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| **Radiocommunication Study Groups** |  |
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| Received: 1 June 2010 | **Document 5D/747-E** |
| **2 June 2010** |
| **English only**  **TECHNOLOGY ASPECTS** |
| WiMAX Forum | |
| Comments on the WORKING DOCUMENT TOWARDS THE PRELIMINARY DRAFT NEW REPORT ITU-R M.[IMT.CRS] Cognitive Radio Systems Specific for IMT Systems | |

# **1 Introduction**

The seventh meeting of WP 5D initiated development of a working document towards the preliminary draft new Report ITU-R M.[IMT.CRS] Cognitive Radio Systems Specific for IMT Systems. Additional contributions were invited to provide comments on Attachment 5.5 of the Working Party 5D Chairman’s Report (Document 5D/679).

The WiMAX Forum submits its comments as Attachment 1 to this contribution.

# 2 Proposal

SWG Radio Aspect should review the proposed changes in Attachment 1, highlighted in yellow, and consider them for inclusion in the working document towards the preliminary draft new Report ITU-R M.[IMT.CRS] Cognitive Radio Systems Specific for IMT Systems resulting from the eight meeting of WP 5D.

**Attachment 1**

**Working document towards the preliminary   
draft new Report ITU-R M.[IMT.CRS]**

**Cognitive Radio Systems Specific for IMT Systems**

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# 1 Introduction

The Cognitive Radio presents potential as an emerging innovative communication technology to address the spectrum scarcity challenge. Cognitive Radio Systems (CRS) could be of interest for specific applications and uses; however its development is still at an early stage. It is expected that CRS may improve the efficiency of the spectrum use and therefore impact spectrum allocation and effective spectrum utilisation. Technical and regulatory aspects have to be carefully addressed.

# 2 Scope

This document addresses all aspects of Cognitive Radio Systems specific for IMT systems including their detailed description and suitable scenarios. Particular attention is given to the potential applications and their impact on the spectrum use.

This document is focusing on studying the impacts of incorporation of cognitive radio systems into existing IMT systems, identifying the IMT specific issues related to CRS, analysing the benefits and impacts of CRS in IMT systems. Develop a PDNR on “Cognitive radio systems specific for IMT systems”

Note that the study of cognitive radio technology itself is not addressed in this document.

Editor’s note: This section reviews the main scope of this working document.

# 3 Definitions, abbreviations and related documents

## 3.1 Definitions

From a general perspective, the Cognitive Radio System (CRS) is radio technology aware of its surroundings and adapts intelligently.

Recently, with the studies linked to the WRC-12 Agenda Item 1.19, the definitions for Software Defined Radio (SDR) and Cognitive Radio Systems (CRS) have been developed within ITU-R to assist when carrying out ITU-R studies. These definitions are contained in Report ITU-R SM. 2152 and read as follows.

**Software defined radio (SDR)**: *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)**: *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.*

**IMT**: *Is the root name that encompasses both IMT-2000 and IMT-Advanced collectively*.

As recently developed by Working Party 1B, general definition of the CRS and illustration for the specific IMT systems should be included as well as relevant ITU‑R Recommendations, Reports and other references.

NOTE − The latest definition of the CRS is included in Report ITU-R SM.2152.

## 3.2 Related documents

ITU-R Report SM.2152: Definitions of software-defined radio (SDR) and cognitive radio system (CRS)

ITU-R PDNR [LMS.CRS][[1]](#footnote-1) : Cognitive radio systems in the land mobile service

Recommendation ITU-R M.1457: Detailed specification of the radio interfaces of International Mobile Telecommunications-2000 (IMT-2000).

Recommendation ITU-R M.1645: Framework and overall objectivesof the future development   
of IMT‑2000 and systems beyond IMT‑2000.

Resolution ITU-R 56: Naming for International Mobile Telecommunications

# 4 Scenarios of Cognitive Radio Systems specific for IMT systems

This section may review the scenarios and highlight the benefit for the IMT operations

One of the main focuses would be to study the use ofCRS technology by an operator of radiocommunication systems to improve the management of an assigned spectrum resource. From the definition, the CRS may allow a radio system to identify “unused” spectrum that may be available for use, determine what type of waveform is required for best propagation and then adapt the radio according to its internal state, external environmental conditions and established policies.

