacent channels.
- **Reference Frequency**: Frequency used as a reference to calculate centre frequencies.
- **First and Last:** The first and the last channel numbers in a plan.

Frequency arrangement-Non Uniform

- Non uniform frequency arrangement edit directly frequency plan.



Frequency arrangement-Examples

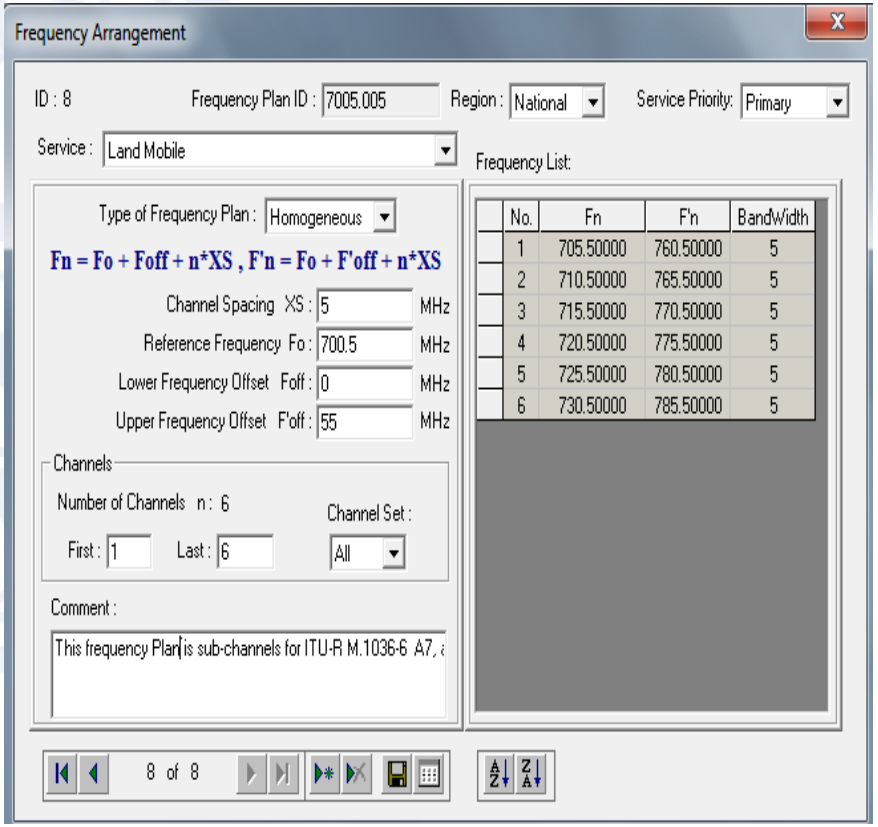
- For the band of 703-788 , the channel arrangement result using SMS4DC

ID : 8
Frequency Plan ID : 7005.005000
Region : National
Frequency Band : [703 - 733] MHz [758 - 788] MHz
Channel Spacing : 5 MHz
RadioCommunication Service : Land Mobile
Priority : Primary
Type of Frequency Plan : Homogeneous
Comment : This frequency plan is sub-channels for ITU-R M.1036-6 A7, and is exclusively allocated for use by IMT services

---

Frequency Unit : MHz

No.	Lower Center Frequency	Upper Center Frequency
001	705.5	760.5
002	710.5	765.5
003	715.5	770.5
004	720.5	775.5
005	725.5	780.5
006	730.5	785.5



Frequency arrangement-Examples

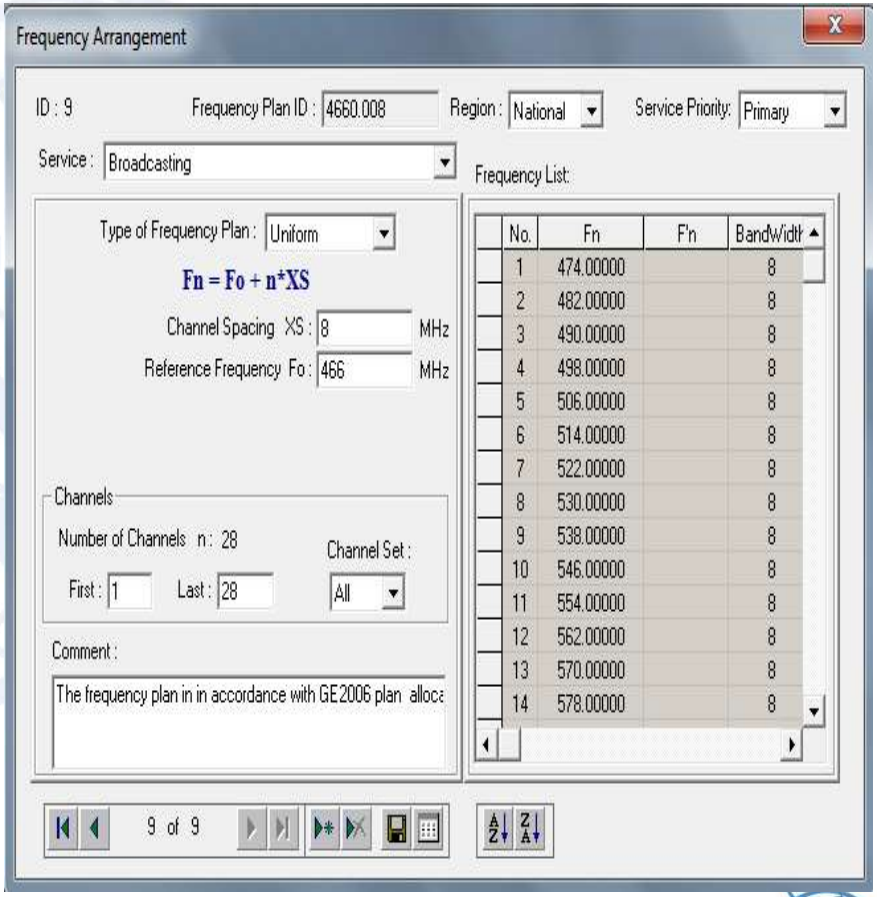
- For the band of 703-788 , the channel arrangement result using SMS4DC

Frequency Plan ID : 4660.008000
Region : National
Frequency Band : [470 - 694] MHz
Channel Spacing : 8 MHz
RadioCommunication Service : Broadcasting
Priority : Primary
Type of Frequency Plan : Uniform
Comment : The frequency plan in in accordance with GE2006 plan allocated to the broadcasting servive with primary status and services ancillary to broadcasting with secondary status

---

Frequency Unit : MHz

No.	Center Frequency
001	474
002	482
.	.
.	.
027	682
028	690



Thank you!

PRIDA Track 1 (T1)

ON-LINE English capacity building workshop

Import from BR IFIC

April 20 - May 1, 2020

Yasir Ahmed
ITU expert
Email: Yasir192@gmail.com

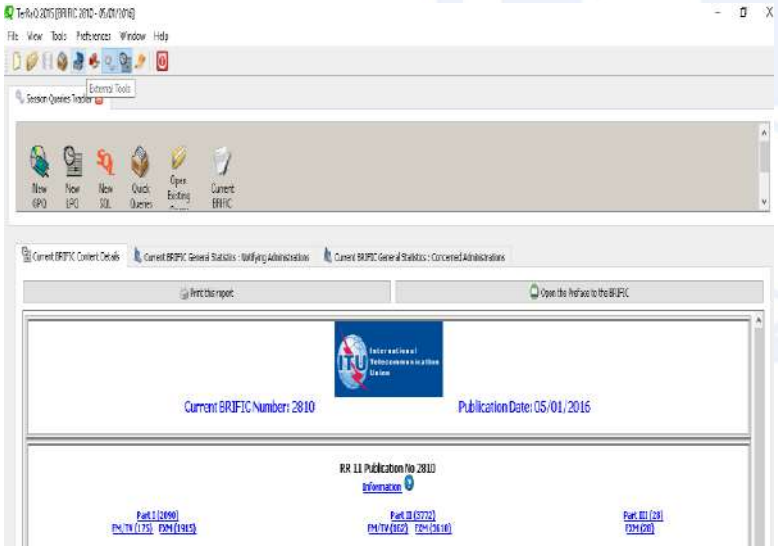
Import from BR IFIC data base

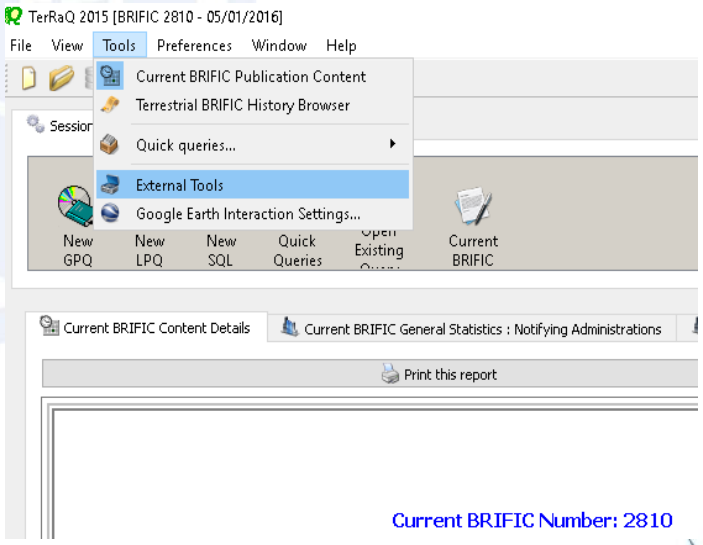
After installation of BR IFIC terrestrial services software run BR IFIC Format Converter to have a bridge between BR IFIC database which is in SQLite format and SMS4DC which is in Microsoft Access format. Also its essential that the MS-Access macros enabled.

Steps for BR IFIC Format Converter

https://www.itu.int/en/ITU-R/terrestrial/brific/BRIFIC/BR_IFIC_and_other_BR_tools.pdf

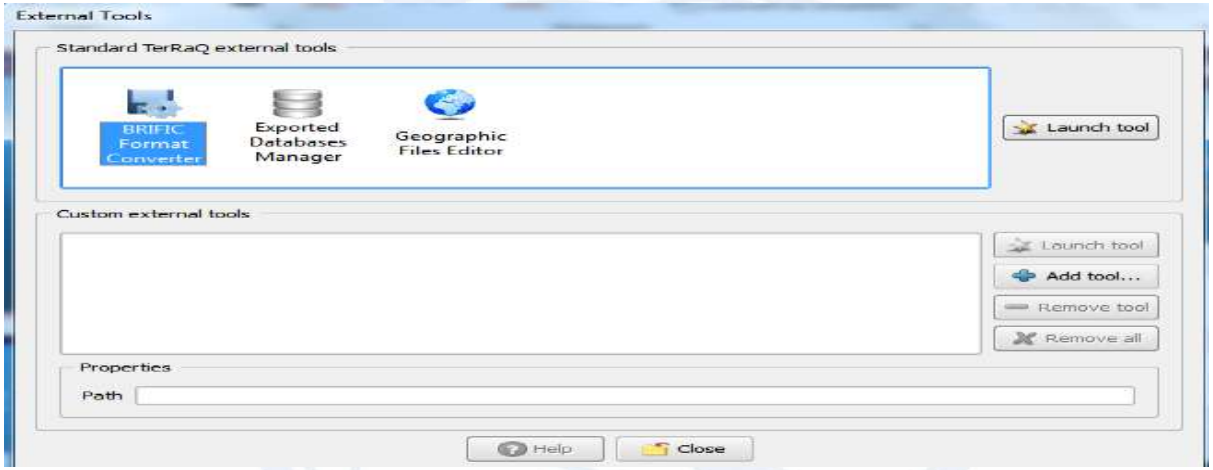
1 Launch TerRaQ. On the tool bar (or alternatively under the Tools menu) please click “External Tools”





Import from IFIC data base

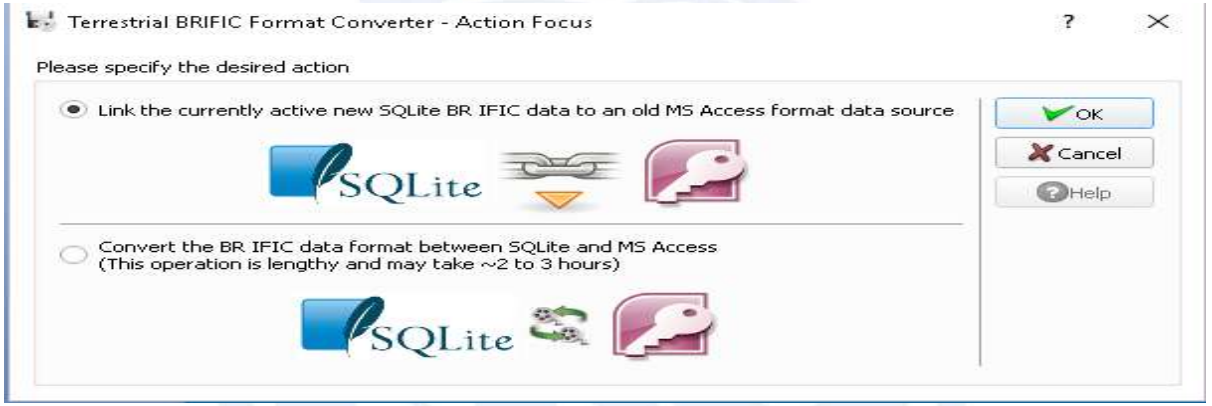
2 On the next dialog that appears, please choose “BRIFIC Format Converter” then click “Launch Tool



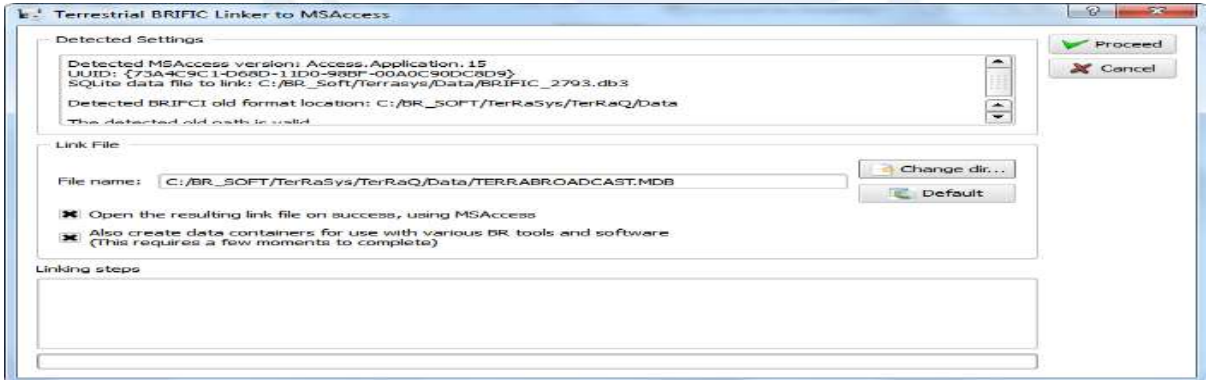
3 Please acknowledge the next dialog that appears by clicking OK, if you have the MS-Access macros enabled.

Import from IFIC data base

4 On the next dialog that appears, please ensure selecting “Link the currently active….” Then click OK



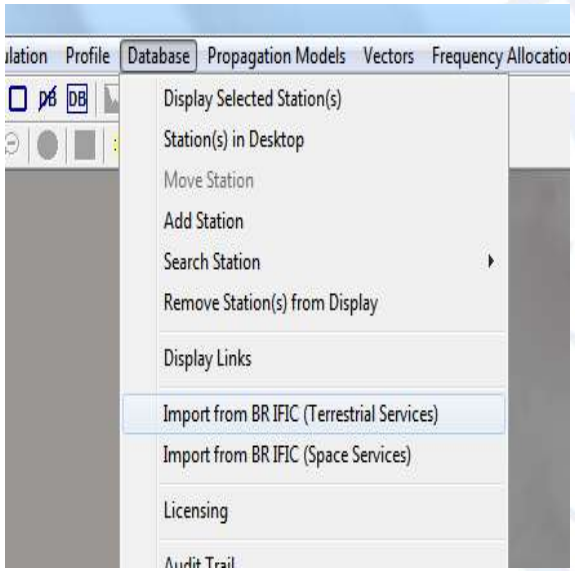
5 On the next dialog that appears, please ensure the box “Also create data containers….” Is checked, then click “Proceed”

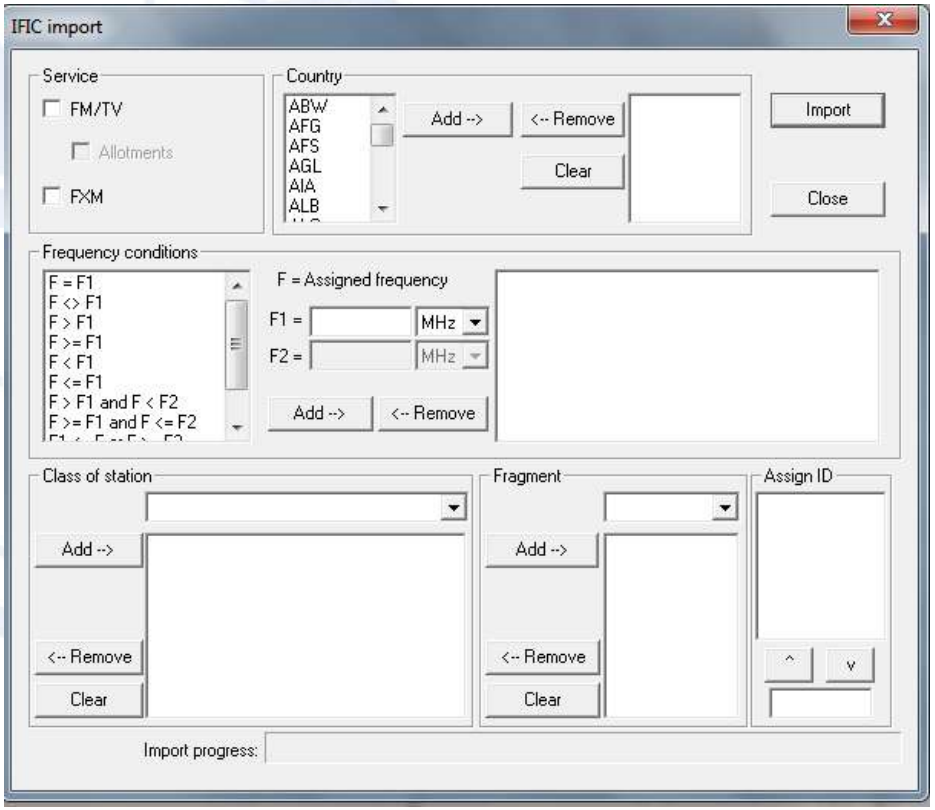


TerRaQ will then create the necessary linked MS-Access database files to ensure compatibility with the other BR tools, like SMS4DC, GE84PLN and GE06Calc, etc..

Import from IFIC data base

- For importing data from BRIFIC database, choose from SMS4DC toolbar “database” then import from BR IFIC (Terrestrial Services), the “IFIC import” dialogue box will popup that provides a data filter to specify the type of data required for import. The





Import from IFIC data base

- The content of this dialogue box is similar to the BR TerRaQ software. The following filter conditions can be set using the dialogue box .

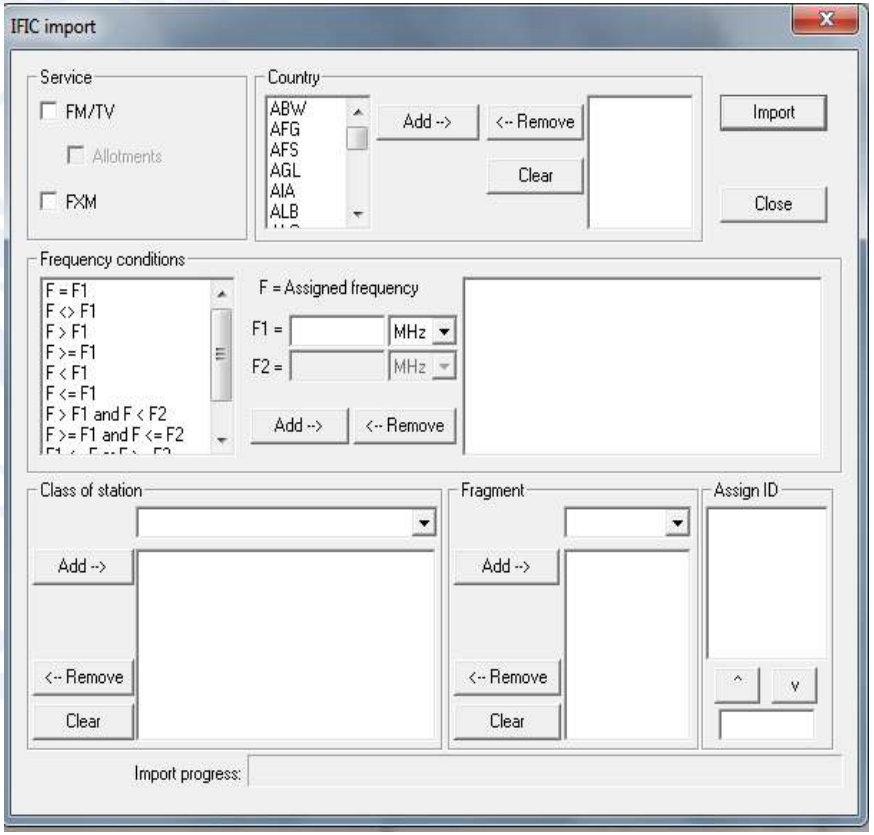
Service type: check boxes to select either FM/TV (for Broadcasting assignments or allotments) or FXM (for Fixed or Land Mobile assignments) .

Administration: select administrations from this window list and add them to (or remove them from) the selection window list.

Frequency condition: To specify a frequency range filter for the imported records.

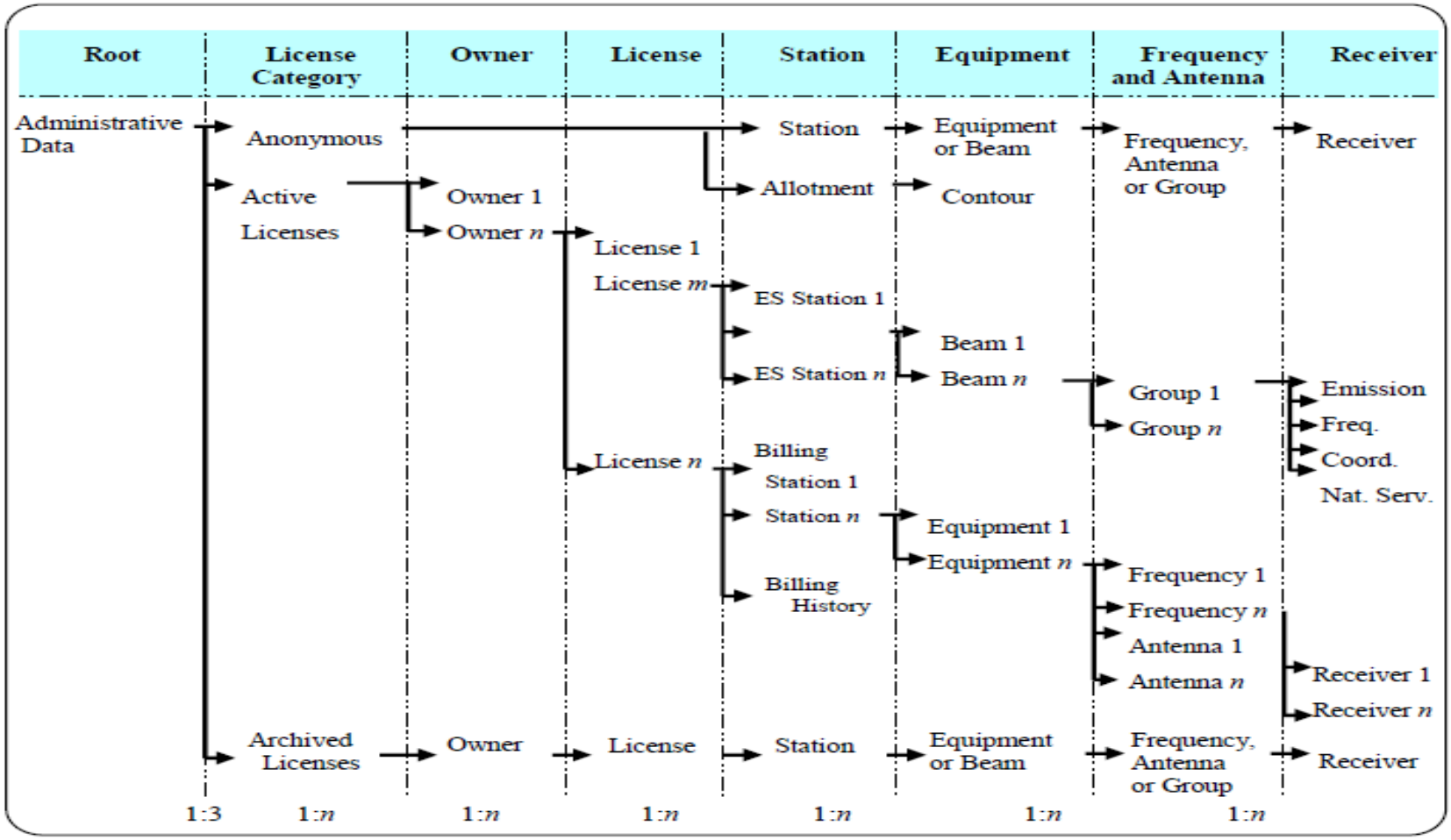
Class of Station: A Combo box to select class of station for which data is to be imported.

