

# SMS4DC

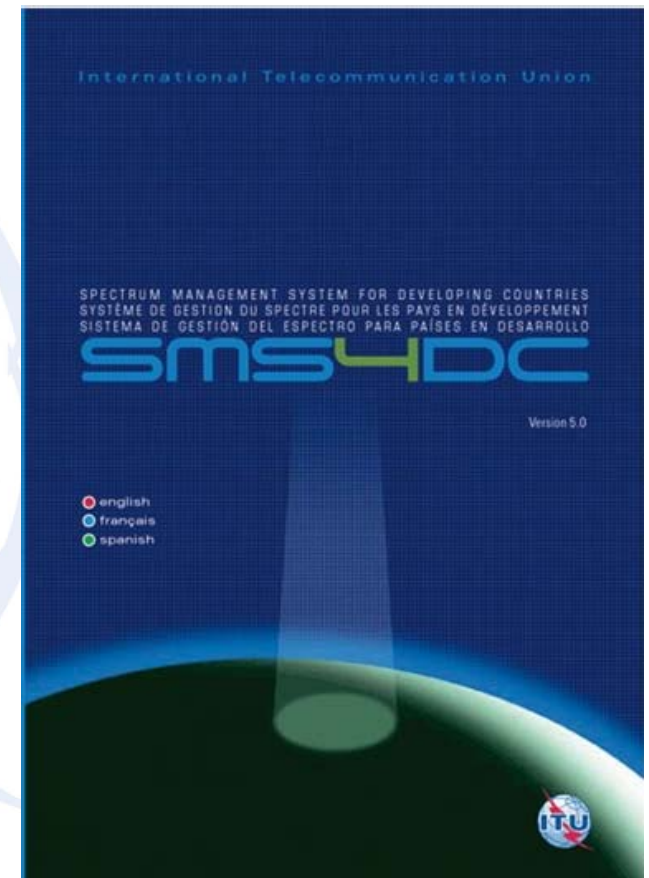


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# ITU Spectrum Management System for Developing Countries (SMS4DC)



