ETSI
World Class Standards

# Indo-European dialogue on ICT standards & Emerging Technologies

*(Growth, Profitability & Nation Building)*

13-14th March 2014 • New Delhi, INDIA

IN THE FRAMEWORK OF
Project
SESEI
http://eustandards.in/

# IMROVING RADIO SEPCTRUM EFFICIENCY

**Presented by Jamshid Khun-Jush: Senior Director, Qualcomm**

Insert your logo here
right click> change picture

## Presentation Outline

- Basics of Reconfigurable Radio Systems
- 1000x Spectrum Challenge: Authorized Shared Access
- TV UHF Band: Current Status and Future
- ANNEX 1: RRS Regulations and Standards in Europe
- ANNEX 2: ASA Details

Indo-European dialogue on
ICT standards & Emerging Technologies
13-14th March 2014 New Delhi, INDIA

Insert your logo here
right click> change picture

# Basics of Reconfigurable Radio Systems

Indo-European dialogue on
ICT standards & Emerging Technologies
13-14th March 2014 · New Delhi, INDIA

Insert your logo here
right click> change picture

# Reconfigurable Radio Systems: Basics - 1

- Reconfigurable Radio Systems (RRS)
  - Generic term for radio systems encompassing Software Defined Radio (SDR) and/or Cognitive Radio (CR)
  - Licensed Shared Access (LSA) is addressed in Europe as RRS, **although it is neither SDR nor CR**
- Software Defined Radio:
  - RF operating parameters including, but not limited to, frequency range, modulation type, or output power can be **set or altered** by **software**, and/or **the technique** by which this is achieved
  - Multi-mode/band 3G/4G systems already provide several such features



# Reconfigurable Radio Systems: Basics - 2

- Cognitive Radio System has following capabilities
  - To obtain the knowledge of radio operational environment & established policies and to monitor usage patterns & users' needs
  - To dynamically and autonomously adjust its operational parameters and protocols according to the obtained knowledge in order to achieve predefined objectives, e.g. **more efficient utilization of spectrum**
    - Current mobile systems **already** posses such capability
  - To learn from the results of its actions in order to further improve its performance



# 1000x Spectrum Challenge: Authorized Shared Access

Indo-European dialogue on
ICT standards & Emerging Technologies
13-14th March 2014 · New Delhi, INDIA

Insert your logo here
right click> change picture

# Mobile data growth— 1000x challenge

❖ Exponential wireless data growth in the past decade

preparing for

**1000x**

data traffic growth**

global data traffic growth

**~2x**

from 2010- 2011*




Insert your logo here
right click> change picture

# Means to meet 1000x mobile data growth - 1

- More spectrum allocation (higher bps)
  - Flexible bandwidth, spectrum aggregation, supplementary downlink,
- Improved spectral efficiency (higher bps/Hz)
  - Air interface evolution (different MIMO versions, high level modulation), interference management/Self Organizing Networks
- Network densification / Intelligent access to 3G/4G/RLAN (higher bps/Hz/km$^2$)
  - HetNet, small cells – everywhere



# Means to meet 1000x mobile data growth - 2

- We are heading towards even faster growth in wireless data consumption in the next decade
- Key measures to meet 1000x mobile data growth
  - Network densification and spectrum allocation
- Assuming network densification and improved spectral efficiency cater for ~100x data growth
  - Need for ~10x more spectrum
    - An approach only based on clearing spectrum for exclusive use, most likely very difficult even within a reasonable time frame
    - Need for multiple efforts to get access to spectrum



# Multiple Efforts to Access more Spectrum

**Exclusive Licensed Spectrum**

Exclusive Use
3G/4G

Most efficient use of spectrum for mobile broadband

Industry's Top Priority for Quality of Service, mobility and control

**Shared Licensed Spectrum**

Authorized Shared Access Use
Complementary for 3G/4G

Unlocks licensed spectrum for partially occupied government bands

Enable use of encumbered spectrum with predictable QoS when and where not used by incumbent

