National Spectrum Management & its Automation

Workshop on Spectrum Management and Harmonized use of Spectrum Resource
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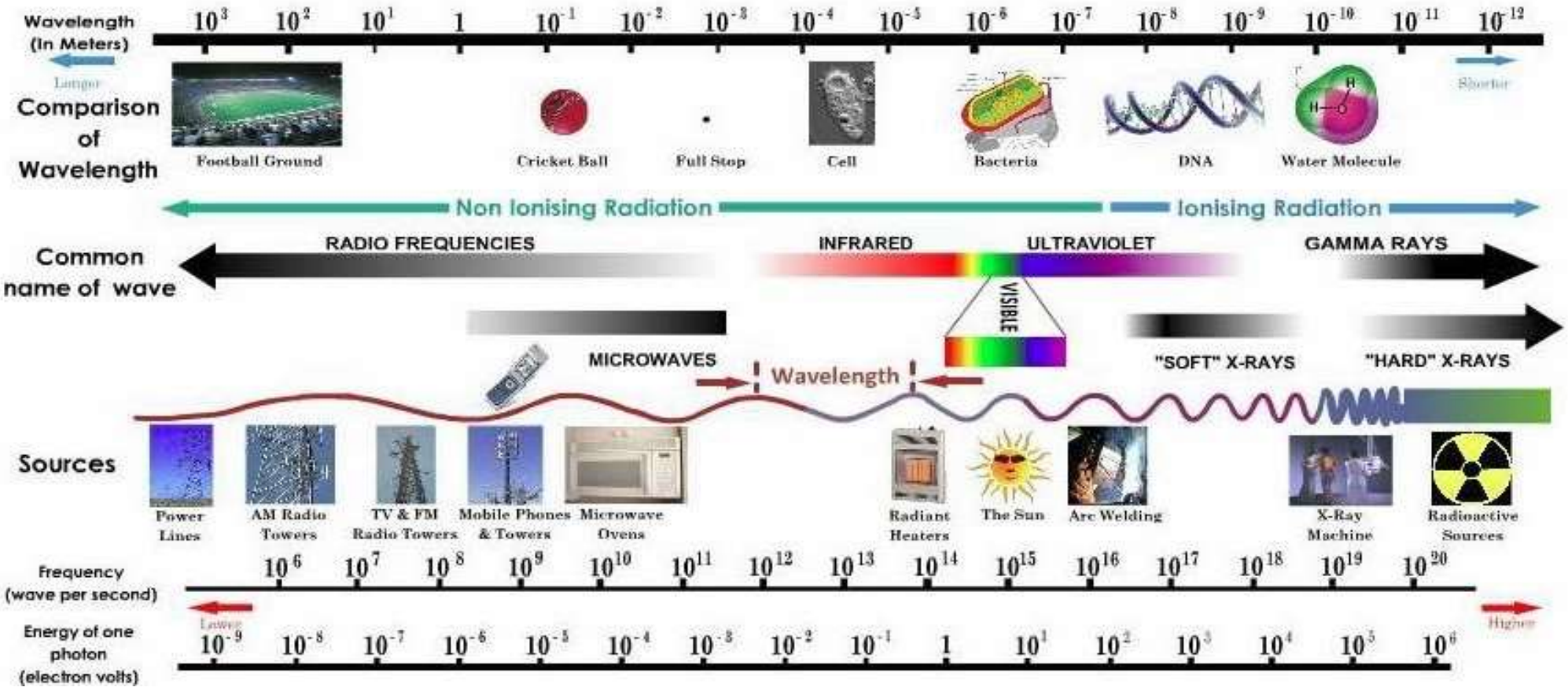
AGENDA

- What is RF and why is it important to any country?
- National Spectrum Management
- Automation of National Spectrum Management
- Examples of SM tools

Radio-Electric Spectrum



Portion of Electromagnetic Waves, used for Communications

Artificial boundary, based on technologic development

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ITU-D 1992 2017

Radio-Electric Spectrum: *General Technical Usage*

Band	Frequency range	Range	Common use	Bandwidth
VLF (myriametric waves)	3-30 kHz	1 000 km	Long-range radionavigation	Very narrow
LF (kilometric waves)	30-300 kHz	1 000 km	Long-range radionavigation	Very narrow
MF (hectometric waves)	300-3 000 kHz	2-3 000 km	Long-range radionavigation	Moderate
HF (decametric waves)	3-30 MHz	Up to 1 000 km	Fixed point-to-point, Global broadcasting	Wide
VHF (metric waves)	30-300 MHz	2-300 km	Broadcasting, Mobile, WAN	Very wide
UHF (decimetric waves)	300-3 000 MHz	< 100 km	Broadcasting, Mobile, Satellite	Very wide
SHF (centimetric waves)	3-30 GHz	30-2 000 km	Fixed, Broadcasting, Mobile, WAN, Satellite communications	Very wide up to 1 GHz
EHF (millimetric waves)	30-300 GHz	20-2 000 km	Broadcasting, Fixed point-to- point, Mobile, Satellite communications	Very wide up to 10 GHz

RF Spectrum as a National Resource

Features	Natural Resource			
	Spectrum	Land	Oil	Water
Is the resource varied?	**YES**	YES	Not very	Not very
Is it scarce?	**YES**	YES	YES	YES
Is it renewable?	**YES**	Partially	NO	YES
Can it be stored for later use?	**NO**	NO	YES	YES
Can it be exported?	**NO**	NO	YES	YES
Can it be traded?	**YES**	YES	YES	YES
Can it be made more productive?	**YES**	YES	YES	NO

Spectrum Management (SM)

Key Terms

	Allocation	Allotment	Assignment
Definition	Allocation (of a frequency band): Entry in the Table of Frequency Allocations of a given frequency band for the purpose of its use by one or more terrestrial or space radiocommunication services or the radio astronomy service under specified conditions. This term shall also be applied to the frequency band concerned.	Allotment (of a radio frequency or radio frequency channel): Entry of a designated frequency channel in an agreed plan, adopted by a competent conference, for use by one or more administrations for a terrestrial or space radiocommunication service in one or more identified countries or geographical areas and under specified conditions.	Assignment (of a radio frequency or radio frequency channel): Authorization given by an administration for a radio station to use a radio frequency or radio frequency channel under specified conditions.
Frequency Distribution to	**Services**	**Areas or Countries**	**Stations**

National Spectrum Management (SM)

Spectrum management is a combination of administrative and technical activities for efficient utilization of spectrum by users without causing harmful interference in their service area