Fragment: A Combo box enables the selection of the fragments corresponding to the service type selected.
Assign ID(s) : of the specific notice(s) to import.



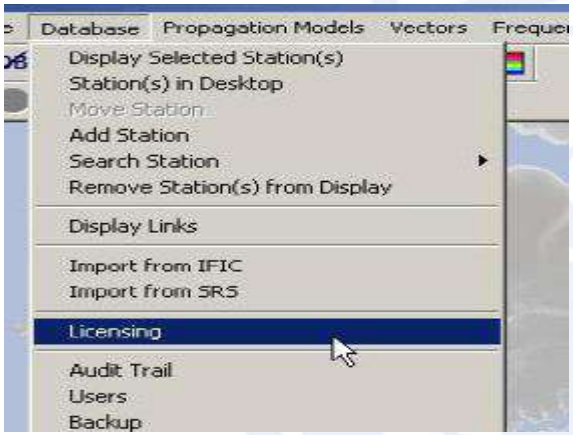
After import all station will be available under licensing, Anonymous station

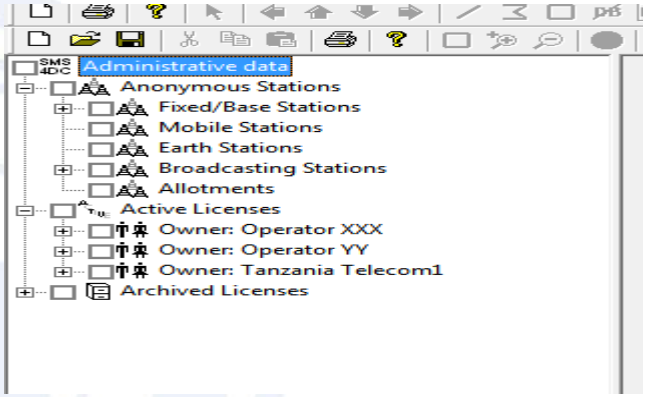
Hierarchical administrative data levels



The administrative data levels

- DEM menu bar: Database , Sub-menu: Licensing



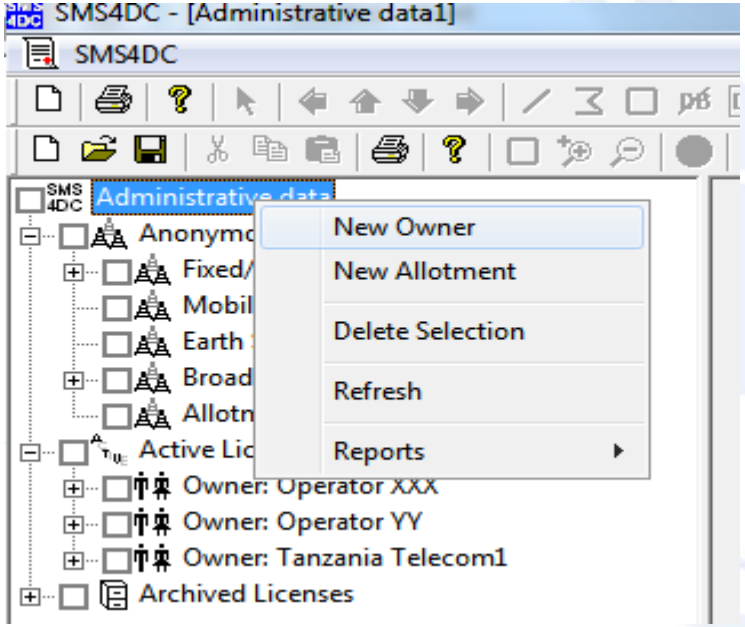


- Data entry is enabled by pushing the modify button
- To enter data into a field:
  - first position the cursor into the required field,
  - press <enter> to activate the field
  - Pressing <enter> to save the data
- All the codes and symbols used in SMS4DC conform to ITU procedures, documents or recommendations

- **Anonymous Stations:** A folder containing all anonymous stations which have been already created outside the Administrative window of SMS4DC and can be moved to a License folder of an Owner in the folder of Active Licenses.
- **Active Licenses**: Folder which holds all active and granted licenses. This folder contains all active Owners with their information in lower hierarchical levels. Creation of new administrative information will be done inside this folder.
- **Archived Licenses:** Folder which holds all canceled granted licenses.

The administrative data levels

- New Owner information



Owner information

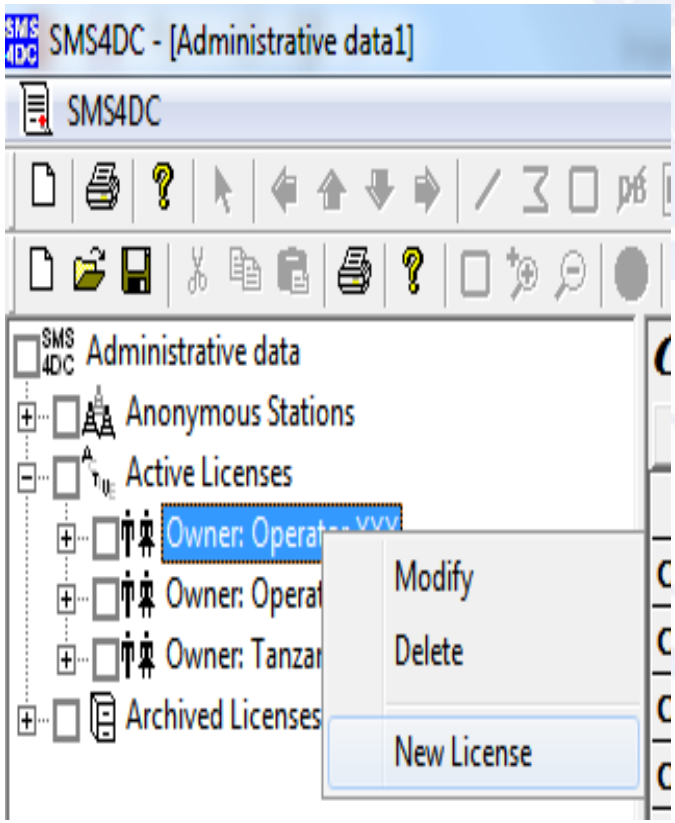
Modify | Cancel | Save

	Value
Owner Name	
Owner Address	
City	
Country	
Telephone	
Telex	
Fax	
Email	
Remarks	
Security Category	
Address Code	
Code of Operating Agency	
Billing	
Billing Name	
Billing Address	

- Fields in bold are mandatory

The administrative data levels

- New license information



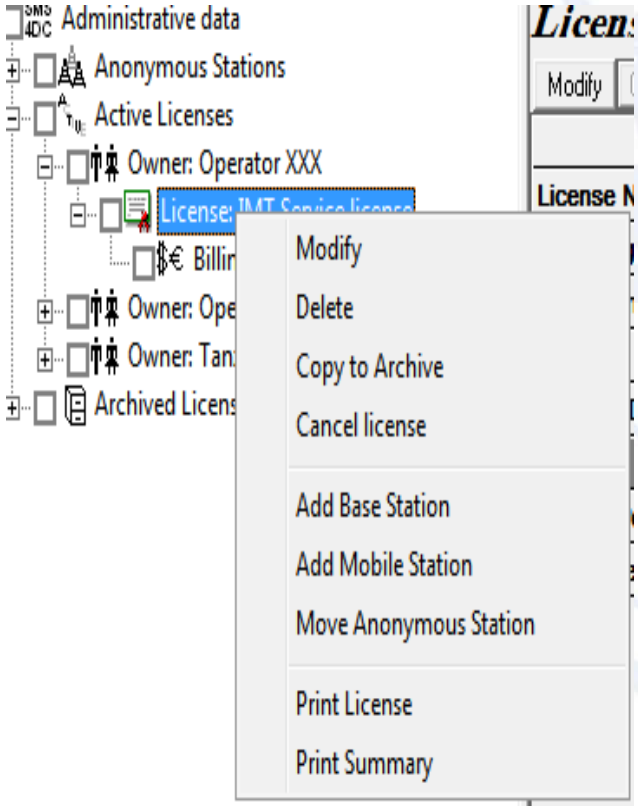
License Information

Modify | Cancel | Save

	Value
License No	
Beginning of Use	2020/02/22
Expiration Date	2021/02/22
Status	
Service ID	
Billing	
Invoice Period	
Initial Fee	

The administrative data levels

- Add or move base station from anonymous



Fixed/Base station information

Modify | Cancel | Save

	Value	Unit
Admin Ref. ID		
Site ID		
Station Name		
Call Sign		
Class of Station		
Station Type	Fixed	
Location		
ITU region		
Latitude		+DDMMSS.SS
Longitude		+DDDMMSS.SS
Country		
Radius of Service		km
Height ASL		m
Misc.		
Provision		
Area of Trans.		
Network ID		
Target Latitude		+DDMMSS.SS
Target Longitude		+DDDMMSS.SS
Type of Notice		

The administrative data levels

- Base station equipment level

Equipment information

Modify | Cancel | Save | Library

	Value	Unit
Equipment Name		
Power		
Power to Antenna		W
Power Type		
Radiated Power		W
Type of Rad. Power		
Physical		
Manufacturer		
Model		
Serial no.		
Misc.		
Sensitivity		uV
Geneva 06		
System Type (1)		
System Type (2)		
Maximum Power Density		dBW/Hz

The administrative data levels

- Equipment level , frequency and antenna information, antenna information to imported from antenna library

Frequency information

Modify | Cancel | Save | Add receiver

	Value	Unit
Assigned Frequency		Hz
Response Frequency		Hz
Reference Frequency		Hz
Frequency Range		
Misc.		
Class of Emission		
Band Width		kHz
Channel Separation		kHz
Traffic		
Peak Hour		UTC
Season		
Nature of Service		
Op. Hour (From)		UTC
Op. Hour (To)		UTC
Fee		
Frequency Fee		
Target Frequency		MHz

Antenna information

Modify | Cancel | Save | Library | Add to Lib.

	Value	Unit
Installation		
Azimuth of Max. Radiation		Degree
Elevation	0	Degree
Antenna Height AGL		m
Technical		
Antenna Name		
Class of Antenna		
Antenna Type		
Polarization		
Antenna Gain		dBi
Antenna Gain Type		
Antenna Directivity		
Hor. Beam Width		Degree
Ver. Beam Width		Degree
Reference Antenna		
Frequency Range (from)		MHz
Frequency Range (to)		MHz
Cross-Polar Discrimination		dB
Insertion Loss		dB

Thank you!

PRIDA Track 1 (T1)

ON-LINE English capacity building workshop

Performing basic engineering functions using SMS4DC

April 20 - May 1, 2020

Yasir Ahmed
ITU expert
Email: Yasir192@gmail.com

Radio propagation fundamentals

- Propagation is a term used to explain how radio waves behave when they are transmitted, or are propagated from one point on the Earth to another.
- In free space, all electromagnetic waves (radio, light, X-rays, etc.) obey the inverse-square law which states that the power density of an electromagnetic wave is proportional to the inverse of the square of the distance from a point source.

$$\rho_P \propto \frac{1}{r^2}.$$

- Doubling the distance from a transmitter means that the power density of the radiated wave at that new location is reduced to one-quarter of its previous value.
- SMS4DC provides a range of field-strength calculations along a line, poly-line, inside a selected rectangular area and at end-points of a link

Radio frequency propagation characteristics

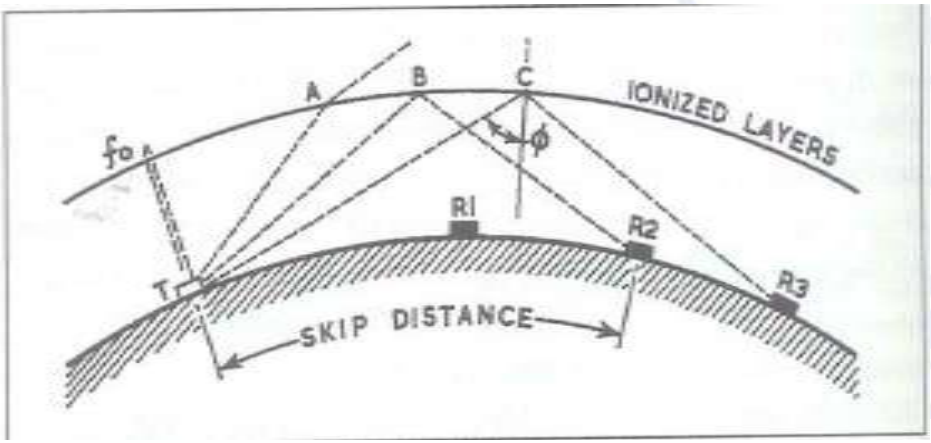
VLF, LF, MF	HF	VHF	UHF	SHF	EHF
▪ Ground waves. ▪ Guided between the Earth and the ionosphere. ▪ Radio navigation	▪ Guided between the Earth and the ionosphere.	▪ Ionospheric refraction during high sunspot. ▪ Line-of-sight propagation. ▪ Tropospheric ducting	▪ Line-of-sight propagation. ▪ Tropospheric ducting.	▪ Line-of-sight propagation. ▪ Rain scatter.	▪ Line-of-sight propagation, ▪ limited by atmospheric absorption to a few kilometers

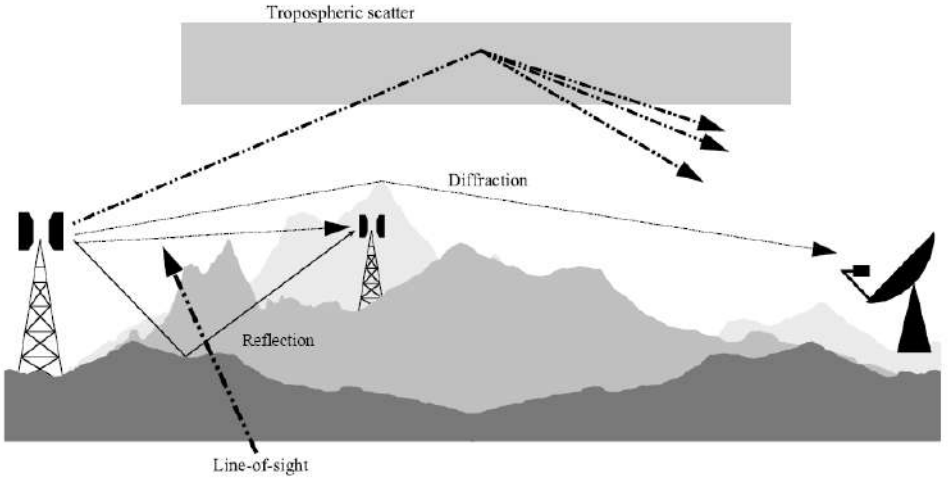
3 KHz — 3 MHz — 30 MHz — 300 MHz — 3 GHz — 30 GHz — 300 GHz

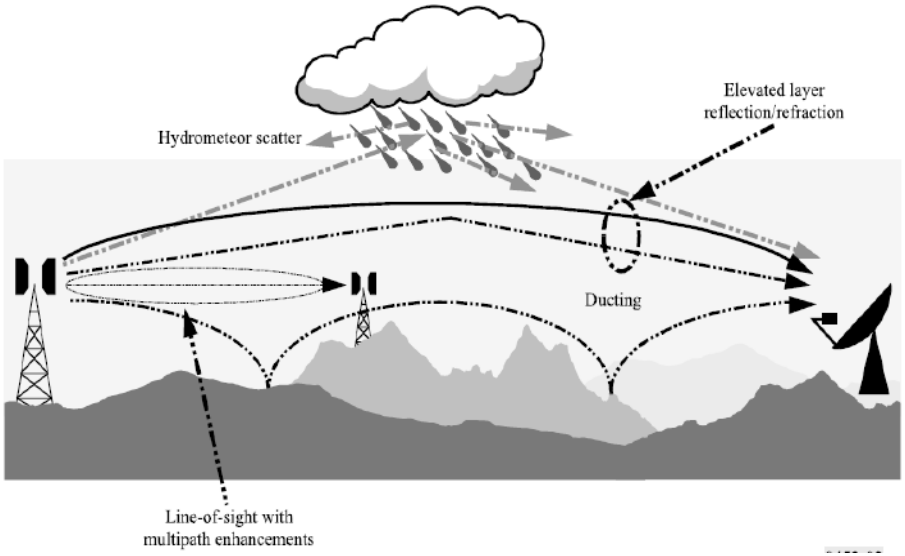
Increasing Range
Decreasing Bandwidth

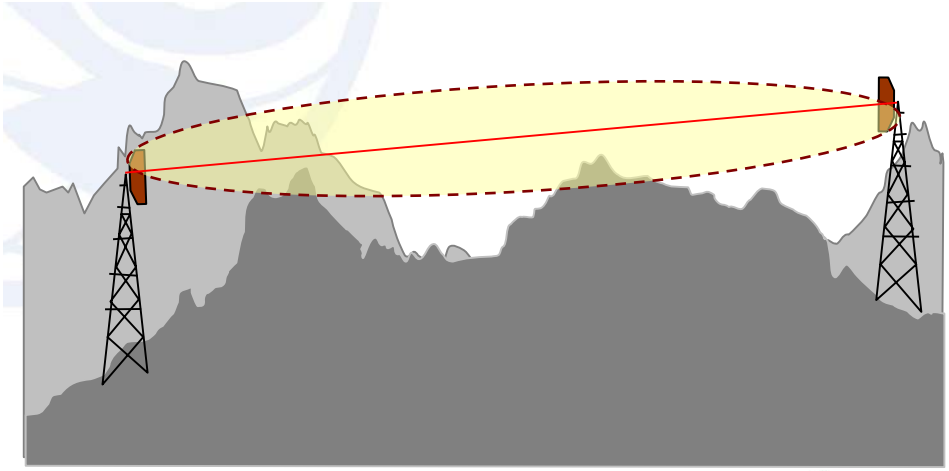
Decreasing Range
Increasing Bandwidth

Radio frequency propagation characteristics









Summary of propagation models functions

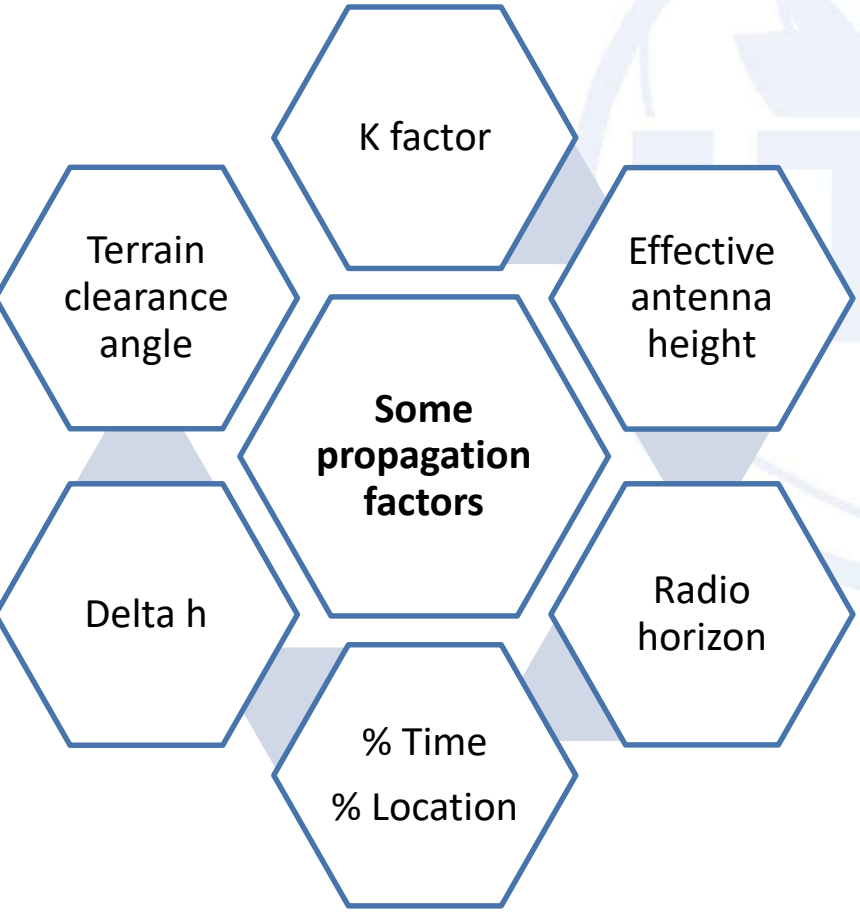
Propagation Models \ Sub-items	Line	Polyline	Area	Link	Contour	Network processor		Earth-space
						Max. Field Strength	Best Server	
Free Space	Y	Y	Y	N	N	Y	Y	N
Line of Sight	Y	Y	Y	N	N	N	N	N
ITU-R P.370	Y	Y	Y	Y	Y	Y	Y	N
ITU-R P.1546	Y	Y	Y	Y	Y	Y	Y	N
ITU-R P.1812	Y	Y	Y	Y	Y	Y	Y	N
Okumura-Hata	N	N	Y	N	N	Y	Y	N
ITU-R P.526 (by diffraction)	N	N	N	Y	N	N	N	N
ITU-R P.526 (Smooth Earth)	N	N	N	Y	N	N	N	N
ITU-R P.452	N	N	N	Y	N	N	N	N
ITU-R P.530	N	N	N	Y	N	N	N	N
ITU-R P.618	N	N	N	N	N	N	N	Y

(1): 'Y' and 'N' stand for "Yes" and "No" respectively.

List of SMS4DC propagation models

Free space	Unaffected by any consideration other than distance
Line of sight	Propagation between two points for which the direct ray is sufficiently clear of obstacles for diffraction to be of negligible effect.
P.370	VHF and UHF propagation curves for the frequency range from 30 MHz to 1 000 MHz.
P.1546	point-to-area predictions for terrestrial services in the frequency range 30 MHz to 4 000 MHz
Okumura-Hata	Used for path loss prediction in urban areas.
P.1812	Used for prediction method suitable for terrestrial point-to-area services in the frequency range 30 MHz to 3 GH
P.526	Propagation by diffraction
P.452	Prediction procedure for the evaluation of microwave interference between stations on the surface of the Earth at frequencies above about 0.1 GHz
P.530	Propagation data and prediction methods required for the design of terrestrial line-of-sight systems.
P.618	Propagation data and prediction methods required for the design of Earth-space telecommunication systems

Propagation terms used in SMS4DC

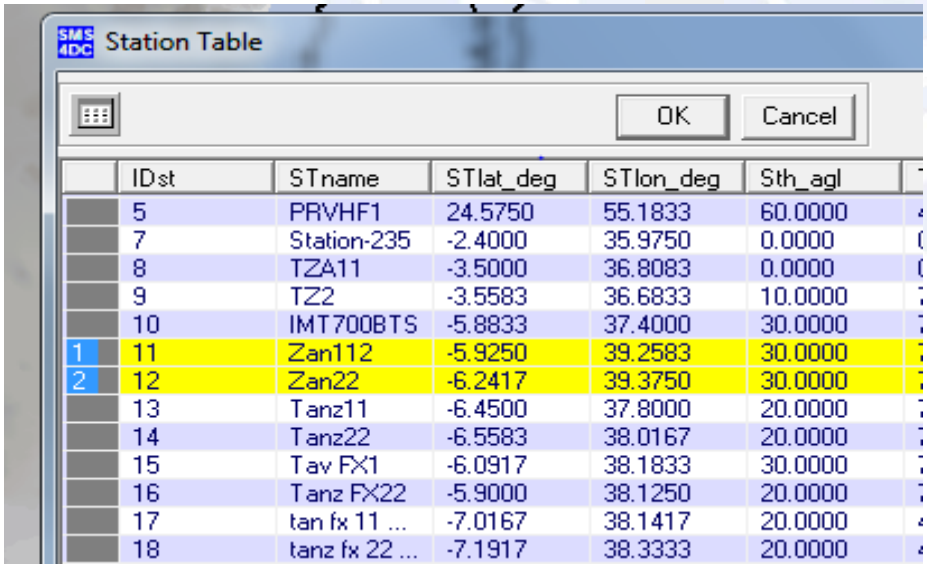


Effective Earth-radius factor, k	Ratio of the effective radius of the Earth to the actual Earth radius. For the standard atmosphere, the effective Earth radius is 4/3 that of the actual Earth radius.
Effective antenna height	The effective height of the transmitting antenna is defined as its height over the average level of the ground between distances of 3 and 15 km from the transmitter in the direction of the receiver.
% Time	The applicable time percentage values or range of values of the ITU Recommendation; % time is the percentage of time that the predicted signal is exceeded during an average year.
% Location	The applicable percent location range of the ITU Recommendation; % location is the percentage of locations within, say, a square with 100 to 200 m sides that the predicted signal is exceeded.
Delta h	defines the degree of terrain irregularity
Radio horizon	The locus of points at which direct rays from a point source of radio waves are tangential to the surface of the Earth.

