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Telecommunications and information exchange between systems — Wireless Regional Area Networks (WRAN) — Specific requirements —

Part 22: Cognitive Wireless RAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Policies and procedures for operation in the bands that allow spectrum sharing where the communications devices may opportunistically operate in the spectrum of primary service

Télécommunications et échange d'information entre systèmes — Réseaux régionaux sans fil (WRAN) — Exigences spécifiques —

Partie 22: Spécifications du contrôle d'accès du milieu sans fil cognitif (MAC) et de la couche physique (PHY) : Politiques et procédures pour le fonctionnement dans les bandes qui permettent le partage du spectre, où les dispositifs de communication peuvent fonctionner de manière opportuniste dans le spectre du service primaire

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Abstract: This standard specifies the air interface, including the cognitive medium access control layer (MAC) and physical layer (PHY), of point–to–multipoint wireless regional area networks (WRANs) comprised of a professional fixed base station (BS) with fixed and portable user terminals operating in the VHF/UHF TV broadcast bands between 54 MHz to 862 MHz, and potentially in the 1300 MHz to 1750 MHz, and 2700 MHz to 3700 MHz bands provided the regulatory regime allows it.

Keywords: broadband wireless access network, cognitive radio, fixed user terminals, IEEE 802.22™, portable user terminals, radio spectrum sensing, regional area network, WRAN standards

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Introduction

This introduction is not part of IEEE Std 802.22–2019, IEEE Standard for Information Technology—Telecommunications and information exchange between systems—Wireless Regional Area Networks (WRAN) Specific requirements—Part 22: Cognitive Wireless RAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Policies and Procedures for Operation in the Bands that Allow Spectrum Sharing where the Communications Devices May Opportunistically Operate in the Spectrum of Primary Service.

This standard specifies the air interface, including the cognitive radio MAC and PHY, of point-to-multipoint and backhaul WRANs comprised of a professional fixed BS with fixed and portable user terminals. The standard specifies operation in the bands that allow spectrum sharing where the communications devices may opportunistically operate in the spectrum of the primary service, such as the VHF/UHF TV broadcast bands between 54 MHz to 862 MHz, and the 1300 MHz to 1750 MHz and 2700 MHz to 3700 MHz bands provided the regulatory regime allows it.

Contents

**IEEE Standard for Information Technology—
Telecommunications and information exchange between systems
Wireless Regional Area Networks (WRAN)—
Specific requirements**

Part 22: Cognitive Wireless RAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Policies and Procedures for Operation in the Bands that Allow Spectrum Sharing where the Communications Devices May Opportunistically Operate in the Spectrum of Primary Service

1. Overview

1.1 Scope

This standard specifies the air interface, including the cognitive radio medium access control layer (MAC) and physical layer (PHY), of point-to-multipoint and backhaul wireless regional area networks (WRANs) comprised of a professional fixed base station (BS) with fixed and portable user terminals. The standard specifies operation in the bands that allow spectrum sharing where the communications devices may opportunistically operate in the spectrum of the primary service, such as the VHF/UHF TV broadcast bands between 54 MHz to 862 MHz, and the 1300 MHz to 1750 MHz and 2700 MHz to 3700 MHz bands provided the regulatory regime allows it.

1.2 Purpose

This standard is intended to enable deployment of interoperable IEEE 802® multivendor WRAN products, to facilitate competition in broadband access by providing alternatives to wireline broadband access and extending the deployability of such systems into diverse geographic areas, including sparsely populated rural areas, while preventing harmful interference to incumbent licensed services. The standard specifies operation in the bands that allow spectrum sharing where the communications devices may opportunistically operate in the spectrum of the primary service, such as the VHF/UHF TV broadcast bands between 54 MHz to 862 MHz, and the 1300 MHz to 1750 MHz and 2700 MHz to 3700 MHz bands provided the regulatory regime allows it.

1.3 Introduction

The WRANs for which this standard has been developed are expected to operate primarily in low population density areas in order to provide broadband access to data networks. The WRAN systems will use vacant channels in the VHF and UHF bands allocated to the Television Broadcasting Service in the frequency range between 54 MHz and 862 MHz while avoiding interference to the broadcast incumbents in these bands. A typical application can be the coverage of the rural area around a village, as illustrated in Figure 1(a), within a radius of 10 km to 30 km from the BS depending on its EIRP and antenna height. The MAC can also accommodate user terminals located as far as 100 km with proper scheduling of the traffic in the frame when exceptional radio frequency (RF) signal propagation conditions are present. With the PHY implemented in this standard, WRAN systems can cover up to a radius of 30 km without special scheduling.

