

# Supporting Standards for DSA: IEEE Dynamic Spectrum Access Networks (DYSPAN) Standards Committee

**Version 2.0**

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# IEEE DYSPAN Standards Committee (DYSPAN-SC)

## ● Scope

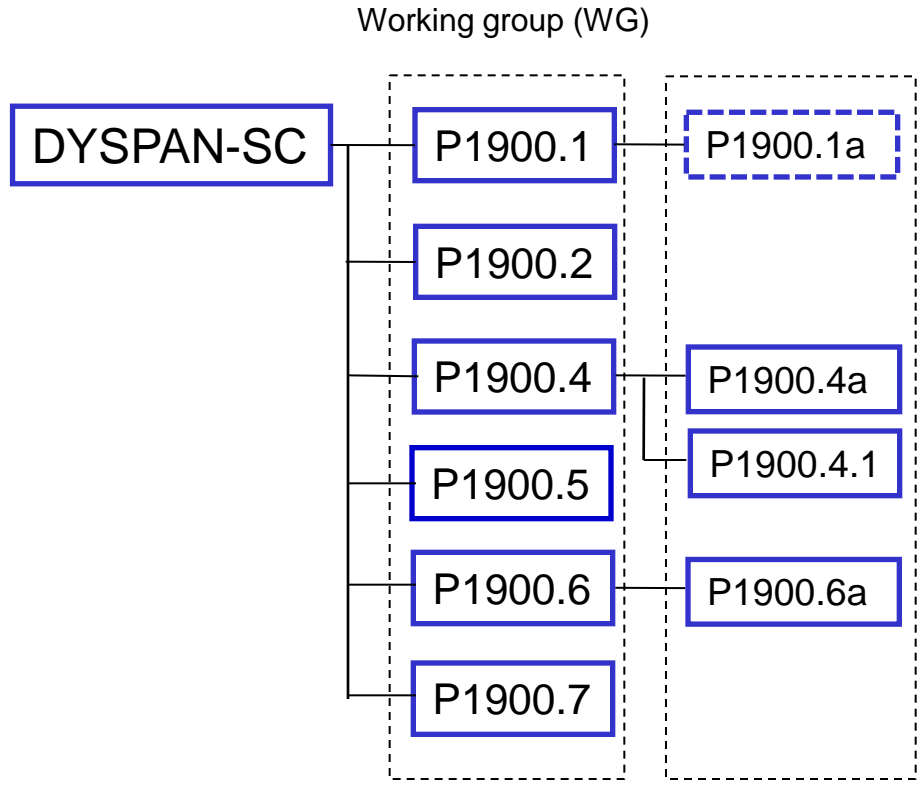
- ▶ The scope of the DySPAN-SC includes the following:
  - dynamic spectrum access radio systems and networks with the focus on improved use of spectrum,
  - new techniques and methods of dynamic spectrum access including the management of radio transmission interference, and
  - coordination of wireless technologies including network management and information sharing amongst networks deploying different wireless technologies.

## ● History

- ▶ The IEEE P1900 Standards Committee, DySPAN-SC's predecessor, was established in the first quarter 2005 jointly by the IEEE Communications Society (ComSoc) and the IEEE Electromagnetic Compatibility (EMC) Society. The objective of the effort was to develop supporting standards dealing with new technologies and techniques being developed for next generation radio and advanced spectrum management.
- ▶ On 22 March 2007, the IEEE Standards Association Standards Board approved the reorganization of the IEEE 1900 effort as Standards Coordinating Committee 41 (SCC41), "Dynamic Spectrum Access Networks (DySPAN)". The IEEE Communications Society and EMC Society were supporting societies for this effort, as they were for the IEEE 1900 effort.
- ▶ IEEE SCC41 was approached by the IEEE ComSoc Standards Board (CSSB) in late 2010, as ComSoc Standards Board was extremely interested in SCC41 being brought back directly under its wing. SCC41 voted to be directly answerable to ComSoc in December 2010, and was thereby renamed as IEEE DySPAN-SC. At its December 2010 Meeting, the IEEE Standards Association Standards Board (SASB) approved the transfer of projects from SCC41 to CSSB.

# IEEE DYSPAN SC Working Groups

- **IEEE 1900.1:** Standard Definitions and Concepts for Spectrum Management and Advanced Radio System Technologies
- **IEEE 1900.2:** Recommended Practice for Interference and Coexistence Analysis
- **IEEE 1900.4:** Standard for Architectural building blocks enabling network-device distributed decision making for optimized radio resource usage in heterogeneous wireless access networks
- **IEEE 1900.5:** Standard on Policy Language and Policy Architectures for Managing Cognitive Radio for Dynamic Spectrum Access Applications
- **IEEE 1900.6:** Standard on interfaces and data structures for exchanging spectrum sensing information for dynamic spectrum access systems
- **IEEE 1900.7:** Standard on radio interface for white space dynamic spectrum access radio systems supporting fixed and mobile operation



# IEEE 1900.1 Standard

IEEE Standard Definitions and Concepts for Dynamic Spectrum Access: Terminology Relating to Emerging Wireless Networks, System Functionality, and Spectrum Management

[Bernd Bochow](#)

IEEE 1900.1 Working Group Chair

[Oliver Holland, PhD](#)

IEEE 1900.1 Working Group Vice-Chair

[Michael Gundlach, PhD](#)

IEEE 1900.1 Working Group Secretary

# 1900.1

- Scope

- ▶ This standard provides definitions and explanations of key concepts in the fields of spectrum management, cognitive radio, policy-defined radio, adaptive radio, software-defined radio, and related technologies. The document goes beyond simple, short definitions by providing amplifying text that explains these terms in the context of the technologies that use them. The document also describes how these technologies interrelate and create new capabilities while at the same time providing mechanisms supportive of new spectrum management paradigms such as dynamic spectrum access.

