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| **Radiocommunication Study Groups** |  |
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# Source Information

This contribution was developed by IEEE Project 802®, the Local and Metropolitan Area Network Standards Committee (“IEEE 802”), an international standards development committee organized under the IEEE and the IEEE Standards Association (“IEEE-SA”).

The content herein was prepared by a group of technical experts in IEEE 802 and was approved for submission by the IEEE 802.16™ Working Group (WG) on Wireless Metropolitan Area Networks, the IEEE 802.18 Radio Regulatory Technical Advisory Group, and the IEEE 802 Executive Committee, in accordance with the IEEE 802 policies and procedures, and represents the view of IEEE 802.

# Introduction

This contribution addresses ITU-R WP 5A’s working document [1] toward a preliminary draft new Report ITU-R [LMS.CRS2]. IEEE 802 wireless standards are well suited for use in Cognitive Radio Systems. To reflect such capabilities, IEEE is proposing a new annex on IEEE 802 Wireless Standard Systems for Cognitive Radio and additional modifications to be included in the working document [1].

# Proposal

IEEE proposes the incorporation into the working document [1] of the changes indicated in Appendix 1.

IEEE is looking forward to continuing the fruitful cooperation with ITU-R WP 5A.

# Reference

[1] Document 5A/788 Annex 2, Working document towards a preliminary draft new Report ITU‑R [LMS.CRS2] “[Cognitive radio systems [(CRS) applications] in the land mobile service]”.

# Appendix 1

# (Proposed modifications to section 5.2.6 of [1])

### 5.2.6 Network configuration of ~~three~~ multi radio systems in service

Within a heterogeneous radio environment, a network configuration of ~~three~~ multi radio systems in service is considered. A system block diagram is shown in Figure 8, where one service provider deploys three radios systems on different frequency bands. Another example is provided in Appendix E, which illustrates the use of IEEE 802 wireless standards and systems for Cognitive Radio Systems. These systems have different coverage areas from small to large cell. The resource manager collects the radio operation environment information from the base stations and user terminals on the geo-location basis, which is one of CR functionality (obtaining knowledge). The radio environment information may include the information of signal strength, throughput, and system delay. The resource manager provides the information to the control equipment. Based on this information, the control equipment selects the appropriate connectivity for the user terminal, which is another one of CR functionality (decision and adjustment).

The deployment of multi radio access technology combined with cognitive radio techniques can be advantageous in several usage scenarios. Of particular importance is the capability to provide service continuity in disaster situations in which a certain radio access network is disrupted or degraded for a sustained period of time. In such situations, networks incorporating multi radio access technologies with cognitive radio techniques would be useful in providing continuity of communications.

# (New ANNEX in [1])

Annex E IEEE 802 Wireless Technologies in Heterogeneous Networks for Cognitive Radio Systems

Cognitive Radio Techniques will enhance current and future communication networks. The IEEE 802 family of wireless technologies provide a set of building blocks for heterogeneous wireless networks that can be controlled by a Cognitive Radio Manager function. IEEE 802 standards support both licensed and license-exempt operations, offering enhanced flexibility in the design and operation of Cognitive Radio Systems. IEEE Std 802.22 specifies cognitive Wireless Regional Area Networks for operation in the VHF/UHF bands. In addition, IEEE Std 802.21 specifies mechanisms for network discovery and handover that facilitate service continuity in heterogeneous networks.

Heterogeneous networks built from licensed and license-exempt radio may be exploited synergistically, resulting in more efficient utilization of spectrum resources leading to low cost/bit, capacity enhancements and improved client quality of service.

For example, use case scenarios may include the followings:

* Offloading traffic from licensed band over to license-exempt band operation with service continuity, e.g. IEEE 802.11 hotspots, when available.
* Offloading traffic amongst various licensed band networks with service continuity,   
  e.g. 3GPP LTE/EUTRA over to IEEE 802.16, and vice versa.

The cost associated with this additional capacity may be significantly lower when offloading to license-exempt spectrum. Also new integrated network devices, such as integrated IEEE 802.11/802.16 access points, can implement tighter coupling between the radio technologies and efficiently utilize the spectrum available across both licensed and license-exempt bands.

Additional capabilities of Cognitive Radio Systems which are essential for deployment in heterogeneous networks:

* Enhanced interference mitigation techniques
* Coexistence of various radio operations
* Enhanced spectrum utilization between Multi-RAT systems
* Seamless mobility that supports service continuity among Multi-RATs (e.g. selective and managed data offloading and handover)
* Enhanced interworking and collaboration among Multi-RAT devices
* Enhanced Energy Saving mechanisms and optimization.

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