

The Role of Spectrum Management in Fostering Innovation and Advancing Services in the Lebanese Telecommunications Sector

A SEMINAR ORGANIZED



IEEE
COMMUNICATIONS
SOCIETY
Lebanon Chapter



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The Telecommunications Regulatory Authority (TRA), Lebanon



Republic of Lebanon
Telecommunications
Regulatory Authority

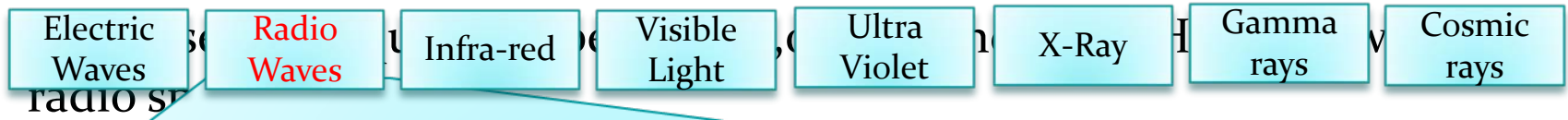
Agenda

- Radio Spectrum Overview
- Spectrum Management Overview
- International Telecommunications Union (ITU)
- Milestones for the TRA Spectrum Management
- Lebanon Case Studies:
 - Next Generation Mobile Wireless Access Spectrum Regulatory Scenarios vs. Technology Trends (The 2.5-2.69 GHz Band Example)
 - Analogue to Digital Switchover Challenges and the Digital Dividend Spectrum Opportunity Questions and Answers
- The Neutrality Policy Question explained!
- Pros-Cons License Exempt vs. Licensed Spectrum
- Regulators best practices
- Conclusion

What Is Spectrum?

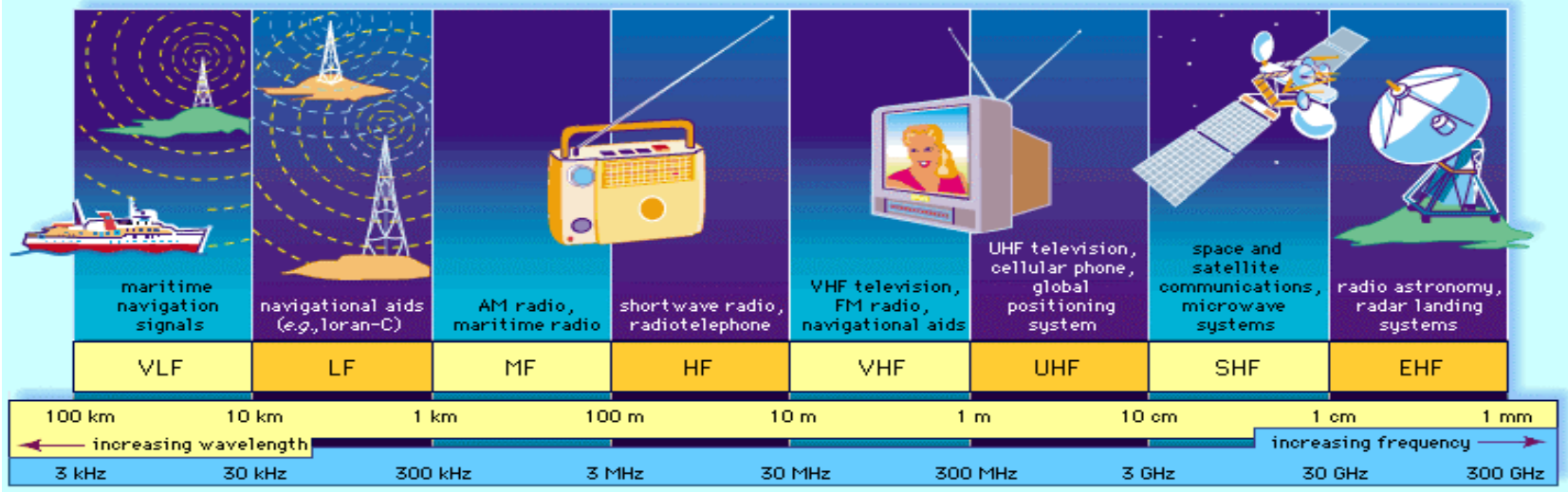
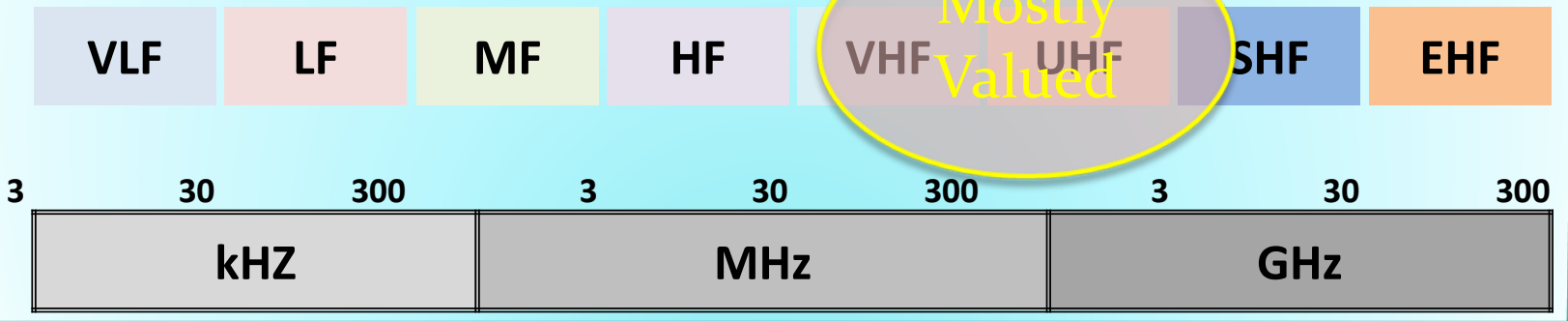
- “Spectrum” is a conceptual tool used to organize and map a set of physical phenomena
- Electric and magnetic fields produce (electromagnetic) waves that move through space at different frequencies
- The set of all possible frequencies is called the “electromagnetic spectrum”

What is Radio Spectrum?