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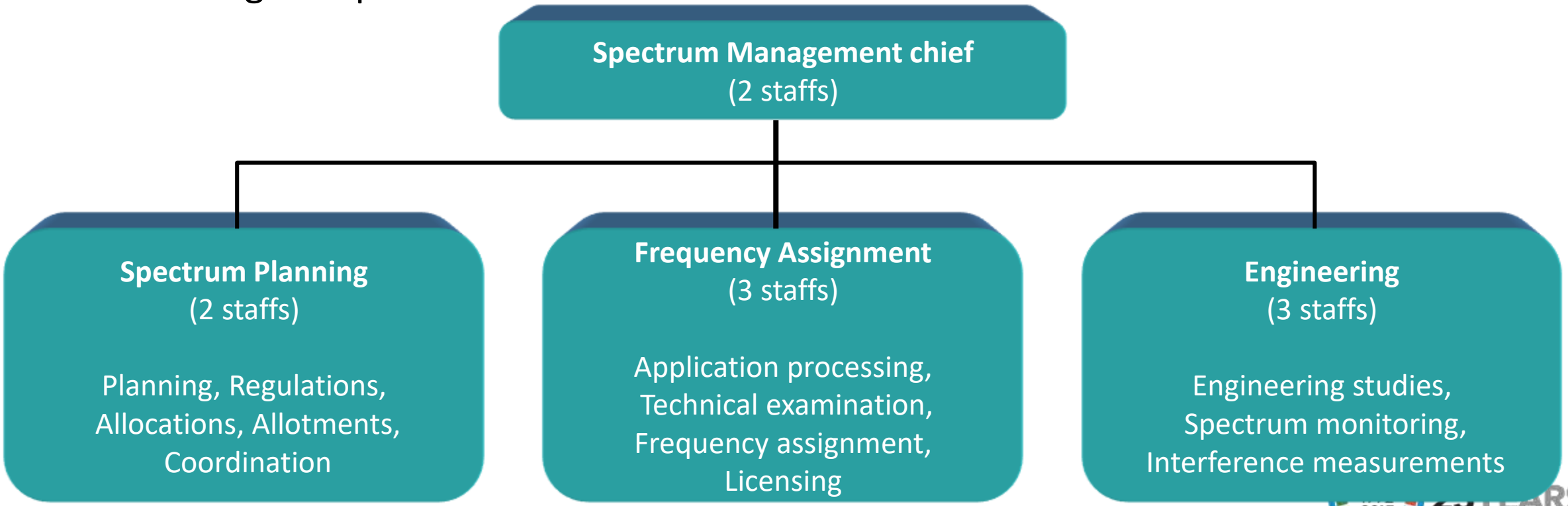
Income from Spectrum Management

- **Fees collected :**
  - License application (not refundable);
  - License issuing, renewing and amendment;
  - Periodically (on monthly/annual basis) from spectrum users proportional with the occupied bandwidth, service type, used frequency, covered location, service area, time duration and etc.;
  - Penalties imposed in effect of breaching of regulation;
  - Type approval fee;
  - Special technical assistance;
  - Auction;
- **Spectrum management authority could earn much more money than its administrative needs if a suitable spectrum pricing regulation developed**
- **Roughly, spectrum fee should not be more than 3~5% of net revenue of licensee**

Organizational Structure of National Spectrum Management Department

➢ Small Economies

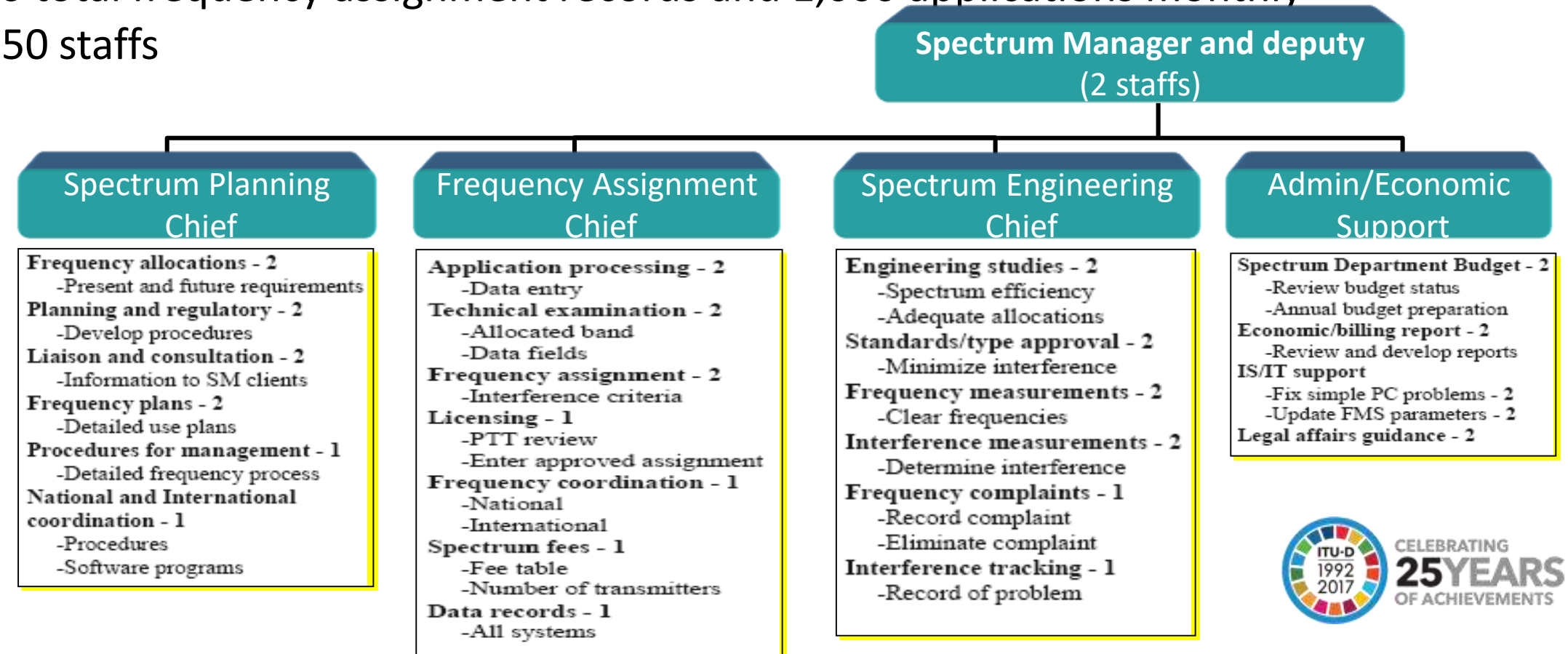
- 5 to 10 staffs
- Not enough for professional functions



Organizational Structure of SM Department

➢ Medium sized organization

- There are different ways for arrangement
- 75,000 total frequency assignment records and 1,000 applications monthly
- 10 to 50 staffs



National Spectrum Management

National SM Framework

Telecom ACT /Law

Spectrum Policy

National Table of Frequency Allocation

National SM Actions

➢ Planning: *Defining the use of different bands*

- provides direction and cohesion in support of policy formulation, and support future steps to achieve optimal spectrum use. Major trends and developments in technology and the needs of both current and future users of the frequency spectrum should be closely monitored and mapped.

➢ Licensing: *Authorizing of emissions, and technical conditions*

- Involves assigning specific frequencies to users, allotting certain frequency bands or sub-bands to specific users under certain specified conditions and in accordance with the national and international table of frequency allocations.

➢ Spectrum Engineering

- Involves the development of electromagnetic compatibility standards for equipment that emits or is susceptible to radio frequencies.

