Trends in Spectrum Management

ITU – MCMC International Training Program 2015

26 - 28 August 2015

Kuala Lumpur, Malaysia

Aamir Riaz

Telecommunication Development Bureau (BDT)

aamir.riaz@itu.int

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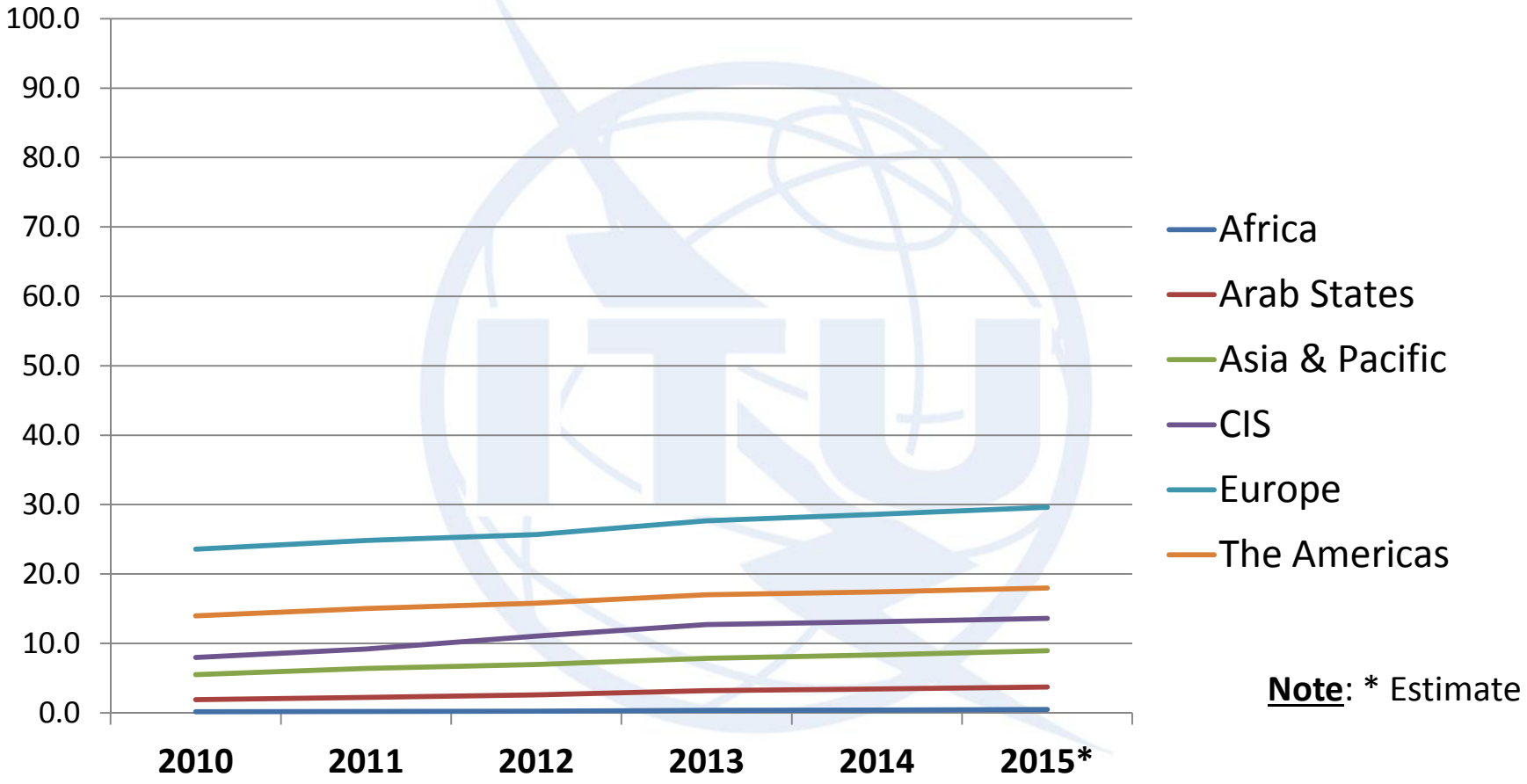
Why the need for Efficient SM now?