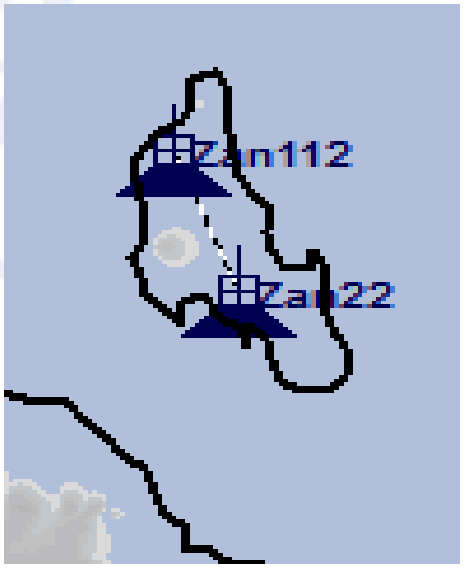
Calculation along a line

- This function calculates field strength values produced by a station along a path profile at a given receiving height above ground level.
- In the case of the line-of-sight (LOS) model, the “Line” calculation sub-item provides only a visibility analysis along the line from the wanted station.
- To activate the “Line” sub items, a line must be drawn in advance on the DEM using “Draw Line” or “Draw Line from Database” toolbar buttons .

1



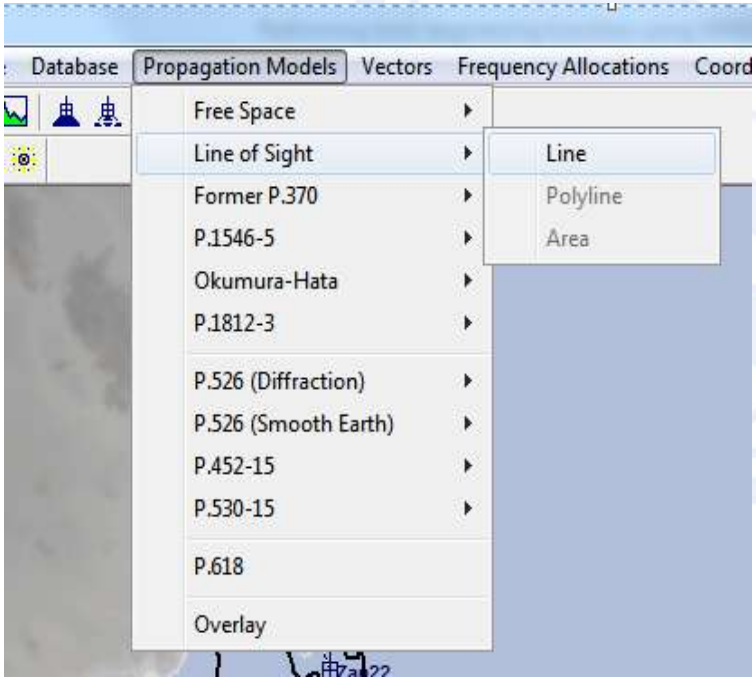
	IDst	STname	STlat_deg	STlon_deg	Sth_agl
	5	PRVHF1	24.5750	55.1833	60.0000
	7	Station-235	-2.4000	35.9750	0.0000
	8	TZA11	-3.5000	36.8083	0.0000
	9	TZ2	-3.5583	36.6833	10.0000
	10	IMT700BTS	-5.8833	37.4000	30.0000
1	11	Zan112	-5.9250	39.2583	30.0000
2	12	Zan22	-6.2417	39.3750	30.0000
	13	Tanz11	-6.4500	37.8000	20.0000
	14	Tanz22	-6.5583	38.0167	20.0000
	15	Tav FX1	-6.0917	38.1833	30.0000
	16	Tanz FX22	-5.9000	38.1250	20.0000
	17	tan fx 11 ...	-7.0167	38.1417	20.0000
	18	tanz fx 22 ...	-7.1917	38.3333	20.0000



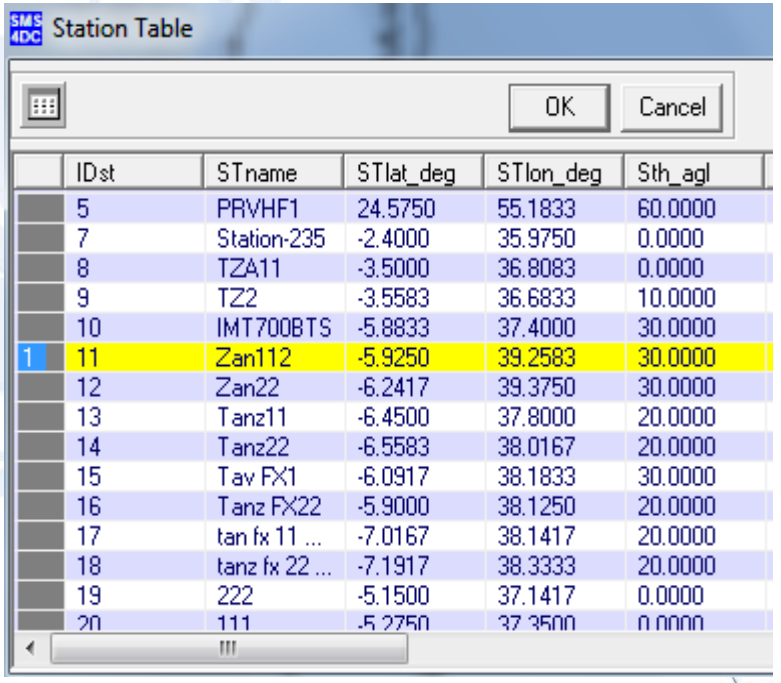
Calculation along a line

- Geographical coordinates, terrain height, ground-distance from the left point (beginning point of the line) and field strength value (dBìV/m), or visibility status in the case of the LOS model, at the position of the vertical marker are displayed on the status bar

2



Select one of two stations



	IDst	STname	STlat_deg	STlon_deg	Sth_agl
	5	PRVHF1	24.5750	55.1833	60.0000
	7	Station-235	-2.4000	35.9750	0.0000
	8	TZA11	-3.5000	36.8083	0.0000
	9	TZ2	-3.5583	36.6833	10.0000
	10	IMT700BTS	-5.8833	37.4000	30.0000
1	11	Zan112	-5.9250	39.2583	30.0000
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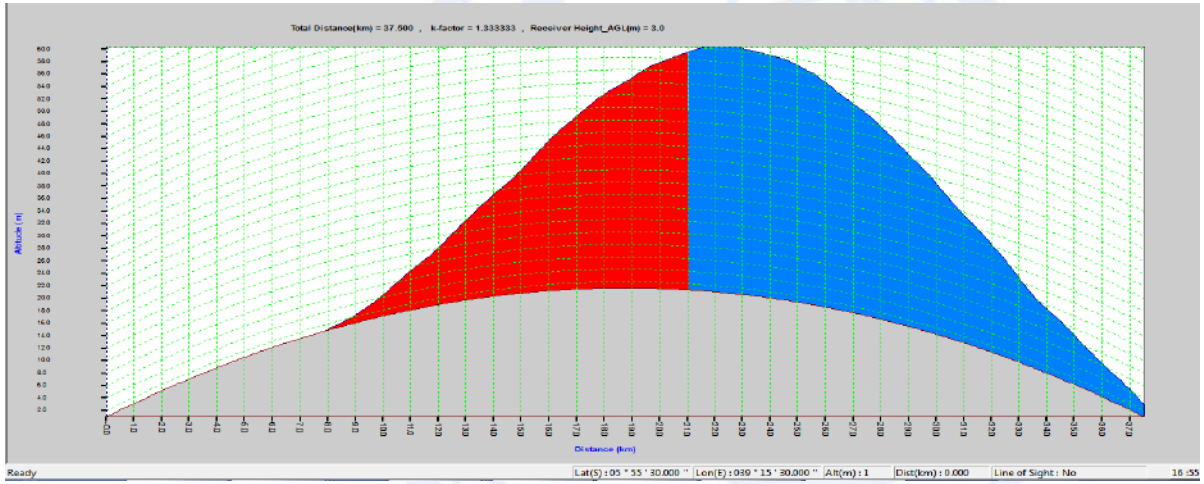
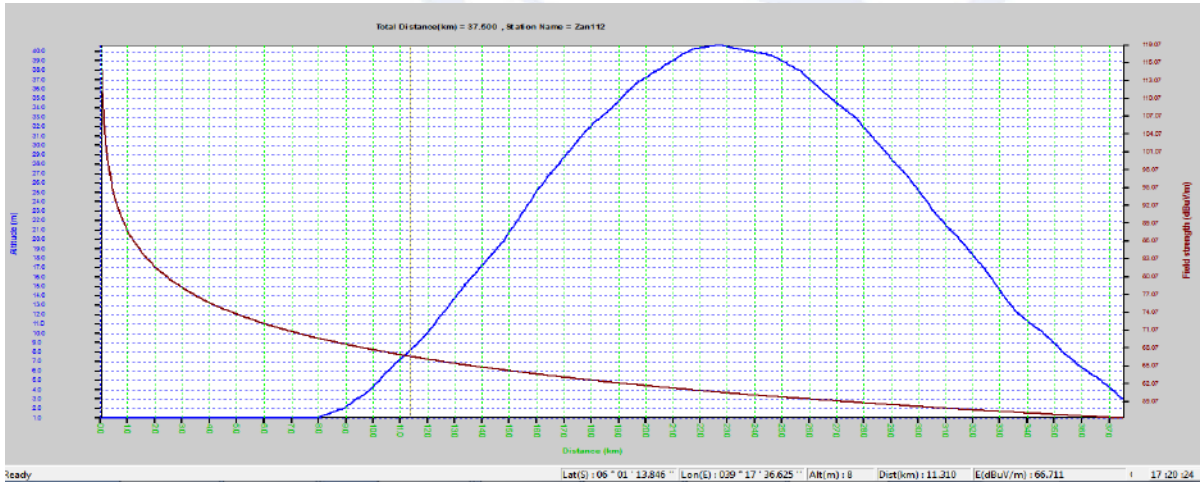
	13	Tanz11	-6.4500	37.8000	20.0000
	14	Tanz22	-6.5583	38.0167	20.0000
	15	Tav FX1	-6.0917	38.1833	30.0000
	16	Tanz FX22	-5.9000	38.1250	20.0000
	17	tan fx 11 ...	-7.0167	38.1417	20.0000
	18	tanz fx 22 ...	-7.1917	38.3333	20.0000
	19	222	-5.1500	37.1417	0.0000
	20	111	-5.2750	37.3500	0.0000

Calculation along a line

- The graph is equipped with a vertical marker which is movable horizontally by the mouse while holding the left click.

3

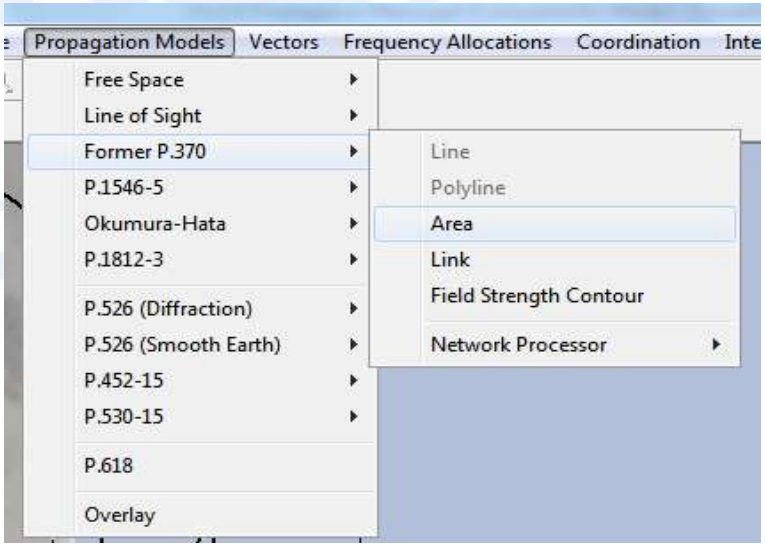




Blue : No LOS, and red: LOS to the concerned station

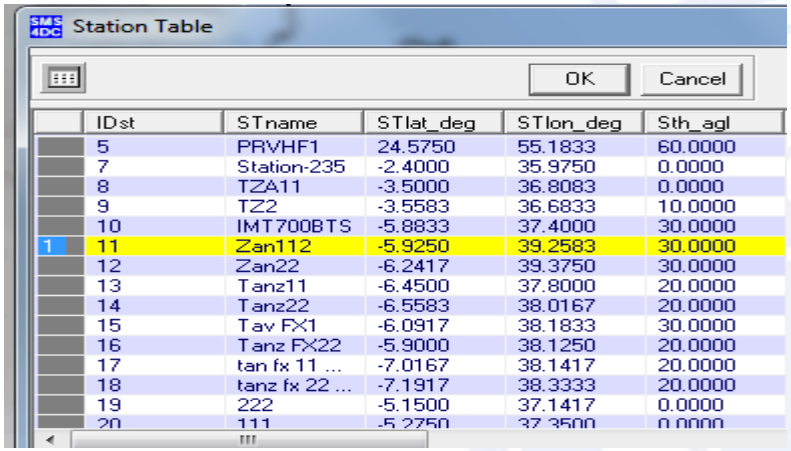
Area calculation

- Calculates of field strength values produced by a selected station inside a rectangular area at a given receiving height above ground level.
- To activate the “Area” sub-items a rectangular area must be drawn in advance on the DEM using the “Draw Box” or “Draw Box from Database” toolbar buttons.
- In the case of the line-of-sight (LOS) model, the “Area” calculation sub-item provides only a visibility analysis along the line from the wanted station
- By choosing “Area” sub-item, a spreadsheet of stations in the database is opened and users may select a station inside the area by a mouse left click on the corresponding row of the record-select column.



Area calculation

Select station



	IDst	STname	STlat_deg	STlon_deg	Sth_agl
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	10	IMT700BTS	-5.8833	37.4000	30.0000
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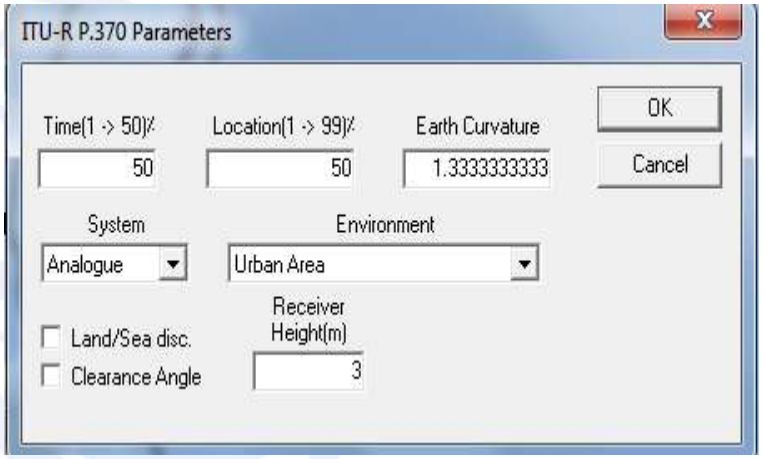
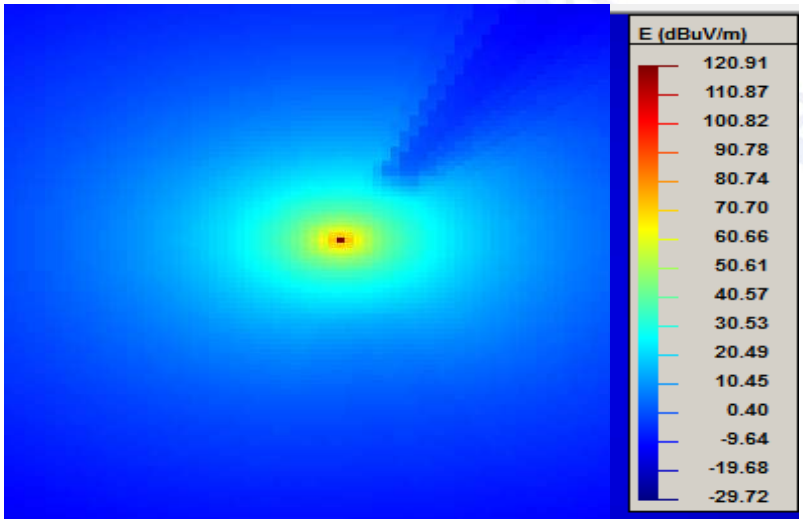
	19	222	-5.1500	37.1417	0.0000
	20	111	-5.2750	37.3500	0.0000

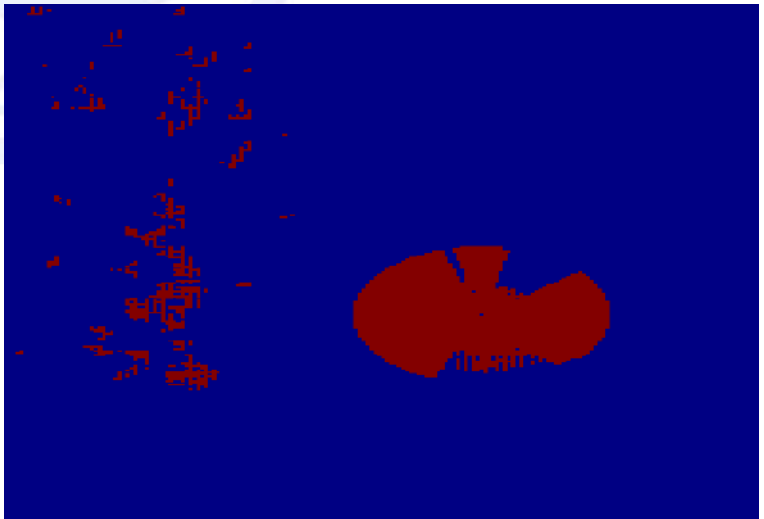
Set parameters



Area Calculation P370

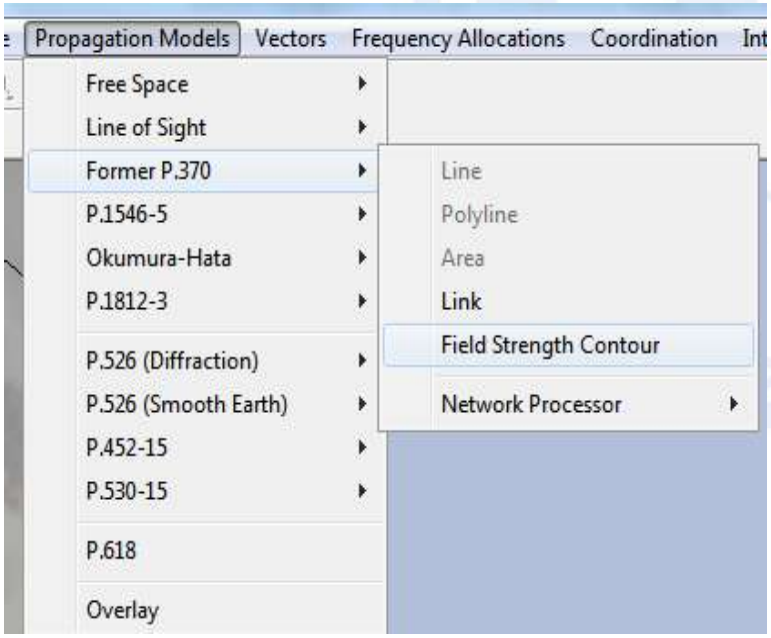


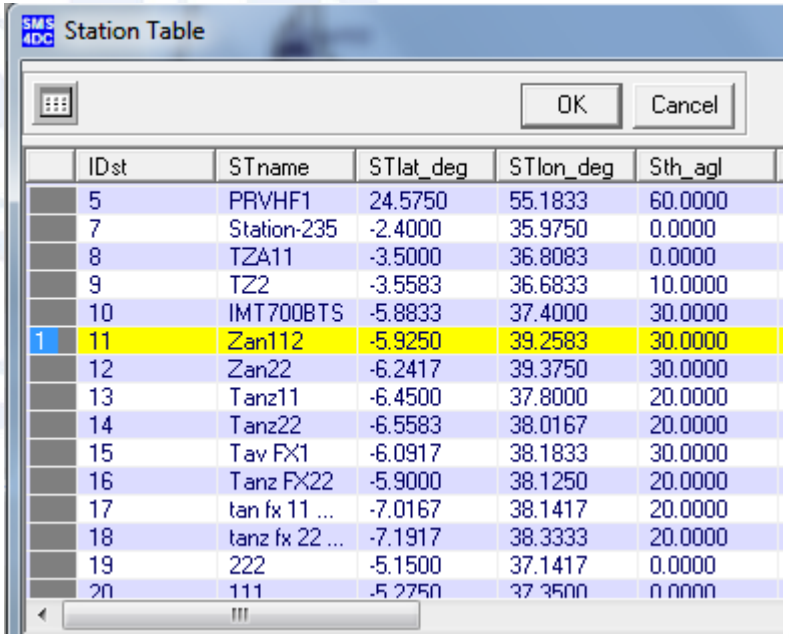
Calculation LOS



Field Strength Contour

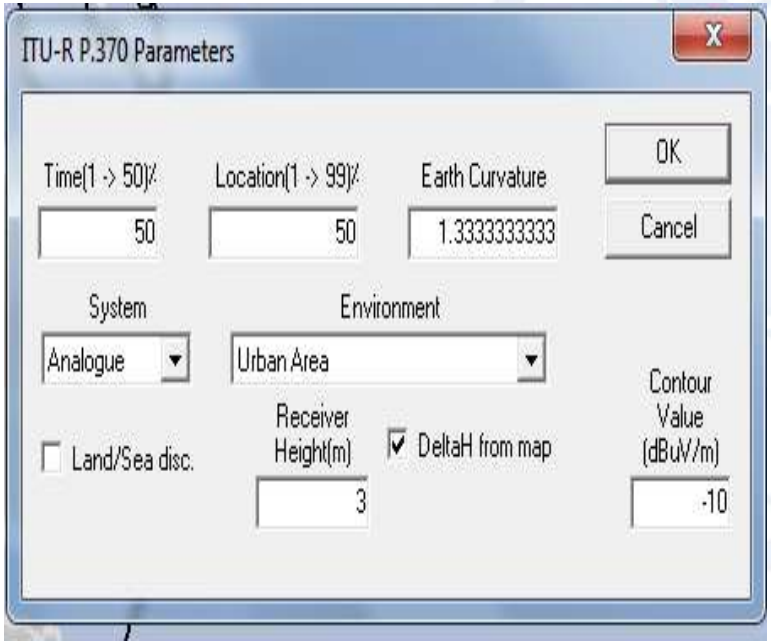
- This function saves and displays field strength contours around a selected station where the field strength values inside the contour are higher than a given threshold.
- A dialogue box of the propagation model requests the user to enter a threshold value for this parameter.



