Automation of Spectrum Management & introduction to SMS4DC

ITU Workshop on cross border Radio Frequency Management in Arab States

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International Telecommunication Union

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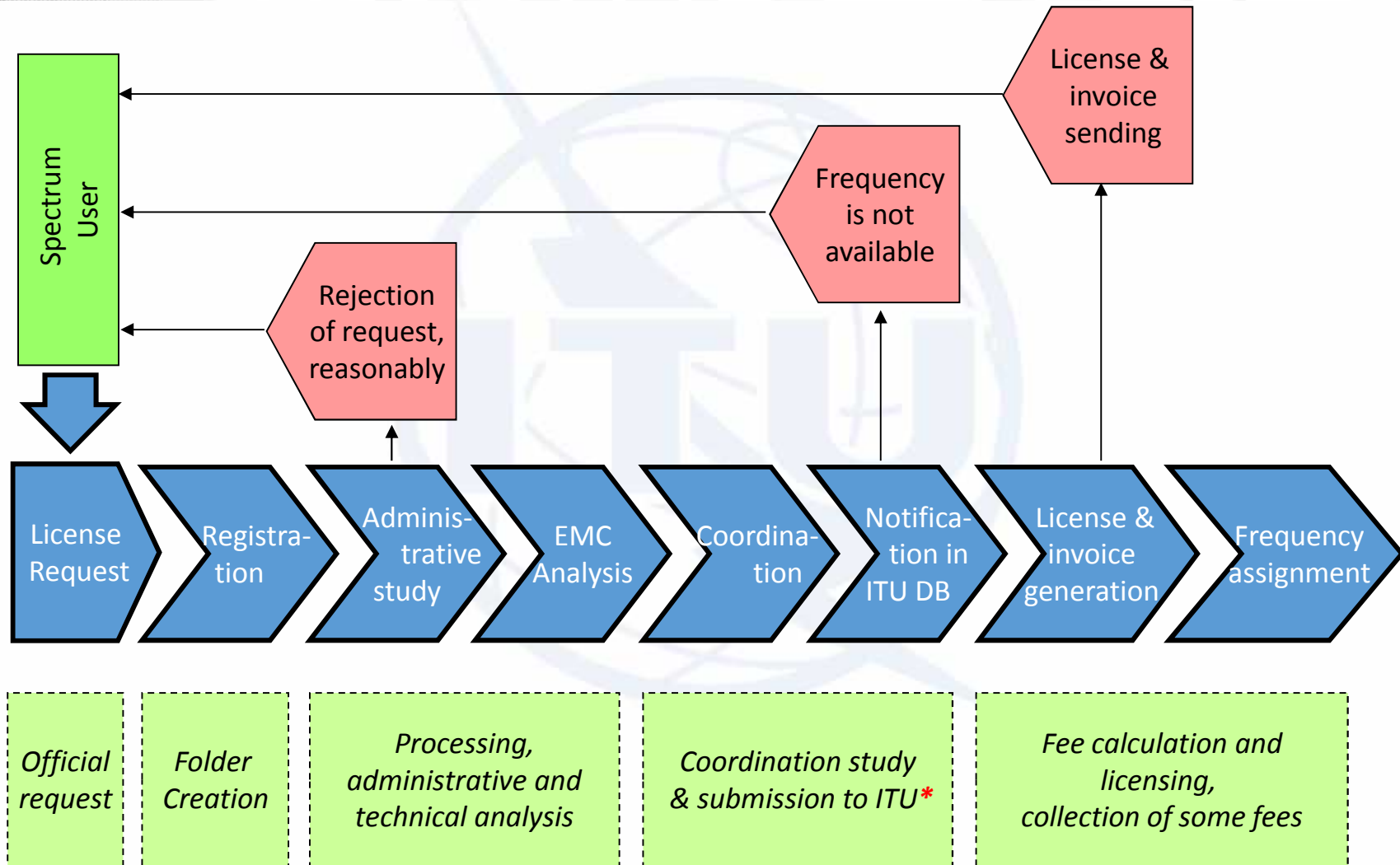
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National Spectrum Management

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

General Procedure for SM

Spectrum User

License & invoice sending

Frequency is not available

Rejection of request, reasonably

License Request → Registra-tion → Adminis-trative study → EMC Analysis → Coordina-tion → Notifica-tion in ITU DB → License & invoice generation → Frequency assignment

Official request	Folder Creation	Processing, administrative and technical analysis	Coordination study & submission to ITU*	Fee calculation and licensing, collection of some fees

*   ITU notification is not required for each cases, and that a bi/multilateral agreement is stronger than the RR (see Article 6 of the RR)

What is Automated SM tool?

Introduction

➢ **Computer techniques can help in at least two ways:**
   1. *Managing and examining large amounts of data.*
   2. *Performing calculations, whether complex, or simple but repetitive.*

➢ **Some crucial aspects in the establishment of a computer-aided spectrum management are:**
   - Technical analysis (propagation, coverage, interference prevention etc.)
   - Administrative procedures (registration and issuing of licenses)
   - Regular Spectrum fee invoicing
   - Frequency coordination
   - Notifications of assignments to the ITU according to the Radio Regulations

➢ **Is it really needed?**

   The definitive answer in every case is "Yes"

   However, it shall be properly designed

Advantages of computer-aided SM

- ➢ **Compliance with policies/legilation**
  - *Verification of the compliance of frequency assignment requests with the NTFA, RR (intl. and regional) etc.*

- ➢ **Compliance with Type Approval Conditions**
  - *Verification that the equipment to be used has the required national certification or meets other mutual recognition agreement standards;*

- ➢ **Accurate Technical planning and Monitoring response**
  - *More accurate and optimized response to assignment requests, through selection of appropriate channels taking into account details such as terrain characteristics;*
  - *Appropriate treatment of radio monitoring data (See ITU-R Monitoring Handbook);*

- ➢ **Decentralization of repetitive processes**
  - *Automatic and decentralized on-line issue and renewal of licenses and invoices (law must allow for electronic signatures);*

Advantages of computer-aided SM

➢ **Faster Administrative processing of applications**
  - *E.g.: expeditious and fully documented, timely billing of spectrum users*

➢ **Increased transparency and data availability to users inside and outside the administration.**

➢ **More accurate preparation and electronic submission of notification forms to be sent to ITU**
  - *Example of automation of ITU activities related to coordination: The BR's Terrestrial Analysis System (TeRaSys) and the Space Network System (SNS) are the computerized tools used by the Bureau to process the frequency assignment notices submitted by administrations.*
  - *The availability of electronic exchange of data between administrations or between an administration and the ITU*

Spectrum Management Data

➢ **Following describe relationships and properties pertaining to types of entities of interest in spectrum management**

- Frequencies and radio services (frequency allocations)
- License holders (Administrative data)
- Frequency assignments and licenses
- Stations and equipment
- Geography of the administration and the surrounding areas
- Levels of emissions (monitoring)
- Other data
  - *License fee schedules.*
  - *Interference complaints filed by license-holders*
  - *Violations of national or international radio regulations by a license-holder*
  - *Inspections of stations*