- Purpose

- ▶ New concepts and technologies are rapidly emerging in the fields of spectrum management, policy-defined radio, adaptive radio, software-defined radio, reconfigurable radio, and networks and related technologies. Many of the terms used do not have precise definitions or have multiple definitions. This document facilitates the development of these technologies by clarifying the terminology and how these technologies relate to each other.

- Status

- ▶ Published in 2008

# 1900.1a

- Title
  - ▶ IEEE Standard Definitions and Concepts for Dynamic Spectrum Access: Terminology Relating to Emerging Wireless Networks, System Functionality, and Spectrum Management Amendment: Addition of New Terms and Associated Definitions
- Scope
  - ▶ This amendment adds new terms and associated definitions to IEEE 1900.1
- Purpose
  - ▶ Due to the rapidly evolving field of dynamic spectrum access (DSA) and related technologies, IEEE 1900.1 does not cover all terms in use as of today. This amendment provides definitions for those missing terms only.
- Status
  - ▶ Preparing for recirculation, publishing should occur late 2012/early 2013.

# IEEE 1900.2 Standard

Recommended Practice for the Analysis of In-Band and Adjacent Band Interference and Coexistence Between Radio Systems

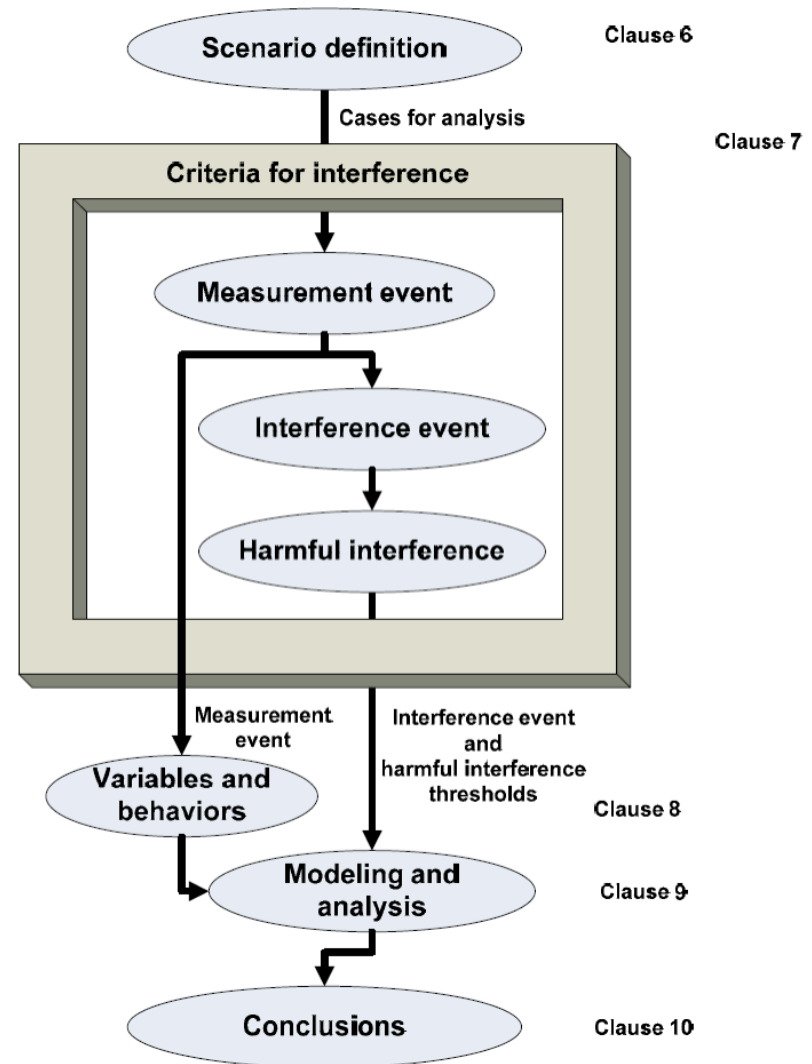
# 1900.2

- Scope
  - ▶ This recommended practice will provide technical guidelines for analyzing the potential for coexistence or in contrast interference between radio systems operating in the same frequency band or between different frequency bands.
- Purpose
  - ▶ New concepts and technologies are rapidly emerging in the fields of spectrum management, policy-defined radio, adaptive radio, and software-defined radio. A primary goal of these initiatives is to improve spectral efficiency. This recommended practice will provide guidance for the analysis of coexistence and interference between various radio services.
- Status
  - ▶ Published in 2008