At the moment, typical approach for the use of cognitive radio technologies is on opportunistic spectrum access whereby a Cognitive Radio System (CRS), for example, could identify “unused” portions of spectrum and share that spectrum without interfering with the existing users. Furthermore, other deployment scenarios such as the use of CRS technology by an operator of a radiocommunication service to improve the management of its assigned spectrum resource are currently under development too.

The “unused” concept introduces two main challenges for the CRS technology. The first challenge is the QoS. When the spectrum owner returns, the spectrum shall be returned and the throughput decreases or the link breaks. The second challenge is co-existence. Current cellular system does not consider co-existence of two technologies in the same band. Therefore, it would raise the interference between technologies and reduce the efficiency or benefits of the CRS. This matter as well as other impacts to the current technologies shall be studied and addressed carefully.

Within the context of CRS in IMT systems, it seems especially appropriate to focus on the use of CRS technology by an operator of radiocommunication systems for improving the management of its assigned spectrum resource. Operator may have minimal benefits from operating the CRS in the early stage. Inter-working of radio technologies could be a feasible way to realize preliminary CRS technology.

As an illustration, an example of an operator who already owns a network and operates in its assigned spectrum could be given. Taking into consideration the non-uniform nature of radiocommunication needs within a given area, an operator having more than one radio access network in this geographical area, based on different radio technologies could dynamically adapt to traffic variations and jointly manage the deployed resources, such as GSM-IMT-2000 IMT‑Advanced, in its assigned spectrum, in order to adapt the configuration of the networks to

maximize the overall network capacity, e.g. by adopting reconfigurable radio base stations and related cognitive management entities. In this scenario, other technologies shall also define the band class support for this “unused” resource.

This case could be expanded when an operator decides to deploy another radio network based on a new generation radio interface technology in another assigned spectrum covering the same geographical area.

# 5 Description and Impacts of Cognitive Radio Systems specific for IMT systems

The key benefit of Cognitive Radio Systems, which could be of interest for IMT, is its flexibility. However, IMT systems, as defined in the Recommendation ITU-R M.1645, are based on the notion of Quality of Service. In the final description, it would be mandatory to evaluate the impact of the CRS on the QoS as specified for IMT systems.

5.1 This section should review the findings in the approaches of CRS from other ITU-R groups and identify IMT-specific issues related to CRS that have not been fully addressed by other groups.

This section should concentrate on the following points:

− capability to obtain knowledge of the radio operational environment such as the geographical environment, the internal states and the frequency band assignations;

− established policies and its internal state: full control on the operators’ policies and rules to manage the use of bands identified for IMT;

− dynamic and autonomous adjustment of operational parameters and protocols based on predefined objectives provided by an IMT network operator to its own network deployment;

− learning from the results obtained which is one of technical parts of CRS;

− supporting of co-existence;

− supporting of network functions.

5.2 Futhermore, the following aspects could be addressed:

− technical implementation consideration;

− high level architecture;

− operational techniques;

− implementation;

− software protocol certification;

− QoS requirement;

−

5.3 Operation of CRS in IMT networks in compliance with Radio Regulations and local administration rules.

− operating scenarios for unused spectrum;

− inter-working of radio technologies.

# 6 Performance Evaluation of IMT systems with CRS capability

This part should address the issues related to the potential benefits and key performance indicators of using CRS in IMT systems.

− Potential benefits of using CRS technology in IMT systems.

− Key performance indicators of using CRS technology in IMT systems.

− Impact on current network operation.

# 7 Conclusions

**[Editor’s Note: The conclusions of this report will focus on the IMT networks.]**

In conclusion, an IMT network operator centric approach to integrate CRS features in the IMT network could be a preferred scenario; however, the impact on the QoS should be carefully assessed.

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1. Currently an ITU-R Working Party 5A working document towards a preliminary draft new Report. [↑](#footnote-ref-1)