Radio Spectrum

Mostly Valued



Spectrum as an Economic Resource

	LAND	OIL RESERVES	WATER	SPECTRUM
Is the resource varied?	Yes	Not very	Not very	Yes
Is it scarce?	Yes	Yes	Yes	Yes
Can it be made more productive?	Yes	Yes	No	Yes
Is it renewable?	Partially	Partially	Yes	Yes
Can it be stored for later use?	No	Yes	Yes	No
Can it be exported?	No	Yes	Yes	No
Can it be Polluted?	Yes	Not very	Yes	Yes

Spectrum as an economic resource

- The Radio Spectrum a natural resource, which unlike other natural resources (water, land, etc)
 - If not used, is wasted
 - Is a resource that is available equally to every country
 - Propagation of radio signal does not stop at the political borders hence need to coordinate with neighboring countries
 - Is limited to the extent that electronic devices can be developed to produce higher frequency radio waves (i.e., 100 GHz at present)
 - Is limited by the capability of management to make it available to all uses

Spectrum as an economic resource - UK

The total economic value of the radio industry in 2005/6 is around £42 billion in contributing to 3% of the GDP

Sector	2006		2002	
	Value (£ billion)	Percentage (%)	Value (£ billion)	(%)
Total	42.4	100%	28.2	100%
Public Mobile	21.8	51%	14.4	51%
Broadcasting	12.3	29%	5.9	21%
Satellite links	2.8	7%	2.9	10%
Fixed links	3.9	9%	3.8	14%
Wireless broadband	0.3	1%	-	-
Private mobile radio	1.2	3%	1.1	4%
Other	0.1	0%	0.1	0%

Source: OFCOM & Europe Economics (2006)

Spectrum as an economic resource -DK

- Direct contribution from the radio spectrum to Danish GDP (per service application in % of GDP) > 1.2%

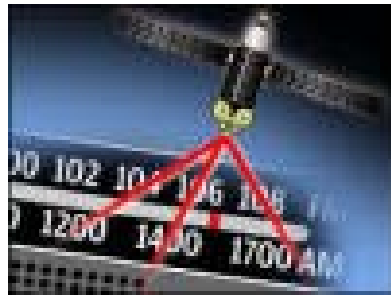
Service application	Equipment	Services	Total
Fixed Links	0.01	0.01	0.02
Maritime	0.01	0.02	0.03
Broadcast	0.09	0.19	0.28
Mobile	0.21	0.56	0.77
PMR	0.03	0.03	0.06
Defense	0	0.04	0.04
Total	0.39	0.81	1.2

Source: Danish Telecommunications Agency (2000)

Spectrum Auctions in the USA

- Direct Proceeds to the treasury from Spectrum Auctions exceeded \$78 Billion in the USA since 1994
- More than 59000 frequency licenses via auction
- More than 85 auctions & 5000 auction rounds

Applications and services across the spectrum



Most spectrum demanding are:

- 1 - Mobile Uses
- 2- Internet Access
- 3- Safety & Security



Reasons to Regulate

- Spectrum is scarce while demand for it is on the rise
- Access for many/more while Avoiding Interference
- Create affordable service for all
- Ensure competition & fair value for spectrum/
revenues
- Protect national defense and public safety needs
- Preserve free flow of information
- Protect public from inappropriate material and over-
exposure
- Promote investment and economic development

Reasons to Regulate cont'd

- Without regulation, the industry will be left without any guidelines as to which frequencies may be available for the provision of different types of services
- This will complicate the design and development of equipment, and slow down service innovation and not benefit from economies of scale

What is Spectrum Management?

- All activities associated with regulating the use of the radio spectrum;
- It includes the structure and processes for allocating, allotting, assigning, and licensing the scarce resource as well as establishing and enforcing the associated rules and regulations

(Source: The ITU RR)

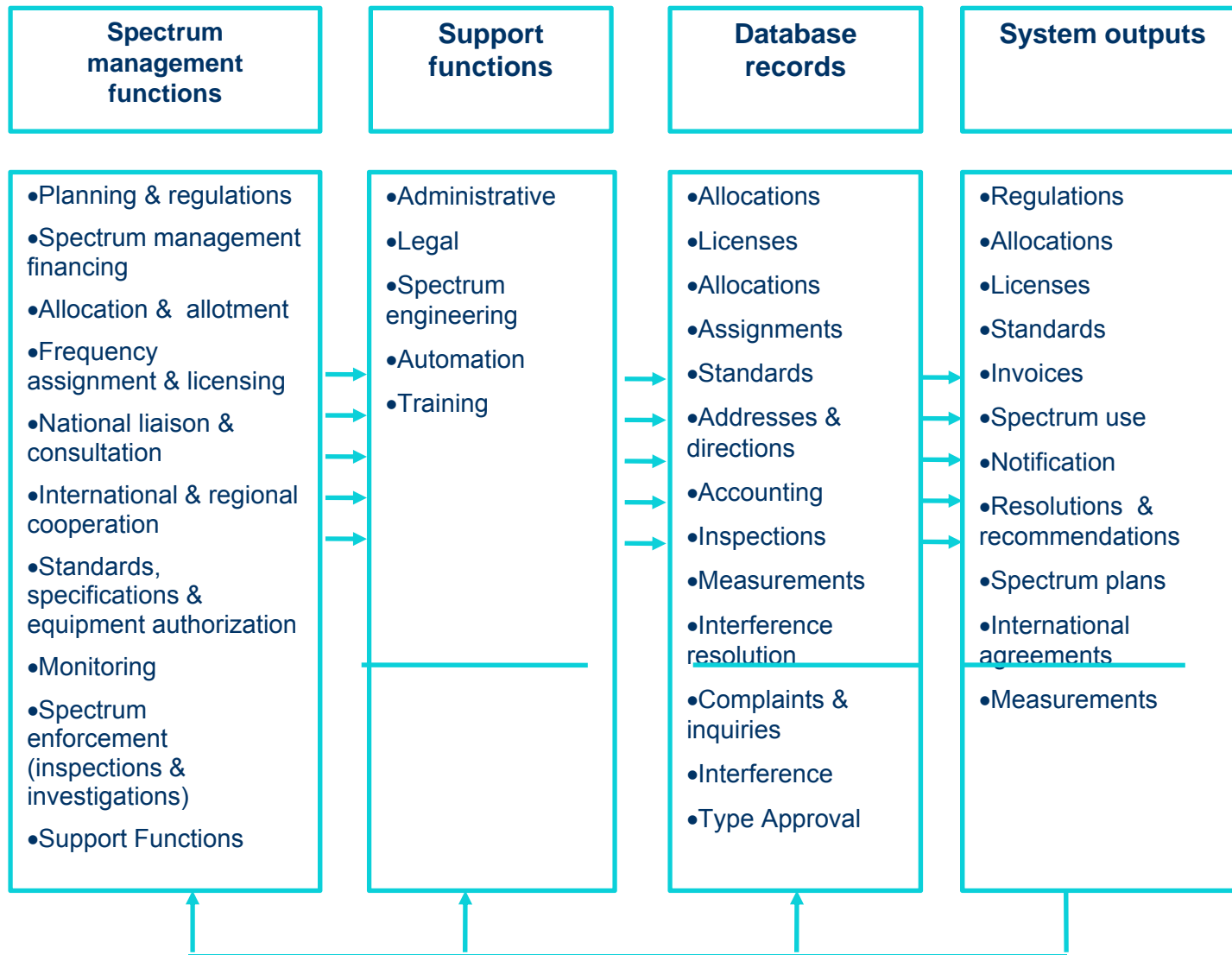
Basic Building Blocks of Spectrum Management

