

Spectrum Management System for Developing Countries (SMS4DC)

**Executive Overview of the main features
Version 5.2**

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1 Introduction

It is generally accepted that an effective telecommunication infrastructure is one of the essential drivers that enables a country to achieve successful social and economic development. Wireless telecommunication is especially important for developing countries because it will reduce the time and expense of installing copper or fiber networks in large rural areas. Therefore, an orderly management of the national use of the radio spectrum resource is crucial to obtain the maximum benefits. A number of administrations of developed countries are exploring the use of market methods to transfer responsibility for detailed spectrum management to industry and users. However, these administrations, without exception, have the benefit of a long standing and strong foundation in traditional (so called command and control) spectrum management methods that enables them to create a technical and regulatory envelope within which the new methods can operate successfully and safely.

The International Telecommunication Union Telecommunication Development Bureau (ITU-BDT) can supply a computer program to assist the administrations of developing countries to perform their spectrum management responsibilities more effectively. This program is known as the Spectrum Management System for Developing Countries (SMS4DC). SMS4DC is intended to be a low-cost, entry-level spectrum management system; however, it is a very complex software tool with many technical features and functions. This document has been prepared by the ITU to provide an executive overview of the system for those intending to purchase and operate the software in their administrations or agencies.

It is emphasized that, for successful installation and operation of SMS4DC, the Administration should have in place existing legal, regulatory and technical mechanisms for national spectrum management. Also, while the system automates many of the technical processes, the final choice and decision for the frequency assignment remains with the engineer. Therefore, operating staff must have sufficient knowledge to understand the regulatory and technical processes that are the operational core of SMS4DC and to interpret correctly the results of the algorithms so that they can make good decisions. Further information on national regulatory, technical and staff training requirements is given in § 2.2-2.6.

The SMS4DC software has been designed to manage frequency assignments to the Land Mobile, Fixed and Broadcasting services and for frequency coordination of Earth stations (RR Appendix 7 procedures). While some assignment and interference analysis processes are unique to a particular service, there are several processes and tools that are applicable to all services. To avoid unnecessary repetition and to provide a logical approach, the common functions are grouped together into task-oriented sections. Where appropriate, brief explanatory information is given to assist in the understanding of the importance or purpose of the various tasks and what will be required from the Administration during installation and set-up.

Annex 2 provides screenshots as selected examples to illustrate some of the SMS4DC functions. The SMS4DC User Manual provides a complete and thorough menu-oriented description of all functions, with many screenshots to illustrate what can be expected at each stage of a process. Annex 3 provides a task-oriented index of the SMS4DC User Manual.

2 Installation and Operational Requirements for SMS4DC

2.1 Computer and Operating System

Computer hardware

SMS4DC may be configured for Single User operation, as a Network Workstation or as a Network Server. The computer hardware and operating system requirements will depend on the configuration and are listed in Annex 1. In general terms, a modest desktop PC (2 GHz clock, 2 GB RAM, 3 GB free hard disk) could be used for a single user or workstation. For better performance, will require a considerably higher specification (3 GHz clock, 4 GB RAM, 10 GB free hard disk). All configurations will require: Visual Display Unit 1024 x 768 resolution (OpenGL capable), DVD drive, and colour printer.

Operating System

Depending on the configuration:

Single User or Network Workstation: Microsoft Windows 8 or 10

Network Server: Microsoft Windows Server 2016 or newer

Other software

All configurations will require:

- Microsoft Office version 2010 or later
- Adobe Acrobat PDF reader version 6 or later
- Google™ Earth software

Also, it is highly recommended that the ITU-BR International Frequency Information Circular (BR IFIC) for Terrestrial and Space Services is installed on the workstation or the network prior to installation of SMS4DC. BR IFIC will be essential for frequency co-ordination procedures. Also, a considerable amount of time can be saved by using the import function to transfer information from BR IFIC into the SMS4DC database, for example the broadcasting assignments and allotments from the GE84 and GE06 Plans.

Internet access

It is further recommended that an internet connection is available to obtain up-to-date information from the ITU website and to enable the interface to Google™ Earth.

2.2 National legal and regulatory framework

As emphasized in the introduction, it is essential that a national legal and regulatory framework is in place, so that the Administration (or spectrum management agency) has the legal authority to manage the spectrum and radiocommunication services for which SMS4DC will be used to assist in frequency assignment. The ITU-R Handbook on National Spectrum Management provides guidance to Administrations on all aspects of spectrum management. Briefly, management includes: the authority to assign frequencies; to specify technical standards; to license users; to charge license fees and to enforce license conditions. In particular, there should be a National Frequency Allocation Table (agreed at ministerial level) from which the available channel lists for

SMS4DC will be created. During the installation, these lists of nationally available channels will be entered into SMS4DC.

2.3 Licensing database

The Administration must supply a database of existing use for the frequency bands and services for which SMS4DC is intended to be used. This database must be transferred to the SMS4DC database, otherwise the frequency assignment process will be unable to perform interference calculations between new assignments and existing users. If the database is in paper format, the information will have to be entered manually. If it is in computer format (e.g. Microsoft Access, or even an Excel spreadsheet); it may be possible for a custom conversion program to be developed. If there is no existing database, the Administration should seek further advice from the ITU. However, creating a database when there are few or inadequate existing records will be a lengthy business, possibly requiring an extensive monitoring campaign.

2.4 Licensing system

SMS4DC and the licensing database must be part of an integrated licensing system; otherwise the data will become outdated. It should be a national legal requirement for all transmissions to be licensed¹ and for licensees to inform the Administration about changes. Also, it will be necessary to provide an appropriate enforcement system so that legal action may be taken against users of unlicensed transmitters or operation not in accordance with license conditions. This ensures that license records are kept up-to-date and an accurate record of frequency use is maintained. There should be an appropriate fee structure for cost recovery for the licensing system (see ITU-R Report 2012). Forms for license applications and license schedules will be required and must be designed to ensure all relevant information is submitted on applications or printed on a licence schedule (which is a legal document). Different forms will be required for each service. Information sheets or an Administration internet website should be provided so that applicants for licenses have sufficient information about license requirements and fees.

2.5 Technical information database

SMS4DC uses several internal technical reference tables during the assignment process:

Channel Arrangements: these are derived from the National Frequency Allocation Table and national technical policies on how particular frequency bands should be used. A channel arrangement will specify whether the channels should be single frequency or two-frequency, the frequency spacing between channels and any necessary guard-bands to protect services in adjacent bands. The service type and typical equipment characteristics will normally be the deciding factors. If there are no national channel arrangements, these can be developed using ITU recommendations and equipment standards from international standards organizations. To assist frequency co-ordination, arrangements should be harmonized with neighboring countries. Arrangements for

¹ Depending on national policies, some transmissions may be “license exempt” because the technology used ensures minimum probability of interference with other systems.

those bands currently in use will have to be decided and agreed before installation. Other sub-bands can be added later when they are brought into use.

Equipment Library

The equipment characteristics are recorded in the database for each station as part of the licensing process. Some information, such as transmitter and receiver emission “masks”, are necessary to calculate interference values during frequency assignment. Typical values for this information can be entered during initial use of SMS4DC. In the longer term, the Administration should consider developing a list of approved equipment as this would help the data entry officers.

Antenna Library

There is a similar requirement to record information on antennas (patterns defining vertical and horizontal gain). Typical information can be entered as part of the installation package but in the longer term, the Administration should consider producing a list of required characteristics, especially for point-to-point links, as unnecessarily wide antenna beam widths can lead to inefficient spectrum use.

2.6 Staff knowledge, experience and training

On request, the ITU may be able to provide special assistance and training in the installation and operation of SMS4DC. However, it is emphasized that SMS4DC is not a fully automatic frequency assignment system. The system automates most of the technical assessment procedures and displays the results. The final decision must be made by a suitably qualified radio engineer who should understand fully the assignment procedures and be able to interpret correctly the results displayed. The engineer should have a thorough understanding of: interference mechanisms, field strengths, protection ratios, propagation modeling and typical operation of the land mobile, fixed and broadcast services. Also, for frequency co-ordination and notification, the engineer should have an understanding of the ITU procedures, especially the procedures in the ST61, GE84, GE89 and GE06 Agreements, if the engineer is to make assignments to broadcast stations. If clerical officers are used for data entry, they will also need basic training to understand some technical terms in order to read the application forms and enter the data accurately. These terms include: service definitions, power, antenna gain, geographical coordinates, ITU designations, types of ITU notification forms etc. A full description of each field in the data entry screens is given in Chapter 4 of the User Manual.

3 Geographical Information System

3.1 Overview

SMS4DC makes extensive use of a **Geographical Information System (GIS)** to improve the effectiveness of assignment tasks. The geographical locations of transmitters and receivers, together with terrain height information are essential factors that must be taken into account in frequency assignment. Therefore a GIS offers the engineer significant benefits to frequency planning and interference management by providing a visual presentation of the relative locations of country and regional borders, mountains and coastal areas and transmitter/receiver sites, with overlays for field strength contours to show coverage areas and interference zones.

SMS4DC has two map displays: International Digital World Map (IDWM) and the Digital Elevation Map (DEM). These also provide an interface, through Windows-style tool bars, to other functions including Google™ Earth.

3.2 International Digitized World Map (IDWM)

SMS4DC incorporates the ITU IDWM. This is a database in map-format of geographical and technical data related to the Radio Regulations and certain Regional Agreements. The drop-down menu allows the following to be displayed on the map:

- ... ITU Regions
- ... Country borders
- ... Coast lines
- ... Islands
- ... Lakes
- ... Propagation zones as defined in the Regional Agreements: ST61, GE84, GE89 and GE2006.

The initial display is of the whole World but users may use the Graphical User Interface (GUI) to zoom-in on particular geographic locations.

3.3 Digital Elevation Model (DEM)

The Digital Elevation Model (DEM) incorporated into SMS4DC is the Global Land One-kilometer Base Elevation model (GLOBE). GLOBE has a resolution slightly better than 1 km at the Equator and progressively finer resolution toward the Poles. The terrain heights above sea level can be represented on the map by a grey scale, a colour scale or by 3D view. SMS4DC reads the terrain heights in the database and can use them, for example, to construct path-profiles between point-to-point link stations or in the propagation models to determine effective antenna height and clearance angles.

Higher resolution raster terrain data can be integrated into SMS4DC (to replace GLOBE), without the need to change or re-compile the software. However, some assistance from the development team may be required to prepare and install alternative terrain data.

The DEM is the main GUI for frequency assignment, with drop-down sub-menus and toolbar buttons providing access to the calculation and assignment functions.

4 Engineering tools (Calculation, Profile and Vector Menus)

4.1 Overview

In addition to the frequency assignment and service-specific analysis tools, the engineer may use a number of engineering tools and aids that have a general applicability and usefulness for any frequency assignment task. These tools may be accessed through the drop-down Calculation, Profile and Vector menus on the DEM. This menu includes some graphical tools which are also used in the Propagation tools menu.

4.2 Graphical tools on the DEM Toolbar

Some tools in the Calculation and Profile menus are activated only after use of certain graphical tools shown as “push-buttons” on the DEM toolbar.

Line: Lines can be “drawn” on the Digital Elevation Map by mouse click on the beginning and end points.

Polyline: *Polylines (two or more joined lines) can be drawn on the DEM by mouse click on the beginning and intermediate points and double click on the end point.*

4.3 Calculation menu

Radio Horizon: Uses the standard formula to calculate the radio horizon distance between two stations, taking into account antenna heights and the effective Earth radius.

Intermodulation: Is a common effect when several transmitters and receivers operate in close proximity (e.g. at a hill-top site) and is the result of two or more signals of different frequencies being mixed together, usually in the amplifier circuits of the receivers or transmitters, to form additional signals that can cause interference to receivers on-site or nearby. This tool calculates the frequencies of these unwanted signals with the objective to avoid using frequencies on the site that have an intermodulation relationship.

Unit conversion: This useful tool enables the engineer to convert different radio engineering unit from one to the other (e.g. from receiver input (dBpV) to field strength (dB μ V/m) at a particular frequency).

Antenna editor: Antenna characteristics (horizontal and vertical gain patterns) are used to calculate effective radiated power (e.r.p.) and are also required for many ITU notification procedures. SMS4DC has an antenna pattern library and this tool is used to enter into the library the patterns for new antennas, or to modify existing patterns.

Effective antenna height of a transmitting antenna is the height of the antenna above terrain height averaged between distances of 3 to 15 km in the direction of the receiving antenna. It is used in many propagation prediction models and is also required for many ITU notification procedures. This tool produces a file of heights for each 1 or 5 degree radial around the transmitter that is compatible with ITU electronic notification procedures. It can also display the result on a colour-scale map.

Once a Line or Polyline has been drawn, the following additional items in the Calculation menu are activated:

- ... **Distance:** gives the distance between the end points of a line or total length of the polylines.
- ... **Area:** if a Polyline encloses a polygon (beginning and end points are the same), the enclosed area is measured.
- ... **Azimuth:** calculates the angle with respect to North of the line, as measured from the beginning point.
- ... **Elevation:** measures the angle of the line with respect to the horizon, as measured from the beginning point.

4.4 Profile menu

Once a line or polyline has been drawn, these items are activated:

- ... **Profile:** shows the terrain height profile along the line or polyline.
- ... **Fresnel zone:** (for line only) shows the terrain height profile and the Fresnel zone clearance between beginning and end points.

4.5 Vectors menu

- ... **Draw Circle:** draws a circle of user-defined radius around a station in the database.
- ... **Draw from file:** draws a vector that has been previously created and stored in a file.
- ... **Remove from display:** removes (clears) all vectors from the map.
- ... **Vector handling:** provides an interface to store or delete circles and field-strength contours and to export them to Google Earth.

4.6 Interface to Google™ Earth mapping

Google™ Earth is a free, on-line (Internet), interactive 3D map display of the Earth with, for many geographical areas, high resolution satellite images of the Earth's surface and features. Overlays of cities, towns and roads are provided and, using the Keyhole Mark-up Language (KML), users may develop their own overlays (e.g. national regions, zones and districts). For example, the ITU-BR generates KML files from its on-line Broadcast Query (BC-Q) tool that can be downloaded to provide overlay mapping information on Plan and MIFR assignments and proposed modifications. SMS4DC provides an interface through the Tools and Vectors menus that provides a conversion for many of its calculation results (field-strength contours, point-to-point links and other types of vectors and raster results) into KML format files so that they may be seen as overlays on the Google™ Earth mapping system.

5 Propagation tools

5.1 Overview

Propagation modeling is an essential frequency management tool that provides the engineer with the ability to predict the path loss between point-to-point link stations or the effective coverage/interference area of broadcast or land mobile transmitters. Although a limited application of propagation models is possible using manual methods, computer methods are needed for practical applications such as constructing field strength contours, transmitter-network interference estimation and using terrain-height information. Furthermore, computer modeling permits the results to be displayed as contour lines or colour-scale images on high-resolution maps.

Several well-known propagation models (including ITU-R “classics”, such as those specified in regulatory agreements) have been implemented in SMS4DC. Two main types of model for predicting propagation are required: those for point-to-point systems (e.g. fixed services) and those for point to area systems (e.g. land mobile or broadcasting services). Some models can be used for both types. All propagation models are designed to enable different values of parameters to be used to take account of differences in the particular path or area under examination and SMS4DC includes various pop-up menu boxes to enable the engineer to enter the appropriate values. Of course, the engineer

must have the necessary training and experience of propagation modeling to understand how to use the SMS4DC tools to obtain valid results.

5.2 Analysis Types

Table 5.2.1 shows the propagation models implemented in SMS4DC and the valid combinations of model and type of analysis.

Lines, Polylines or an Area (box) may be defined (drawn) on the Digital Elevation Map using the DEM toolbar functions (see §4.2). Once drawn, the relevant menu items are enabled in the **Propagation Tools Menu** for further analysis in accordance with Table 5.1 (valid combinations are marked Y). Depending on the analysis type and model, the output could be, for example, a graph of field strength along a line or polyline, or a window containing a colour-scale field strength value map from a selected transmitter in a defined area. Such maps may be overlaid (with variable transparency) on the Digital Elevation Map.

Link analysis enables a complete analysis of the link budget between selected stations in a point-to-point link, including the path profile and Fresnel zones, in a comprehensive graphical display. Various parameters may be adjusted and the link budget is automatically recalculated to determine the effect.

Contour analysis determines field strength values along each radial at 1 degree intervals around the selected transmitter and draws a contour through all locations where the field strength is equal to a specified value. For example using P.1546 as the model, within this contour, the field strength at L% of locations and T% of time should be greater than the specified field strength (values for L and T may be specified in accordance with P.1546).

The **Network Processor** analysis enables comparison of the service areas (or interference areas) from two or more transmitters to be determined and displayed in different colors on the Digital Elevation Map.

Table 5.2.1

Propagation Models	Analysis type					Network Processor	
	Line	Polyline	Area	Link	Contour	Max Field Strength	Best Server
Free Space	Y	Y	Y	N	N	Y	Y
Line of Sight	Y	Y	Y	N	N	N	N
ITU-R P.370	Y	Y	Y	Y	Y	Y	Y
ITU-R P.1546	Y	Y	Y	Y	Y	Y	Y
ITU-R P.1812	Y	Y	Y	Y	Y	Y	Y
Okumura-Hata	N	N	Y	N	N	Y	Y
ITU-R P.526	N	N	N	Y	N	N	N
ITU-R P.452	N	N	N	Y	N	N	N
ITU-R P.530	N	N	N	Y	N	N	N

6 Administrative database and Licensing System

6.1 Overview

The database structure, the user access control and the networking capabilities permit SMS4DC to be operated in several configurations depending on the needs (size and resources) of the Administration (or spectrum management authority). For example, for very small administrations, SMS4DC may be configured as a stand-alone workstation for a single operator who is responsible for all tasks. However, for larger administrations, several terminals may be networked and the access controls set up to allow clerical officers to perform data entry, engineering officers to perform assignment and licensing officers to perform licensing and accounting. SMS4DC provides a simple accounting system for recording fee payments and invoicing.

6.2 Stations, Licenses and Billing

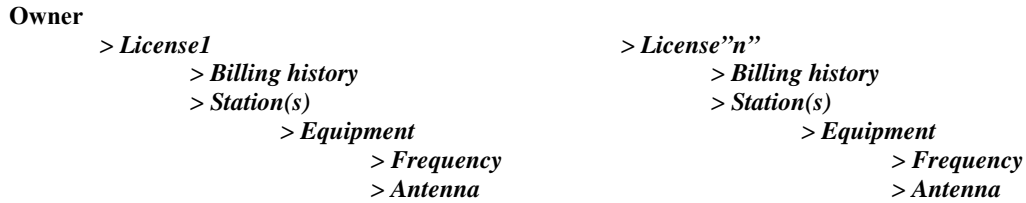
The Licensing tools are accessed from the DEM *Database Menu* or directly at sign-on, if the user has only Data Entry or Licensing access permission. Licensing information is presented in the *Administrative data* window in a “tree” or hierarchical format. There are three main sections:

Anonymous stations: These stations are not (yet) licensed. They are added to the database in the engineering analysis stage of the assignment process. If a frequency is successfully assigned, they may be transferred to a license. However, such stations could also be added for test purposes only and deleted once the analysis is complete.

Active licenses: Each Active license contains the details of the Owner, License(s), Billing history (fees paid and invoices issued), Stations (including frequencies, antennas etc.)

Archived licenses: When an Active license is deleted, cancelled or modified, it can be transferred to the Archived licenses part of the database for future information and record keeping.

The database has a hierarchical structure:



An **Owner** may have one or more **Licenses**. A **License** may have one or more **Stations** (in the same service). A **Station** may have one or more **Frequencies** or **Antennas**.

Licenses in some services may have additional levels, for example a Broadcasting license may have **Allotments**, an Earth station may have **Beams** and a Fixed station may have a **Receiver**.

Access to **License printing** is at the **License** level and **Fee payments and invoicing** are at the **Billing history** level.

7 Frequency Assignment and Interference

7.1 Overview

SMS4DC offers a range of functions that can be used to provide detailed technical and administrative assistance in the assignment of frequencies to the Land Mobile, Fixed and Broadcasting Services.

These include:

- ... Providing a database structure that contains all the necessary technical and administrative information with an interface between assignment and licensing processes;
- ... Ability to specify which channels are available through user-defined channel arrangements (service-type, frequency spacing, single and paired frequency channels etc.);
- ... Automatic assessment of all available channels in a given frequency range, taking into account co-channel and adjacent-channel interference between the new and existing assignments. Detailed results are displayed for the assignment engineer to choose the most suitable channel;
- ... Use of propagation tools to estimate service/coverage/interference areas with geographical display;
- ... International frequency coordination tools, including assessment of the proposed assignment for compliance with ITU Regional Agreements, bilateral or multilateral agreements.

SMS4DC automates the technical analysis used in the assignment process but does not decide which frequency should be assigned. After the automated technical analysis procedure has completed, the results for each available frequency are displayed to an engineer who can make the assignment decision based on the results. The engineer must have a thorough understanding of the principles of frequency assignment in order to interpret the results and, if necessary, carry out more detailed analysis.

Although there are differences in the assignment procedures and technical considerations for the Land Mobile, Fixed and Broadcasting Services, there is a core procedure, common to all service-types, which is explained briefly in §7.2-7.3 below. After SMS4DC has completed the initial examination of available channels, the engineer may use the specialized analysis tools for the service-type concerned.