➢ Enforcement: *Verifying the use of spectrum in conformity with licensing*

- Involves the monitoring of the use of the radio spectrum and the implementation of measures to control unauthorized use

National Spectrum Management

Adherence to

- National Telecom ACT and Spectrum policy
- International Radio Regulations
- Regional frequency allotments and allocations

Covers

- Current and Future demands of different category of users
- Telecommunication technology growth and trends

Major National Document

- National Table of Frequency Allocation

Requires

- Regular Update Especially after World (or Regional) Radiocommunication Conference (WRC/RRC)

National Table of Frequency Allocations (NTFA)

A national Level Document that:

- Divides portion of all allocable spectrum into number of frequency bands for use and/or reservation for future use.
- Defines Primary, Secondary, Co-Primary usages of band and the bands reserved for specific services
- Details the national policy on preparation of band plans that are consistent with corresponding spectrum allocations and with existing national and international allotment plan.
- Other parameters for frequency assignment;

National Table of Frequency Allocations (NTFA)

- **Primary Basis:**

  means that in accordance with the nature of a right granted to the assignee of a particular spectrum (band or spot frequency), the assignee is the only entity to use the identified spectrum and is entitled to protection from:

  - harmful interference caused by any other spectrum user who may be authorized to use same spectrum on secondary basis; and
  - claims of harmful interference by any such spectrum user

- **Secondary basis:**

  means the nature of a right granted to the assignee of a particular spectrum (band or spot frequency), is subject to the condition that the entity does not cause any harmful interference to, or claim protection from any harmful interference caused by, other licensees who have been granted the right to use same frequency bands on primary or co primary basis.

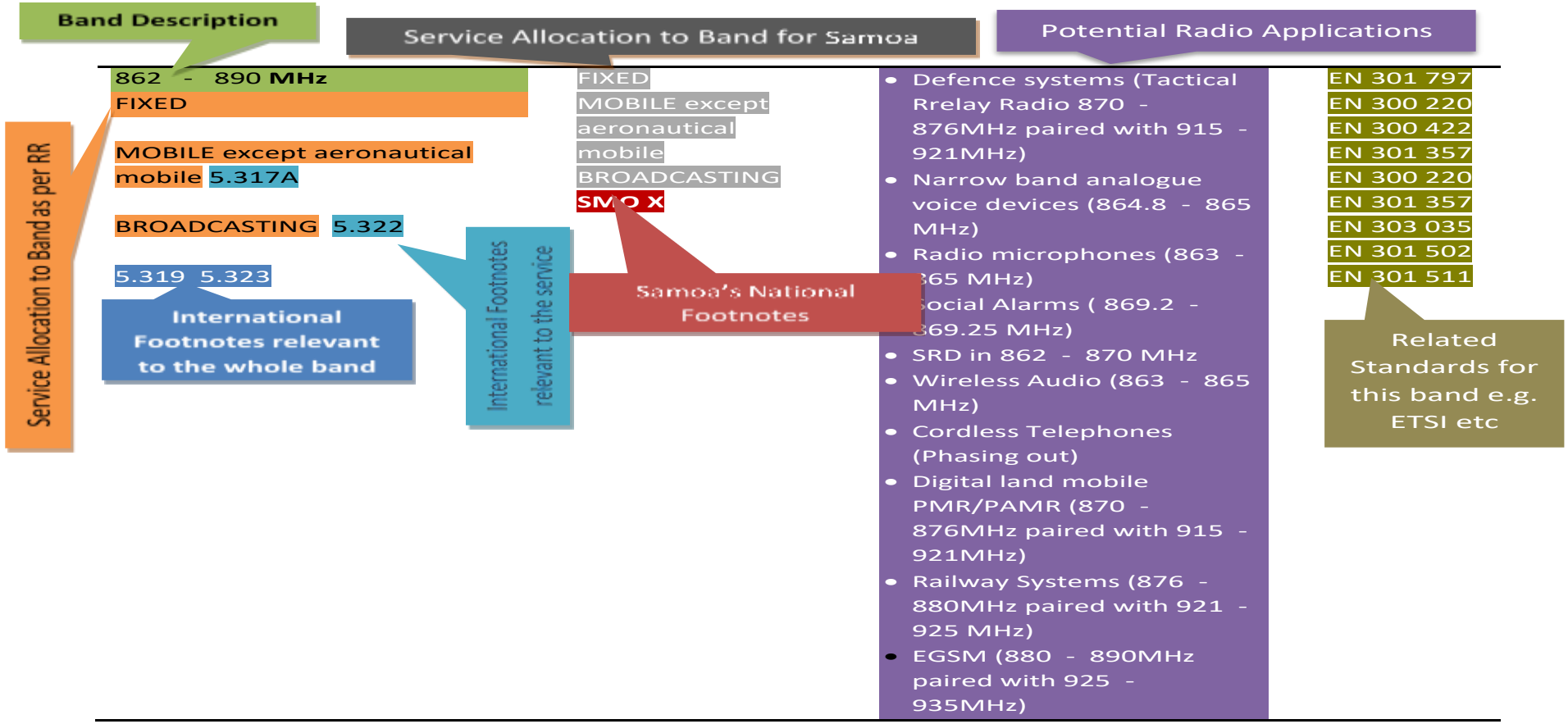
National Table of Frequency Allocations (NTFA)

➢ Co-primary Basis:

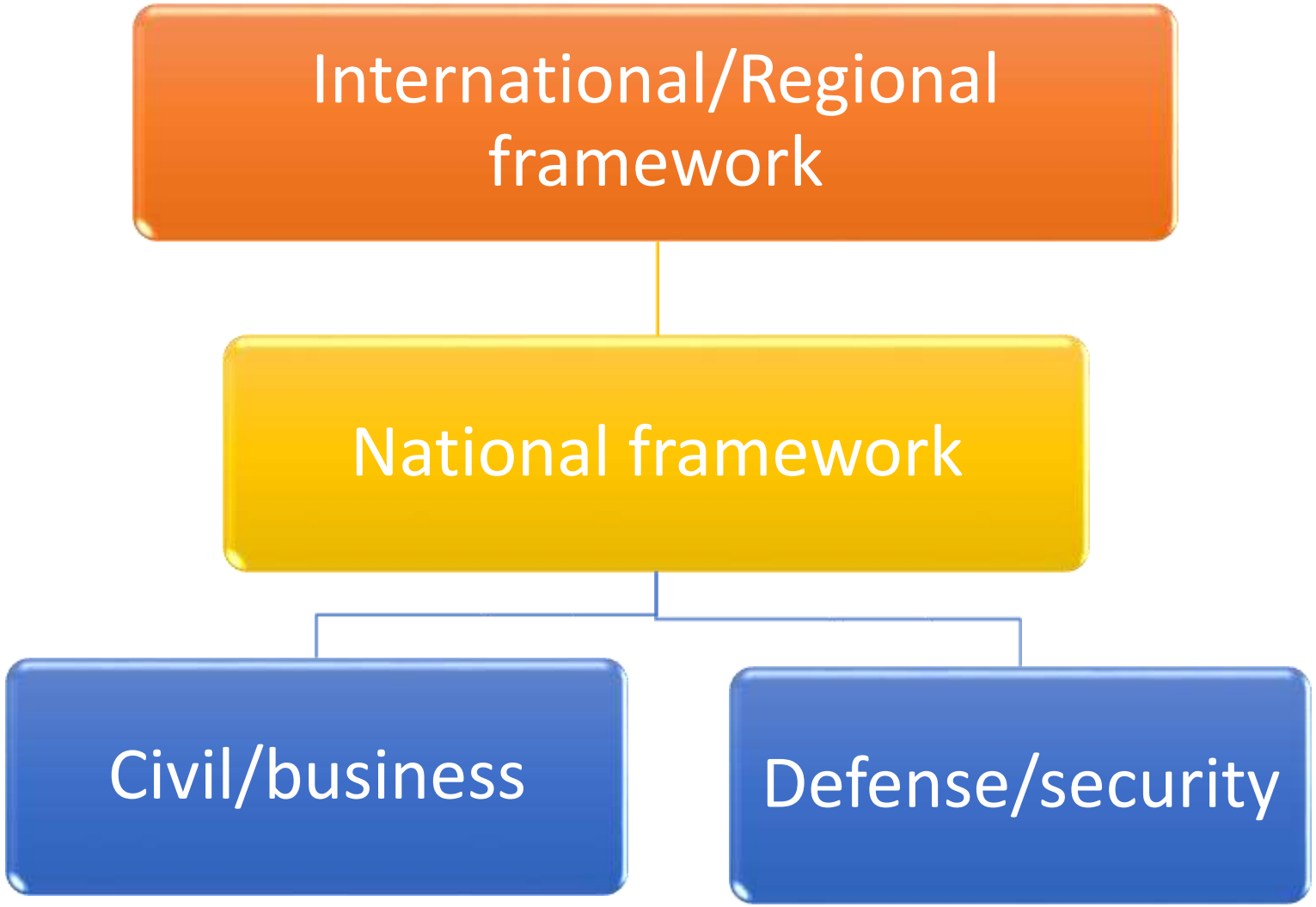
means that nature of the right granted to the assignee of a particular spectrum (band or spot frequency), to use the specified frequency bands is subject to the condition that