- Telecommunications law
- Spectrum allocation table
- Regulations and procedures
- Spectrum technical standards
- Spectrum data

Major Functions in Spectrum Management

- Spectrum management planning and regulations
- Spectrum management financing including fees
- Allocation and allotment of frequency bands
- Frequency assignment and licensing
- National liaison and consultation
- International and regional cooperation including frequency coordination and notification
- Standards, specifications, and equipment authorizations
- Spectrum Monitoring & Enforcement

Spectrum Management Activities



Allocation

- *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.

(Source ITU RR)

Allotment

- Allotment (International)
 - Entry of a designated frequency channel in an agreed upon plan for a particular service for use in certain identified countries or geographical areas and under specified conditions
- Allotment (National –Lebanon)
 - In general, refers to a subdivision of particular service band (allocation) for a specific user and/or provider group within the service
 - In broadcasting , an allotment is the association of a specific frequency or channel with a particular geographic area

Assignments

- An assignment is a grant of authority, a license , for a specific party/individual to operate a transmitter on a specific channel at a specific location under specified conditions
- In recent years and in certain services (e.g., cellular mobile), the grant of authority has been expanded to include multiple channels covering a large geographic area employing multiple transmitter sites (area licensing)

Standards, Specifications & Equipment Authorization

- Radio equipment standards establish the minimum acceptable technical specifications and performance characteristics of radio equipment
- National spectrum authorities may adopt radio equipment standards developed in other countries or by international standards organizations
- Spectrum-use-standards state the minimum technical requirements for efficient use of specified frequency bands.
- Radiation standards address concerns that radio transmissions may be harmful to health or a concern of public safety
- Other standards relating to the environment, construction, and land use may apply to spectrum management

National Spectrum Allocation Table

- Follow ITU Regional Plan
- Develop a Country Plan
- Address current and future spectrum users
- Allow military users
- Openly available to all:
 - Flexible allocations for future use
 - General allocation categories
 - Minimum footnotes (i.e. Exceptions to general allocation)

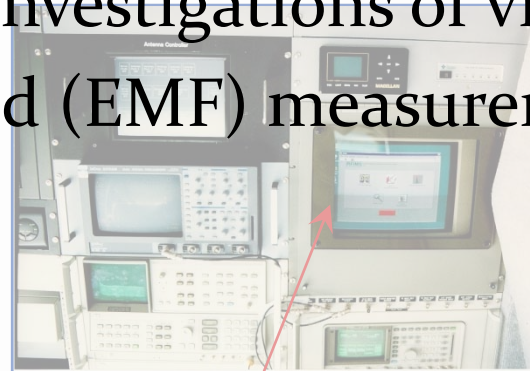
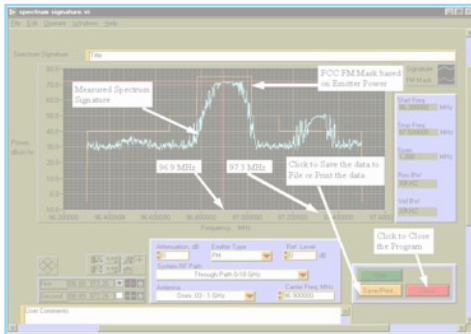
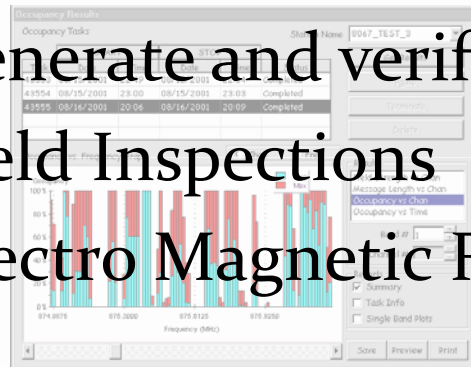
Lebanese Frequency Allocation Table

Frequency Band (kHz MHz or GHz)	International Region 1 Allocation	National Allocation	Main application	Notes
460-470 MHz	FIXED MOBILE Meteorological-Satellite (S/E) 5.287 5.289 5.290	MOBILE 5.XXX 5.287 5.289	Analog and digital PMR Maritime on board communications	Annex 1, FB paired with 450-460 MHz 450-470 MHz identified for IMT (WRC07) Res. 224 (rev. WRC07) Maritime on board communications 467.525-467.575MHz
470-790 MHz	BROADCASTING 5.291A 5.149 5.296 5.302 5.306 5.311A	BROADCASTING 5.291A 5.296 5.311A LBN 12	Defense (ch.21-ch.26) Analog TV DVB-T	Stockholm Agreement 1961 GE06 Agreement Band 620-790 MHz see Res. COM4/1 (WRC07)
790-862	FIXED BROADCASTING MOBILE except aeronautical mobile 5.XXX 5.312 5.314 5.315 5.316 5.319	BROADCASTING MOBILE 5.XXX 5.317A LBN 12 bis	Analog TV DVB-T	Stockholm Agreement 1961 GE06 Agreement Band 790-862 MHz proposed for IMT from June 2015 after WRC11

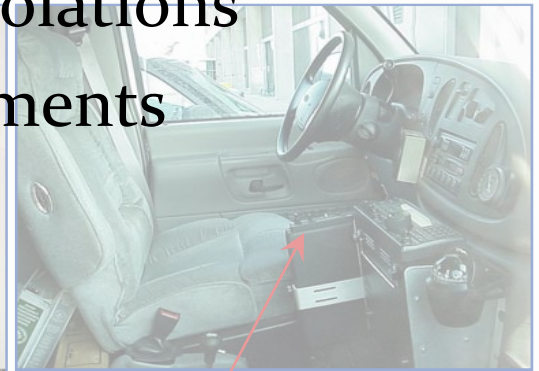
LBN 12 The band 410-430 MHz is designated as replacement spectrum for defense systems occupying the band 470-512 MHz. The transfer will be undertaken in accordance with the Spectrum Migration Plan and will be implemented not later than 1 January 2010.