7.2 Determine available channels from the Channel Arrangement Tables

SMS4DC obtains a list of channels available for the assignment service-type from the ***national channel arrangement tables*** that were entered into the database during initial setup and is consistent with the National Frequency Allocation Table (NFAT).

The NFAT is based on the Frequency Allocation Table in the Radio Regulations (Article 5) which specifies the international allocation of frequency bands to radiocommunication services. However, additional national information is included to show, for each band, which government departments or agencies have authority to make frequency assignments. Each relevant department or agency may then decide how the frequency bands within its authority should be arranged to facilitate assignment (channel bandwidths, single frequency or two frequency channels etc.). In view of its importance, the NFAT is usually agreed at inter-department level. An agreed NFAT is therefore essential to prepare the ***national channel arrangement tables*** for entry into SMS4DC as part of the initial installation procedure.

7.3 Initial analysis of the available channels for existing stations

- ... Each of the channels in the appropriate national channel arrangement table is examined to find any existing assignments within a circular area (engineer-defined). The results are displayed on-screen in spreadsheet format with each channel shown on a separate row. A row is marked in yellow for any channel with an existing assignment within the defined area.
- ... The engineer can select any channel for a detailed interference analysis by mouse-click on the appropriate row. The free-space propagation model is used to calculate the field-strengths to and from the proposed assignment and existing assignments. Results are displayed in spreadsheet format with a separate row to show calculation results for each existing assignment. If the difference between wanted and unwanted field strength exceeds an engineer-defined level, that row is marked in red as a potential interference case.
- ... At this point, the engineer may decide to assign the channel, consider other channels or to undertake more detailed analysis using the other analysis tools available including the special interference tools for the service concerned.

7.4 Land Mobile Service

The general frequency assignment procedure described in §7.2 – 7.3 above can be used to assign frequencies to the Land Mobile Service. Assignments can be made to Fixed Base (FB) or Mobile (ML) stations. FB stations will have a specific transmitting site, while ML stations can operate within a specified area. FB and ML stations may be linked together in the database if they are part of the same system. If the Fixed Base is part of a larger system, using other Fixed Base stations to provide wider geographical

coverage, the Network Processor in the propagation tools menu may be used to assess overall coverage. Once a frequency has been assigned, probably it will be necessary to co-ordinate with neighboring countries (see **Section 8 Co-ordination menu**).

7.5 Fixed service

Point-to-point links in the Fixed service will have two stations at each end of the link (or “hop”) using highly directional antenna. The engineer will first use the engineering tools, for example, to check the azimuth directions between the link stations so that the correct values are entered for the interference calculations and to check the Fresnel zone clearance. Complex systems may have several hops in “tandem” to cover longer distances over difficult (e.g. mountainous) terrain or to link several intermediate points to provide a backbone-like communications system. Each hop will use a two-frequency channel for “go” and “return” duplex operation, probably in accordance with one of the ITU-R recommended channel arrangements. One frequency of the channel is assigned for transmit at one end of the link (station “A”) and the other frequency of the channel is assigned at the other end of the link (station “B”). The general frequency assignment procedure described in §7.2 – 7.3 above can be used to assign one frequency of a suitable channel to station A and then the procedure is repeated to assign the other frequency of the same channel to station B. SMS4DC has a facility to associate Station A and B with each other in the database so they are displayed as a link on the DEM and considered as a pair for interference assessment. The Interference menu can then be used and two interference tools are provided: ***FX2FX(link)***: calculates interference of stations between different point-to-point hops, taking into account antenna radiation patterns and cross-polar-discrimination (XPD) in accordance with recommendation ITU-R P.452. ***FX2FX (station)***: calculates interference between fixed stations in accordance with recommendation ITU-R P.452, taking into account antennas pattern and Net Filter Discrimination (NFD) (overlap between transmitter and receiver emission masks). Once a frequency has been assigned, probably it will be necessary to co-ordinate with neighboring countries (see **Section 8 Co-ordination menu**).

7.6 Broadcasting service

The general frequency assignment procedure described above in §7.2-7.3 may be used to find frequencies for new broadcasting stations (not in the Plans). However, in most cases, Administrations will be using the frequency co-ordination tools described in Section 8 to implement (bring into service and coordinate) their allotments and assignments included in the various Plans associated with the ST61, GE84, GE89, and GE06 Agreements. In cases where Administrations are not satisfied with their allotments and assignments in the Plans and are seeking to make large changes or additions to the Plans, advice from the ITU Radiocommunication Bureau should be obtained.

The ***Interference menu*** provides two tools: ***BC2BC*** for analogue sound and ***BT2BT*** for analogue TV stations. These calculate aggregate interference level of interfering broadcasting (BC or BT) stations on a directional receiver of a wanted BC or BT station.

8 Frequency Co-ordination Menu

8.1 Overview

SMS4DC has the co-ordination tools required for:

Broadcasting service (Regional Agreements):

- ... Analogue Sound Broadcasting (GE84 Agreement)
- ... Analogue Television (ST61, GE89 and GE06 Agreements)
- ... Digital Sound Broadcasting (GE06 Agreement)
- ... Digital Television Broadcasting (GE06 Agreement)

Fixed and Land Mobile services:

- ... Bi-lateral and Multi-lateral Co-ordination Agreements (including HCM)

Earth station coordination:

- ... RR Appendix 7 procedure

Broadcasting service 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.

ST61 Co-ordination: for the few remaining frequency bands still subject to ST61 co-ordination, [BC,BT]2[BC,BT] calculates the co-ordination distance of a wanted VHF sound or TV broadcasting station to the nearest point on the border of neighboring countries which are in ST61 plan, Rev.2006

GE89 Co-ordination: for the few remaining frequency bands still subject to GE89 co-ordination, there are several tools to identify stations in neighboring countries that maybe affected by a wanted TV (BT) station: Television (*BT2BT co-ordination distance*); Fixed (*BT2FX field strength*); Land Mobile (*BT2LM field strength*). Also Fixed and Land Mobile stations that may affect a TV station (*[FX,LM]2BT field strength*).

GE84 Co-ordination: there are several tools to co-ordinate FM sound broadcasting station with stations in the broadcasting, fixed and land mobile radiocommunication services, in accordance with the GE84 plan: Sound broadcasting stations (*BC2BC coordination distance*); ST61 TV stations (*BC2BT ST61 coordination distance*); Fixed (*BC2FX field strength*); Land Mobile (*BC2LM field strength*). There are additional tools to calculate aggregate interference and nuisance field strengths to and from sound broadcasting stations to other sound broadcasting stations.

GE06 Co-ordination:

BCBT2BCBT (Affected Admin): identifies Administrations whose Sound or TV Broadcast services might be affected by a Sound or TV broadcast transmitter of another Administration.

BCBT2FXLM (Affected Admin): identifies Administrations whose Fixed or Land Mobile services might be affected by a Sound or TV broadcast transmitter of another Administration.

FXLM2BCBT (Affected Admin): identifies Administrations whose Sound or TV broadcast services might be affected by a Fixed or Land Mobile transmitter of another Administration.

FXLM2BCBT (Affected Admin)/TX FXLM: identifies by a coordination contour (defined in the GE06 Plan) Administrations whose broadcasting service might be affected by a Fixed or Land Mobile transmitter of another Administration.

FXLM2BCBT (Affected Admin)/RX FXLM: identifies by a coordination contour (defined in the GE06 Plan) Administrations whose broadcasting service might be affected by a Fixed or Land Mobile receiver of another Administration.

Coverage Area: calculates the noise-limited and interference-limited coverage areas for a wanted broadcasting assignment. These may be displayed on the DEM.

Service Area: calculates the service area test points for a wanted broadcasting assignment. These may be displayed on the DEM.

Interference To and *Interference From*: different scenarios are implemented to calculate interference between the broadcasting assignments/allotments and between the broadcasting assignments/allotments and stations in the fixed and land mobile services included in the GE06 Plan. These scenarios include interference to and from Digital Sound/TV, Analogue TV, Fixed and Land Mobile services.

8.2 Fixed and Land Mobile Service Coordination Agreements: these are agreed between countries on a bi-lateral or multi-lateral basis and are generally used to assist frequency coordination and avoid interference in border areas. Without such an agreement, co-ordination could be on a first-come-first-served basis. Agreements allow frequency bands to be shared equitably between all the countries sharing a border, by dividing the bands into “preferred” and “non-preferred” sub-bands. In its preferred sub-bands, a country has preferential usage rights. Agreements define the preferred sub-bands allotted to each country and the associated technical conditions for the usage rights, for example by specifying the maximum field strength at the border or at some distance from the border in the territory of the other country. The SMS4DC Coordination menu (*Agreements*) enables the technical details of Coordination Agreements to be stored in the database, while (*Border*) provides functions to assess whether a station meets the technical conditions of the Agreement.

8.3 Earth station coordination (RR Appendix 7 procedure): SMS4DC has two main menu items that assist with the Appendix 7 procedure. The first menu item, RR Appendix 7, uses BR R1448 software and the second menu item, RR Appendix 7 (GIBC), uses BR software which is integrated into GIBC.

The Options->RR Appendix 7 sub-menu in the IDWM view, enables selection of an Earth station in the database and drawing the various coordination contours (in accordance with BR R1448 software) on the IDWM map. Other sub-menu under this item displays details of the calculation results (including probably affected countries, coordination contour data and coordination information data).

The Options->RR Appendix 7 (GIBC) sub-menu in the IDWM view uses Appendix 7 software which is integrated into GIBC and programmatically produces coordination contours information around earth stations. The input and output to the program will be the same GIBC uses.

By selecting an Earth station from SM44DC database the input data is generated automatically in SNS V7 database format, and sent to BR GIBC Appendix 7 software. After calculation of coordination contours by GIBC software, these contours could be shown on SMS4DC IDWM/DEM maps.

The DEM Interference menu has sub-menu items to calculate interference caused or received by a selected Earth station on or from other Earth stations or Fixed stations located inside a circular area around the selected Earth station, using ITU-R Recommendation P.452, by consideration of antenna patterns and NFD (Net Filter Discrimination).

8.4 HCM Agreement

The item “HCM Agreement” in the menu of Coordination, performs the coordination calculations for concerned stations in the fixed or land mobile radiocommunication services, in accordance with Harmonized Calculation Method (HCM) agreement.

8.5 Generation of notices of frequency assignments for electronic submission to the ITU Radio Communications Bureau

Any frequency assignment has to be notified to BR if:

- ... its use is likely to cause harmful interference;
- ... it will be used for international communications;
- ... its use is governed by a plan (e.g. GE84 and GE06);
- ... its use is subject to a coordination procedure (Article 9);
- ... there is a desire to secure international recognition of its use.

SMS4DC can generate, store and display electronic notices to notify ITU BR the assigned frequency(s) or administrative modification(s) for assignments to Land Mobile, Fixed and Broadcast stations. The relevant ITU electronic notice forms are: T01, T02, T11, T12, T13, T14, TB1, TB2, TB3, TB4, TB5, G11, G12, G13, G14, GS1, GT1, GS2, GT2, G02, GA1 and GB1. Also for Earth stations, electronic notice files will be created in the form of Microsoft Access database files. During data entry, SMS4DC assists the officer by automatically taking into account the notice type and predicting which data items should be filled and used. Notice forms cannot be generated if the mandatory fields in any of the data entry masks are incomplete or have invalid data.

9 Importing data from BR IFIC (Terrestrial Services) and BR IFIC (Space Services) on DVD-ROMs.

The BR International Frequency Information Circular (BR IFIC) Terrestrial Services issued once every two weeks by the Radiocommunication Bureau. It contains information on the frequency assignments/allotments submitted by Administrations to the Radiocommunication Bureau for recording in the Master International Frequency Register and in the various regional or worldwide Plans/Agreements.

The BR International Frequency Information Circular (BR IFIC) Space Services issued once every two weeks by the Radiocommunication Bureau. It contains information (alphanumeric and graphic) relating to satellite networks and Earth stations recorded in the Master International Frequency Register (MIFR) or in the process of coordination or published under the advanced publication of information procedure.

The information in these ITU publications is essential for an administration to perform its international coordination responsibilities in accordance with the Radio Regulations.

SMS4DC provides an import facility so that relevant data, in particular about frequency assignments in neighboring countries, can be imported from the BR IFICs into the SMS4DC database. Without this data, the frequency coordination functions described in §8.2 and §8.3 above, cannot be used.

10 System and Database Security

10.1 Overview

A fully operational system, with database, licensing and technical analysis facilities, represents a large investment in time and resources. Once the spectrum management organization has integrated the SMS4DC into its operations and comes to depend on it, there would be severe disruption to the organization and licensees if the data was lost (though malfunction or disaster) or if unauthorized persons gained access to the data and used it incorrectly or inappropriately.

10.2 Database back-up and restore

SMS4DC provides the facility to back-up the database so that it may be stored in a secure location separate from the SMS4DC server. This back-up copy may be re-installed on the server or on a different server in the case of a major hardware failure.

10.3 User access security levels

SMS4DC has six (6) levels of security for user access to prevent unauthorized persons using the system, modifying licensee records or reference tables. This function is required when the organization intends to have different levels of staff using the system, for example clerical officers, licensing officers, accounting officers, engineering officers etc. A large organization would appoint a “System Supervisor” with access at all levels and overall authority to manage user-identification name (User-ID), passwords and security level, for each member of staff working on SMS4DC. These security levels are:

- a) *Supervisor*: Authorized to read/write all parts of the database, to manage user-IDs and passwords, reference tables and to configure and use any features of the software;
- b) *Data entry (Licensing and Billing)*: Authorized to read/write the licensing and billing contents of the database;
- c) *Engineers*: Authorized to read/write the technical contents of the database;
- d) *Senior operator*: Same as Supervisor;
- e) *Licensing*: Same as Data entry;
- f) *Read-only*: Authorized to use only the information displays without permission to edit any part of the database.

Also, the Supervisor may read and analyze an “Audit Trail”, this is an automatic log of all activity on the system and lists the user-ID of the person responsible for the action and the time. Thus incorrect or inappropriate action may be traced and the officer identified.

11 Monitoring Menu

One of the important parts of a Spectrum Management System is the monitoring subsystem which acts as the eyes of the total system. With the cooperation of Rohde and Schwarz (R&S) and THALES Companies, it is now possible for SMS4DC to interact with ARGUS (R&S monitoring software) and ESMERALDA (THALES monitoring software) and communicate bidirectionally. Also there is a possibility for SMS4dc to interact with others monitoring systems as described in § 11.3 below.

The first essential step in connecting SMS4DC with ARGUS and ESMERALDA is the correct setup of the ARGUS.TXT and ESMERALDA.TXT files respectively which are located in the TEXTS folder of SMS4DC installation. The lines of the text file correspond to the path of INBOX and OUTBOX folders of ARGUS and ESMERALDA system respectively. The monitoring software might be installed on the same PC having SMS4DC. In this case the path to local INBOX and OUTBOX of monitoring system should be placed in the *.TXT files. If monitoring software is located on another PC, then the SMS4DC PC and monitoring PC should be connected to each other through a network (LAN or WAN).

11.1 ARGUS Menu

This menu item groups all the functionalities needed for communication with ARGUS software. The data exchange between SMS4DC and ARGUS is done through two kinds of orders:

- SMDI - Spectrum Management Data Interface: ARGUS requests data from SMS4DC.
- ORM - Order Report Module: SMS4DC requests measurements from ARGUS.

11.1.1 Respond to Order sub-menu of ARGUS menu

Activation of this menu makes SMS4DC ready to listen to the SMDI orders issued by ARGUS system and as soon as it receives an order, prepares the requested information and sends for the ARGUS system.

11.1.2 GSP Order sub-menu of ARGUS menu

SMS4DC should know the system configuration of the measurement devices connected to ARGUS system. Otherwise it is not possible to issue a precise measurement order. In order to know this configuration, the SMS4DC requests those specifications from ARGUS by a Get System Parameters (GSP) order. By selection of this menu item, a GSP order will be sent to ARGUS and normally after a few seconds, the specifications will be sent back to SMS4DC.

11.1.3 ORM Order sub-menu of ARGUS menu

By selection of this menu, SMS4DC looks for the latest result of the GSP orders which shows the latest known configuration of the measurement system. In the displayed screen, there are 3 tab dialogs called "General Setting", "Date and Time Setting" and "Result Setting"

Sub-Order Task: The following types of measurements are available

- Frequency List Scan
- Transmitter List Scan
- Scan

- DScan
- FFM (Fixed Frequency Measurement)
- Sweep
- PScan
- DFPan

Measurement Parameter: At most four of these parameters can be measured simultaneously with the exception of "Location" which should be measured alone.

- Level
- Offset
- Frequency
- IF
- Audio
- AM
- FM
- PM
- BandWidth
- Bearing
- Sub Audio Tone
- Program
- PI Code
- Sound ID
- Location

11.1.4 Order Status sub-menu of ARGUS menu

By this facility, it is possible to see the status of all existing orders in the INBOX folder of ARGUS system. The states might be one of the "Open", "In Process", "Finished" and "Forwarded".

11.1.5 Stop Order sub-menu of ARGUS menu

By selection of this menu, a list of all running or pending ORM orders will be displayed and one of them can be selected and stopped by pressing the "Create Stop Order" button.

11.1.6 Draw Output sub-menu of ARGUS menu

After successful completion of measurement of an ORM order, by selection of "Draw Output" menu it is possible to visualize the results in either ARGUS or SMS4DC.

11.2 ESMERALDA Menu

This menu item groups all the functionalities needed for communication with ESMERALDA monitoring software. The data exchange between SMS4DC and ESMERALDA is done through creation of different special files which are listed below:

- *.REQ: Request files. Created by the monitoring system and submitted to the SMS4DC to create a check file based on that.
- *.CHK: Check files. Measurement orders created by SMS4DC to be submitted to the monitoring system.
- *.RES: Result files
- *.ATR: Results of ATR measurement

11.2.1 Check-list Generation/Mission Creation sub-menu of ESMERALDA menu

Creation of measurement missions (orders) as follows, for submission to the ESMERALDA monitoring software is possible by selection of this menu.

- FBF**: Frequency Band occupancy with Fast scanning;
- FBM**: Frequency Band occupancy with Measurement;
- FSM**: Frequency Scanning occupancy with Measurement;
- FSF**: Frequency Scanning occupancy with Fast scanning;
- SCT**: Systematic Control of Transmitters;
- SFS**: Specific Frequencies Scanning;
- TOR**: Transmitter Occupancy Rate;
- USS**: Unknown transmitters Scanning Searching;
- UBS**: Unknown transmitters Band Searching;
- ATR**: Field strength measurements “Along The Route”;
- CAM**: Channel Analysis and Measurements;
- TVM**: TV Measurements.

Further parameters could be chosen for the desired mission type through four more screens.

11.2.2 Check-list Generation/Requests sub-menu of ESMERALDA menu

When there are request files (*.REQ) coming from the monitoring system, by this menu it is possible to create the corresponding check file (*.CHK) and submit to the monitoring system.

11.2.3 Check-list Generation/Requests (Automatic) sub-menu of ESMERALDA menu

Activation of this menu makes SMS4DC ready to listen to the requests issued by ESMERALDA monitoring system and as soon as it receives a request, processes the information and creates a check file and sends back to ESMERALDA monitoring software.

11.2.4 View/Check-list sub-menu of ESMERALDA menu

This menu item is used for displaying the content of check files (*.CHK).

11.2.5 View/Results sub-menu of ESMERALDA menu

This menu item is used for displaying the content of result files (*.RES).

11.2.6 View/Occupancy Rate sub-menu of ESMERALDA menu

This menu item is used for displaying the content of occupancy files (*.OCC).

11.2.7 View/Requests sub-menu of ESMERALDA menu

This menu item is used for displaying the content of request files (*.REQ).

11.2.8 Draw Output sub-menu of ESMERALDA menu

After successful completion of a measurement, it is possible to visualize some the results in SMS4DC.

11.2.9 Show ATR sub-menu of ESMERALDA menu

This menu item is used for displaying the content of result files (*.ATR).

11.3 Others Menu

This menu item groups all the functionalities needed for communication with other monitoring software. The data exchange between SMS4DC and monitoring software is done through two kinds of orders:

- M2S - Spectrum Management Data Interface: monitoring software requests data from SMS4DC.
- S2M - Order Report Module: SMS4DC requests measurements from monitoring software.

11.3.1 Respond to M2S Order sub-menu of Others menu

Activation of this menu, makes SMS4DC ready to listen to the M2S orders issued by monitoring system and as soon as it receives an order, prepares the requested information and sends to the monitoring system.

11.3.2 S2M Order sub-menu of Others menu

By this function it is possible to create an S2M measurement order by selection of "S2M Order" menu. By selection of this menu, Order Report screen will appear. In the displayed screen, there are 3 tab dialogs called "General Setting", "Date and Time Setting" and "Result Setting".

