

SMS4DC

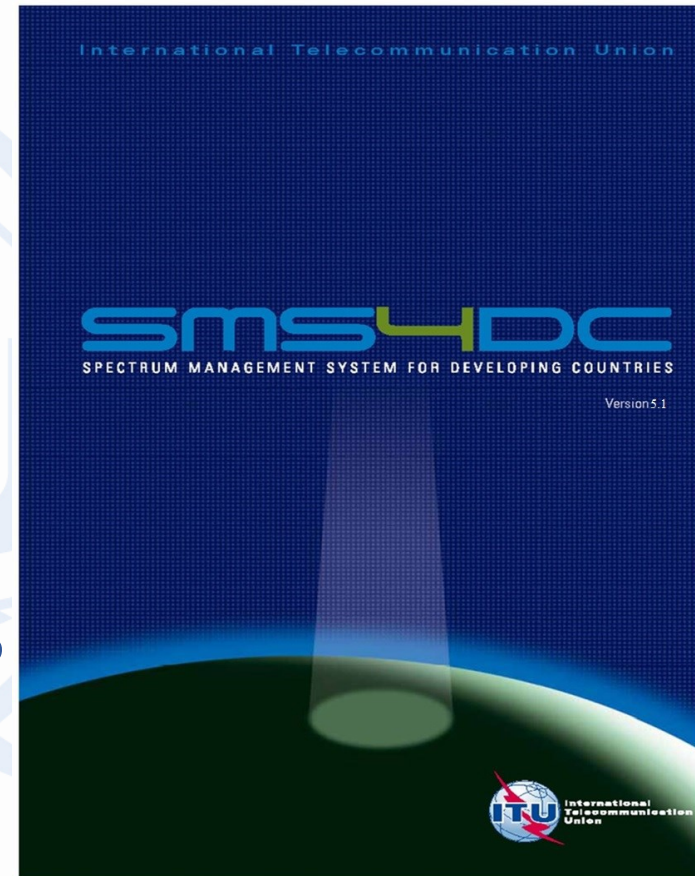


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ITU Spectrum Management System for Developing Countries (SMS4DC)



- 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



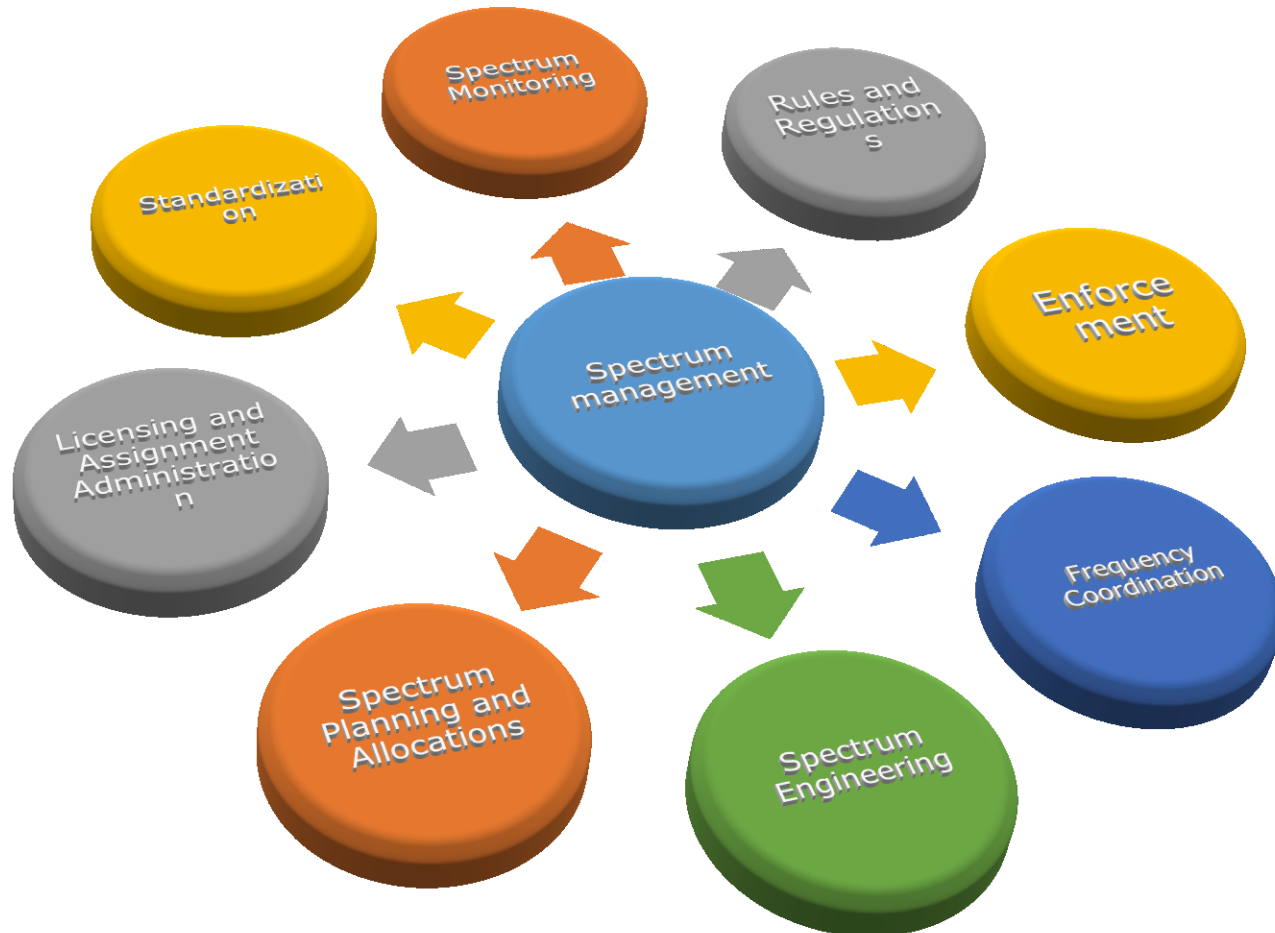


Computer aided spectrum management

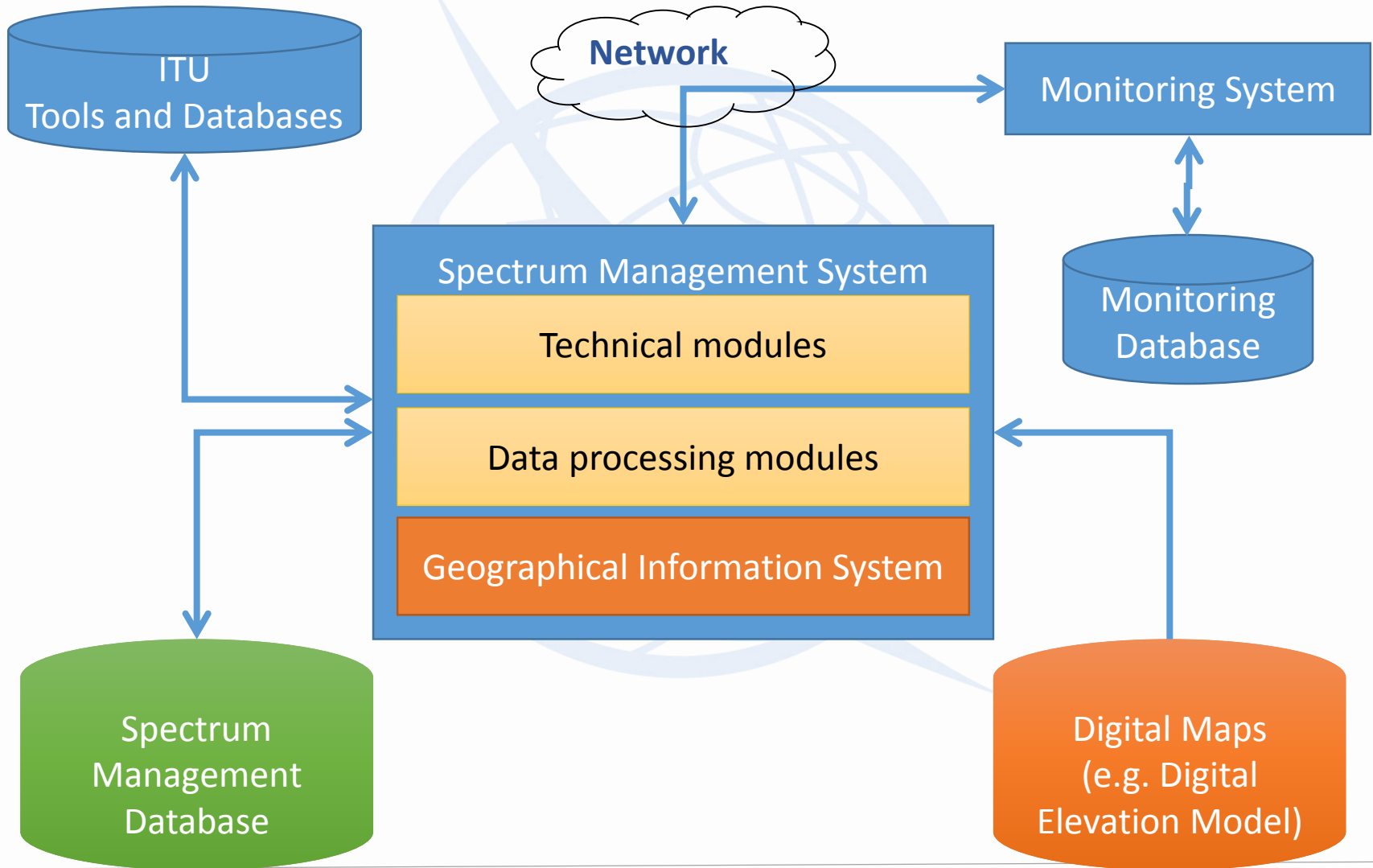
- The use of computers in the spectrum management process has become crucial for most administrations that are faced with the ever-increasing use of the radio frequencies.
- Several aspects of this process, such as frequency coordination, administrative procedures (registration and issuing of licenses) 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, *New*)
<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