# 1900.2

- Interference between systems occurs when operation of one system affects the performance of another system. Two or more radio systems successfully coexist when the level of interference is tolerable or generally judged to be within acceptable limits.
- Emerging technologies such as cognitive radio, ad hoc wireless networks, as well as dynamic and adaptive systems, make the interference and coexistence analysis, a challenging task.
- This standard provides recommended practice on the structure for interference and coexistence analysis. Such structure is believed to guide the analyst in considering all relevant issues in a systematic way.
- Furthermore, a standardized structure makes the comparison of different analyses easier. When different analyses utilize a common structure and method of analysis the reasons for similarities or differences in conclusions are more quickly identified.
- The analytical framework adopted in this standard consists of four cascaded, interdependent steps: scenario definition, establishment of interference and coexistence criteria for the recipient system, definition of variables or behaviors used in modeling, and the modeling, measurement or analysis itself.
- The standard also provides guidance on the performance and documentation of each of these steps.



# IEEE 1900.4 Standard

Architectural Building Blocks Enabling Network-Device Distributed Decision Making for Optimized Radio Resource Usage in Heterogeneous Wireless Access Networks.

[Masayuki Ariyoshi, PhD](#)

IEEE 1900.4 Working Group Chair

[Hiroshi Harada, PhD](#)

IEEE 1900.4 Working Group Vice-Chair



# 1900.4

- Scope

- ▶ The standard defines the building blocks comprising (i) network resource managers, (ii) device resource managers, and (iii) the information to be exchanged between the building blocks, for enabling coordinated network-device distributed decision making that will aid in the optimization of radio resource usage, including spectrum access control, in heterogeneous wireless access networks. The standard is limited to the architectural and functional definitions at a first stage. The corresponding protocols definition related to the information exchange will be addressed at a later stage.

- Purpose

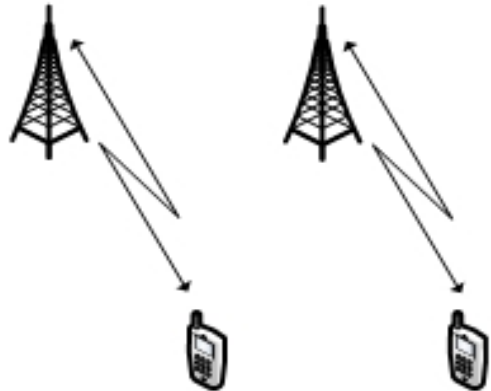
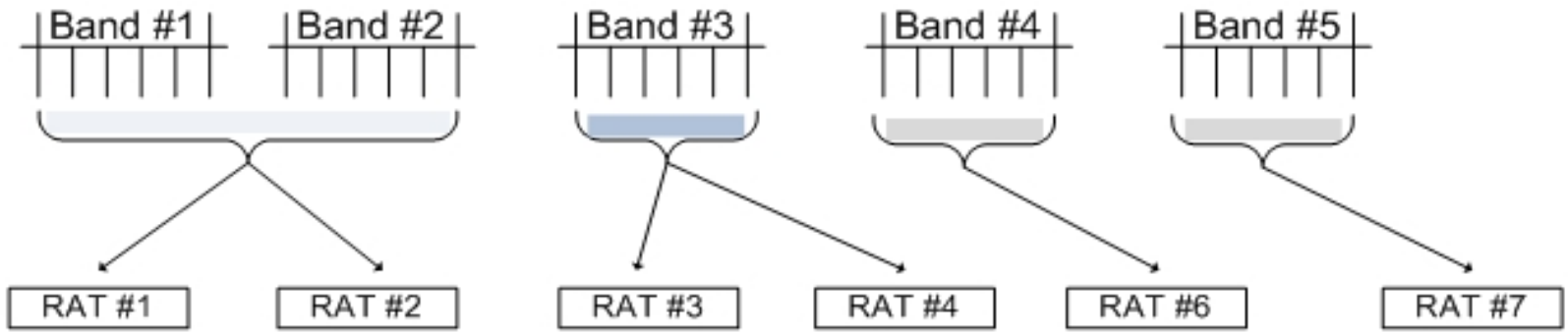
- ▶ The purpose is to improve overall composite capacity and quality of service of wireless systems in a multiple Radio Access Technologies (RATs) environment, by defining an appropriate system architecture and protocols that will facilitate the optimization of radio resource usage, in particular, by exploiting information exchanged between network and mobile Terminals, whether or not they support multiple simultaneous links and dynamic spectrum access.