- Order Task: Currently the following types of measurements are available
 - o Frequency List Scan
 - o Transmitter List Scan
 - o Scan
 - o DScan
 - o FFM (Fixed Frequency Measurement)
- Measurement Parameter: At most four of these parameters can be measured simultaneously with the exception of "Location" which should be measured alone.
 - o Level
 - o Offset
 - o Frequency
 - o IF
 - o Audio
 - o AM
 - o FM
 - o PM
 - o BandWidth
 - o Bearing
 - o Sub Audio Tone
 - o Program
 - o PI Code
 - o Sound ID
 - o Location

11.3.3 Order Status sub-menu of Others menu

By this facility, it is possible to see the status of all existing orders in the INBOX folder of Others system. The states might be one of the "Open", "In Process" and "Finished".

11.3.4 Stop Order sub-menu of Others menu

By selection of this menu, a list of all running or pending S2M orders will be displayed and one of them can be selected and stopped by pressing the "Create Stop Order" button.

11.3.5 Draw Output sub-menu of Others menu

After successful completion of measurement of a S2M order, it is possible to visualise the results in either monitoring system or SMS4DC.

11.4 Network Planning

The aim of this menu is planning and optimization of spectrum monitoring networks in the VHF/UHF frequency range. It includes calculation of coverage zone of monitoring networks, location zone for different spectrum monitoring systems configurations including AOA (angle of arrival) and TDOA (time difference of arrival) and coverage area (maximum field strength and best server).

11.4.1 Coverage Zone sub-menu of Network Planning menu

By this function the overall coverage zone of the selected monitoring stations are calculated for different monitoring tasks, listening (aural monitoring), emission characteristics measurement (remote measurement of emission parameters such as frequency, field strength, spectrum occupancy, bandwidth, type of modulation and so on) and DF.

11.4.2 Location Zone (AOA) sub-menu of Network Planning menu

By this function the location zone of the selected monitoring stations are calculated in AOA (angle of arrival) DF spectrum monitoring systems configuration. For planning AOA SMNs, it is necessary that each test transmitter shall be covered by at least two monitoring stations. So for each pair of monitoring stations, their common coverage zone is determined by area within which location uncertainty will not exceed predefined value of maximum location uncertainty ((ΔErr)).

11.4.3 Location Zone (TDOA) sub-menu of Network Planning menu

By this function the location zone of the selected monitoring stations are calculated in TDOA (time difference of arrival) spectrum monitoring systems configuration. For planning TDOA SMNs, it is necessary that each test transmitter shall be covered by at least three monitoring stations.

11.4.4 Rx Coverage Area sub-menu of Network Planning menu

This item includes Maximum Field Strength and Best Server functions. Maximum Field Strength function calculates and displays the maximum value of field strength values at monitoring stations produced by test transmitting stations located inside a predefined rectangular area. Best Server function calculates and displays the best serving monitoring station, among various monitoring stations, for each point inside a predefined rectangular area.

Annex 1-System requirements

Minimum	Recommended
<ul style="list-style-type: none"> ... Core™ i3 ... 2 Gigabytes Random Access Memory (RAM); ... Hard Disk Drive with a minimum of 3 Gigabytes free available for installation in case of single-user setup; or 300 MB in case of setup on network, ... CD Drive; ... SVGA Color Monitor capable of 1024 x 768 pixel resolution; ... Colour Inkjet or Laser printer; ... Graphics adapter with OpenGL support; 	<ul style="list-style-type: none"> • Core™ i5 or higher • 4 Gigabytes Random Access Memory (RAM); • Hard Disk Drive with a minimum of 10 Gigabytes free available for installation; • DVD Drive; • SVGA Color Monitor capable of 1024 x 768 pixel resolution; • Colour Inkjet or Laser printer; • Graphics adapter with OpenGL support;

The minimum hardware requirements listed above assumes operation under Windows 7, 8 or 10. The use of a more resource-consuming Windows version requires a more capable hardware platform, especially with respect to the processor and the amount of RAM (e.g. suitable operation under Windows 10 will be best achieved with a Core™ i5-based PC with a least 4 Gbytes of RAM). SMS4DC has been developed and tested for operation on systems with the following configurations:

- ... Microsoft Windows Operating system Windows 7 and 10 for single-user setup or for workstation in case of setup on network;
- ... Windows Server 2016 in case of setup on network;
- ... Microsoft Office 2010 or later
- ... Adobe Acrobat PDF reader version 8 or later

Note: The DPI settings for the Windows screen should be set to normal size (96 dpi).

Annex 2-Example SMS4DC screenshots to illustrate the main features

1 *Graphic Information System*

- 1-1** Vector map: International Digitized World Map (IDWM)
- 1-2** Raster Map: Digital Elevation Map (Global Land One-kilometer Base Elevation model (GLOBE))
- 1-3** Digital Elevation Map in 3D view
- 1-4** DEM: Station display and line-draw function

2 *Propagation calculation results*

- 2-1** Sample Propagation calculation (field-strength contour and area) and DEM display.
- 2-2** Results of contour and area propagation calculation exported and displayed on Google Earth map.
- 2-3** Point-to-point link budget calculation using recommendation ITU P.530

3 *Frequency Allocation Chart and Footnotes*

- 3-1** National Allocation Chart
- 3-2** Allocation Chart sub-band editor
- 3-3** Footnote Editor
- 3-4** Import/Export

4 *Reference Tables and Libraries*

- 4-1** Channel arrangement editor
- 4-2** Equipment Library
- 4-3** Transmitter emission mask (and editor)
- 4-4** Antenna Library
- 4-5** Antenna pattern editor

5 *Administration and Licensing*

- 5-1** Data entry screen: DEM *Add Station* toolbar button
- 5-2** Administrative Data screen 1. In left pane: Hierarchical “Tree” display for Anonymous stations at Station level showing sub-level 1: Equipment; Sub-level 2: Frequency, Antenna; Sub-level 3: Receiver. In right pane: Station information data entry mask.

- 5-3 Administrative Data screen 2: In left pane, hierarchical “Tree” display for Active Licenses at Owner level, showing sub-level 1: Licenses; sub-level 2: Billing History, Stations; sub-level 3: Equipment; sub-level 4: Frequency, Antenna; Sub-level 5: Receiver. In right pane: Owner information data entry mask.

- 6 ***Frequency assignment***
 - 6-1 Frequency Assignment Procedure Results spreadsheet

- 7 ***Interference calculation***
 - 7-1 Example Interference calculation (1) Point-to-point link interference (FX2FX(Link))

 - 7-2 Example interference calculation (2): Interference from a Broadcasting station to selected stations in accordance with the GE84 Agreement.

- 8 ***Frequency Coordination***
 - 8-1 GE06 Agreement FXLM2BCBT (Affected Administrations): 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.

 - 8-2 Border coordination agreement example for the Land Mobile service between three administrations

 - 8-3 Generation of an electronic notification of a frequency assignment for submission to the ITU Radiocommunication Bureau (ITU-BR).

- 9 ***Import from BR-IFICs***
 - 9-1 BR IFIC (Terrestrial Services) and BR IFIC (Space Services) data import interface with filters to specify what information to import (e.g. administration, frequency band, service)

- 10 ***System security***
 - 10-1 User-IDs, passwords and access levels

 - 10-2 ***Audit trail***

 - 10-3 ***Database back-up and restoration***

- 11 ***Monitoring***
 - 11-1 ARGUS

 - 11-2 ESMERALDA

 - 11-3 Others

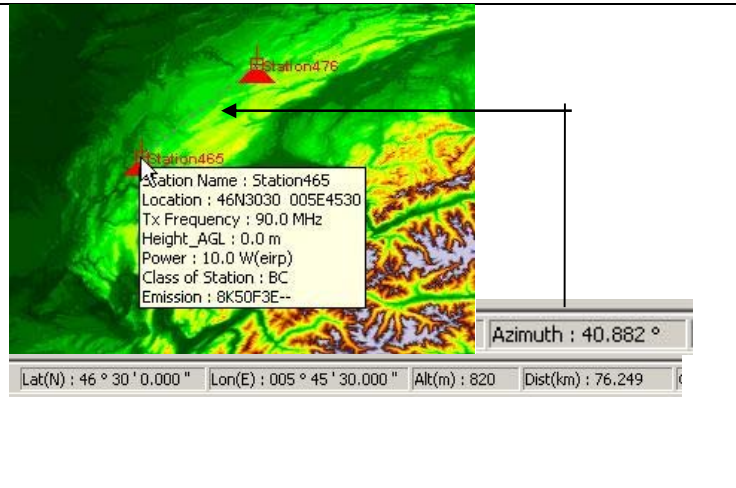
 - 11-4 Network Planning

Figure 1-4

Station display and line-draw function

DEM showing two station symbols and the pop-up information display for Station465

The arrow shows the line drawn between stations and the result on the status bar for distance and azimuth calculation function



2 Propagation calculation results

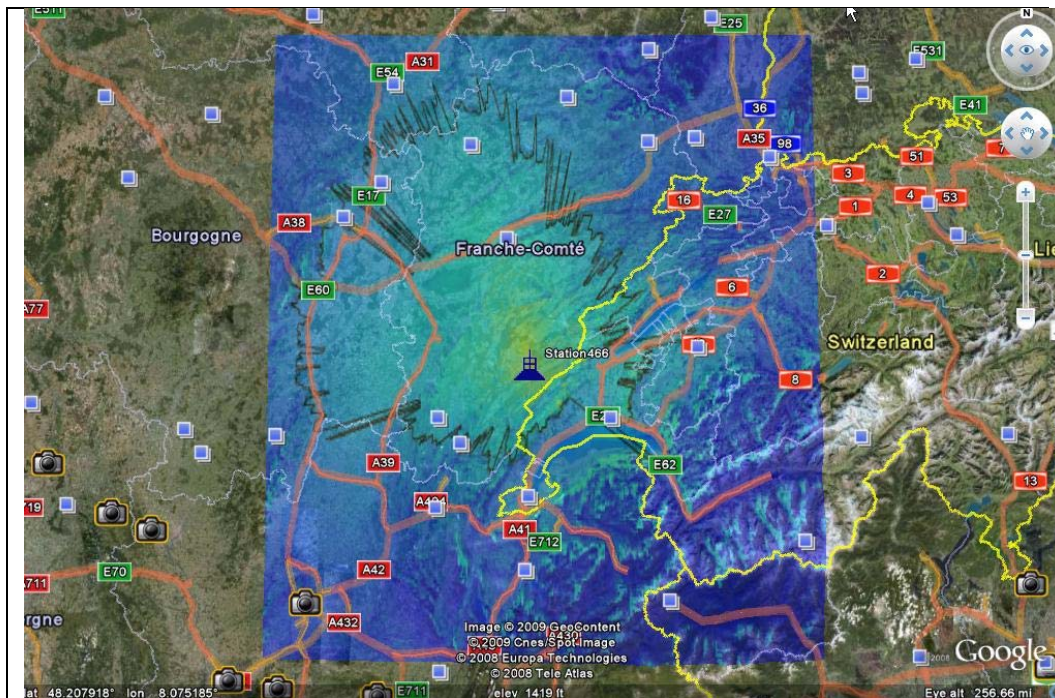
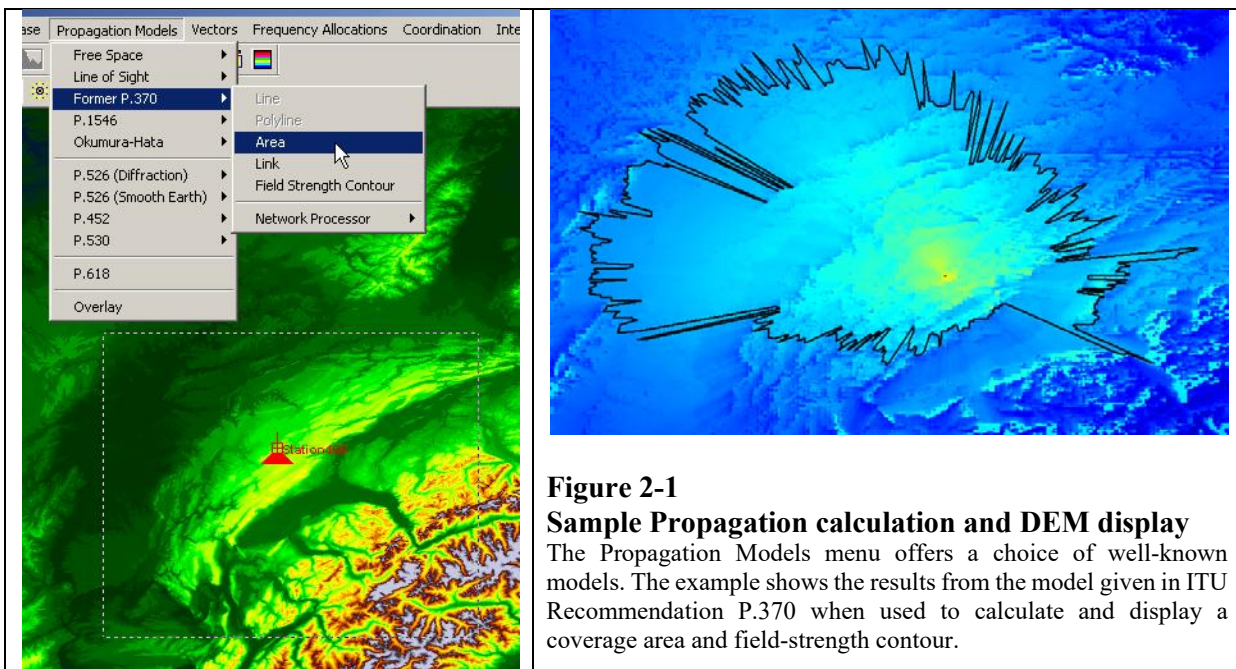


Figure 2-2

Area propagation display exported and displayed on Google Earth map

The Vector Handling function has been used to create and export, in Google Earth format, the result from the ITU-R P.370 area and contour calculation example.

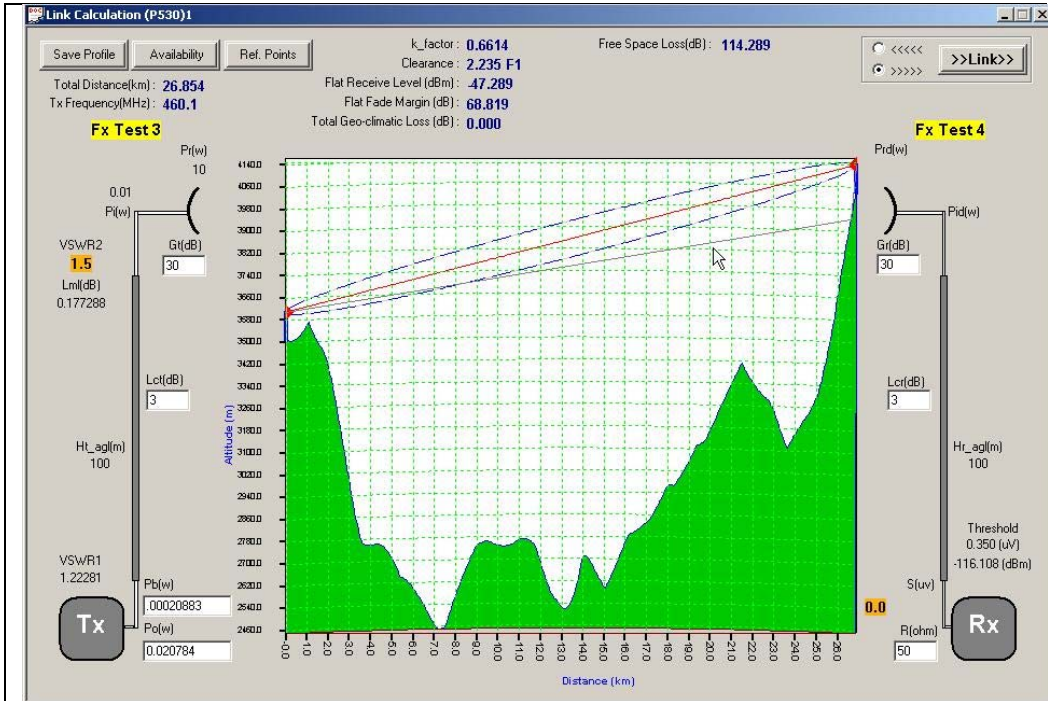


Figure 2.3: Link budget analysis using ITU Recommendation P.452. Parameters may be changed, including antenna height, and the budget is automatically recalculated to give the power at the receiver input.

3 Frequency Allocation Chart and Footnotes

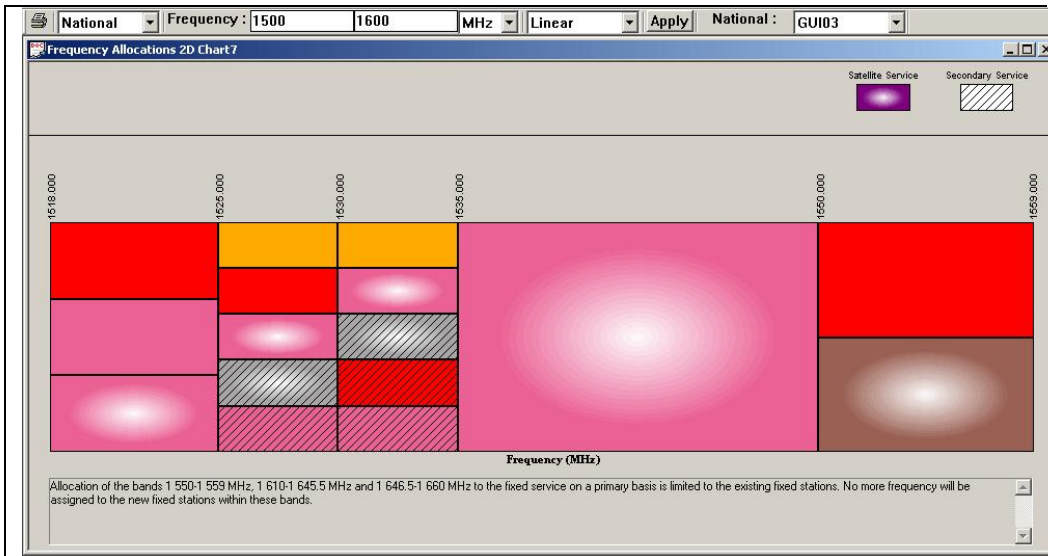
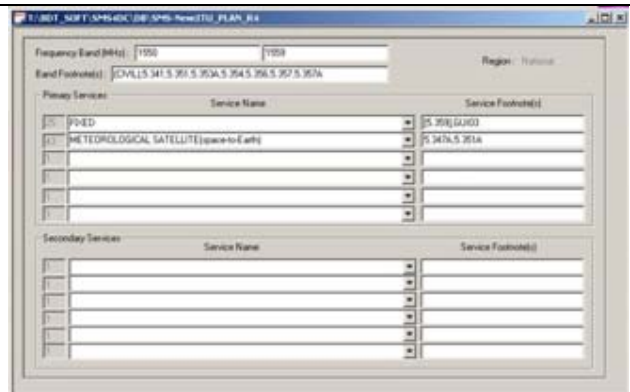


Figure 3-1: Draw Frequency Allocation Chart
Example of a National Chart for 1500-1600 MHz, showing a National Footnote

**Figure 3-2
National Frequency
Allocation Chart: sub-band
editor**

The editor enables national sub-bands to be created for specific service and with Primary or Secondary category of service status



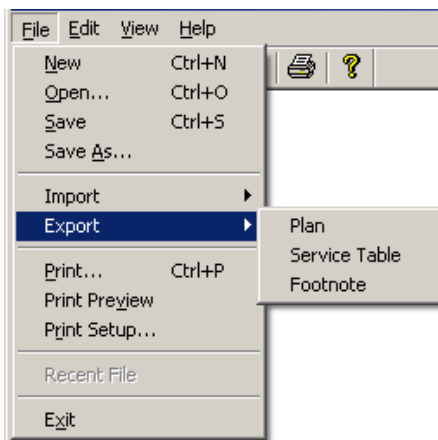
**Figure 3-3
National Frequency
Allocation Chart: national
footnote editor**

The editor enables National Footnotes to be created, modified and saved.



Figure 3-4
National Frequency Allocation Chart:
Import/Export

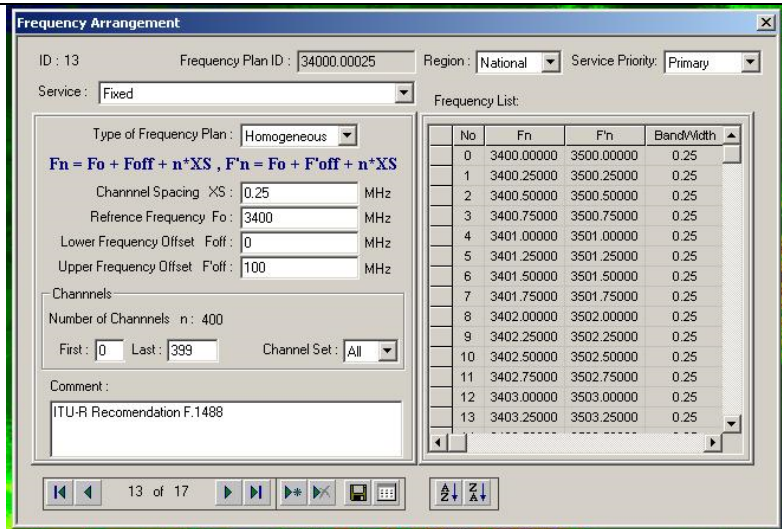
This screenshot displays the dialogue box for the importing and exporting of plan, service table and footnotes, of selected Region or national frequency allocation.