- 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





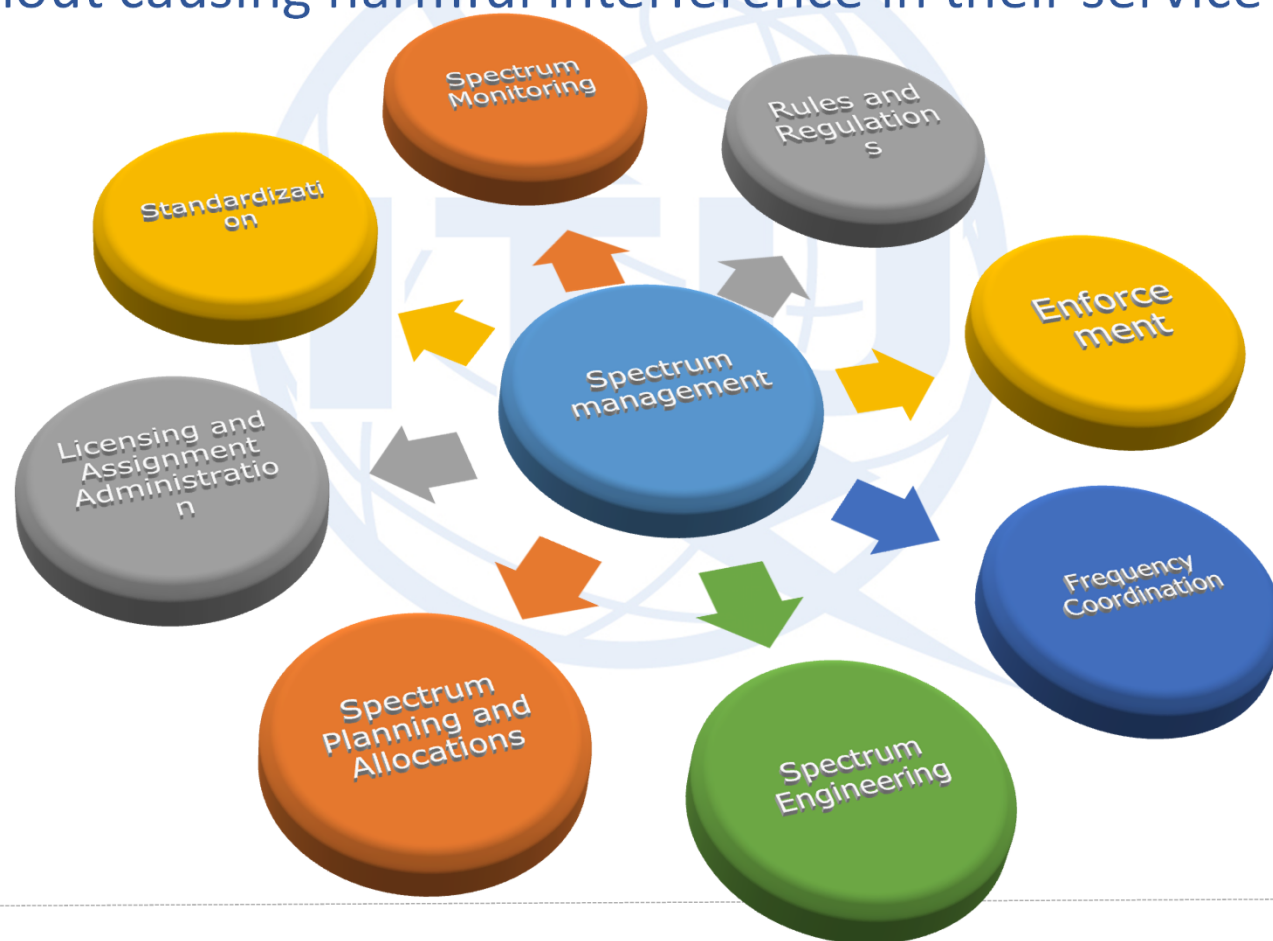
## Computer aided spectrum management

- 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>

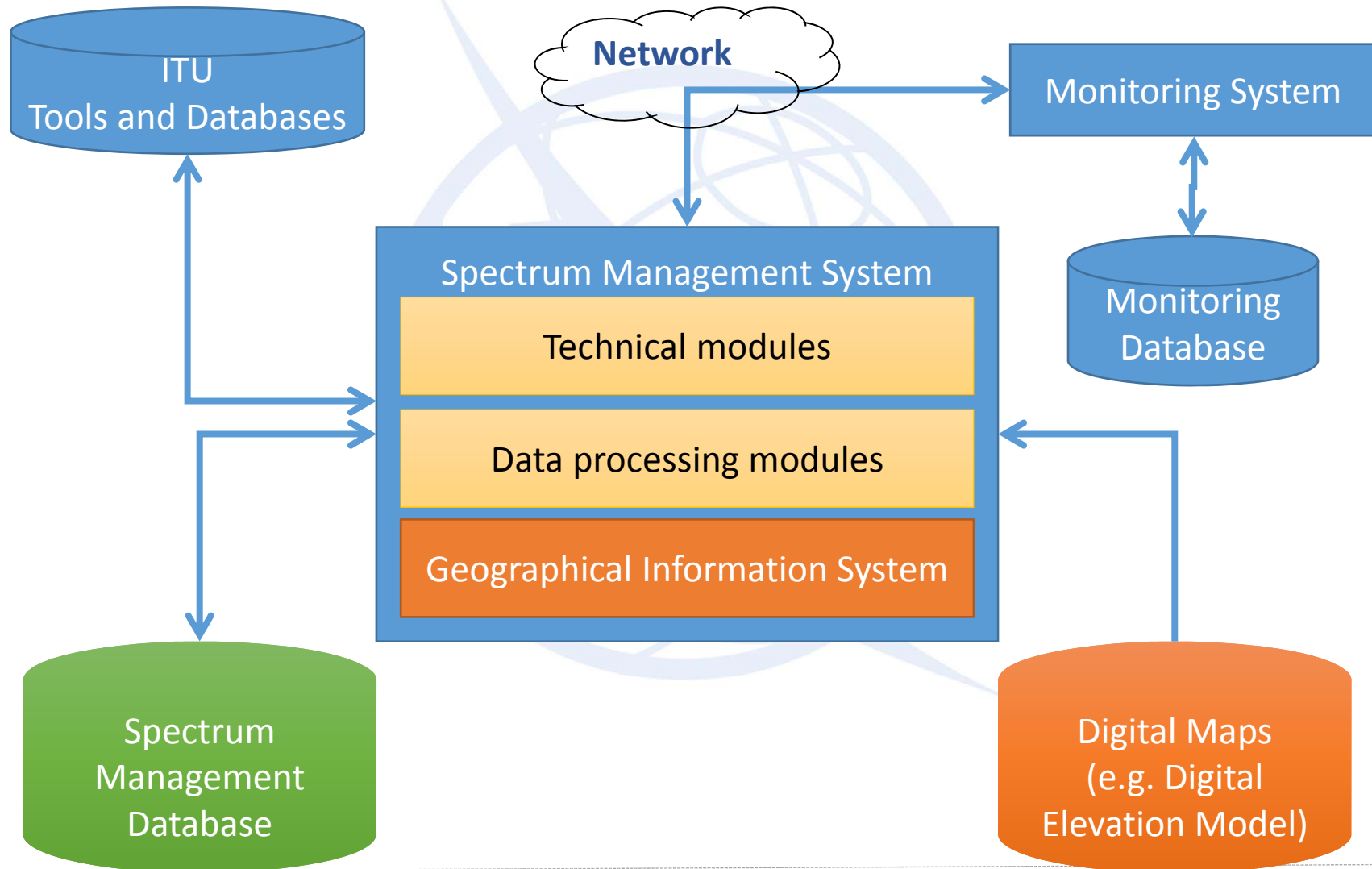
# National Spectrum Management



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

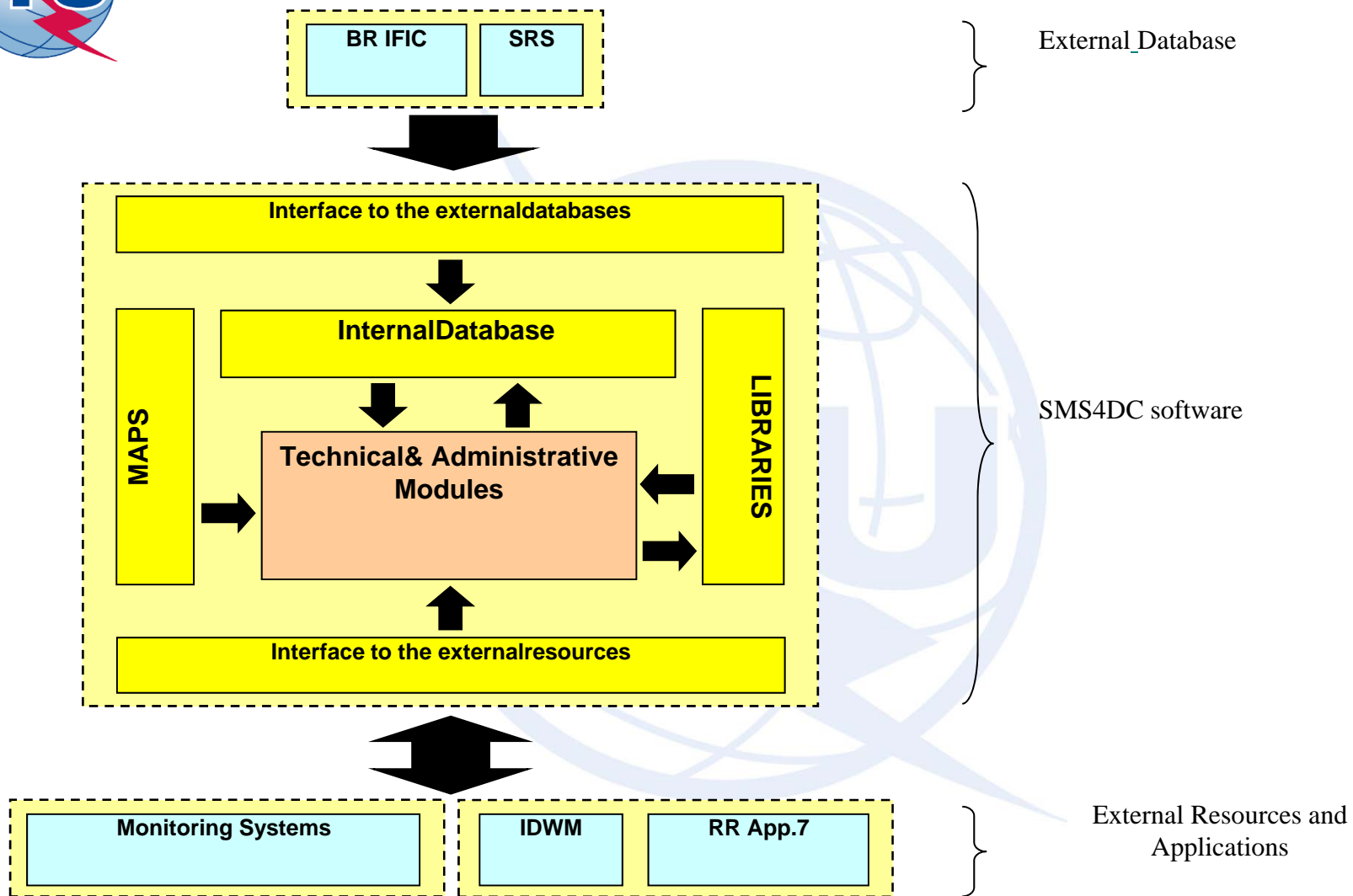
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- **2007:** *SMS4DC Version 1.0*
  - **2008:** *SMS4DC Version 2.0 (Addition of Digital TV planning tools (GE06))*
  - **2009:** *SMS4DC Version 3.0 (Addition of Google Earth and monitoring interface)*
  - **2012:** *SMS4DC Version 4.0 (link to ESMERALDA 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).*
-



# Structure of the SMS4DC



# Functions of SMS4DC

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- **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



