ITU-R SG 1/WP 1B WORKSHOP: SPECTRUM MANAGEMENT ISSUES ON THE USE OF WHITE SPACES BY COGNITIVE RADIO SYSTEMS (Geneva, 20 January 2014)

Cognitive Radio Systems (CRS) Studies within ITU-R SG 5 (Terrestrial Services)

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ITU-R Definition

Cognitive Radio System (CRS):

“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.”

CRS concept

Methods to obtain knowledge

- Radio link and network quality assessment
- Listening to a wireless control channel
- Spectrum sensing
- Geo-location
- Database usage
- Collaboration between CRS nodes and other different radio system nodes.
Decision and Adjustment

- The operational parameters that the CRS may modify include but are not limited to the following parameters:
  - Output power
  - Operating frequency
  - Modulation type
  - Radio access technology
- This may be implemented using software defined radio (SDR) technology.
Learning

- Enables performance improvement for the CRS by using stored information of its previous actions and their results.
- Each action is evaluated and the parameters are routinely optimized to further improve the performance (e.g., improve capacity).
- Gathers and maintains knowledge while operating in a changing radio environment and to potentially use this information in future transmissions.
Some benefits of CRS

- Additional flexibility
- Improving the efficiency of spectrum use
- Self-correction and fault tolerance
- Deploying new communication systems in disaster-stricken areas or in emergency situations
- Additional power efficiency using CRS
- Potential new mobile communication applications.
The use of CRS in Radiocommunication

- CRS is an enabler: CRS is a set of functionalities of nonspecific radio technologies, and is not to be confused with a Radiocommunication Service.

- “Any system of a radiocommunication service that uses CRS technology in a given frequency band will operate in accordance with the provisions of the Radio Regulations governing the use of that band”


  [Link](http://www.itu.int/pub/R-REG-RR-2012)
Radiocommunication in line with the Radio Regulations (RR)

- **Within an allocated Radiocommunication Service** under the established regulations for the band in case, including international, regional and national regulations as required.

- **Under RR No. 4.4** “Administrations of the Member States shall not assign to a station any frequency in derogation of either the Table of Frequency Allocations in this Chapter or the other provisions of these Regulations, except on the express condition that such a station, when using such a frequency assignment, shall not cause harmful interference to, and shall not claim protection from harmful interference caused by, a station operating in accordance with the provisions of the Constitution, the Convention and these Regulations.”
TV white space

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.

Scope of the work within SG 5

Work is conducted under:

- **Question ITU-R 241-2/5** “Cognitive radio systems in the mobile service”

and

- **Resolution ITU-R 58** “Studies on the implementation and use of cognitive radio systems”
On-going work within SG 5

- **ITU-R Working Party 5A**: Wireless Access & Amateur
  - Report ITU-R M.2225 “Introduction to cognitive radio systems in the land mobile service”
  - Seminar on CRS and the use of white spaces (18 Nov 2013) Summary Record: Document 5A/INFO/8

- **ITU-R Working Party 5C**: Fixed Service
  - Working towards a draft new Report ITU R F.[FS-SDR] on the impact of SDR and CRS on the fixed service

- **ITU-R Working Party 5D**: IMT Systems
  - Report ITU-R M.2242: CRS specific for IMT systems
  - Additional studies of CRS implementation in IMT
On-going work within WP 5A


  - Applications
  - Capabilities and enabling technologies
  - Implementation and use
  - Characteristics and operational technical requirements
  - Performances and potential benefits
  - Factors related to the introduction of CRS technologies and corresponding migration issues.
Deployment Scenarios Studies

- Use of CRS technology to guide reconfiguration of connections between terminals and multiple radio systems.
- Use of CRS technology by an operator of a radiocommunication system to improve the management of its assigned spectrum resource.
- Use of CRS technology as an enabler of cooperative spectrum access.
- Use of CRS technology as an enabler for opportunistic spectrum access in bands shared with other systems and services.
## Future meetings planned

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Summary of WP 5A Seminar

WP 5A held a seminar on CRS and the use of White Spaces on 18 November 2013 (14:00-19:00 hours), the purpose of the seminar was to provide a technical view of the use of CRS in Radiocommunications, in the light of the results of WRC-12 agenda item 1.19, including Resolution ITU-R 58 and Recommendation 76 (WRC-12). It enabled an open discussion of issues and ideas and it was not intended for the presentation of proposals to WP 5A.

- Session 1: Ongoing Studies
- Session 2: General issues and opportunities
- Session 3: Specific projects
- General discussion

Session 1
Ongoing Studies


P1-2 Dr. Markus Mueck, Chairman of ETSI RRS TC (Intel), “A technical view on ETSI activities on cognitive radio”

P1-3 Dr. Artūras Medeišis (Chairman of COST-TERRA), and Dr. Oliver Holland (Vice-Chairman of COST Action IC0905 TERRA (King’s College London, UK)), “Cognitive Radio is dead... Long live Cognitive Radio!”

P1-4 Dr. Keith Nolan (Wireless Innovation Forum (CTVR / The Telecommunications Research Centre, Ireland)), “Technical challenges, opportunities for CRS, and the Wireless Innovation Forum top ten most wanted wireless innovations”

Questions and Answers
Session 2
General issues and opportunities

P2-1  Wassim Chourbaji (Qualcomm Inc.), “ASA: a new framework to unlock more licensed spectrum for mobile broadband”

P2-2  Dr. Zhiyong Feng, Dr. Ying Xu (Beijing University of Post and Telecommunications), “Cognitive TD-LTE System Operating in TV White Space in China: Challenges, Solutions and Testbed”

P2-3  Homare Murakami (WhiteSpace Alliance, NICT (Japan)), “Cognitive Radio based Spectrum Sharing in the Television Broadcast Bands”

P2-4  Dr. Dominique Nussbaum (Eurécom, on behalf of Monaco Telecom), “SPECTRA: Spectrum and energy efficiency in 4G and beyond communication systems”

Questions and Answers
Session 3
Specific projects

P3-1  Dr. Marja Matinmikko (VTT, Finland), “Finnish Trial Program Activities”

P3-2  Andreas Georgakopoulos (WINGS ICT Solutions, Greece), “A Cognitive Radio Experimentation on the Validation of Control Channels for the Management of D2D Constructs”

P3-3  Dr. Olivier Van Der Aa (Neul Ltd.), “Singapore White Space Pilot Project”

P3-4  Prof. Animesh Kumar (Indian Institute of Technology Bombay, India), “Mesh-Network for Rural Broadband Coverage Using TV White Spaces in India”

Questions and Answers

Closing Session: General discussion
References

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

Report ITU-R M.2117-1 “Software defined radio in the land mobile, amateur and amateur satellite services”

Report ITU-R M.2225 “Introduction to cognitive radio systems in the land mobile service”

Report ITU-R M.2242 “Cognitive radio systems specific for IMT 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”

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”

(Next WP 5A meeting is planned for May 2013)

SDR and CRS Seminar held by ITU-R WP 5A on 4 February 2008: [http://www.itu.int/oth/R0A06000047/en](http://www.itu.int/oth/R0A06000047/en)