4 Reference Tables and Libraries

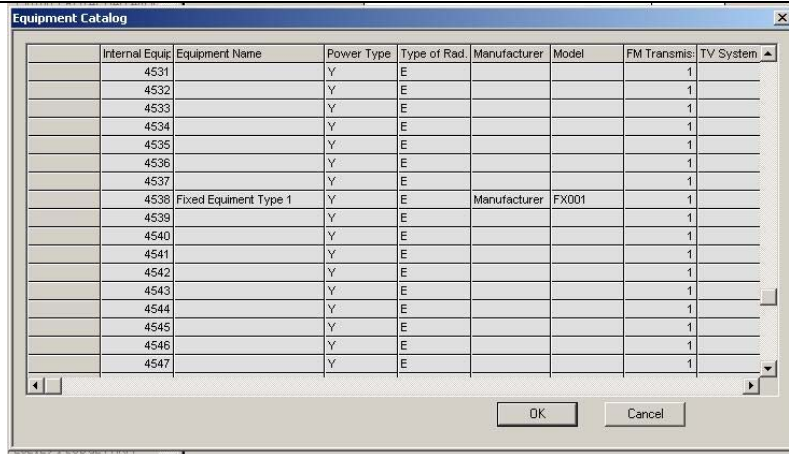
**Figure 4-1
Frequency (Channel)
arrangement editor
screen**

The set-up screen for frequency (or channel) arrangements is shown with an example of a Fixed service arrangement based on the formula given in ITU F.1488. Once the appropriate parameters have been entered (e.g. channel spacing, reference frequency and upper/lower frequency offset, SMS4DC calculates the channel centre frequencies (Fn, F'n) and saves them in a file.



**Figure 4-2
Equipment catalogue**

Library of technical information for equipment. For New Station data entry, if the same equipment has already been stored in the library, the technical information can be recalled to save re-entering the data.



**Figure 4-3
Transmitter emission
mask (and editor)**

Also receiver filter mask and editor. Emission masks and receiver filters are used in interference calculations using Net Filter Discrimination (NFD). Actual values must be entered for each type of equipment otherwise a default value is used.

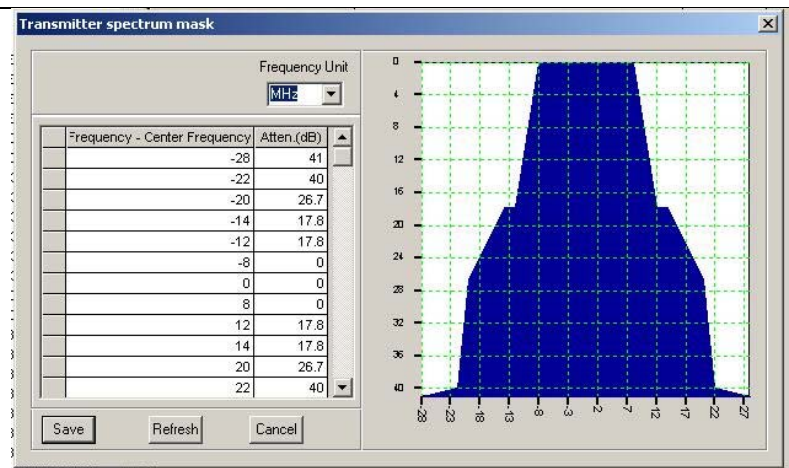


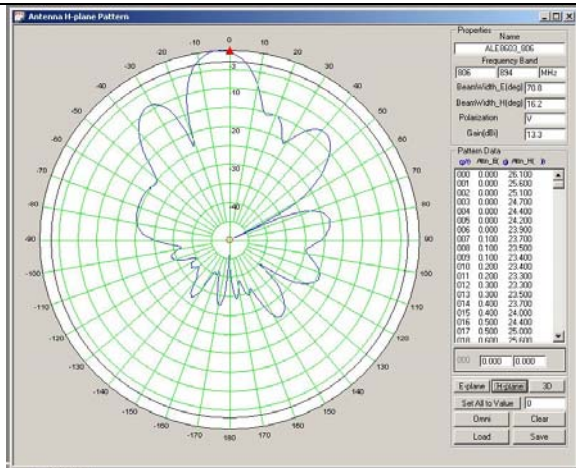
Figure 4-4
Antenna catalogue

Library of technical information for antennas. For New Station data entry, if the same antenna has already been stored in the library, the technical information can be recalled to save re-entering the data.

Internal Ant	Antenna Name	Polarization	Antenna Gain	Antenna Dire	Hor. Beam V/v
118	cpvtest1	V	42.0	D	10.0
119	ge06test	V	20.0	D	180.0
120	ge06testM	V	20.0	D	180.0
121	ge06testM	M	20.0	D	180.0
122	ge06testM	M	20.0	D	180.0
127	cpvtestH	H	42.0	D	10.0
128	cpvtest1H	h	42.0	D	10.0
129	cpvtest1H	H	42.0	D	10.0
130	ge06testM	M	20.0	D	180.0
147	RND8437	H	0.0	N	360.0
148	RND8487	H	0.0	N	360.0
149	RND8437	H	0.0	D	60.0
150	RND8487	H	0.0	D	80.0
157	CHEFCHAOU	V	0.0	D	230.0
158	OLJAZZAN	V	0.0	D	180.0
193	000000186	H	0.0	N	360.0
194	000000186	H	0.0	N	360.0
311	ALE8603_80	V	13.3	D	70.8

Figure 4-5
Antenna pattern editor

Enables horizontal and vertical antenna gain patterns to be entered and stored. Antenna patterns and azimuth direction are used in interference calculations e.g. point-to-point link analysis. The editor can be accessed from the DEM Tools menu.



5 Administration and Licensing

Figure 5-1

Data Entry Screen for a New Station

This screen is displayed by selecting the Add Station button on the DEM Tool Bar. This example is for a Broadcasting (sound) station. However, Service Type and Class of Station fields have drop-down menus to choose different services and classes. Once the data entry is complete and the "Save" button is pushed, a station symbol is displayed on the DEM at the location given by the Latitude and Longitude values.

The screenshot shows a software dialog box titled "New Station Parameters". It is divided into several sections for data entry:

- Service Type:** A dropdown menu set to "B - Broadcasting".
- Class of Station:** A dropdown menu set to "BC - Broadcasting station, sound".
- Station:**
 - Name:** Text input field containing "Station466".
 - Latitude:** Input fields for "46", "N", "44", and "30.0", with a calculated "Latitude(deg.)" of "46.741667".
 - Longitude:** Input fields for "006", "E", "08", and "30.0", with a calculated "Longitude(deg.)" of "6.141667".
 - Height_asl(m):** Input field containing "1068".
 - Power(W_eirp):** Input field containing "10000".
 - Frequency(MHz):** Input field containing "90".
 - Insertion Loss(dB):** Input field containing "3".
 - Rx Sensitivity(uV):** Input field containing "0.35".
 - Emission:** Input field containing "8K50F3E-".
- Antenna:**
 - Name:** Text input field containing "GE84D-V".
 - Azimuth(deg.):** Input field containing "0".
 - Elevation(deg.):** Input field containing "0".
 - Gain(dB):** Input field containing "3".
 - Height_agl(m):** Input field containing "200".
 - BeamWidth_E(deg.):** Input field containing "360".
 - BeamWidth_H(deg.):** Input field containing "360".
 - Polarization:** A checked checkbox.
 - Buttons:** "Assign Antenna" and "Show Pattern" buttons are located to the right of the antenna parameters.
- Bottom:** "Save" and "Cancel" buttons.

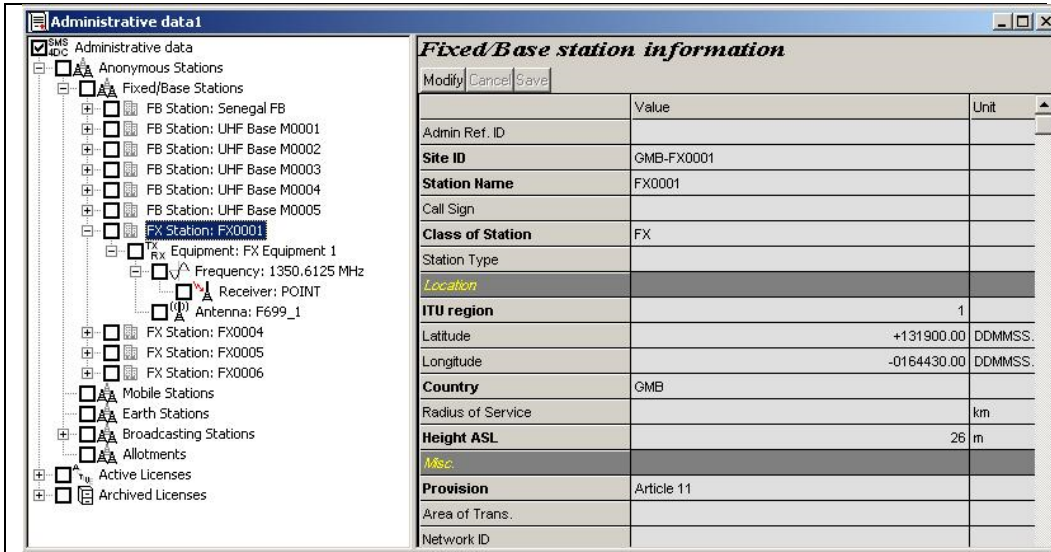


Figure 5-2: Administrative data screen 1 (Anonymous Stations). In the left panel, the hierarchical “tree” structure showing Anonymous stations and an example expanded display for a Fixed station with frequency, antenna and receiver levels. In the right panel, detailed information may be displayed at each level. Data fields with titles in **Bold** typeface *must* have information entered. The information on the screen can be modified and saved. The example shows information for the Station level.

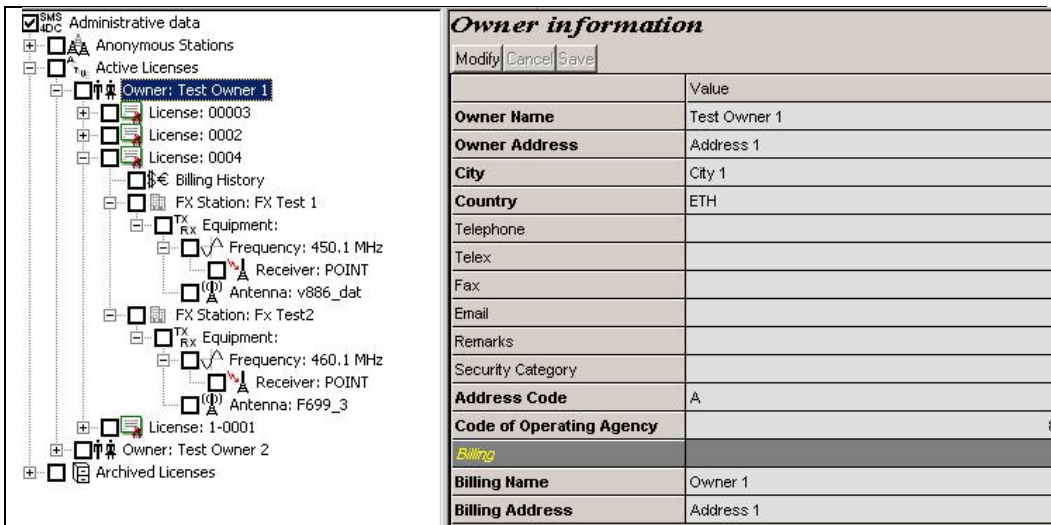


Figure 5-3: Administrative data screen 2 (Active licenses). In the left panel the “tree” structure showing Active licenses with an example expanded display for a Fixed station license showing billing history, equipment, frequency, linked-receiver, antenna levels. In the right panel, detailed information may be displayed for each level. This information can be modified and saved. The example shows information for the Owner level.

6 Frequency assignment

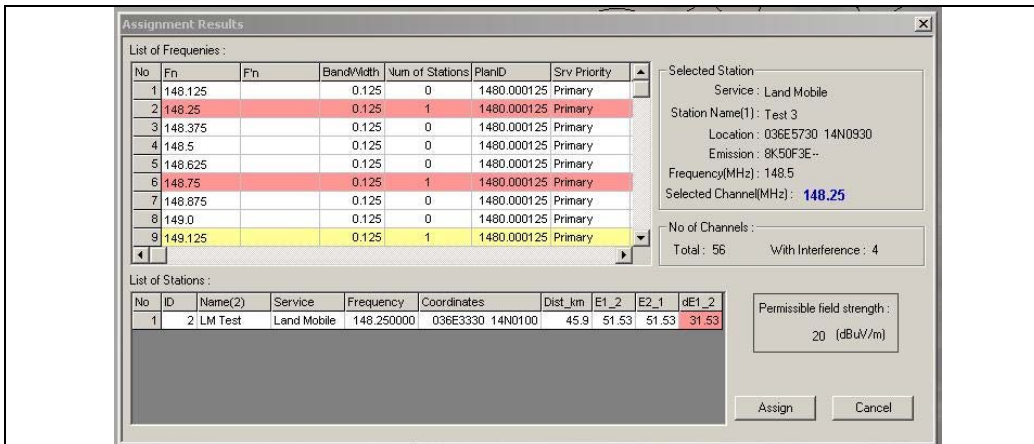
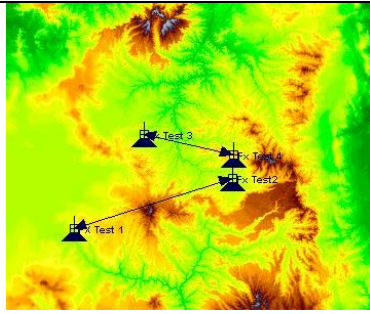


Figure 6-1: Frequency Assignment Procedure Results spreadsheet. Shows analysis of all channels available to the service in the requested frequency range. Frequency rows shown in yellow have existing stations within a predetermined distance. Frequency rows shown in red have already been selected for more detailed analysis with the existing stations and a potential interference condition has been detected. The detailed results of the interference calculation for one of the “red” channels are shown in the lower panel. The results of interference calculations to and from the existing station and level of field strength above the maximum permitted interference level are given.

7 Interference



Display Links on DEM

Fixed stations with receivers associated as point-to-point hops and displayed on the DEM

P.452 FX2FX: Interference from the Wanted Hop to the Selected Hop(s)								
Wanted Hop (Tx)								
No	TxName	TxLocation	RxName	RxLocation	Freq(MHz)			
1	Fx Test 1	037E3630 11N3300	Fx Test 2	038E5330 11N5730	450.1000			
Selected Hop(s) (Rx)								
No	TxName	TxLocation	RxName	RxLocation	IntDist(km)	PathLoss(dB)	I-S(dB)	I(dBm)
1	Fx Test 4	038E5400 12N0900	Fx Test 3	038E1030 12N1900	105	125.96	7.34	-108

Figure 7-1: Interference Calculation for Links: Fixed link interference (*FX2FX(Link)*) calculation result. In accordance with ITU-R Recommendation P.452. Takes into antenna directional, beamwidth and cross-polar discrimination and transmitter/receiver Net Filter Discrimination (NFD).

GE84 : Interference from wanted station to selected stations									
Wanted Station :									
No	AssignID	Site Name	Country	Frequency(MHz)					
1	092000700	CARDADA	SUI	87.600000					
Interference to :									
No	AssignID	Site Name	Country	Esi(dBuV/m)	Eu(dBuV/m)	Eref(dBuV/m)	Eu-Eref(dBuV/m)		
1	102004012	GRODNO	BLR	-49.297073	63.561144	76.307000	-12.745056		
2	102008669	KLAIPEDA	LTU	-42.631613	63.775866	76.307000	-12.531134		
3	104002304	BIRZAI	LTU	-61.037057	64.399697	76.307000	-11.907303		
4	084004539	KHOURIBGA	MRC	-41.495063	44.877429	76.307000	-31.429571		
5	084025407	ZARZIS	TUN	15.102610	60.044737	76.307000	-16.262263		
6	084033556	AFLOU	ALG	3.147353	59.799180	76.307000	-16.507820		
7	084004713	ZAIU	MRC	1.497005	65.626721	76.307000	-10.680279		
8	084102625	AG ISIDOROS	GRC	-7.362263	67.676879	76.307000	-8.630121		
9	084033230	KEF EL AKHAL	ALG	26.006367	59.100321	76.307000	-17.206679		
10	084102452	CAIRETHIANA	GRC	2.848667	99.466676	76.307000	23.159676		
11	084009123	MARBELLA	E	-36.249154	76.904415	76.307000	0.597415		
12	084102421	NEDOUSA	GRC	-7.788932	101.337845	76.307000	25.030845		

Figure 7-2: Interference from a Broadcasting station to selected stations in accordance with the GE84 Agreement. Calculation of the nuisance field strength of a selected FM sound broadcasting station, at the location of other GE84 FM sound broadcasting stations, inside a circular area. Results displayed in spreadsheet (and html report): country code, the field strength produced by wanted station (Esi), the aggregate field strength value (Eu) of all stations (including wanted station), reference usable field strength value (Eref) and the value in excess of the reference usable field strength value (Eu-Eref).

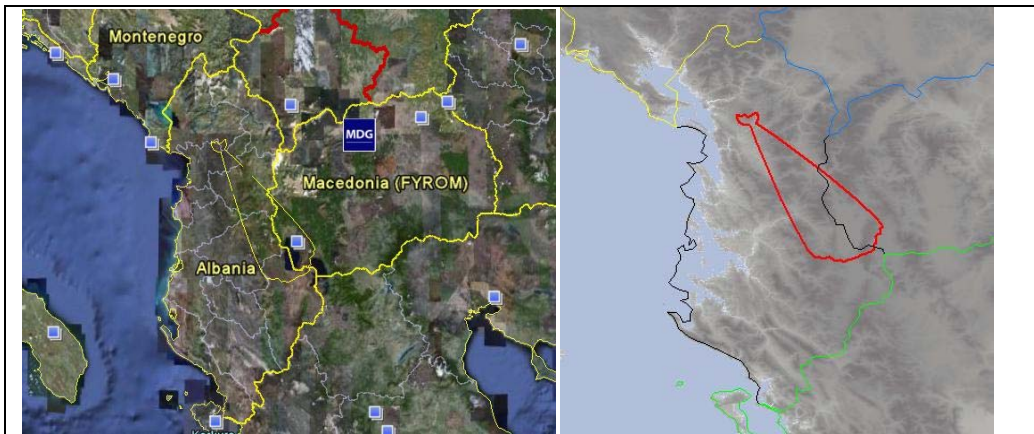


Figure 8-1: GE06 Agreement FXLM2BCBT (Affected Admin): Identification of Administrations whose broadcasting service is likely (potentially) to be affected by a wanted station in fixed or land mobile service inside another country. Right-hand screenshot shows the coordination contour for the wanted FX 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.

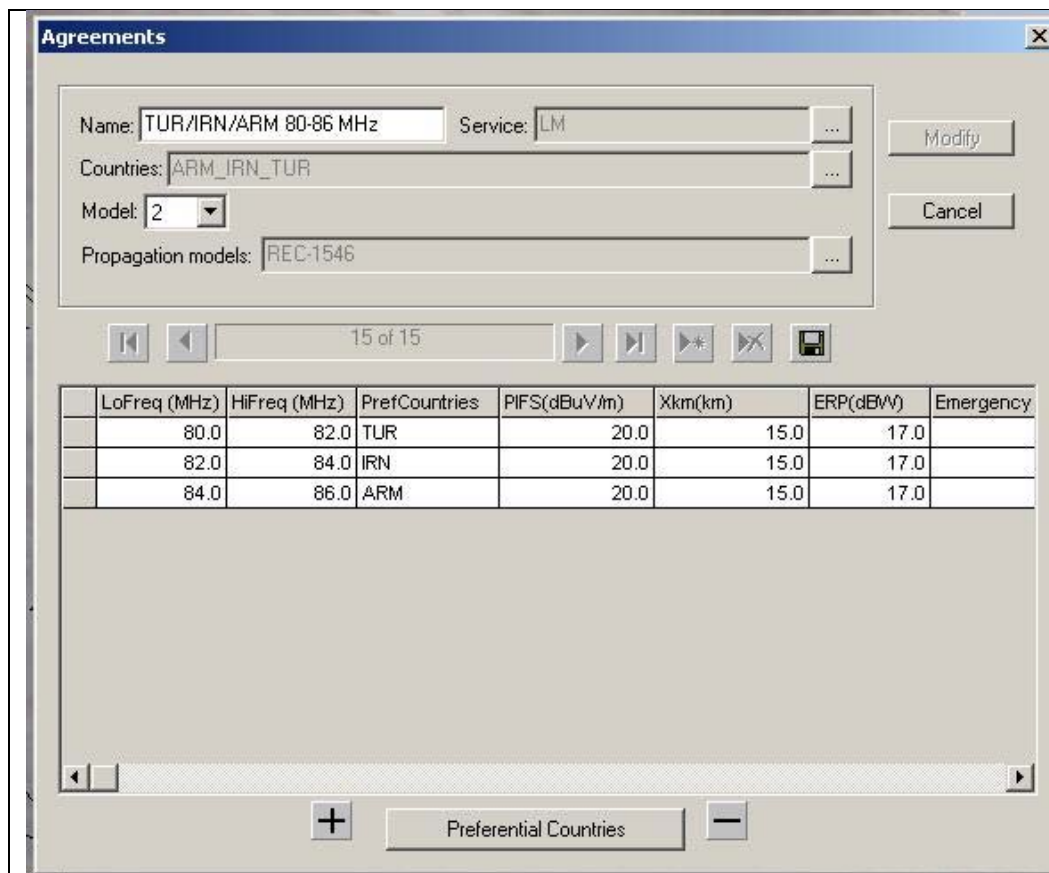
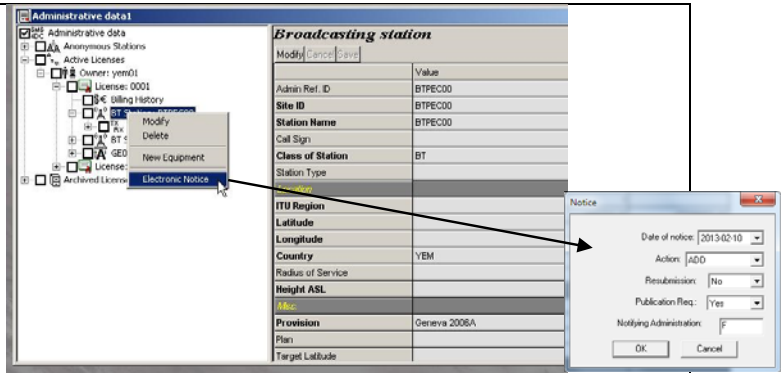


Figure 8-2: Border coordination agreement example for the Land Mobile service between three administrations (SMS4DC set-up screen): The example shows a border coordination agreement for the band 80-86 MHz. Three sub-bands are established, one for each country, giving preferential assignment rights. The 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.

