European Conference of Postal and Telecommunications Administrations

- 48 European countries cooperating to regulate posts, radio spectrum and communications networks

COST-TERRA

COST Action IC0905 TERRA

TECHNO-ECONOMIC REGULATORY FRAMEWORK FOR RADIO SPECTRUM ACCESS FOR COGNITIVE RADIO/SOFTWARE DEFINED RADIO

Workshop on Cognitive Radio and Software Defined Radio
(BundesnetzAgentur, Mainz, Germany, 2-3 May 2012)

ITU activities on Cognitive Radio Systems & Software-Defined Radio

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ITU is the UN agency for information and communication technologies

AGENDA

Day 1: 2 May 2012

10:30 - 12:30 Opening and key-notes: setting the stage for CR/SDR policies, Chaired by Thomas Ewers, ECC Chairman

- Fabio Leite, Deputy Director of ITU BR

ITU Constitution states it shall:

…allocate spectrum, register frequency allocation of radio services and manage and register the orbital positions and other parameters of satellites, **"in order to avoid harmful interference between radio stations of different countries"**.

ITU Mission

*"To ensure rational, equitable, efficient and economical use of the **radio-frequency spectrum** by all radiocommunication services, including those using satellite orbits, and to carry out studies and adopt **recommendations** (standards) on radiocommunication matters."*

Establish and update international regulations governing use of the spectrum, through radiocommunication conferences adopting international treaties.

Apply the international regulations governing use of the spectrum.

Inform and assist administrations on radiocommunication matters.

Definitions for SDR and CRS

*"**Software-defined radio (SDR)** is a radio transmitter and/or receiver employing a technology that allows the RF operating parameters including, but not limited to, frequency range, modulation type, or output power to be set or altered by software, excluding changes to operating parameters which occur during the normal pre-installed and predetermined operation of a radio according to a system specification or standard."*

*"**Cognitive radio system (CRS)** is a radio system employing technology that allows the system to obtain knowledge of its operational and geographical environment, established policies and its internal state; to dynamically and autonomously adjust its operational parameters and protocols according to its obtained knowledge in order to achieve predefined objectives; and to learn from the results obtained."*

Source: Report ITU-R SM.2152

Studies of the regulatory measures

WRC-07 Resolution 956: Regulatory measures and their relevance to enable the introduction of software-defined radio and cognitive radio systems

…

resolves to invite ITU-R to study whether there is a need for **regulatory measures** related to the application of SDR and CRS technologies.

WRC-12 §1.19: to consider **regulatory measures** and their relevance, in order to enable the introduction of SDR and CRS, based on the results of ITU-R studies, in accordance with Resolution **956 (WRC-07)**.

SDR

Two specific issues related to the particular hardware and software implementation and software reliability and security were identified that appear to be independent of the type of the radiocommunication service:

i) An SDR station, part of any system in a radiocommunication service, can be remotely reprogrammed and can gain the capability to transmit within a frequency band in which there is no allocation to the radiocommunication services under which it normally operates or there is an allocation to the radiocommunication service under which it operates but there is no assignment of radio frequency or radio frequency channel for this SDR station.

ii) Issues related to SDR software to ensure that the station operates within its allowable parameters (e.g. in-band and unwanted emission levels) to avoid harmful interference.

(Source: Report ITU-R M. 2117)

CRS deployment scenarios

- ✓ to guide reconfiguration of connections between terminals and multiple radio systems
- ✓ by an operator of radiocommunication systems to improve the management of its assigned spectrum resources
- ✓ as an enabler of cooperative spectrum access
- ✓ as an enabler of opportunistic spectrum access

Adaptive Systems

RR 1.109A ***adaptive system:*** *A radiocommunication system which varies its radio characteristics according to channel quality.*

WRC-97 Resolution 729: Use of frequency adaptive systems in the MF and HF bands

…

resolves

1 that, in authorizing the operation of frequency adaptive systems in the fixed and mobile services for the MF and HF bands, administrations shall:

1.1 not make assignments in those bands:

– governed by the Appendix **25** frequency allotment Plan for the maritime mobile service or the Appendix **27** frequency allotment Plan for the aeronautical mobile (R) service;

– shared on a co-primary basis with the broadcasting service, radiodetermination service or the amateur services;

– allocated to the radio astronomy service;

1.2 avoid use which may affect frequency assignments involving safety services made in accordance with Nos. **5.155**, **5.155A** and **5.155B**;

1.3 take into account any footnotes applicable to the proposed bands and the implications regarding compatibility;

2 that frequency adaptive systems shall automatically limit simultaneous use of frequencies to the minimum necessary for communication requirements;

3 that, with a view to avoiding harmful interference, frequency adaptive systems should evaluate the channel occupancy prior to and during operation;

4 that assignments for frequency adaptive systems shall be notified to the Bureau in accordance with the provisions of Article **11** and Appendix **4**.

WiFi @ 5 GHz

WRC-03 → RR 5.446A *The use of the bands 5 150-5 350 MHz and 5 470-5 725 MHz by the stations in the mobile, except aeronautical mobile, service shall be in accordance with Resolution 229 (WRC-03).*

↳ -5 150-5 250 MHz: indoors only with limited power
-5 250-5 350 & 5 470-5 725 MHz MHz: limited power & transmitter power control (to protected radars) – see Recommendation ITU-R M.1652

↳ **Dynamic Frequency Selection** (DFS)

Note: The DFS feature was specified in the 5 GHz radio LAN (RLAN) standards initially in order to mitigate interference among uncoordinated RLAN clusters, and to provide optimized spectral efficiency for high-capacity, high bit-rate data transmission.