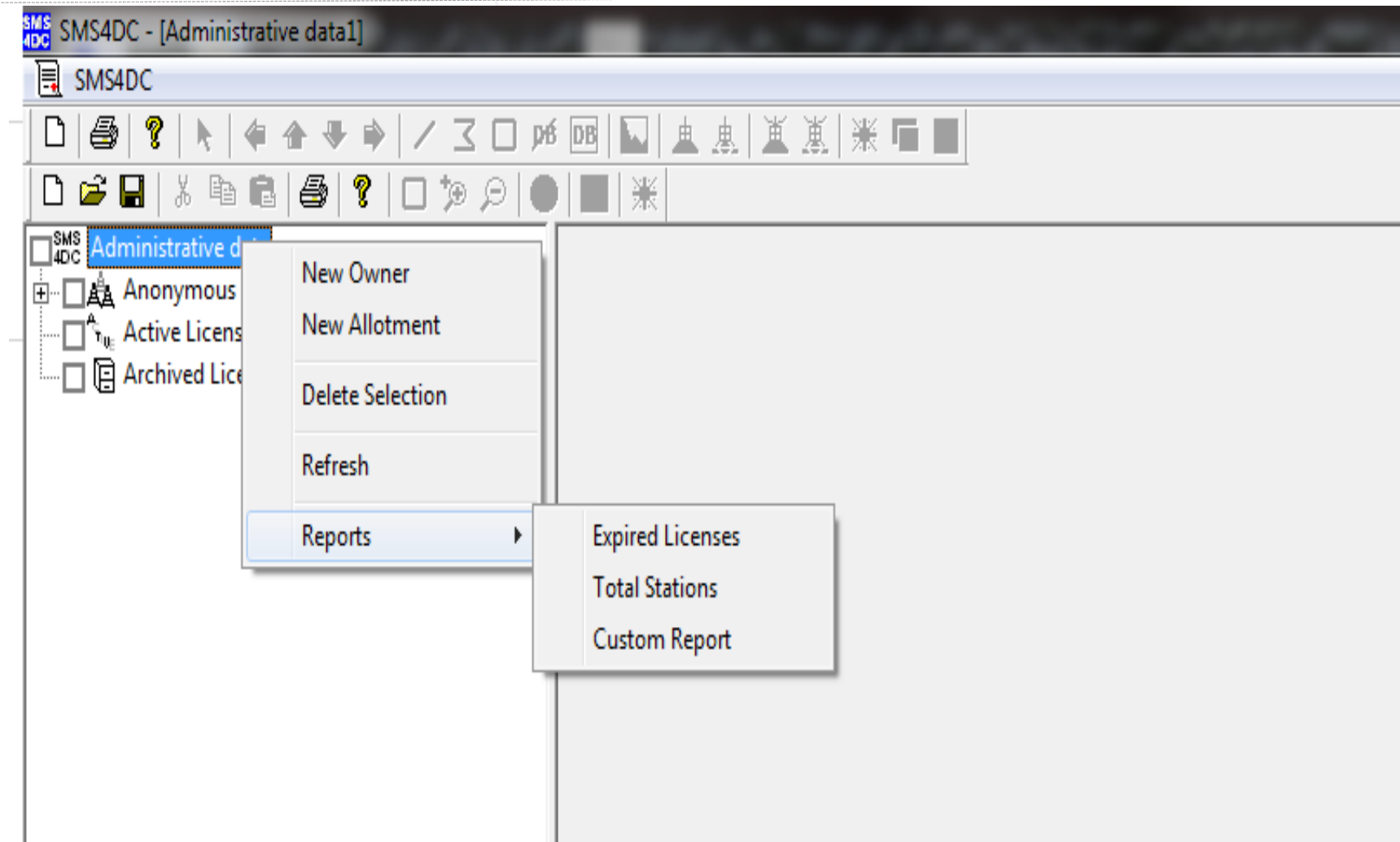
-Main application

Workstation A



-Main application

# SMS4DC License Database GUI

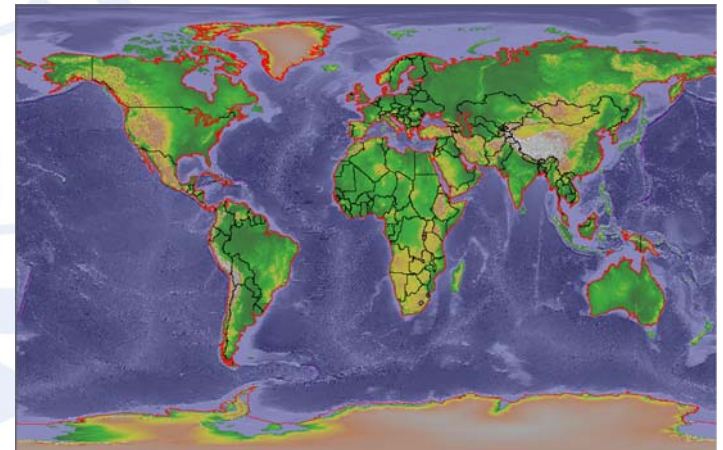


**Easy generation of customizable reports for Licenses and their status**

# GIS Functions of SMS4DC



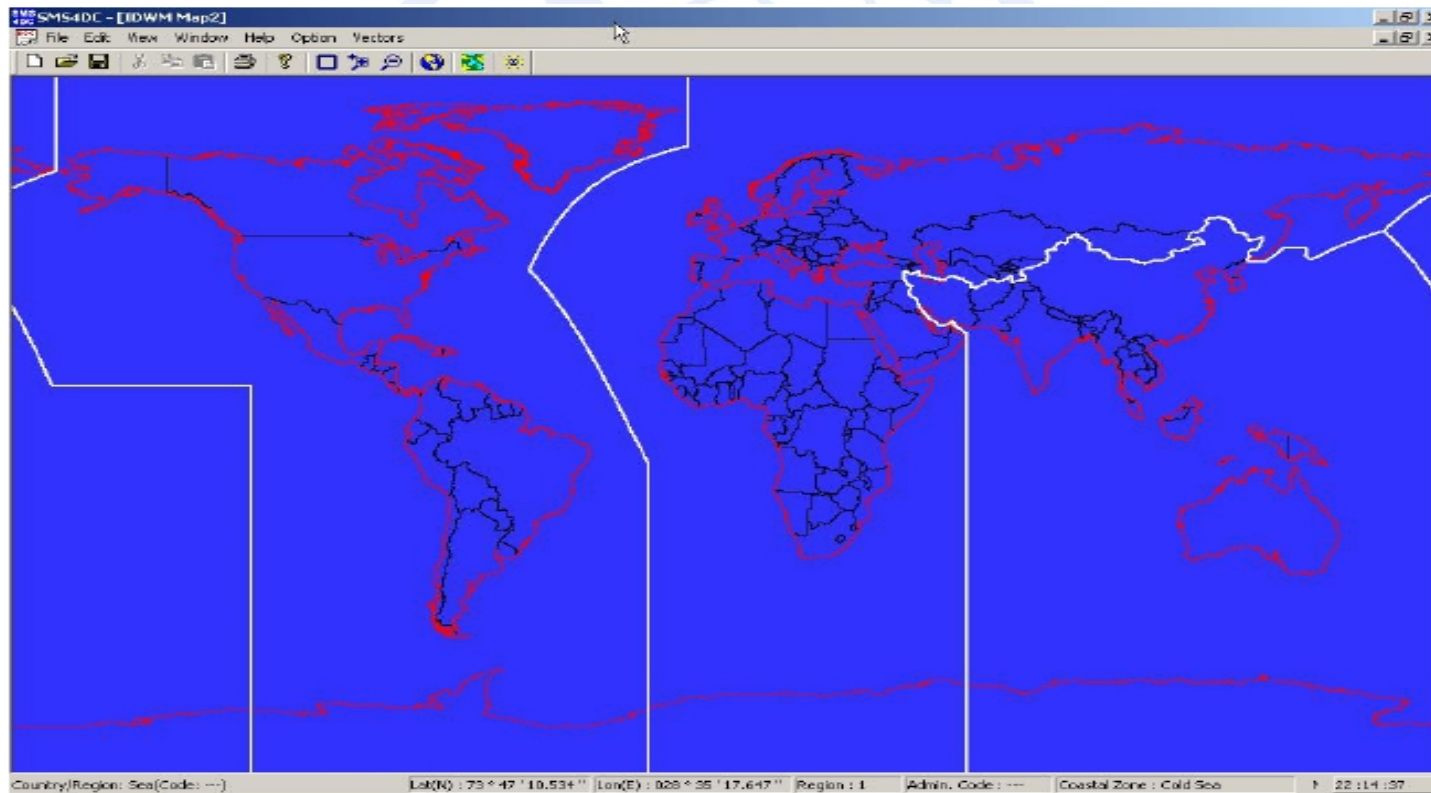
- **User friendly interface with text menus and icon-tool bars;**
- **Display views**
  - *International Digital World Map (IDWM)*
  - *Digital Elevation Map (DEM) (2-D and 3-D)*
- **Data entry/Assigning of new stations on DEM by mouse point-and-click**
- **Export of maps, overlays and vectors to Google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