- the entity must coordinate with other co-primary licensees in order to limit harmful interference to existing links and services operating in the relevant frequency bands, and to facilitate the introduction of additional links and services in the relevant frequency bands.
- Co-primary user must refrain from causing harmful interference to, and may not require protection from operations of other co-primary user in relevant band.
- Co-primary usage of band is subject to protection from:
  - harmful interference caused by any other spectrum user that may be authorized to use the same spectrum on secondary basis,
  - claims of harmful interference by holders of licenses granting secondary status with respect to frequency bands covered

NTFA Example : Samoa



International roles of SM



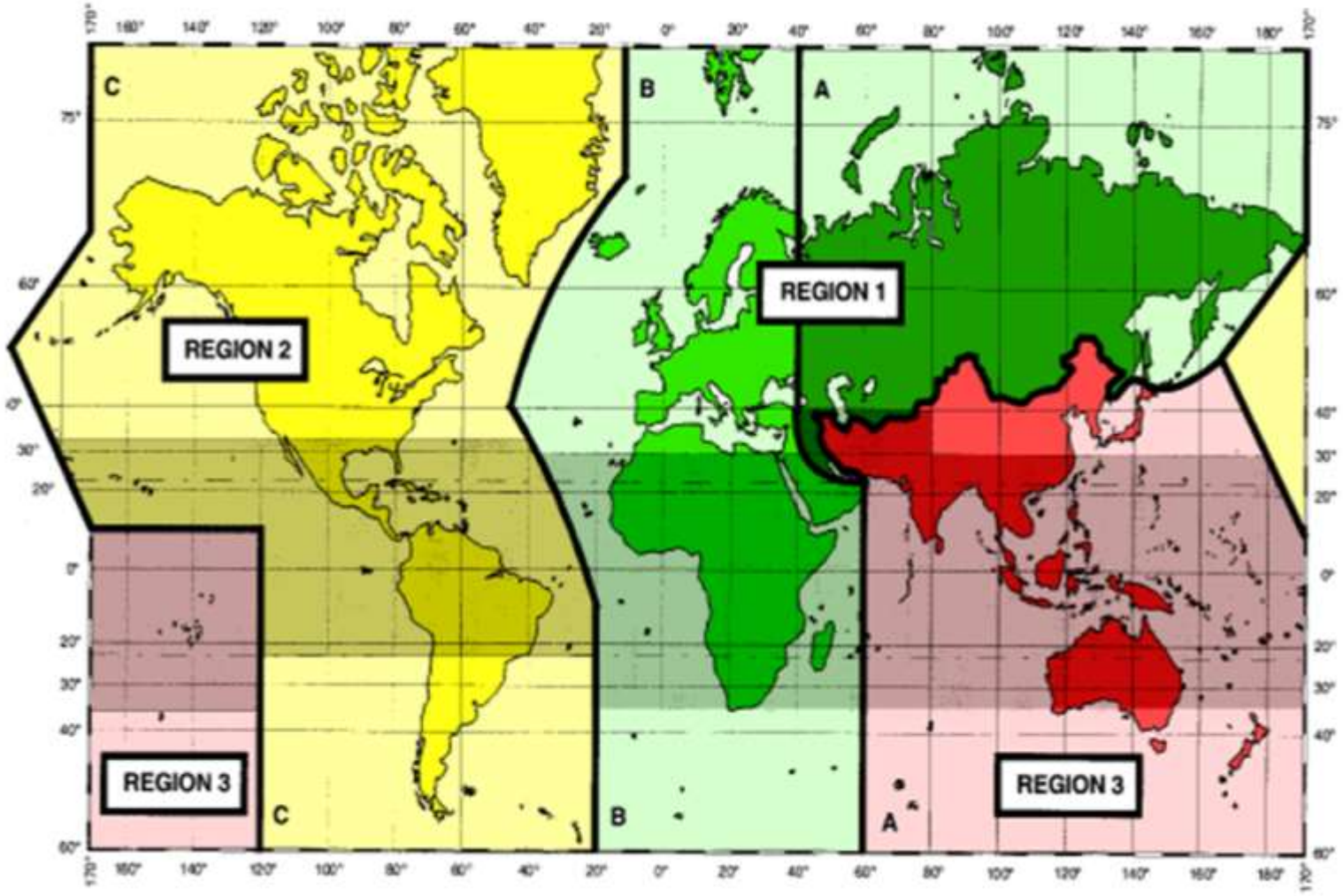
ITU and Spectrum Management

- The Radio Regulations govern the use of the radio-frequency spectrum and the geostationary satellite and non-geostationary-satellite orbits.

- Article 5 of the Radio Regulations deals with regulations for frequency allocation and contains the (international) Table of Frequency Allocations.