- Status

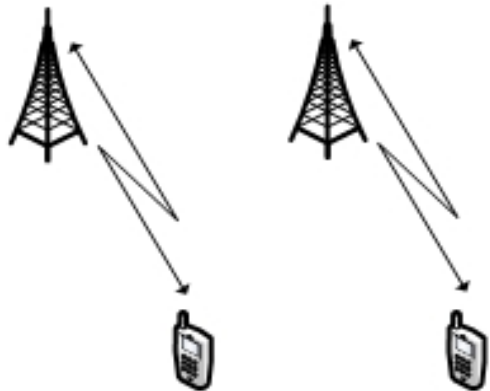
- ▶ Published in 2009

# 1900.4 usage model

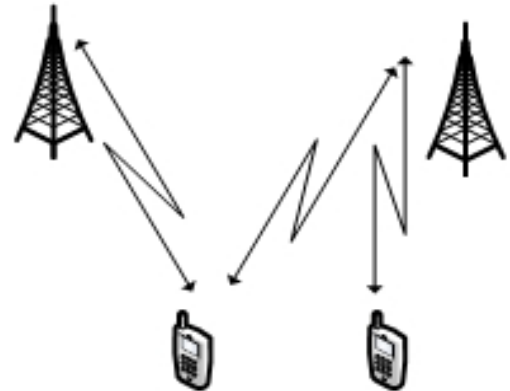
Spectrum



Dynamic spectrum assignment



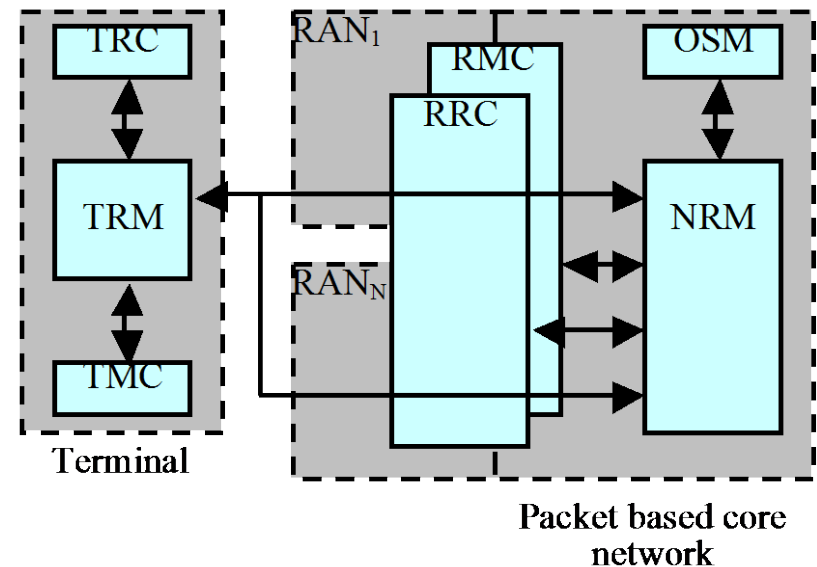
Dynamic spectrum sharing



Distributed radio resource usage optimization

# 1900.4 system architecture

- **TRM** connects with terminal measurement controller (**TMC**) and terminal reconfiguration controller (**TRC**)
  - ▶ **TMC**: the entity that collects terminal-related context information and provides it to TRM
  - ▶ **TRC**: the entity that enables reconfiguration of terminal on the basis of TRM's decision
- **NRM** connects with RAN measurement controller (**RMC**) and RAN reconfiguration controller (**RRC**)
  - ▶ **RMC**: the entity that collects RAN-related context information and provides it to NRM, and may be implemented in a distributed manner.
  - ▶ **RRC**: the entity that enables reconfiguration of RANs on the basis of NRM's decision and may be implemented in a distributed manner



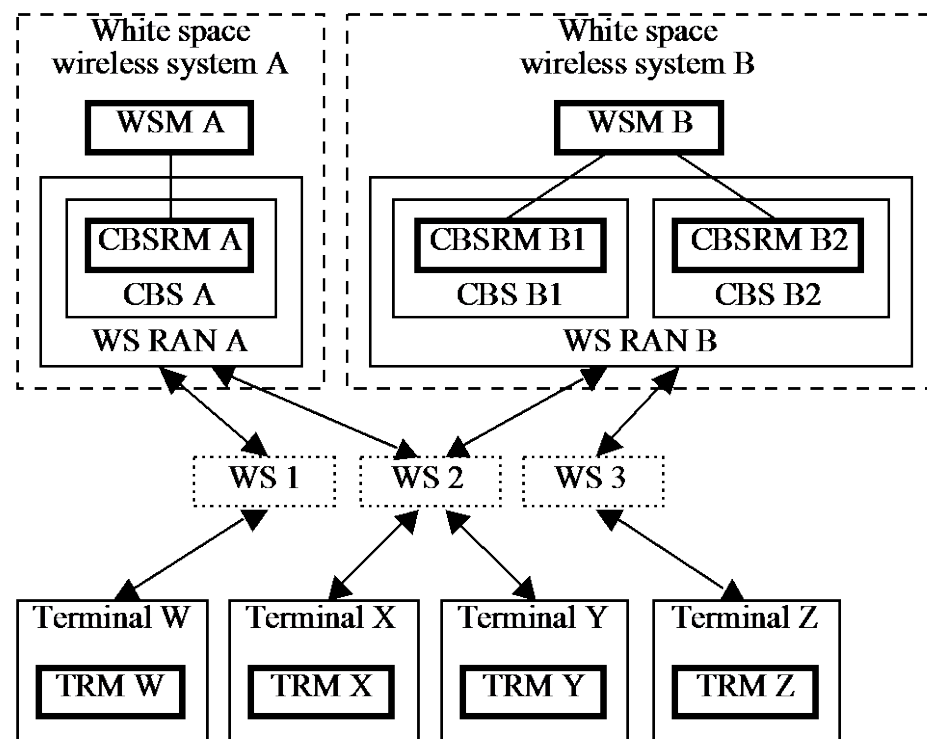
TRC – Terminal Reconfiguration Controller  
TRM – Terminal Reconfiguration Manager  
TMC – Terminal Measurement Collector  
RMC – RAN Measurement Collector  
RRC – RAN Reconfiguration Controller  
OSM – Operator Spectrum Manager  
NRM – Network Reconfiguration Manager  
RAN – radio access network