**Shared Unlicensed Spectrum**

Unlicensed Shared Use
WiFi, BT, LTE-U & others

Unpredictable QoS, ideal for local area access and opportunistic traffic offload

Maximize unlicensed spectrum benefits, where possible



Insert your logo here
right click> change picture

# Network deployment in ASA model

## Exclusive use

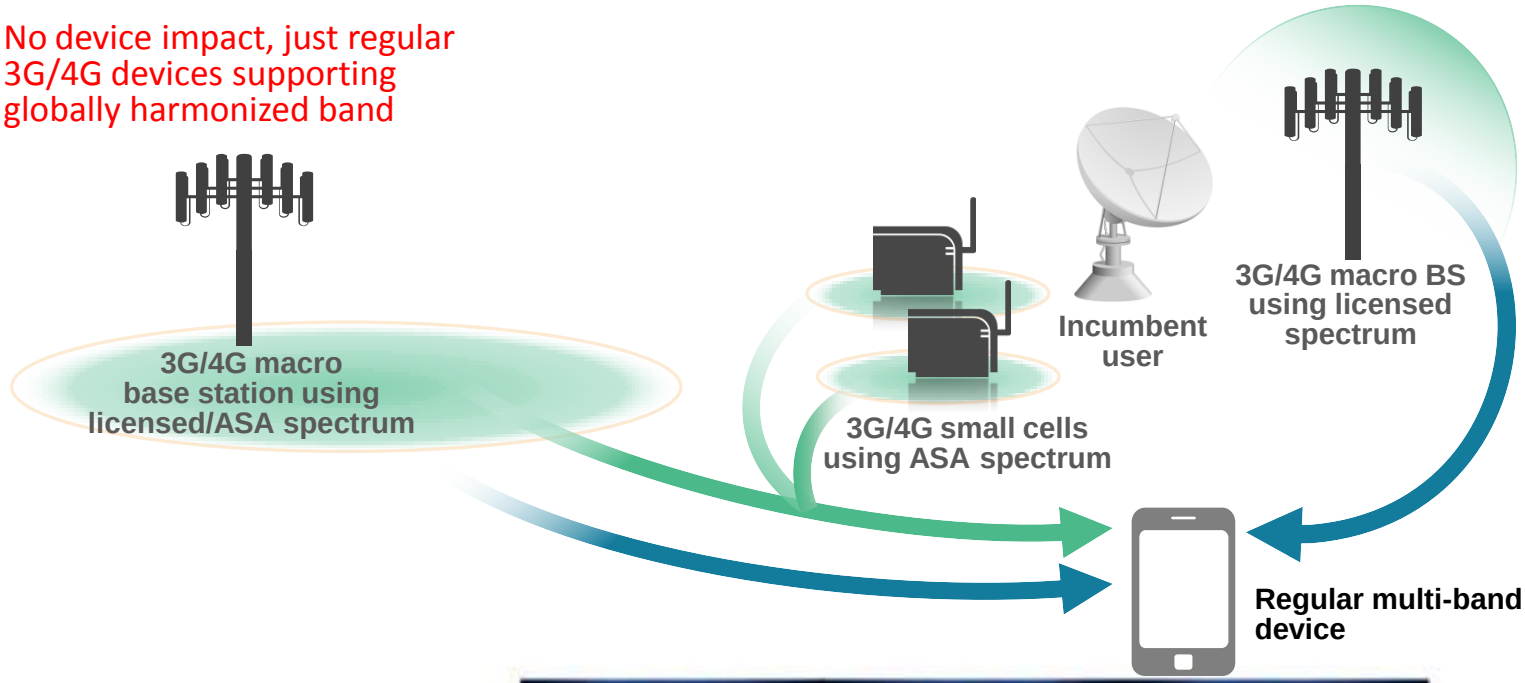
- At given locations/times ensures predictability for long-term investments
- LSA target bands:
  - Already globally allocated to IMT but not cleared due to incumbents
  - No device impact, just regular 3G/4G devices supporting globally harmonized band

## Protect incumbents

- Binary use: either incumbent or operator
- Protection zones required
  - The higher frequency range, the smaller protection distance

## Optimal for small cells

- Small cells can be closer to incumbent than macros
  - Higher frequency ranges optimal targets for ASA, e.g. 2.3 GHz, 3.5 GHz






Insert your logo here
right click> change picture

# TV UHF Band: Current Status and Future

Indo-European dialogue on
ICT standards & Emerging Technologies
13-14th March 2014 · New Delhi, INDIA

Insert your logo here
right click> change picture

# “TV UHF” frequency band in CEPT - 1

- Frequency range 470-862 MHz ideal for rural area coverage
  - Frequency range 790 – 862 MHz has been already cleared for IMT
  - Frequency range 694 – 790 MHz is about to be cleared for IMT
    - 698 – 806 MHz is designated by AWG for IMT/mobile (LTE Band 28)
- Future evolution of mobile and TV terrestrial broadcasting
  - Broadcast community currently considers defining a “world standard”
  - A big portion of 1000x mobile data growth will be TV & video content
  - Unclear if the two communities could bring about a closer alignment between the two services
- Future use of TV spectrum depends on this evolution
  - I.e. anew spectrum division between TV and mobile or Joint spectrum use by them



# "TV UHF" frequency band in CEPT - 2

- CEPT has published several reports on the operation of Cognitive Radio Systems in the "White Spaces" of the Frequency Band 470-790 MHz (see ANNEX 1)
  - Besides in the UK, the reports didn't get any considerable traction
  - Even in the UK, the industry divided on CRSs in TV WS
- The main reason
  - Drawbacks of unlicensed operation of CRS in TV band WSs