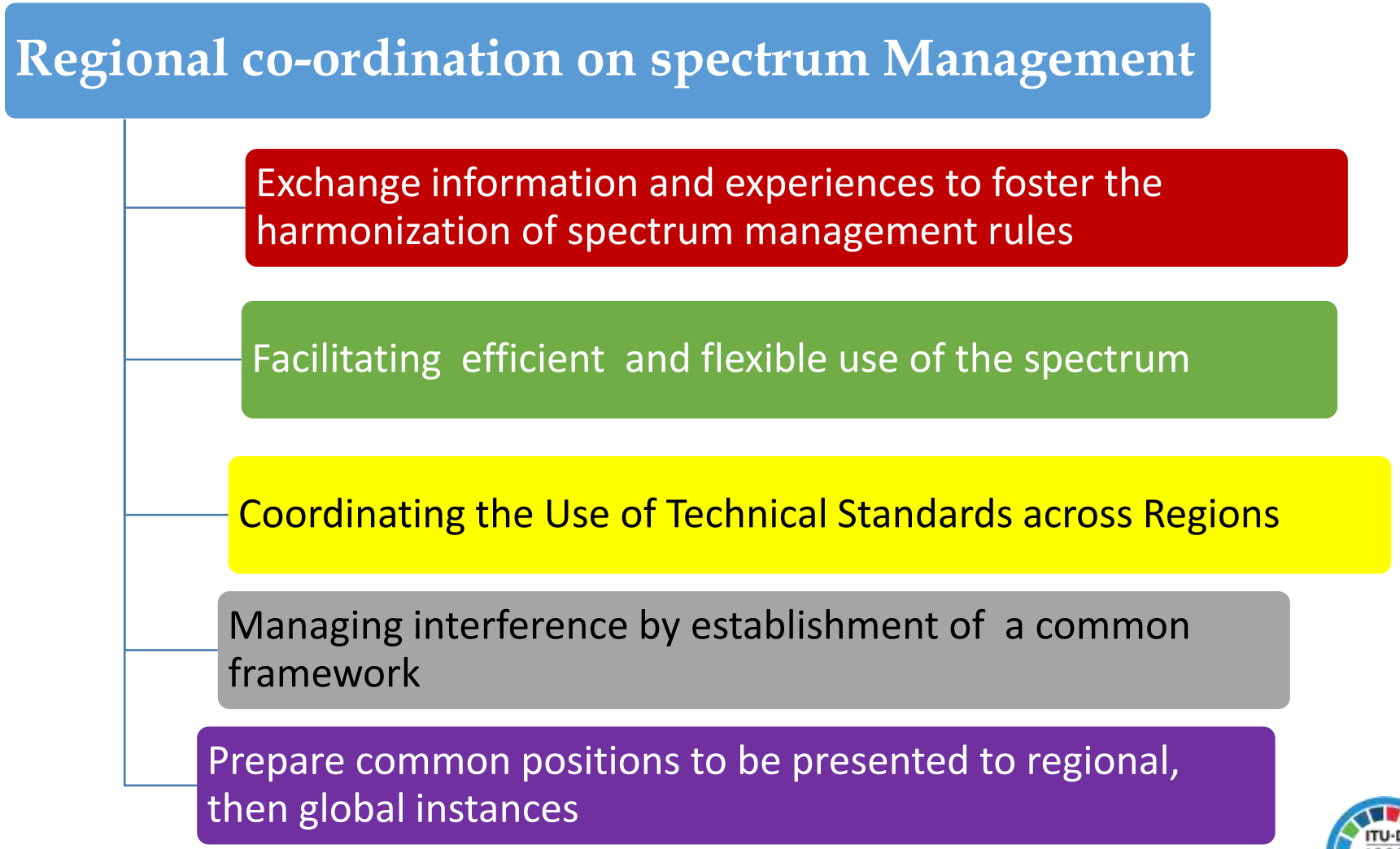
- The Table of Frequency Allocations reflects decisions made on the purpose or purposes to which particular frequencies will be put.

International Frequency Allocations



The shaded part represents the Tropical Zones as defined in Nos. 5.16 to 5.20 and 5.21

Regional Organizations



Regional Organizations

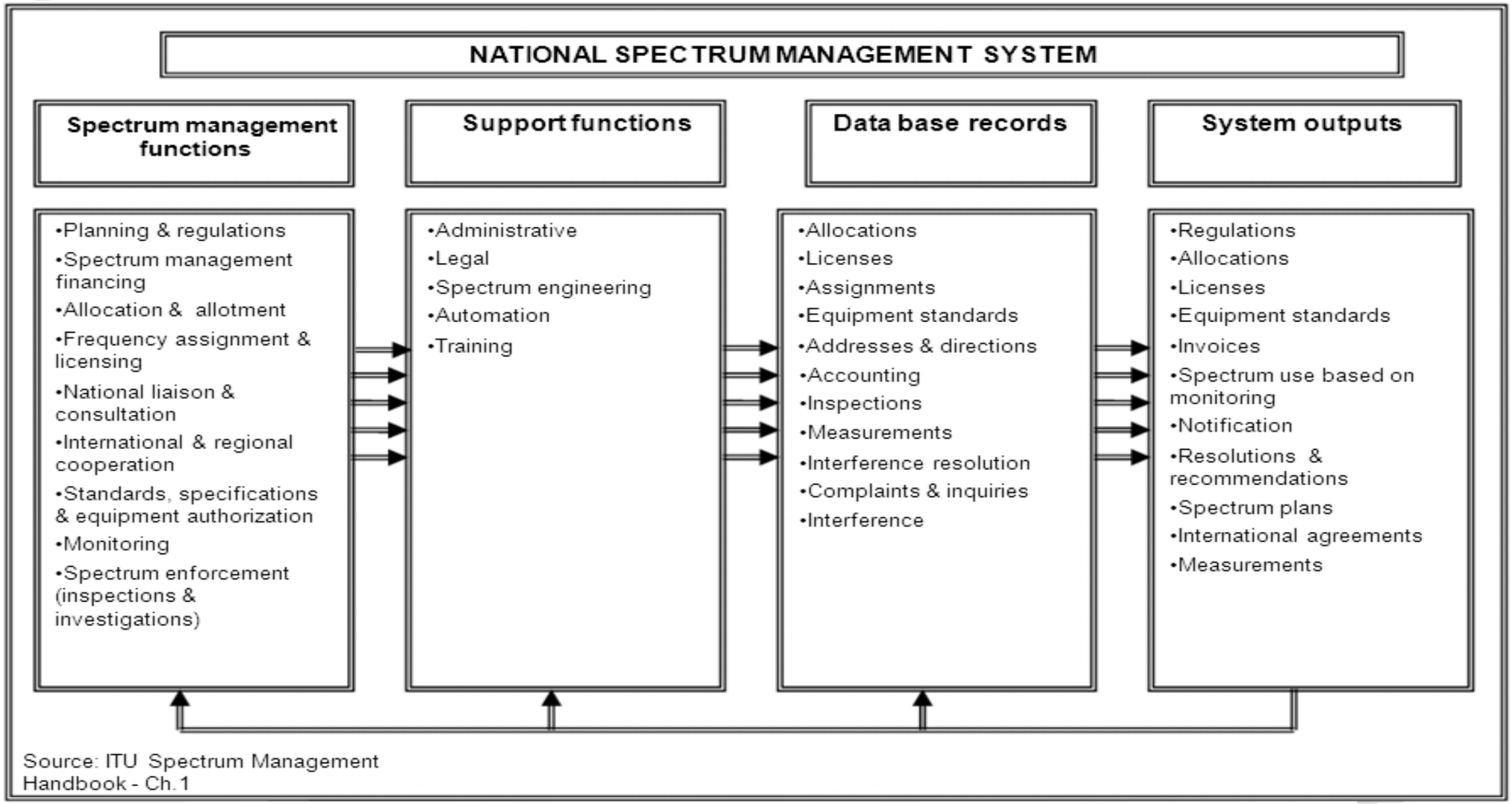
Name	Official website
APT - Télécommunauté Asie-Pacifique - Asia-Pacific Telecommunity - Telecomunidad Asia-Pacífico, BANGKOK, Thailand	www.apt.int
ASMG- Arab Spectrum Management Group	http://asmg.ae
ATU - Union africaine des télécommunications - African Telecommunications Union - Unión Africana de Telecomunicaciones, NAIROBI, Kenya	www.atu-uat.org
CANTO - Association des entreprises nationales de télécommunications des Caraïbes - Caribbean Association of National Telecommunication Organizations - Asociación de Organizaciones Nacionales de Telecomunicaciones del Caribe, PORT OF SPAIN, Trinidad and Tobago	www.canto.org
CEPT - Conférence européenne des Administrations des postes et des télécommunications - European Conference of Postal and Telecommunications Administrations - Conferencia Europea de Administraciones de Correos y Telecomunicaciones, VALLETTA, Malta	www.cept.org
CITEL - Commission interaméricaine de télécommunications - Inter-American Telecommunication Commission - Comisión Interamericana de Telecomunicaciones, WASHINGTON, D.C., United States	www.citel.oas.org
COMTELCA - Commission technique régionale des télécommunications - Telecommunications Regional Technical Commission - Comisión Técnica Regional de Telecomunicaciones, TEGUCIGALPA, M.D.C., Honduras	www.comtelca.org
COPTAC - Conférence des Postes et Télécommunications de l'Afrique centrale - Conference of Posts and Telecommunications of Central Africa - Conferencia de Correos y Telecomunicaciones de África Central, YAOUNDE, Cameroon	n/a
CTU - Union des télécommunications des Caraïbes - Caribbean Telecommunications Union - Unión de Telecomunicaciones del Caribe, PORT-OF-SPAIN, Trinidad and Tobago	http://www.ctu.int/
ETSI - Institut européen des normes de télécommunication - European Telecommunications Standards Institute - Instituto Europeo de Normas de Telecomunicaciones, SOPHIA ANTIPOLIS CEDEX, France	www.etsi.org
LAS - Ligue des Etats Arabes - League of Arab States - Liga de los Estados Árabes, CAIRO, Egypt	www.arableagueonline.org
RCC - Communauté régionale des communications - Regional Commonwealth in the Field of Communications - Comunidad Regional de Comunicaciones, MOSCOW, Russian Federation	www.rcc.org.ru