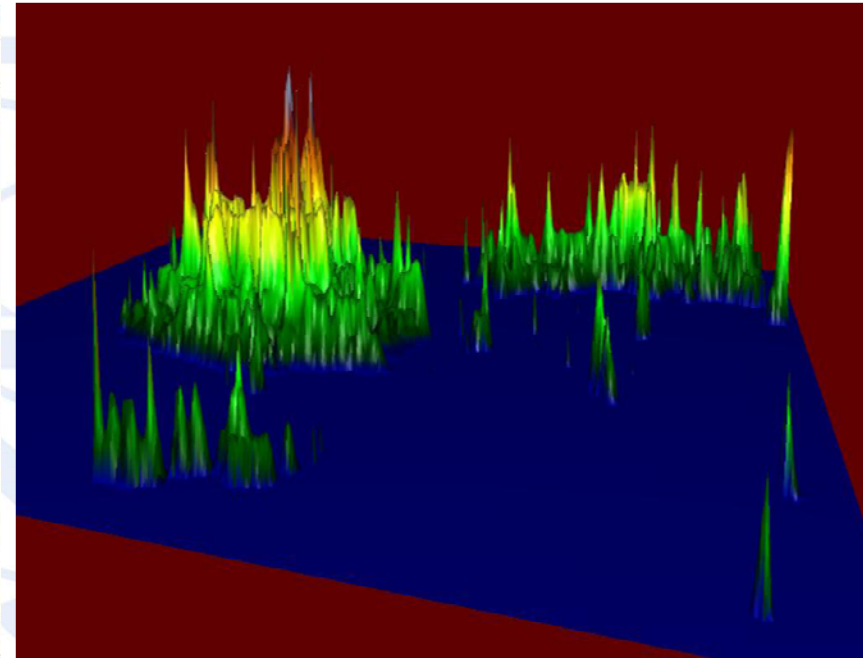
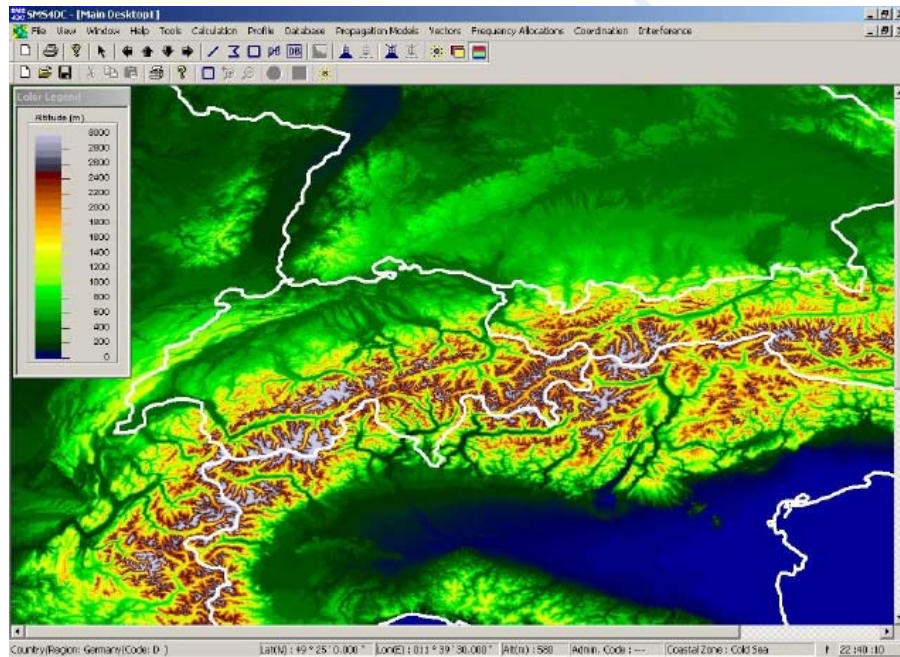


The image displays the software interface for SMS4DC, focusing on the GIS functions. The main menu bar includes 'Database', 'Propagation Models', and 'Vectors'. Three callout boxes provide detailed views of these menus:

- Database Menu:**
  - 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
  - Display Converted Assignment(s)
- Propagation Models Menu:**
  - 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
  - Overlay
- Vectors Menu:**
  - Draw Circle
  - Draw from File
  - Draw Country Border
  - Remove from Display
  - 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 displays the SMS4DC software interface. On the left, a 'Link Table' window shows a table with columns for HopID, TxID, TxName, and TxLat. The first row is highlighted in yellow. Below the table, a 'Save As' dialog box is open, showing a file explorer view of the 'Reports' folder. The file name is 'Links.kml' and the save type is 'Google Files (\*.kml)'. On the right, a Google Earth window is open, showing a map of the Iberian Peninsula and the Strait of Gibraltar. Several stations are marked on the map with blue icons and labels: DESIERTO, DON BENITO, (Seville), Andalucía (Andalusia), Málaga (Malaga), Gibraltar, Strait of Gibraltar (Tangier), Tanger, and MEHDIA. The map also shows geographical features like the Alboran Sea and the city of Valencia.

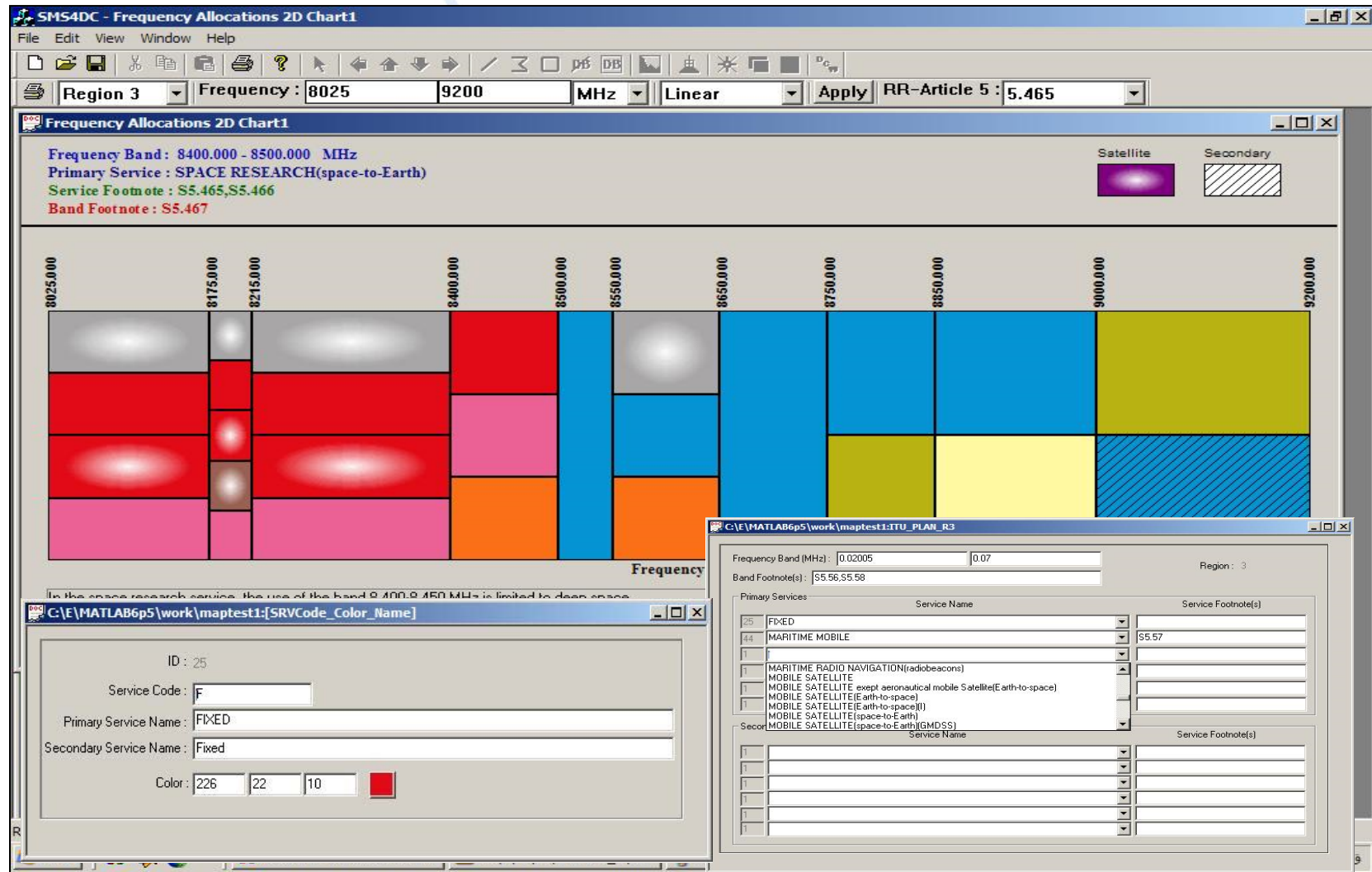
HopID	TxID	TxName	TxLat
3	27	EUPEN	50
4	29	EUPEN	50
5	31	EUPEN	50
6	33	EUPEN	50
9	53	Boukhouali	34
10	55	ZAGORA 1	30