System architecture
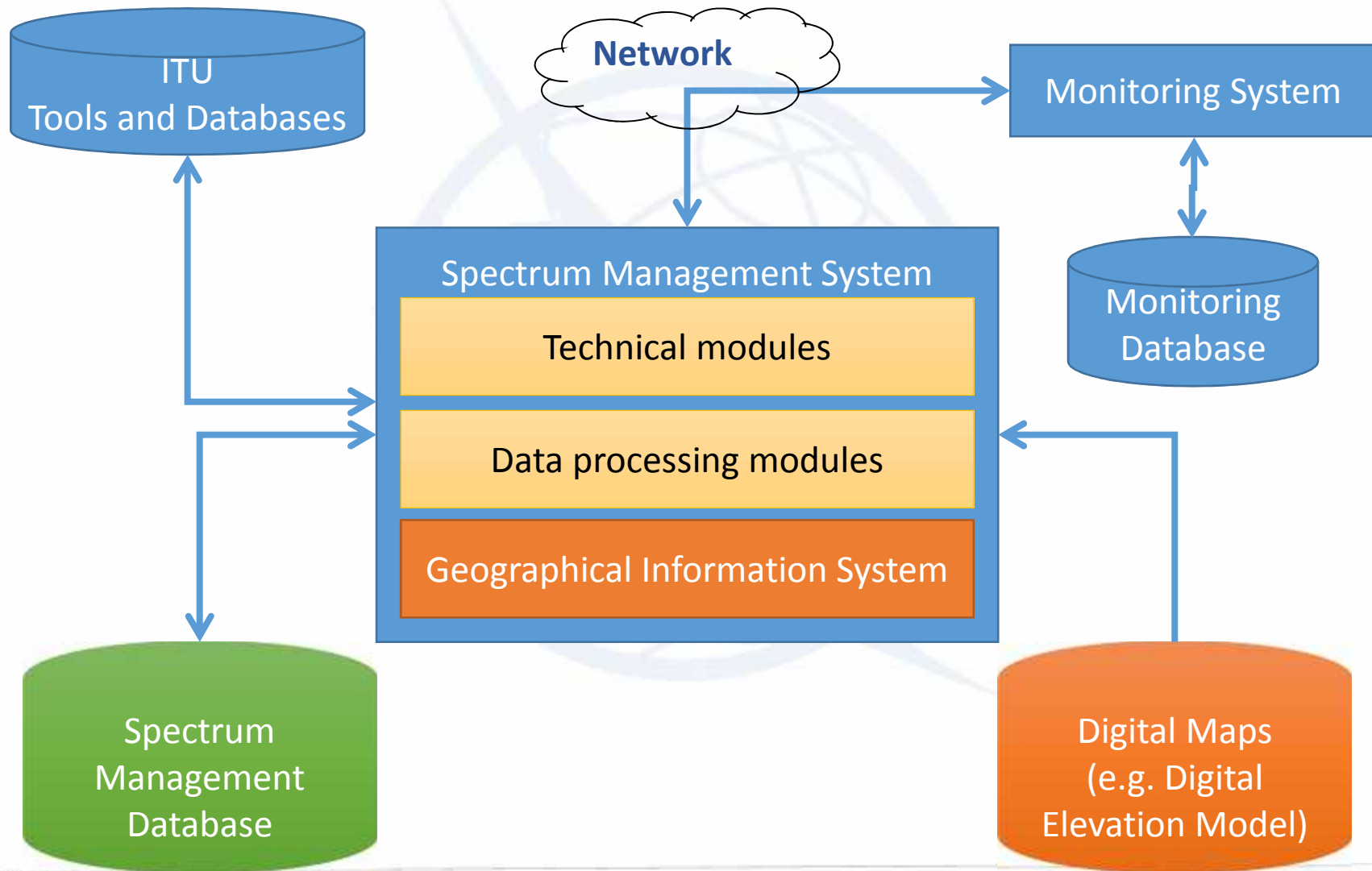
Database Management Systems (DBMS)

➢ **The database management system (DBMS) is a computerized system that maintains spectrum management data and makes it available to a variety of users.**

- *A well-designed, modern database will allow easy input and modification of data and provide useful "views/reports" of data to users without the users having to understand the details of the DBMS*

- *DBMS should be designed to minimize redundancy across the database, provide validation of data, provide security for sensitive data, provide data backup to avoid catastrophic losses in the event of system failures.*

- *When considering the design of a DBMS, an administration should consider systems used by administrations with which they must often exchange data, as well as systems used by the BR.*

A DBMS can be implemented such that files containing the reference administrative and technical parameters in a central location are replicated or "mirrored" at the user sites. This technique, while transparent to the users, improves response time.

Geographic Information Systems (GIS)

➢ **Geographic information systems (GIS) can be integrated with the DBMS to help administrations to account for environmental effects (terrain, population, etc.) in spectrum management.**

- *Usually offer two-dimensional geographic information representation and often three-dimensional capabilities as well (especially for antenna patterns).*

➢ **The ITU Digitized World Map (IDWM), available at** **http://www.itu.int/pub/R-SOFT-IDWM,**

- *Include databases for geographical (coastlines, seas, islands, lakes), political (country borders and regional boundaries), meteorological (rain and climatic zones) and technical information (ground conductivity areas, noise zones, allotment areas, maritime zones, broadcasting CIRAF zones and propagation zones).*

➢ **Many other mapping sources of varying capabilities, such as the GTOPO30 database and the NASA database, are available online.**

Examples of Automated SM tools : SMS4DC

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**
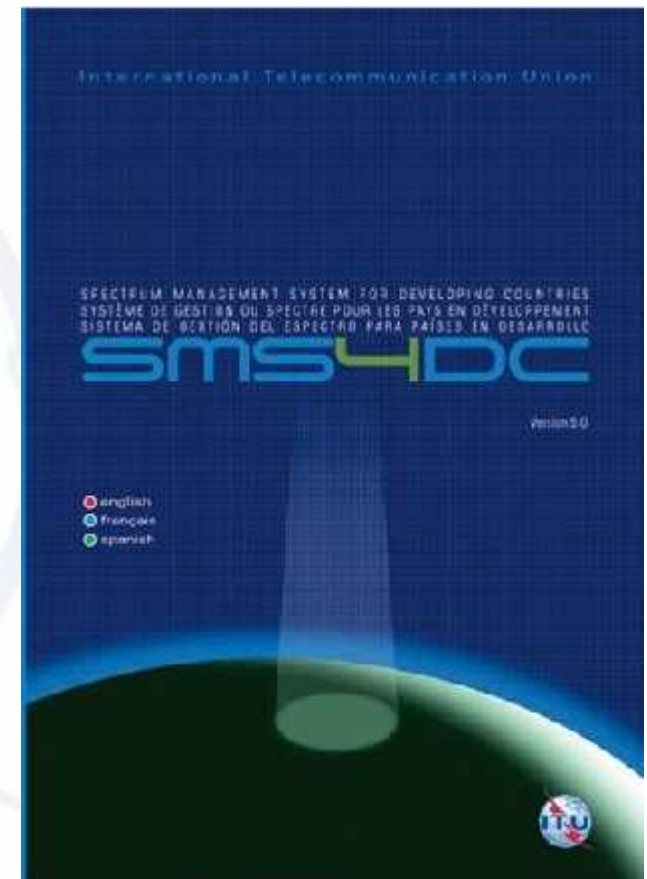
SMS4DC Development Cycle