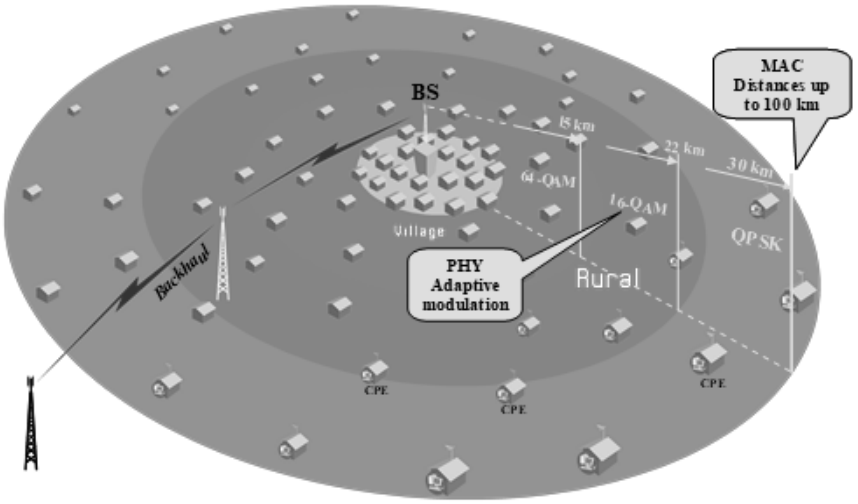

Figure 1(a)—IEEE 802.22 WRAN cell with a base station and user terminals

A BS complying with this standard shall be able to provide high-speed Internet service for up to 512 fixed or portable customer premise equipment (CPE) devices or groups of devices within its coverage area assuming different quality of service (QoS) requirements for various CPEs, while meeting the regulatory requirements for protection of the incumbents.

This standard includes cognitive radio techniques to mitigate interference to incumbents, including geolocation capability, provision to access a database of incumbent services, and spectrum-sensing technology to detect the presence of incumbent services, other WRAN systems, and IEEE 802.22.1 wireless beacons.

The Advanced Wireless Regional Area Networks (A-WRANs) for which this standard has also been developed are expected to support enhanced broadband services and monitoring applications such as real-time and/or near real-time monitoring, emergency broadband services, remote medical services, etc. The A-WRAN provides all essential functionalities of PHY, MAC, security, and cognitive radio technologies defined in the original IEEE 802.22 WRAN and supports an additional PHY Operational mode (PHY-OM2) and additional functionalities of multi-hop relay operations, multiple channel operations, multiple-input-multiple-output (MIMO) operations, and advanced security to extend regional area broadband services to the regional monitoring applications and the enhanced broadband services. The A-WRAN provides connectivity through two new types of services, multi-hop relay and multi-channel operation. Figure 1(b) and Figure 1(c) are examples of the A-WRAN providing enhancement to connectivity using multi-hope relay. Figure 1(d) and Figure 1(e) are examples of the A-WRAN increasing capacity in the network using multi-channel operation at the A-BS, or at the A-BS and A-CPEs. The A-WRAN can only operate in the multirelay or multi-channel services at any given time.