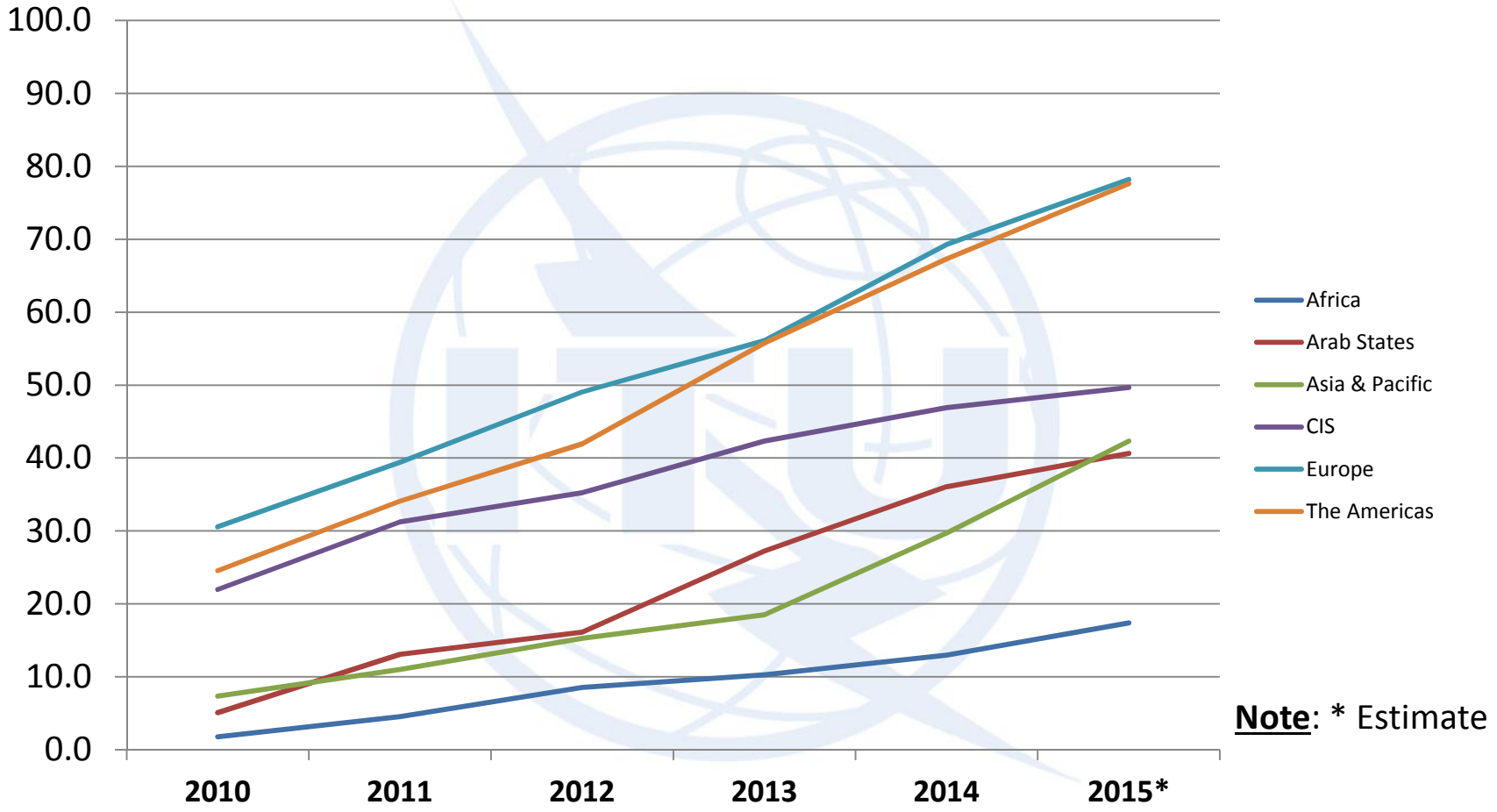
Fixed BB Growth across regions of the world



Fixed (wired) Broadband subscriptions per 100 inhabitants 2010-2015*

Why the need for Efficient SM now?