- ➤ **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 + 11343).*

Functions of SMS4DC

➢ **Administrative Functions**

➢ **Graphical User Interface (GIS) Functions** *(including Map Displays)*

➢ **Engineering Analysis Functions**

Administrative Functions of SMS4DC

➢ **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.*

➢ **Graphical User Interface Functions (including Map Displays)**

➢ **Engineering Analysis Functions**

Administrative Functions of SMS4DC

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SMS4DC Configuration

SMS4DC License Database GUI
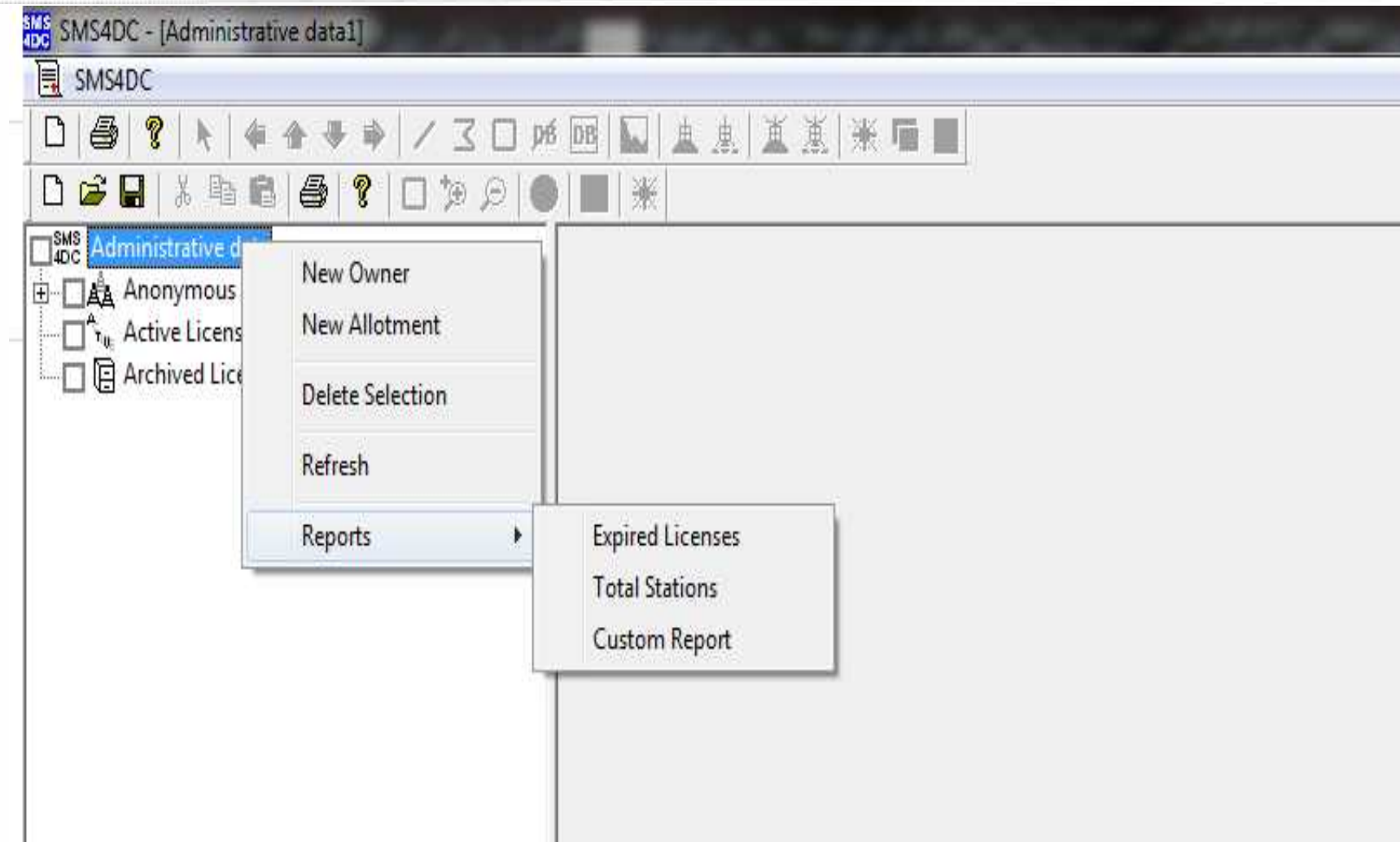
Easy generation of customizable reports for Licenses and their status

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**
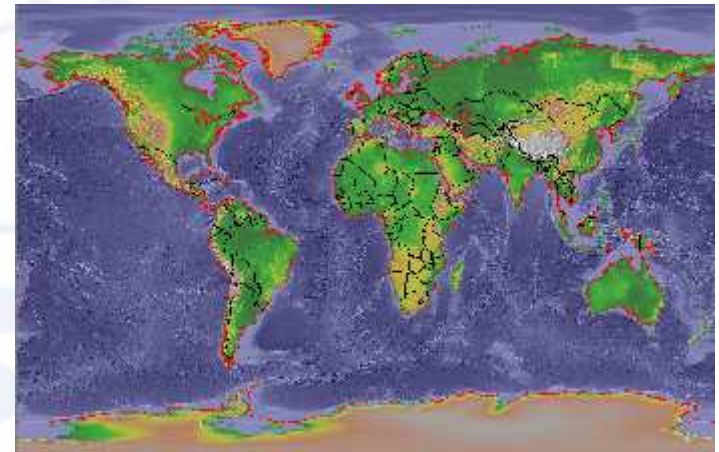
GIS Functions of SMS4DC