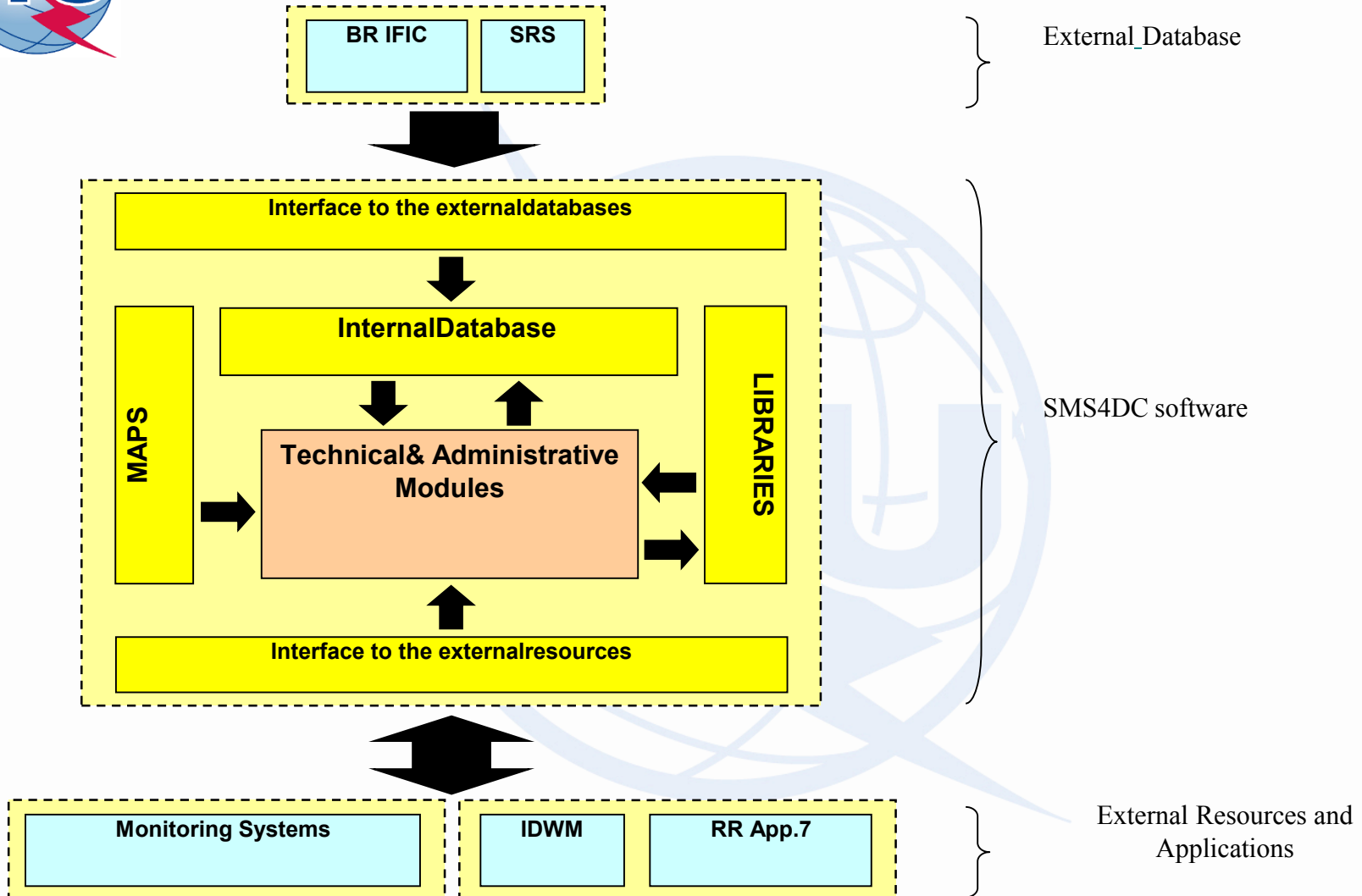
SMS4DC Development Cycle



- **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)*
- **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).*
- **2017:** *SMS4DC Version 5.1 (WRC-15 Article 5, HCM)*



Structure of the SMS4DC



Functions of SMS4DC

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

Administrative Functions of SMS4DC



- 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;
- 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.*