Mobile BB Growth across regions of the world



Note: * Estimate

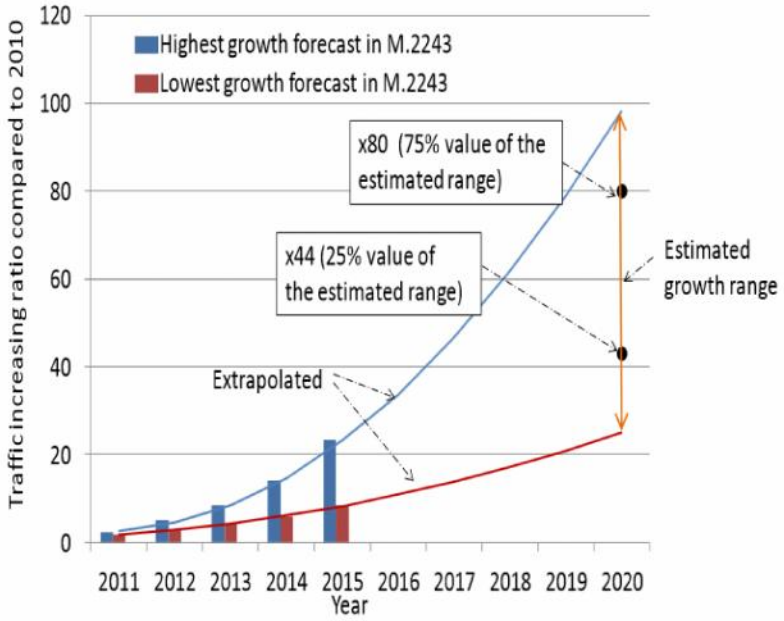
Active Mobile Broadband subscriptions per 100 inhabitants 2010-2015*

What is RF Spectrum?

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

Why the need for Efficient SM now?

Demand of Content – Internet Traffic Explosion



37% of Internet traffic during prime time is online video

Video	Smartphones	Mobile Internet	Machine-to-Machine
~ 70% of internet traffic **by 2014**	**2.5 billion** devices **by 2015** **32x** increase per km^2	**~ 70%** of mobile traffic **by 2014**	**3x** growth in the **next five years**

Mobile broadband networks are at the heart of this trend ...

Source: ITU M. 2243 and Alcatel Lucent

SM for tomorrow?

Radio spectrum shall continue playing ever more vital role in provisioning of broad variety of radiocommunications services - public, private and governmental alike

Pressure on spectrum managers to find solutions to ensure unrestricted long term growth of services through allocation of new bands and finding innovative ways of more efficient utilisation of spectrum

TIME TO CRANK EFFICIENCY OF SPECTRUM USE, TIME TO SHARE ITS BENEFITS EVEN MORE ..