IDWM Menu: *The IDWM is used to draw political boundaries of countries on the desktop of SMS4DC*
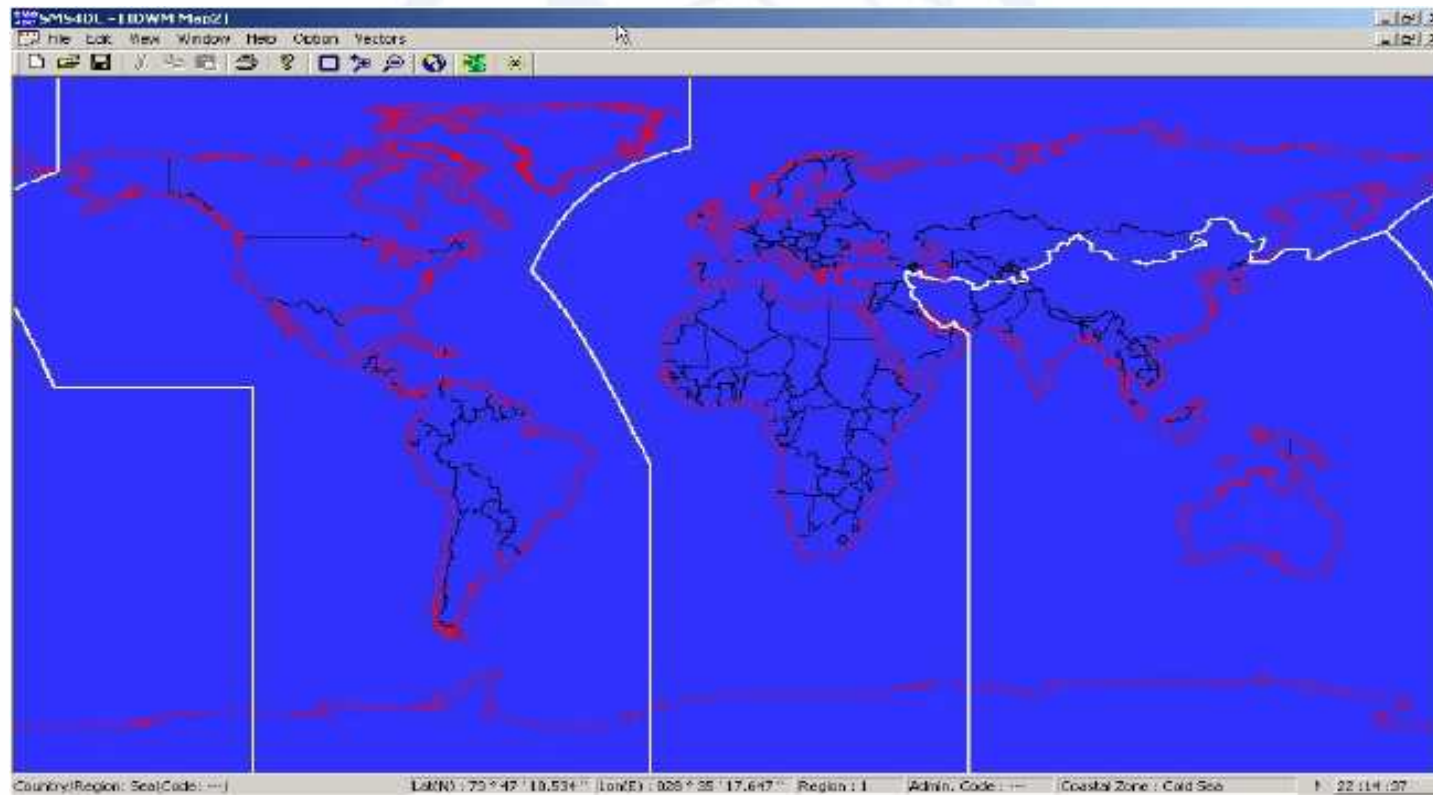
GIS Functions of SMS4DC
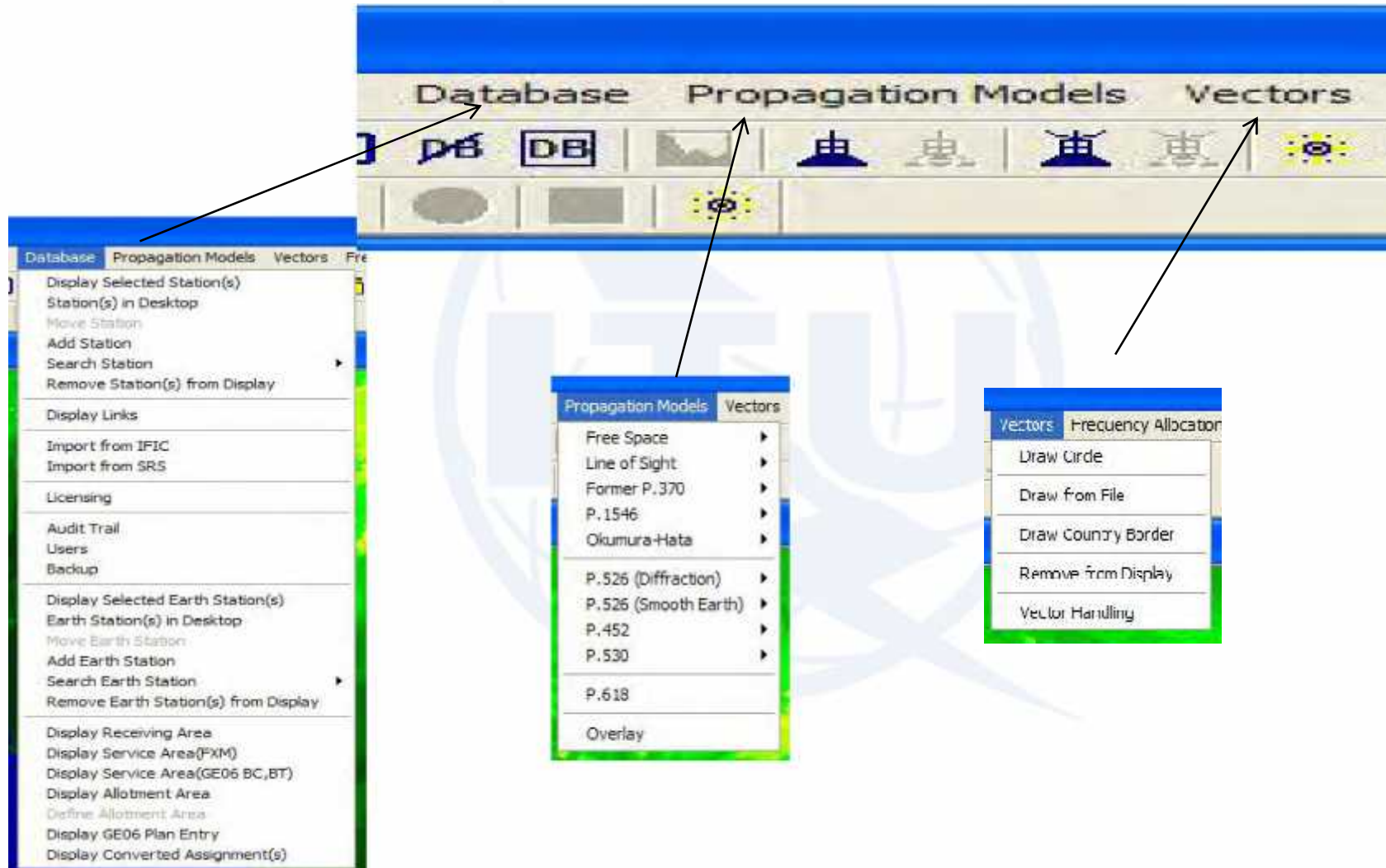
Digital Elevation Model (DEM) Menu