Figure 8-3
Generation of an electronic notice from the License

Mouse right click at station level opens menu. Choosing electronic notice opens pop-up to specify notice details (date, action etc.)



9 Import data from BR-IFIC(Terrestrial Services)

Figure 9-1
Import from BR-IFIC (Terrestrial Services)
 Information can be imported from the ITU International Frequency Information Circular (BR-IFIC) on DVD-ROM.

The import interface has filters which enable the required data to be specified. In this example: Service = FM/TV; Administration = SUI; frequency band = 88 - 108 MHz; Class = BC(sound); Fragment = GE84

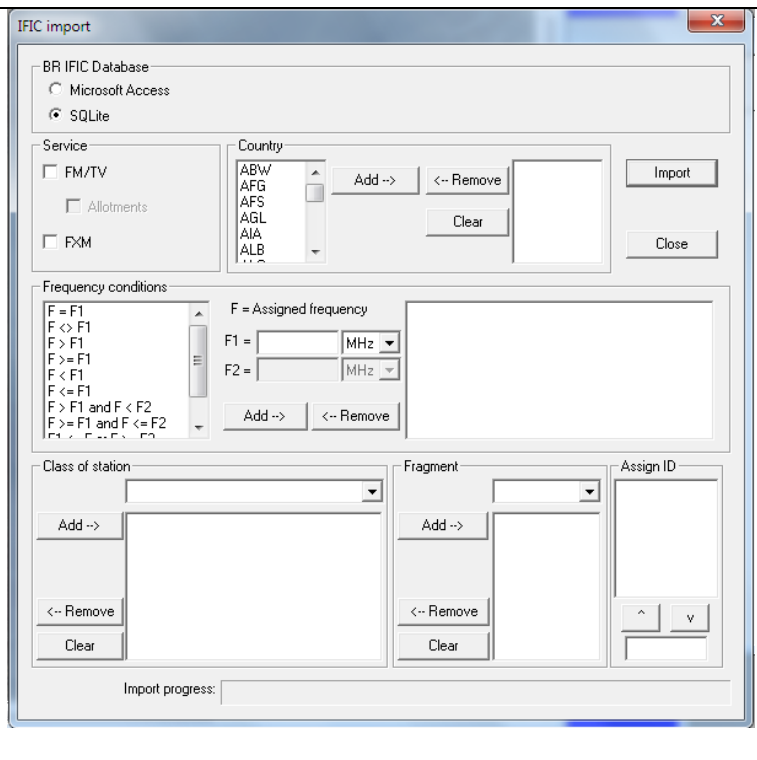


Figure 10.1
User-IDs, passwords
and access levels

The User authorization screen enables the System Supervisor to set-up a new user with user name (ID), password and set access permission to the SMS4DC database and functions to one of six levels.

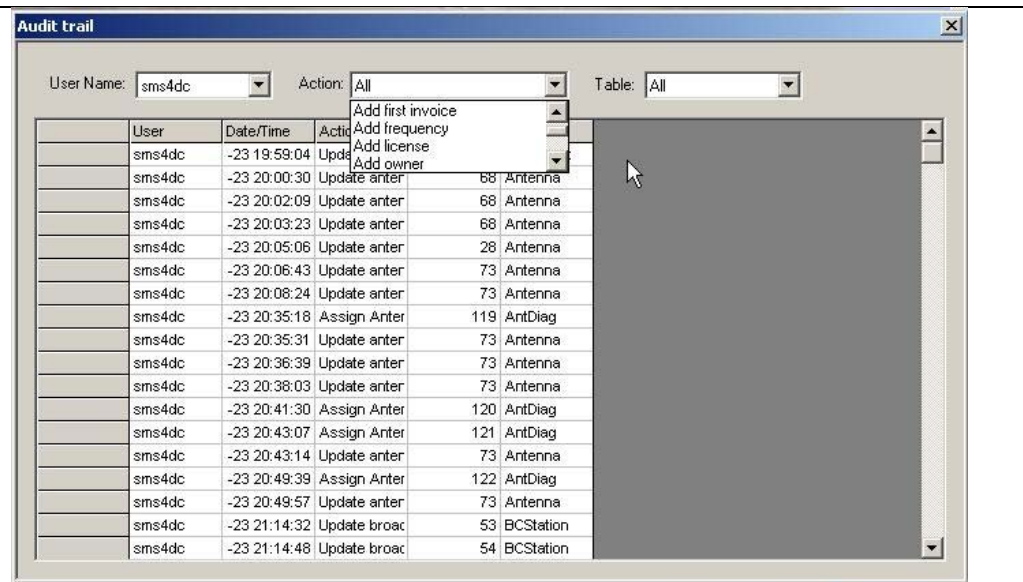
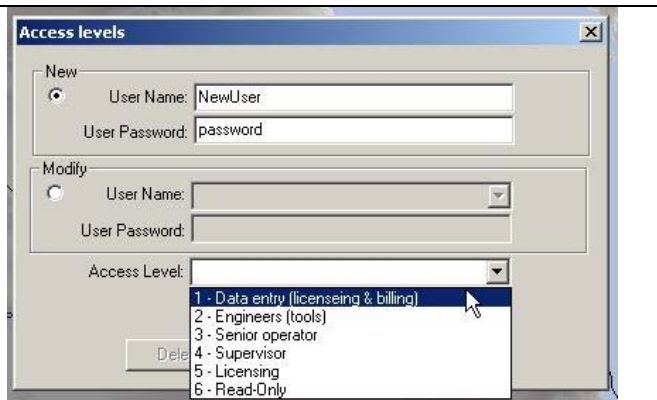
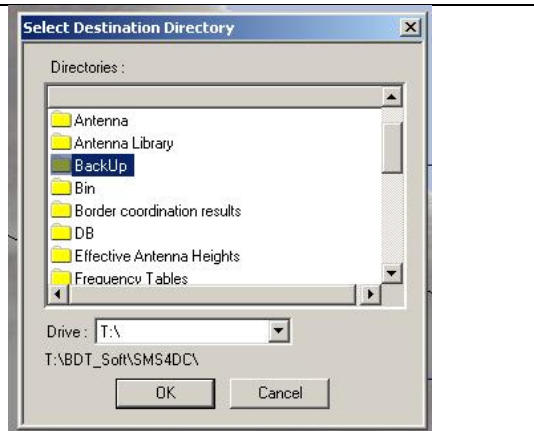


Figure 10.2: Audit Trail. This displays a log of SMS4DC activity, action taken, time and the user responsible for the action. The System Supervisor can define the search on the following items: user name, action type and the database table of interest.

Figure 10.3
Database back-up and restoration

The System Supervisor should make regular back-ups of the database using the back-up facility. The back-up should be kept in a secure location well away from the SMS4DC server.

The back-up may be used to restore the database by copying the back-up file into the SMS4DC DB folder and changing the name of it to the original database name.



11 **Monitoring**
11.1 **ARGUS**

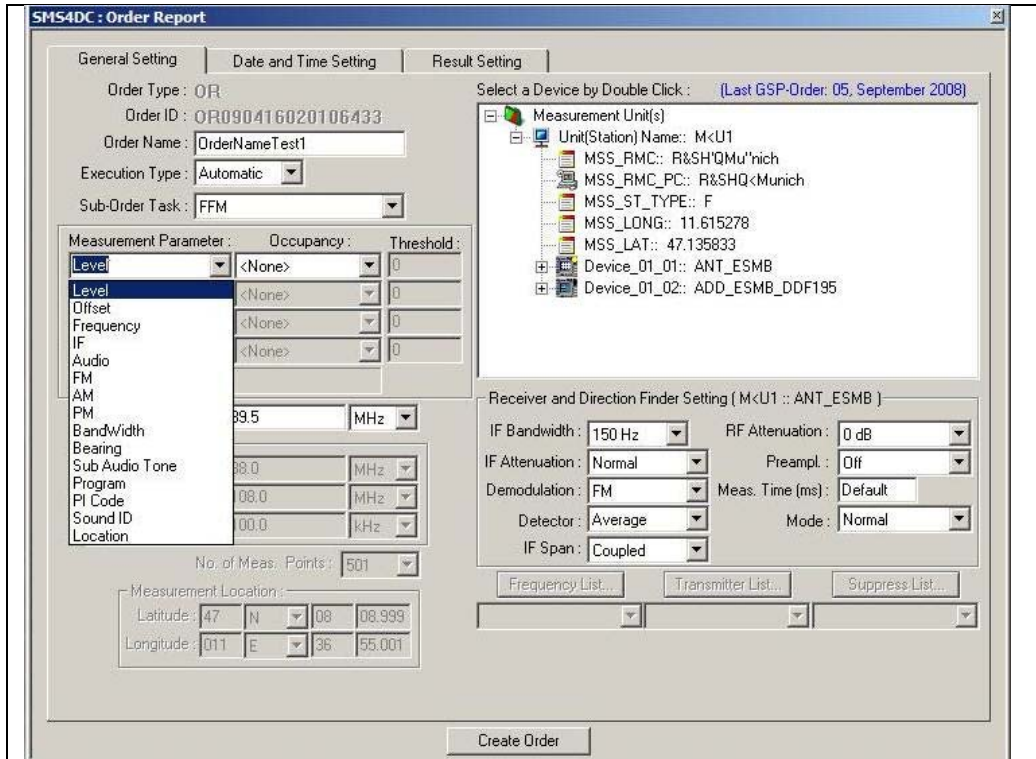


Figure 11.1.1: General Setting of a measurement order
 SMS4DC displays the latest known configuration of the measurement system. In this tab. Also in this screen selection of measurement parameters such as Level, Offset, Frequency, Audio, FM, AM,...for creation of measurement order is possible.

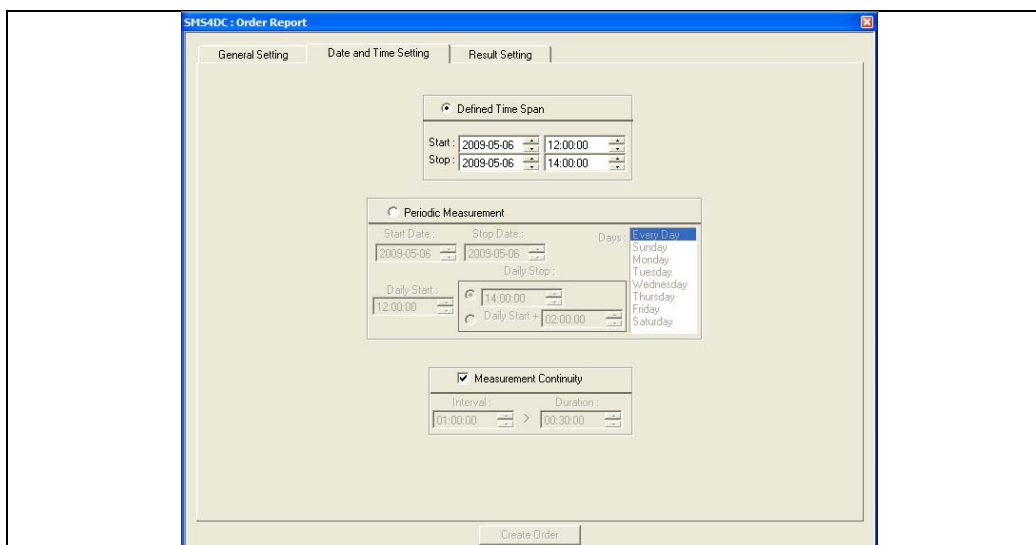


Figure 11.1.2: Date and Time Setting of a measurement order
 In this screen it is possible to create a one-time measurement which is defined using the items on the top of the screen or a periodic measurement using the items in the center of the screen. And also using the items at the bottom of the page, the continuity of the measurement in the defined time span or period, can be defined.

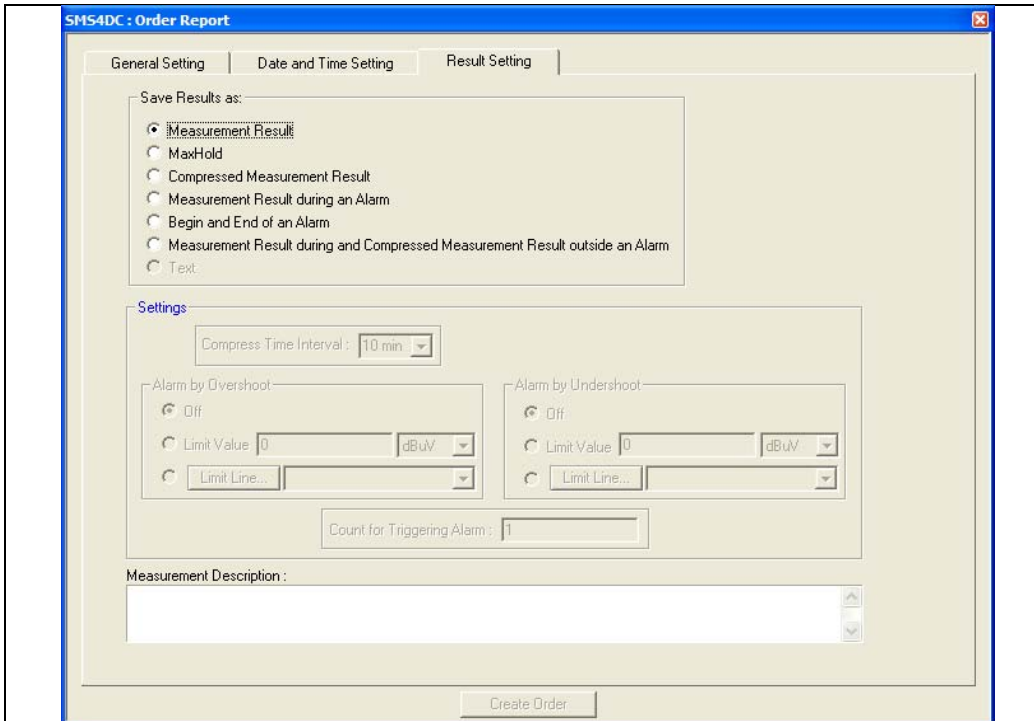


Figure 11.1.3: Result Setting of a measurement order

In the final screen for creation of an ORM, the following selections are available: Measurement Result, MaxHold, Compressed Measurement Result, Measurement Result during an Alarm, Begin and End of an Alarm, Measurement Result during and Compressed Measurement Result outside and Alarm.

Order	Name	Order State	SubOrder State	Comment
OR-081122-170334435-0.xml	AMz	Open	Finished	
OR-081122-171735493-0.xml	FM	Open	Finished	
OR-081122-171948144-0.xml	PM	Open	Finished	
OR-081122-172209317-0.xml	AM5	Finished	Finished	
OR-081122-173321313-0.xml	CMR	In Process	In Process	
OR-081122-175942844-0.xml	CMR	Finished	Finished	Error 2008-11-22T18:02:00+03:30 ...
OR-081122-180739080-0.xml	CMR2	Open	Finished	
OR-081124-202523990-0.xml	CMR-New	Open	Finished	
OR-081126-173937885-0.xml	Lebanon-1	Open	Finished	
OR-081126-175216846-0.xml	OrderNameTest1	Open	Finished	
OR-081208-210152744-0.xml	SubAudio-2	Finished	Finished	Result type not available for measurement...
OR-081208-211703127-0.xml	LevelAlarm	Open	Finished	
OR-090206-173803234-0.xml	Maual-Test	Finished	Finished	This is the result of Manual Test order whi...
OR-090402-211320994-0.xml	OrderNameTest1	Open	Open	
OR-090402-212624844-0.xml	OrderNameTest1	Open	Open	
ORH-081122-170334435-0.xml	AMz	Finished	Finished	
ORH-081122-171735493-0.xml	FM	Finished	Finished	
ORH-081122-171948144-0.xml	PM	Finished	Finished	
ORH-081122-180739080-0.xml	CMR2	Finished	Finished	
ORH-081124-202523990-0.xml	CMR-New	Finished	Finished	
ORH-081126-173937885-0.xml	Lebanon-1	Finished	Finished	
ORH-081126-175216846-0.xml	OrderNameTest1	Finished	Finished	

Figure 11.1.4: Order Status

The screen showing the status of all existing orders in the INBOX folder of ARGUS. The states might be one of the following: Open, In Process, Finished, Forwarded

Figure 11.1.5 Stop Order

The screen showing all running or pending orders ready to be stopped

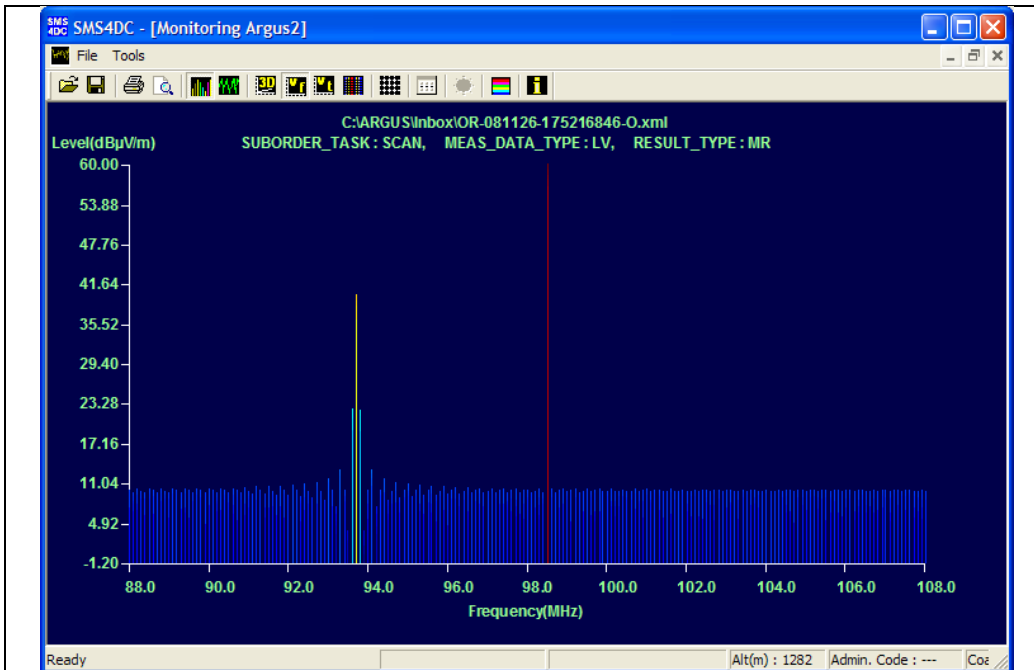
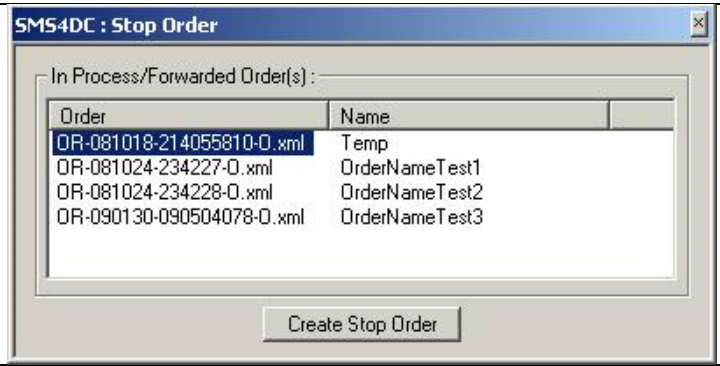


Figure 11.1.6: A sample screen shot of a 2D (Freq., Value) display of measurement results.

This option displays the resulted values as a 2D chart. The following figure is a sample screen shot of a 2D display of measurement results, having Frequency as X-axis and Level as Y-axis.