Bilateral

Bilateral Agreements

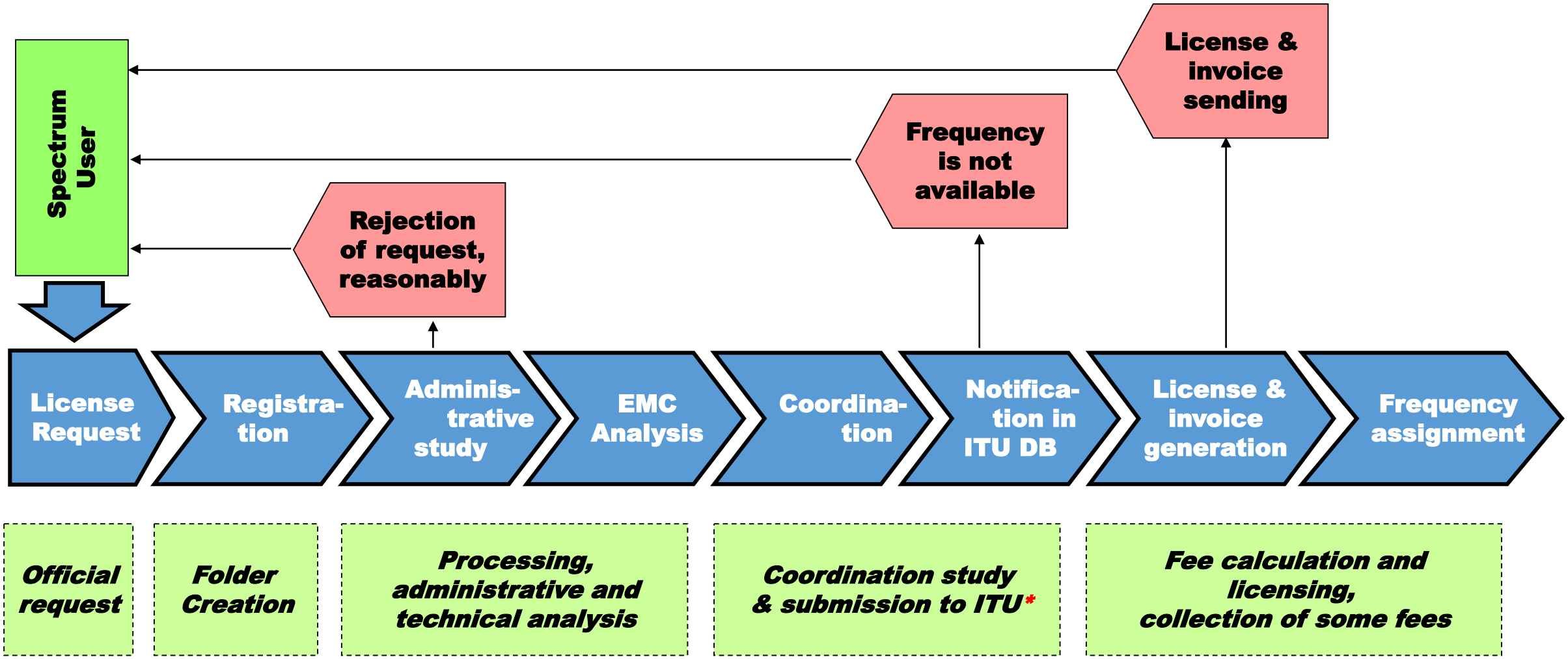
- Cross-border co-ordination by harmonizing the use of frequency spectrum.
- develop means of resolving instances of unexpected harmful interference

Summary



Source: ITU Spectrum Management Handbook - Ch.1

General Procedure for Licensing



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

Automation of National Spectrum Management

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Background

- **The use of computers in the spectrum management process has become crucial for most Administrations that are faced with the ever-increasing use of the radio frequencies.**
- **Some crucial aspects in the establishment of a computer-aided spectrum management are:**
  - Technical analysis (propagation, coverage, interference prevention etc.)
  - Administrative procedures (registration and issuing of licenses)
  - Regular Spectrum fee invoicing
  - Frequency coordination
  - Notifications of assignments to the ITU according to the Radio Regulations
- **Is it really needed?**

The definitive answer in every case is "Yes"

However, it shall be properly designed

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Introduction

- **Computer techniques can help in at least two ways:**

  - *Managing and examining large amounts of data.*

  - *Performing calculations, whether complex, or simple but repetitive.*

Advantages of computer-aided SM

- **Compliance with policies/legilation**
  - *Verification of the compliance of frequency assignment requests with the NTFA, RR (intl. and regional) etc.*
- **Compliance with Type Approval Conditions**
  - *Verification that the equipment to be used has the required national certification or meets other mutual recognition agreement standards;*
- **Accurate Technical planning and Monitoring response**
  - *More accurate and optimized response to assignment requests, through selection of appropriate channels taking into account details such as terrain characteristics;*
  - *Appropriate treatment of radio monitoring data (See ITU-R Monitoring Handbook);*
- **Decentralization of repetitive processes**
  - *Automatic and decentralized on-line issue and renewal of licenses and invoices (law must allow for electronic signatures);*