SMS4DC Configuration



Single user

Workstation



- Main application
- Database
- Reports
- Maps

Multi user



Server

- Database
- Reports
- Maps

Workstation B



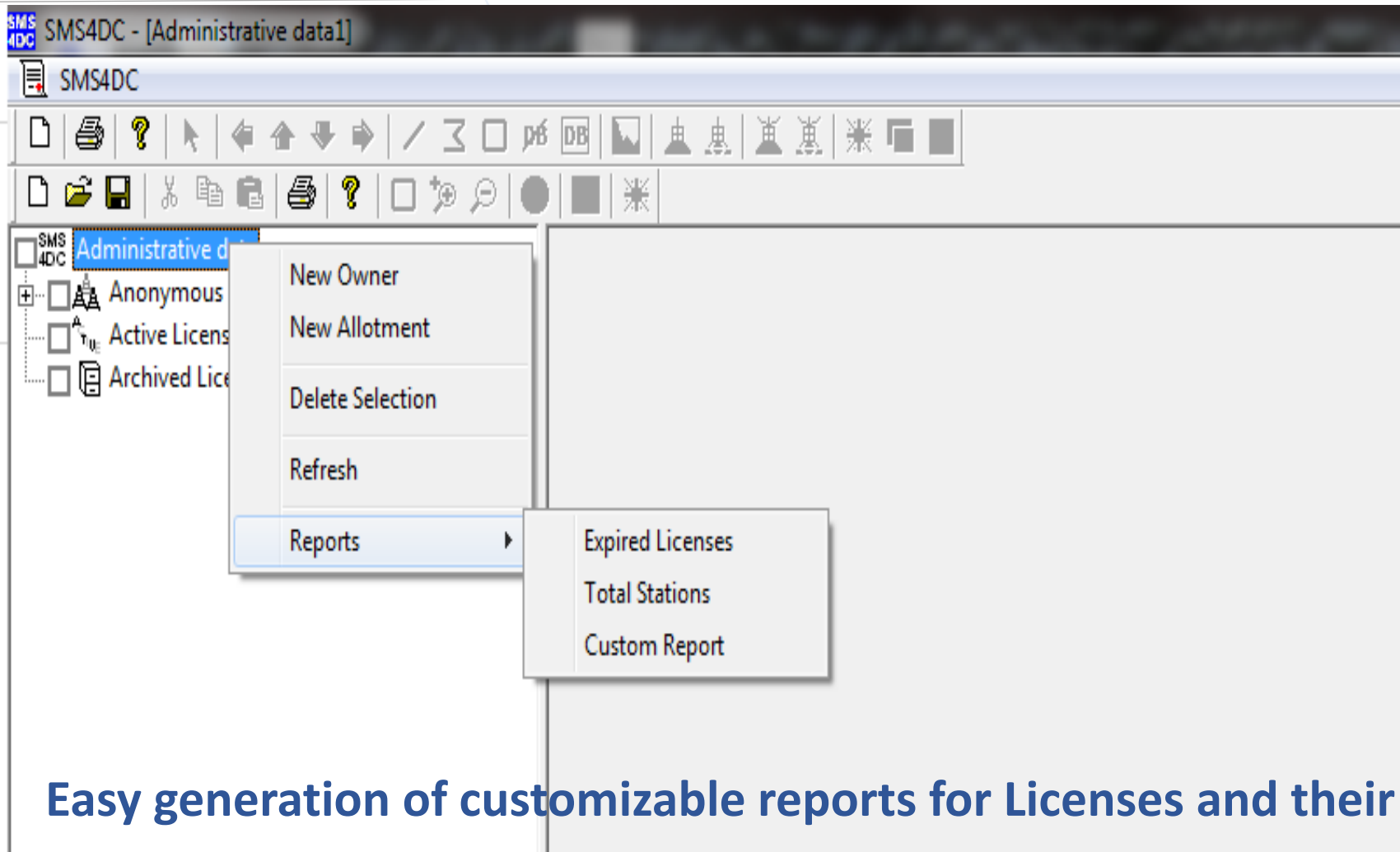
-Main application

Workstation A



-Main application

SMS4DC License Database GUI

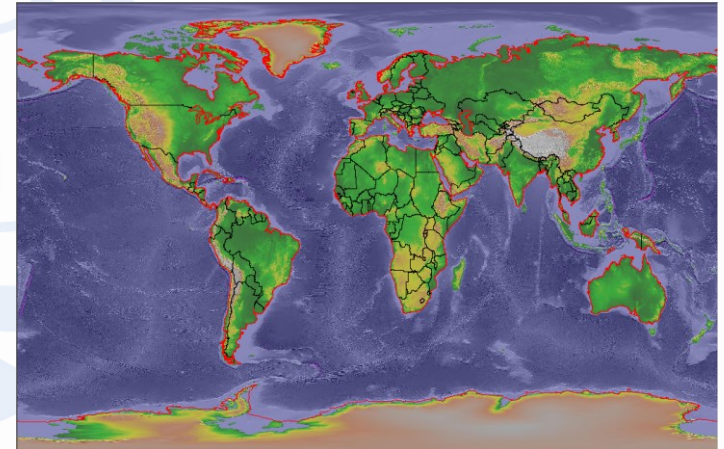


Easy generation of customizable reports for Licenses and their status

GIS Functions of SMS4DC



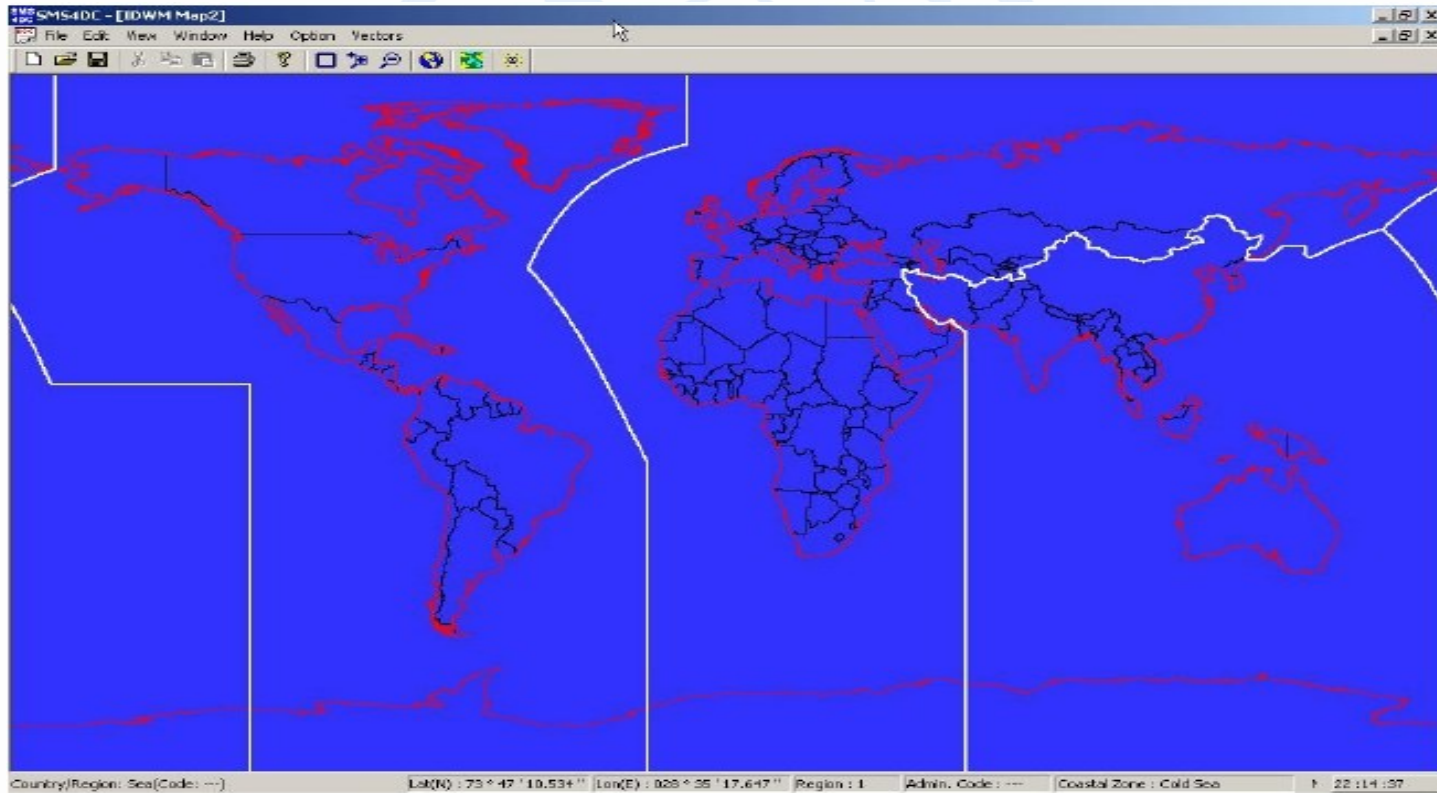
- **User friendly interface with text menus and icon-tool bars;**
- **Display views**
 - *International Digital World Map (IDWM)*
 - *Digital Elevation Map (DEM) (2-D and 3-D)*
- **Data entry/Assigning of new stations on DEM by mouse point-and-click**
- **Export of maps, overlays and vectors to Google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



GIS Functions of SMS4DC



IDWM Menu: The IDWM is used to draw political boundaries of countries on the desktop of SMS4DC



GIS Functions of SMS4DC

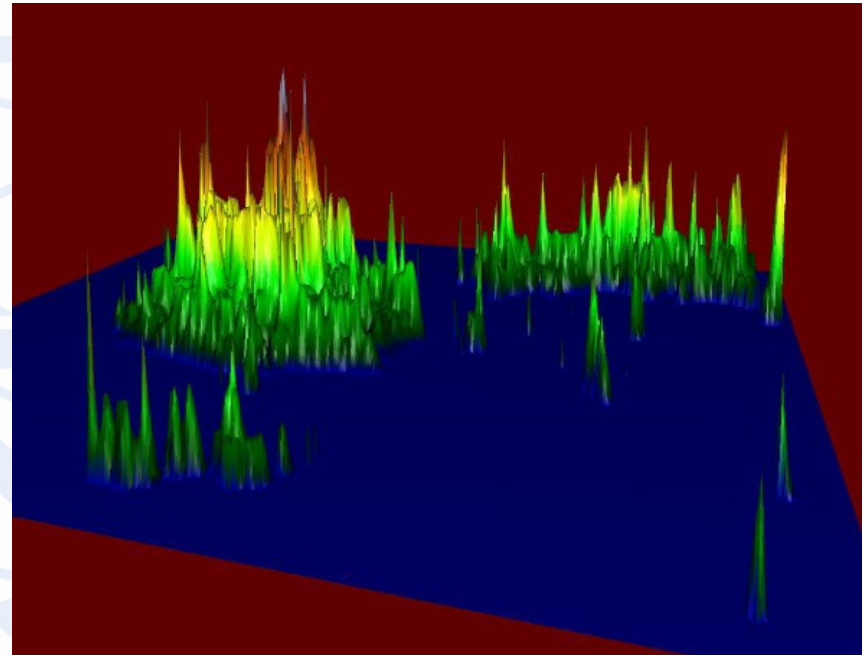
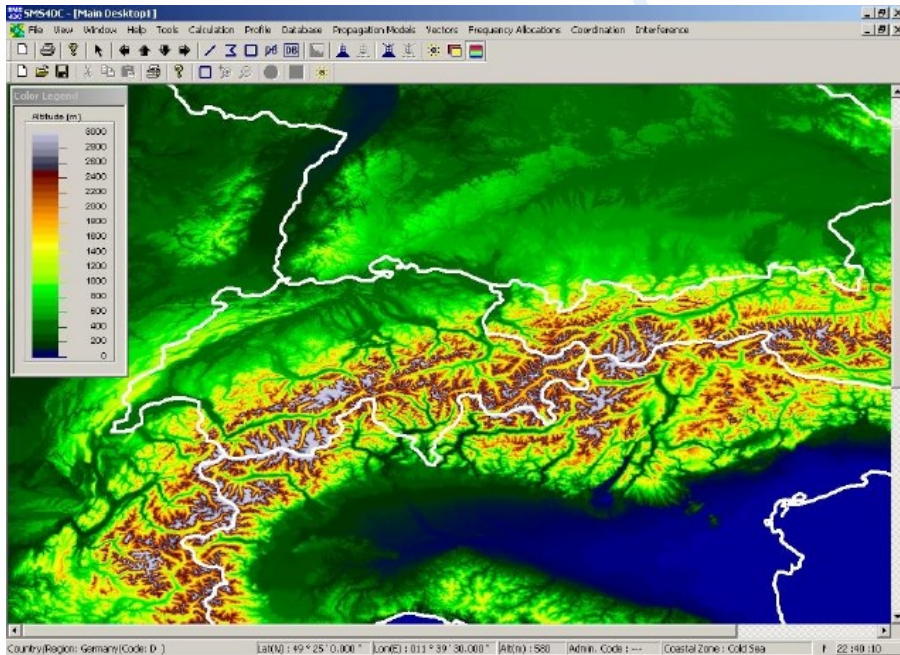