Spectrum Monitoring & Enforcement

- Measurements of channel and band usage/ occupancy
- Resolution of interference problems
- Verification of operational characteristics
- Detection and identification of illegal transmitters
- Generate and verify frequency records
- Field Inspections & Investigations of violations
- Electro Magnetic Field (EMF) measurements



Automated or Manual Full Equipment Suite



DF Control/Mapping 20 - 3000 MHz

Public Consultations

- Regulator issues draft decisions or regulations and seeks public feedback before final decision
- Is a necessary step on major decisions to seek the feedback and comments of different stakeholders (operators, investors, end users, technology advocates...) to draft regulations or policy decisions that the regulator may issue from time to time
- Regulator does not have to take opinion in response to consultation but to consider as deemed necessary

Regulations and Procedures

- Second step in law/regulation process
- Legally binding on users
- Key to knowing how to operate spectrum management system
- Can be changed with new requirements
- Regulations should be kept to a minimum

The International Dimension of Spectrum Management

- Registration and notification to BR on frequency uses within country
- Coordination with neighboring countries
- Participation in ITU activities and contributing in the regulations and decisions (WRC)

The International Telecommunication Union



- One of the United Nations specialized agencies with
 - 191 Member states & 700 Sector members
- Major ITU Sectors are:
 - Radiocommunication Sector (ITU-R)
 - Radio Regulations
 - Recommendations, Reports and Handbooks
 - International frequency registration
 - Telecommunication Standardization Sector (ITU-T)
 - Telecommunication Development Sector (ITU-D)



International
Telecommunication
Union

Recognized Organizations

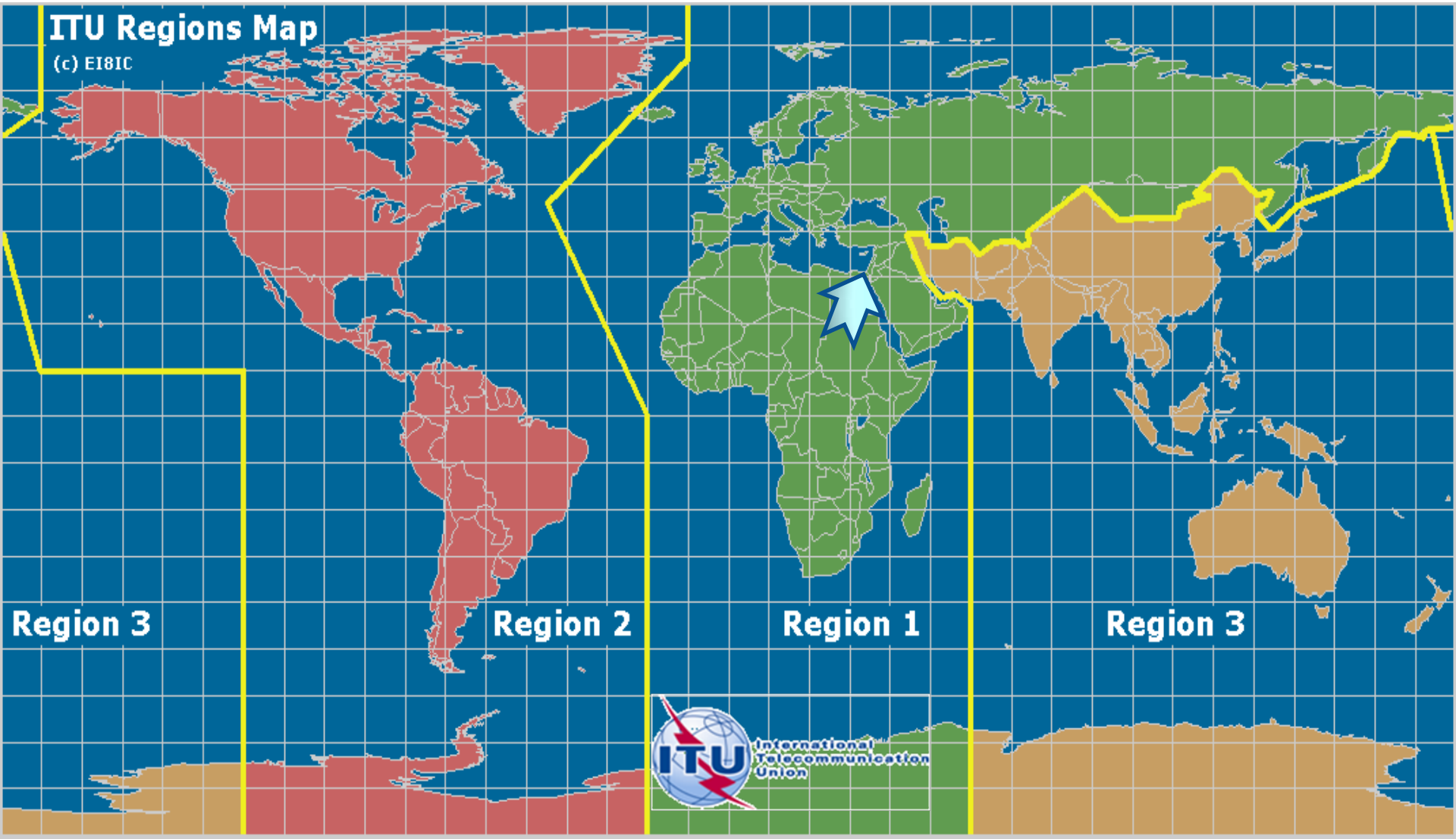
- **Other Specialized UN Agencies**

- Intl Civil Aviation Org. (ICAO)
- Intl Maritime Org. (IMO)
- World Meteorological Org. (WMO)
- High Commission on Refugees (UNHCR)
- Coordinator of Humanitarian Affairs (OCHA)