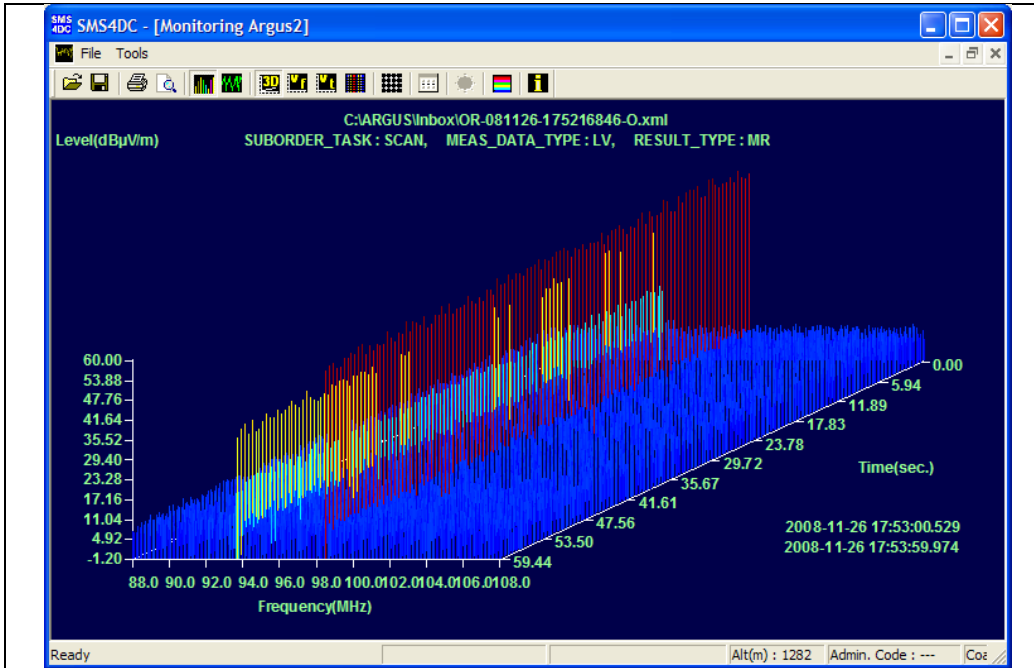


Figure 11.1.7: A sample screen shot of a 3D display of measurement results. 3D View button of Toolbar of ARGUS Monitoring Results view, displays the resulted values as a 3D chart.

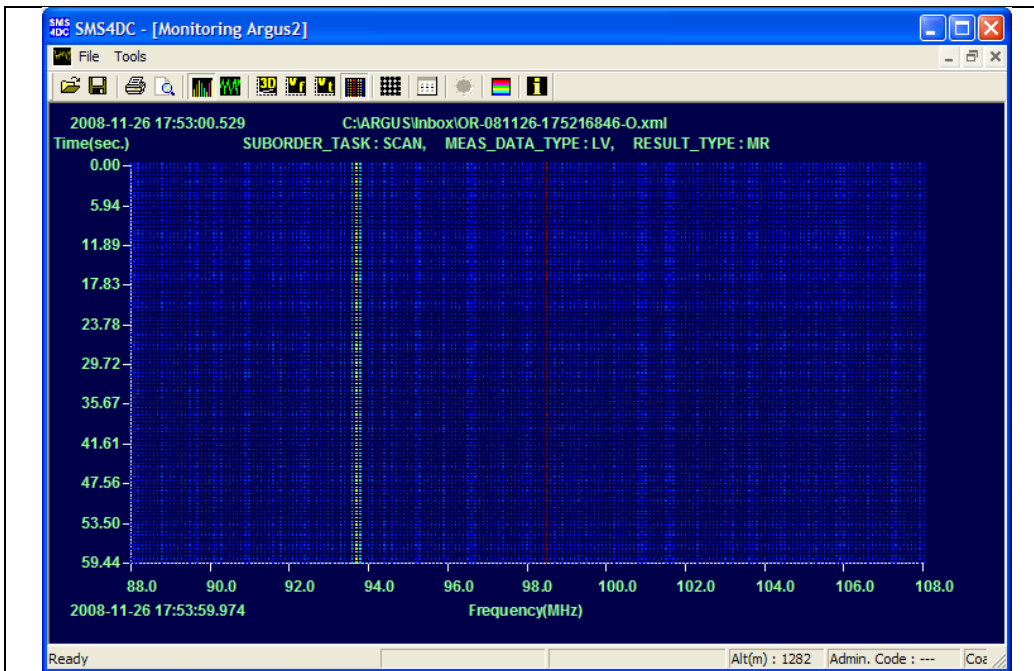


Figure 11.1.8: A sample screen shot of a 2D Water Fall display of measurement results. 2D Water Fall View button of Toolbar of ARGUS Monitoring Results view, displays the resulted values as a 2D chart having Frequency as X-axis and Time as Y-axis.

Figure 11.1.9 Direction Finding

This option is active only when a bearing measurement result is loaded. This result may contain different Level and Quality values for each direction, each frequency (if measured for a frequency range or list) and at different sampling times. In the screen it is possible to select between Level and Quality values, view each measured data alone or a group of measured data for each frequency.

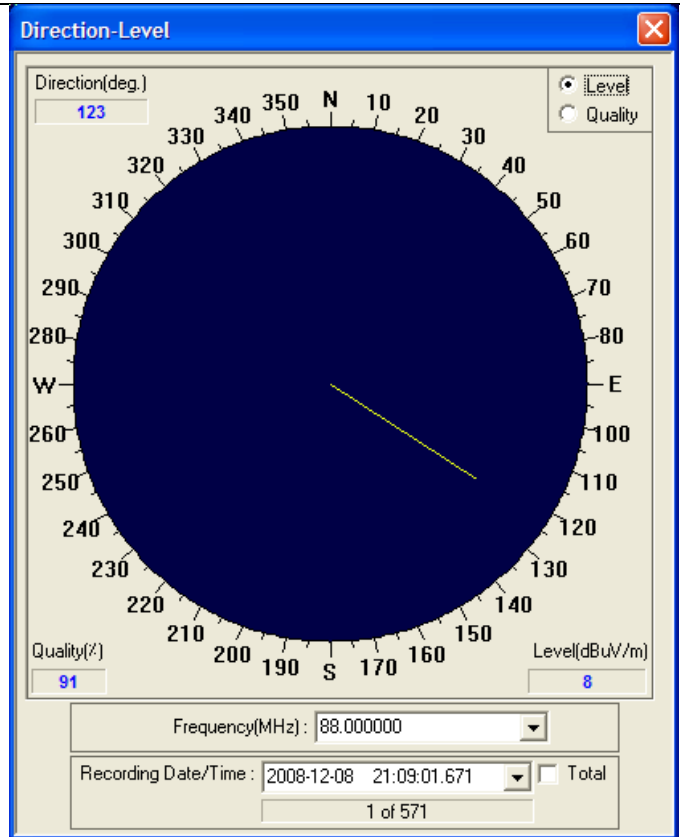


Figure 11.2.1
The screen for measurement mission creation

By selection of this menu item, it is possible to create measurement missions (orders) to be submitted to the ESMERALDA monitoring software.

After selection of the desired mission type then there will be four more screens for further parameters as shown in Figure 11.2.2 to Figure 11.2.5.

Select Monitoring Function and Monitoring Station

Monitoring function

- FBF : Frequency Band occupancy with Fast scanning
- FBM : Frequency Band occupancy with Measurement
- FSM : Frequency Scanning occupancy with Measurement
- FSF : Frequency Scanning occupancy with Fast scanning
- SCT : Systematic Control of Transmitters
- SFS : Specific Frequencies Scanning
- TOR : Transmitter Occupancy Rate
- USS : Unknown transmitters Scanning Searching
- UBS : Unknown transmitters Band Searching
- ATR : Field strength measurements along a route
- CAM : Channel Analysis and Measurements
- TVM : TV Measurements

Monitoring station

ID	Name	Longitude	Latitude
1	ms11	051E1122	35N3344
2	ms2	052E1111	35N0222
3	ms3	053E0101	36N0101

OK

Figure 11.2.2
Step 1 of the parameter definition
for the missions

Mission creation : Frequency Band occupancy with Fast scanning

Step 1 | Step 2 | Step 3 | Step 4 | **Header** | Send

Monitoring function

- FBF : Frequency Band occupancy with Fast scanning
- FBM : Frequency Band occupancy with Measurement
- FSM : Frequency Scanning occupancy with Measurement
- FSF : Frequency Scanning occupancy with Fast scanning
- SCT : Systematic Control of Transmitters
- SFS : Specific Frequencies Scanning
- TOR : Transmitter Occupancy Rate
- USS : Unknown transmitters Scanning Searching
- UBS : Unknown transmitters Band Searching
- ATR : Field strength measurements along a route
- CAM : Channel Analysis and Measurements
- TVM : TV Measurements

Source station :
 Data base

Monitoring function	Source station	Date/Time of mission creation	Monitoring station	Monitoring station longitude	Monitoring station latitude	Date/Time of mission beginning
FBF	G	2010/10/29 17:36:24	ms11	051E1122	35N3344	2010/10/29 17:3

Add | Change | Delete | **Sub-Band(s)**

Start frequency (Hz)	End frequency (Hz)	Continuous sub-band scanning step (Hz)	Detection threshold (dBuV)	Transmission designation	Measurement antenna identifier

Figure 11.2.3
Step 2 of the parameter definition
for the missions

Date and Time settings

Mission creation : Frequency Band occupancy with Fast scanning

Step 1 | Step 2 | Step 3 | Step 4 | **Header** | Send

Monitoring station

Name : ms11

Longitude : 051 E 11 22

Latitude : 35 N 33 44

Mission Date/Time

Beginning date : 10/29/2010 Beginning time : 5:36:24 PM

Ending date : 10/29/2010 Ending time : 6:36:24 PM

Monitoring function	Source station	Date/Time of mission creation	Monitoring station	Monitoring station longitude	Monitoring station latitude	Date/Time of mission beginning
FBF	G	2010/10/29 17:36:24	ms11	051E1122	35N3344	2010/10/29 17:3

Add | Change | Delete | **Sub-Band(s)**

Start frequency (Hz)	End frequency (Hz)	Continuous sub-band scanning step (Hz)	Detection threshold (dBuV)	Transmission designation	Measurement antenna identifier

Figure 11.2.4
Step 3 of the parameter definition
for the missions

Mission creation : Frequency Band occupancy with Fast scanning

Step 1 | Step 2 | Step 3 | Step 4 | Header | Send

Measurements

- ITU measurements
- Direction Finding
- Location
- TV Measurement
- TV Protection

Measurements tolerance

Azimuth (deg.):

AM modulation rate (%):

Frequency: kHz

FM deviation: kHz

Alert

Alert instruction: Message to operator

Detections before masking:

Masking duration (mn):

Monitoring function	Source station	Date/Time of mission creation	Monitoring station	Monitoring station longitude	Monitoring station latitude	Date/Time of mission beginning
FBF	G	2010/10/29 17:36:24	ms11	051E1122	35N3344	2010/10/29 17:3

Add | Change | Delete | Sub-Band(s)

Start frequency (Hz)	End frequency (Hz)	Continuous sub-band scanning step (Hz)	Detection threshold (dBuV)	Transmission designation	Measurement antenna identifier

Figure 11.2.5
Step 4 of the parameter definition
for the missions

Mission creation : Frequency Band occupancy with Fast scanning

Step 1 | Step 2 | Step 3 | Step 4 | Header | Send

Measurement Interval: 500 ms

Repetition interval (mn):

Occupancy parameters based on ITU-R SM.182

Occupancy rate reliability (%): 95

Occupancy rate resolution (mn): 5

Sample type: Dependants

Communication time (mn): 1

Representation

Synthesis Historical Statistics

Monitoring function	Source station	Date/Time of mission creation	Monitoring station	Monitoring station longitude	Monitoring station latitude	Date/Time of mission beginning
FBF	G	2010/10/29 17:36:24	ms11	051E1122	35N3344	2010/10/29 17:3

Add | Change | Delete | Sub-Band(s)

Start frequency (Hz)	End frequency (Hz)	Continuous sub-band scanning step (Hz)	Detection threshold (dBuV)	Transmission designation	Measurement antenna identifier

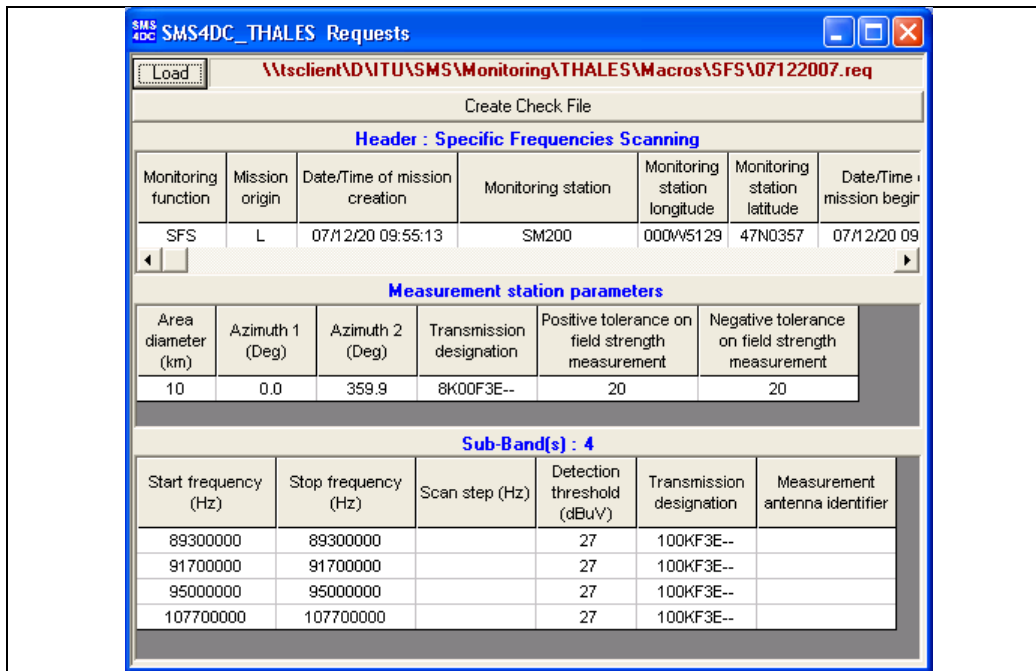


Figure 11.2.6 Screen for creation of a Check file based on a Request file
Check list creation based on request which comes from monitoring system

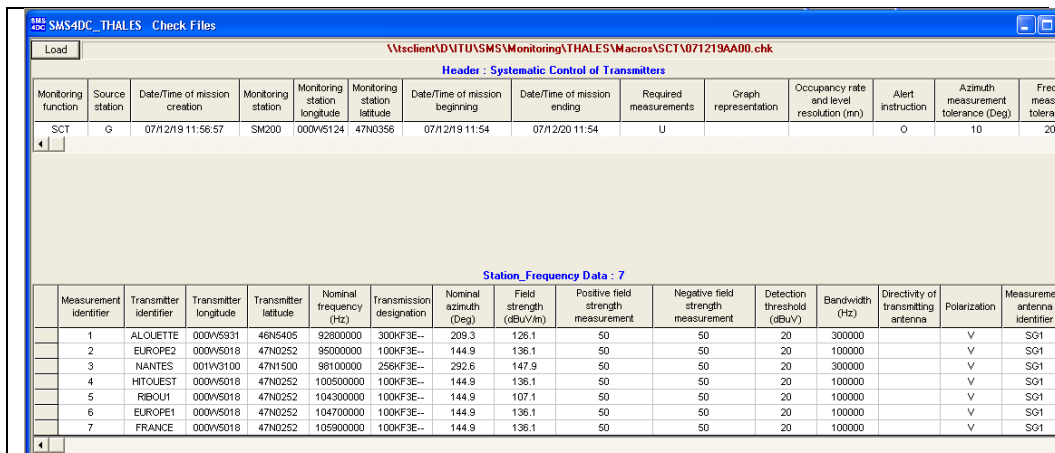


Figure 11.2.7 Screen for Viewing the Check-list files
This menu item is used for displaying the content of check files. This Figure shows an example of a check file for SCT mission.

AMS 4DC SMS4DC_THALES Results

Load

\\tsclient\DMTUV\SMS\Monitoring\THALES\Macros\SCT\071219AA00.res

Header : Systematic Control of Transmitters

Monitoring function	Mission origin	Date/Time of mission creation	Monitoring station	Monitoring station longitude	Monitoring station latitude	Date/Time of mission beginning	Date/Time of mission ending	Graph representation	Measured noise level (dBuV)
SCT	G	07/12/19 11:56:57	SM200	00005129	47N0357	07/12/19 12:04	07/12/19 12:06		

Measurement list : 13

Measurement identifier	Transmitter identifier	Date/Time of detection	Measured transmitter longitude	Measured transmitter latitude	Location mark	Measured frequency (Hz)	Measured azimuth (Deg)	Direction finder quality mark	Measured bandwidth (beta method) (Hz)	Measured bandwidth (x dB method) (Hz)	Measured modulation rate (%)	Me fre drift
1	ALOUETTE											
2	EUROPE2											
3	NANTES STE LUCE											
4	HITOUEST											
5	RIBOUI											
6	EUROPE1											
7	FRANCE INFO											
1001		07/12/19 12:04				105906251	36.4	8	76171	95182	7	1
1002		07/12/19 12:04				104699965	35.7	8	93098	105338	21	2
1003		07/12/19 12:04				104299915	35.6	8	97135	106054	23	3
1004		07/12/19 12:04				100500262	35.7	8	100325	107161	35	4
1005		07/12/19 12:04				94999957	35.9	8	99153	106705	24	3
1006		07/12/19 12:04				92799954	36.1	7	150976	217773	9	4

Figure 11.2.8 Screen for Viewing the Result files
 This menu item is used for displaying the content of result files. This Figure shows an example of a check file for SCT mission.

AMS 4DC SMS4DC_THALES Occupancy Rates

Load

\\tsclient\DMTUV\SMS\Monitoring\THALES\Macros\TOR\071219AA01.occ

Détection de fréquences [Esmeralda XE : Nb 1 : Voie 1]

Date de début 19/12/07 - 14:58:02 Date de fin 19/12/07 - 15:01:12

Tranche horaire	Canal	Taux global	Temps moy.	Temps max.	Temps min.	Niveau max. (dBm)	Niveau moy. (dBm)	from : 19/12/07 - 14:58:02		from : 19/12/07 - 14:59:01		from : 19/12/07 - 15:00:01		from : 19/12/07 - 15:01:01		from : 19/12/07 - 15:01:12	
								Taux	Précision rel.	Taux	Précision rel.	Taux	Précision rel.	Taux	Précision rel.		
	92.800000 MHz	0	00:00:00	00:00:00	00:00:00	-127.0	0.0	0	100.00	0	100.00	0	100.00	0	100.00	0	100.00
	Inconnu [92.800000 MHz	34	00:00:16	00:00:32	00:00:01	-83.0	-85.9	34	39.68	40	52.13	32	39.68	0	100.00	0	100.00
	95.000000 MHz	0	00:00:00	00:00:00	00:00:00	-127.0	0.0	0	100.00	0	100.00	0	100.00	0	100.00	0	100.00
	Inconnu [95.000000 MHz	100	00:03:03	00:03:03	00:00:00	-65.0	-69.0	100	22.17	100	31.31	100	21.57	0	100.00	0	100.00
	98.100000 MHz	0	00:00:00	00:00:00	00:00:00	-127.0	0.0	0	100.00	0	100.00	0	100.00	0	100.00	0	100.00
	Inconnu [98.100000 MHz	0	00:00:00	00:00:00	00:00:00	-127.0	0.0	0	100.00	0	100.00	0	100.00	0	100.00	0	100.00
	100.500000 MHz	0	00:00:00	00:00:00	00:00:00	-127.0	0.0	0	100.00	0	100.00	0	100.00	0	100.00	0	100.00
	Inconnu [100.500000 MHz	100	00:03:03	00:03:03	00:00:00	-62.0	-68.5	100	22.17	100	31.31	100	21.57	0	100.00	0	100.00
	104.300000 MHz	0	00:00:00	00:00:00	00:00:00	-127.0	0.0	0	100.00	0	100.00	0	100.00	0	100.00	0	100.00
	Inconnu [104.300000 MHz	97	00:00:49	00:01:37	00:00:01	-70.0	-74.9	100	22.17	90	33.16	100	21.57	0	100.00	0	100.00
	104.700000 MHz	0	00:00:00	00:00:00	00:00:00	-127.0	0.0	0	100.00	0	100.00	0	100.00	0	100.00	0	100.00
	Inconnu [104.700000 MHz	100	00:03:03	00:03:03	00:00:00	-69.0	-74.0	100	22.17	100	31.31	100	21.57	0	100.00	0	100.00
	105.900000 MHz	0	00:00:00	00:00:00	00:00:00	-127.0	0.0	0	100.00	0	100.00	0	100.00	0	100.00	0	100.00
	Inconnu [105.900000 MHz	100	00:03:03	00:03:03	00:00:00	-69.0	-73.0	100	22.17	100	31.31	100	21.57	0	100.00	0	100.00

Figure 11.2.9 Showing Occupancy Rate
 This Figure shows an example of the content of occupancy file for TOR mission.