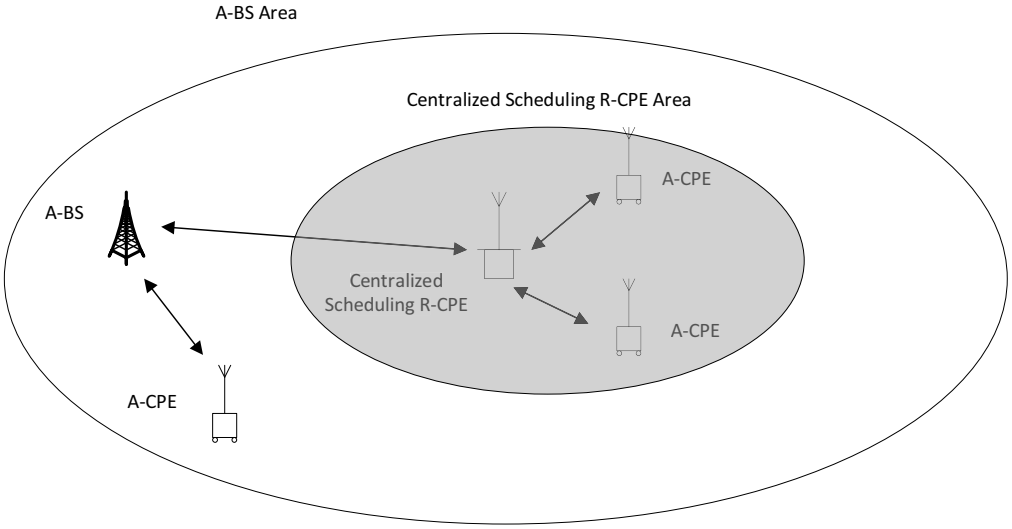

Figure 1(b)—Example of an IEEE 802.22 A-WRAN cell with centralized scheduling multi-hop relay

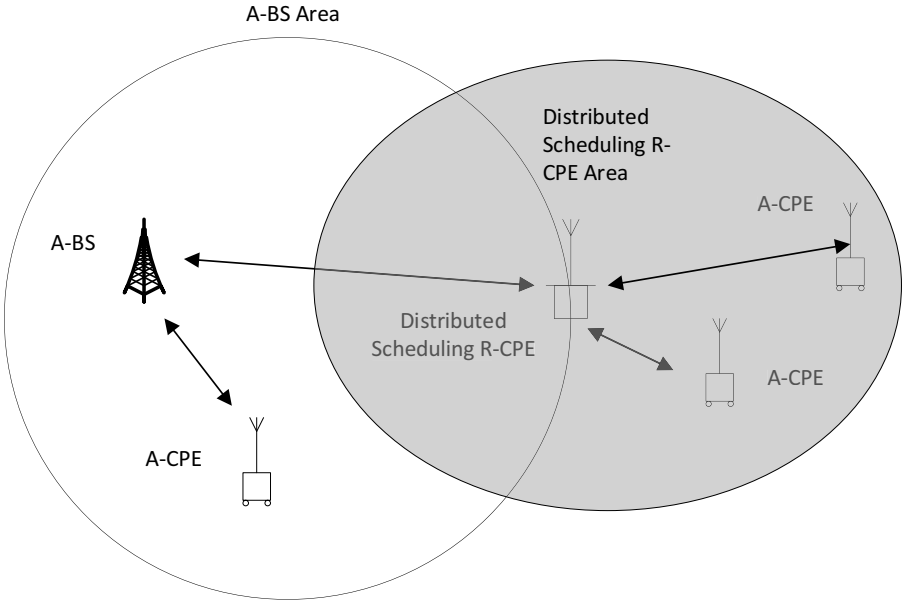

Figure 1(c)—Example of IEEE 802.22 A-WRAN cell with distributed scheduling multi-hop relay

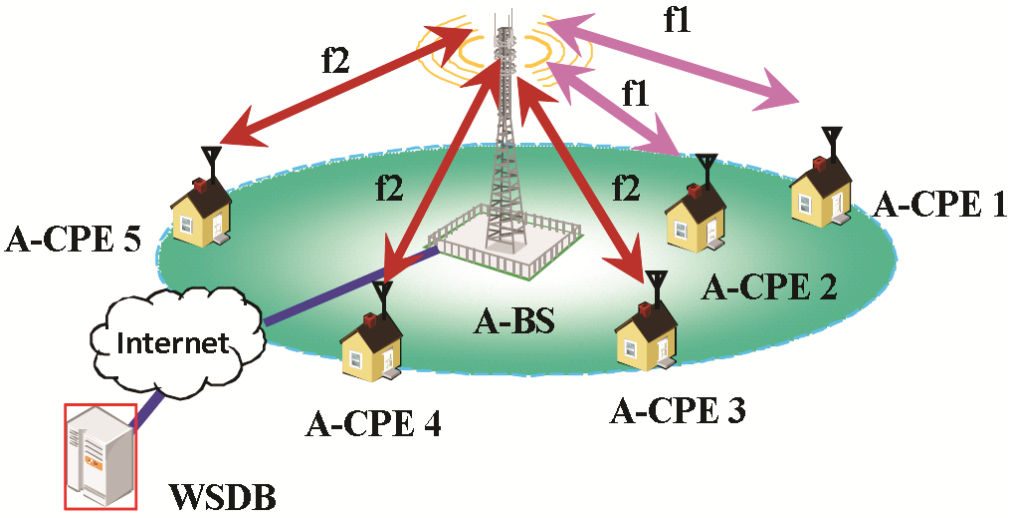

Figure 1(d)—Example of IEEE 802.22 A-WRAN cell with multi-channel operation at the A-BS

