P1900.7 introduction

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IEEE DYSPAN-SC WS Radio

DYSPAN WS Radio

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Abstract

- This contribution introduces IEEE ComSoc DYSAPN-SC WS Radio

Background

- On March 8, 2010 the ad hoc group on White Space Radio was created within IEEE SCC41 standardization committee
  - To consider interest in, feasibility of, and necessity of developing standard defining radio interface (MAC and PHY layers) for white space communication system
- The group spent 4 months to prepare to develop PAR and 5C and 4 more months to develop PAR and 5C

Key Results

- Usage models (31r0)
- WS regulatory bands (13r0)
- Requirements (35r0)
- 5C (30r8)
- PAR (29r12)

- All contributions are publically available at
  - http://grouper.ieee.org/groups/scc41/adhoc-wsr/contrib/

Usage models (31r0)

No.	UM	Description
1	Wide Area Connectivity	High speed backbone connecting fixed stations
2	Utility Grid Networks	Low power consumption fixed stations for measurement collection
3	Transportation Logistics	Low data rate mobile stations for control and logistics
4	Land Mobile Connectivity	Providing wireless access for mobile stations
5	Maritime Connectivity	Connecting ships in harbor, shore and sea
6	High Speed Vehicle Broadband Access	High speed backbone for high speed vehicles
7	Office and Home Networks	High speed short range, coordinated/uncoordinated connection
8	Emergency and Public Safety	High reliability connectivity for portable and mobile stations

Key Results

- Usage models (31r0)
- WS regulatory bands (13r0)
- Requirements (35r0)
- 5C (30r8)
- PAR (29r12)

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5C (30r8)

- Summary of PHY layer features

PHY layer feature	ECMA-392	IEEE P802.22	IEEE P802.11af	IEEE 802.16h	New standard (expected)
Multichannel support	No	No	Yes (only continuous channels)	Yes (only continuous channels)	Yes (also discontinuous channels)
Mobility support	Yes	No	No	Yes	Yes (up to 300 km/h)
Maximum throughput	31.56 Mbps	22.69 Mbps	---	134.4 Mbps	Up to several tens of Mbps
Typical range	---	17-33 km	---	10 km	Up to several tens of km
Channelization	6,7,8 MHz	6,7,8 MHz	5,10,20,40 MHz	1.5 to 28 MHz	TBD
Modulation	OFDM	OFDM	OFDM	SC, OFDM	TBD

5C (30r8)

- Summary of MAC sublayer features

MAC sublayer feature	ECMA-392	IEEE P802.22	IEEE P802.11af	IEEE 802.16h	New standard (expected)
Multichannel support	No	No	No	No	Yes (also discontinuous channels)
Cellular topology support	No	No	No	Yes	Yes
Mobility and handover support	No	No	No	Yes	Yes
Mesh topology support	Yes	No	Yes	No	Yes
Range for best MAC efficiency	---	17-33 km	Short and mid range	Several km	Up to several tens of km
Power efficiency	Yes	No	No	Yes	Yes
Self-coexistence	Yes	Yes	Yes	Yes	Yes
Multiple access method	CSMA/CS, TDMA	OFDMA	CSMA/CS, TDMA	TDMA, OFDMA	TBD

5C (30r8)

- Summary of cognitive features

Cognitive feature	ECMA-392	IEEE P802.22	IEEE P802.11af	IEEE 802.16h	New standard (expected)
Interface with spectrum sensors	Yes	Yes	No	No	Yes
Interface with geolocation device	No	Yes	No	No	Yes
Quite periods for spectrum sensing	Yes	Yes	No	No	Yes
Inter-system coexistence	No	No	No	No	Yes
Interface with TVWS database	Yes	Yes	Yes	No	Yes

5C (30r8)

- It is beneficial to develop a new white space radio system standard because, compared to ECMA-392 standard, IEEE P802.22 draft standard, and IEEE P802.11af draft standard, it will have the following new features:
  - Full mobility support including handover etc
  - Support of cellular and mesh topologies
  - Power efficiency for mobile and low power users
  - Multichannel support
  - Support of inter-system coexistence.