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)

**Frequency Plan**

ID : 1      Frequency Plan ID : 382480.13      Region : Region 3      Service Priority : Primary

Service : Fixed

Type of Frequency Plan : Homogeneous

**$F_n = F_o + F_{off} + n \cdot X_S$  ,  $F'_n = F_o + F'_{off} + n \cdot X_S$**

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

Channels

Number of Channels n : 40

First : 1      Last : 40      Channel Set : All

Comment :

CEPT Channel arrangement in 38 GHz Band-Homogeneous

Frequency List:

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

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# SMS4DC's Engineering Functions

Frequency assignment parameters & EMC analysis results

**Assignment Parameters**

Fmin(MHz): 145      Fmax(MHz): 155  
 Channel scan range(kHz): 15

Search Radius(km): 50  
 Permissible field strength(dBuV/m): 20

OK      Cancel

(a) Frequency assignment parameters

**Assignment Results**

List of Frequencies :

No	F <sub>n</sub>	F <sub>n</sub>	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	048E5900 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)

Assign      Cancel

(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 divided into several sections: "Service Type" (set to "F - Fixed"), "Class of Station" (set to "FX - Fixed station, i.e. station in the fixed service"), "Station" (with fields for Name, Latitude, Longitude, Height, Power, Frequency, Insertion Loss, Rx Sensitivity, and Emission), and "Antenna" (with fields for Name, Azimuth, Elevation, Gain, Height, Beam Width, and Polarization). There are also "Assign Antenna" and "Show Pattern" buttons, and "Save" and "Cancel" buttons at the bottom.

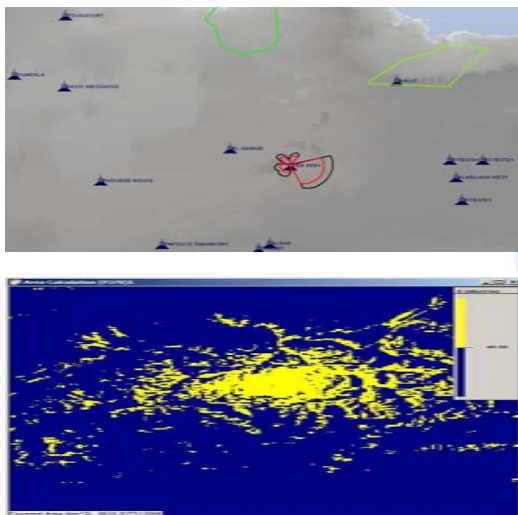
Field	Value
Service Type	F - Fixed
Class of Station	FX - Fixed station, i.e. station in the fixed service
Station Name	Fiji Fixed 001
Latitude	18 S 58 30.0
Latitude(deg.)	-18.975
Longitude	178 E 23 0.0
Longitude(deg.)	178.383333
Height_asl(m)	32
Power(W_eirp)	10
Frequency(MHz)	1500.0
Insertion Loss(dB)	3
Rx Sensitivity(uV)	0.35
Emission	16k0F3E--
Antenna Name	FX1500_Yagi
Azimuth(deg.)	0
BeamWidth_E(deg.)	60
Elevation(deg.)	0
BeamWidth_H(deg.)	40
Gain(dB)	30
Polarization	V
Height_agl(m)	50

New Radio station parameters in-line with ITU coordination requirements

# Engineering Analysis Functions of SMS4DC

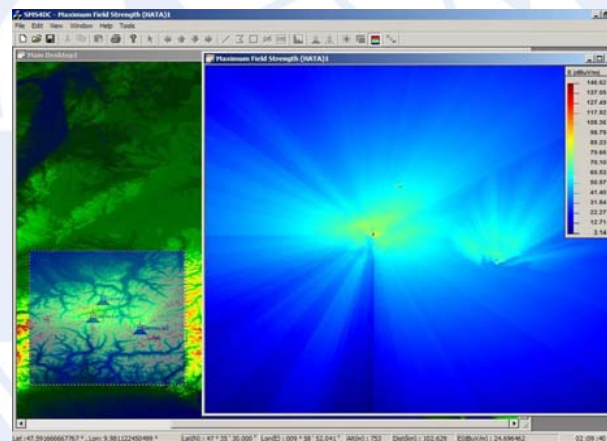


Calculation of coverage area, field strength, field strength contour, network coverage and best server calculations



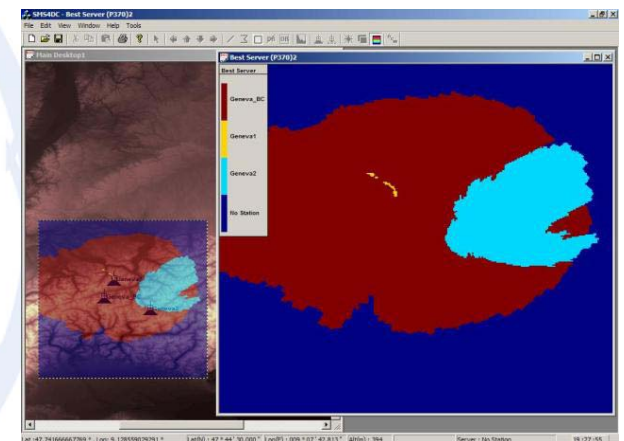
## Coverage area

Item to calculate area in km<sup>2</sup> 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