AMS 4DC SMS4DC_THALES Requests

Load

\\tsclient\DMTUV\SMS\Monitoring\THALES\Macros\SCT\07122001.req

Header : Systematic Control of Transmitters

Monitoring function	Mission origin	Date/Time of mission creation	Monitoring station	Monitoring station longitude	Monitoring station latitude	Date/Time of mission beginning	Date/Time of mission ending	Required measurements	Graph representation	Occupancy and lev resolution
SCT	L	07/12/20 09:33:22	SM200	000W5129	47N0357	07/12/20 09:31	08/12/20 09:31			

Measurement station parameters

Area diameter (km)	Azimuth 1 (Deg)	Azimuth 2 (Deg)	Transmission designation	Positive tolerance on field strength measurement	Negative tolerance on field strength measurement
10	0.0	359.9	8K00F3E--	20	20

Sub-Band(s) : 1

Start frequency (Hz)	Stop frequency (Hz)	Scan step (Hz)	Detection threshold (dBuV)	Transmission designation	Measurement antenna identifier
88000000	108000000		27	100KF3E--	

Figure 11.2.10 View Request files
 This Figure shows an example of the content of request file for SCT mission.

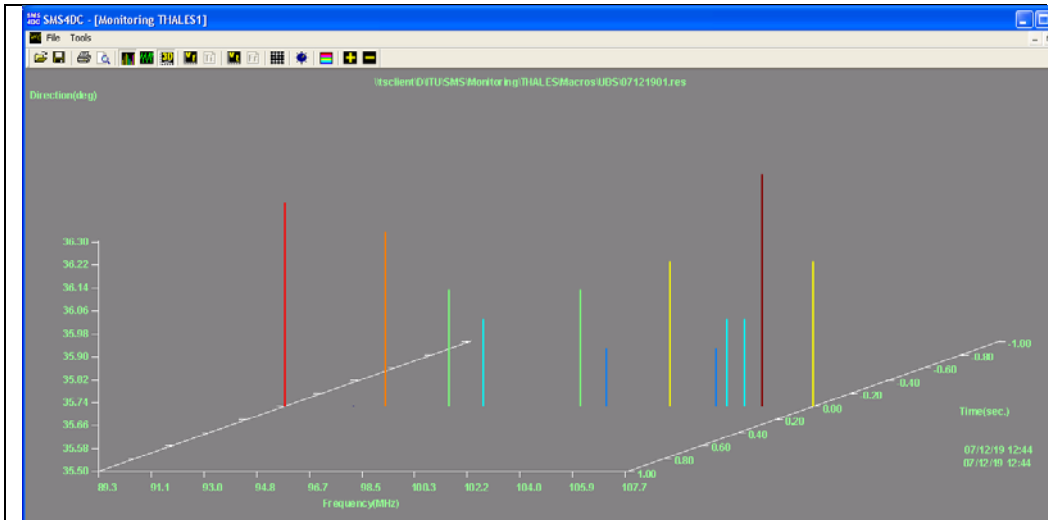
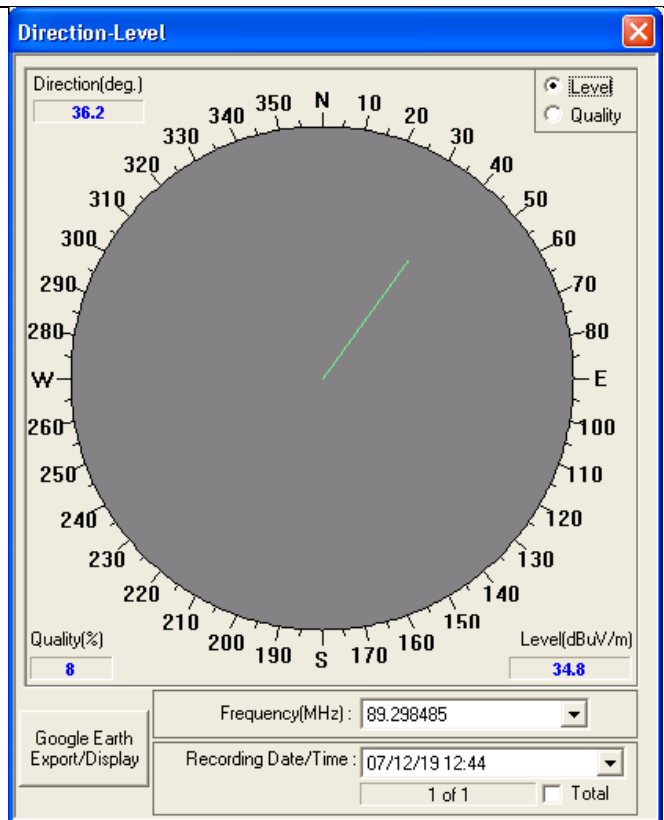


Figure 11.2.11 Graphical display of the measurement results
 This Figure shows an example of the results for a UBS measurement.

Figure 11.2.12 Direction Finding

Screen for displaying and/or exporting the results of a direction measurement

By pressing "Google Earth Export/Display" button, the signal direction is displayed on the Google Earth screen (for this capability, the Google Earth application must be installed).



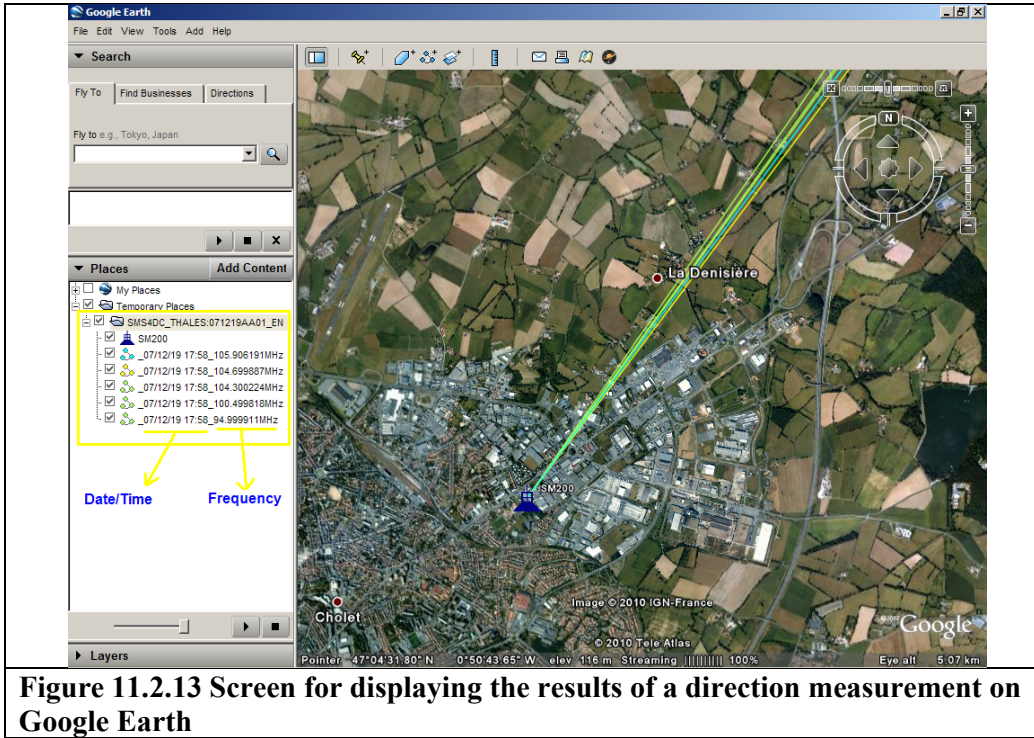


Figure 11.2.13 Screen for displaying the results of a direction measurement on Google Earth

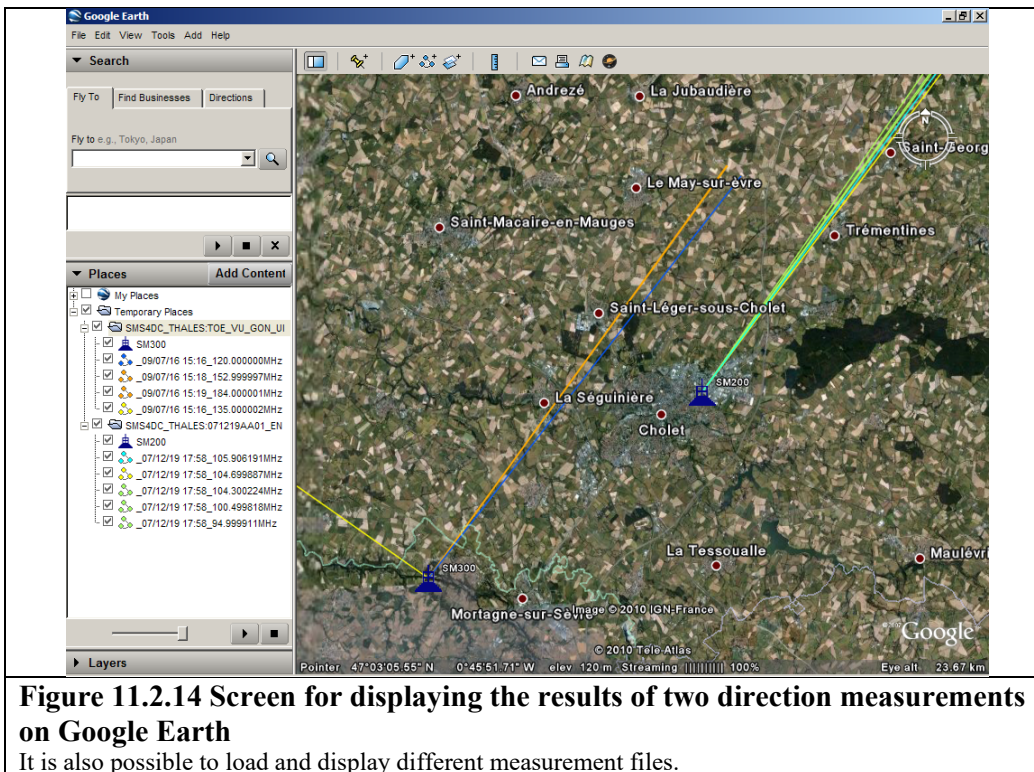


Figure 11.2.14 Screen for displaying the results of two direction measurements on Google Earth
It is also possible to load and display different measurement files.

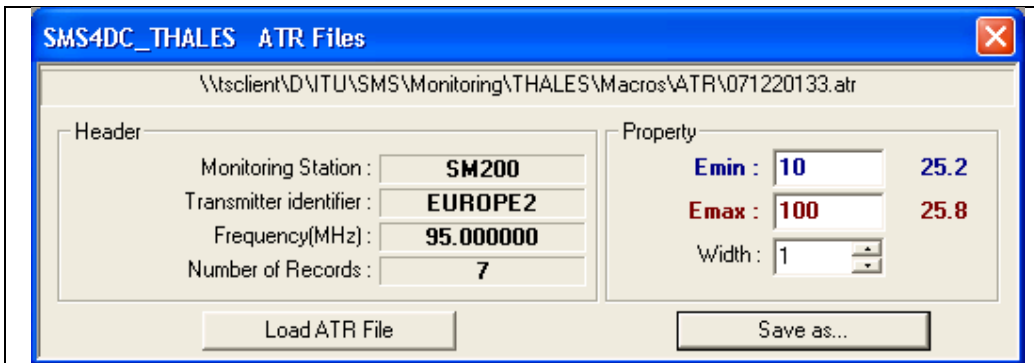


Figure 11.2.15 Screen for displaying and/or converting the results of an ATR mission

This Figure shows an example of the results for an ATR mission.

Figure 11.2.16
Showing an ATR mission on Google Earth



SMS4DC: Order Report

General Setting | Date and Time Setting | Result Setting

Order Type: OR
 Order ID: OR140427144326562
 Order Name: OrderNameTest1
 Execution Type: Automatic
 Sub-Order Task: FFM

Measurement Parameter: Occupancy: Threshold:
 Level: <None> 0
 <None> <None> 0
 <None> <None> 0
 <None> <None> 0
 LV

Fixed Frequency: 89.5 MHz
 Frequency Range:
 Start: 88.0 MHz
 Stop: 108.0 MHz
 Step Width: 100.0 kHz
 No. of Meas. Points: 501
 Measurement Location:
 Latitude: N
 Longitude: E

Receiver and Direction Finder Setting
 IF Bandwidth: 120 kHz
 IF Attenuation: Normal
 Demodulation: FM
 Detector: Peak
 IF Span: 250 kHz
 RF Attenuation: Auto
 Preampl.: Off
 Meas. Time (ms): Default
 Mode: Normal

Frequency List... Transmitter List... Suppress List...

Create Order

Figure 11.3.1: General Setting of a measurement order

In this screen selection of measurement parameters such as Level, Offset, Frequency, Audio, FM, AM,... for creation of measurement order is possible.

SMS4DC: Order Report

General Setting | Date and Time Setting | Result Setting

Defined Time Span
 Start: 14/05/17 12:00:00
 Stop: 14/05/17 14:00:00

Periodic Measurement
 Start Date: 14/05/17
 Stop Date: 14/05/17
 Days: Every Day
 Sunday
 Monday
 Tuesday
 Wednesday
 Thursday
 Friday
 Saturday
 Daily Start: 12:00:00
 Daily Stop: 14:00:00
 Daily Start + 02:00:00

Measurement Continuity
 Interval: 01:00:00 > Duration: 00:30:00

Create Order

Figure 11.3.2: Date and Time Setting of a measurement order

In this screen it is possible to create a one-time measurement which is defined using the items on the top of the screen or a periodic measurement using the items in the center of the screen. And also using the items at the bottom of the page, the continuity of the measurement in the defined time span or period, can be defined.

Figure 11.3.5 Stop Order

The screen showing all running or pending orders ready to be stopped

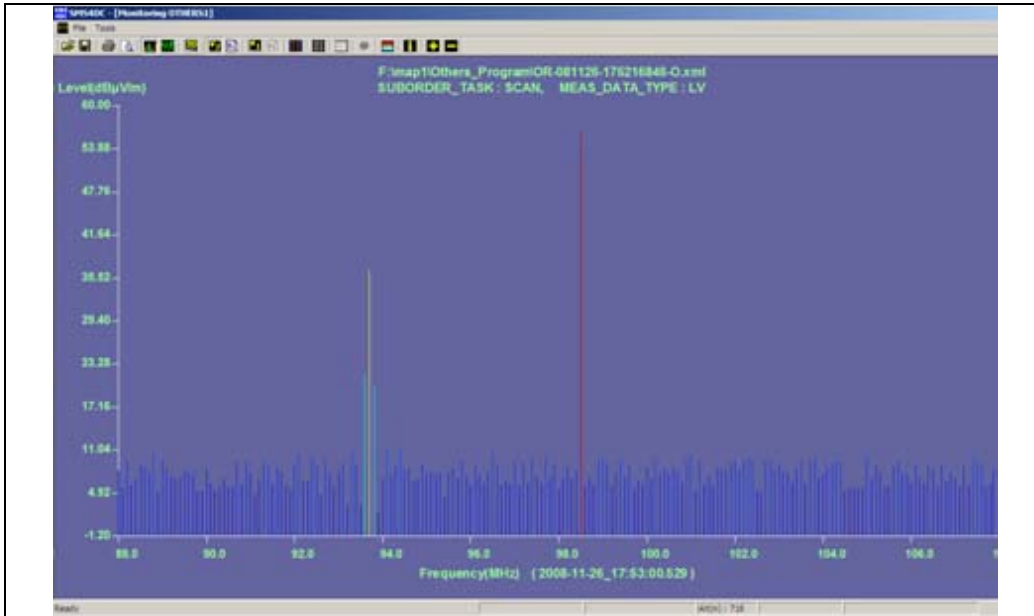
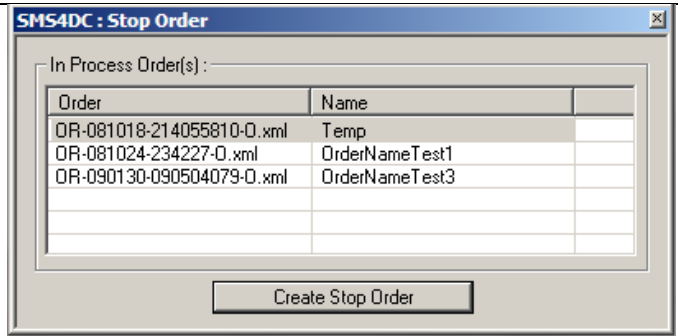


Figure 11.3.6: A sample screen shot of a 2D (Freq., Value) display of measurement results.

This option displays the resulted values as a 2D chart. The following figure is a sample screen shot of a 2D display of measurement results, having Frequency as X-axis and Level as Y-axis.

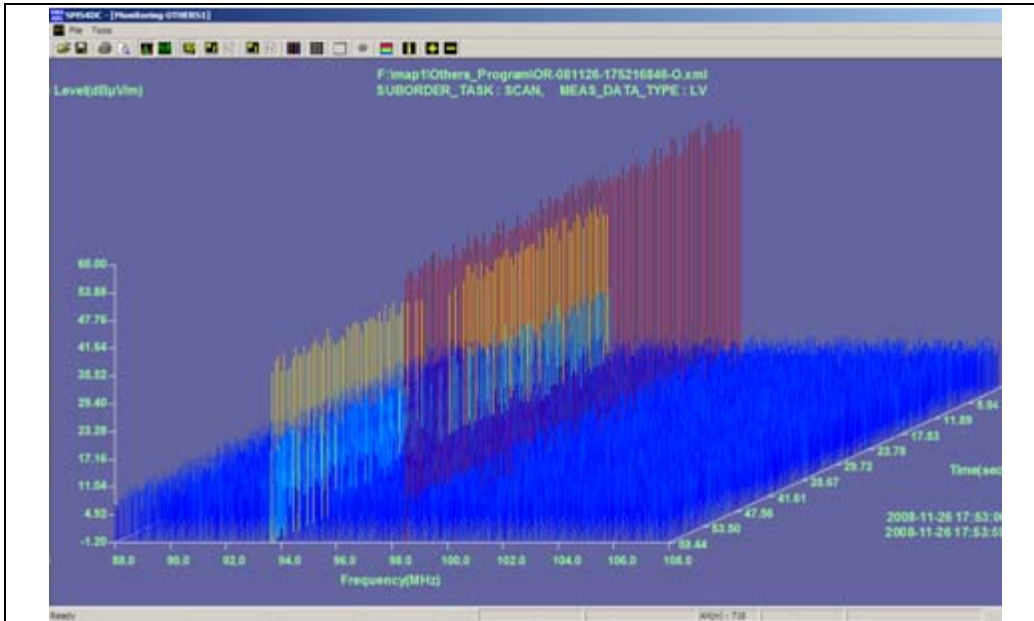


Figure 11.3.7: A sample screen shot of a 3D display of measurement results. 3D View button displays the resulted values as a 3D chart.

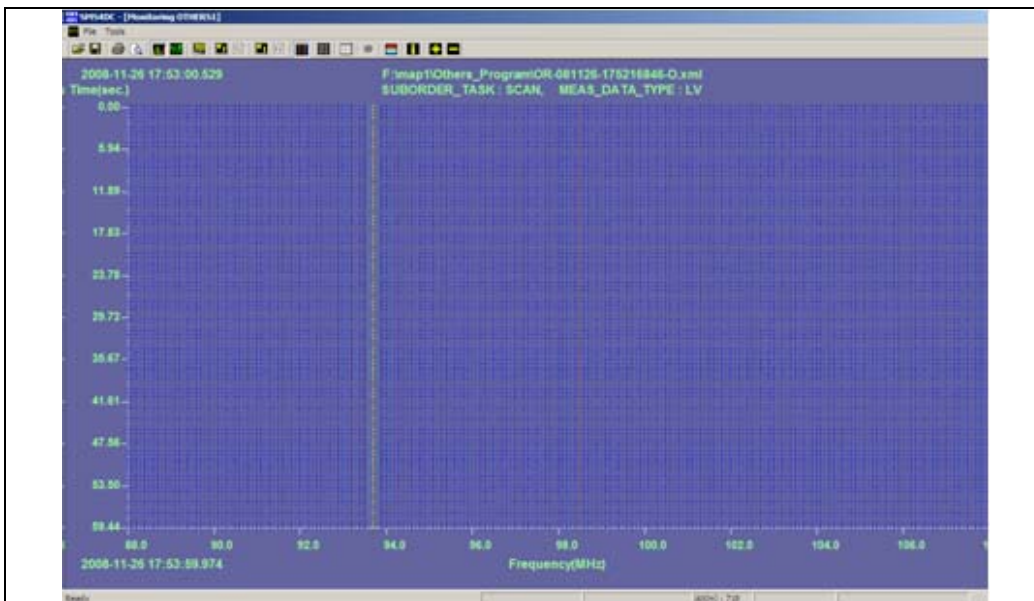
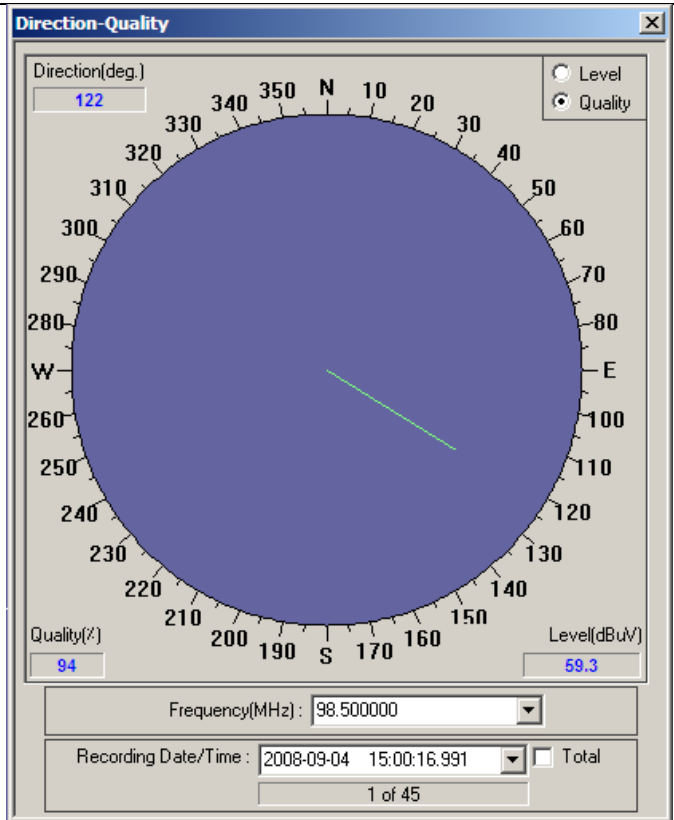


Figure 11.3.8: A sample screen shot of a 2D Water Fall display of measurement results. 2D Water Fall View button of Toolbar displays the resulted values as a 2D chart having Frequency as X-axis and Time as Y-axis.