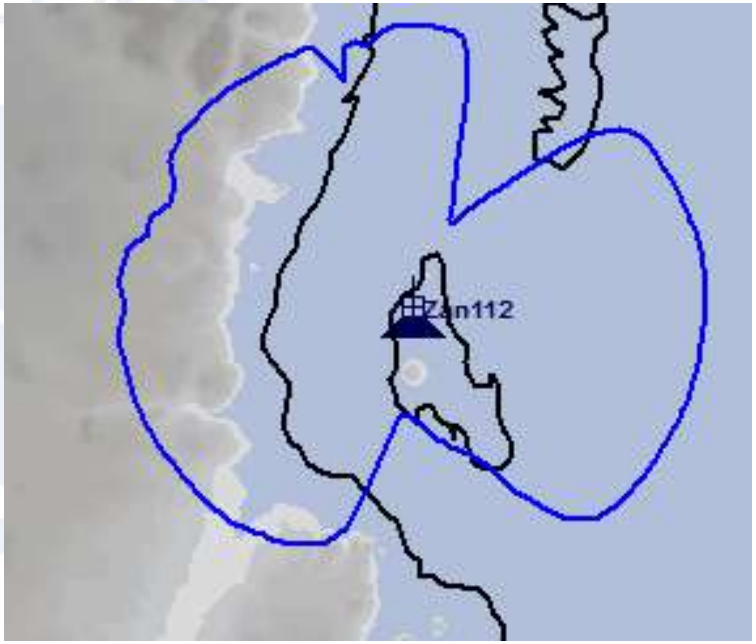


Field Strength Contour

Choose contour parameters



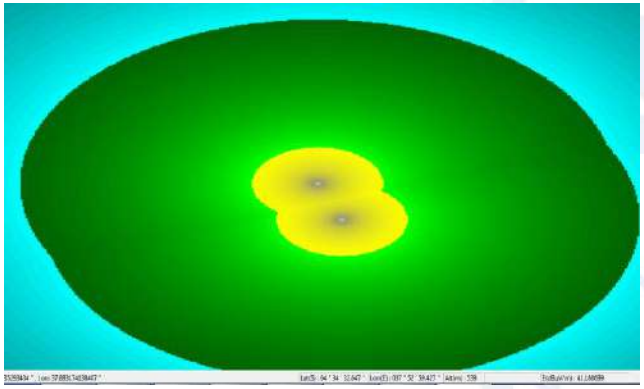
Field Strength Contour – P.370



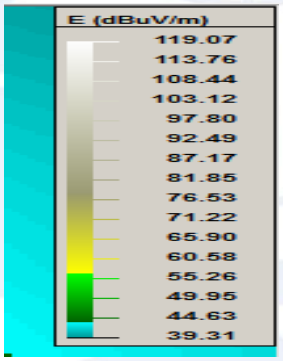
Field Strength Contour

- Using tools menu of the area calculation window the following items can be showed

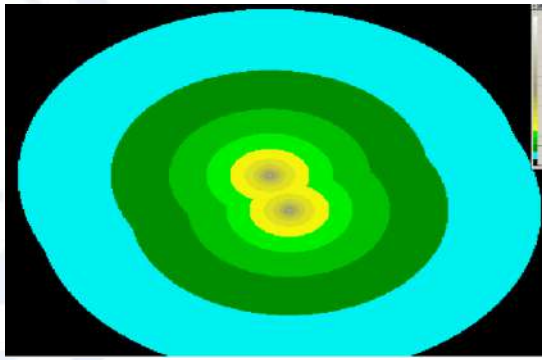
Change color



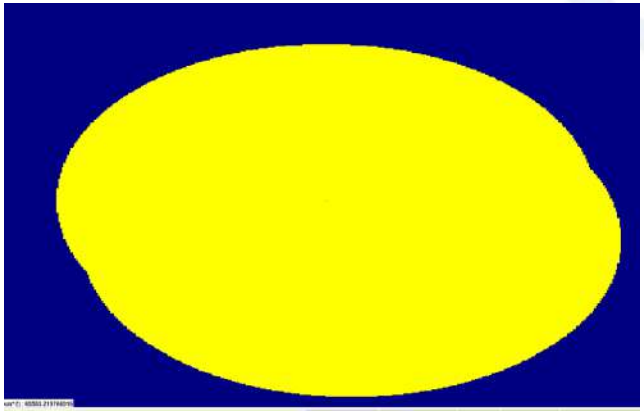
Show legend



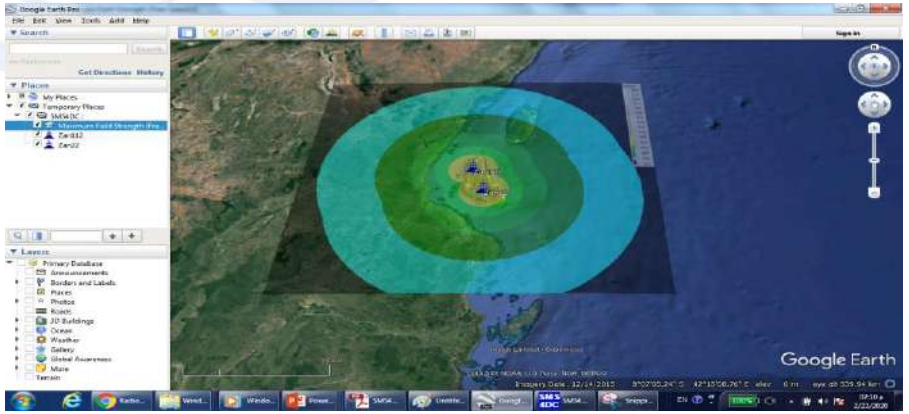
Contour



Coverage

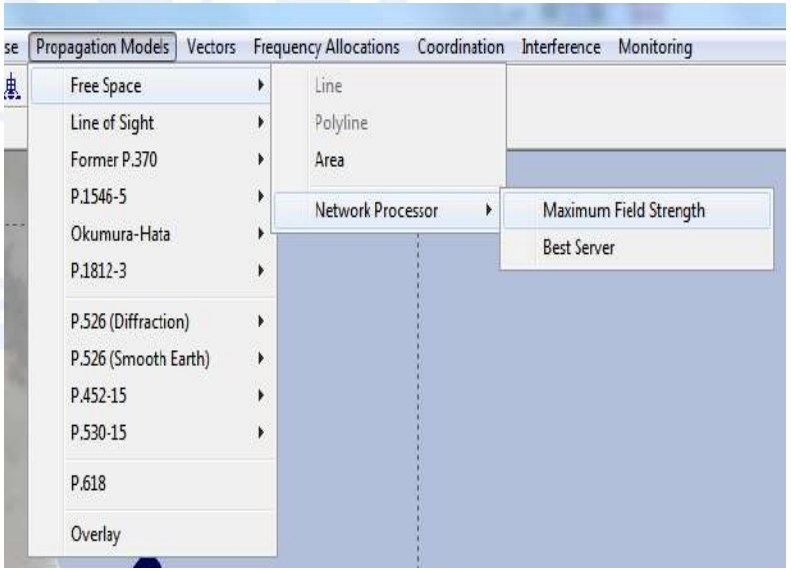


Export results to google earth



Maximum field strength

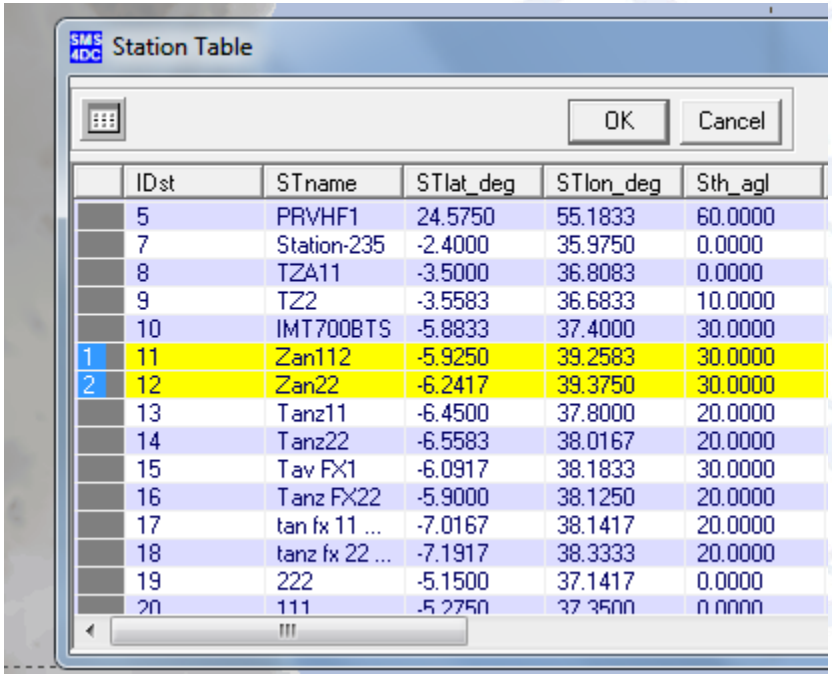
- This item calculates and displays the maximum value of field strength values produced by more than one transmitting stations at any point inside a predefined rectangular area.
- Prior to the selection of this sub-item, a rectangular area must be selected using the “Draw Box” or “Draw Box from Database” toolbar buttons.



Maximum field strength

Select more than one station nearby

Free Space Maximum Field Strength



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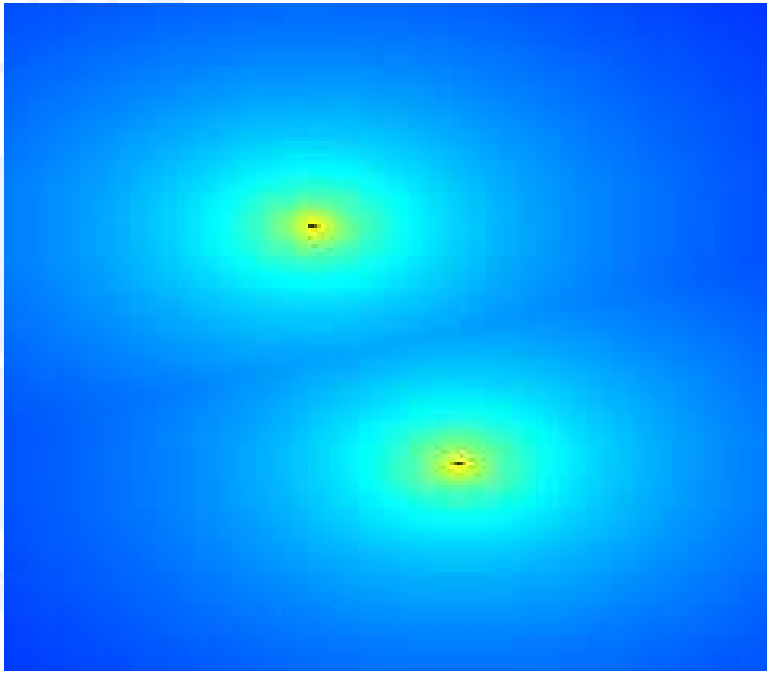
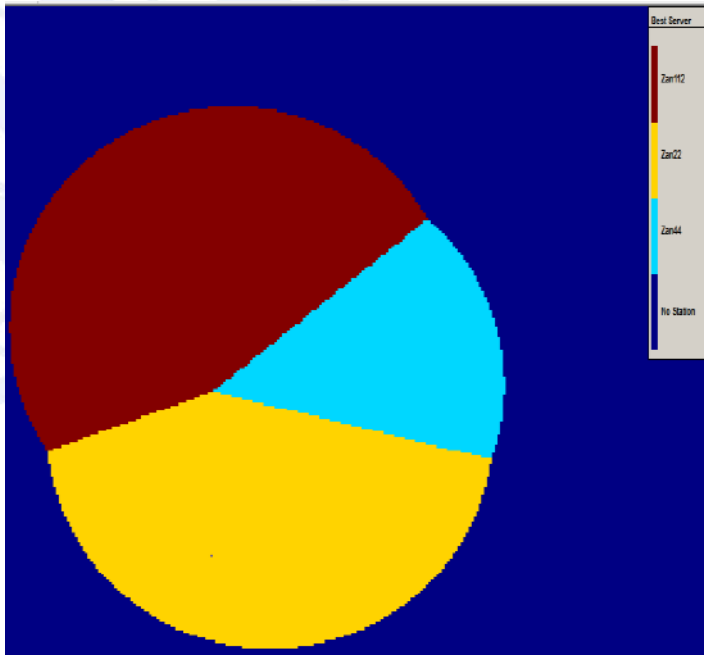
	20	111	-5.2750	37.3500	0.0000

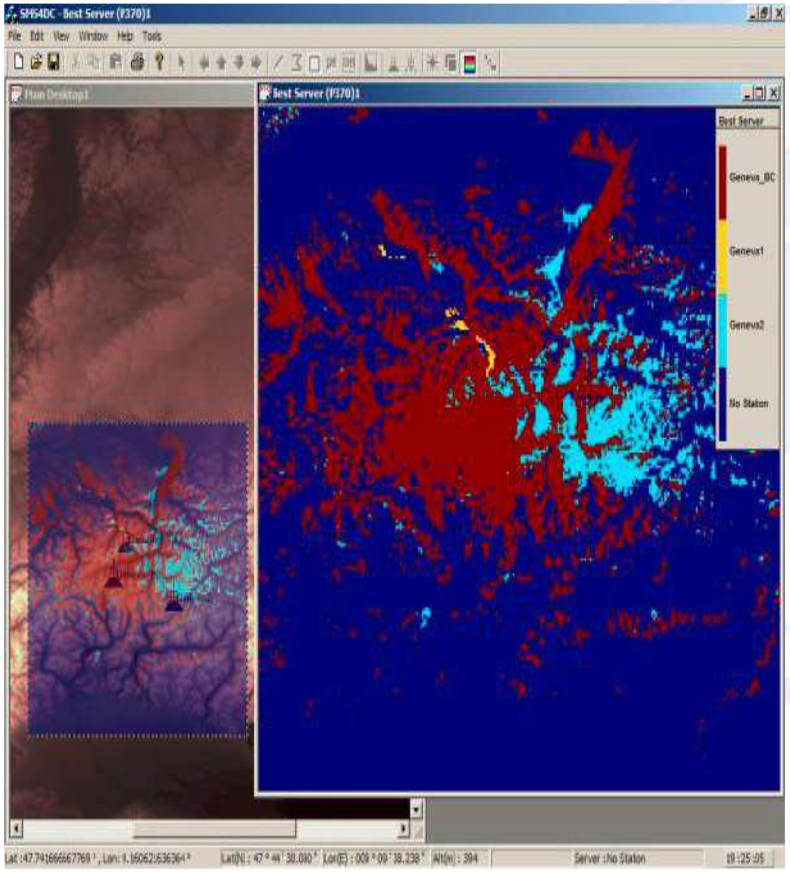


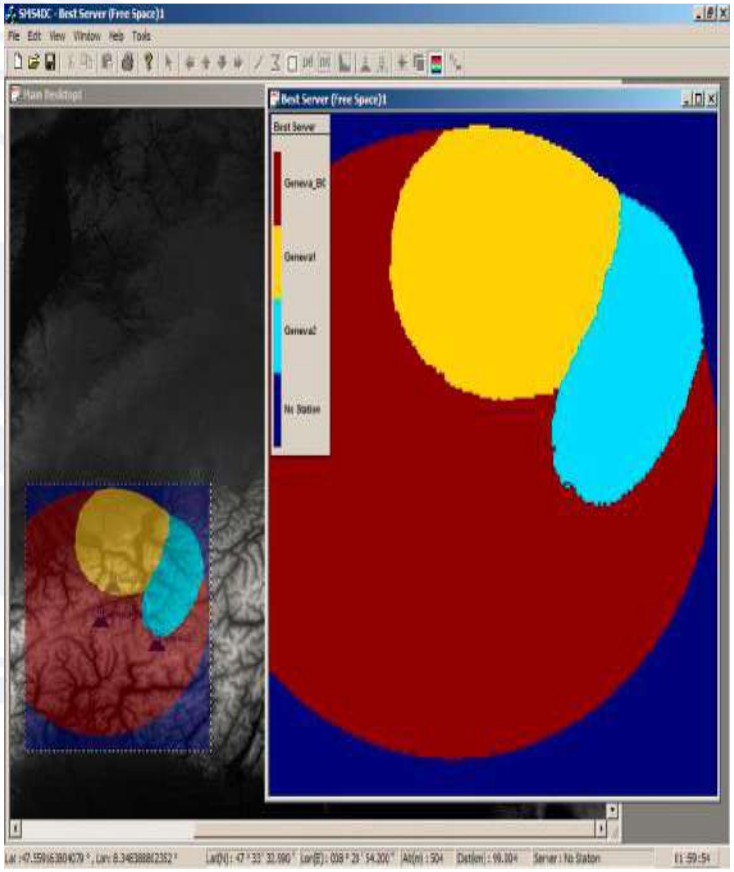
Best Server

- This function calculates and displays the best serving station, among various stations, at each point inside a predefined rectangular area.
- Prior to the selection of this sub-item, a rectangular area must be selected using the “Draw Box” or “Draw Box from Database” toolbar buttons.



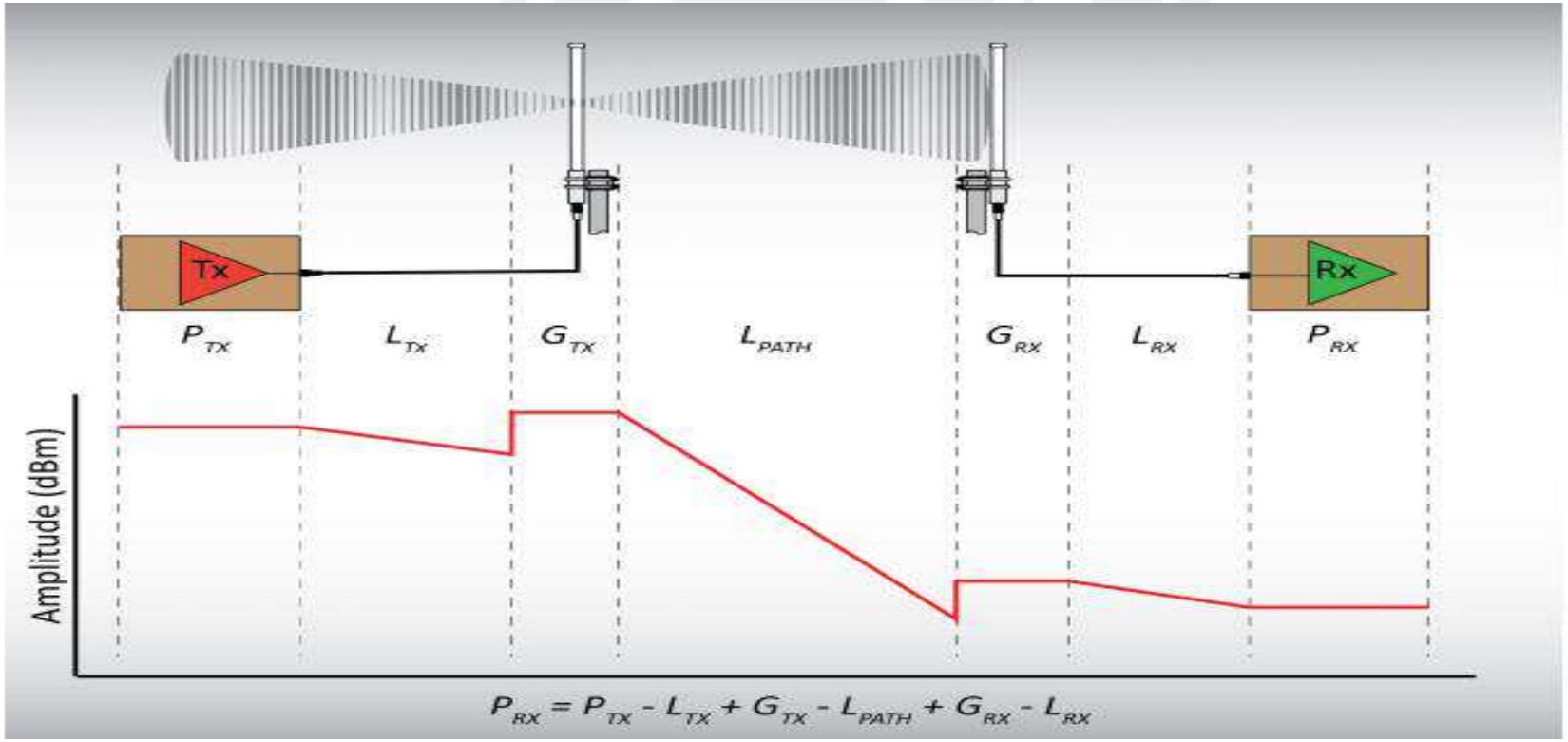
Best Server


SM54DC - Best Server (P370)1
Best Server (P370)1
Best Server
Geneva_BC
Geneva1
Geneva2
No Station


SM54DC - Best Server (Free Space)1
Best Server (Free Space)1
Best Server
Geneva_BC
Geneva1
Geneva2
No Station

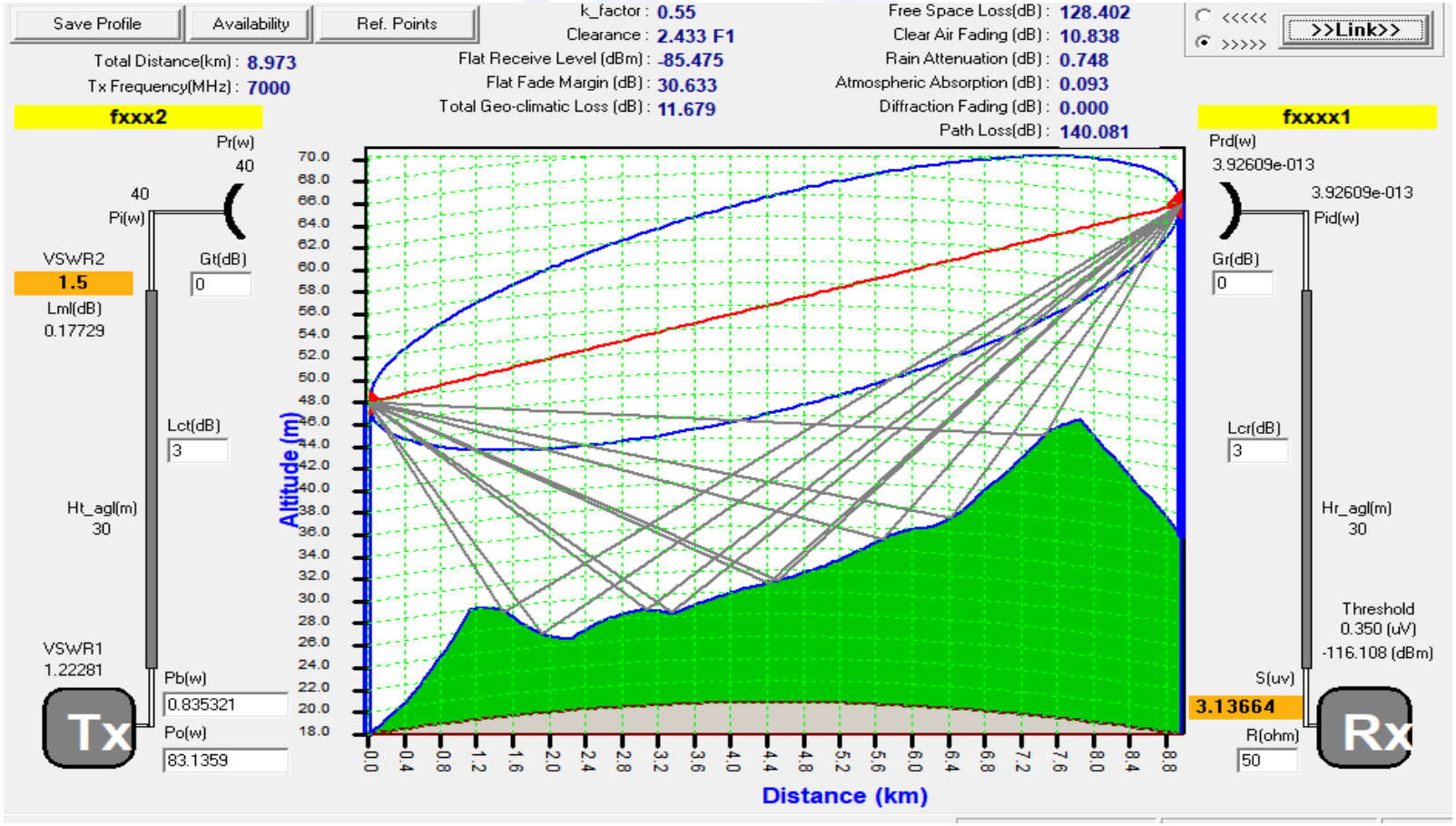
Link budget calculation

- Link budget calculation, displays calculation results between two stations as well as providing a visual user-interface to optimize the link characteristics.
- The link calculation contains: a path profile diagram, the Fresnel zone, Earth curvature and those technical characteristics of a link that are relevant to the propagation model in use.