Institutional Best Practices in Spectrum Management

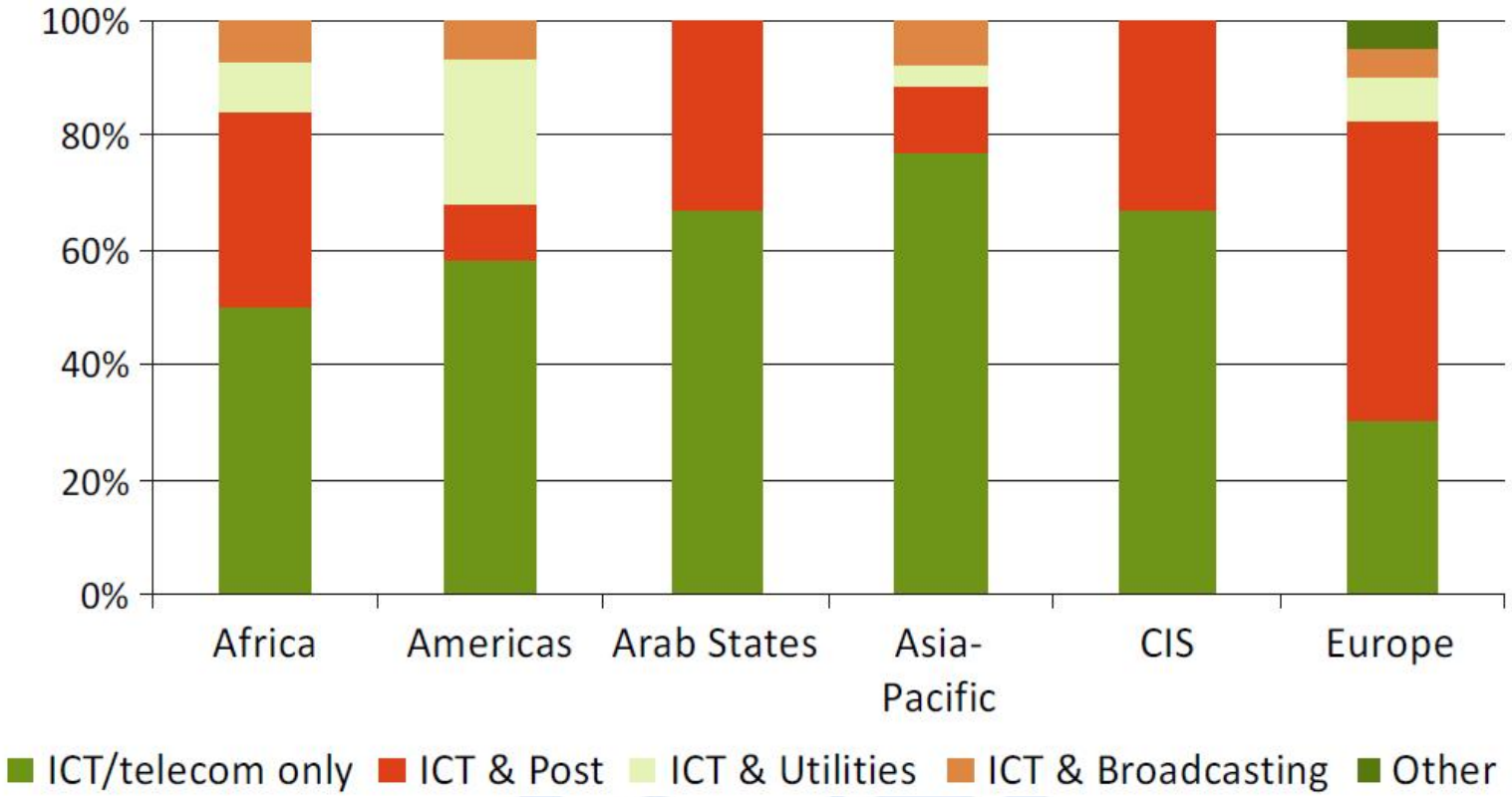
Institutional Best Practices

- **Setting up efficient SM organization:**
  - Achieving streamlined and efficient SM on both short-term and long-term basis
  - Allocating spectrum in an economic and efficient manner, and by relying on market forces, economic incentives and technical innovations
- **Transparency of SM operations:**
  - Promoting transparent, non-discriminatory, economically efficient and effective SM policies, that provide regulatory certainty
- **Technological neutrality and flexible spectrum use:**
  - Promoting wireless innovation, by creating conditions for the development of new services, reducing investment risks and stimulating competition among different technologies, including facilitating entry into market of new competitors

Institutional Best Practices

- **Timely availability and efficient use of spectrum**
  - Facilitating timely introduction of new applications and technology, while protecting existing services from harmful interference; ensuring most efficient use of radio spectrum
- **International harmonization:**
  - Aligning domestic spectrum policies with international best practices, in order to achieve faster take-up of new bands and economies of scale
- **Affordable and fair spectrum access:**
  - Reducing financial barriers for new wireless entrants to the market and promoting development of wireless technologies, especially in less developed areas
  - Ensuring that all wireless players have equitable and fair access to spectrum resources

Mandate of Modern NRA



Increasing trend towards seeing ICT policy and regulation as integral part of overall national infrastructure provisioning platform