# 1900.4a (1/2)

- Title
  - ▶ Standard for Architectural Building Blocks Enabling Network-Device Distributed Decision Making for Optimized Radio Resource Usage in Heterogeneous Wireless Access Networks - Amendment: Architecture and Interfaces for Dynamic Spectrum Access Networks in White Space Frequency Bands
- Scope
  - ▶ This standard amends the IEEE 1900.4 standard to enable mobile wireless access service in white space frequency bands without any limitation on used radio interface (physical and media access control layers, carrier frequency, etc) by defining additional components of the IEEE 1900.4 system.
- Purpose
  - ▶ This standard facilitates cost-effective and multi-vendor production of wireless access system, including cognitive base stations and terminals, capable of operation in white space frequency bands without any limitation on used radio interface, as well as, accelerates commercialization of this system to improve spectrum usage..
- Status
  - ▶ Published 2011.

# 1900.4a (2/2)

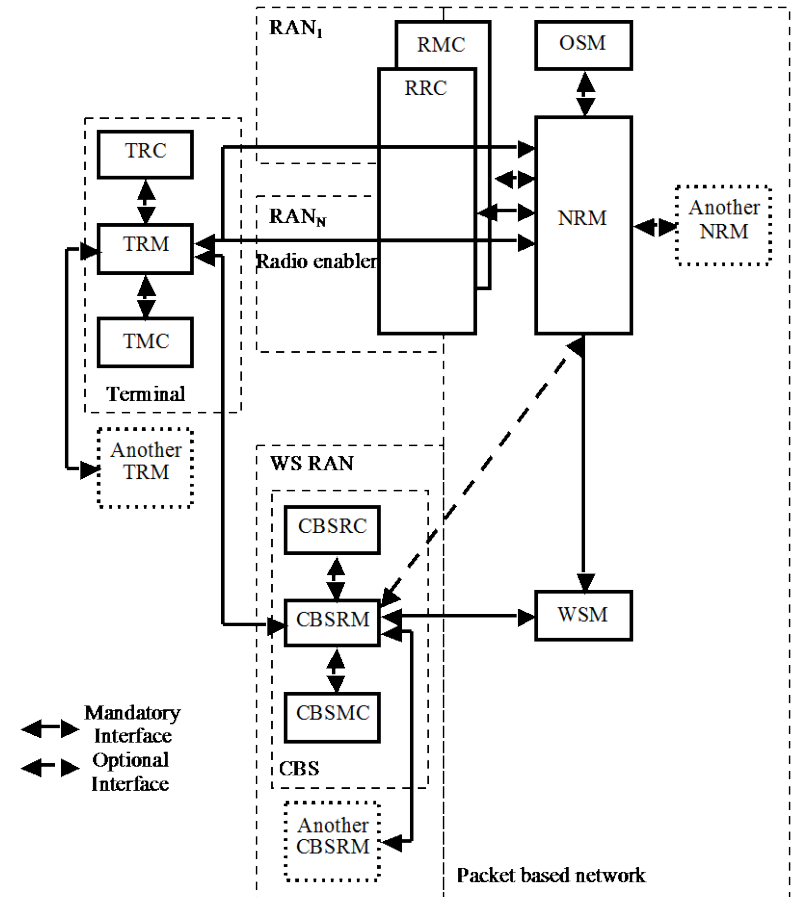
- P1900.4a uses IEEE standard 1900.4 as a baseline. It concentrates on dynamic spectrum sharing use case of IEEE standard 1900.4. P1900.4a defines additional entities and interfaces to enable efficient operation of white space wireless systems.



WSM – White Space Manager  
RAN – Radio Access Network  
CBS – Cognitive Base Station  
CBSRM – CBS Reconfiguration Manager  
TRM – Terminal Reconfiguration Manager  
WS – White Space

# 1900.4a system architecture

- In the architecture defined in P1900.4a, four additional management entities are defined on the network side:
  - the White Space Manager (WSM),
  - the CBS Measurement Collector (CBSMC),
  - the CBS Reconfiguration Manager (CBSRM)
  - the CBS Reconfiguration Controller (CBSRC).
- The White Space Manager (WSM) provides regulatory context information to Cognitive Base Station Manager (CBSRM), and enables communication between CBSRM and white space database.
- The CBSRM manages Cognitive Base Station (CBS) and Terminals for network-terminal distributed optimization of spectrum usage. The key functions of the CBSRM specific to dynamic spectrum access in white space frequency bands are: management of spectrum sensing, e.g., by coordinating silent periods for measurements, classification of white space frequency bands, coordination of white space frequency bands usage with CBSRMs of the same RAN for radio resource management and with CBSRMs of other RANs for coexistence.