Source: Campbell Scientific, Inc

Link budget calculation



Propagation Loss

- Attenuation due to atmospheric gases
- Diffraction fading due to obstruction or partial obstruction of the path,
- Fading due to multipath, beam spreading and scintillation,
- Attenuation due to variation of the angle-of arrival/launch,
- Attenuation due to precipitation,
- Attenuation due to sand and dust storms
- Total Loss = [Free Space Loss]+ [Atmospheric Gaseous Loss]+ [Rain Attenuation]+ [Clear Air Fading]+ [Diffraction Loss]+ [NFD].
- Flat Receive Level = PT + GT– [Free Space Loss]– [Atmospheric Gaseous Loss]– [Diffraction Loss]+ GR– [Receiver Insertion Loss]
- Fade Margin = [Flat Receive Level] – [Receiver Threshold]

Propagation Loss

- Attenuation due to atmospheric gases
- Diffraction fading due to obstruction or partial obstruction of the path,
- Fading due to multipath, beam spreading and scintillation,
- Attenuation due to variation of the angle-of arrival/launch,
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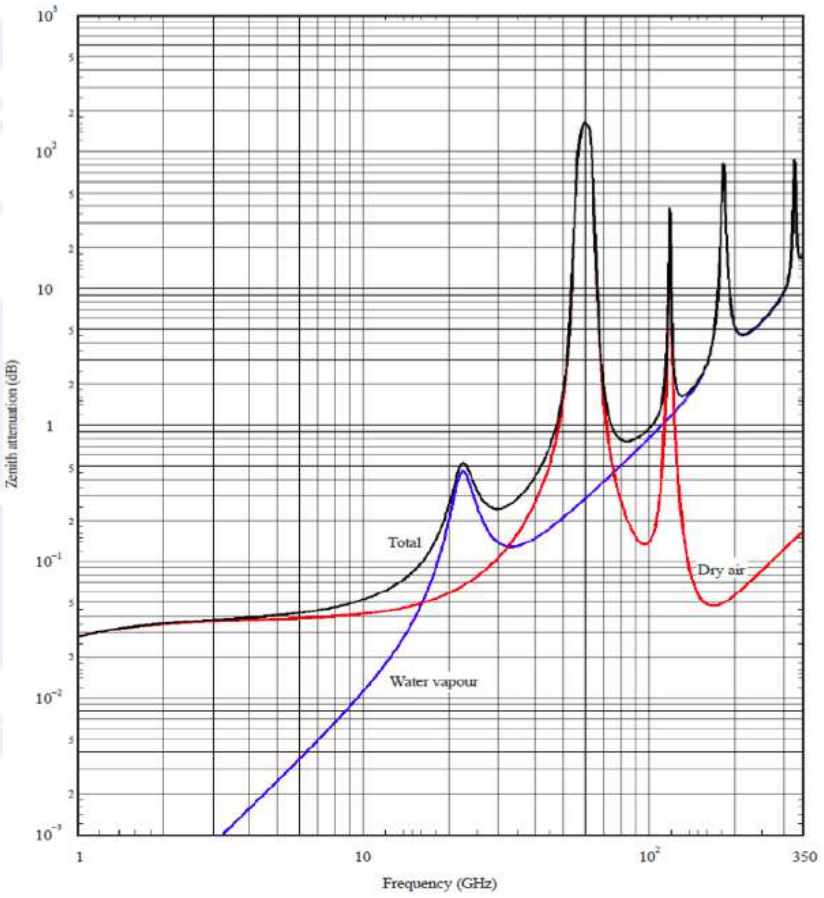
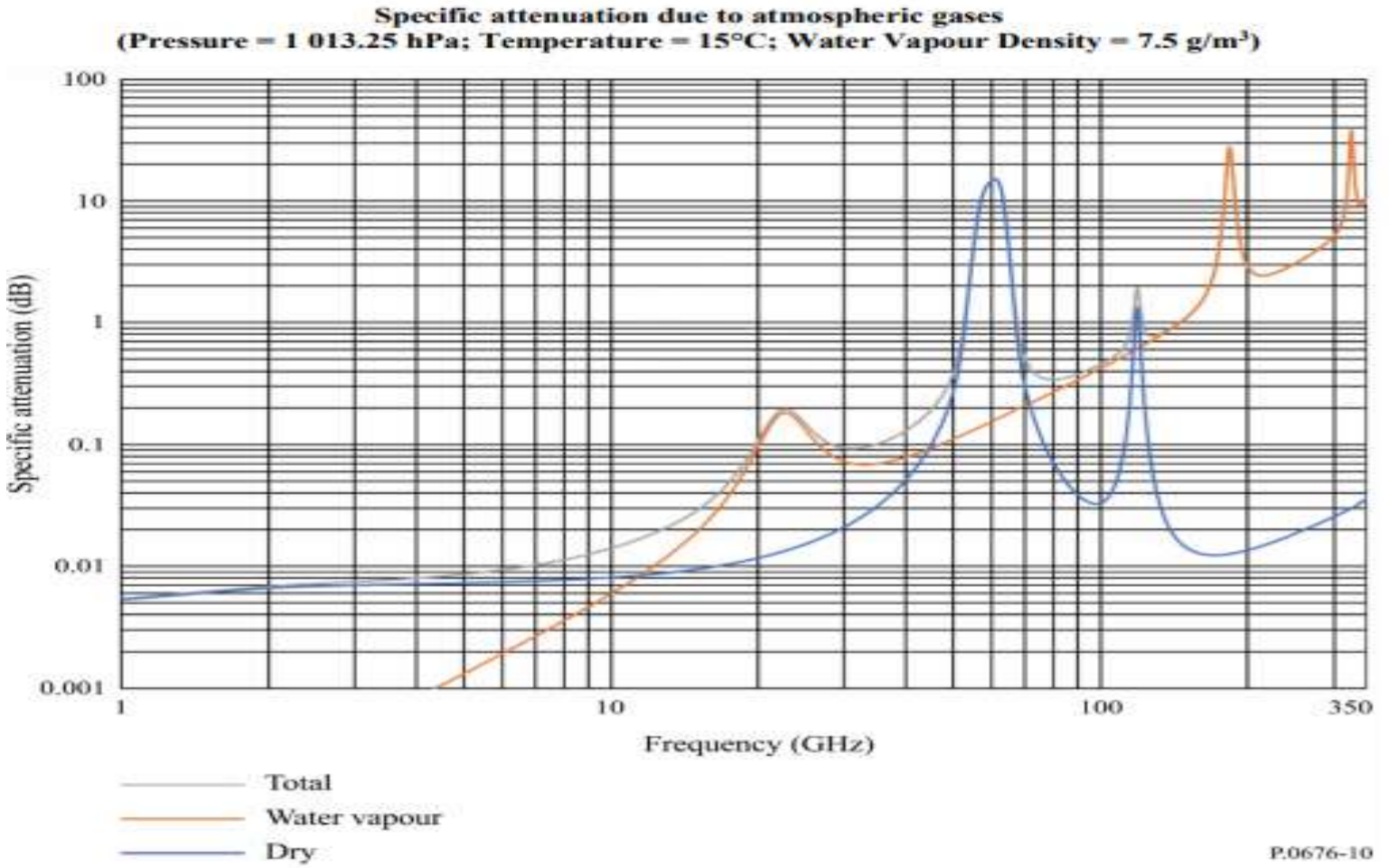
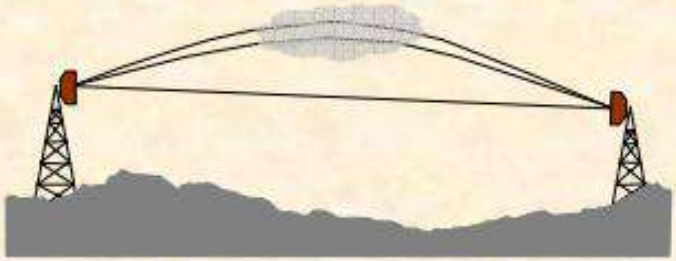


Propagation Loss

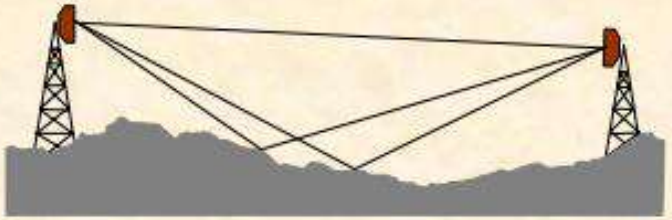
- Atmospheric gases considerable loss above 10 GHz



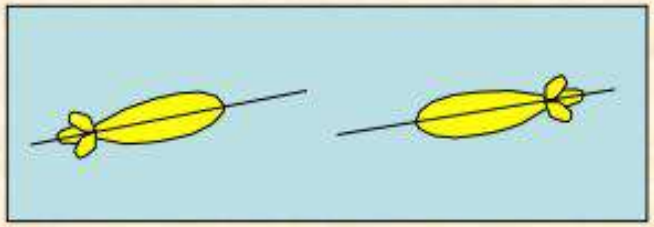
Propagation Loss



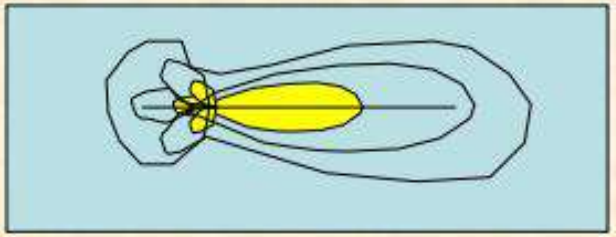
atmospheric Multipath



surface Multipath

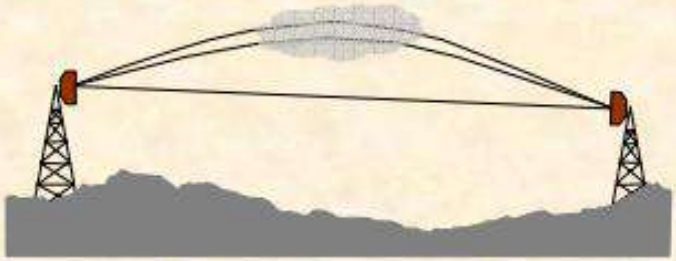


Antenna Decoupling
(governs the minimum beamwidth)

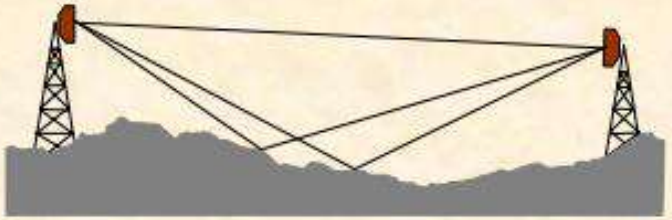


Beam Spreading
(defocusing)

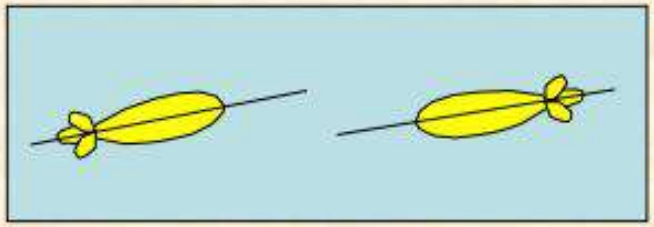
Propagation Loss



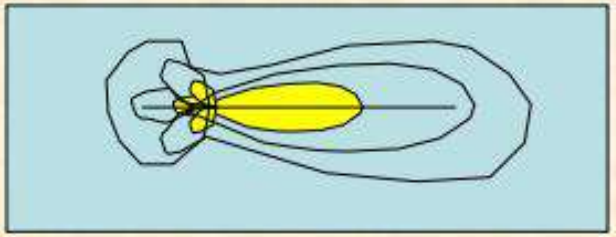
atmospheric Multipath



surface Multipath

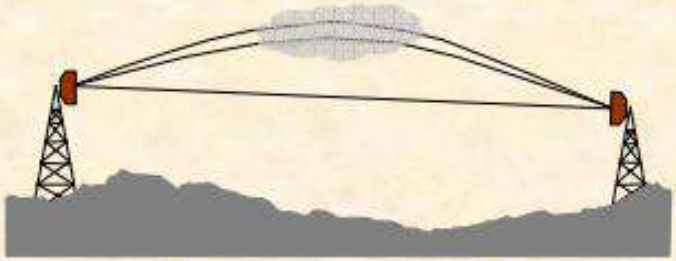


Antenna Decoupling
(governs the minimum beamwidth)

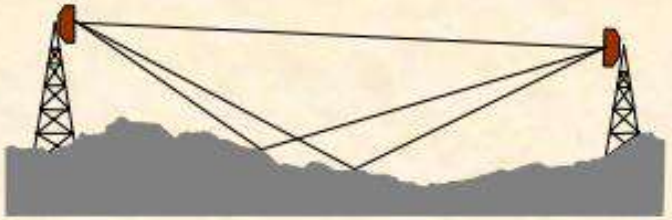


Beam Spreading
(defocusing)

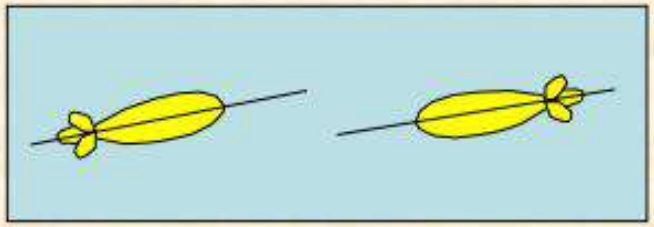
Propagation Loss



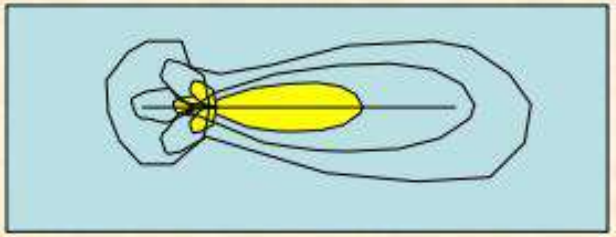
atmospheric Multipath



surface Multipath



Antenna Decoupling
(governs the minimum beamwidth)



Beam Spreading
(defocusing)

Practice and exercise

SMS4DC interference calculations

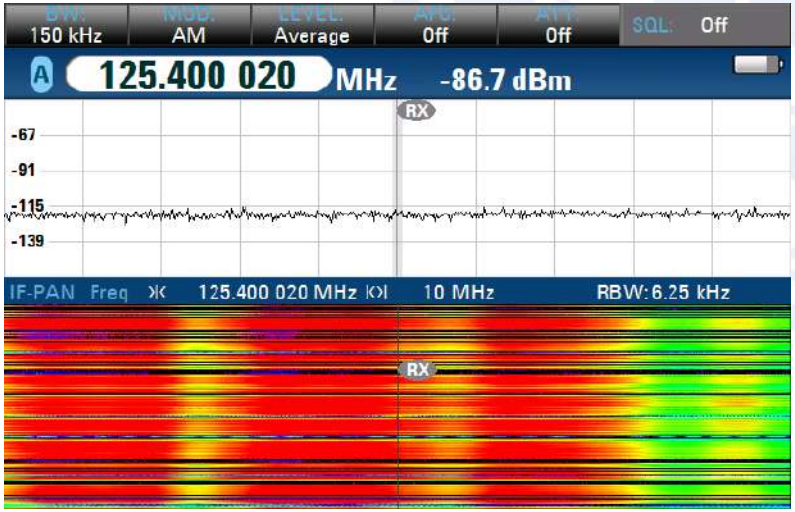
Definition

The effect of unwanted energy due to one or a combination of emissions, radiations, or inductions upon reception in a radiocommunication system, manifested by any performance degradation, misinterpretation, or loss of information which could be extracted in the absence of such unwanted energy.

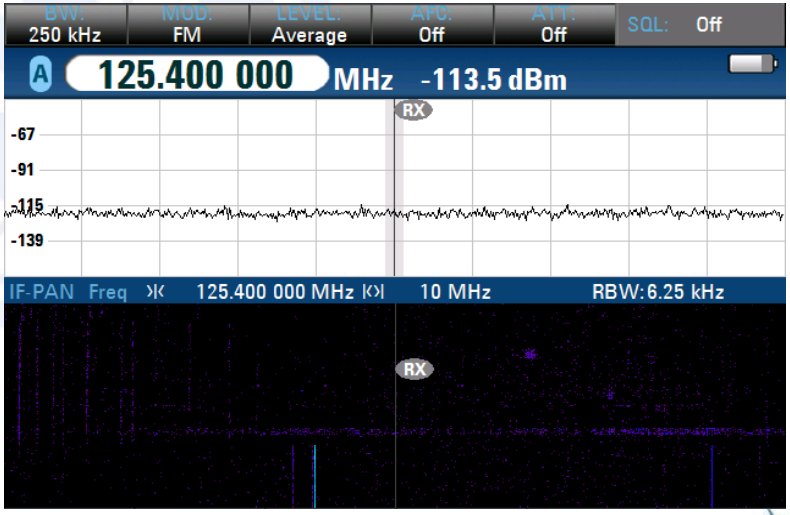
Types

Power sources (50 Hz): due to leakage, arcing neon signs (continual arc) fluorescent light fixtures.

Power line interference



Power line interference resolved



SMS4DC interference calculations

Definition

The effect of unwanted energy due to one or a combination of emissions, radiations, or inductions upon reception in a radiocommunication system, manifested by any performance degradation, misinterpretation, or loss of information which could be extracted in the absence of such unwanted energy.

Types

Co-channel: same frequency various power levels - strongest signal captures receiver

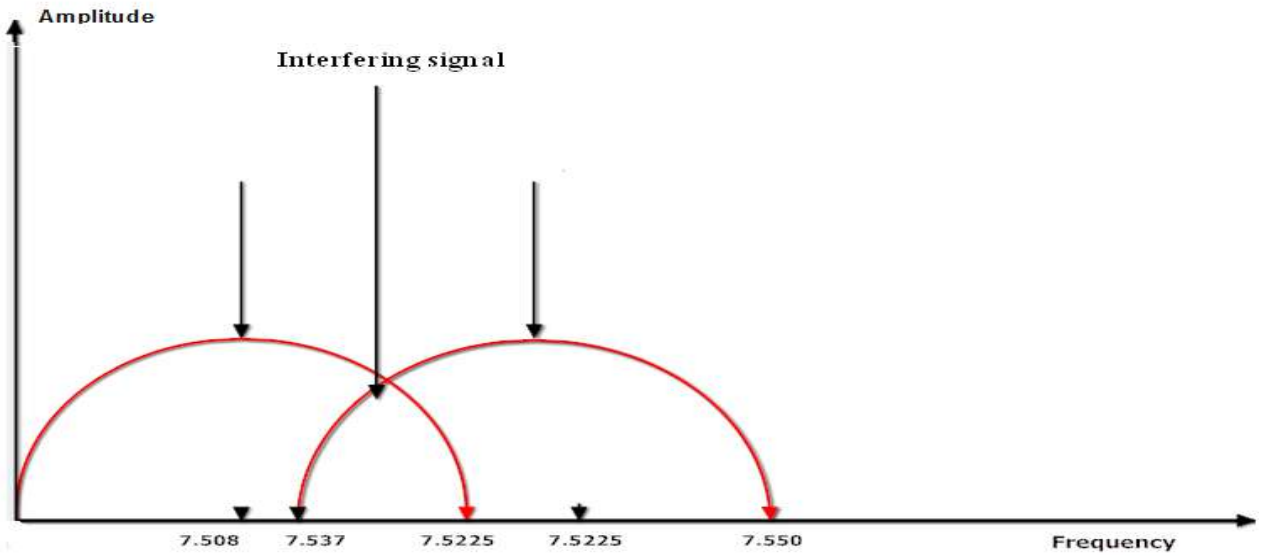
SMS4DC interference calculations

Definition

The effect of unwanted energy due to one or a combination of emissions, radiations, or inductions upon reception in a radiocommunication system, manifested by any performance degradation, misinterpretation, or loss of information which could be extracted in the absence of such unwanted energy.

Types

adjacent Channel: is interference caused by extraneous power from a signal in an adjacent channel. ACI may be caused by inadequate filtering



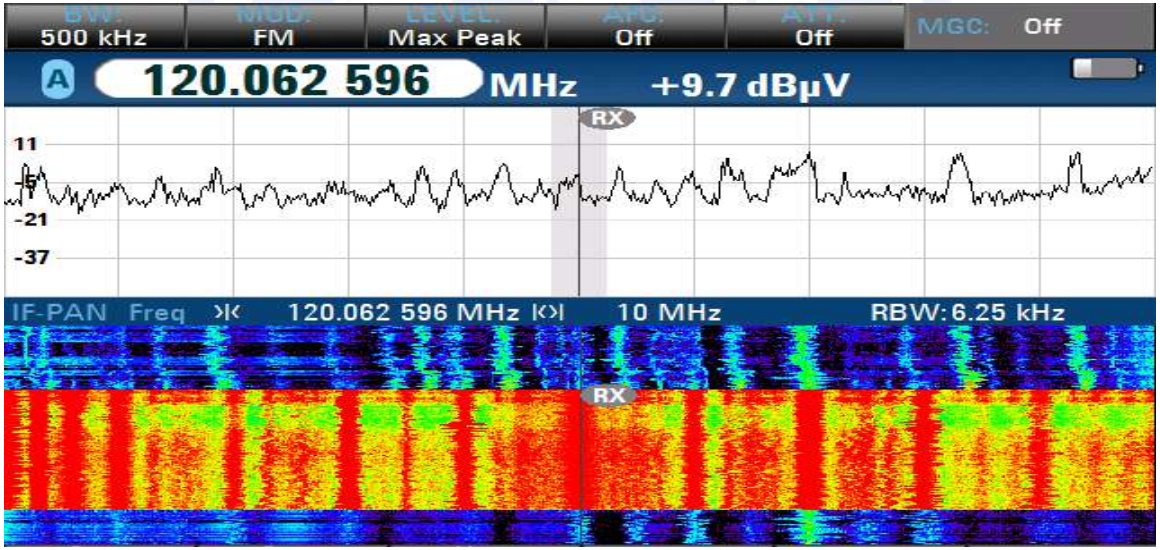
SMS4DC interference calculations

Definition

The effect of unwanted energy due to one or a combination of emissions, radiations, or inductions upon reception in a radiocommunication system, manifested by any performance degradation, misinterpretation, or loss of information which could be extracted in the absence of such unwanted energy.

Types

Intermodulation: unrelated frequency mixes with another signal generating a signal on or close to the receive frequency.



SMS4DC interference calculations

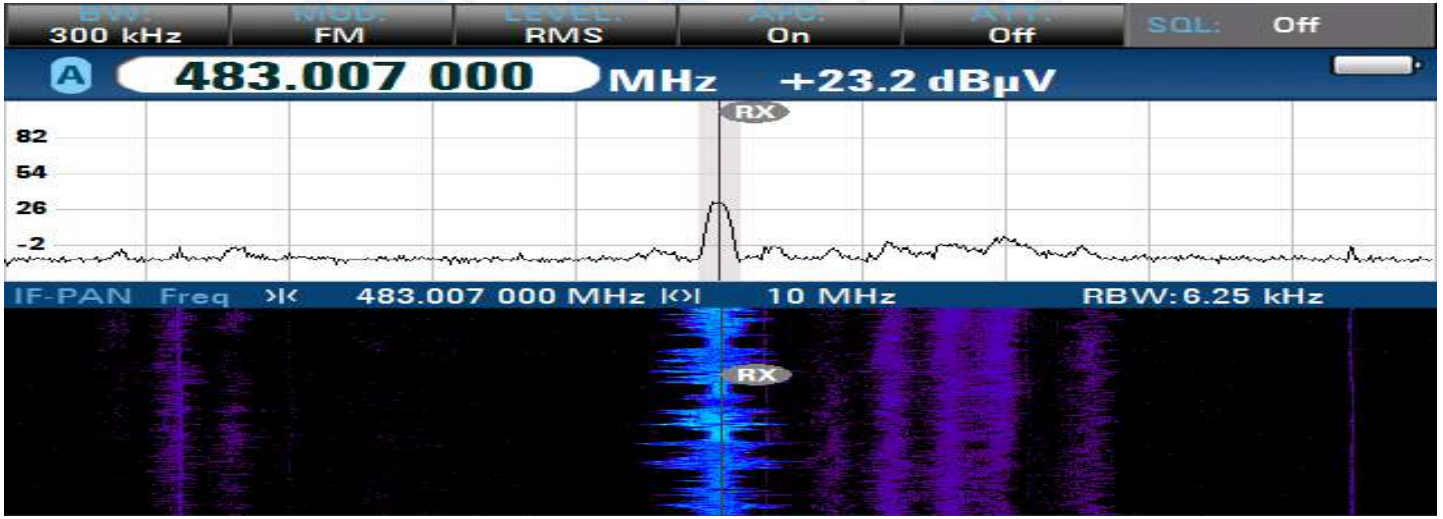
Definition

The effect of unwanted energy due to one or a combination of emissions, radiations, or inductions upon reception in a radiocommunication system, manifested by any performance degradation, misinterpretation, or loss of information which could be extracted in the absence of such unwanted energy.

Types

Harmonic signals are usually unwanted signals which are exact multiples of the operating frequency.

