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.

Elements of 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

- ITU Tools and Databases
- Network
- Monitoring System
- Spectrum Management System
  - Technical modules
  - Data processing modules
  - Geographical Information System
- Monitoring Database
- Digital Maps (e.g. Digital Elevation Model)
- Spectrum Management Database

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

External Database

SMS4DC software

External Resources and Applications

Interface to the external databases

Internal Database

Technical & Administrative Modules

Interface to the external resources

Monitoring Systems

External Databases

SMS

LIBRARIES

BR IFIC

SRS

BRs

External Resources and Applications

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

Digital Elevation Model (DEM) Menu
GIS Functions of SMS4DC

Digital Elevation Model (DEM) 2D and 3D views
Based on the Global Land One-kilometer Base Elevation model (GLOBE)

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)
**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.

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

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

Monitoring request to SMS4DC

1. Outbox
2. MONITORING SOFTWARE
3. Inbox
4. Results
**SMS4DC’s Engineering Functions**

**SMS4DC and monitoring software interface**

SMS4DC order to monitoring

1. Inbox
2. Order(s)
3. Outbox
4. MONITORING SOFTWARE

**Results**

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**Engineering Analysis Functions of SMS4DC**

**3D radiation Patterns**

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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
Version 5.1

- V5.1 released in 2017
- [https://www.itu.int/pub/D-STG-SPEC-2017-V5.1](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 preparation 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

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.
  o 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.
  o 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:

- SMS4DC 5.0 User Guide
- Recommendation ITU-R SM.1370
- Recommendation ITU-R SM.1537
- Recommendation ITU-R SM.1604
Thank you!

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