GIS Functions of SMS4DC
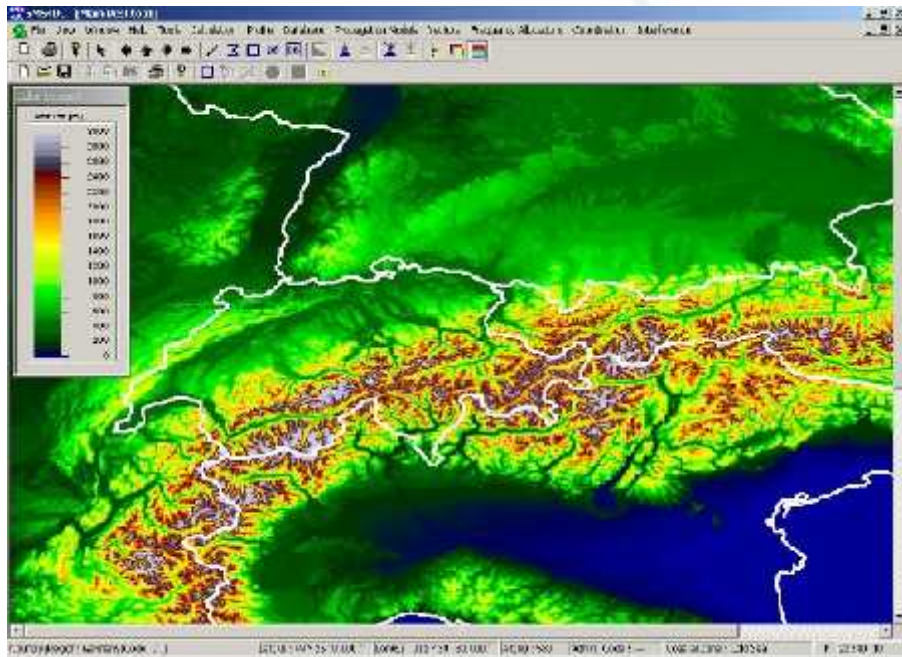
Digital Elevation Model (DEM) 2D and 3D views
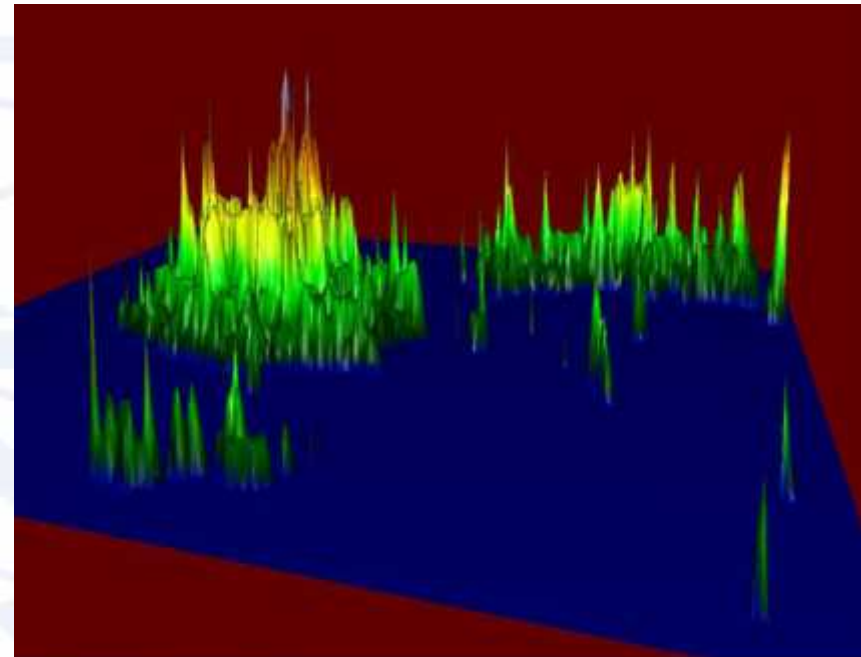
Map Display in 3D

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

GIS Functions of SMS4DC
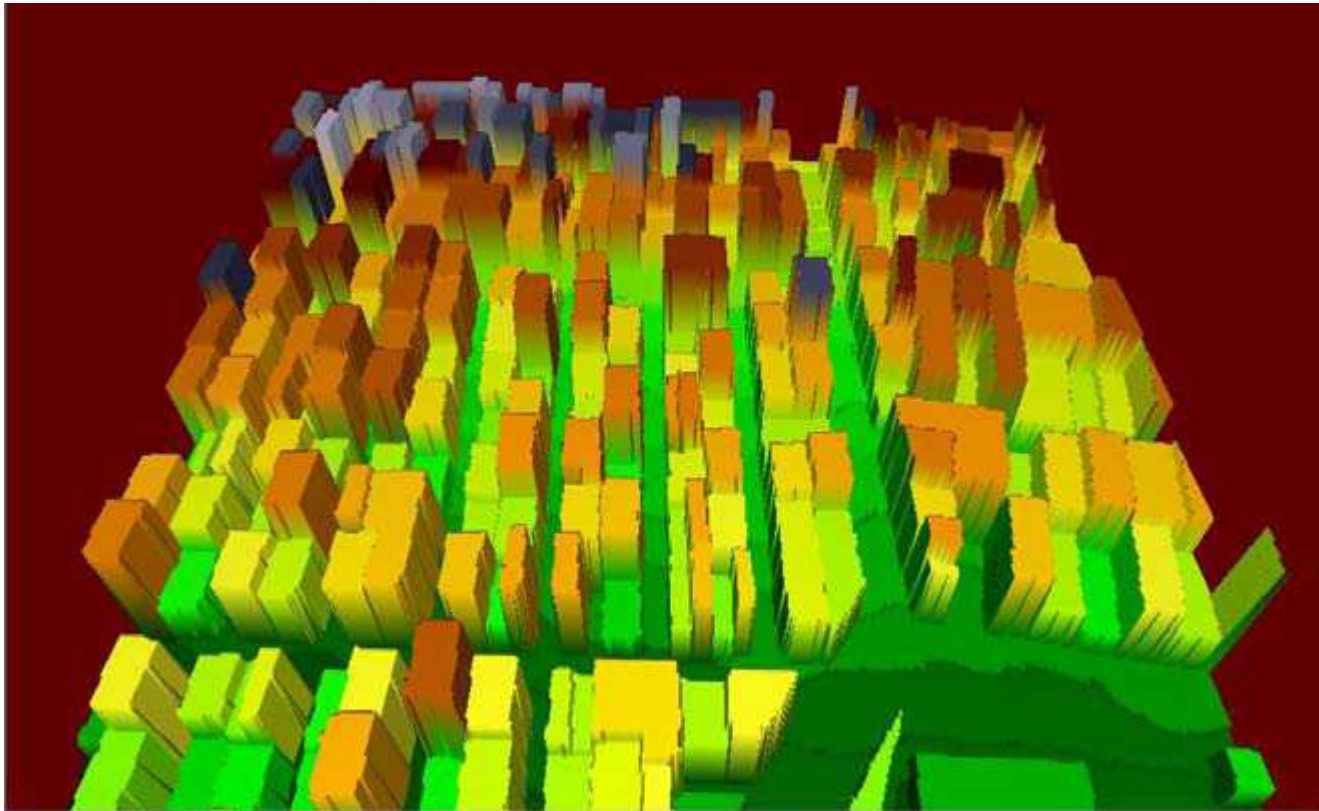
Raster Map 1m resolution