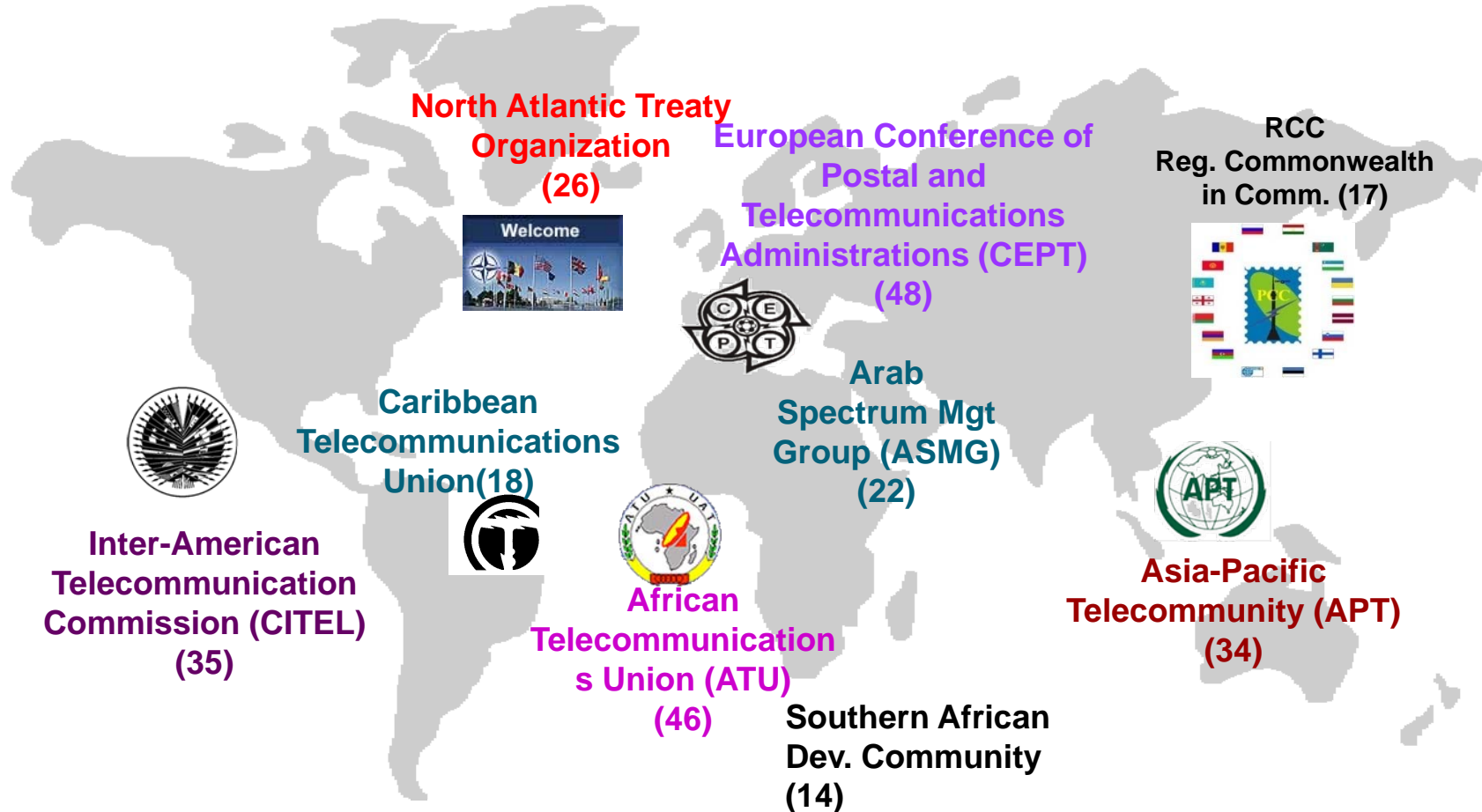
- **External Organizations**

- **IEEE**
- ISO/IEC (standards)
- IATA (air transport)
- IARU (amateur radio union)
- EBU (broadcasting)
- EUROCONTROL (air safety)
- 3GPP forum
- WiMax Forum
- ESA (Eur. Space Agency)
- ETSI (Eur. Tel. Standards)
- ...