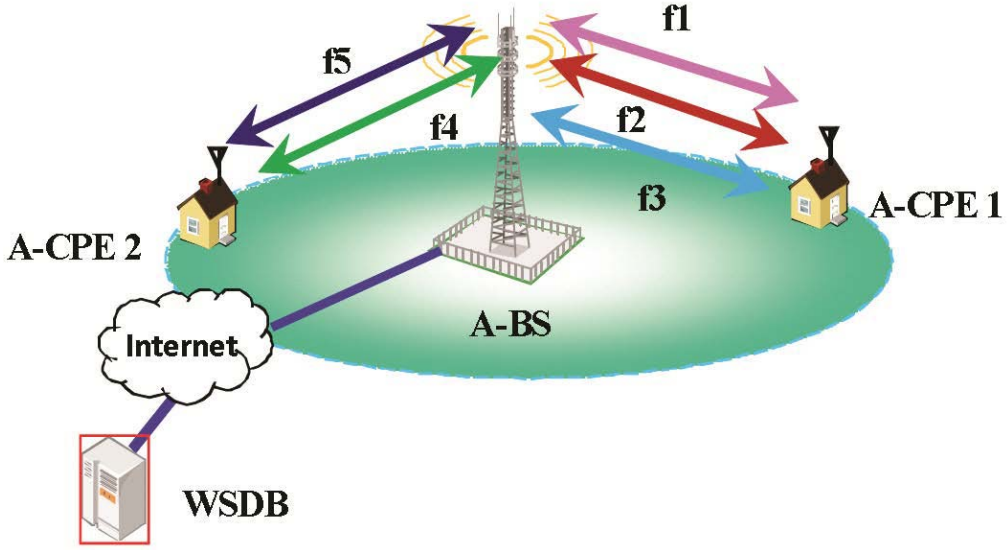

Figure 1(e)—Example of IEEE 802.22 A-WRAN cell with multi-channel operation at the A-BS and the A-CPE

An advanced base station (A-BS) complying with this standard shall be able to provide broadband services for the CPEs such as the advanced CPE (A-CPE) through direct connectivity to the A-BS, and/or through a relay CPE (R-CPE) that is an A-CPE configured to act as a relay CPE. An A-BS complying with this standard shall be able to provide broadband services to A-CPEs operating on multiple channels when multi-channel operation is enabled.

1.4 Word usage

The word *shall* indicates mandatory requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted (shall equals is required to).[1, 2]

The word *should* indicates that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required (should equals is recommended that).

The word *may* is used to indicate a course of action permissible within the limits of the standard (may equals is permitted to).

The word *can* is used for statements of possibility and capability, whether material, physical, or causal (can equals is able to).

[1] The use of the word *must* is deprecated and cannot be used when stating mandatory requirements, *must* is used only to describe unavoidable situations.

[2] The use of *will* is deprecated and cannot be used when stating mandatory requirements, *will* is only used in statements of fact.

2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

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IETF RFC 2437, PKCS #1: RSA Cryptography Specifications Version 2.0, October 1998.[8]

IETF RFC 2578, Structure of Management Information Version 2 (SMIv2), April 1999.

[3]ANSI publications are available from the American National Standards Institute (http://www.ansi.org/).

[4]FCC publications are available at https://www.fcc.gov/edocs.

[5]FIPS publications are available from the National Technical Information Service, U. S. Department of Commerce (http://www.ntis.org/).

[6]The IEEE standards or products referred to in Clause 2 are trademarks owned by The Institute of Electrical and Electronics Engineers, Incorporated.

[7]IEEE publications are available from the Institute of Electrical and Electronics Engineers (http://standards.ieee.org).

[8]IETF documents (i.e., RFCs) are available for download at http://www.rfc-archive.org/.

IETF RFC 2758, Definitions of Managed Objects for Service Level Agreements Performance Monitoring, February 2000.

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IETF RFC 5216, The EAP-TLS Authentication Protocol, March 2008.

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[9]ITU-T publications are available from the International Telecommunications Union (http://www.itu.int/).
[10]NIST publications are available from the National Institute of Standards and Technology (http://www.csrc.nist.gov/).
[11]NMEA publications are available from the National Marine Electronics Association at https://www.nmea.org/.
[12]Available at https://www.secg.org/.
[13]Trusted Computing Group publications available at https://trustedcomputinggroup.org/resource/tpm-main-specification/.