The screenshot displays the main menu bar of the SMS4DC software, which includes 'Database', 'Propagation Models', and 'Vectors'. Below the menu bar, three context menus are shown, each with arrows pointing to its corresponding menu item in the main bar:

- Database Menu:** Contains options such as 'Display Selected Station(s)', 'Station(s) in Desktop', 'Move Station', 'Add Station', 'Search Station', 'Remove Station(s) from Display', 'Display Links', 'Import from IFIC', 'Import from SRS', 'Licensing', 'Audit Trail', 'Users', 'Backup', 'Display Selected Earth Station(s)', 'Earth Station(s) in Desktop', 'Move Earth Station', 'Add Earth Station', 'Search Earth Station', 'Remove Earth Station(s) from Display', 'Display Receiving Area', 'Display Service Area(FXM)', 'Display Service Area(GE06 BC,BT)', 'Display Allotment Area', 'Define Allotment Area', 'Display GE06 Plan Entry', and 'Display Converted Assignment(s)'.
- Propagation Models Menu:** Contains options such as 'Free Space', 'Line of Sight', 'Former P. 370', 'P. 1546', 'Okumura-Hata', 'P. 526 (Diffraction)', 'P. 526 (Smooth Earth)', 'P. 452', 'P. 530', 'P. 618', and 'Overlay'.
- Vectors Menu:** Contains options such as 'Draw Circle', 'Draw from File', 'Draw Country Border', 'Remove from Display', and 'Vector Handling'.

Digital Elevation Model (DEM) Menu

GIS Functions of SMS4DC



**Digital Elevation Model
(DEM) 2D and 3D views**

Map Display in 3D

**Based on the Global Land One- kilometer Base Elevation model
(GLOBE)**

GIS Functions of SMS4DC



The screenshot shows the Google Earth interface with a 'Link Table' window and a 'Save As' dialog box. The 'Link Table' window contains the following data:

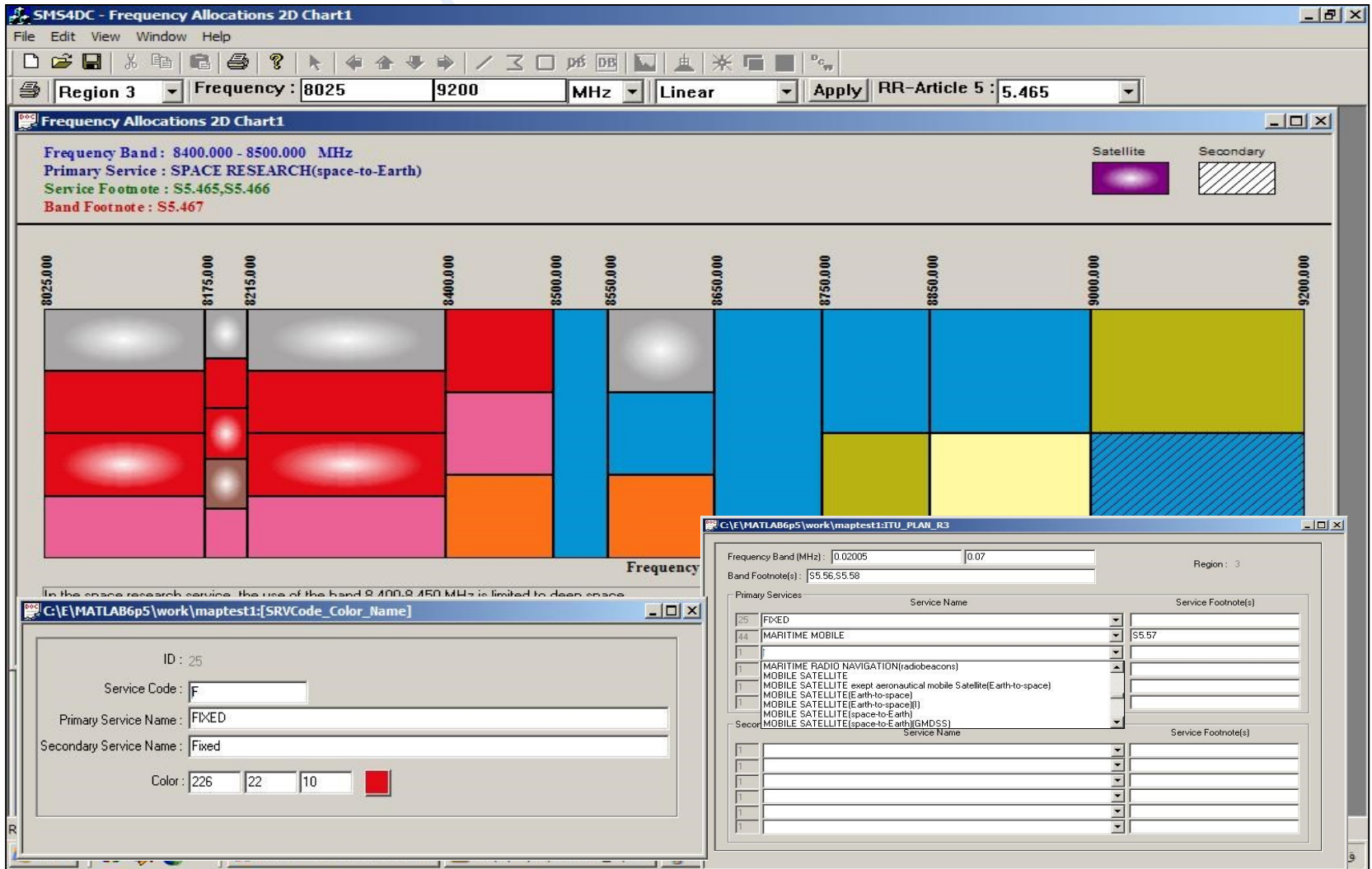
HopID	TxID	TxName	TxLat
3	27	EUPEN	50
4	29	EUPEN	50
5	31	EUPEN	50
6	33	EUPEN	50
9	53	Boukhouali	34
10	55	ZAGORA 1	30

The 'Save As' dialog box shows the file name 'Links.kml' and the save location 'Reports'. The map displays various stations and geographical features, including 'DON BENITO', 'DESIERTO', 'MEHDIA', 'Gibraltar', 'Tanger', 'Málaga', 'Seville', 'Andalucía (Andalusia)', 'Castilla-La Mancha', 'Valencia', and 'Alboran Sea'. The map also shows a DEM overlay and a yellow line representing a path or boundary.

Export of maps, overlays and vectors to **Google Earth** Searching and displaying stations on DEM)

SMS4DC's Engineering Functions

International & National frequency allocations table (chart)



SMS4DC's Engineering Functions

Frequency arrangement (Homogeneous)

The screenshot shows the 'Frequency Plan' window with the following configuration:

- ID : 1
- Frequency Plan ID : 382480.13
- Region : Region 3
- Service Priority : Primary
- Service : Fixed
- Type of Frequency Plan : Homogeneous
- Equation: $F_n = F_o + F_{off} + n \cdot X_S$, $F'_n = F_o + F'_{off} + n \cdot X_S$
- Channel Spacing X_S : 130 MHz
- Reference Frequency F_o : 38248 MHz
- Lower Frequency Offset F_{off} : -1260 MHz
- Upper Frequency Offset F'_{off} : 0 MHz
- Number of Channels n : 40
- First : 1, Last : 40, Channel Set : All
- Comment : CEPT Channel arrangement in 38 GHz Band-Homogeneous

The Frequency List table is as follows:

No	F_n	F'_n	BandWidth
1	36988	38248	130
2	37118	38378	130
3	37248	38508	130
4	37378	38638	130
5	37508	38768	130
6	37638	38898	130
7	37768	39028	130
8	37898	39158	130
9	38028	39288	130
10	38158	39418	130
11	38288	39548	130
12	38418	39678	130
13	38548	39808	130
14	38678	39938	130
15	38808	40068	130

SMS4DC's Engineering Functions

Frequency assignment parameters & EMC analysis results

Assignment Parameters

Fmin(MHz): Fmax(MHz):

Channel scan range(kHz):

Search Radius(km):

Permissible field strength(dBuV/m):

(a) Frequency assignment parameters

Assignment Results

List of Frequencies :

No	F _n	F' _n	BandWidth	Num of Stations	PlanID	Srv Priority
1	148.0125	150.0125	0.0125	0	1490.0000125	Primary
2	148.025	150.025	0.0125	0	1490.0000125	Primary
3	148.0375	150.0375	0.0125	1	1490.0000125	Primary
4	148.05	150.05	0.0125	2	1490.0000125	Primary
5	148.0625	150.0625	0.0125	3	1490.0000125	Primary
6	148.075	150.075	0.0125	2	1490.0000125	Primary
7	148.0875	150.0875	0.0125	2	1490.0000125	Primary
8	148.1	150.1	0.0125	2	1490.0000125	Primary
9	148.1125	150.1125	0.0125	2	1490.0000125	Primary
10	148.125	150.125	0.0125	1	1490.0000125	Primary

List of Stations :

