Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Detailed scope of IEEE 802.16h**
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Re:	Call for Contributions, IEEE 802.16h Task Group on License-Exempt Coexistence, 2004-12-17, IEEE 802.16h-05/01
Abstract	Elements and comments on the 802.16h detailed scope
Purpose	Discuss the document and clarify the 802.16h opinion, to be used in further work.
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Detailed scope of IEEE 802.16h

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Introduction

This document presents and discusses the detailed Scope of the 802.16h work.
Shared Radio Resource includes the radio channels, scheduling, S/(I+N), power control to be optimally used by different systems in LE operation.

Mandate of 802.16h

The official mandate of 802.16h is included in the PAR Title and Scope.

The PAR Title:

Amendment to IEEE Standard for Local and Metropolitan Area Networks - Part 16: Air Interface for Fixed Broadband Wireless Access Systems - Improved Coexistence Mechanisms for License-Exempt Operation.

The 802.16h mandate is described in the PAR scope:

"This amendment 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."

Note that the LE operation is not limited to LE bands, but may take place in Licensed bands as well, for specific cases that a operation of a system is licensed-exempt.

Coexistence problems identified in 802.16 LE SG and Ad-Hoc

The activity in LE Ad-Hoc and 802.16 SG on LE coexistence identified the following interference cases:

- BS to BS
- ST to BS
- BS to ST
- ST to ST
- BS and ST to Primary Services.

Detailed Scope of 802.16h:

Interference victims and sources

- Identification of the interference situations
  - Interferer identification
    - Self-declaration
      - *Discussion*: Generally the victims are also sources of interference, if the units use similar eirp power levels and have similar receive antennae
      - Creating a frame for general identification
        - Avoid overloading
          - *Discussion*: should be identified only the interference sources, otherwise the needed resources may be exaggerated; Base Stations should identify them-self in any case; STs should identify them-selves if they hear another system
  - Non-Interferer identification / self-identification
    - *Discussion*: according to the existing literature sources, it is important to determine groups of units (e.g. AP, STs) that do NOT interfere with each other. The activity of these units may be scheduled in parallel, when using different frequency channels.
- Identification of primary users
  - The cognitive properties of these users, like radars, are defined in regulations
  - Messages to disseminate the information
    - *Discussion*: the STs should transmit to BS the information regarding a detected Radar
  - Avoid false-identification situations
    - *Discussion*: Bursty traffic may be interpreted as Radar presence.

Interference avoidance

- Dynamic Channel Selection – DCS
  - For inter-system coexistence
    - *Discussion*: the channel switching policy may be different for Radars avoidance and co-existence; a different naming is needed for co-existence
- Dynamic Frequency Selection - DFS
  - For coexistence with target Primary Services (Radars)
- Pro-active cognitive approach
  - Announce when a system/unit transmits and receives
    - *Discussion*: another system will try avoiding interfering or be interfered; this approach will be useful for providing coexistence between different 802.16 PHY modes (as OFDM, OFDMA, SC) or between 802.16 and other spectrum users.

Transmission of information

- Using dedicated messages
  - Between AP and ST
    - Report like messages
      - *Discussion*: to inform the BS about interference levels, their distribution in time, existence of primary users
    - Action request like messages
      - *Discussion*: to request channel switching
  - Between different APs
    - *Discussion*: to inform the BS about interference levels, their distribution in time, existence of primary users, traffic targets.
    - *Problem*: AP will generally have to associate with another Base station and for doing this, to hop between the two or more frequency channels; will be easier if ST will be used for relaying messages; the ST will use similar procedures with those defined for hand-over.
- Using a common MIB
    - *Discussion:* a common MIB approach is easy to use, as most of 802.16e systems will be manageable. A system may have 2 management addresses, access rights and security features(security of internal management): one for intra-system management and one for inter-system Shared Radio Resource management.
  - A system may make available its channel number, scheduling, transmitted power info, traffic targets to other systems
    - *Discussion*: based on this information, other systems may identify the interference sources and ask for a different Shared Radio Resource allocation.
  - A system should know the Network Management address of other systems
      - *Discussion*: to communicate.
    - Should be transmitted in a PHY independent mode
      - *Discussion*: to address inter-802.16 PHY modes (OFDM,OFDMA,SC) transmission; messages that can be translated in simple PHY properties may be used by each one of the PHY modes.
  - A system can host the common MIB info for systems that work in an Ad-hoc mode
    - *Discussion*: systems working in Ad-Hoc mode may not implement the MIBs standards and Network Management functionality.
  - A system should be able to receive requests from other systems, regarding the operating channel, scheduling, etc.
    - *Discussion*: to adapt its Shared Radio Resource usage.

Common policies

- How to select a " free" channel (for DCS and DFS)

  - Acceptable S/(N+I)
  - Acceptable time occupancy
  - Capability of systems sharing the spectrum to implement a Shared Radio Resource policy
  - No free channels may exist; what should be done.
    - *Discussion*: nobody has rights, in LE operation, to own frequency channels; the meaning of a "free" channel is not obvious and may change in the context of a general Shared Radio Resource.

- Interference reduction policies:
  - BS synchronization
    - *Discussion:* the Tx/Rx synchronization will transform TDD systems in FDD-like systems, avoiding BS-BS and SS-to-SS interference.
    - GPS
      - *Discussion*: to implement a general synchronization policy, with the condition that BSs have a GPS receiver.
    - Ad-hoc
      - *Discussion*: to allow that systems will synchronize one to each other, without implementing GPS receiver or being mounted with visibility to GPS Satellites.
  - Shared Radio Resource Management
    - Define the "fairness" criteria
      - *Discussion*: in order to have a fair resource sharing, a collection of rules and criteria should be defined
    - Distributed scheduling to avoid interference
      - *Discussion*: scheduling is one of the used tools for RRM in existing cellular systems; however, the used algorithms imply a central scheduling approach, not suitable to a shared RRM approach.
    - Distributed power control
      - *Discussion*: distributed power control algorithms are already used for RRM in existing cellular systems.
  - Connection sponsorship
    - *Discussion*: a system may prefer to handle another's system user, instead to suffer from its interference. This is the case of ST working in the vicinity of another BS.