IEEE 1900.6b: Sensing Support for Spectrum Databases

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IEEE C SCN 2015, Tokyo, Japan, 30 October 2015
Note: This is not an official presentation of IEEE-SA or IEEE 1900.6
Background: IEEE 1900.6
IEEE 1900.6

- IEEE 1900.6 Working Group on “Spectrum Sensing Interfaces and Data Structures for Dynamic Spectrum Access and other Advanced Radio Communication Systems”

- The baseline standard of the IEEE 1900.6 Working Group, IEEE 1900.6-2011, was published in April 2011. It can be obtained at: http://standards.ieee.org/findstds/standard/1900.6-2011.html

- The first amendment standard for IEEE 1900.6-2011, IEEE 1900.6a-2014 on the topic of "Procedures, Protocols and Data Archive Enhanced Interfaces", was published in June 2014. It can be obtained at: http://standards.ieee.org/findstds/standard/1900.6a-2014.html

- Since August 2014, IEEE 1900.6 has been working on a new project:
1900.6 Work
Baseline standard

IEEE Standard for Spectrum Sensing Interfaces and Data Structures for Dynamic Spectrum Access and Other Advanced Radio Communication Systems

Sponsor: IEEE Standards Coordinating Committee 41 (now IEEE DySPAN Standards Committee)
Published in April 2011

Key aspects
• System model: Definition of entities and interfaces involved in spectrum sensing and use of sensing information; relationships between the entities and interfaces to satisfy use cases
• Reference model: Interactions of interfaces with defined entities, e.g., service primitives in definition of service access points
• Information model: Information types and data structures to exchange sensing-related information and configurations between entities, also encompassing instructions
• State diagram and generic procedures
• A range of “informative” content, e.g., on use cases, use case analysis
Interfaces – Scope of the P1900.6 standard

The client role can be taken by Cognitive Engine, Sensor, and Data Archive

- **CE/DA-S** interface between cognitive engine or data archive and sensor to exchange sensing information and sensing control information.
- **S-S** interface between sensor and sensor to exchange sensing information and sensing control information.
- **CE-CE/DA** interface between cognitive engine and cognitive engine or data archive to exchange sensing information and sensing control information.
Technical aspects of the IEEE 1900.6-2011 standard

Distributed sensing

(a) Cooperative sensing, (b) Collaborative sensing, and (c) Selective sensing
1900.6 Work
1900.6a Amendment

IEEE Standard for Spectrum Sensing Interfaces and Data Structures for Dynamic Spectrum Access and other Advanced Radio – Amendment: Procedures, Protocols and Data Archive Enhanced Interfaces

Sponsor: IEEE Standards Coordinating Committee 41 (now IEEE DySPAN-SC)
Published in June 2014

- 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.
Current Work: IEEE (P)1900.6b

- Timescale: Initiated in August 2014, anticipated completion (start of voting on the standard) at the latest June 2017
- On the topic of the use of spectrum sensing information to support spectrum databases
- Encompasses, e.g., geolocation (or similar) databases that are currently a key area of work in, among other areas,
  - TV white spaces
  - Under the FCC’s 3.5GHz three-tier small cells proposal
  - Under a number of implementations/trials of the Licensed Shared Access concept
- Aim of this standard is to enhance the performance and capabilities of spectrum databases through the use of spectrum sensing information
IEEE (P)1900.6b
(so far... )
Scenarios

- Interfacing a spectrum database with distributed spectrum sensing system potentially operated by some third party

- Seamless integration of a spectrum sensing sub-system and a spectrum database
Use Cases

• Case A: database controls spectrum sensors

• Case B: database utilizes decision capacities of the spectrum sensing
Use Cases

- Case C: database utilizing spectrum sensing with local decision capacities and actively providing sensing related information (e.g. regulatory information) through a IEEE 1900.6 DA entity
Why Do We Need 1900.6b?

- TV White Spaces
  - Key test scenario for the secondary reuse of locally unused spectrum by “white space devices”
  - Example from UK case: Large pilot of TV White Spaces technology for approx 1.5 years now, run by the UK regulator Ofcom; one key aspect has been issues such as “are the parameters of the framework correct”
  - Through such a sensing solution, much of the process could have been automated and sped up
    - Also seems likely that will continue after the commercial deployment of the white space devices starts at the end of 2015 (current estimate)
- Other uses
  - Assist in development of the path loss models and characteristics that the TVWS framework assumes—potentially make more white space available
  - Verify interference calculations assumed by the framework, or flag any errors with them – e.g., aggregate interference
  - Help detect malicious, malfunctioning or poorly configured white space devices
Why Do We Need 1900.6b?

• Licensed shared access scenarios
  – Might assist the calculation of where/when the spectrum might be reused by another operator
  – In case of mobile communications deployments in particular, spectrum sensing performances might even be standardized, e.g., for mobile devices that are able to perform sensing as they travel to different locations
  – Will assist in reliably optimizing propagation models assumed for such purposes, monitoring of interference effects (note also interference aggregation uncertainty), among many other benefits

• Self-organising networks and network optimisation
  – Similarly to the case of LSA-type spectrum sharing
  – Sensing might be used for the case of SONs, e.g., to better parameterize frequency reuse calculations
Why Do We Need 1900.6b?