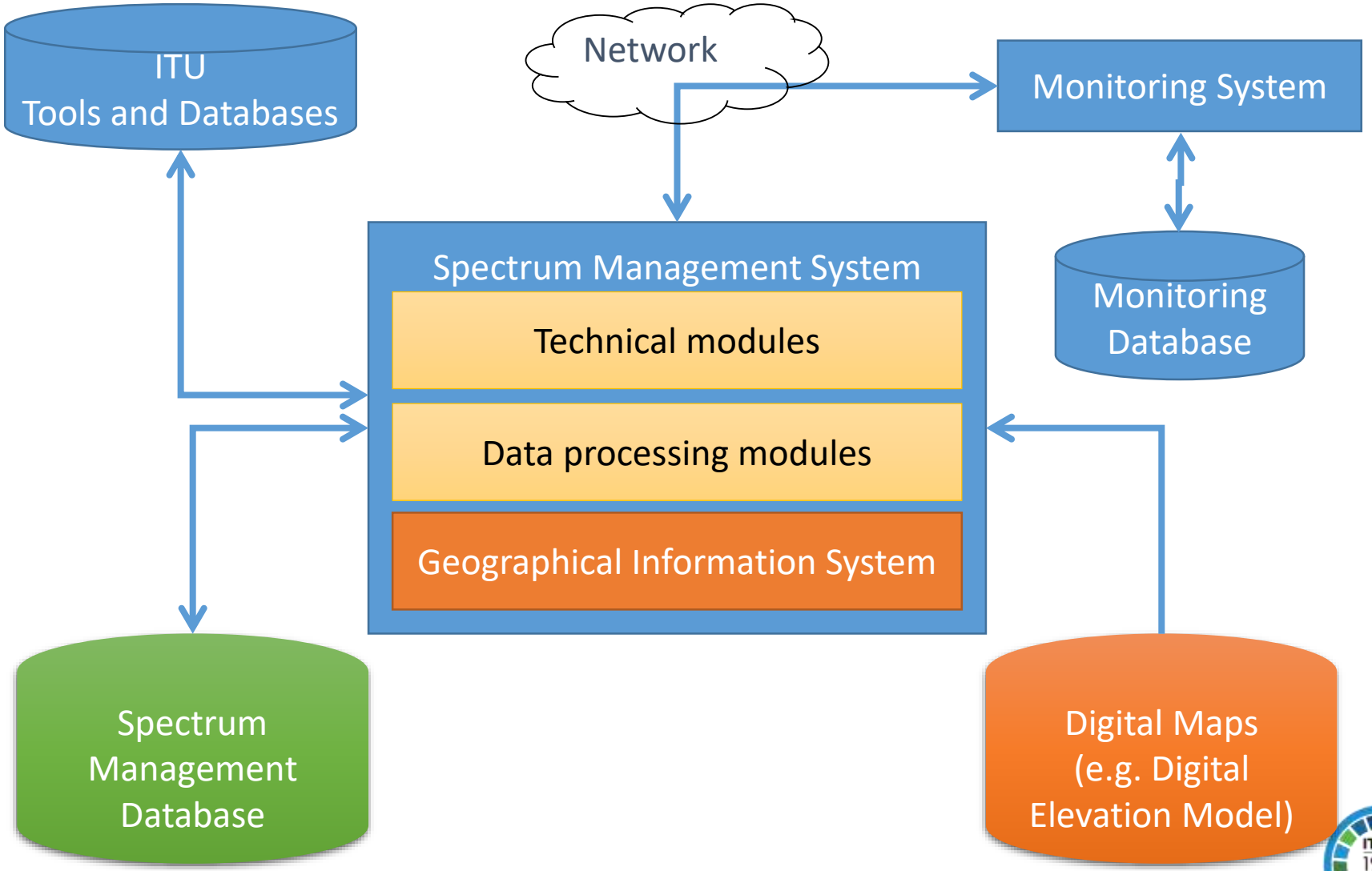
Advantages of computer-aided SM

- **Faster Administrative processing of applications**
  - *E.g.: expeditious and fully documented, timely billing of spectrum users*
- **Increased transparency and data availability to users inside and outside the administration.**
- **More accurate preparation and electronic submission of notification forms to be sent to ITU**
  - *Example of automation of ITU activities related to coordination: The BR's Terrestrial Analysis System (TeRaSys) and the Space Network System (SNS) are the computerized tools used by the Bureau to process the frequency assignment notices submitted by administrations.*
  - *The availability of electronic exchange of data between administrations or between an administration and the ITU*

Spectrum Management Data

- **Following describe relationships and properties pertaining to types of entities of interest in spectrum management**
  - Frequencies and radio services (frequency allocations)
  - License holders (Administrative data)
  - Frequency assignments and licenses
  - Stations and equipment
  - Geography of the administration and the surrounding areas
  - Levels of emissions (monitoring)
  - Other data
    - *License fee schedules.*
    - *Interference complaints filed by license-holders*
    - *Violations of national or international radio regulations by a license-holder*
    - *Inspections of stations*

System architecture



Database Management Systems (DBMS)

- **The database management system (DBMS) is a computerized system that maintains spectrum management data and makes it available to a variety of users.**
  - *A well-designed, modern database will allow easy input and modification of data and provide useful "views/reports" of data to users without the users having to understand the details of the DBMS*
  - *DBMS should be designed to minimize redundancy across the database, provide validation of data, provide security for sensitive data, provide data backup to avoid catastrophic losses in the event of system failures.*
  - *When considering the design of a DBMS, an administration should consider systems used by administrations with which they must often exchange data, as well as systems used by the BR.*

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

Geographic Information Systems (GIS)

- Geographic information systems (GIS) can be integrated with the DBMS to help administrations to account for environmental effects (terrain, population, etc.) in spectrum management.
  - *Usually offer two-dimensional geographic information representation and often three-dimensional capabilities as well (especially for antenna patterns).*

- The ITU Digitized World Map (IDWM), available at http://www.itu.int/pub/R-SOFT-IDWM,
  - *Include databases for geographical (coastlines, seas, islands, lakes), political (country borders and regional boundaries), meteorological (rain and climatic zones) and technical information (ground conductivity areas, noise zones, allotment areas, maritime zones, broadcasting CIRAF zones and propagation zones).*

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

Examples of Automated SM tools

1. RR App. 7

Coordination distance calculations based on RR Appendix 7

- *Automated methods are applicable to the procedure outlined in RR Appendix 7 for determining the coordination area around an earth station in frequency bands between 100 MHz and 105 GHz shared by space and terrestrial services.*
- *Computer programs developed by the BR and other administrations are available in the BR software packages and are used to calculate coordination distances during technical examination of frequency assignment notices.*
- *A coordination diagram has been automatically drawn on a computer-generated map*