GIS Functions of SMS4DC
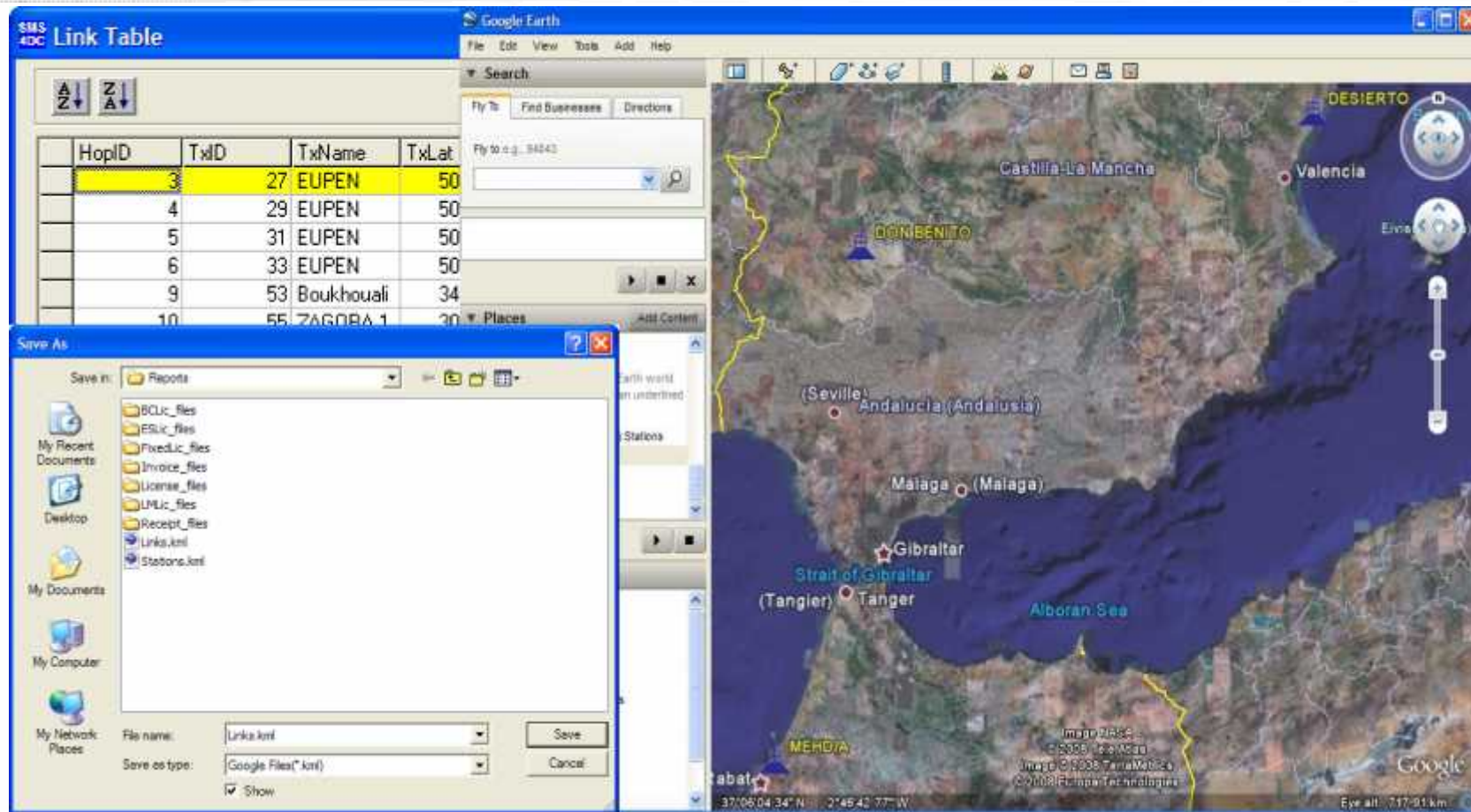
Export of maps, overlays and vectors to Google Earth Searching and displaying stations on DEM)

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;

New Radio station parameters in-line with ITU coordination requirements

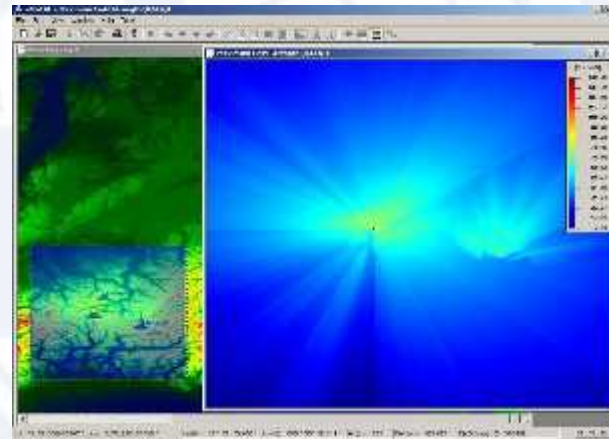# Engineering Analysis Functions of SMS4DC

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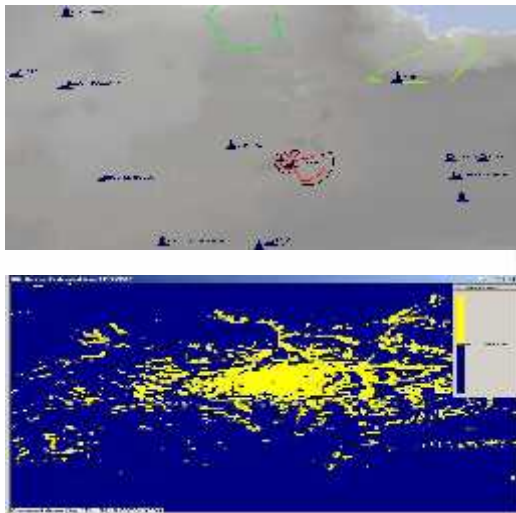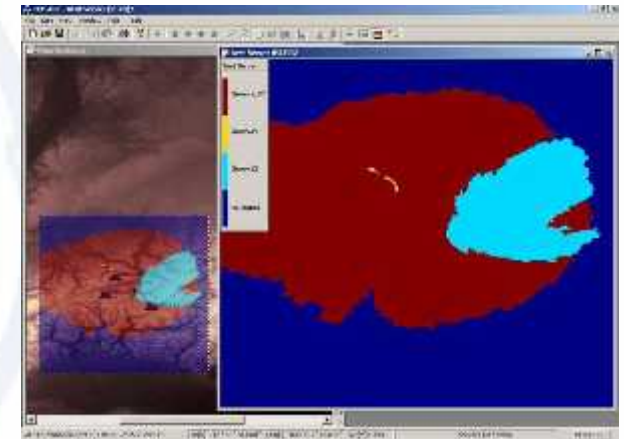

Coverage area

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.
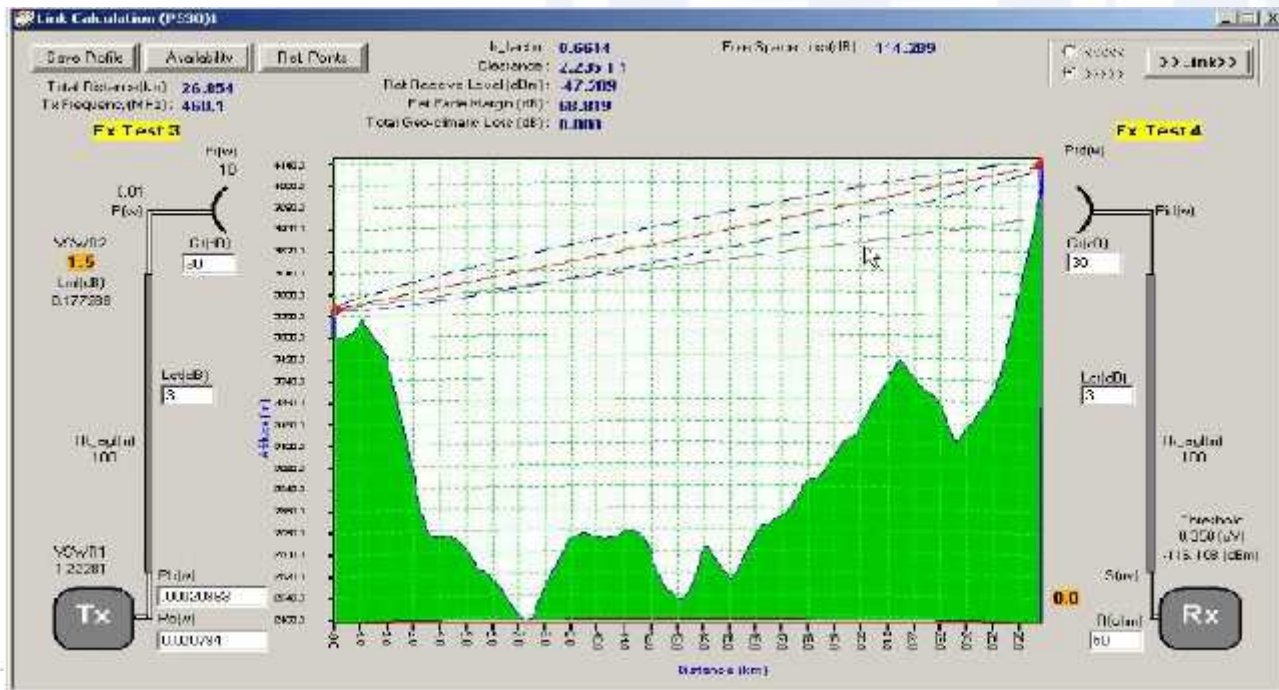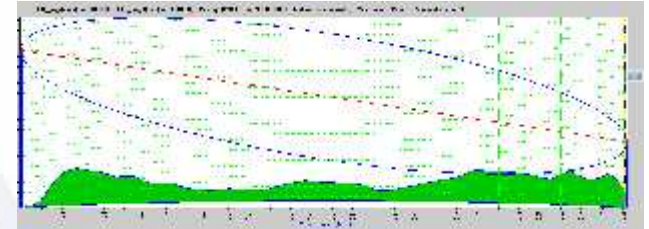

