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Spectrum Management Automation

Traditional Spectrum Management

- Deal with less number of services
- No spectrum trading
- Non Integration of Spectrum Management Systems
- Incomplete records of existing authorizations
- limited capability to monitor and enforce compliance
- Slow processing of new applications.

Modern Spectrum Management

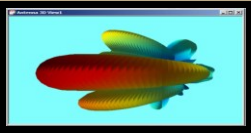
- Spectrum Trading
- Technology advancement
- New technologies and services
- New licensing types e.g. light licensing
- Deal with thousands of stations/records
- Integration of Spectrum Management System

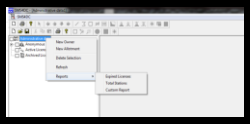
Full automation for SMS4DC

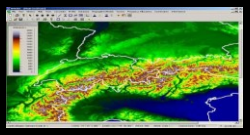
- Export import features
- Integrate with Monitoring systems
- Internet/online frequency application
- Automatic renewal of frequency licenses and license payments
- Fees calculation from the technical and administrative parameters of the frequency assignments and the licenses
- Generation of documents (report, invoices, receipts), billing,..etc.

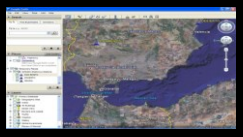
Key features of SMS4DC system

- Spectrum planning , frequency assignments.
- Licensing management and Approvals.
- Documentation and Record keeping.
- Generation of documents (report, invoices, receipts), billing,..etc.
- Stations notifications and border coordination.
- Spectrum monitoring – Interference calculations.
- Satellite Earth stations contours and interference calculations.
- Communication with other ITU tools(BRIFIC, SRS) and monitoring systems.
- Graphical User Interface (GUI) Functions.
- Security management.
- Covering Broadcasting, Fixed and Mobile services.
- Export results to Google earth.
- IDWM Map









My trainings experience

- Africa for English speaking countries
  - Nigeria May 2013 , about 56 participants from 8 countries
  - Ethiopia December 2014, to participants from Ethiopia and Swaziland
  - South Sudan – Ministry of Telecommunication and Postal Services December, 2013.
- Arab countries
  - Djibouti June 2015, 20 participants from 6 countries
  - 3 times trainings to delegate from Yemen and Somalia 2012-2014
  - UAE – Centre of excellence 2012 and 2016.
  - UNIFIL April 2013.
- Asia-Pacific Region
  - Timor Leste August , 2014 , 23 participants from 6 countries
- South America
  - Venezuela- CONATEL January, 2014.

Most of trainings to Telecom authorities, and some trainings to Organizations have large number of frequency holdings

Main Training Challenges

- Most of participants are not familiar with the other ITU-R Tools such as:

1.International Frequency Information Circular BR IFI

2.ITU-R website and WISFAT account

3.Radio regulations

4.Telecom basics like (Antenna, Radiation pattern, Frequency bands characteristics)

In such cases I fixed some times to give a brief description/background about each topic

Trainings Improvements

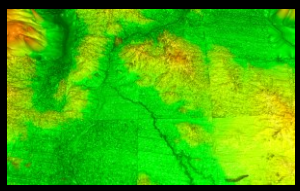
- Send a questionnaire to participants prior to any training program, for better planning.
- Fix time in each session to give general background on the related topics.
- Increase trainings days to be 3 weeks instead of 1 or 2 weeks.
- More material documents and videos

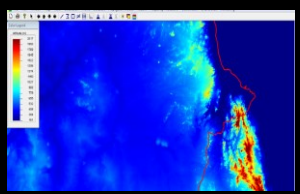
Main questions from participants

- ITU- To create specific portal for General discussion, information/knowledge sharing and online support.
- Additional map layers so as to enable zooming.
- Export /import data to SMS4DC system.
- Billing models.
- Specific and dedicated training workshop on Spectrum Planning, National Frequency Allocation Table, stations notifications, and broadcasting so as to build base background for future trainings.
- Is necessary that the software allows graph the coverge at the borders of two or more stations simultaneously.
- I would like the software could be more manageable, friendly with the uses, add the option of to create personal links to access specific topics and import database from excel.
- Despite the fact that the software is very complete, I would recommend that it would be possible zoom the maps
- Review and improve simulation coverage as the signal propagation does not conform to the ground.
- It is necessary more days for more comprehension and retention of the information

At the end of each training I send all comments of the patriciates and my own to ITU to assist in future developments.

Work experience National Telecommunication Corporation –NTC Sudan

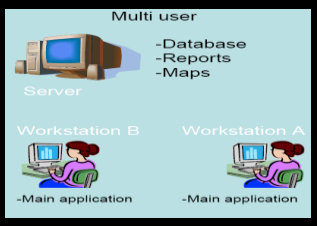




- Started using SMS4DC system since 2007 version 1
- Used to perform tasks of Spectrum Management department
- Insert plans/arrangements of the key bands such as FM radio, VHF, Mobile and Microwave.
- Data base of licensed Services and stations.
- Frequency assignment
- Technical analysis: Coverage, field strength, field strength contour, Microwave link calculations, interfere calculations.
- Used for border coordination and coordination of GE2006 Agreement
- Create electronic notices, reports, Build networks.