No	ID	Name(2)	Service	Frequency	Coordinates	Dist_km	E1_2	E2_1	dE1_2
1	56	LM2	Land Mobile	148.050000	049E2630 36N5030	17.4	8.07	11.08	-11.93
2	59	LM5	Land Mobile	148.062500	049E5900 36N4400	30.5	52.07	52.07	32.07
3	60	FX1	Fixed	148.075000	049E2600 36N2730	30.3	3.23	6.24	-16.77

Selected Station:
Service: Land Mobile
Station Name(1): LM1
Location: 049E1930 36N4300
Emission: 8K50F3E--
Frequency(MHz): 148.0125
Selected Channel(MHz): 148.0625

No of Channels:
Total: 40 With Interference: 15

Permissible field strength:
20 (dBuV/m)

(b) EMC analysis result for assigning available planned frequencies to a concerned station

Engineering Analysis Functions of SMS4DC



Enhanced analysis tools to assist a spectrum engineer in frequency assignment, national and international frequency coordination and interference calculation for the Land Mobile, Fixed and Broadcast services and satellite Earth Station coordination;

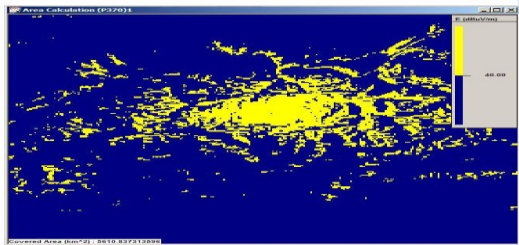
A screenshot of a software dialog box titled "New Station Parameters". The dialog is organized into several sections. At the top, there are two dropdown menus: "Service Type" set to "F - Fixed" and "Class of Station" set to "FX - Fixed station, i.e. station in the fixed service". Below this is the "Station" section, which includes a text field for "Name" containing "Fiji Fixed 001". It has two rows of coordinate fields: "Latitude" (18 S 58 30.0, Latitude(deg.) -18.975) and "Longitude" (178 E 23 0.0, Longitude(deg.) 178.383333). Other fields include "Height_asl(m)" (32), "Power(W_eirp)" (10), "Frequency(MHz)" (1500.0), "Insertion Loss(dB)" (3), "Rx Sensitivity(uV)" (0.35), and "Emission" (16k0F3E--). The "Antenna" section at the bottom has a "Name" field with "FX1500_Yagi". It includes fields for "Azimuth(deg.)" (0), "Elevation(deg.)" (0), "Gain(dB)" (30), "Height_agl(m)" (50), "BeamWicth_E(deg.)" (60), "BeamWidth_H(deg.)" (40), and "Polarization" (V). There are "Assign Antenna" and "Show Pattern" buttons on the right, and "Save" and "Cancel" buttons at the bottom.

New Radio station parameters in-line with ITU coordination requirements

Engineering Analysis Functions of SMS4DC

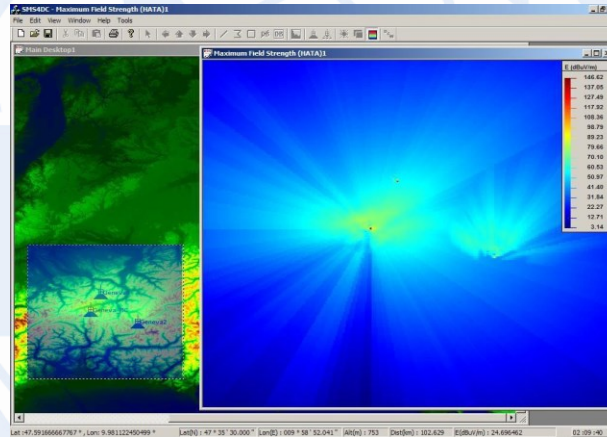


Calculation of coverage area, field strength, field strength contour, network coverage and best server calculations



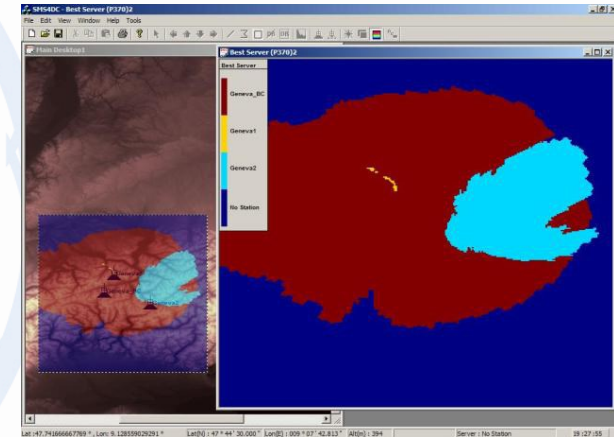
Coverage area

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

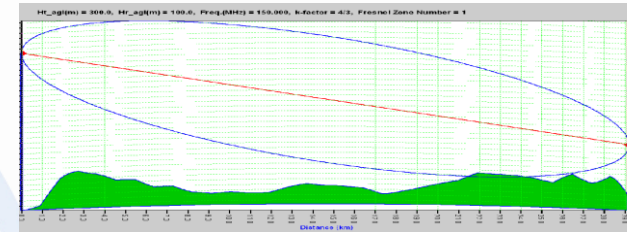
Item to calculate and visualize the best serving station at each point among various stations inside a predefined rectangular area.

Engineering Analysis Functions of SMS4DC



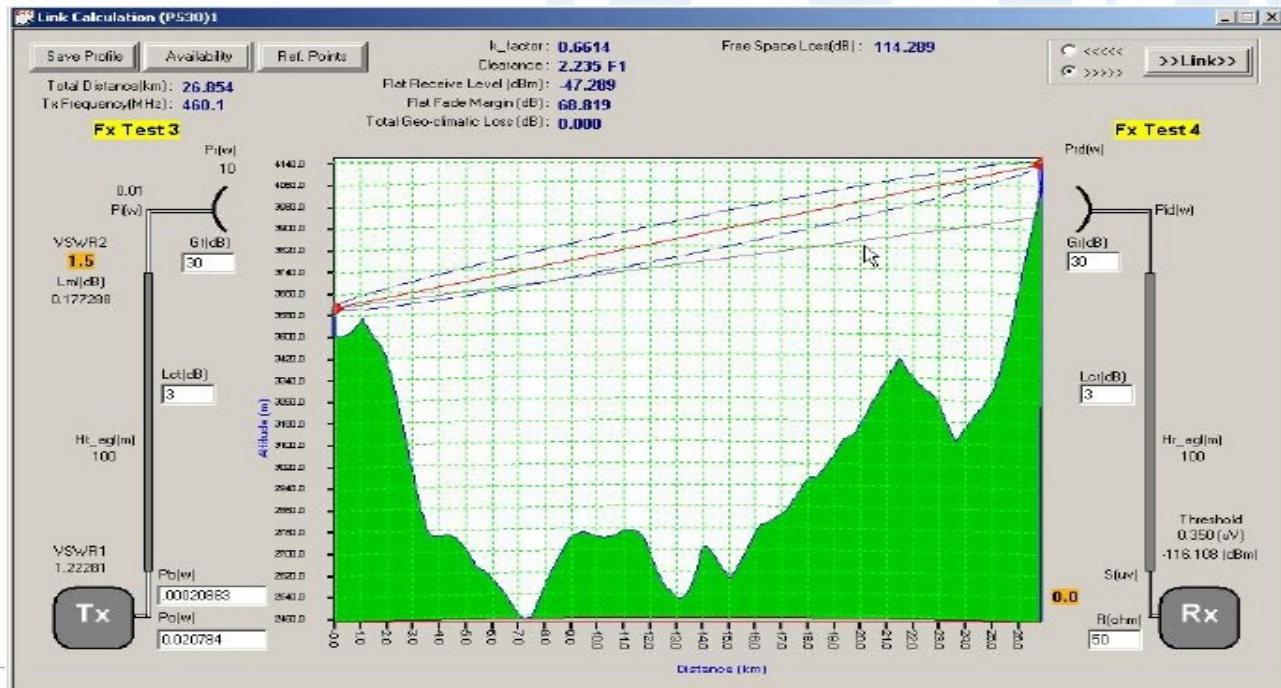
For fixed service (point-to-point radio links):

- Link budget calculations
- Link availability
- Path profiles
- Fresnel zone clearance



Fresnel Zone:

- Measure for multipath effect
- Mostly used for Aperture antenna
- Number of zone each one represents
- degree of out phase reflect signal from the LOS signal
- First Fresnel Zone includes 90% of radiation pattern (LOS component).





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



GE-06 (Broadcasting)

GE06 Agreement FXLM2BCBT (Affected Admin)



Identification of Administrations whose broadcasting service is likely (potentially) to be affected by a wanted station in fixed or land mobile service inside another country. Right-hand screenshot shows the coordination contour for the wanted FX station crossing the border of an administration whose broadcasting service is likely to be affected. Left-hand screenshot shows this result exported to Google Earth.