Best Server

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*
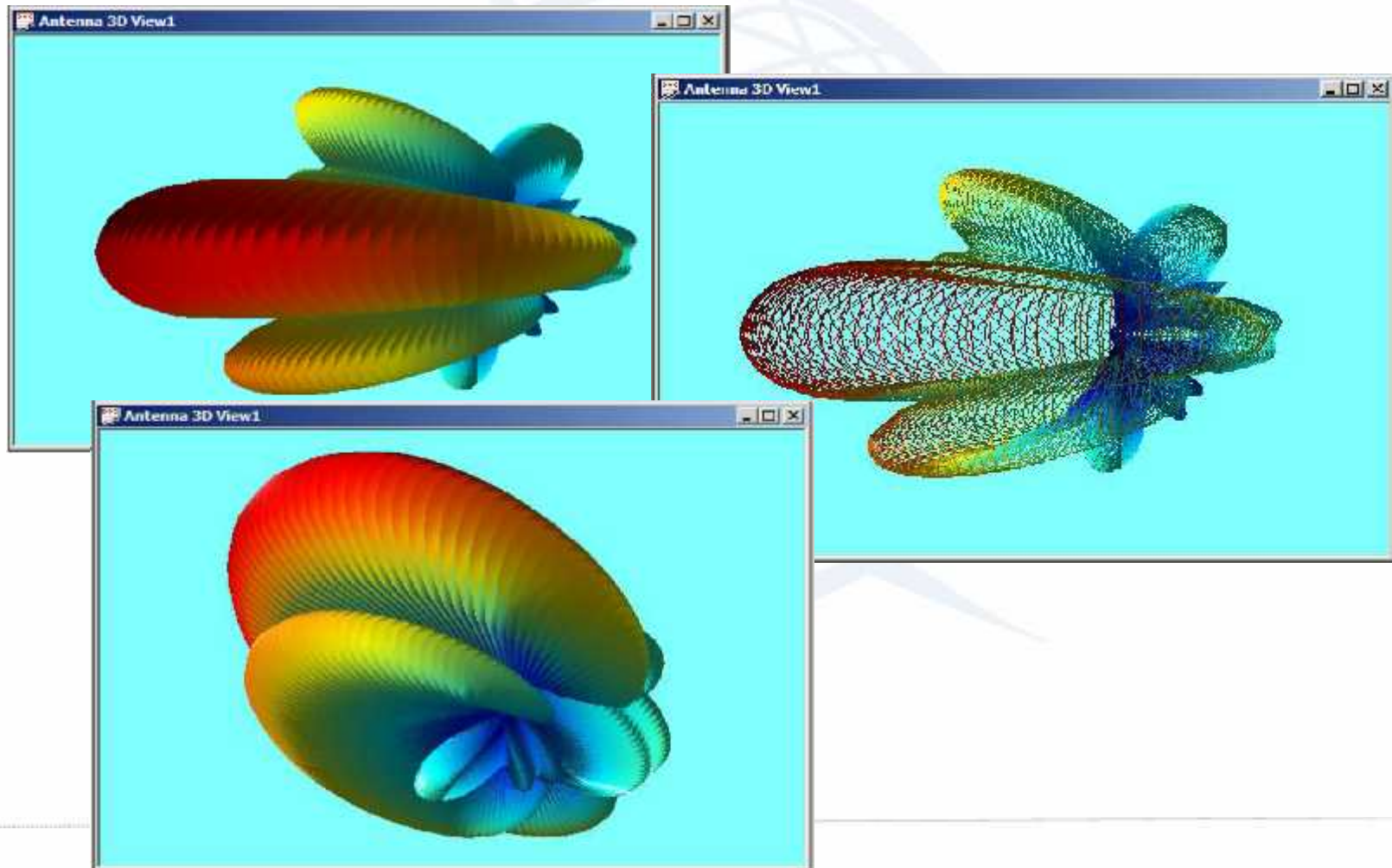- *Path profiles*
- *Fresnel zone clearance*

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).*

Engineering Analysis Functions of SMS4DC

3D radiation Patterns

Examples of Automated SM tools : **Others tools**

1. RR App. 7

➢ **Coordination distance calculations based on RR Appendix 7**

- *Automated methods are applicable to the procedure outlined in RR Appendix 7 for determining the coordination area around an earth station in frequency bands between 100 MHz and 105 GHz shared by space and terrestrial services.*

- *Computer programs developed by the BR and other administrations are available in the BR software packages and are used to calculate coordination distances during technical examination of frequency assignment notices.*

- *A coordination diagram has been automatically drawn on a computer-generated map*

2. Online calculation services

➢ **Online BR calculation services for testing purposes and assisting in coordination**

- *The BR has implemented a fully automated system which allows TIES users to perform calculations on-demand for testing purposes and assisting in coordination.*

- *The system is composed by a web front-end portal (for input data submission and display/download of calculation results) and a back-end system composed of services (for managing the calculation workload) and a database (for queuing requests and storing input data and calculation results).*

- *The system is accessible from the URL: http://www.itu.int/ITU-R/eBCD/MemberPages/eCalculations.aspx*
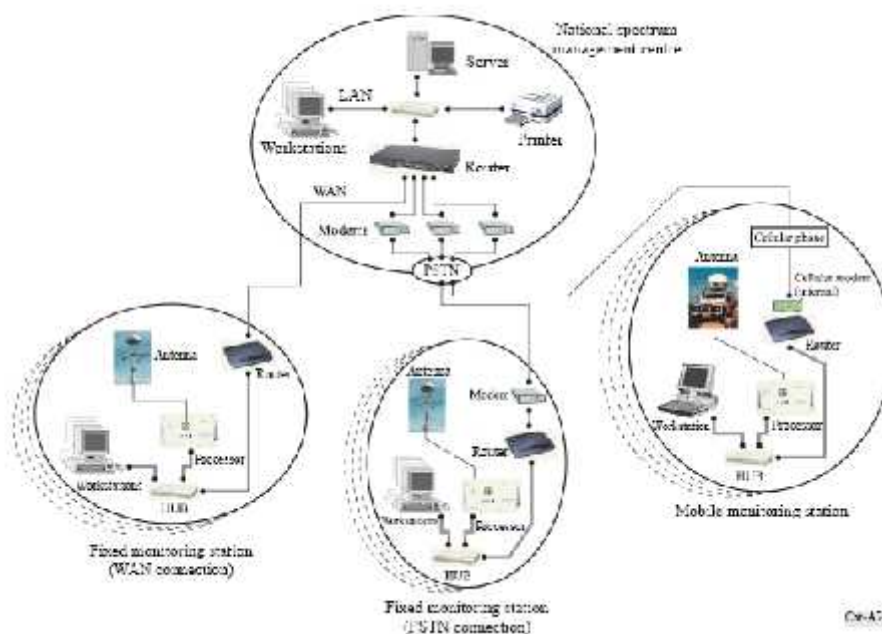
3. SPECTRA