Source: ITU – Based on data form 158 countries

Granting Access to Spectrum

UK : Study Case

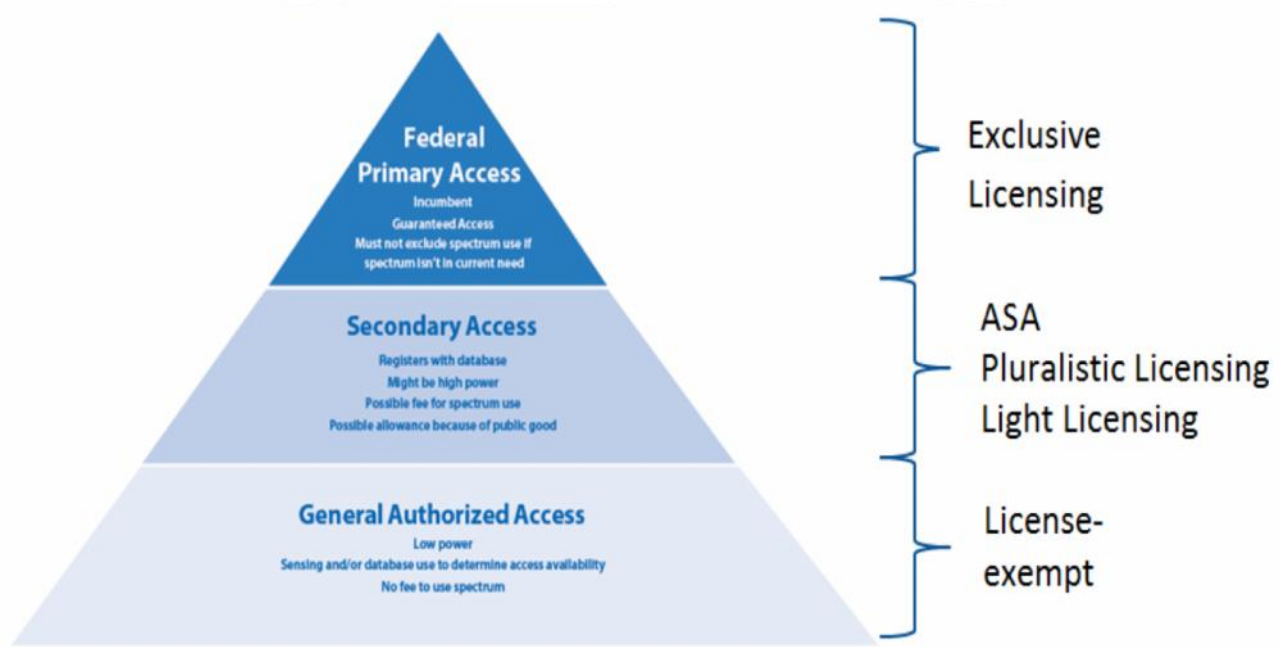
SM method	% of spectrum allocated in the UK *(source: Ofcom)*	
	Year 2000	**Year 2010**
Administrative	**96 %**	**22 %**
Market	**0 %**	**71 %**
Commons *(Unlicensed Spectrum)*	**4 %**	**7 %**

Market consultations and self-regulation as means of deciding the most economical way to utilise spectrum are gaining importance

Spectrum Licensing

Novel solutions that promote various forms and degrees of organised sharing of spectrum:

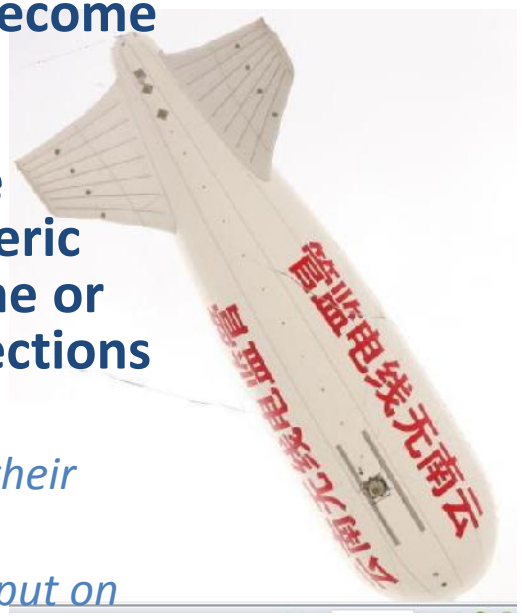
- Light-licensing
- Authorised Shared Access/Licensed Shared Access
- Pluralistic Licensing, etc.