5th harmonic of 96.6 MHz



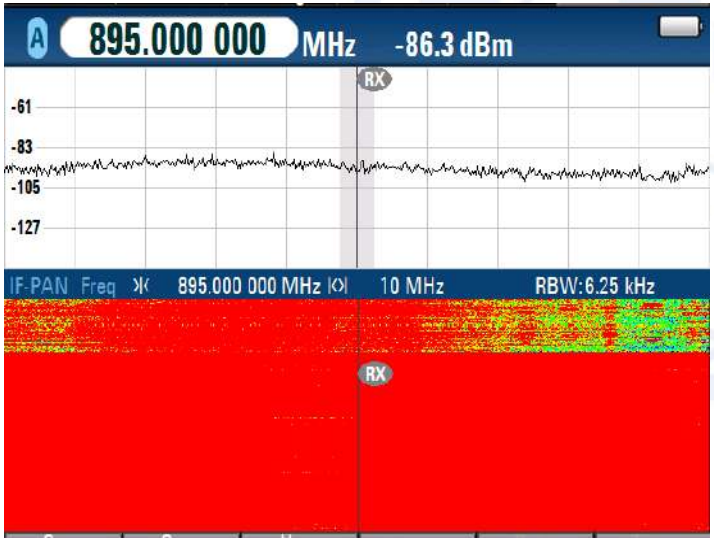
SMS4DC interference calculations

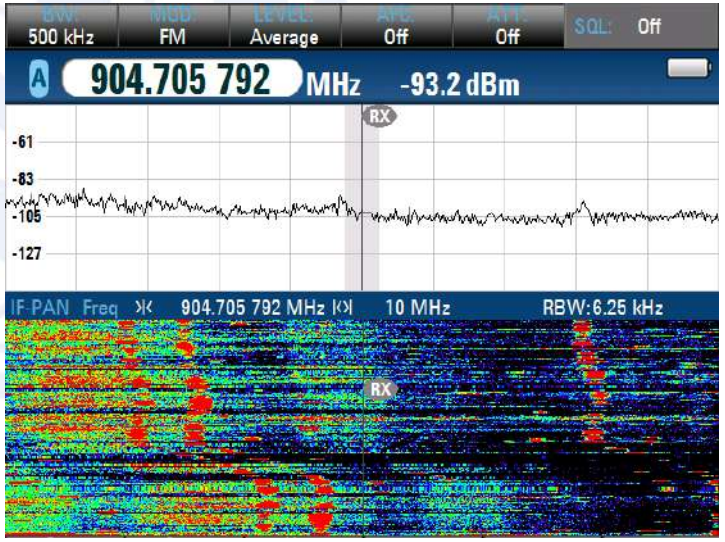
Definition

The effect of unwanted energy due to one or a combination of emissions, radiations, or inductions upon reception in a radiocommunication system, manifested by any performance degradation, misinterpretation, or loss of information which could be extracted in the absence of such unwanted energy.

Types

Out of band emissions Out-of-band emission is emission on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process.



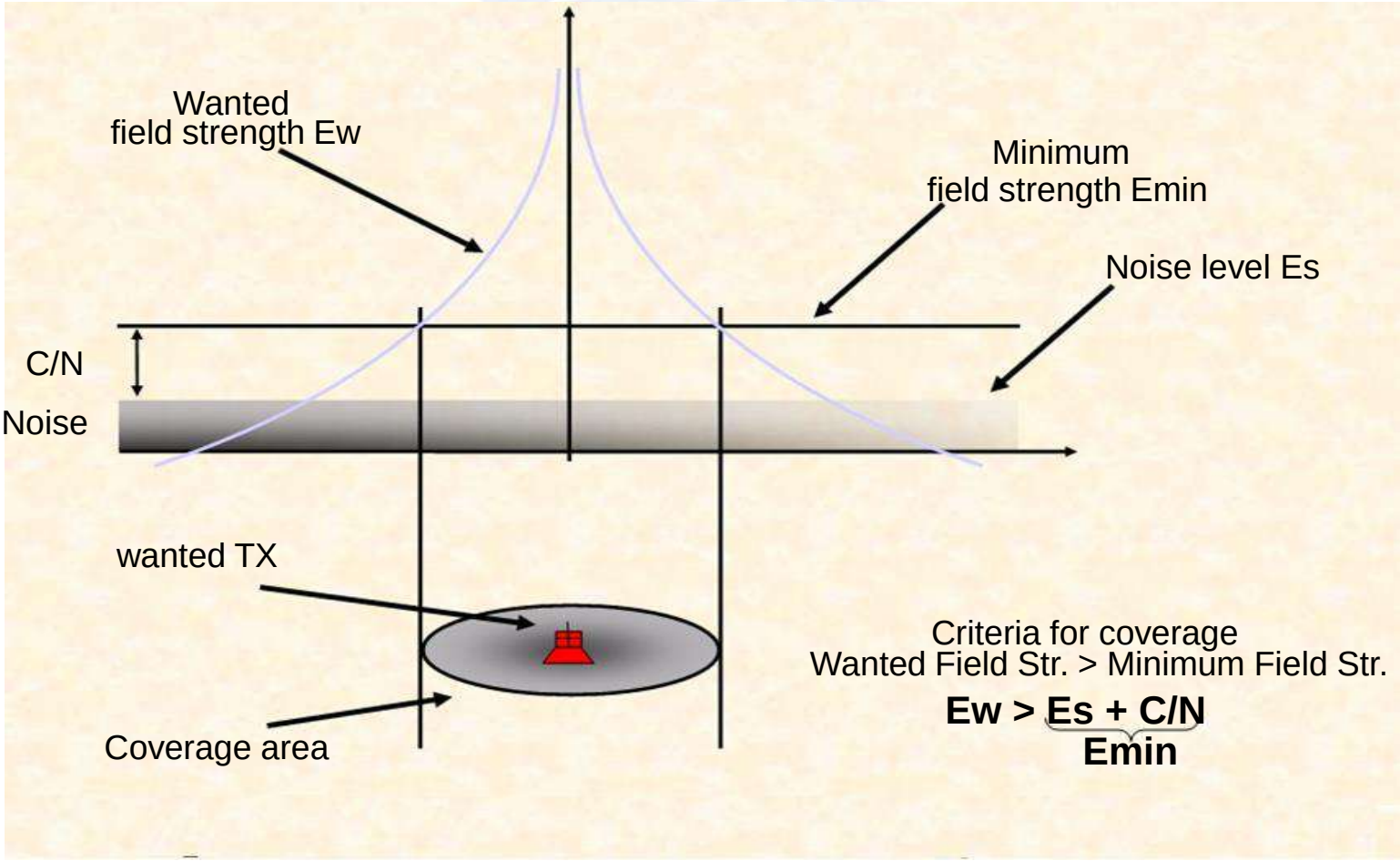


Important parameters

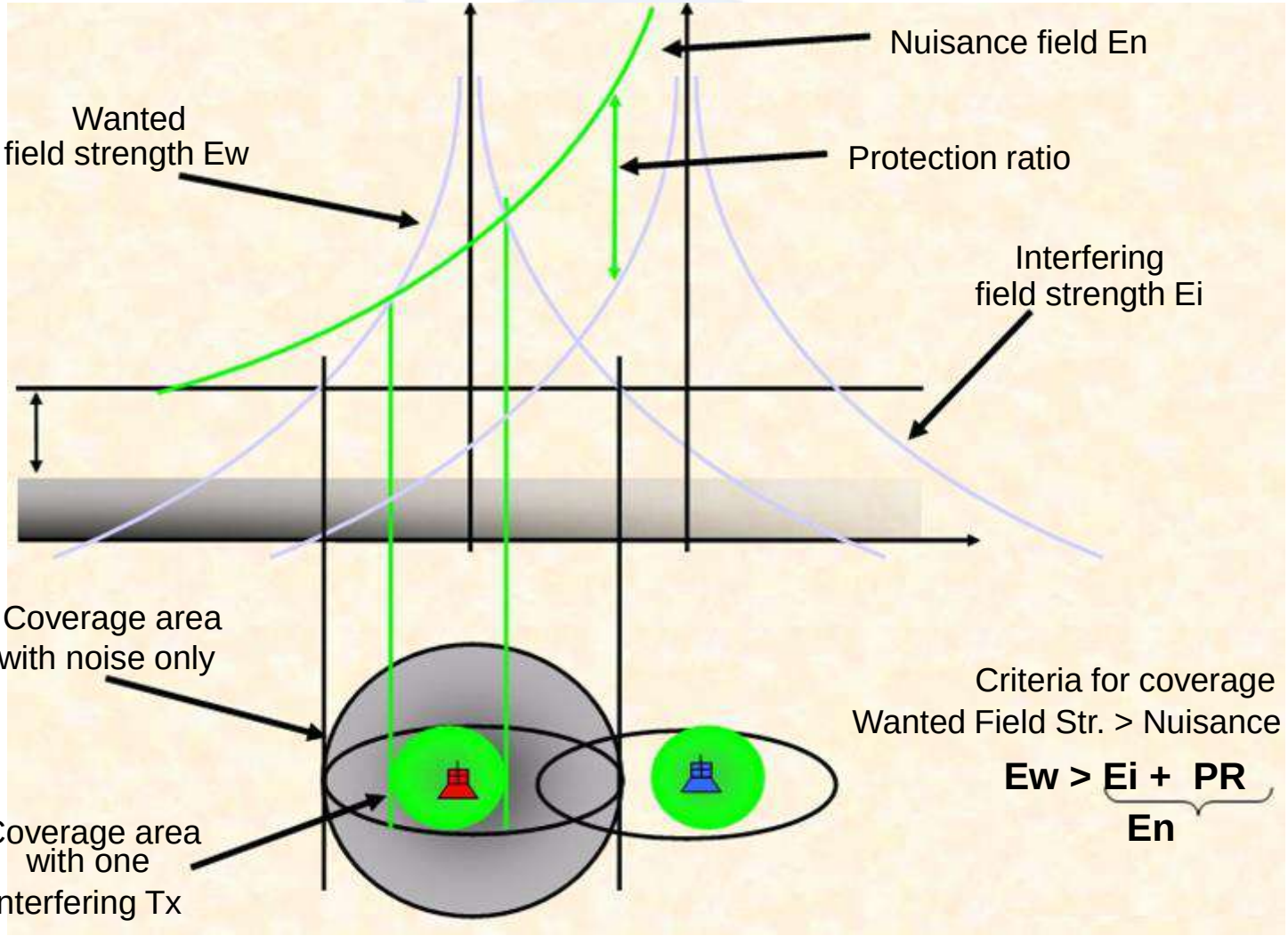
- **Minimum field strength (C/N)(db):** It is a minimum field strength level which is necessary to fulfil the signal quality for coverage.
- **Protection ratio, PR**: The required difference in dB between the level of the wanted signal and the level of the interfering signal to achieve the required quality of reception.
- **Nuisance field strength(En):** The equivalent required field strength of a wanted signal to achieve the required quality of reception, considering a single interfering signal and its corresponding protection ratio.

  En= Ei(interference field strength)+ PR
- **Waned field strength (Ew):** The required field strength of a wanted signal to achieve the required quality of reception, considering multiple interfering signals and their corresponding protection ratios .Ew>En

Interference by Noise



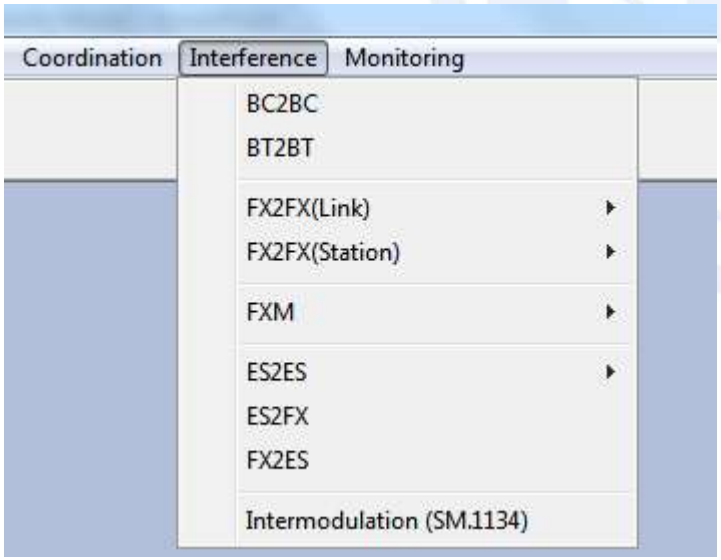
Interference by one Transmitter



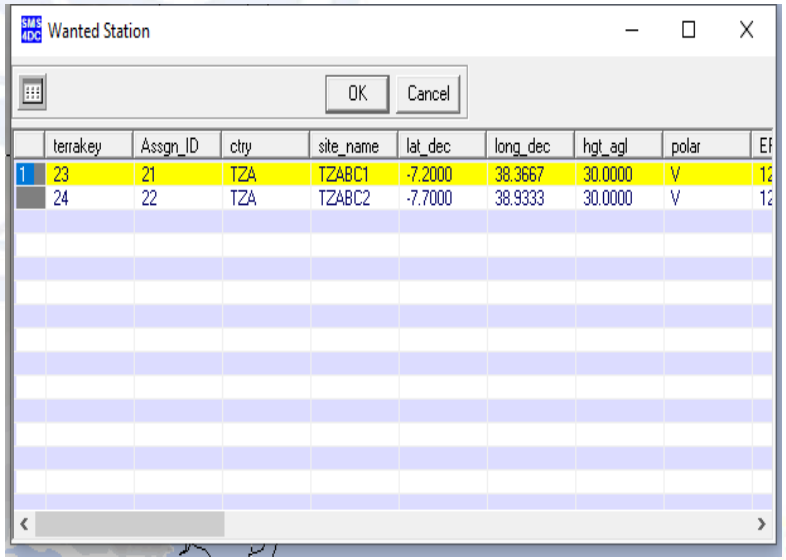
SMS4DC Interference calculations

- Interference calculations have been implemented in this menu to analyze several configurations of wanted and victim stations.
- BC2BC and BT2BT: This items calculates the aggregate interference level of interfering BC stations on a directional receiver of a wanted BC station.
- BT2BT: This item calculates the aggregate interference level of interfering BT stations on a receiver of a wanted BT station.

1

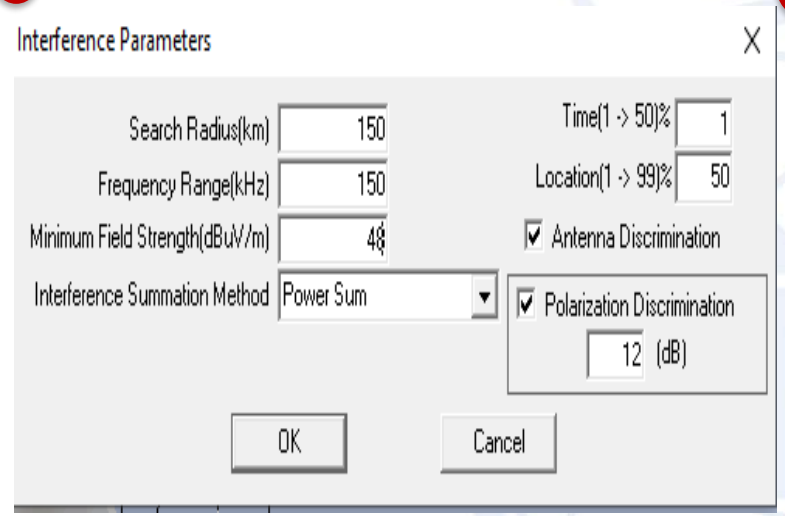


2 Select a wanted BC station

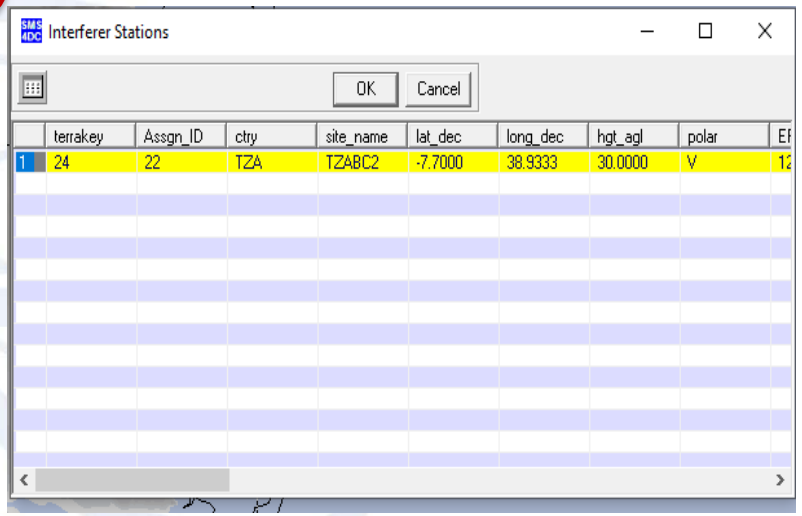


Broadcasting Interference calculations

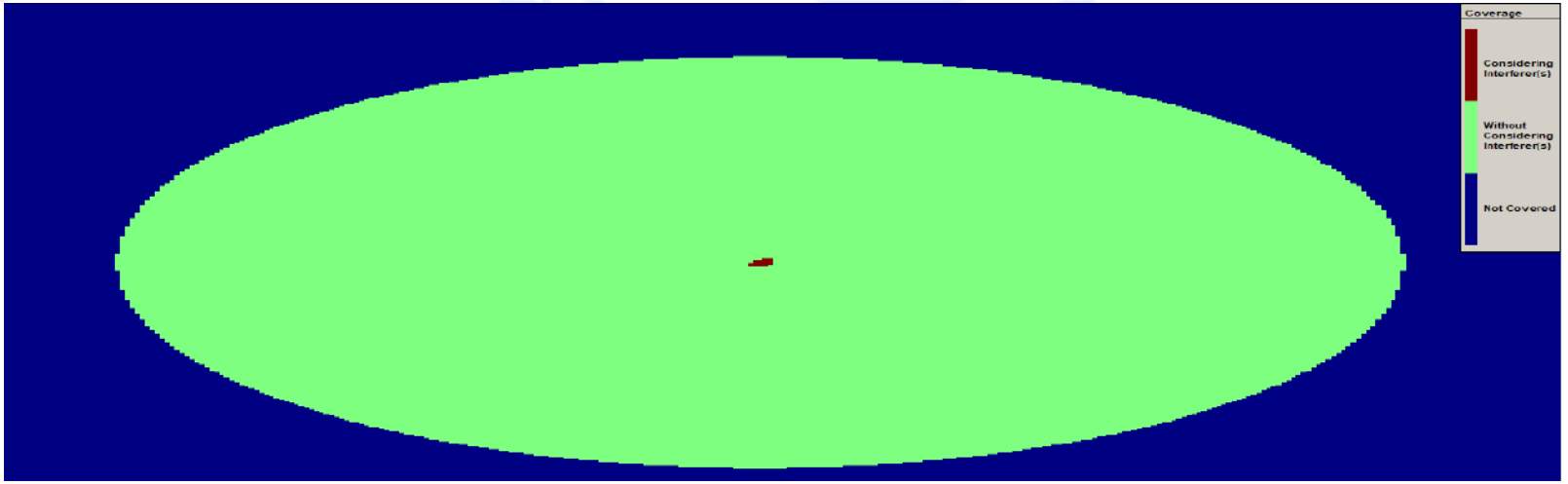
3 Set interference Parameters



4 Select the available stations



5 Result: Coverage area with/without interference of a concerned BC station

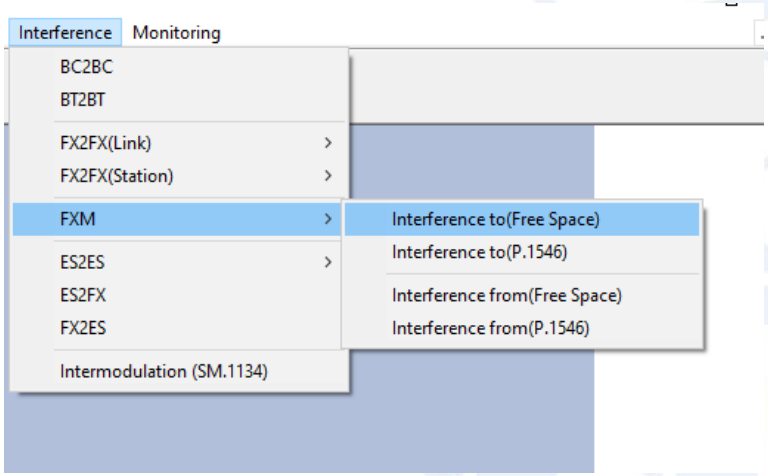


Fixed and Mobile Interference calculations

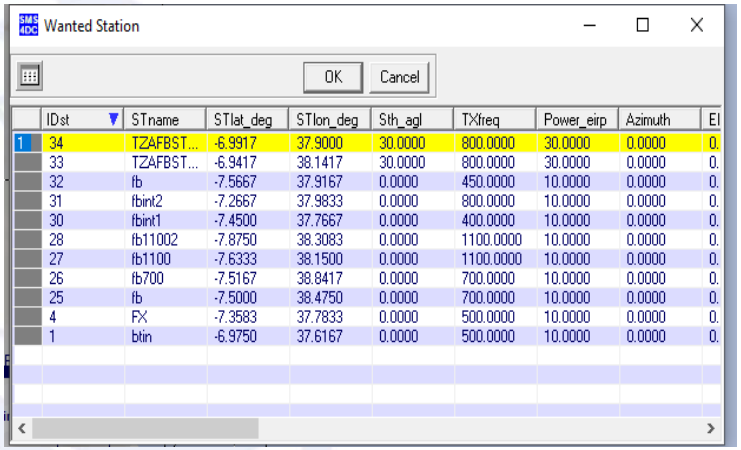
- The item “FXM” in the “Interference” menu has been implemented for the calculation of interference produced/experienced between stations in the land mobile service and between stations in the fixed service (below 1GHz) and between each other.
- Interference to (Free Space and P.1546): This item calculates interference to fixed or land mobile receiving stations from a wanted transmitting station in the fixed or land mobile services.
- Interference from (Free Space and P.1546): This item calculates interference from fixed or land mobile transmitting stations to a wanted receiving station in the fixed or land mobile services, under given conditions.

Fixed and Mobile Interference calculations

1 FXM interference calculations

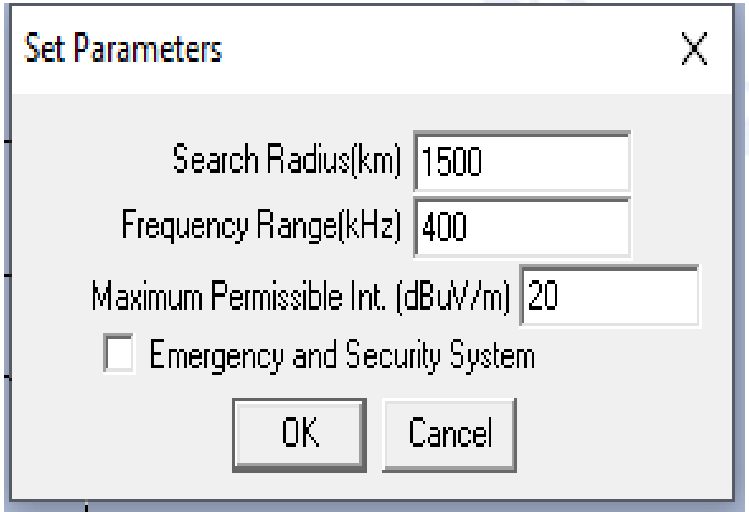


2 Select a wanted station

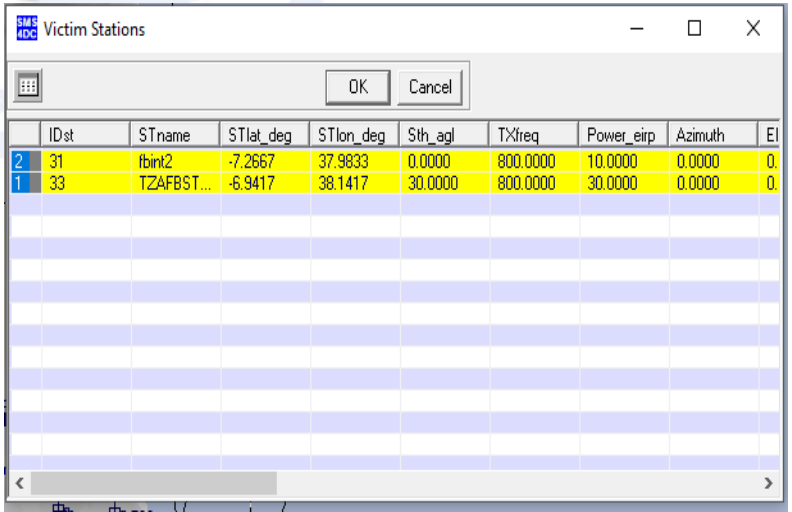


IDst	STname	STlat_deg	STlon_deg	Sth_agl	TXfreq	Power_eirp	Azimuth	El
34	TZAFBST...	-6.9917	37.9000	30.0000	800.0000	30.0000	0.0000	0.
33	TZAFBST...	-6.9417	38.1417	30.0000	800.0000	30.0000	0.0000	0.
32	fb	-7.5667	37.9167	0.0000	450.0000	10.0000	0.0000	0.
31	fbint2	-7.2667	37.9833	0.0000	800.0000	10.0000	0.0000	0.
30	fbint1	-7.4500	37.7667	0.0000	400.0000	10.0000	0.0000	0.
28	fb11002	-7.8750	38.3083	0.0000	1100.0000	10.0000	0.0000	0.
27	fb1100	-7.6333	38.1500	0.0000	1100.0000	10.0000	0.0000	0.
26	fb700	-7.5167	38.8417	0.0000	700.0000	10.0000	0.0000	0.
25	fb	-7.5000	38.4750	0.0000	700.0000	10.0000	0.0000	0.
4	FX	-7.3583	37.7833	0.0000	500.0000	10.0000	0.0000	0.
1	btin	-6.9750	37.6167	0.0000	500.0000	10.0000	0.0000	0.