Example for the Land Mobile service cross—border frequency co-ordination

Agreements

Name: Service:

Countries:

Model:

Propagation models:

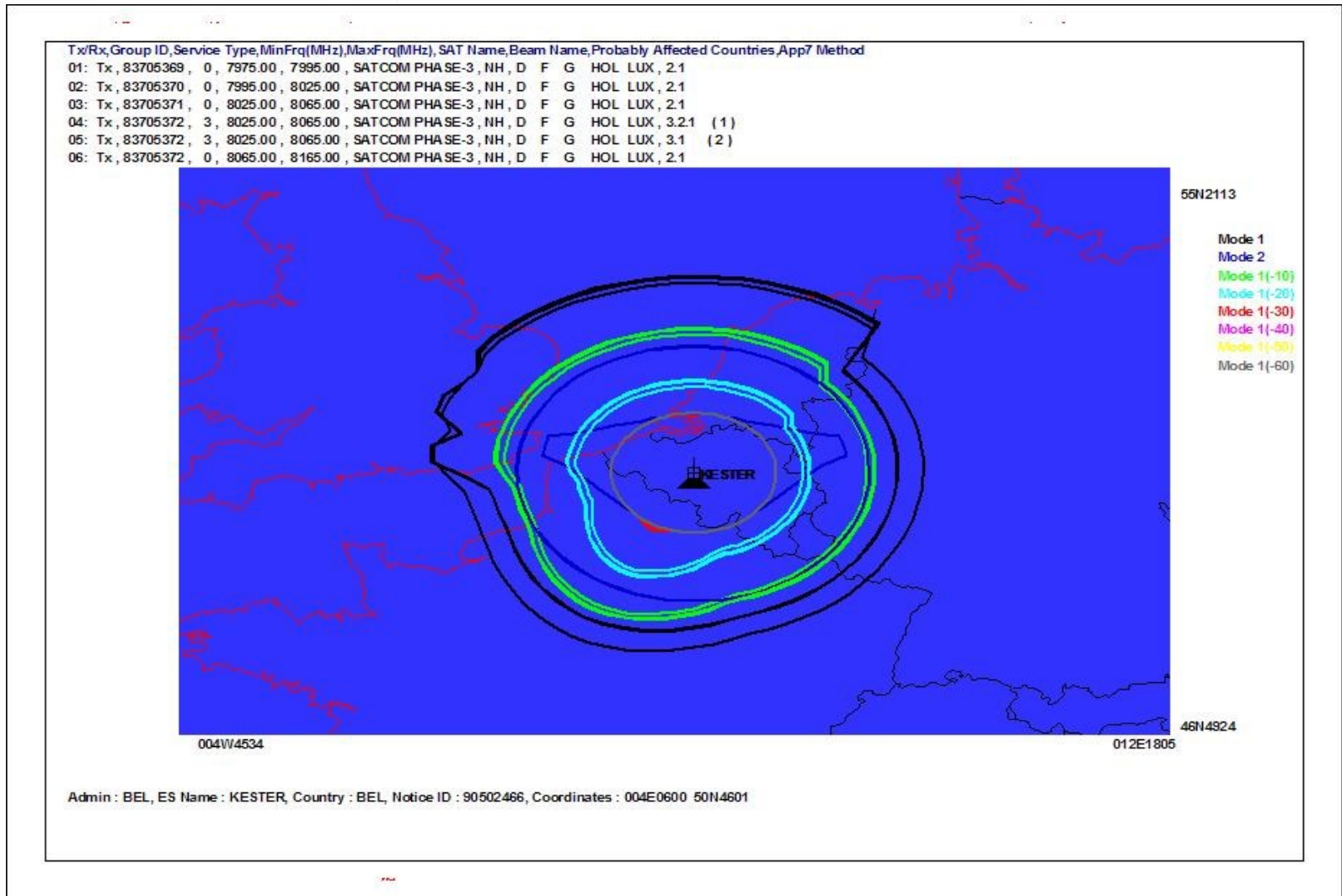
15 of 15

LoFreq (MHz)	HiFreq (MHz)	PrefCountries	PIFS(dBuV/m)	Xkm(km)	ERP(dBW)	Emergency
80.0	82.0	TUR	20.0	15.0	17.0	
82.0	84.0	IRN	20.0	15.0	17.0	
84.0	86.0	ARM	20.0	15.0	17.0	

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

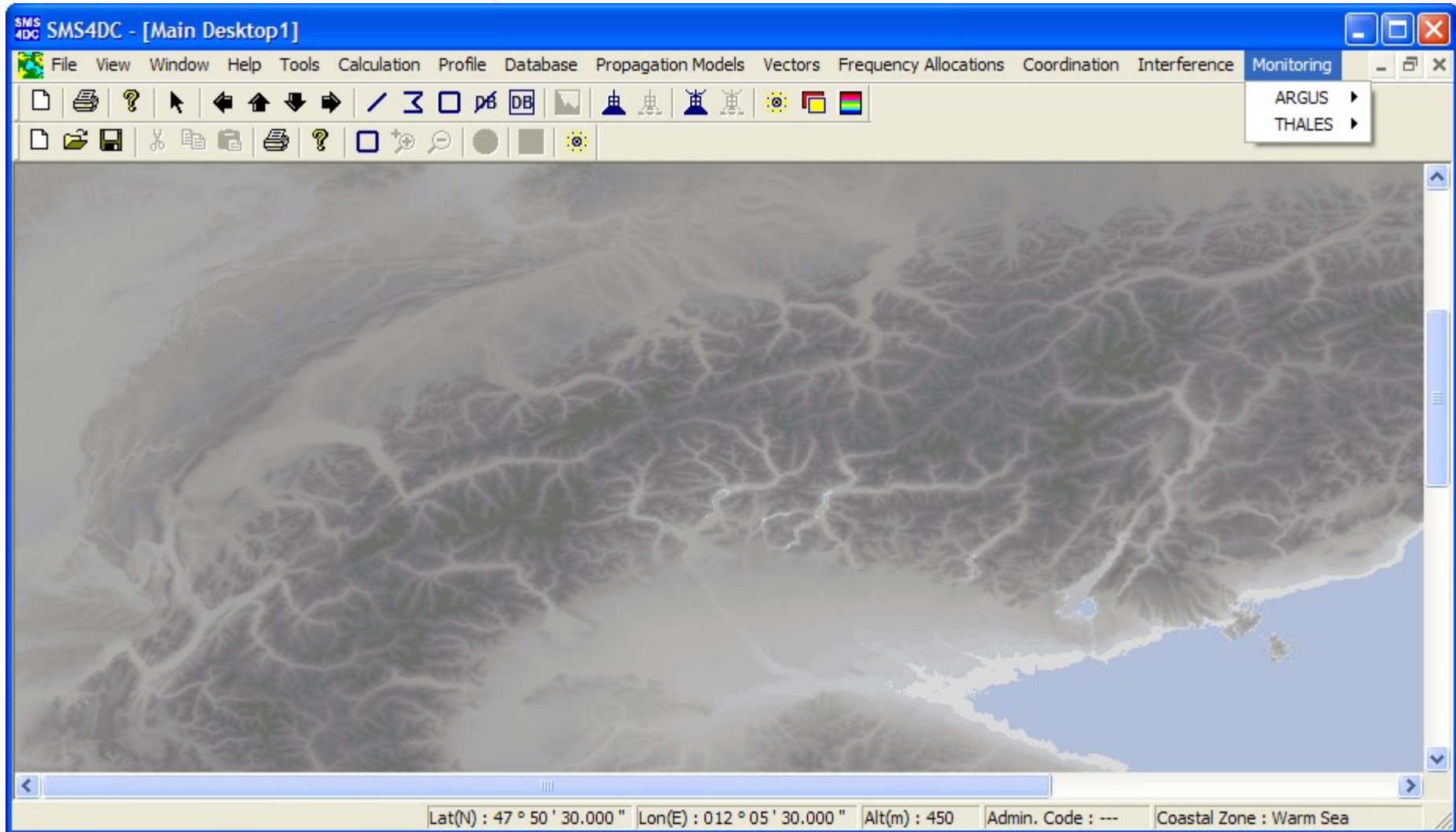


Admin : BEL, ES Name : KESTER, Country : BEL, Notice ID : 90502466, Coordinates : 004E0600 50N4601