Source: Adapted from US PCAST report

Spectrum Monitoring 1/2

- **Monitoring, market-supervision and enforcement become increasingly integrated fields of operation**



- **Trend to make all monitoring stations (including the regional stations spread throughout the country) a generic hub for control and enforcement functions, whereas one or more teams of inspectors would carry out regular inspections of:**
  - *Licensed radio stations: prior and at regular intervals during their operation*
  - *Vendors of radio equipment in order to control whether they put on the market suitable (type approved) equipment*
  - *Assessment of interference complaints*

- **Concept and studies on "cloud" monitoring by dispersed nodes**

- **Airborne Radio Monitoring**

Spectrum Monitoring 2/2

- **Market self-regulation, especially for the highly congested bands used by a limited set of professional operators**

- **Bi or Multi lateral Cross Border Agreements practice is now becoming most optimal approach to mitigate cross border Radio Frequency interference issues in order to:**
  - *Ensure equal distribution, and*
  - *Speed up the day-to-day frequency assignments in border areas*

Technological Trends

Technology Trend

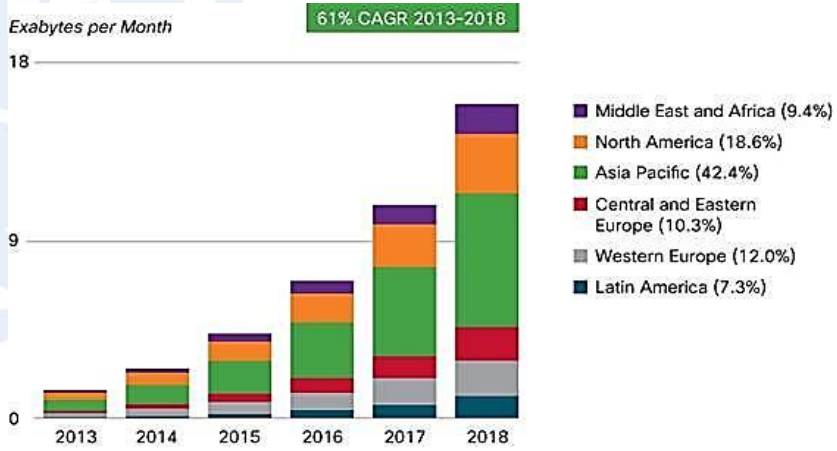
Commercial Mobile Services

- General Trend of Timely availability and efficient use of spectrum
- All upcoming IMT/IMT Advanced technologies based around data traffic
- Increasing requirements of Spectrum for access

User Density	Spectrum requirements		Total spectrum requirements
	for RATG 1	for RATG 2	
Lower user density settings	440 MHz	900 MHz	1 340 MHz
Higher user density settings	540 MHz	1 420 MHz	1 960 MHz

Total spectrum requirements in the year 2020 calculated by ITU-R WP 5D working on WRC Agenda item 1.1

Mobile data traffic in Asia Pacific is forecast to grow 13-fold from 2013 to 2018 reaching 6.7 Exabytes per month (*equivalent to 1,679 million DVDs each month*)



Source: Cisco's Visual Networking Index (Feb 2014)

Technology Trend

Terrestrial Broadcast Services

- Trend of A to D conversion with cut off dates defined
- Further planning of SFN
- Adoption of APT 700 MHz band plan (*more band for Mobile Services*)
- Usage of more spectrally efficient broadcasting technologies

Format	Source coding	No of progs DVB-T	No of progs DVB-T2	No of progs DVB-T	No of progs DVB-T2
		Fixed MUXing		Fixed MUXing FUTURE	
SD	MPEG-2	6	10	6	10
SD	MPEG-4/AVC	9	13	10	15
HD-720p	MPEG-4/AVC	3	4	3	5
HD-1080i	MPEG-4/AVC	2	4	3	4
		Statistical MUXing		Statistical MUXing FUTURE	
SD	MPEG-2	8	13	8	13
SD	MPEG-4/AVC	11	16	13	19
HD-720p	MPEG-4/AVC	3	5	3	5
HD-1080i	MPEG-4/AVC	3	4	3	5