• **High-Altitude Platforms**
  – May in many cases be sharing spectrum
    • Existing terrestrial or satellite wireless communications systems
    • Lower frequency uses?
    • Even perhaps other higher-frequency usages, such as the ITU standardised 28/31 GHz and 47/48 GHz—mm-wave in 5G?
  – Noted that high-altitude platforms can be locus of all of the elements defined/considered in 1900.6b (although will often need sensing support on the ground), with generally good chance of access being maintained to mobile devices given their location
  – Hence might serve not only HAP participating in spectrum sharing, but also cases where the 1900.6b systems is deployed in mobile communications in general
Why Do We Need 1900.6b?

- **Industrial wireless**
  - Major trend that will utilize more and more wireless/mobile communications systems in industrial applications
  - Highly demanding due to the nature of the data exchanged: potentially mission and safety critical process control data
  - Requires robust, low latency, reliable and highly available wireless links in interference-prone industrial environments as well as coexistence and interoperability with consumer equipment
Why Do We Need 1900.6b?

• General Cellular Spectrum Usage and Aggregation Coordination
  – Noted that spectrum databases can also be used for coordination purposes, e.g., among the “secondary” users, among users under a given entity’s control (e.g., an operator), or among whichever other forms of users or radios the spectrum databases are serving
  – Future 5G operator’s context, will be range of potential spectrum opportunities and different types of systems using those spectrum opportunities, and significant dynamicity thereof; centralised/coordinated system of spectrum management is necessary in order to manage such usage
  – Need to carefully consider aggregation of resources in such cases: which resources should be (and technical capabilities indicate can be) used when and where to satisfy traffic demand
  – Sensing supports far better decisions on resource usage choices in such cases
Proof Spectrum Databases Could Do Better Through Spectrum Sensing Information

- TV white spaces case, Ofcom (UK) pilot example (again)
- Taking case at King’s College London Strand Campus
- Only 3 channels (24 MHz) can be used by a Class 3 white space device according to the database, all with reduced power (typically 31 dBm, although depends on height above ground level), due to vast PMSE usage (e.g., theatres) nearby
  - Database is vastly over-conservative in many cases, e.g., doesn’t take into account indoor uses that will cause little or no interference to outdoor
- Shown in the paper that, sensing in a given room with a very high sensitivity spectrum analyser, that it is possible to use at least ten times that white space through sensing (240 MHz)
- Also allowing for 10 dB extra protection, e.g., due to unknown channel to PMSE receiver location (only the transmitters visible through sensing!)
Proof Spectrum Databases Could Do Better Through Spectrum Sensing Information

-155 dBm/Hz sensitivity spectrum analyser max hold, for 28 hour duration covering busy (theatre) Saturday night, Strand Campus room
IEEE (P)1900.6b
(time plan and participation)
IEEE 1900.6b Time Plan

1. Consideration of Use Cases for the standard. Finalisation of changes that are necessary to the IEEE 1900.6 System Model (Section 4). Additional entities added, changes to interfaces between them, etc.

June 2015
Second phone conference after July 2015 (Berlin face-to-face meeting)

2. Finalisation of changes that are necessary to the high-level description of the IEEE 1900.6 Reference Model, i.e., up to and including Section 5.2. Start of work on detailed description (Section 5.3).

November/December 2015

3. Completion of work on detailed description of Reference Model (Section 5.3). Start of work on Information Description and State Diagram/procedures (Sections 6/7). Creation of SED and beginning of merging inputs to that.

March 2016

4. Continuation of work on Information Description and State Diagram/Procedures (Sections 6/7). Implementation of all new content up to and including Section 5 in SED.
IEEE 1900.6b Time Plan

5. Finalisation of work on Sections 6/7. Completion of SED integrating all new content. Letter Ballot on submission for Sponsor Ballot.  


7. Recirculation Sponsor Ballot.  


July/August 2016
Late 2016
Early 2017
Early-Mid 2017
Participation in IEEE 1900.6

- Can attend to monitor, even without having voting membership
- Voting membership
  - Gained by attending two consecutive face-to-face meetings (face-to-face or phone conference) and requesting membership
    - Attendance credit if you attend at least 50% of the meeting
  - Maintaining voting membership that requires at least one in any two consecutive meetings is attended, and that at least one in any two consecutive letter ballots is
- To mark your interest in 1900.6b and join the mailing list for IEEE 1900.6, go to https://development.standards.ieee.org and sign in to “myProject” with your IEEE credentials, click on “Manage Activity Profile”, search “1900.6”, tick the Working Group “COM/DySPAN-SC/DYSPAN-P1900.6” as well as the Project “COM/DySPAN-SC/DYSPAN-P1900.6/1900.6b”, then click “Continue” and follow the further prompted steps to complete your selection
- Or email me (oliver.holland@kcl.ac.uk)
Thank you! Questions?

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IEEE 1900.6 Chair