The World by ITU Regions



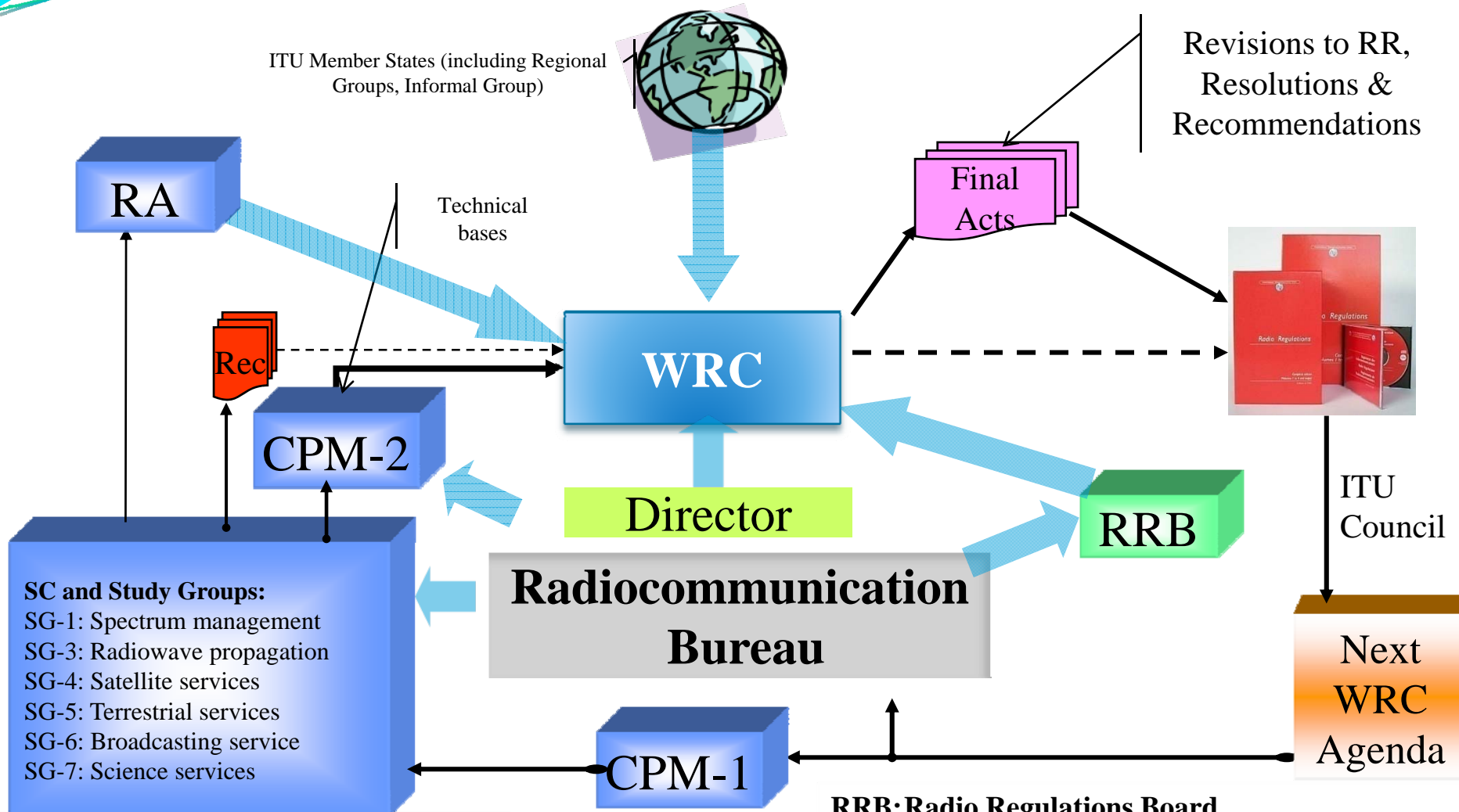
Regional Spectrum Management Groups



- Each Nation has Sovereignty Over the Use of its Spectrum, but as a geographic group of nations they can have stronger presence and common interest to coordinate and harmonize

ITU World Radiocommunication Conferences

- International Forum for world agreement
- Held every 4 years
- Operates by consensus, voting on occasion
- Sets the world stage for future technological development
- Puts greater emphasis on consolidated regional positions and proposals
- Sets international regulations for radio equipment operation, review and revise the Radio Regulations
- Allocates spectrum to general radio services
- Establishes spectrum coordination methods



CPM: Conference Preparatory Meeting
Rec: ITU-R Recommendation
RR: Radio Regulations (treaty status)

RRB: Radio Regulations Board
SGs: Radiocommunication Study Groups
RA: Radiocommunication Assembly
WRC: World Radiocommunication Conference

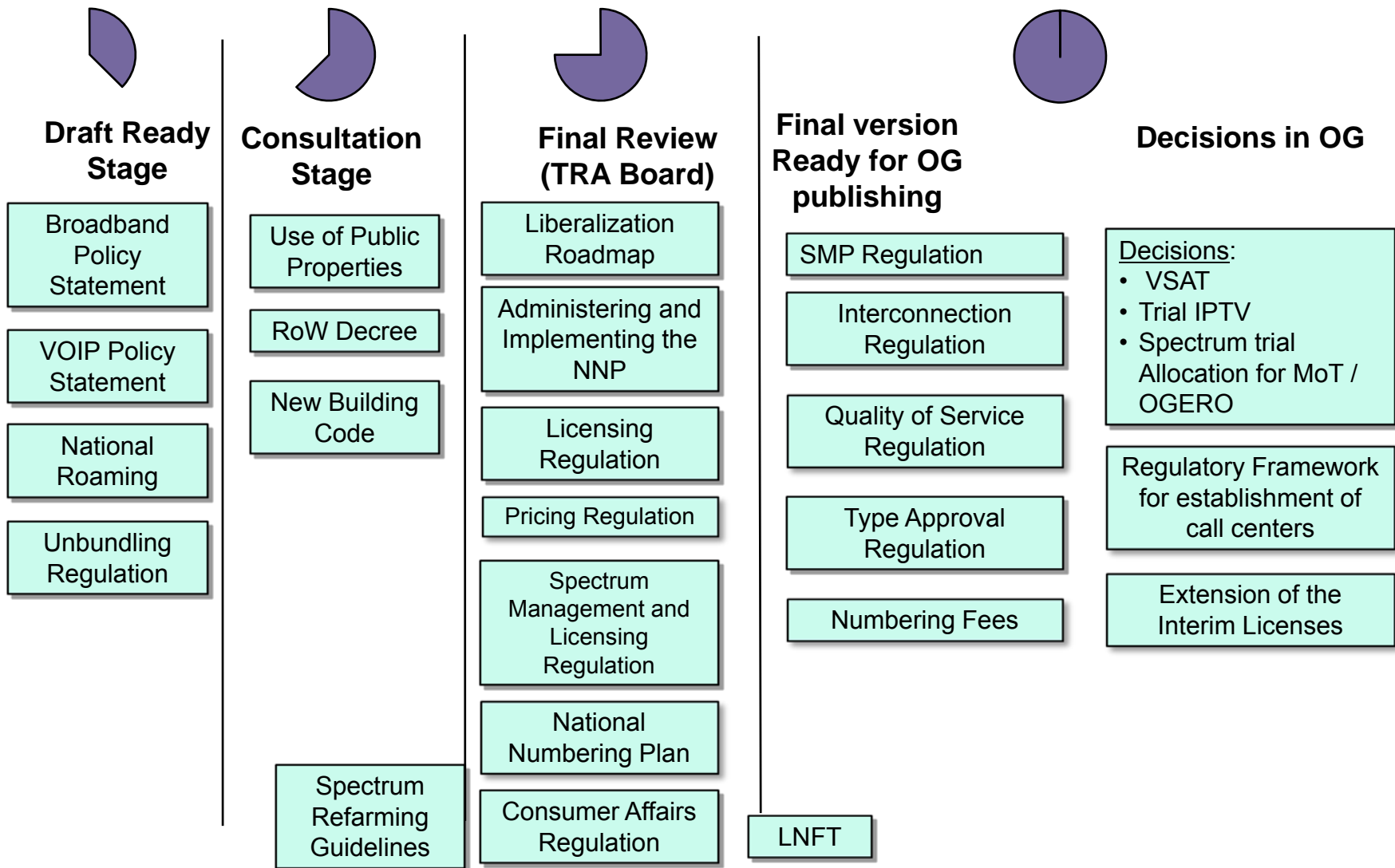
Lebanon Telecommunications Law 431

The Law 431 of 2002 set the legal basis for liberalization of the telecommunications sector and established an independent regulatory authority to regulate the sector in Lebanon

- The Telecommunications Regulatory Authority, (الهيئة المنظمة للاتصالات) is endowed with the **exclusive power** to administer, manage the allocation, distribute and monitor radio frequencies to all users including government, commercial providers of telecommunications services and as well as any broadcasting or private users
- Law 431 and the telecommunications regulation including those related to management of radio spectrum are available on TRA Website:

www.tra.gov.lb

TRA Regulatory Achievements in 2 Years



Cases from Lebanon

- The 2.5-2.69GHz band Opportunity for Mobile Broadband services
- The Digital Broadcasting Dividend Spectrum allocation challenges