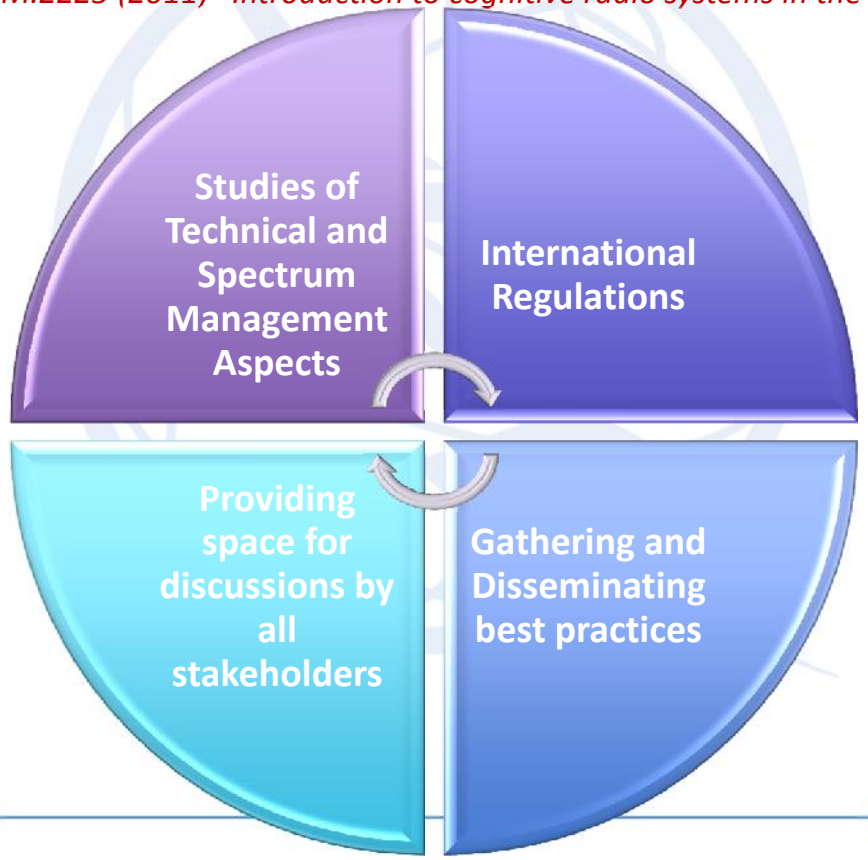
Advantages of Digital TV **Source**: EBU TECHNICAL REVIEW

Technology Trend

Terrestrial Broadcast Services

- **TV White Spaces:**
  - *a portion of spectrum in a band allocated to the broadcasting service and used for television broadcasting that is identified by an administration as available for wireless communication at a given time in a given geographical area on a non-interfering and non-protected basis with regard to other services with a higher priority on a national basis.*

    Source: Report ITU-R M.2225 (2011) "Introduction to cognitive radio systems in the land mobile service"



Technology Trend

Terrestrial Broadcast Services

International Regulations

- ***RR 4.4*** *Administrations shall not assign …any frequency in derogation of either the Table of Frequency Allocations …, except on the condition that using such assignment shall not cause harmful interference to, and shall not claim protection from a station operating in accordance with …these Regulations*. Means usage is not stable (reliable) : if there are no free channels for TVWS device, it has to switch-off, stopping service to customers
- ***RR18.1*** *No transmitting station may be established or operated … without a licence issued in … conformity with the provisions of these Regulations by or on behalf of the government of the country to which the station is subject. All radios shall operate under a license (individual or general) and follow established national rules*

Some references of ITU Work on the TVWS and DSA *(Dynamic Spectrum Access)*:

- *Resolution ITU-R 58 "Studies on the implementation and use of cognitive radio systems"*
- *Recommendation 76 (WRC-12) "Deployment and use of cognitive radio systems"*
- *Question ITU-R 230-3/5 "Software defined radios"*
- *Question ITU-R 241-2/5 "Cognitive radio systems in the mobile service"*
- *Question ITU-R 235/1 "Spectrum monitoring evolution"*
- *Report ITU-R SM.2152 "Definitions of Software Defined Radio (SDR) and Cognitive Radio System (CRS)"*
- *Report ITU-R M.2225 "Introduction to CRS in LMS"*
- *Report ITU-R M.2242 "CRS specific for IMT systems"*
- *PDN Report ITU-R [LMS.CRS2]" CRS in land mobile service*
- *ITU-R WP 5A Seminar: Seminar on Cognitive Radio Systems and the use of White Spaces (Geneva, 18 November 2013)*
- *ITU-R WP 1B Workshop: Spectrum Management issues on the use of White Spaces by Cognitive Radio Systems (Geneva, 20 January 2014)*