ITU-R Studies on SDR

QUESTION ITU-R 230-2/5: *Software Defined Radio*

1 What should the appropriate ITU-R definition for SDR be?

2 What are the key technical characteristics that are associated with the design and application of SDR?

3 What frequency band considerations are important to the application of SDR?

4 What special interference considerations may be required in SDR applications?

5 What are the operational implications of SDR to mobile radio systems?

6 What technical considerations are necessary to insure conformance with ITU Recommendations and Radio Regulations?

Report ITU-R M.2117: *Software defined radio in the land mobile, amateur and amateur satellite services*

Report ITU-R SM.2152: *Definitions of Software Defined Radio (SDR) and Cognitive Radio System (CRS)*

ITU-R Studies on CRS

Resolution ITU-R 58: ***Studies on the implementation and use of CRS***

1 to continue studies for the implementation and use of CRS in radiocommunication services;
2 to study operational and technical requirements, characteristics, performance and possible benefits associated with the implementation and use of CRS in relevant radiocommunication services and related frequency bands;
3 to give particular attention to enhancing coexistence and sharing among radiocommunication services;
4 to develop relevant ITU-R Recommendations and/or Reports based on the aforementioned studies, as appropriate,

QUESTION ITU-R 241-1/5: ***CRS in the mobile service***

1 ITU **definition** of CRS?
2 closely **related radio technologies** (e.g. smart radio, reconfigurable radio, policy-defined adaptive radio and their associated control mechanisms) and their functionalities that may be a part of CRS?
3 key technical characteristics, requirements, performance and benefits are associated with the implementation of CRS?
4 potential applications of CRS and their **impact on spectrum management**?
5 operational implications (including privacy and authentication) of CRS?
6 cognitive capabilities that could facilitate **coexistence** with existing systems in the MS and in other services, such as broadcast, mobile satellite or fixed?
7 spectrum-**sharing** techniques to implement CRS to ensure coexistence with other users?
8 CRS to promote the **efficient use** of radio resources?

→ Reports ITU-R SM.2152 & [LMS.CRS]

Participants: 3000+
Countries: 160+
Companies: 100+
Proposals: 3000+

WRC-12 discussions-1

CRS raises the following questions on the need for regulations for solving border problems between neighboring countries:

- ✓How the CRS frequency assignments will be notified and coordinated?
- ✓What regulatory provisions apply in the case of operation of stations implementing CRS for dynamic spectrum access in the bands shared with radiocommunication services with equal or higher status, such as space services (space-to-Earth), radiodetermination service, passive services (radioastronomy, Earth exploration-satellite service and space research service) and safety services?
- ✓What is the procedure for elimination of harmful interference created by stations implementing CRS?

WRC-12 discussions-2

Answer with further questions:

- ✓What are the CRS parameters subject to be modified by the equipment itself (frequency, power, bandwidth, etc)?
- ✓Could we follow a similar method as the one adopted for the Adaptive Systems based on two variable parameters (frequency and power)?
- ✓In what services CRS is planned to be implemented?
- ✓If CRS is applied to all services, in all bands, should Appendix 4 of the RR include the new data elements for all services concerned?
- ✓Do the procedure of RR Article 15 provide instructions on how to proceed to solve harmful interference from the technical point of view or for specific systems as CRS?
- ✓Which monitoring approach to be used for CRS?

WRC-12 discussions-3

Draft new Resolution on CRS (not adopted):

…

resolves

1 that any radio station, including such employing CRS, within any radiocommunication service shall operate in accordance with the provisions of the Radio Regulations applicable for that specific service in the related frequency band;

2 to urge administrations when implementing stations employing CRS for dynamic spectrum access to consider any practical measures to avoid possible interference in the bands allocated to safety services, passive services (radio astronomy, Earth exploration-satellite service and space research service), space services (space-to-Earth) and radiodetermination service,

instructs the Director of the Radiocommunication Bureau

to report to the future WRC on the results of studies under Resolution ITU-R 58 and with regard to the possible difficulty of applying provisions of the Radio Regulations for stations employing CRS and on any regulatory measures, if appropriate.

WRC-12 outcomes

SDR & CRS: No change to the Radio Regulations has been identified for the time being & suppress Resolution 956 (WRC-07)

RECOMMENDATION 76 [COM6/1] (WRC-12)

Deployment and use of cognitive radio systems

recognizing

a) that any radio system implementing CRS technology needs to operate in accordance with the provisions of the Radio Regulations;

b) that the use of CRS does not exempt administrations from their obligations with regard to the protection of stations of other administrations operating in accordance with the Radio Regulations;

c) that CRSs are expected to provide flexibility and improved efficiency to overall spectrum use,

recommends

that administrations participate actively in the ITU-R studies conducted under Resolution ITU-R 58, taking into account *recognizing a)* and *b)*.

Conclusions

SDR technology is currently operating in some systems and networks in the land and maritime mobile, broadcasting and broadcasting-satellite, fixed and mobile-satellite services. It offers flexibility in radio system design and may help with forward compatibility.

Systems which use some cognitive features have already been deployed and some administrations are authorizing these systems (e.g., dynamic frequency selection, white space devices).

These administrations have national equipment approval processes to protect existing services from harmful interference. A radio system implementing CRS technology may, however, have an impact on neighboring countries and coordination may be needed. Should there be applications in which CRS technology is implemented on a non-interference and non-protection basis, the concerned **administrations should desirably satisfy themselves that interference will not be actually generated**.

ITU in brief

✓ **Founded on 17 May 1865**

Leading United Nations agency for ICTs

5 Elected Officials

✓192 Member States,
700+ Sector Members, Associates & Academia

✓750+ staff & 100+ nationalities

✓Annual budget = US$180,000,000

4 regional offices, 8 area offices
HQ in Geneva, Switzerland

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