3 Set parameters



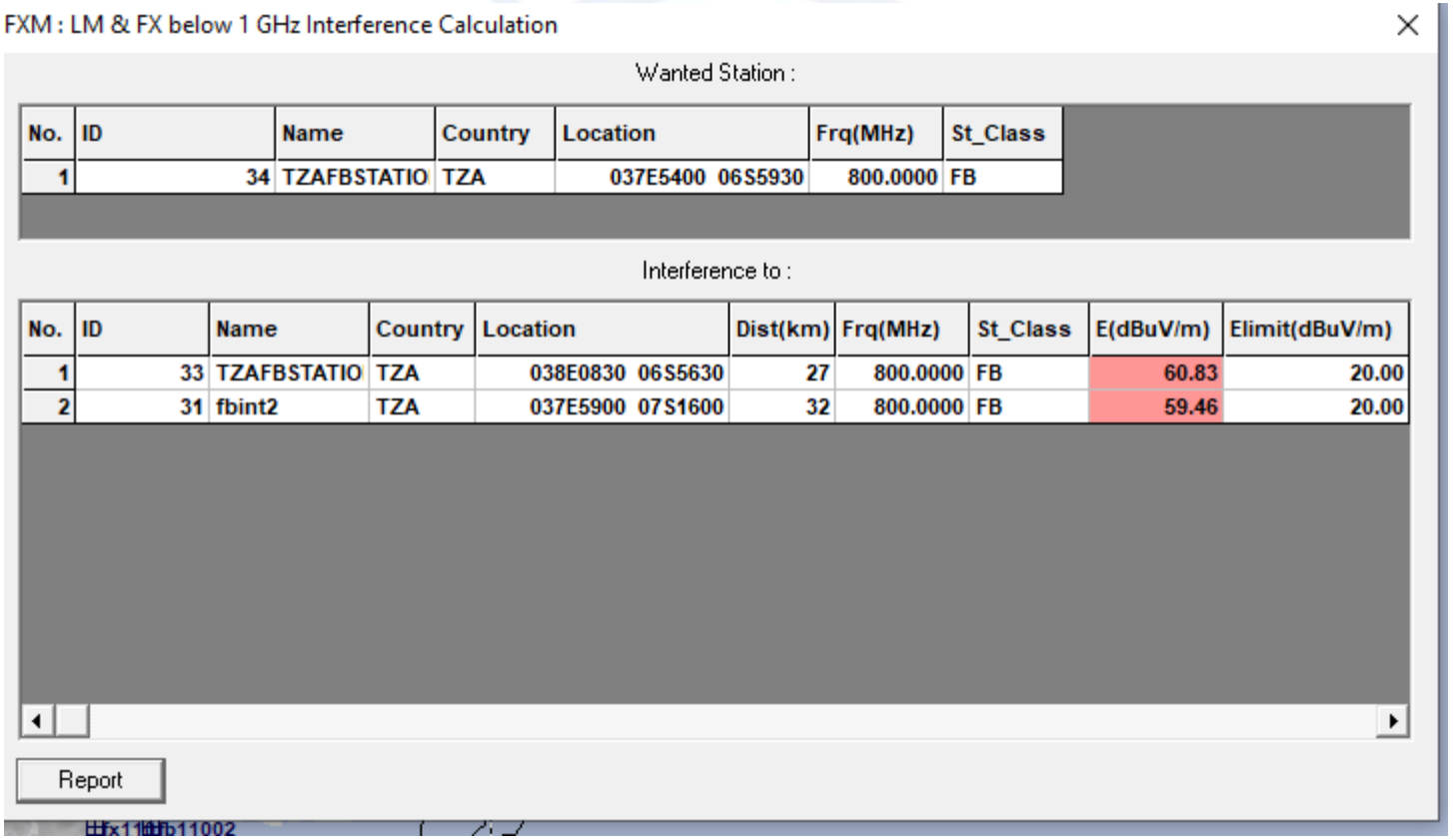
4 Select victim stations



IDst	STname	STlat_deg	STlon_deg	Sth_agl	TXfreq	Power_eirp	Azimuth	El
31	fbint2	-7.2667	37.9833	0.0000	800.0000	10.0000	0.0000	0.
33	TZAFBST...	-6.9417	38.1417	30.0000	800.0000	30.0000	0.0000	0.

Fixed and Mobile Interference calculations

5 View results



No.	ID	Name	Country	Location	Frq(MHz)	St_Class
1	34	TZAFBSTATIO	TZA	037E5400 06S5930	800.0000	FB

No.	ID	Name	Country	Location	Dist(km)	Frq(MHz)	St_Class	E(dBuV/m)	Elimit(dBuV/m)
1	33	TZAFBSTATIO	TZA	038E0830 06S5630	27	800.0000	FB	60.83	20.00
2	31	fbint2	TZA	037E5900 07S1600	32	800.0000	FB	59.46	20.00

Fixed service Interference calculations

- FX2FX (link): calculate interference from stations of different point – to – point hops on each other in accordance with recommendation ITU-R P.452, by consideration of antenna radiation patterns and XPD .
- FX2FX (station): calculates interference from fixed stations to each other in accordance with recommendation ITU-R P.452, by consideration of antenna patterns and NFD (Net Filter Discrimination).
- For FX2FX (link) system calculates interference based on sensitivity of victim receiver and received interference level .

P.452 FX2FX : Interference from the Wanted Hop to the Selected Hop(s)

Wanted Hop (Tx):

No.	TxName	TxLocation	RxName	RxLocation	Freq(MHz)
1	MTN LINK1	029E1530 17N5530	MTN LNK11	029E2430 17N4900	7000.0000

Selected Hop(s) (Rx):

No.	TxLocation	RxName	RxLocation	IntDist(km)	PathLoss(dB)	I-S(dB)	I(dBm)	S(dBm)
1	029E2800 18N0730	sudatel link3	029E5200 18N0300	66	158.67	3.47	-112.64	-116.11
2	029E5200 18N0300	Sudatel link1	029E2800 18N0730	31	143.55	18.59	-97.52	-116.11

Fixed service Interference calculations

- FX2FX (station) system calculates in Threshold Degradation (TD) of the wanted station due to the occurrence of the interference.

P.452 FX2FX : FX above 1 GHz Interference Calculation

Wanted Station :

No.	ID	Name	Country	Location	Frq(MHz)
1	44	Sudatel link1	SDN	029E2800 18N0730	7000.0000

Interference to :

No.	ID	Name	Country	Location	Dist(km)	Frq(MHz)	I(dBW)	TD(dB)	TD(dB)-0.2	Pa
1	42	MTN LINK1	SDN	029E1530 17N5530	31	7000.0000	-133.120	31.57	31.37	Tr
2	43	MTN LNK11	SDN	029E2430 17N4900	35	7000.0000	-154.446	10.63	10.43	Tr
3	45	sudatel link3	SDN	029E5200 18N0300	43	7000.0000	-128.000	36.68	36.48	Tr

Intermodulation interference

- Intermodulation interference is the undesired combining of several signals in a nonlinear device , e.g. at semiconductors, klystrons, ..etc, and in passive devices like combiners, circulators, connectors, etc. producing new, unwanted frequencies, which can cause interference in adjacent receivers.
- If two signals at frequencies f1 and f2, the nonlinearity would give rise to additional output components at f2 + f1 and f2 – f1 known as the second-order intermodulation products. These second-order products will mix with the original signals to produce third-order intermodulation products of frequencies 2f1 + f2, 2f1

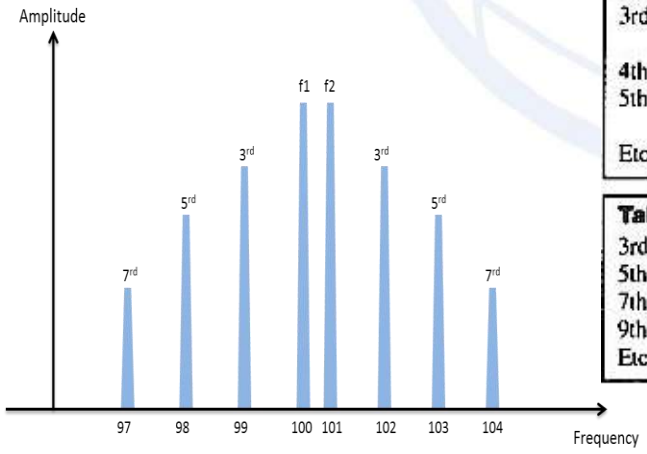


Table 1 – Intermodulation Products

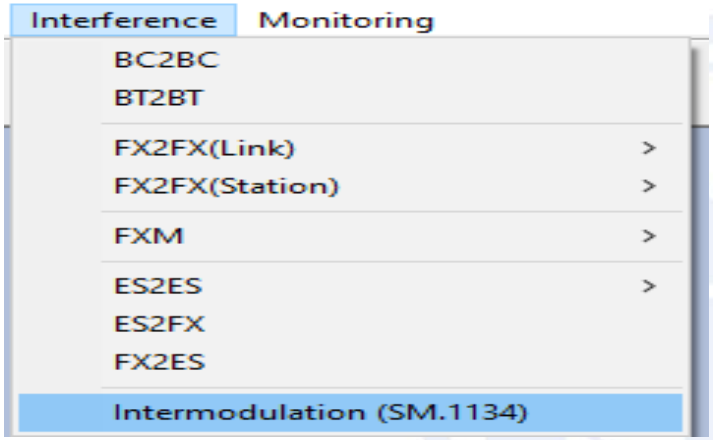
1st Order	f1,	f2	100 kHz	101 kHz
2nd Order	f1+f2,	f2-f1	201 kHz	1 kHz
3rd Order	2f1-f2,	2f2-f1	99 kHz	102 kHz
	2f1+f2,	2f2+f1	301 kHz	302 kHz
4th Order	2f2+2f1,	2f2-2f1	402 kHz	2 kHz
5th Order	3f1-2f2,	3f2-2f1	98 kHz	103 kHz
	3f1+2f2,	3f2+2f1	502 kHz	503 kHz
Etc.				

Table 2 – Odd Order Products

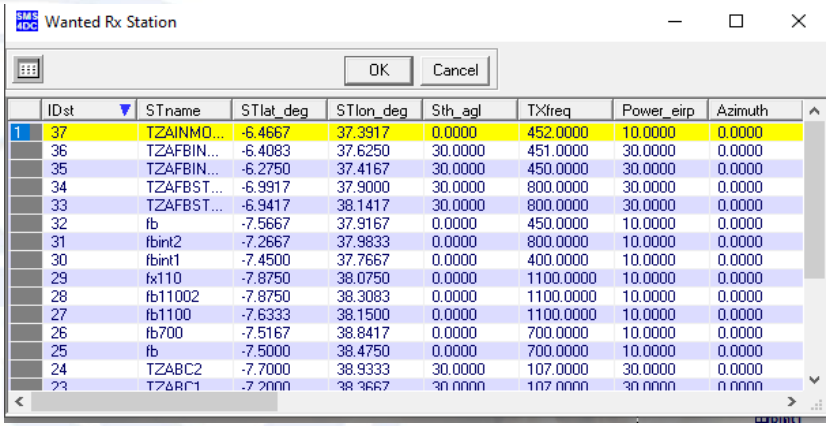
3rd Order	2f1-f2,	2f2-f1	99 kHz	102 kHz
5th Order	3f1-2f2,	3f2-2f1	98 kHz	103 kHz
7th Order	4f1-3f2,	4f2-3f1	97 kHz	104 kHz
9th Order	5f1-4f2,	5f2-4f1	96 kHz	105 kHz
Etc.				

Intermodulation interference

1

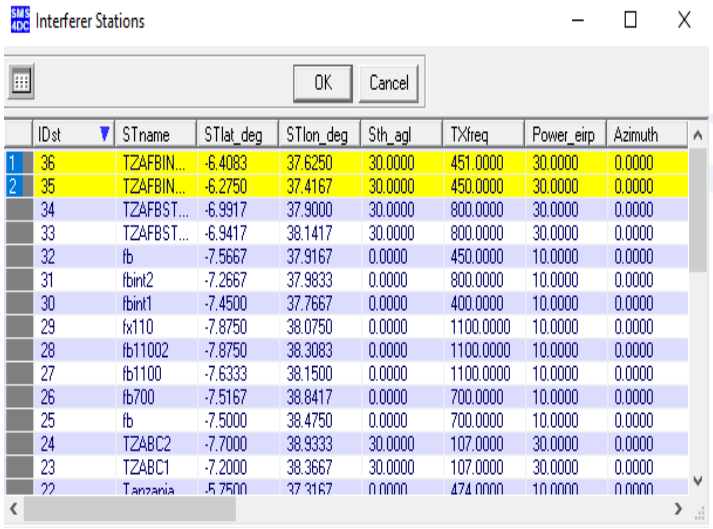


2 Select a wanted receiving station



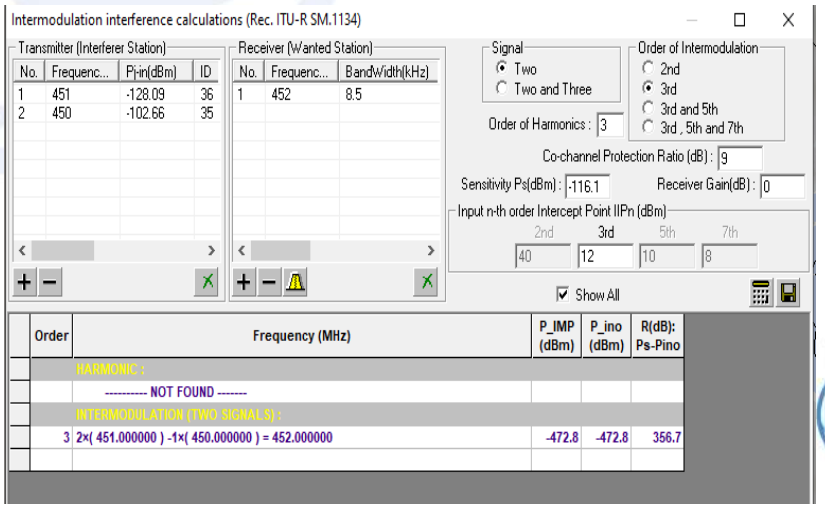
	IDst	STname	STlat_deg	STlon_deg	Sth_agl	TXfreq	Power_eirp	Azimuth
1	37	TZAINMO...	-6.4667	37.3917	0.0000	452.0000	10.0000	0.0000
	36	TZAFBIN...	-6.4083	37.6250	30.0000	451.0000	30.0000	0.0000
	35	TZAFBIN...	-6.2750	37.4167	30.0000	450.0000	30.0000	0.0000
	34	TZAFBST...	-6.9917	37.9000	30.0000	800.0000	30.0000	0.0000
	33	TZAFBST...	-6.9417	38.1417	30.0000	800.0000	30.0000	0.0000
	32	fb	-7.5667	37.9167	0.0000	450.0000	10.0000	0.0000
	31	fbint2	-7.2667	37.9833	0.0000	800.0000	10.0000	0.0000
	30	fbint1	-7.4500	37.7667	0.0000	400.0000	10.0000	0.0000
	29	fx110	-7.8750	38.0750	0.0000	1100.0000	10.0000	0.0000
	28	fb11002	-7.8750	38.3083	0.0000	1100.0000	10.0000	0.0000
	27	fb1100	-7.6333	38.1500	0.0000	1100.0000	10.0000	0.0000
	26	fb700	-7.5167	38.8417	0.0000	700.0000	10.0000	0.0000
	25	fb	-7.5000	38.4750	0.0000	700.0000	10.0000	0.0000
	24	TZABC2	-7.7000	38.9333	30.0000	107.0000	30.0000	0.0000
	23	TZABC1	-7.2000	38.3667	30.0000	107.0000	30.0000	0.0000

2 Select some or all interferer stations



	IDst	STname	STlat_deg	STlon_deg	Sth_agl	TXfreq	Power_eirp	Azimuth
1	36	TZAFBIN...	-6.4083	37.6250	30.0000	451.0000	30.0000	0.0000
2	35	TZAFBIN...	-6.2750	37.4167	30.0000	450.0000	30.0000	0.0000
	34	TZAFBST...	-6.9917	37.9000	30.0000	800.0000	30.0000	0.0000
	33	TZAFBST...	-6.9417	38.1417	30.0000	800.0000	30.0000	0.0000
	32	fb	-7.5667	37.9167	0.0000	450.0000	10.0000	0.0000
	31	fbint2	-7.2667	37.9833	0.0000	800.0000	10.0000	0.0000
	30	fbint1	-7.4500	37.7667	0.0000	400.0000	10.0000	0.0000
	29	fx110	-7.8750	38.0750	0.0000	1100.0000	10.0000	0.0000
	28	fb11002	-7.8750	38.3083	0.0000	1100.0000	10.0000	0.0000
	27	fb1100	-7.6333	38.1500	0.0000	1100.0000	10.0000	0.0000
	26	fb700	-7.5167	38.8417	0.0000	700.0000	10.0000	0.0000
	25	fb	-7.5000	38.4750	0.0000	700.0000	10.0000	0.0000
	24	TZABC2	-7.7000	38.9333	30.0000	107.0000	30.0000	0.0000
	23	TZABC1	-7.2000	38.3667	30.0000	107.0000	30.0000	0.0000
	22	Tanzania	-5.7500	37.3167	0.0000	474.0000	10.0000	0.0000

3 Intermodulation results

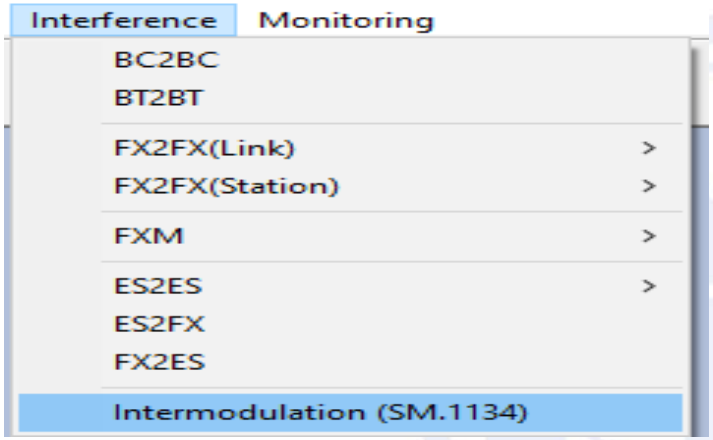


No.	Frequenc...	Pi-in(dBm)	ID
1	451	-128.09	36
2	450	-102.66	35

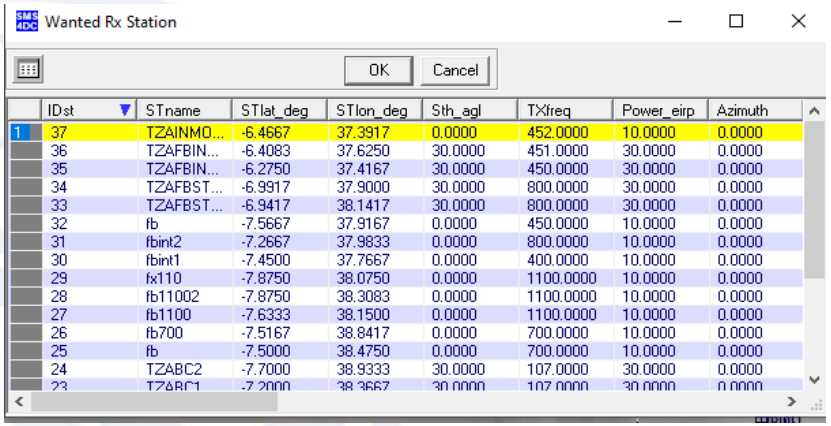
No.	Frequenc...	BandWidth(kHz)
1	452	8.5

Intermodulation interference

1

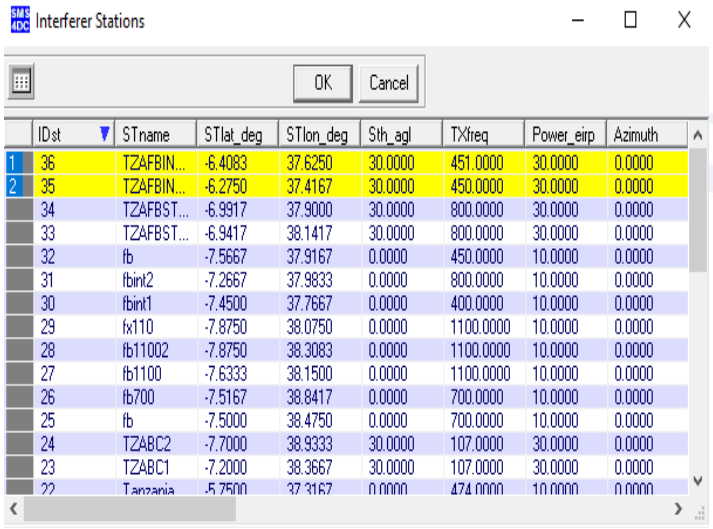


2 Select a wanted receiving station



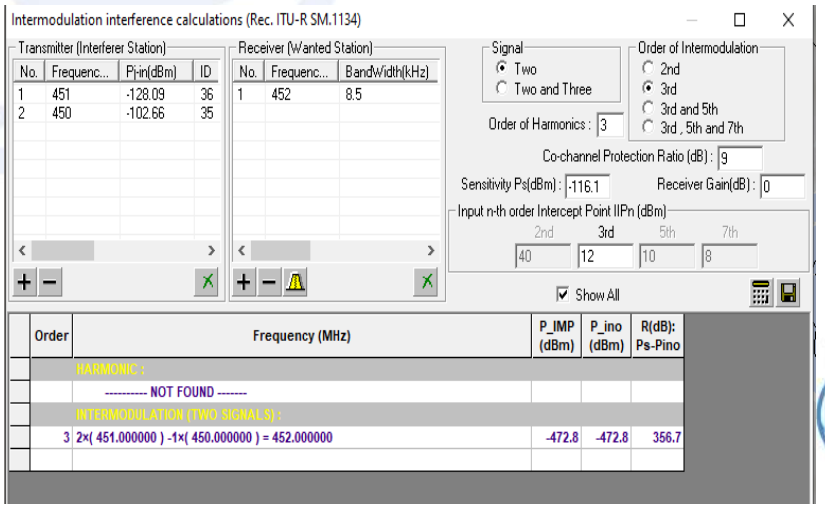
	IDst	STname	STlat_deg	STlon_deg	Sth_agl	TXfreq	Power_eirp	Azimuth
1	37	TZAINMO...	-6.4667	37.3917	0.0000	452.0000	10.0000	0.0000
	36	TZAFBIN...	-6.4083	37.6250	30.0000	451.0000	30.0000	0.0000
	35	TZAFBIN...	-6.2750	37.4167	30.0000	450.0000	30.0000	0.0000
	34	TZAFBST...	-6.9917	37.9000	30.0000	800.0000	30.0000	0.0000
	33	TZAFBST...	-6.9417	38.1417	30.0000	800.0000	30.0000	0.0000
	32	fb	-7.5667	37.9167	0.0000	450.0000	10.0000	0.0000
	31	fbint2	-7.2667	37.9833	0.0000	800.0000	10.0000	0.0000
	30	fbint1	-7.4500	37.7667	0.0000	400.0000	10.0000	0.0000
	29	fx110	-7.8750	38.0750	0.0000	1100.0000	10.0000	0.0000
	28	fb11002	-7.8750	38.3083	0.0000	1100.0000	10.0000	0.0000
	27	fb1100	-7.6333	38.1500	0.0000	1100.0000	10.0000	0.0000
	26	fb700	-7.5167	38.8417	0.0000	700.0000	10.0000	0.0000
	25	fb	-7.5000	38.4750	0.0000	700.0000	10.0000	0.0000
	24	TZABC2	-7.7000	38.9333	30.0000	107.0000	30.0000	0.0000
	23	TZABC1	-7.2000	38.3667	30.0000	107.0000	30.0000	0.0000

2 Select some or all interferer stations



	IDst	STname	STlat_deg	STlon_deg	Sth_agl	TXfreq	Power_eirp	Azimuth
1	36	TZAFBIN...	-6.4083	37.6250	30.0000	451.0000	30.0000	0.0000
2	35	TZAFBIN...	-6.2750	37.4167	30.0000	450.0000	30.0000	0.0000
	34	TZAFBST...	-6.9917	37.9000	30.0000	800.0000	30.0000	0.0000
	33	TZAFBST...	-6.9417	38.1417	30.0000	800.0000	30.0000	0.0000
	32	fb	-7.5667	37.9167	0.0000	450.0000	10.0000	0.0000
	31	fbint2	-7.2667	37.9833	0.0000	800.0000	10.0000	0.0000
	30	fbint1	-7.4500	37.7667	0.0000	400.0000	10.0000	0.0000
	29	fx110	-7.8750	38.0750	0.0000	1100.0000	10.0000	0.0000
	28	fb11002	-7.8750	38.3083	0.0000	1100.0000	10.0000	0.0000
	27	fb1100	-7.6333	38.1500	0.0000	1100.0000	10.0000	0.0000
	26	fb700	-7.5167	38.8417	0.0000	700.0000	10.0000	0.0000
	25	fb	-7.5000	38.4750	0.0000	700.0000	10.0000	0.0000
	24	TZABC2	-7.7000	38.9333	30.0000	107.0000	30.0000	0.0000
	23	TZABC1	-7.2000	38.3667	30.0000	107.0000	30.0000	0.0000
	22	Tanzania	-5.7500	37.3167	0.0000	474.0000	10.0000	0.0000

3 Intermodulation results



No.	Frequenc...	Pi-in(dBm)	ID
1	451	-128.09	36
2	450	-102.66	35

No.	Frequenc...	BandWidth(kHz)
1	452	8.5

Practice and exercise

Thank you!