Work experience National Telecommunication Corporation –NTC Sudan

Starting	System preparation	Daily use
▪ SMS4DC system installed on server in a network with access from client PCs. ▪ Each Engineer has user name and password. ▪ SM4DC is used for administrative and technical assistant to the spectrum management department.	▪ All plans /arrangements of the key bands such as FM radio, VHF, Mobile an Microwave where inserted to the system. ▪ Licensed users information together with stations where inserted to the system	▪ Handle all new assignment using SMS4DC system. ▪ In case of any interference claim first run the case in SMS4D, then investigate wit monitoring stations. ▪ Create notifications of planned stations and sent the text file to ITU for registration. ▪ Assist in coordination with neighbor countries together with other ITU tools. ▪ Planning of fixed, mobile and broadcasting services, before sending to ITU for registration. ▪ Import recoded stations from BRIFIC.



Work experience National Telecommunication Corporation –NTC Sudan

Main difficulties	Advantages/ Solutions
Maps	Contacted ITU and added 90 m resolution map, but still need map with zooming capabilities.
Export / Import	Took much time to finish importing of license data, good news is that V5 has these capabilities, but need more enhancement and also export features.
Spectrum fee	Developed local system to handle national spectrum fee model.
More user friendly	Still need for this features such as search, modification, export of results copy and duplicate.

SMS4DC system together with other tools are used to handle the tasks of spectrum management department.

Proposals For Further Developments

Short Term Motivations	Long Term Motivations
▪ Export database to Excel or Words (listing by query) ▪ Upload the printed and singed licenses letter to SMS4DC. ▪ More flexibility in licensing data records and fast retrieval of data. ▪ Fees calculation from the technical and administrative parameters of the frequency assignments and the license and ability to add national formulas. ▪ Reports for number of licenses, frequency applications for specific period. ▪ More enhancement to the frequency allocation charts ▪ Step by step follow of the work starting from application untill issuing of lisense letter.	▪ Online application of frequency licenses requests. ▪ High resolution maps ▪ Automatic renewal of frequency licenses and license payments.

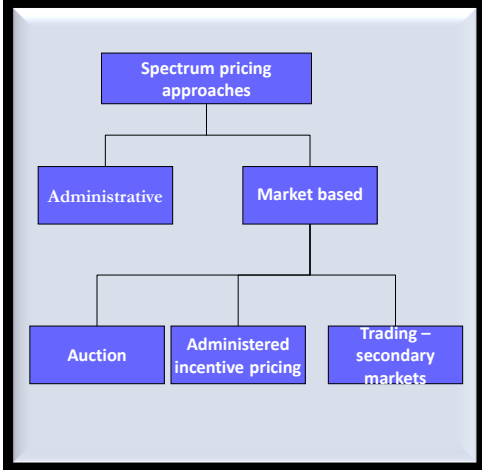
Spectrum pricing

The broad goals and objectives associated with spectrum pricing are

Administrative fee	Covering the costs of spectrum management activities borne by the spectrum management authority or regulators;
Spectrum efficiency	Ensuring the efficient use of the spectrum management resource by ensuring sufficient incentives are in place.
Economy	Maximizing the economic benefits to the country obtained from use of the spectrum resource;
User revenue	Ensuring that users benefiting from the use of the spectrum resource pay for the cost of using spectrum;

Developing spectrum pricing strategies invariably involves alignment with the government's and regulator's revenue goals and objectives, setting targets, and discussion with key stakeholders such as the Ministry of Finance and key sector groups – telecommunications service providers.

Spectrum pricing approaches



Administrative	▪ The administrative assignment of spectrum usually includes the imposition of spectrum management fees and spectrum usage fees. These fees can take the form of simple charges or more complex formulae
Auction	▪ Auctions represent a market based pricing and assignment mechanism whereby the price and the licensee of the frequency are determined in a bidding process.
Trading – secondary markets	▪ Is to allow license owner to transfer the rights of using licensed frequencies with other user..
Administered incentive pricing	▪ Setting charges for spectrum holdings to reflect the value of the spectrum in order to promote efficient use of the spectrum

General formula of spectrum fee calculation

A spectrum price can be formulated from a number of separate elements based on any or all of various criteria such as the amount of spectrum used, number of channels or links used degree of congestion, efficiency of radio equipment, transmitter power/coverage area, geographical location and so forth.

$$P = \frac{V}{M} \times \frac{K_f K_S}{K_m} \times C_S \times K_P$$

Where:
P = the spectrum price
V = volume of space or geometric area occupied
M = useable results obtained from the radio equipment considered, for example the number of channels to be provided or users to be served
K_f = coefficient reflecting specific characteristics of range used
K_s = coefficient taking into account the region/location of the radio station installation
K_m = coefficient reflecting the social benefit of radio system
C_S = annual spectrum management costs
K_p = coefficient reflecting the level of spectrum access demand in the band in question

Spectrum fee recommendation

ITU to develop a general formula then users to fix their coefficient values or.
Each user send ITU considered model and coefficients values for customization.

THANK YOU