Figure 11.3.9 Direction Finding

This option is active only when a bearing measurement result is loaded. This result may contain different Level and Quality values for each direction, each frequency (if measured for a frequency range or list) and at different sampling times. In the screen it is possible to select between Level and Quality values, view each measured data alone or a group of measured data for each frequency.



11-4 Network Planning

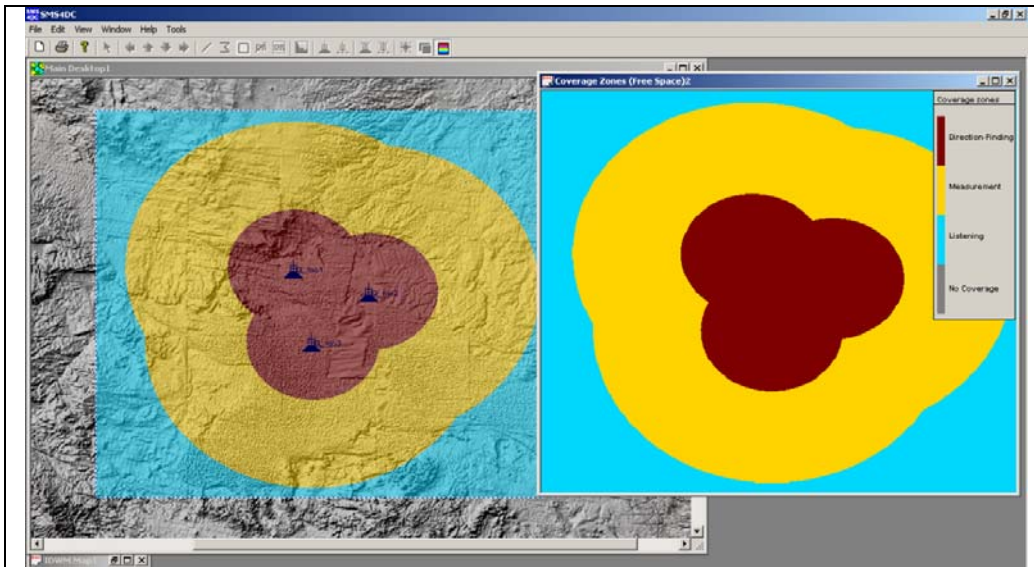


Figure 11.4.1: Coverage zone of selected monitoring network based on various monitoring tasks

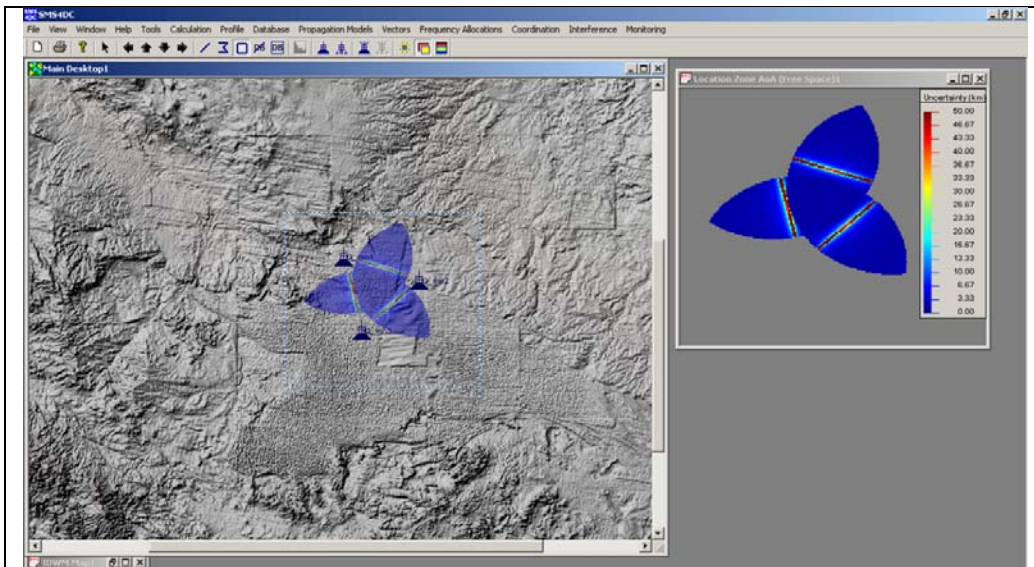


Figure 11.4.2: Location zone (AOA) of selected monitoring network based on location uncertainty

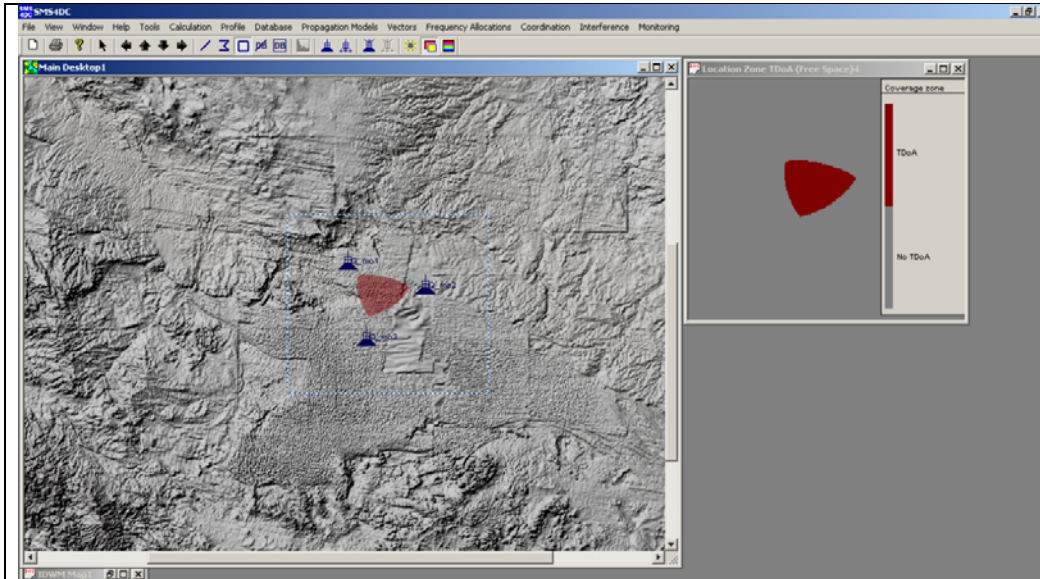


Figure 11.4.3: Location zone (TDOA) of selected monitoring network

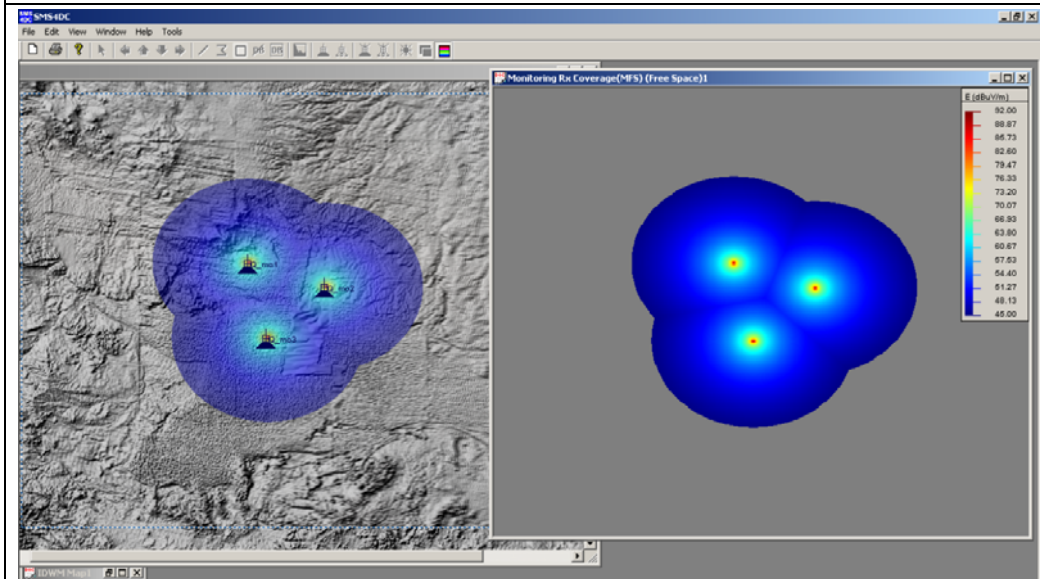


Figure 11.4.4: Rx Coverage Area (Maximum Field Strength)

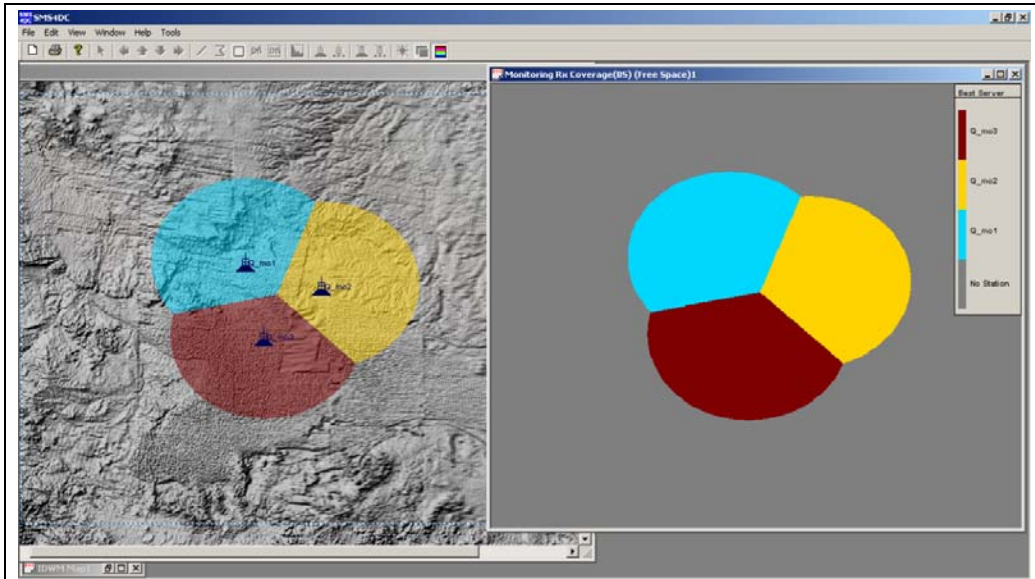


Figure 11.4.5: Rx Coverage Area (Best Server)

Annex 3-Task-oriented Index for the SMS4DC User Manual

Description of task or sub-task	SMS4DC User Manual Reference
Introduction and background	1.1. Background 1.2. Objectives of SMS4DC software 1.3. Features of SMS4DC software 1.4. Structure of SMS4DC software 1.4.1. Core of SMS4DC software 1.4.2. Shell and external elements of SMS4DC software
System installation and operational requirements for SMS4DC	2.1. System requirement 2.2. Setup 2.2.1. Setup on a multiple-client network 2.2.2. Single – user Setup 2.3. USB Hard lock setup 2.4. Directory structure of SMS4DC 2.6. Local database migration 2.7. Customization of administrative functions
Creating Reference files, tables and libraries	1.6. Database structure of SMS4DC 1.7. Utilized reference materials from ITU 3.4.2.5.1. Antenna Editor in Tools menu of DEM view 6.6. New antenna definition 6.10. Modification of a frequency allocation 232 6.11. Addition of footnotes 232 6.12. Definition and modification of frequency arrangements
Setting up System and Database Security	3.1. Program start 2.5. Security 3.2. Definition of User-ID and Password 6.4. Restoring backup 6.7. User account management

Description of task or sub-task	SMS4DC User Manual Reference
Using the Geographical Information System	1.5. Geographical information systems of SMS4DC software 1.5.1. Vector maps 1.5.2. Raster maps 6.3. Changing of DEM map 6.16. Importing a vector file and depicting on map
Using the Vector Map	3.3. Vector map view 3.3.1. Option menu of vector map view 3.3.2. Help menu of vector map view 3.3.3. Toolbar of vector map view
Using the DEM	3.4. DEM view 3.4.1. Toolbar of DEM view 3.4.2. Menus of DEM view 3.4.2.1. File menu of DEM view 3.4.2.2. View menu of DEM view 3.4.2.3. Window menu of DEM view 3.4.2.4. Help menu of DEM view

Description of task or sub-task	SMS4DC User Manual Reference
Using the Calculation, Profile and Tools menus	3.4.2.5. Tools menu of DEM view 3.4.2.5.2. 2D View/Contour item in Tools menu of DEM view 3.4.2.5.3. 3D View item in Tools menu of DEM view 3.4.2.6. Calculations menu of DEM view 3.4.2.6.1. Effective height calculation in the Calculations menu 3.4.2.6.2. Intermodulation calculation in the Calculation menu 3.4.2.7. Profile menu of DEM view
Using the Propagation tools	3.4.2.9. Propagation Models menu of DEM view 3.4.2.9.1. Menu of propagation models, P.618 propagation model 3.4.2.9.2. Tools menu of area calculation window 3.4.2.10. Vectors menu of DEM view 6.5. Path profile extraction 6.9. Field strength calculation

Description of task or sub-task	SMS4DC User Manual Reference
Frequency Assignment and Interference	3.4.2.11. Frequency Allocations menu of DEM view 3.4.2.13. Interference menu of DEM view 6.1. Establishing a station 6.2. Finding station 6.13. Frequency assignment 6.14. Interference calculation
Interference: Fixed service	3.4.2.13. Interference menu of DEM view 5.4. Interference of stations in Fixed services on each other above 1 GHz
Interference: Fixed and Mobile services	3.4.2.13. Interference menu of DEM view 5.3. Interference of stations in Fixed and Land mobile services on each other
Interference: Broadcast service	3.4.2.13. Interference menu of DEM view 5.1. BC to BC interference calculation procedure 5.2. BT to BT interference calculation procedure
Interference: Earth stations	3.4.2.13. Interference menu of DEM view
Interference: Intermodulation interference calculation	3.4.2.13. Interference menu of DEM view
Frequency Co-ordination	3.4.2.12. Coordination menu of DEM view
Frequency Co-ordination: Broadcasting services ST61	3.4.2.12.2. ST61 sub-menu of DEM view
Frequency Co-ordination: Broadcasting services GE84	3.4.2.12.1. GE84 sub-menu of DEM view
Frequency Co-ordination: Broadcasting services GE89	3.4.2.12.3. GE89 sub-menu of DEM view 3.4.2.12.3.1. GE89 Interference sub-menu of DEM view
Frequency Co-ordination: Broadcasting services GE06	3.4.2.12.4. GE06 sub-menu of DEM view 3.4.2.12.4.1. GE06 Interference To sub-menu of DEM view 3.4.2.12.4.2. GE06 Interference From sub-menu of DEM view
Frequency Co-ordination: Fixed and Mobile services (Bilateral and multilateral agreements)	3.4.2.12. Coordination menu of DEM view 3.4.2.12.5. Agreement item in Coordination menu of DEM view
Frequency Co-ordination: Earth stations RR Appendix 7	3.3.1.1. RR Appendix 7 item in Option menu 3.3.1.2. RR Appendix 7 (GIBC) item in Option menu 3.4.2.12.6. Border coordination item in Coordination menu of DEM view
Frequency Co-ordination: HCM Agreement	3.4.2.12.7. HCM Agreement item in Coordination menu of DEM view
Frequency Co-ordination: ITU notification	6.17. Production of BR electronic notices
Frequency Co-ordination: Importing data from BR-IFIC (Terrestrial Services) and BR-IFIC (Space Services) on DVD-ROMs.	6.8. Importing information published by ITU-BR

Description of task or sub-task	SMS4DC User Manual Reference
Administrative database and Licensing System	3.4.2.8. Database menu of DEM view 4.1. Hierarchical administrative levels 4.2. The level of Administrative Data 4.2.1. Context menu in the level of Administrative Data 6.18. Customization of SMS4DC
Data entry: Owner	4.3. The level of Owner 4.3.1. Context menu in the level of Owner
Data entry: License	4.4. The level of License 4.4.1. Context menu in the level of License
Data entry: Earth Stations	4.5. The level of Earth Station 4.5.1. Context menu in the level of Earth Station 4.6. The level of Beam 4.6.1. Context menu in the level of Beam 4.7. The level of Group 4.7.1. Context menu in the level of Group
Data entry: Stations (LM, F, B)	4.8. The level of Station 4.8.1. Context menu in the level of Station
Data entry: Equipment	4.10. The level of Equipment 4.10.1. Context menu in the level of Equipment
Data entry: Frequency	4.11. The level of Frequency 4.11.1. Context menu in the level of Frequency
Data entry: Antenna	4.12. The level of Antenna 4.12.1. Context menu in the level of Antenna
Data entry: Receiver	4.13. The level of Receiver 4.13.1. Context menu in the level of Receiver
Data entry: Allotments and Contours	4.14. The level of Allotment 4.14.1. Context menu in the level of Allotment 4.15. The level of Contour 4.15.1. Context menu in the level of Contour
Database Manager- Entering the existing data to SMS4DC	Annex 1- Database Manager
Billing and invoicing	4.9. The level of Billing History 4.9.1. Context menu in the level of Billing History 6.15. Billing in SMS4DC 2.7. Customization of administrative functions 6.18. Customization of SMS4DC
Monitoring- ARGUS	3.4.2.14.1. ARGUS menu 3.4.2.14.1.1. Respond to Order sub-menu of ARGUS menu 3.4.2.14.1.2. GSP Order sub-menu of ARGUS menu 3.4.2.14.1.3. ORM Order sub-menu of ARGUS menu 3.4.2.14.1.4. Order Status sub-menu of ARGUS menu 3.4.2.14.1.5. Stop Order sub-menu of ARGUS menu 3.4.2.14.1.6. Draw Output sub-menu of ARGUS menu 3.4.2.14.1.7. Toolbar of ARGUS Monitoring Results view
Monitoring- ESMERALDA	3.4.2.14.2. ESMERALDA menu 3.4.2.14.2.1. Check-list Generation/Mission Creation sub-menu of ESMERALDA menu

	<p>3.4.2.14.2.2. Check-list Generation/Requests sub-menu of ESMERALDA menu</p> <p>3.4.2.14.2.3. Check-list Generation/Requests (Automatic) sub-menu of ESMERALDA menu</p> <p>3.4.2.14.2.4. View/Check-list sub-menu of ESMERALDA menu</p> <p>3.4.2.14.2.5. View/Results sub-menu of ESMERALDA menu</p> <p>3.4.2.14.2.6. View/Occupancy Rate sub-menu of ESMERALDA menu</p> <p>3.4.2.14.2.7. View/Requests sub-menu of ESMERALDA menu</p> <p>3.4.2.14.2.8. Draw Output sub-menu of ESMERALDA menu</p> <p>3.4.2.14.2.9. Show ATR sub-menu of ESMERALDA menu</p>
Monitoring- Others	<p>3.4.2.14.3. Others menu</p> <p>3.4.2.14.3.1. Respond to M2S Order sub-menu of Others menu</p> <p>3.4.2.14.3.2. S2M Order sub-menu of Others menu</p> <p>3.4.2.14.3.3. Order Status sub-menu of Others menu</p> <p>3.4.2.14.3.4. Stop Order sub-menu of Others menu</p> <p>3.4.2.14.3.5. Draw Output sub-menu of Others menu</p> <p>3.4.2.14.3.6. Toolbar of Others Monitoring Results view</p>
Monitoring- Network Planning	<p>3.4.2.14.4. Network Planning menu</p> <p>3.4.2.14.4.1 Coverage Zone sub-menu of Network Planning menu</p> <p>3.4.2.14.4.2 Location Zone (AOA) sub-menu of Network Planning menu</p> <p>3.4.2.14.4.3 Location Zone (TDOA) sub-menu of Network Planning menu</p> <p>3.4.2.14.4.4 Rx Coverage Area sub-menu of Network Planning menu</p>