The SPECTRA system, developed by LS telcom AG, Germany, is comprehensive and advanced automated spectrum management systems covering the whole range of administrative and technical functionalities for all radio services.
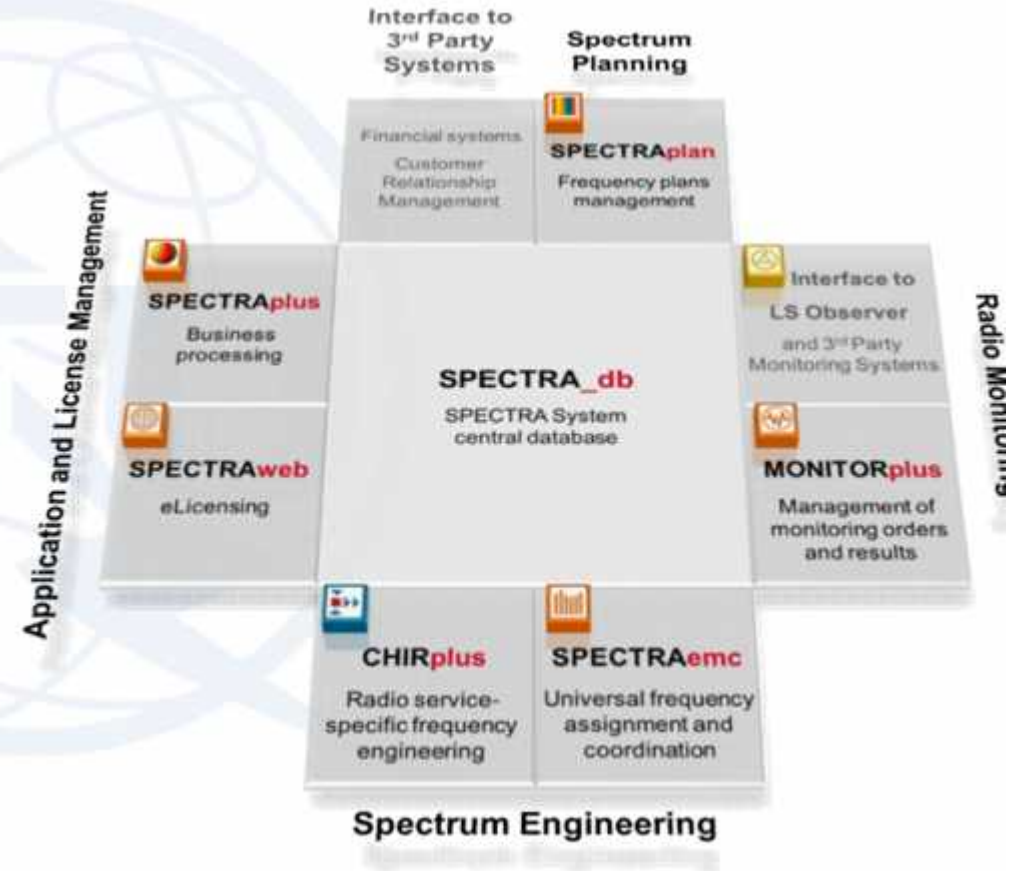
4. TCI ASMS solutions

TCI provides fully automated and integrated spectrum management and monitoring systems.

A complete system typically consists of a national spectrum management center, with its database server and workstations, and multiple fixed and mobile monitoring stations, each with a measurement server and one or more workstations.
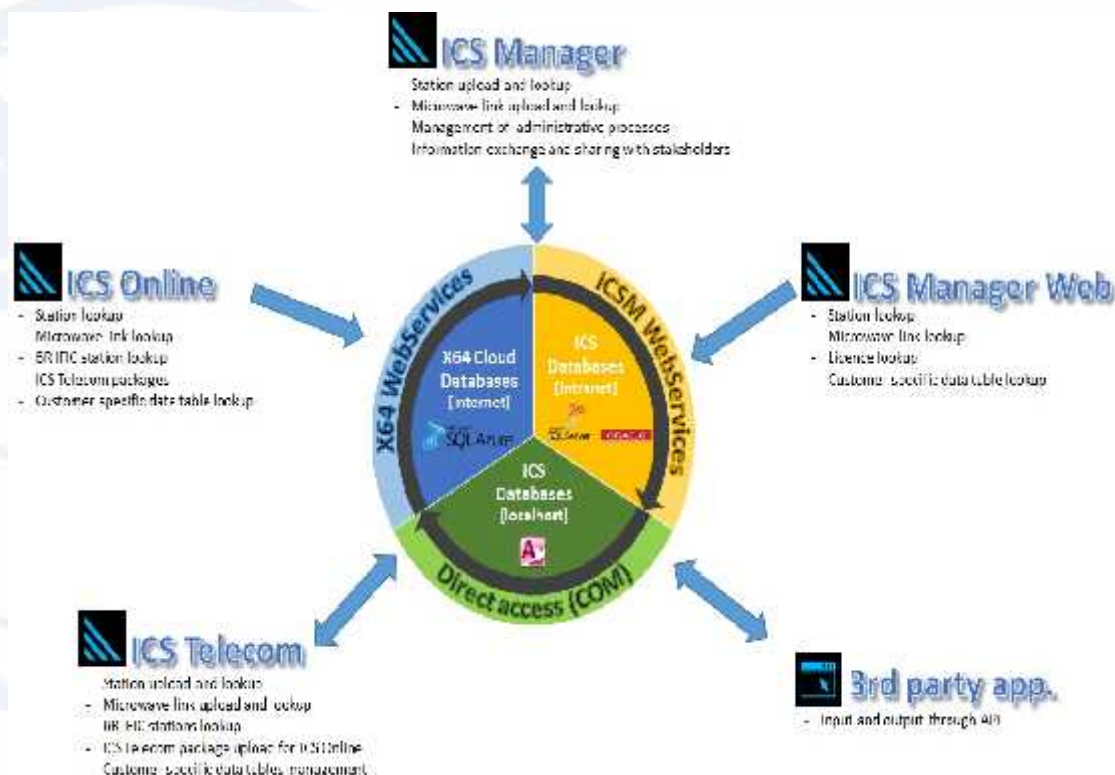

TCI Integrated Management and Monitoring System

5. ATDI

ATDI has modular solutions covering various automated functions and services including

- **ICS telecom** *for RF planning*
- **ICS manager** *Data basing functions*
- **HTZ warfare** *Spectrum engineering, radio network planning and communication electronic warfare*
- **Spectrum E**: *Spectrum Engineering Online*

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**

I Thank U

"Committed to connecting the WORLD"

Major ITU-ASP SM Events in 2017

ITU COE online training on Spectrum Management (Legal and wireless innovation Issues)
13 - 24 February 2017

ITU COE training on Spectrum Engineering and Cross border Coordination
Xian, China, May 2017

ITU-Forum Global regional workshop on Spectrum Management
Bangkok-Thailand, Q2/3 2017

ITU Study Group Meetings
ITU-D (Res. 9) and ITU-R SG1

Your active participation in and contribution to these events is most welcome!