Technology Trend

Land Mobile Services

- **Trend of A to D conversion with simple data services like SMS**
- **More spectrum efficient equipment**
  - *Digital land mobile equipment operates with 12.5 kHz (or 6.25 kHz) as compared with 25 kHz for analogue equipment*
- **Spectrum demand from some services fading**
  - *Paging replaced by SMS and Walkie Talkie by Smartphones that can mimic the same service*
- **Spectrum demand from new consumer oriented mobile systems**
  - *Family Radio Systems and General Mobile Radio Systems (GMRS) (462/467 MHz)*
- **Critical role in Emergency and Public safety systems**
  - *Public Protection and Disaster Relief (PPDR) systems require more spectrum to support mobile video (WRC agenda item 1.3 – BB in UHF)*

Technology Trend

Short Range Devices

- **SRDs will continue to be in demand as connected home and Internet of things (IoT) becomes a reality.**

- **New Equipment making use of unlicensed spectrum to have applications including**
  - ***WLAN*** *- Three blocks of spectrum in the 5GHz range for radio LAN – 5150 – 5350 MHz, 5470 – 5725 MHz and 5725 – 5875 MHz already identified. Manufacturers are developing wireless access in higher frequency range (57 – 66 GHz) to support multiple Gbps data rate (European standard EN 302 567)*
  - *RFID*
  - *NFC*
  - *UWB based applications*
  - ***Radiolocation*** *- WRC 2015 agenda item 1.18 will consider the allocation to the radiolocation service for automotive applications in the 77.5 – 78.0 GHz frequency band*

- **Manufacturers working through the ITU and other standardisation bodies to harmonise the frequency ranges and the technical standards.**

- **Administration working to have Mutual Recognition Agreement (MRA) in order to ease the Type approval process and generate economies of scale**

Technology Trend

Satellite Services

- **Administrations preparing their position for WRC 2015 Agenda Item 1.1 that will take into consideration the future satellite requirements.**

- **Several bands are being considered as candidate bands for additional allocation for IMT. The most critically debated include**
  - *1518 – 1559 MHz*
  - *1610 – 1660.5 MHz*
  - *3600 – 4200 MHz*
  - *4500 – 4800 MHz*
  - *5850 – 6725MHz.*

- **Some ITU references that can help in adopting a position**
  - *Report ITU-R M.2109 Sharing studies between IMT Advanced systems and geostationary satellite networks in the fixed-satellite service in the 3 400-4 200 and 4 500-4 800 MHz frequency bands*
  - *Joint Task Group 4-5-6-7 Chairman's Report including the Annexures*
  - *Report ITU-R M.2290-0 - Future spectrum requirements estimate for terrestrial IMT*

Summary

Summary

- **SM remains a vibrant sphere of activities that makes an important constituent part of ICT industry functioning and innovation**
- **Some of the most general trends for SM in future are:**
  - *Radio spectrum shall continue playing ever more vital role, such as to accommodate unrelenting growth of public demand for broadband services*
  - *The key to further increasing efficiency of overall spectrum utilisation would be through better sharing, enabled by continued international collaboration and innovation in SM*
  - *Proportion of flexible allocations allowing markets to self-determine best utilisation of spectrum will continue to grow, helped by emergence of new empowering technologies such as Geolocation databases and Cognitive Radio*
  - *The NRAs' authorization toolbox shall benefit of wider use of licensing schemes that create market incentives and allow various degrees of shared use of spectrum resource, such as light-licensing, ASA/LSA etc.*

I Thank U

"Committed to connecting the WORLD"

Major ITU SM Global Events in 2015

ITU-D Study Group Meeting (Res. 9)
14 – 18 September 2015,
Geneva, Switzerland

World Radio-communication Conference
2 – 27 November 2015,
Geneva Switzerland

Your active participation in and contribution to these events is most welcome!