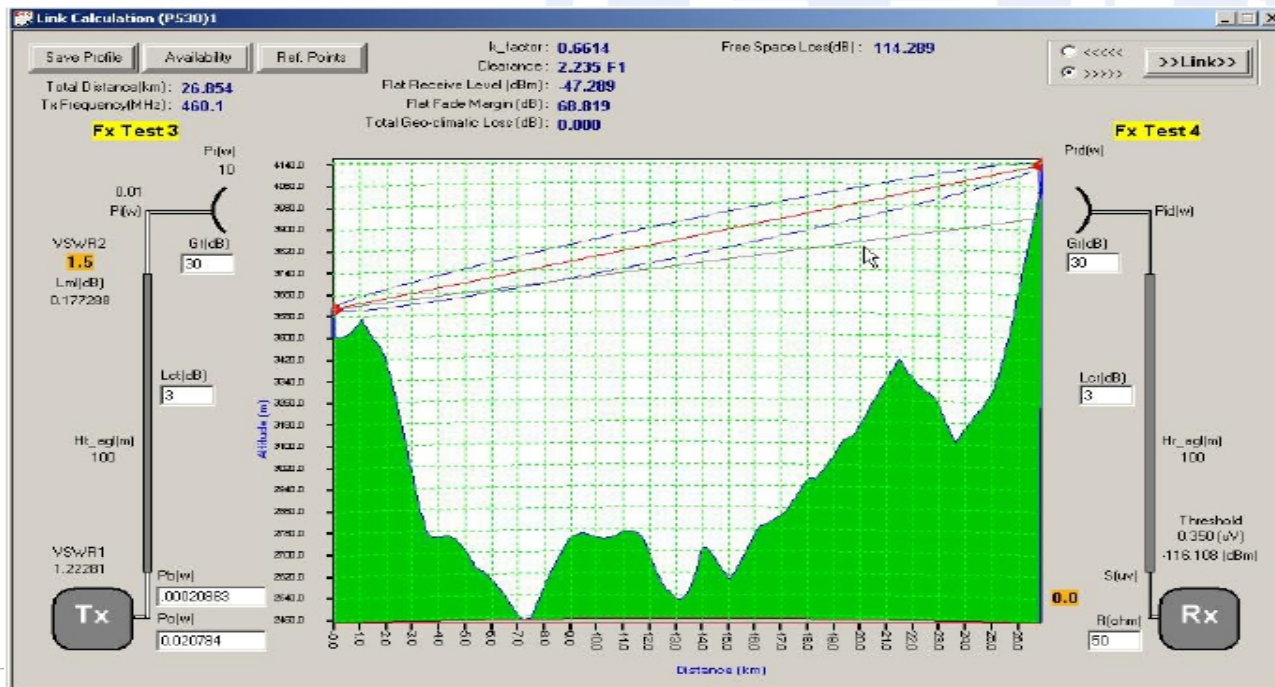
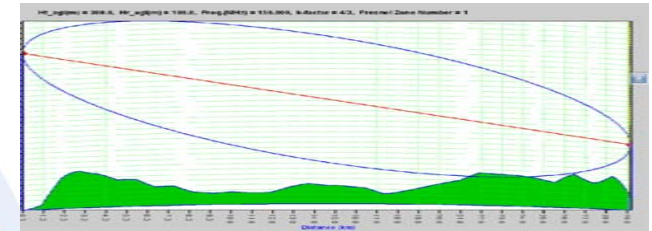
Item to calculate and visualize the best serving station at each point among various stations inside a predefined rectangular area.

# 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

**Agreements**

Name:  Service:

Countries:

Model:

Propagation models:

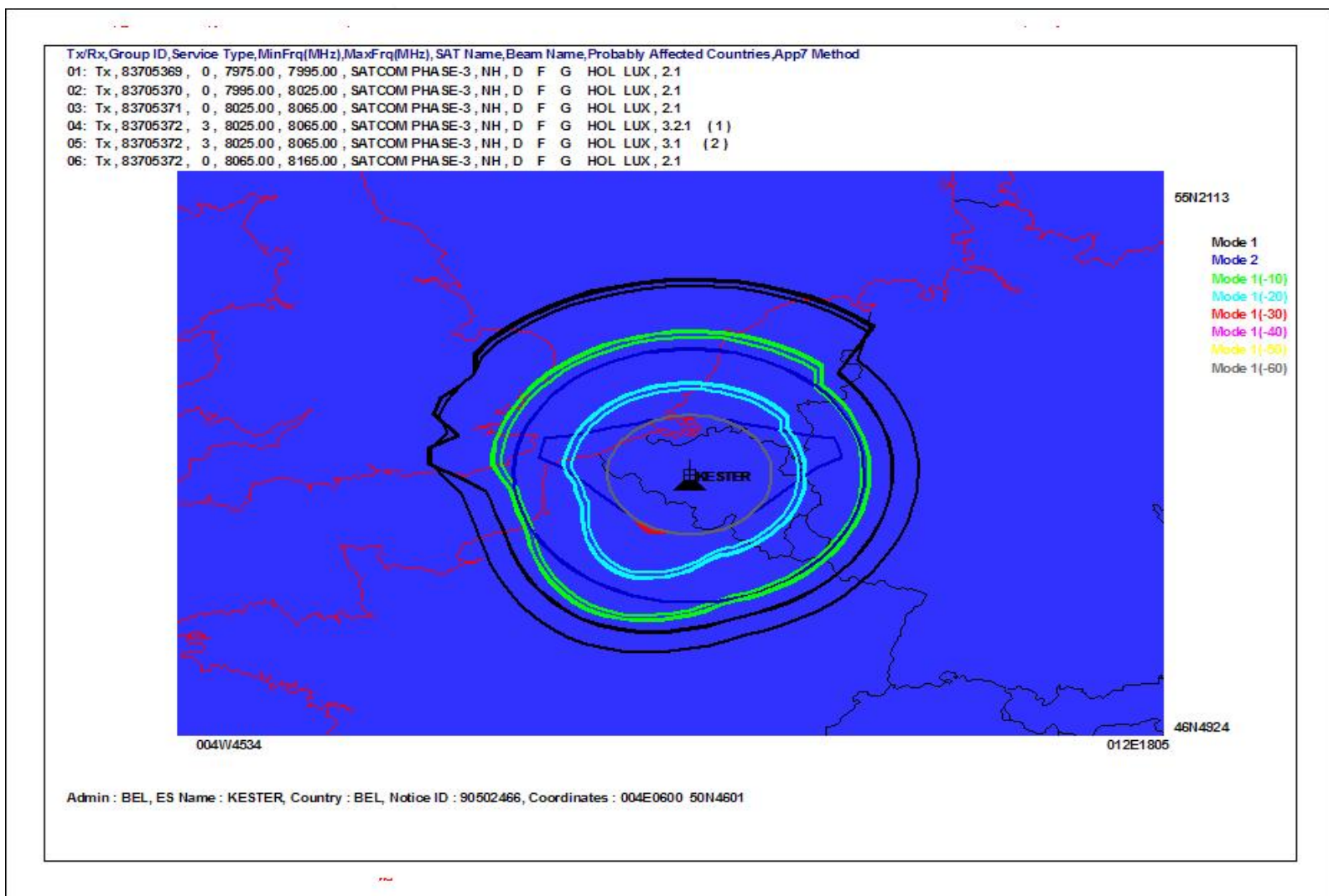
15 of 15

	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.