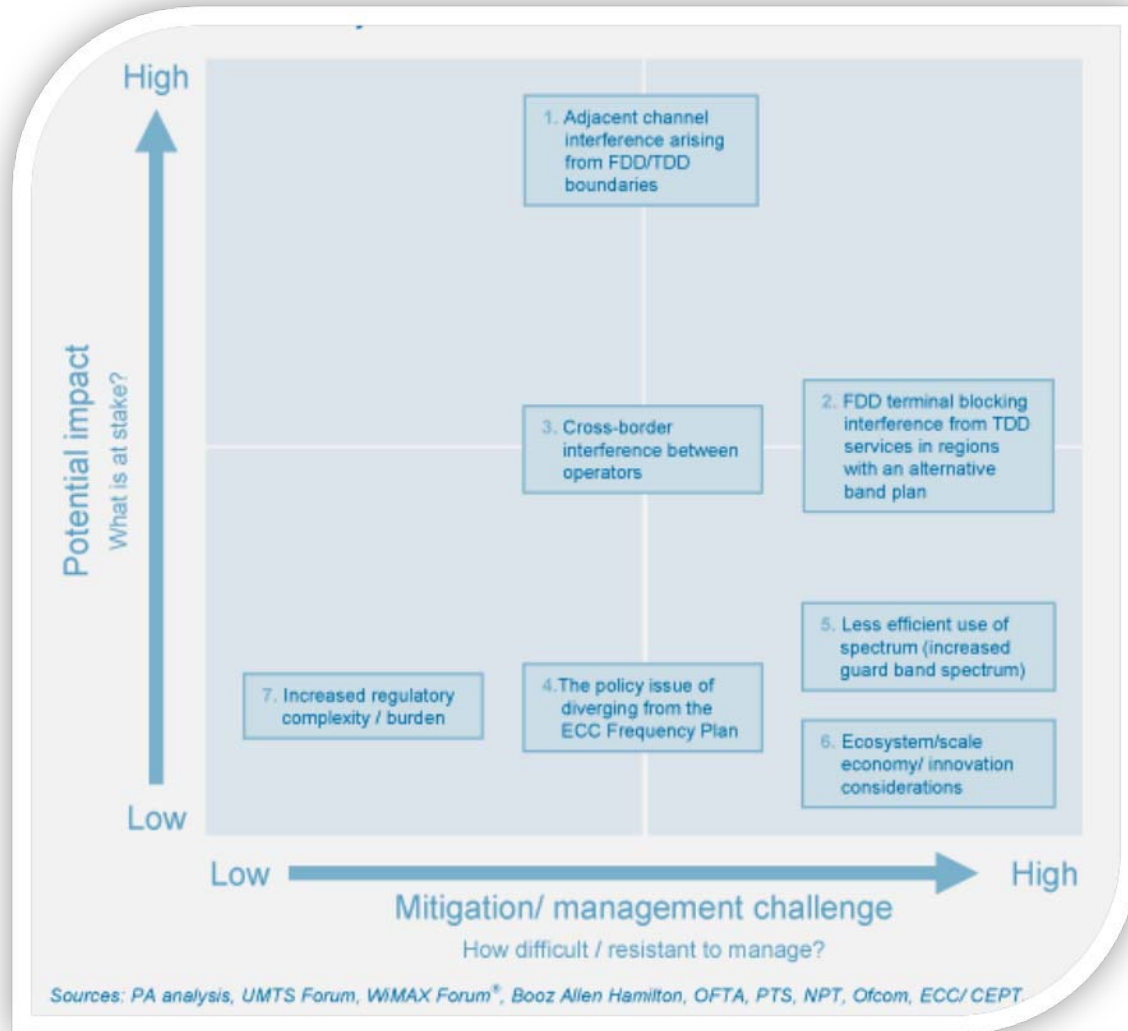
The Band 2.50- 2.90 GHz Opportunity

- Worldwide harmonization for mobile services, IMT application (across Regions 1, 2 & 3)
- ECCREC(05)05 specifies channel plan based on
 - 70x2 for FDD (120Mhz spacing),
 - 50MHz for TDD in the middle
- Recent auctions around the world indicated that FDD spectrum is generating more revenue (\$/Hz) compared to TDD hence, less likely to let market decide more TDD
- Some countries deviated from plan letting the market decide on arrangement of blocks for TDD/FDD at the expense of maximizing spectrum auction proceeds

The 2.6GHz Flexibility Issues

- If awarded now*:
 - TDD => WiMAX 802,16-2005 (Traditional W-ISPs & data service providers and new MBWA entrants)
 - FDD => LTE (2G/3G Mobile Tier 1 operators selected LTE technology) looking for expanding beyond HSxPA and offering broadband wireless

(*Both radio technologies have TDD and FDD profiles on their roadmap)

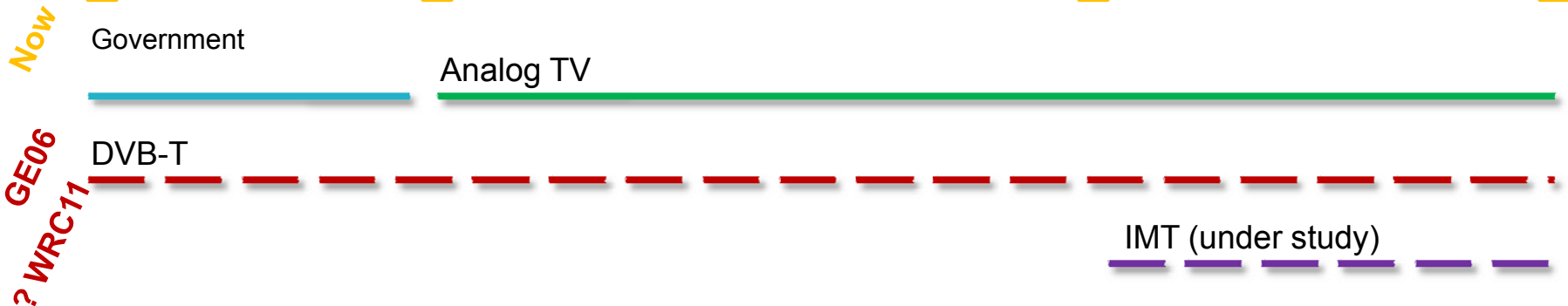
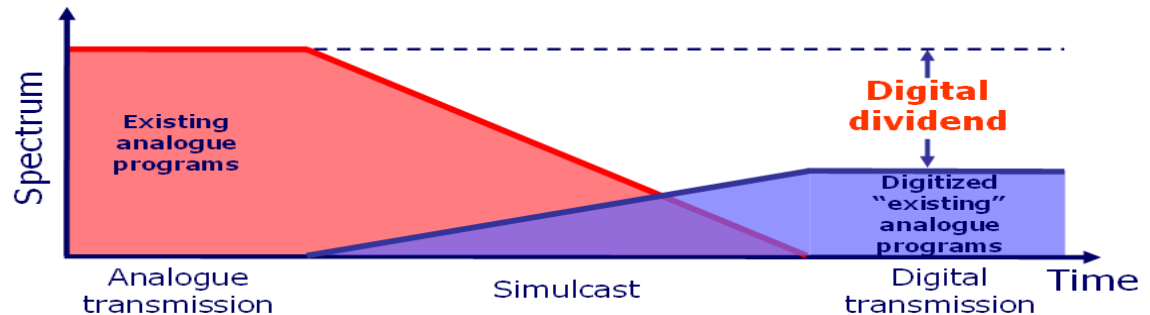