# Unlicensed operation of CRS in TV band WSs - 1

- Main drawbacks
  - From a "frequency engineering" perspective
    - Need for **very big protection zones** to manage the interference resulting in inefficient frequency reuse
    - To avoid this disadvantage, the **transmit power needs to be considerably limited (short range communications)** which fully contradicts to the advantage of using lower frequencies
    - **Uncontrolled interference** results in low level QoS guarantees and hence in **low incentives** for MNOs to make long term investments



# Unlicensed operation of CRS in TV band WSs - 2

- Main drawbacks (cont'd)
  - From a "frequency management" perspective
    - Different CEPT countries have different TV WSs fostering **fragmented** use of this valuable frequency in CEPT to disadvantage of **harmonised** use
    - This will have adverse effects in terms of **global harmonised use** of this band and **global roaming** of mobile devices
  - From a "frequency need" perspective:
    - Given enormous mobile data grow consisting of TV and video content, the need for **dedicated spectrum** for mobile will dramatically increase
    - Especially lower frequency ranges very valuable to master digital divide between rural and urban areas, particularly in **developing countries**
    - Unlicensed use of this spectrum essentially **devalues** it



# Thank Your

Indo-European dialogue on
ICT standards & Emerging Technologies
13-14th March 2014 · New Delhi, INDIA

Insert your logo here
right click> change picture

# ANNEX 1: RRS Regulations and Standards in Europe

Indo-European dialogue on
ICT standards & Emerging Technologies
13-14th March 2014 · New Delhi, INDIA

Insert your logo here
right click> change picture

# RRS at ETSI - 1

- Technical Committee RRS responsible for developing standards for radio systems addressing SDR and CR
  - The work mainly focused on CR
    - Several Technical Specifications / Reports have been developed
  - CR systems mainly restricted to White Space Devices (WSD) in the TV UHF band 470-790 MHz (TV WSD)
  - Technical Committee BRAN developed a Harmonised Standard for TV WSD, currently under national voting
    - Very limited interest, driven only by the UK, although controversial even there



# RRS at ETSI - 2

- TC RSS added Licensed Shared Accept to its scope
  - A System Reference Document developed as input to CEPT
    - Outlining market perspectives, main technical characteristics, high-level system architecture and required regulatory changes
    - Currently limited to 2300-2400 MHz frequency band
  - Development of a Technical Specification on detailed technical and operational requirements in the final phase
  - The work on a Technical Specification for defining detailed architecture and required interfaces has just started



# RRS in Europe: EC Mandate

- EC issued Mandate M/512 on RRS with 3 Objectives to ESOs (European Standards Organizations) in 2013
  - ETSI as the main relevant ESO for this mandate accepted M/512 and selected TC RRS as the responsible body
    - Objective A: for the **Commercial Domain** to enable the deployment and operation of **CRS including WSD and devices under LSA***
    - Objective B: for the **Civil Security and Military Domain** to ensure the standardization of suitable SDR architecture(s) (on hold)
    - Objective C: to explore potential areas of **synergy** among commercial, civil security and military applications

*It is a misconception, since LSA devices don't use any CR feature and are just regular 3G/4G devices supporting bands target for LSA



Insert your logo here
right click> change picture

# RRS in Europe: CEPT deliverables on TV WSD

- CEPT published the ECC Report 159 in January 2011
  - Technical and Operational Requirements for the Possible Operation of Cognitive Radio Systems in the "White Spaces" of the Frequency Band 470-790 MHz
- CEPT subsequently developed ECC Reports 185 and 186 as complementary studies to ECC Report 159 in January 2013
  - In particular, the geo-location approach is considered in more details in ECC Report 186
- Besides the UK, no other CEPT country took any action based on these reports/studies
  - Even in the UK industry divided on the TV WSD concept



# RRS in Europe: CEPT deliverables on LSA

- CEPT approved the publication of ECC Report 205 on LSA
  - The Report defines LSA and provides guidelines to CEPT administrations on how to implement it.
- CEPT released for public consultation the draft ECC Decision on harmonised technical and regulatory conditions for the use of the band 2300-2400 MHz
  - The Decision recognizes LSA as THE CEPT regulatory provisions for administrations wishing to maintain current incumbent use and to ensure the long term use of the band by incumbent
  - In some countries, e.g. France, the administrations have started with the definition of details for regulatory provisions to implement LSA



# ANNEX 2: LSA Details

Indo-European dialogue on
ICT standards & Emerging Technologies
13-14th March 2014 · New Delhi, INDIA

Insert your logo here
right click> change picture

# ASA: A new framework to unlock spectrum for 1000x capacity in mobile broadband

Jamshid Khun-Jush: Senior Director, Qualcomm

*Helsinki-Finland, September 3, 2013*

QSIO

QUALCOMM
Standards & Industry Organizations

Presentation to ASA/LSA workshop
Organized by Tekes' Trial-Programme and COST-TERRA

Indo-European dialogue on
ICT standards & Emerging Technologies
13-14th March 2014 · New Delhi, INDIA

Insert your logo here
right click> change picture