5C (30r8)

- The new standard will enable efficient implementation of the following usage models as compared to ECMA-392 standard, IEEE P802.22 draft standard, and IEEE P802.11af draft standard:
  - Wide Area Connectivity usage model due to simultaneous support of long range and high data rate
  - Transportation Logistics, Land Mobile Connectivity, and High Speed Vehicle Broadband Access usage models due to full mobility support and support of cellular topology
  - Maritime Connectivity usage model due to full mobility support and support of cellular and mesh topologies.

5C (30r8)

- IEEE 802.16h standard is designed for license-exempt operation and does not have cognitive features for dynamic spectrum access in white space frequency bands, such as, interface with geolocation device, TVWS database, and spectrum sensors, quite periods for spectrum sensing, and support of inter-system coexistence
- Compared to IEEE 802.16h standard, the new standard will have all cognitive features that are required for white space communication

PAR (29r12)

- Title
  - MAC and PHY Specification for Fixed and Mobile Operation of White Space Dynamic Spectrum Access Radio Systems
- Scope
  - This standard specifies a radio interface including medium access control (MAC) sublayer and physical (PHY) layer of white space dynamic spectrum access radio systems supporting fixed and mobile operation in white space frequency bands. The standard provides means to support other related IEEE 1900 standards.

PAR (29r12)

- Purpose
  - This standard enables the development of cost-effective, multi-vendor white space dynamic spectrum access radio systems capable of interoperable operation in white space frequency bands. This standard facilitates a variety of applications, including the ones capable to support high mobility, both low-power and high-power, short-, medium, and long-range, and a variety of network topologies.

PAR (29r12)

- Standards/projects with a similar scope
  - ECMA-392 standard specifies local area network (LAN) based MAC and PHY for operation in TV white space.
  - IEEE P802.22 draft standard specifies MAC and PHY for point-to-multipoint wireless regional area networks comprised of a professional fixed base station with fixed and portable user terminals operating in TV white space.
  - IEEE P802.11af draft standard defines modifications to 802.11 MAC and PHY to meet the legal requirements for channel access and coexistence in the TV White Space.
  - IEEE standard 802.16h specifies improved mechanisms, as policies and medium access control enhancements, to enable coexistence among license-exempt systems based on IEEE Standard 802.16 and to facilitate the coexistence of such systems with primary users.

PAR (29r12)

- Standards/projects with a similar scope
  - With regard to ECMA-392, IEEE P802.22, IEEE P802.11af, and IEEE 802.16, physical layer features, MAC sublayer features, and cognitive features that are important for dynamic spectrum access in white space frequency bands have been analyzed. Below are the results of these analyses.
  - The proposed standard will support the other IEEE 1900 standards, such as P1900.4a for white space management, P1900.5 for policy languages, and P1900.6 to obtain and exchange sensing related information (spectrum sensing and geolocation information). Also, the proposed standard may support other standards, for example, P802.19.1 for white space coexistence.

PAR (29r12)

- Standards/projects with a similar scope
  - It is beneficial to develop a new white space radio system standard because, compared to ECMA-392 standard, IEEE P802.22 draft standard, and IEEE P802.11af draft standard, it will have the following new features:
    - Full mobility support including handover etc
    - Support of cellular and mesh topologies
    - Power efficiency for mobile and low power users
    - Multichannel support
    - Support of inter-system coexistence.

PAR (29r12)

- Standards/projects with a similar scope
  - The new standard will enable efficient implementation of the following usage models as compared to ECMA-392 standard, IEEE P802.22 draft standard, and IEEE P802.11af draft standard and would enable other relevant usage models:
    - Wide Area Connectivity usage model due to simultaneous support of long range and high data rate
    - Transportation Logistics, Land Mobile Connectivity, and High Speed Vehicle Broadband Access usage models due to full mobility support and support of cellular topology
    - Maritime Connectivity usage model due to full mobility support and support of cellular and mesh topologies.
  - These usage models drive PHY and MAC layer requirements and parameters that cannot be met by simple extensions or modifications of ECMA-392, IEEE P802.22 or IEEE P802af. Therefore, a new standards development effort is required.

PAR (29r12)

- Standards/projects with a similar scope
  - IEEE 802.16h standard is designed for license-exempt operation and does not have cognitive features for dynamic spectrum access in white space frequency bands, such as, interface with geolocation device, TVWS database, and spectrum sensors, quite periods for spectrum sensing, and support of inter-system coexistence. Compared to IEEE 802.16h standard, the new standard will have all cognitive features that are required for white space communication.