RAN – radio access network  
 WS RAN – white space RAN  
 CBS – Cognitive Base Station  
 OSM – Operator Spectrum Manager  
 NRM – Network Reconfiguration Manager  
 TRM – Terminal Reconfiguration Manager  
 CBSRM – CBS Reconfiguration Manager

RMC – RAN Measurement Collector  
 TMC – Terminal Measurement Collector  
 CBSMC – CBS Measurement Collector  
 RRC – RAN Reconfiguration Controller  
 TRC – Terminal Reconfiguration Controller  
 CBSRC – CBS Reconfiguration Controller  
 WSM – White Space Manager



# 1900.4.1

- Title
  - ▶ Standard for Interfaces and Protocols Enabling Distributed Decision Making for Optimized Radio Resource Usage in Heterogeneous Wireless Networks
- Scope
  - ▶ This standard uses the IEEE 1900.4 standard as a baseline standard. It provides detailed description of interfaces and service access points defined in the IEEE 1900.4 standard enabling distributed decision making in heterogeneous wireless networks and obtaining context information for this decision making.
- Purpose
  - ▶ This standard facilitates innovative, cost-effective, and multi-vendor production of network side and terminal side components of IEEE 1900.4 system and accelerates commercialization of this system to improve capacity and quality of service in heterogeneous wireless networks.
- Status
  - ▶ Ongoing
- Overview
  - ▶ P1900.4.1 uses the IEEE standard 1900.4 as a baseline standard. The purpose of P1900.4.1 is to provide detailed description of interfaces and service access points defined in the IEEE standard 1900.4 enabling distributed decision making in heterogeneous wireless networks and obtaining context information for this decision making. Procedures and data models for the IEEE 1900.4 entities are also defined in P1900.4.1.

# IEEE 1900.5 Standard

Standard on Policy Language and Policy Architectures for Managing Cognitive Radio for Dynamic Spectrum Access Applications.

[Lynn Grande](#)

IEEE 1900.5 Working Group Chair

[Yuriy Posherstnik](#)