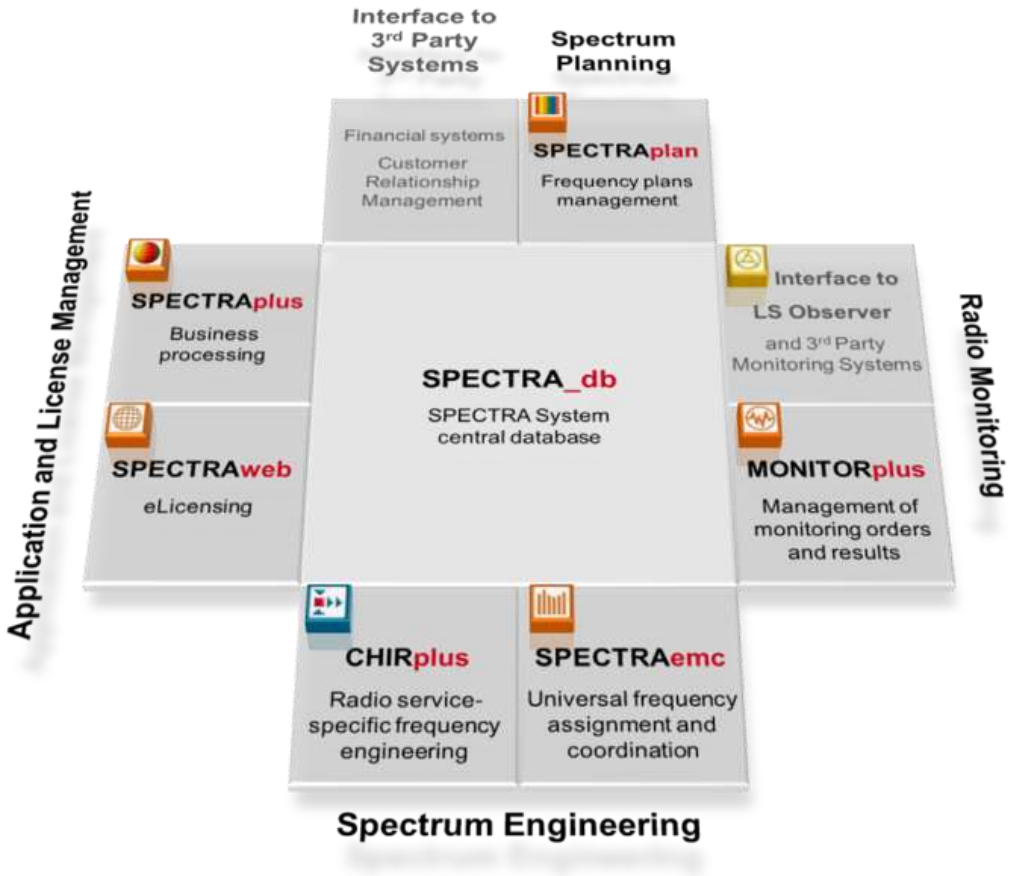
2. Online calculation services

Online BR calculation services for testing purposes and assisting in coordination

- *The BR has implemented a fully automated system which allows TIES users to perform calculations on-demand for testing purposes and assisting in coordination.*
- *The system is composed by a web front-end portal (for input data submission and display/download of calculation results) and a back-end system composed of services (for managing the calculation workload) and a database (for queuing requests and storing input data and calculation results).*
- ***The system is accessible from the URL:***
  http://www.itu.int/ITU-R/eBCD/MemberPages/eCalculations.aspx

3. SPECTRA

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



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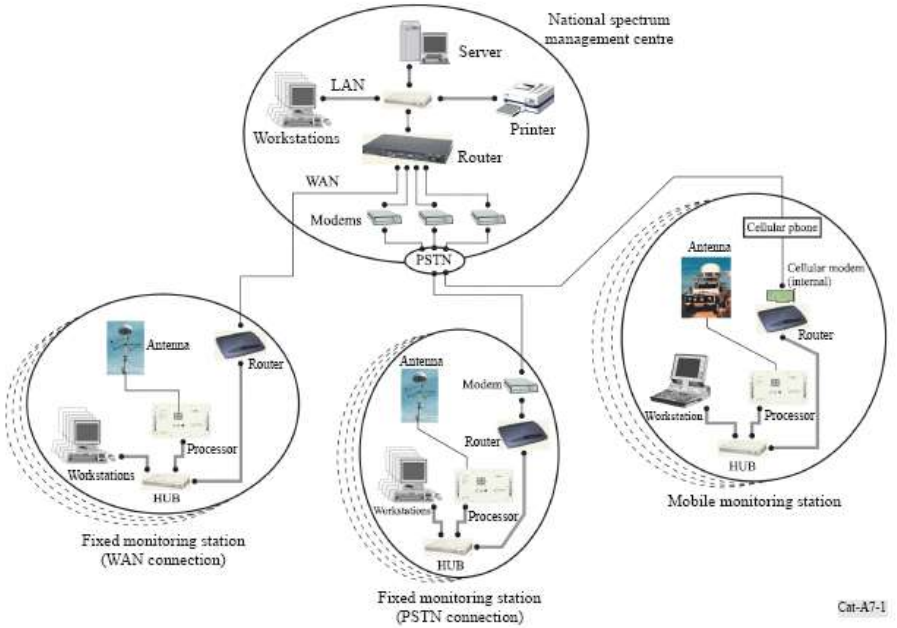
4. TCI ASMS solutions

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

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



TCI Integrated Management and Monitoring System

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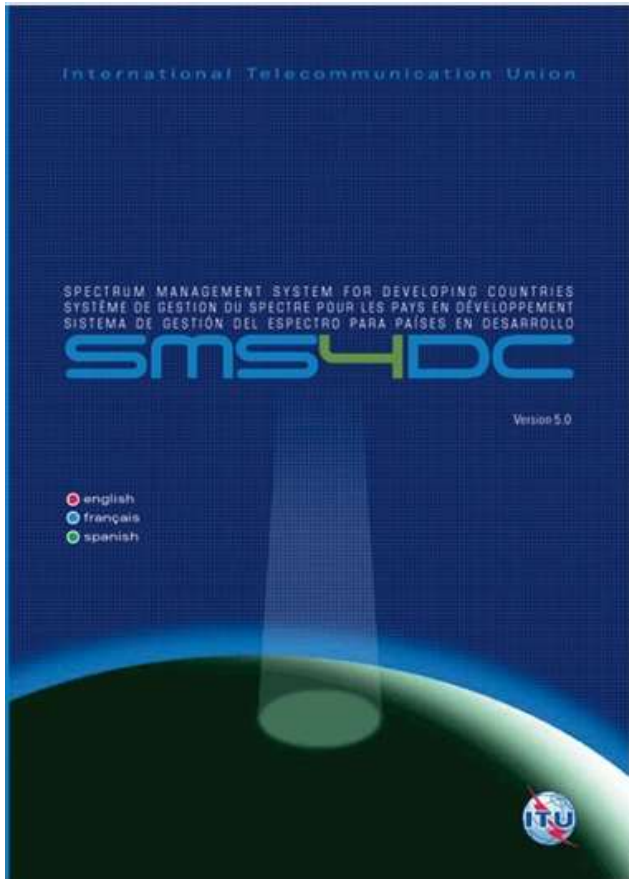
5. ATDI

ATDI has modular solutions covering various automated functions and services including

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

ITU Spectrum Management System for Developing Countries (SMS4DC)

- SMS4DC is software designed by ITU based on ITU recommendations
- Developed to assist the administrations of developing countries to undertake their spectrum management responsibilities more effectively;
- SMS4DC covers terrestrial fixed, mobile, sound and television broadcasting services in the bands above 30 MHz, including GE-06 as well as frequency coordination of Earth stations



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SMS4DC subscribers

V.5.0 V.4.1 V.4.0

Until Dec 2016

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For further reading:

- ITU Handbook - Computer-Aided Techniques for Spectrum Management (CAT), 2015
- ITU Handbook on National Spectrum Management, 2015
- SMS4DC 5.0 User Guide
- ITU Handbook on Spectrum Monitoring, 2011
- Recommendation ITU-R SM 1370
- Recommendation ITU-R SM 1537
- Recommendation ITU-R SM.1604

I Thank U

"Committed to
connecting the WORLD"

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