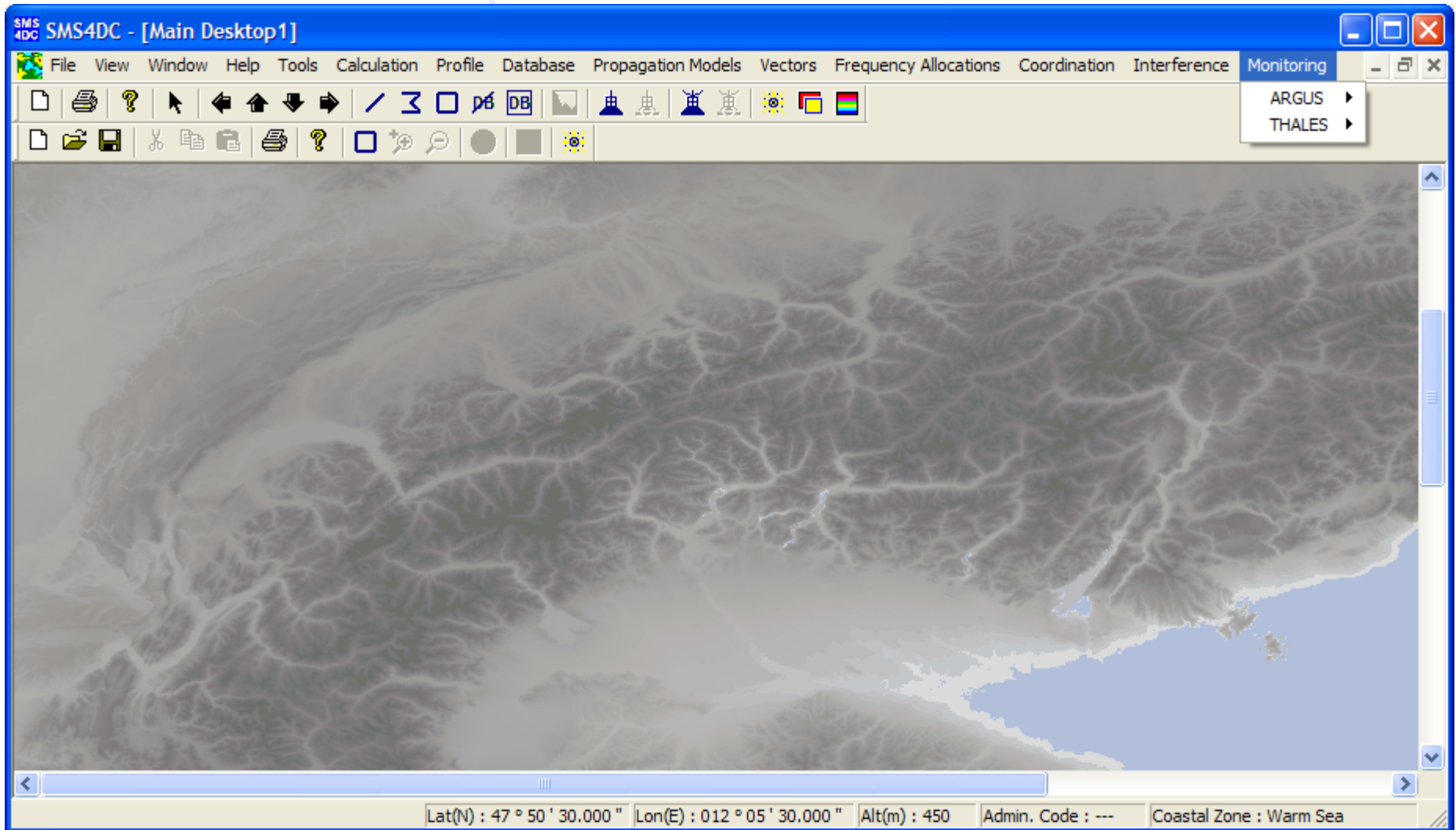


# Coordination contours around an Earth station



# SMS4DC's Engineering Functions

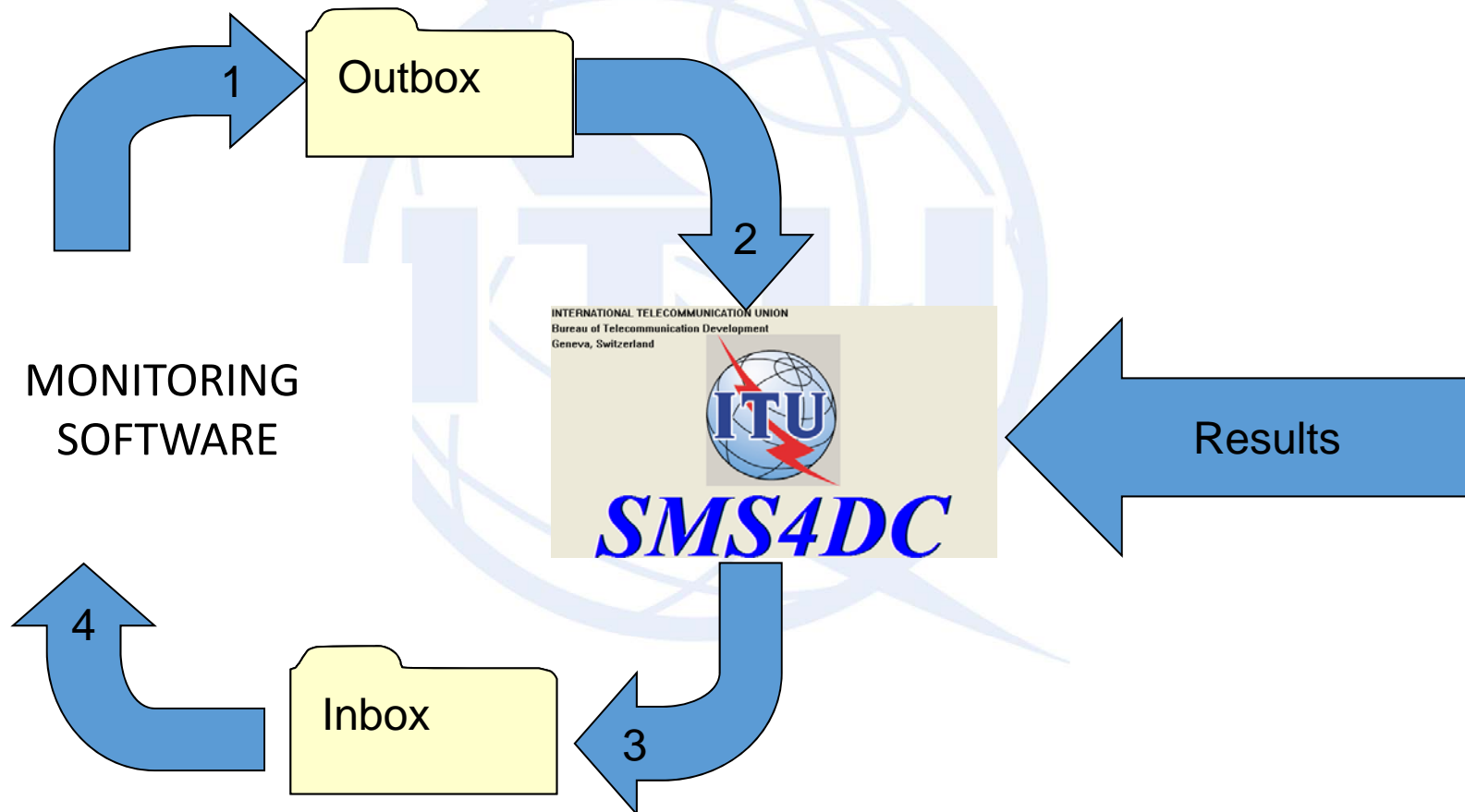
SMS4DC and monitoring software interface