The 2.6GHz Issues Summarized

- Questions raised are mainly about:
 - Technology Neutrality vs. Harmonization
 - Best Value of Spectrum (proceeds) vs. Mobile Broadband Services Earlier to Market
 - Treatment of Current Users
 - A case specific to Lebanon as use for fixed applications and BWA requires re-farming or migration of users while reducing impact on users

TV Broadcasting & The Digital Dividend Opportunity

The Sooner ASO the sooner Digital Dividend spectrum is available to new services



TV Broadcasting & The Digital Dividend Opportunity

- Digital Dividend Spectrum auction in 2008 generated \$ **18.9Billion** proceeds in the USA
- To realize Digital Switch Over (DSO) plan before 2015, a draft migration plan was prepared by the TRA to:
 - Separate between transmission broadcast license and broadcast program license
 - Introduce legal framework for digital broadcasting licensing in Lebanon
 - Insure switch over is achieved while people are aware of transition and low income are protected to receive public TV
 - Decide on national allocation of remaining spectrum and complete sharing studies before next WRC in 2011
 - Make available dividend spectrum before 2015 to be auctioned

Regulator to decide on Neutrality Approach

- Harmonized vs. Technology Neutrality (TN)
- TN is when regulator let user select what technology and network architecture appropriate to use in a certain band vs. requiring certain technology like Mobile GSM radio interface in 900MHz
- Service Neutrality (SN) is to allow for any telecommunication service without restrictions Example: Broadcasting or mobile
- Many approaches bust most common:
 - TN+SN on restricted frequencies/areas
 - TN given interoperable fixed service
 - SN in a technology fixed environment
 - Example: in 2.6, LTE & WiMAX are IMT radio interfaces respecting band arrangement and sharing conditions

Licensed vs. Unlicensed Spectrum

Another questions faces regulators:

- How much License Exempt vs. Licensed spectrum?
- Can License exempt be used to provision telecommunications services?
- How can efficiency be insured when no one is protected?
- How easy to enforce control over spectrum when devices in other countries only require RTTE approval?
- How could technologies like UWB contribute to change of thinking in spectrum management?

Licensed Spectrum Option

Advantages

- Promotes investment by providing more certainty for investors
- Provides more certainty regarding interference environment for network design
- May provide greater revenue collection opportunities to government (e.g., through auctions)

Disadvantages

- Licensing step creates entry barrier
- Stifles innovation in products and services unless accompanied by greater regulatory flexibility (including spectrum trading)
- Creates opportunities for spectrum “hoarding”
- Diminishes opportunities for local initiatives and microfinance

Unlicensed (commons) Spectrum Option

Advantages

- Promotes rapid innovation in services/devices because of minimal regulatory restrictions
- Reduces barriers to entry and opportunities for corruption by eliminating the licensing step
- Eliminates opportunities for spectrum “hoarding”
- Creates opportunities for local initiatives and microfinancing

Disadvantages

- Creates conditions that may lead to the tragedy of the commons
- May reduce investment incentives due to lack of exclusivity
- Reduces opportunities for government to collect revenues
- Creates issues of fairness related to spectrum users who have paid for spectrum

Spectrum Management Best Practices

- Establishing and maintaining a national spectrum management organization responsible for managing the radio spectrum in the public interest
- Promoting transparent, fair, economically efficient, and effective spectrum management policies
- Making public, wherever practicable, national frequency allocation plans and frequency assignment data to encourage openness, and to facilitate development of new radio systems
- Maintaining a stable decision-making process that permits consideration of the public interest in managing the radio frequency spectrum

Spectrum Management Best Practices

- Providing in the national process, where adequately justified, for exceptions or waivers to spectrum management decisions
- Having a process for reconsideration of spectrum management decisions
- Minimizing unnecessary regulations to the extent practicable
- Encouraging radiocommunication policies that lead to flexible spectrum use, to the extent practicable, to allow for the evolution of services and technologies
- Assuring open and fair competition in the marketplaces for equipment and services, and removing any barriers that arise to open and fair competition

Spectrum Management Best Practices

- Harmonizing, as far as practicable, effective domestic and international spectrum policies, including radio-frequency use and, for space services, for any associated orbital position in the geostationary-satellite orbit or of any associated characteristics of satellites in other orbits
- Working in collaboration with regional and other international colleagues to develop simplified regulatory practices
- Removing any regulatory barriers to free circulation and global roaming of mobile terminal and similar radiocommunication equipment
- Adopting decisions that are technologically neutral and which allow for evolution to new radio applications

Spectrum Management Best Practices

- Facilitating timely introduction of appropriate new applications and technology while protecting existing services from harmful interference including, when appropriate, the provision of a mechanism to allow compensation for systems that must redeploy to accommodate new spectrum needs.
- Considering policies to mitigate harm to users of existing services when reallocating spectrum.
- Promoting spectrum sharing using available techniques (frequency, temporal, spatial, modulation coding, processing, etc.), including using interference mitigation techniques and economic incentives, to the extent practicable. Using enforcement mechanisms, as appropriate, under relevant appeal processes.
- Utilizing regional and international standards whenever possible, and where appropriate, reflecting them in national standards.
- Relying to the extent possible on industry standards in lieu of regulations.

Conclusion

- Transition from current situation into a more liberalized market regulation involves decisions that balance between spectrum harmonization, efficiency, value (auction proceeds) while reducing impact on economy and the users. This being said must be done in a transparent and fair manner to encourage investments and developments of new services
- In the short run, restrictions will continue on how various parts of the spectrum are used, and regulator will decide on allocations of resources between different applications and insure that usage is efficient and harmonized across countries
- In the long run, convergence amongst services and emerging technologies could put pressure on regulators to let free market allocate spectrum to services.



Thank You

Q & A

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