SMS4DC's Engineering Functions



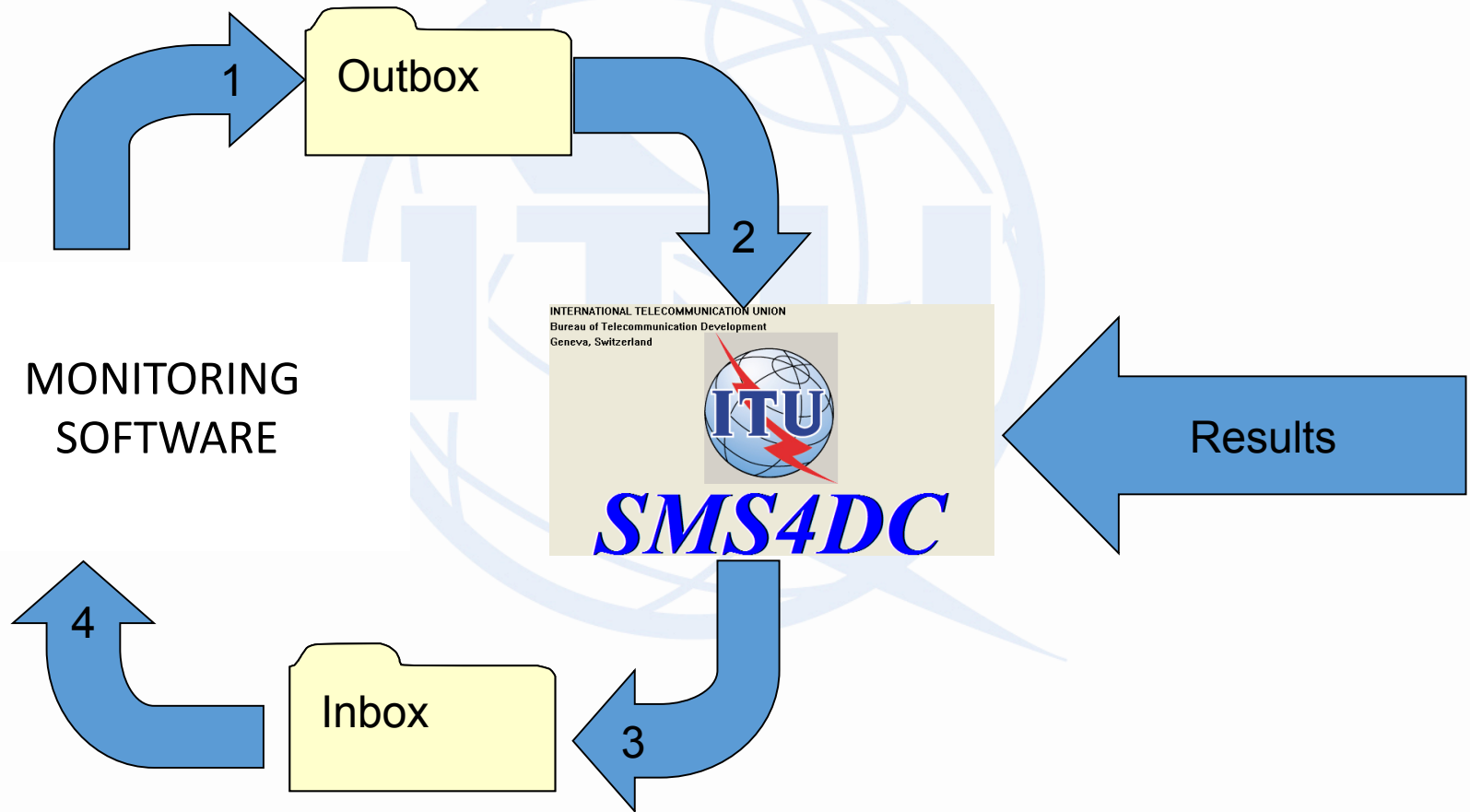
SMS4DC and monitoring software interface