# SMS4DC's Engineering Functions

## SMS4DC and monitoring software interface

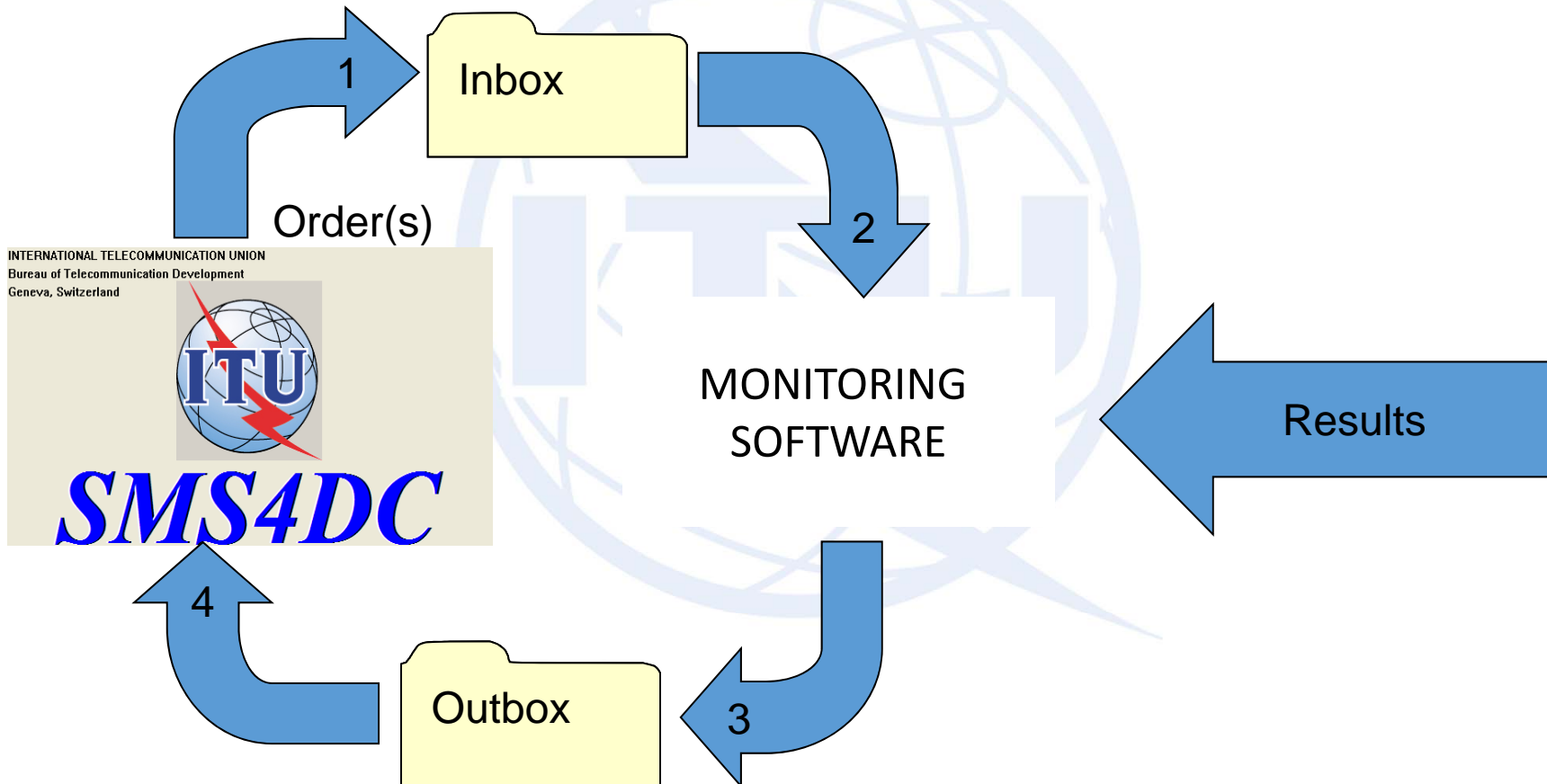
### Monitoring request to SMS4DC



# SMS4DC's Engineering Functions

## SMS4DC and monitoring software interface

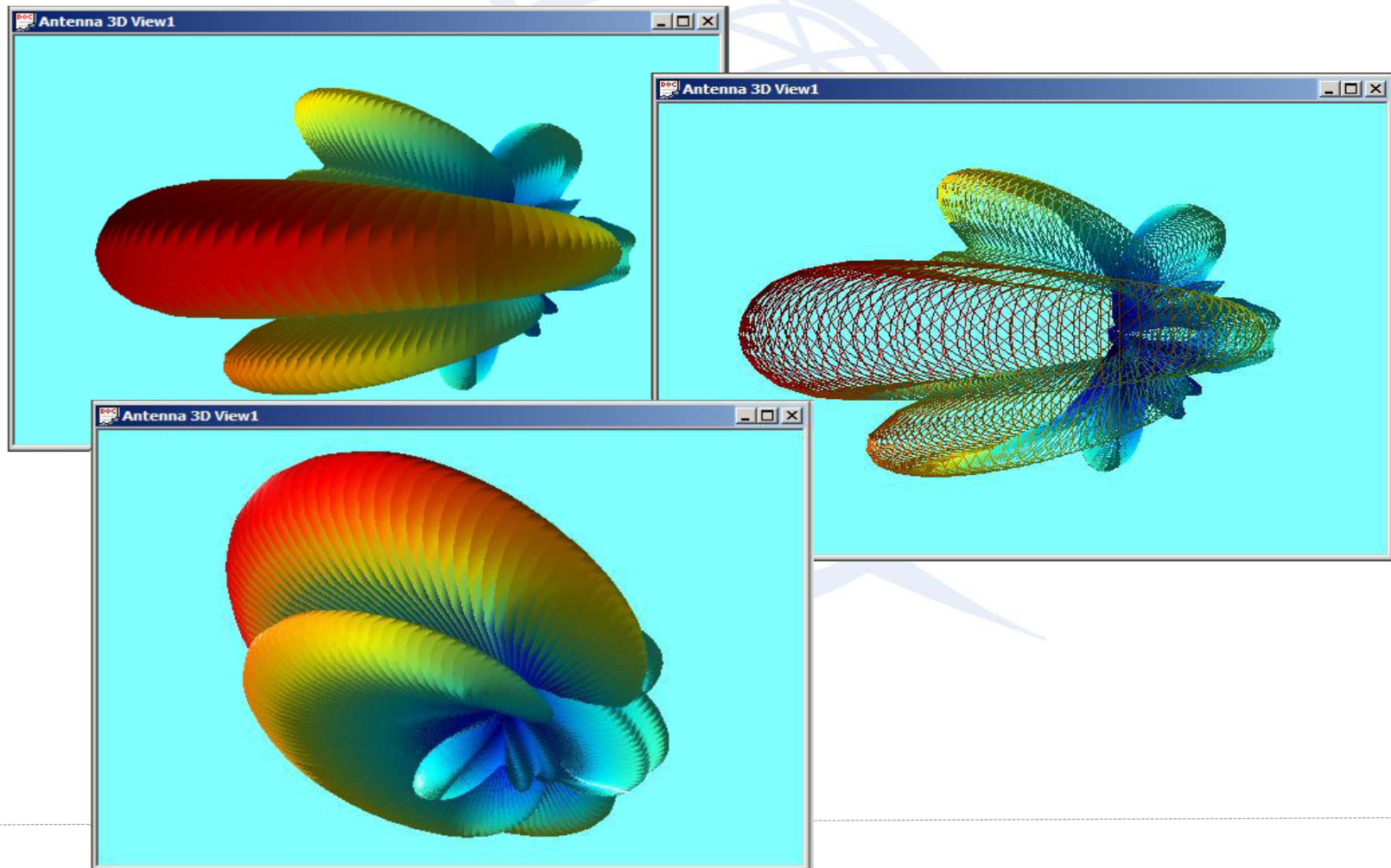
### SMS4DC order to monitoring



# Engineering Analysis Functions of SMS4DC



## 3D radiation Patterns





## HCM in SMS4DC

- V5 released at the end of 2015
- V5.1 of SMS4DC is under development
  - HCM calculations will be included
- HCM4A.dll has to be developed by the African experts and when ready, it will be added



# Meeting of SMS4DC users

- The meeting is 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](http://www.itu.int/en/ITU-D/Spectrum-Broadcasting/Pages/International-SMS4DC-Users-Meeting_Geneva_December16.aspx)



# SMS4DC Subscribers



 **V.5.0**

 **V.4.1**

 **V.4.0**



# For further reading:

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- **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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