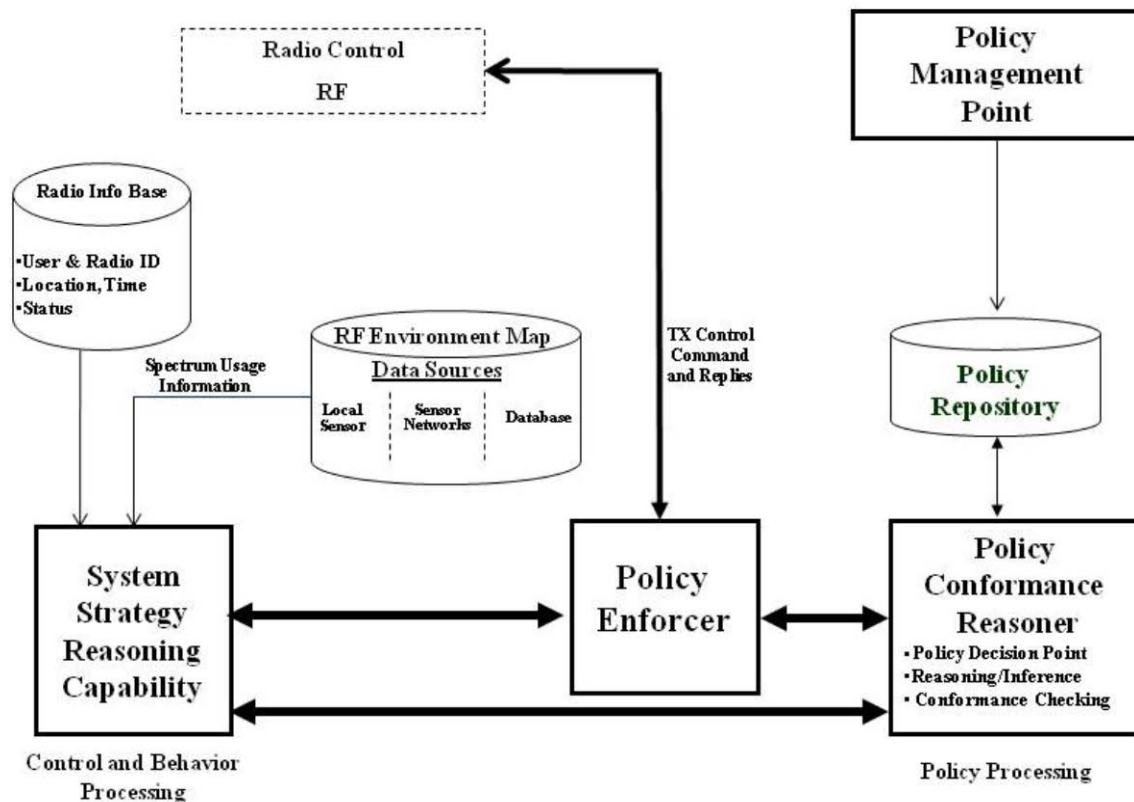
IEEE 1900.5 Working Group Secretary

# 1900.5

- Scope
  - ▶ This standard defines a vendor-independent set of policy-based control architectures and corresponding policy language requirements for managing the functionality and behavior of dynamic spectrum access networks.
- Purpose
  - ▶ The purpose of this standard is to define policy language and associated architecture requirements for interoperable, vendor-independent control of Dynamic Spectrum Access functionality and behavior in radio systems and wireless networks. This standard will also define the relationship of policy language and architecture to the needs of at least the following constituencies: the regulator, the operator, the user, and the network equipment manufacturer.
- Status
  - ▶ Published January 2012.

# 1900.5

- This standard specifies policy language (PL) requirements and policy architecture (s) for policy-based dynamic spectrum access (DSA) radio systems. In this standard, a distinction is made between the policy reasoning that is accomplished within the Policy Based Radio (PBR) node and policy generation and validation that is accomplished through a policy generation system prior to provision of the policy to the PBR node. Policy reasoning may be distributed, i.e., it may take place either within a PBR node or in other elements of a policy based radio communications network.



# 1900.5.1

- Title
  - ▶ Standard Policy Language for Dynamic Spectrum Access Systems.
  
- Scope
  - ▶ This standard defines a vendor-independent policy language for managing the functionality and behavior of dynamic spectrum access networks based on the language requirements defined in the IEEE 1900.5 standard. The standard developed under this PAR will take into consideration both the Policy Language Requirements of IEEE 1900.5 and the results of the Modeling Language for Mobility Work Group (MLM-WG) within the Wireless Innovation Forum (SDRF v2) Committee on Advanced Wireless Networking and Infrastructure. MLM-WG is developing use cases, an ontology, corresponding signaling plan, requirements and technical analysis of the information exchanges that enable next generation communications features such as spectrum awareness and dynamic spectrum adaptation, waveform optimization, capabilities, feature exchanges, and advanced applications. The MLM-WG expects this effort to lead to specifications/standards for languages and data exchange structures to support these capabilities..
  
- Status
  - ▶ Ongoing
  - ▶ Discussing PAR modification to define a policy ontology for DSA systems and identify a policy language that supports the ontology.
  - ▶ Discussing where Model-Based Spectrum Management (Stine, Schmitz 2011) work fits into the policy management area of the 1900.5 architecture.
  - ▶ Working Group had face to face meeting prior to ISART conference here in Boulder.

# IEEE 1900.6 Standard

Spectrum Sensing Interfaces and Data Structures for Dynamic Spectrum Access and other Advanced Radio Communication Systems.

[Michael Gundlach, PhD](#)

IEEE 1900.6 Working Group Chair

[Ha Nguyen Tran, PhD](#)

IEEE 1900.6 Working Group Secretary

# 1900.6

- Scope

- ▶ The intended standard defines the information exchange between spectrum sensors and their clients in radio communication systems. The logical interface and supporting data structures used for information exchange are defined abstractly without constraining the sensing technology, client design, or data link between sensor and client.