SMS4DC's Engineering Functions

SMS4DC and monitoring software interface

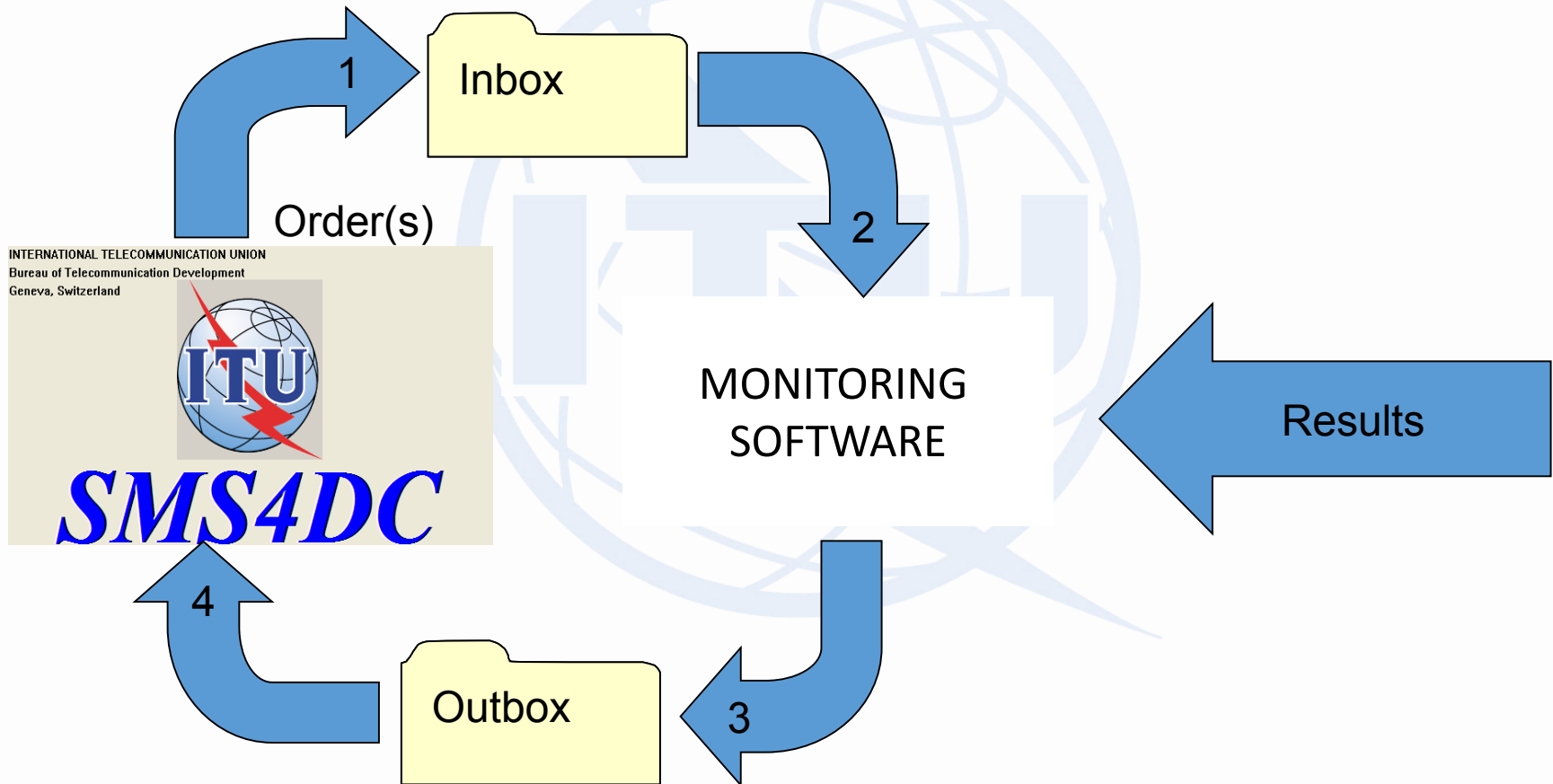
Monitoring request to SMS4DC



SMS4DC's Engineering Functions

SMS4DC and monitoring software interface

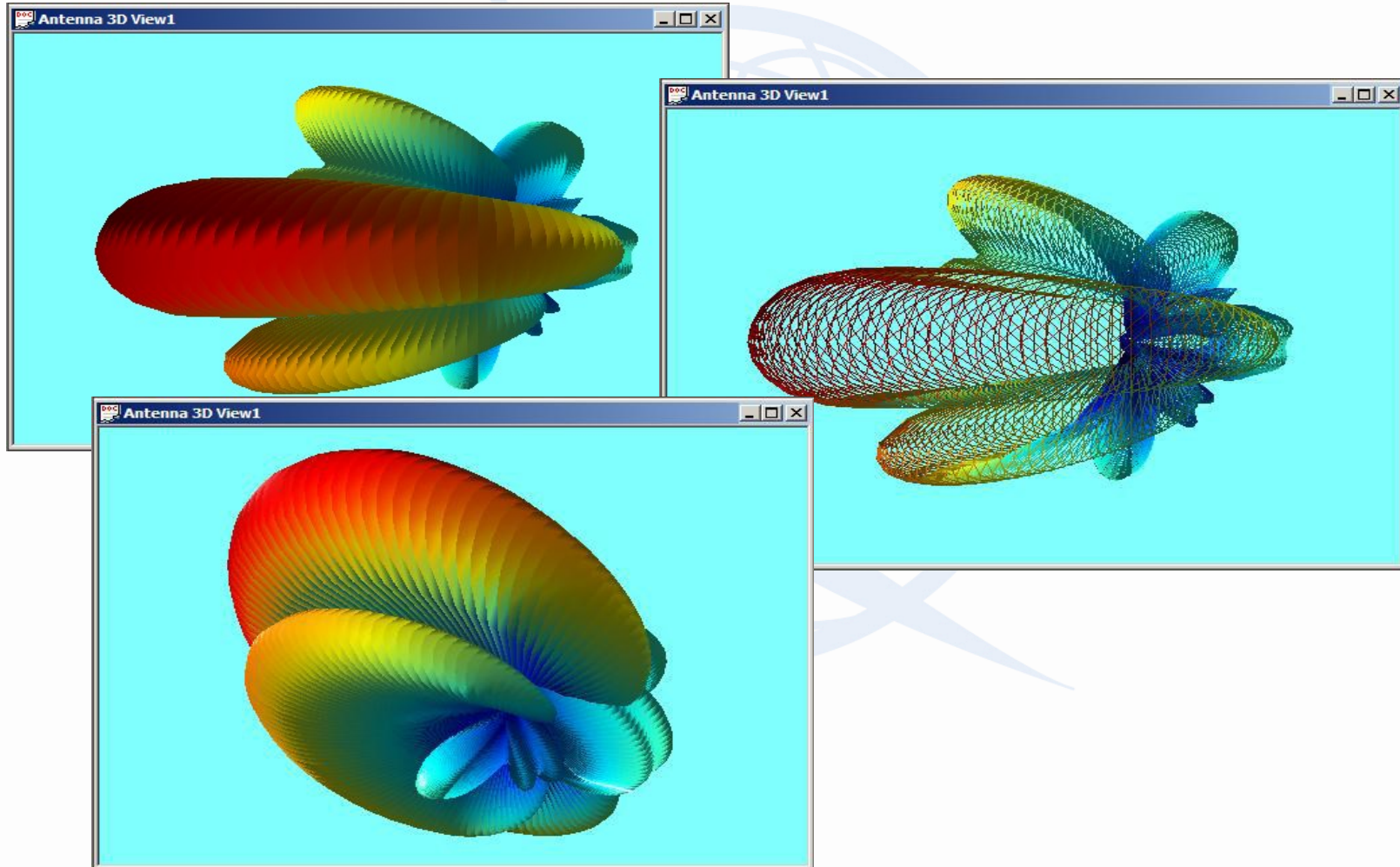
SMS4DC order to monitoring



Engineering Analysis Functions of SMS4DC



3D radiation Patterns





Meeting of SMS4DC users

- The meeting was designed to address mid to senior level management from policy makers, regulators, corporate executives and managers undertaking Spectrum Management responsibilities in their respective organizations and the users of the software. The workshop would focus on:
 - *Short frequency management summary, highlighting the main functions, structure of spectrum management organization, necessary information for efficient spectrum management*
 - *The role of computerized aided spectrum management*
 - *Overview of the SMS4DC: the structure, main features and the different functions*
 - *Some practical examples*
 - *Country presentations from those who are using SMS4DC: how they are using the tool, what are their experiences*
 - *Requirements, needs, proposals and remarks on the further development of the tool.*
- 8 pm - 9 December 2016, Geneva
- Questionnaire to collect information, opinions, proposals
- http://www.itu.int/en/ITU-D/Spectrum-Broadcasting/Pages/International-SMS4DC-Users-Meeting_Geneva_December16.aspx



Version 5.1

- V5.1 released in 2017
- <https://www.itu.int/pub/D-STG-SPEC-2017-V5.1>

Was developed from the contribution of MSIP (Republic of Korea). It contains

- the revised Article 5 of the Radio Regulations (as per decisions made at WRC-15),
- further development on data transfer from other databases to the SMS4DC,
- calculations according to the HCM (European cross-border frequency coordination agreement).

Interface to the spectrum monitoring software of

- Rohde & Schwarz
- Thales
- General interface for any other monitoring software (TCI's for example).

Self-learning training material can be provided upon request.

Time limited version preparatrion for testing

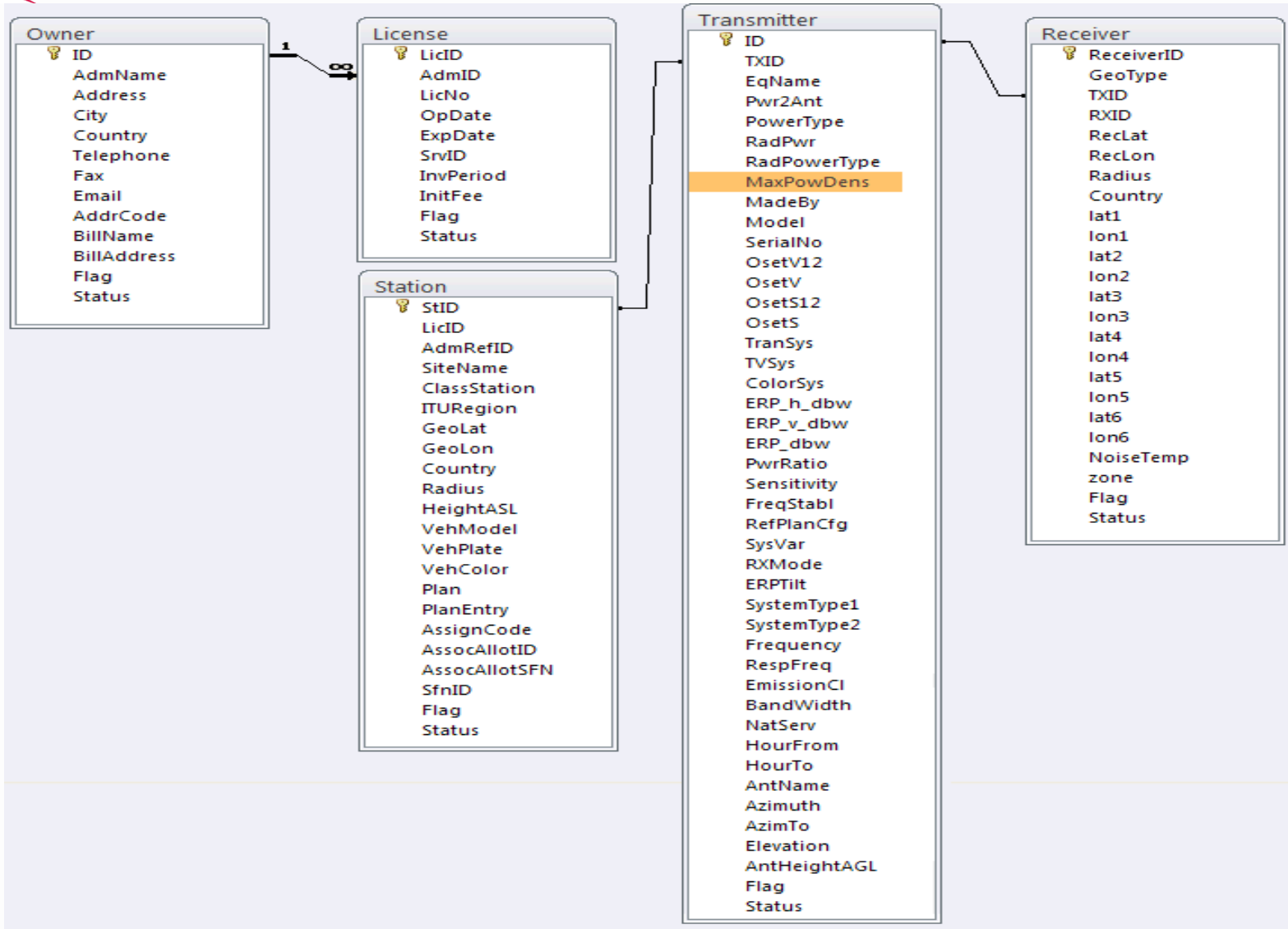


Data transfer from other databases to the SMS4DC

- Entering the existing data to SMS4DC is usually a time consuming and error prone job.
- In order to facilitate this process, a tool is provided separately to the SMS4DC package to the users requiring it.
- As each user has its own unique data structure and format, a database container in Microsoft Access format is defined and in which the user should put his data in the defined format.
- This container database is called ImportTemplate.mdb and can be found in the DB folder of the SMS4DC installation.
- It contains 5 tables which are linked together with some key data items.



Data transfer from other databases to the SMS4DC





Data transfer from other databases to the SMS4DC

As shown in the structure of the container, there are so many data items in those five tables.

There are two fields named “Flag” and “Status” which are common in all tables.

These two fields should be left empty by the user as the import tool uses these fields to communicate the import result and problems with the user

Copy the ImportTemplate.mdb to another folder and fill this copied database file (e.g. Import.mdb) with the data that you wish to import.

It is very important to create the antenna file for each antenna used in the Transmitter table. These antenna files should be created by SMS4DC and be copied in the Antenna folder of the SMS4DC installation.

When the data is completely and correctly placed in the Import.mdb then you need to execute the DBManager.exe which can be found in the BIN folder of the SMS4DC installation



Data import

- The database containing the import data should be selected (e.g. Import.mdb).
- The “Validate the data” button the validity of the database and the data entered in each table and each record is checked and a report will be shown on the screen.
- The Flag and Status fields in each table will show the reason for possible validation errors.
- There might be major or minor errors in the data.
 - In case of major errors, the validation check will be aborted and it is not possible to import the data. The problems should be solved externally and the validation check should be performed again.
 - In case of minor errors, a warning message will be shown but it is possible to continue importing the validated information.
- After successful validation of the data, start “Begin Import” for the import process. Related to the number of records, this process may be lengthy.
- When finished, an activity report will be shown on the screen.
- No duplication and backup of the original SMS4DC database.

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**
- **Recommendation ITU-R SM.1537**
- **Recommendation ITU-R SM.1604**

Thank you!



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