PRIDA Track 1 (T1)

ON-LINE English capacity building workshop

Frequency assignment

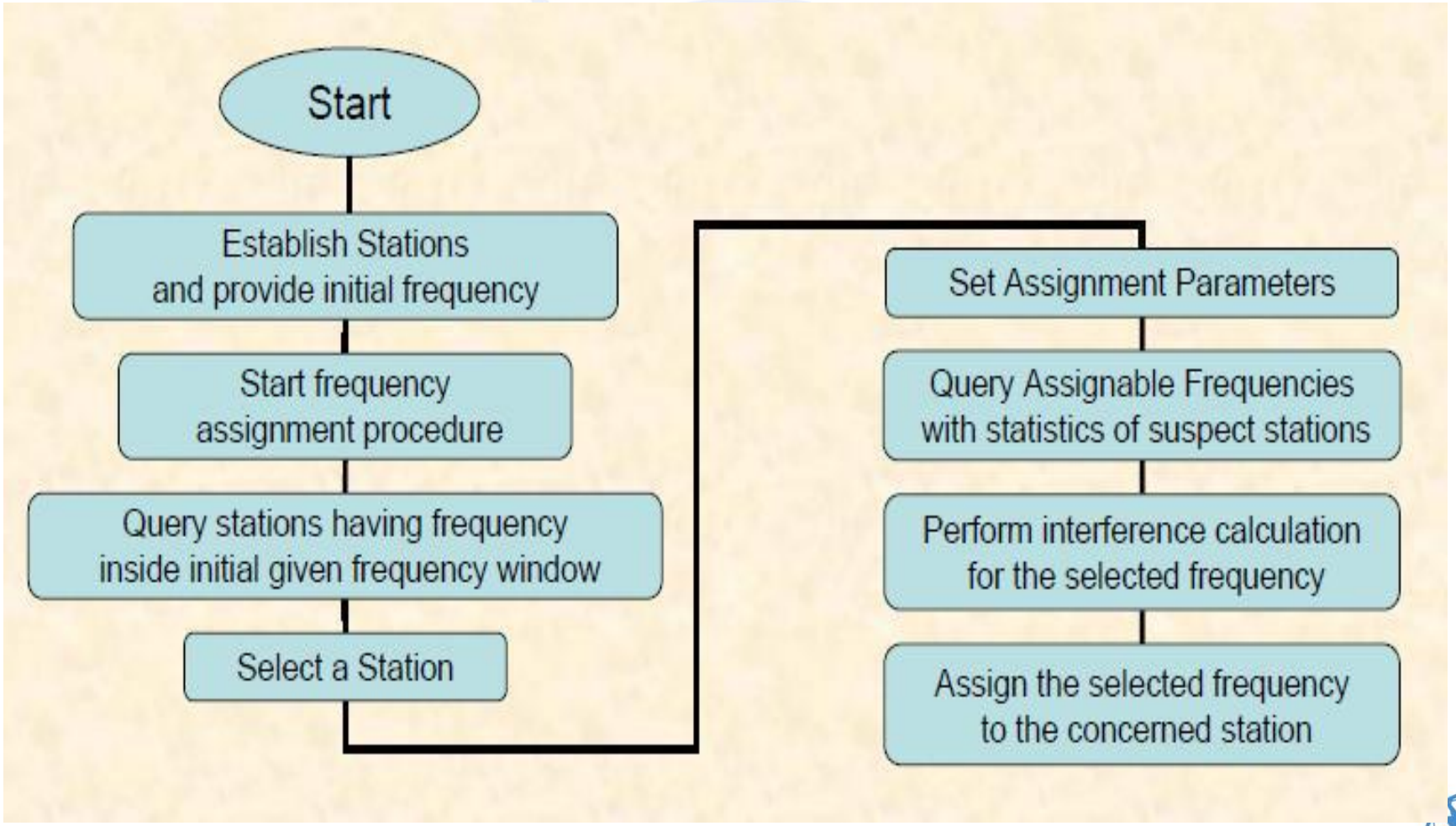
April 20 - May 1, 2020

Yasir Ahmed
ITU expert
Email: Yasir192@gmail.com

Frequency assignment

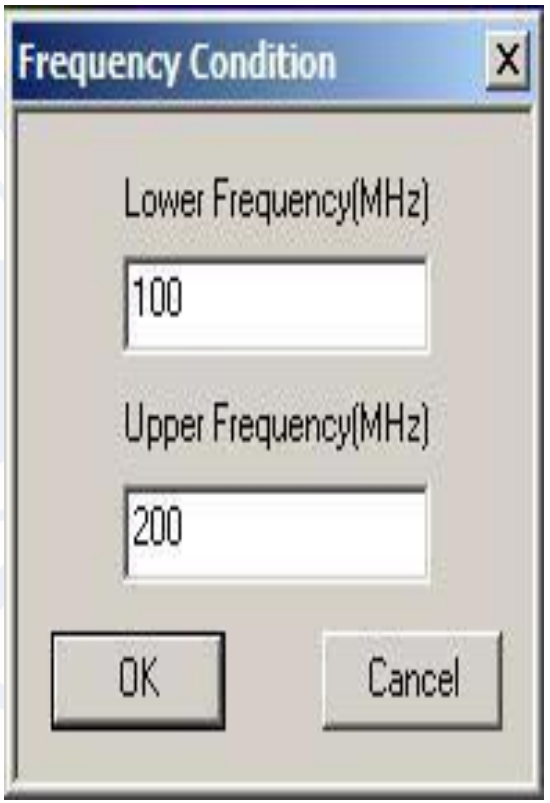
- SMS4DC is powered by an advanced method of frequency assignment
- based on interference calculations to/from any other stations (in these services) in a given frequency band inside a circular search area
- This procedure is implemented in the item “Frequency Allocations->Frequency Assignment”
- The procedure starts by selecting from a list of stations the national station for which a transmitting frequency assignment has been requested.
- after comprehensive interference analysis, SMS4DC will suggest a suitable frequencies for assignment

Frequency assignment process



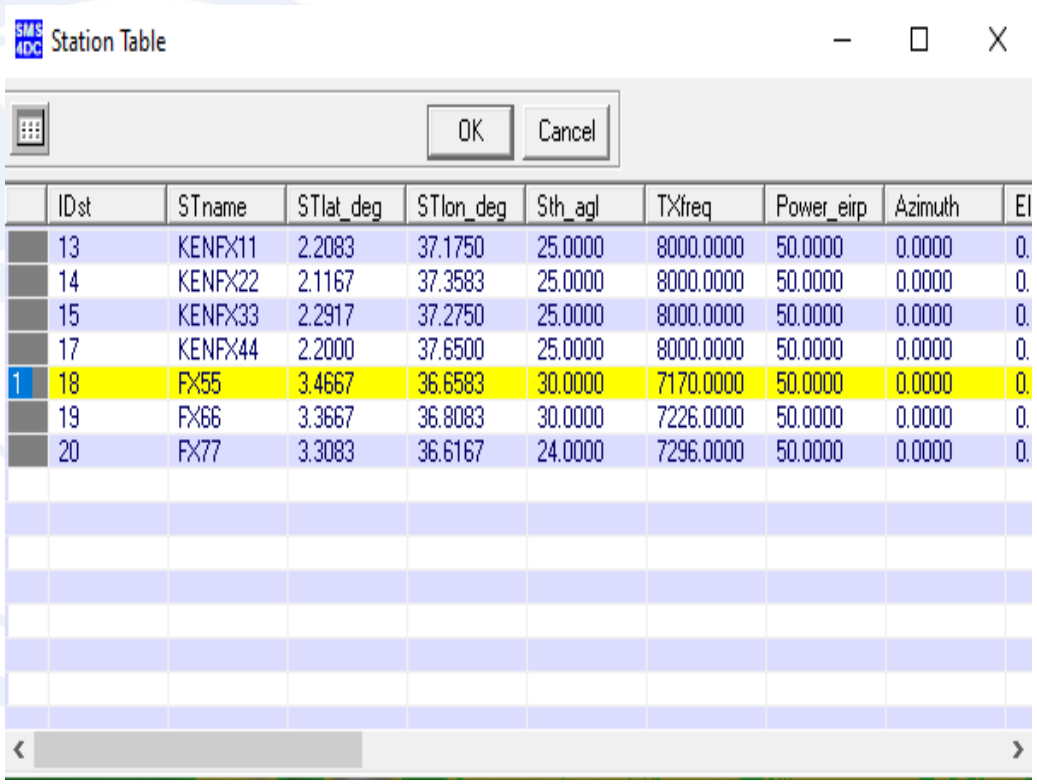
Frequency assignment process

- Since the number of national stations stored in the local database may become thousands, SMS4DC makes it easier to find the concerned station by applying a frequency condition (filter). This filter shortens the list to show only those stations within a limited frequency range specified to include the concerned station.



Frequency assignment process

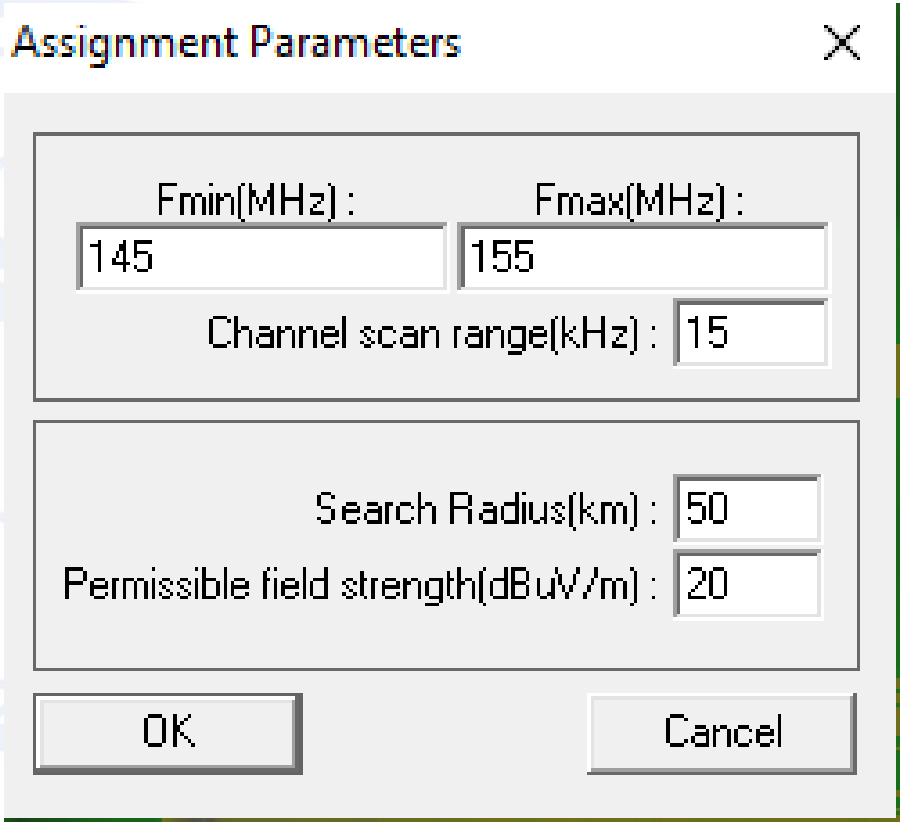
- Dialogue box is opened for the user to define the frequency range in which an assignment is required and thereby limit the number of stations listed in the station selection spreadsheet.
- Selection of a station can be made by a left click on the record-select column of the concerned row



	IDst	STname	STlat_deg	STlon_deg	Sth_agl	TXfreq	Power_eirp	Azimuth	El
	13	KENFX11	2.2083	37.1750	25.0000	8000.0000	50.0000	0.0000	0.
	14	KENFX22	2.1167	37.3583	25.0000	8000.0000	50.0000	0.0000	0.
	15	KENFX33	2.2917	37.2750	25.0000	8000.0000	50.0000	0.0000	0.
	17	KENFX44	2.2000	37.6500	25.0000	8000.0000	50.0000	0.0000	0.
1	18	FX55	3.4667	36.6583	30.0000	7170.0000	50.0000	0.0000	0.
	19	FX66	3.3667	36.8083	30.0000	7226.0000	50.0000	0.0000	0.
	20	FX77	3.3083	36.6167	24.0000	7296.0000	50.0000	0.0000	0.

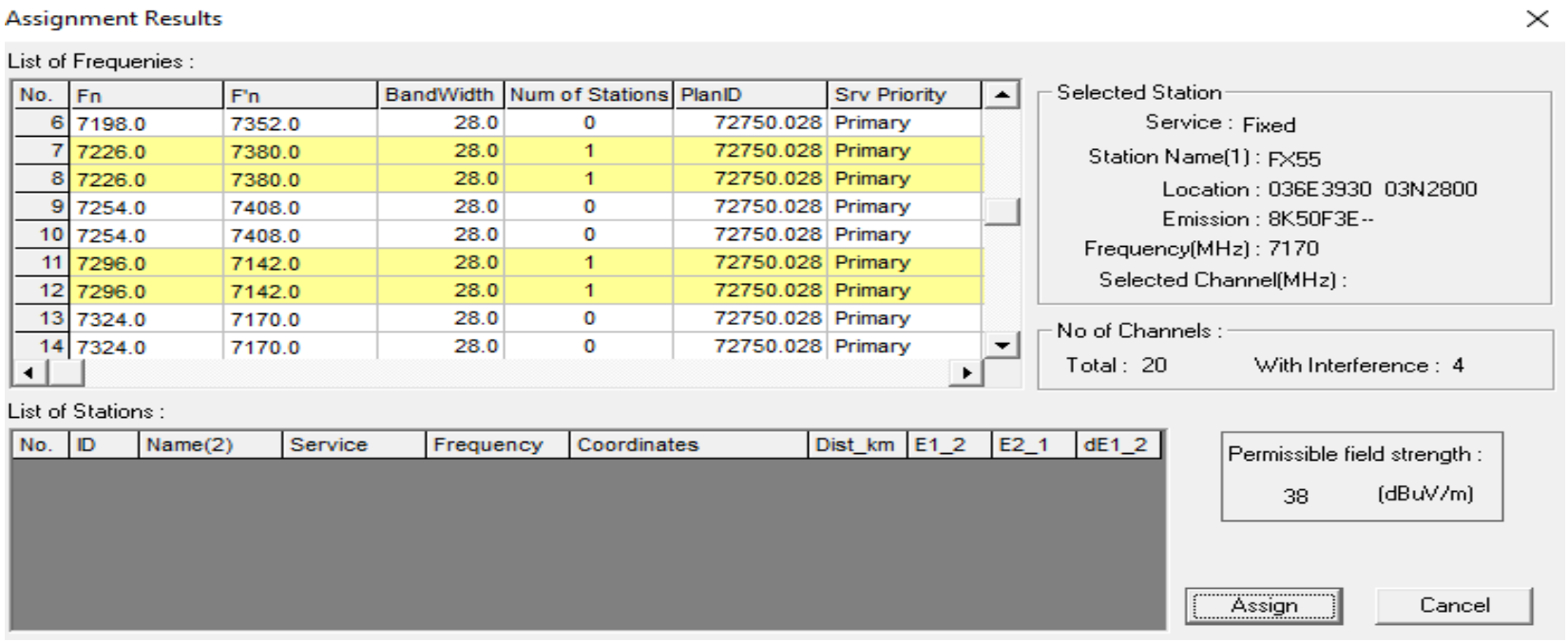
Frequency assignment process

- The assignment algorithm searches for suitable channels to assign within any channel plan arrangement in the range between Fmin and Fmax.
- Then, all existing stations within the “Channel Scan Range” of each channel in that plan and within the search radius specified are examined for potential interference.



Frequency assignment process

- Once the assignment parameters have been set, all frequencies available within those parameters are examined for potential interference and the results are displayed in the result dialogue box.

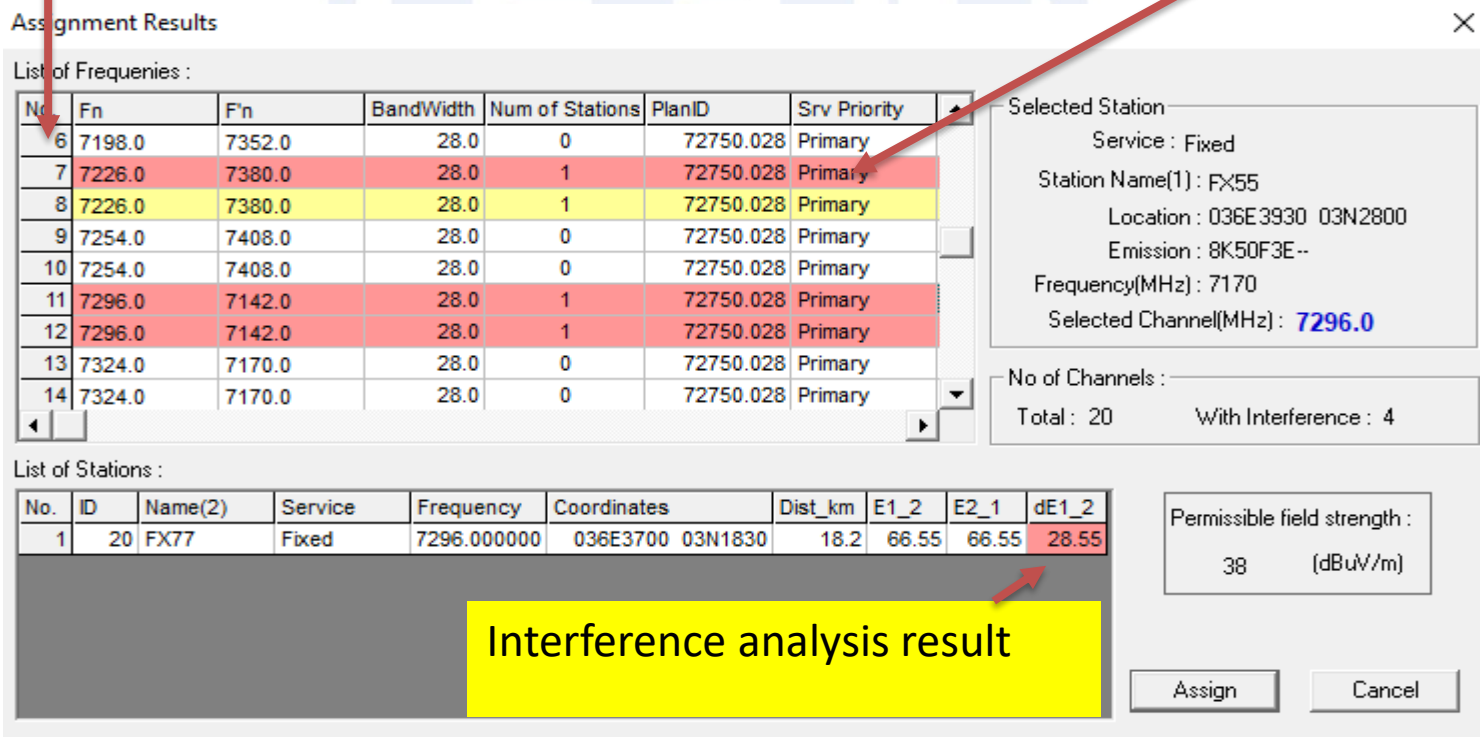


Frequency assignment process

- Choosing any row with yellow highlight from the list of frequencies by a mouse double left-click, initiates detailed interference calculations.

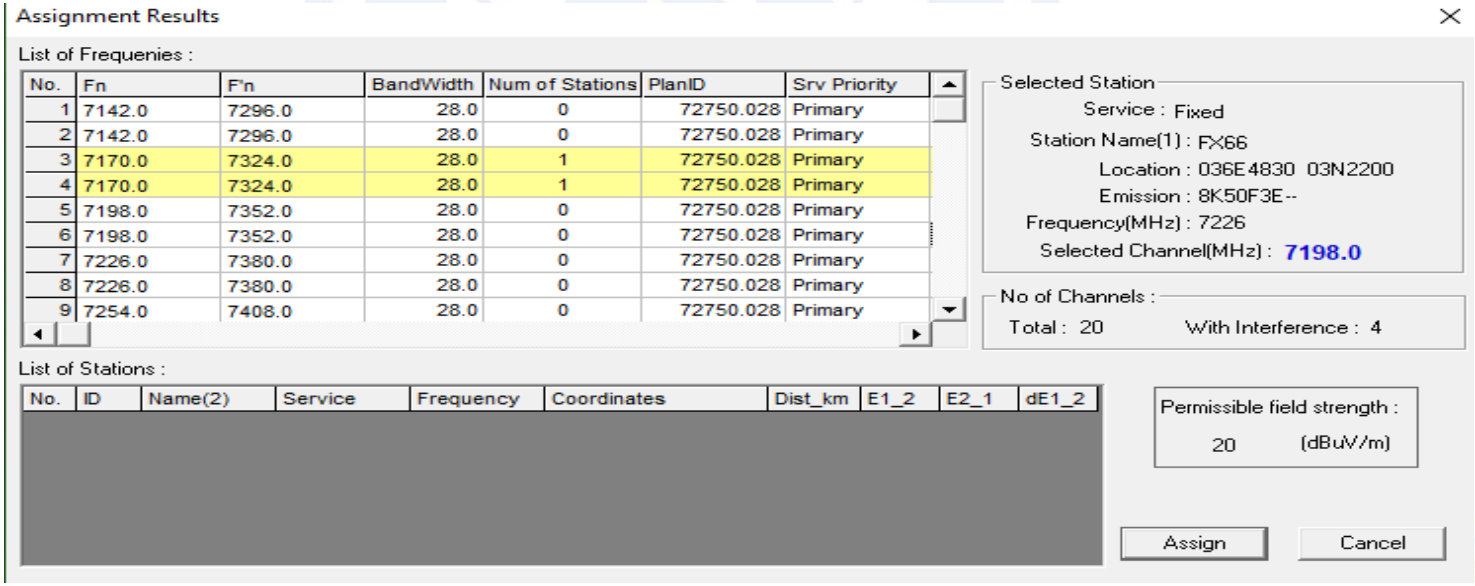
Double click to select the frequency for further analysis

Frequency may cause or receive interference



Frequency assignment process

- After considering the results, a suitable frequency for assignment may be selected by a double right mouse click on the “No.” (channel number) column and the row for the frequency to be selected.
- Once the “Assign” push button is used, the selected transmitting frequency in the list and its corresponding receiving frequency will be assigned to the concerned station



Thank you!