- Purpose

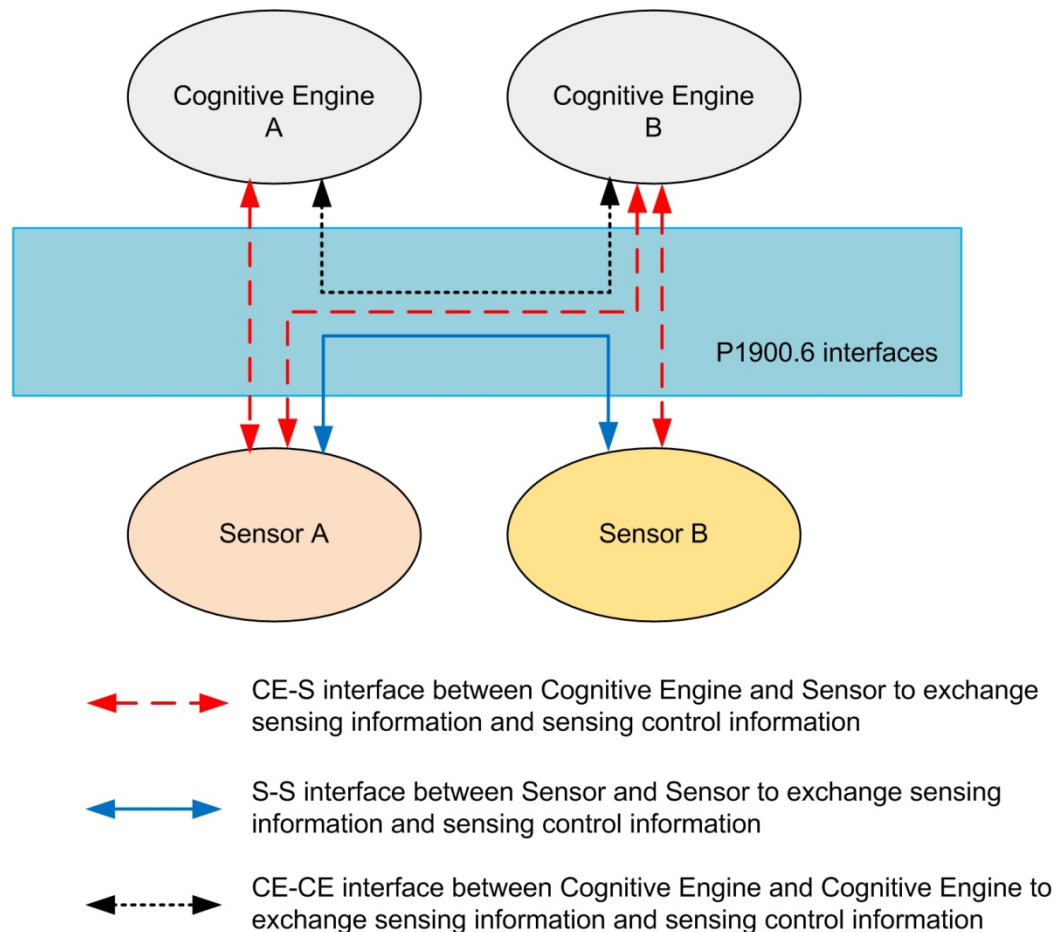
- ▶ The purpose of this standard is to define spectrum sensing interfaces and data structures for dynamic spectrum access (DSA) and other advanced radio communications systems that will facilitate interoperability between independently developed devices and thus allow for separate evolution of spectrum sensors and other system functions.

- Status

- ▶ Published in 2011

# 1900.6 Interfaces

- The background of this standard is the need to alleviate the limitations of spectrum availability for new technologies and evolution of the regulatory regimes. Changes to the regulatory environment will require reliable dependable trusted spectrum sensing capabilities that are fundamental to any advanced radio systems application, this standard will facilitate the provision and exchange of such information.
- The standard has been published on April 22nd 2011, it provides a formal definition of the data structures and interfaces (see Figure above) for exchange of sensing related information between sensors and users of sensing information (client/cognitive engines).





# 1900.6a

- Title
  - ▶ Standard for Spectrum Sensing Interfaces and Data Structures for Dynamic Spectrum Access and other Advanced Radio – Amendment: Procedures, Protocols and Data Archive Enhanced Interfaces.
  
- Scope
  - ▶ This Amendment to the IEEE Std 1900.6™ adds procedures, protocols and message format specifications for the exchange of sensing related data, control data and configuration data between spectrum sensors and their clients. In addition, it adds specifications for the exchange of sensing related and other relevant data and specifies related interfaces between the data archive and other data sources.
  
- Purpose
  - ▶ This amendment provides specifications to allow integrating 1900.6 based distributed sensing systems into existing and future dynamic spectrum access radio communication systems. It enables existing legacy systems to benefit so as to widen the potential adoption of the IEEE 1900.6 interface as an add-on to these systems and to claim standard conformance for an implementation of the interface. In addition it facilitates sharing of spectrum sensing data and other relevant data among 1900.6 based entities and external data archives.
  
- Status
  - ▶ Ongoing
  - ▶ Work plan and schedule modified to reach milestone of submission of 1900.6a to RevCom in October 2013

# IEEE 1900.7 Standard

Standard on radio interface for white space dynamic spectrum access radio systems supporting fixed and mobile operation.

[Filin Stanislav, PhD](#)

IEEE 1900.7 Working Group Chair

[Oliver Holland, PhD](#)

IEEE 1900.7 Working Group Vice-Chair

[Muhammad Zeeshan Shakir, PhD](#)

IEEE 1900.7 Working Group Secretary

# 1900.7

- Scope
  - ▶ This standard specifies a radio interface including medium access control (MAC) sublayer(s) and physical (PHY) layer(s) of white space dynamic spectrum access radio systems supporting fixed and mobile operation in white space frequency bands, while avoiding causing harmful interference to incumbent users in these frequency bands. The standard provides means to support P1900.4a for white space management and P1900.6 to obtain and exchange sensing related information (spectrum sensing and geolocation information).
- 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 on a non-interfering basis to incumbent users in these 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. This standard is a baseline standard for a family of other standards that are expected to be developed focusing on particular applications, regulatory domains, etc.
- Status
  - ▶ Project was approved on June 16 by IEEE SASB

# Future plan

- Meeting (Plenary)
  - ▶ [P1900.5] 23-24 July 2012, in conjunction with ISART, Boulder, CO
  - ▶ [P1900.4] 3 August 2012, Yokohama, Japan
  - ▶ [P1900.6 / P1900.7] Week of 8-12 October, 2012, Beijing, China
  - ▶ [DySPAN-SC] 7-10 January 2013, Washington, DC, USA
- For more information
  - ▶ Website <http://www.dyspan-sc.org/>