

**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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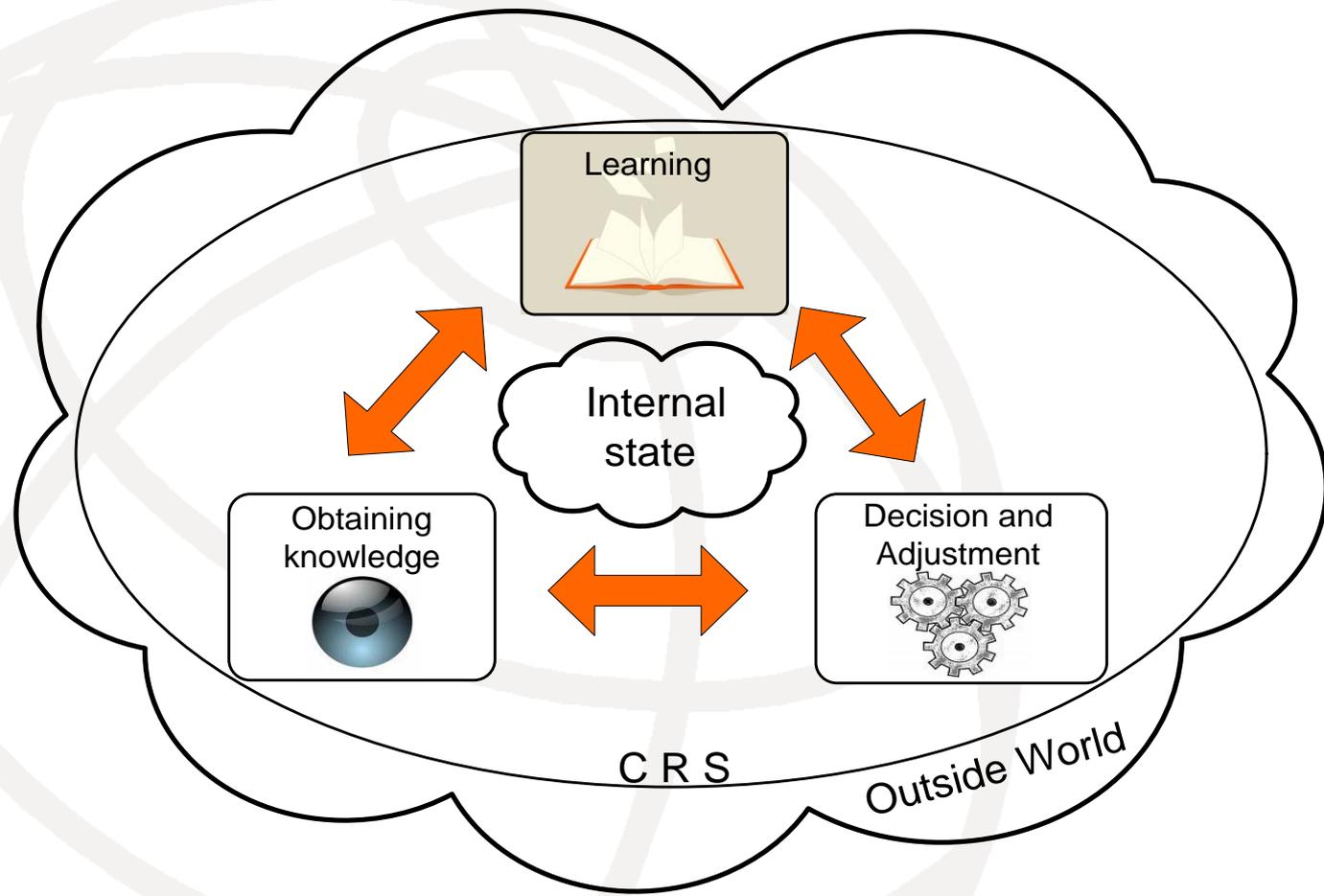
ITU-R Definition

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.”

Reference: [Report ITU-R SM.2152](#) (2009) “Definitions of Software Defined Radio (SDR) and Cognitive Radio System (CRS)”

CRS concept



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



- 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”

Reference: [Report ITU-R M.2225](#) (2011) “Introduction to cognitive radio systems in the land mobile service”

- Radio Regulations (RR) Edition of 2012
<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.

Reference: [Report ITU-R M.2225](#) (2011) “Introduction to cognitive radio systems in the land mobile service”



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”
 - Working towards a draft new Report ITU-R M. [LMS.CR2] on CRS in the land mobile service ([Annex 20](#) to [Document 5A/421](#))
 - [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



- Working towards a draft new Report ITU-R M. [LMS.CR2] on CRS in the land mobile service ([Annex 20](#) to [Document 5A/421](#)) – continuation of the work in [Report ITU-R M.2225](#) (2011) “Introduction to cognitive radio systems in the land mobile service”.
 - 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.

Stable text



- 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



Meeting	Dates	
WP 5D	12 Feb 2014	19 Feb 2014
WP 5A, WP 5B, WP 5C	19 May 2014	30 May 2014
WP 5D	18 Jun 2014	25 Jun 2014
WP 5D	15 Oct 2014	22 Oct 2014
WP 5A, WP 5B, WP 5C	27 Oct 2014	7 Nov 2014
SG 5	10 Nov 2014	11 Nov 2014



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

Reference: <http://www.itu.int/en/ITU-R/seminars/rsg/RWP5A-2013> – [Summary Record: Doc. 5A/INFO/8](#)



Session 1

Ongoing Studies



- P1-1 Philippe Aubineau (ITU Radiocommunication Bureau), “Activities on Cognitive Radio Systems and White Spaces in **ITU-R**”
- 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”

**[Annex 20 to Document 5A/421](#): “Working document towards a preliminary draft new report ITU-R [LMS.CRS2]”
(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>

[Doc. 5A/INFO/4 \(2008\)](#) Presentations, speaker biographies and audio feeds - Seminar on software defined radio and cognitive radio systems (Geneva, 4 February 2008)

[Doc. 5A/INFO/3 \(2008\)](#) Summary highlights of the Seminar on software defined radio and cognitive radio systems - Geneva, 4 February 2008

ITU-R WP 5A Seminar: Geneva, 18 November 2013 – [WP 5A Seminar on Cognitive Radio Systems and the use of White Spaces](http://www.itu.int/en/ITU-R/seminars/rsg/RWP5A-2013) - <http://www.itu.int/en/ITU-R/seminars/rsg/RWP5A-2013> – [Summary Record: Document 5A/INFO/8](#)