Possible Coexistence Cases in TVWS and Topics to be Considered in P802.19.1

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Abstract

This presentation describes some possible scenarios where various co-located heterogeneous or independently operated systems try to operate in the TVWS bands and hence coexistence becomes necessary.

Some possible solution approaches for the coexistence problem are discussed and topics to be considered in 802.19.1 are listed.
Coexistence of Homogenous Systems (802)

• *Seems to be no problem, since*

• **P802.22**
  – Self coexistence is supported by
    • Self-coexistence window in each frame for network discovery
    • Spectrum etiquette
    • Coexistence beacon protocol (CBP)
    • On demand frame contention (ODFC)

• **802.16h**
  – Self coexistence supported by
    • Dynamic channel selection
    • Coexistence control channel and sub-channel
    • Coexistence frame containing master, slave and shared sub-frames
    • Few protocols

• **P802.11af**
  – Self coexistence would be supported by
    • CSMA/CA
Coexistence of Heterogeneous Systems

• *Should be the main focus*
• The coexisting method that will be the most effective depends on the technologies used by the heterogeneous systems
• Basic requirement includes *Event Triggering* such as recognizing that coexistence is necessary at any instance
• *Exchange of information* is needed among the systems that may be achieved by any one or more than one of the following options
  – Messaging
  – Accessing database
  – Coexistence controller/manager
  – Beacon based information exchange
  – Coexistence/Cognitive pilot channel etc.
  – Others
• Based on the exchanged information, *decision making* is necessary on how to proceed for coexistence
Coexistence Scenario and Solution – Example I

- Consider Sys 1 and Sys 2 are already there and Sys 3 wishes to start.
- Understanding the presence of Sys 1 and Sys 2 helps the newcomer system Sys 3 to decide if any un-coordinated and hence simpler method can be applied for coexistence. For instance, if there is no open channel and if Sys 3 can manage to operate with reduced power not to interfere with the nearby systems, it need not request for resource sharing to the nearby systems.
Coexistence Scenario and Solution – Example II

- Consider a case where the previous solution doesn’t apply:
  - Sys 1 has a large coverage. Sys 2 has most of its coverage area overlapped with Sys 1 coverage. Sys 3 coverage is contained within the coverage area of Sys 1.

- In such a case,
  - if less than 2 channels are available or if there are no 2 different channels available that Sys 1, 2, 3 support/can operate in, we either need channel sharing or we need time domain solution.
Coexistence Scenario and Solution – Example III

- Consider another case where the previous solution doesn’t apply:
  - Sys 1 has a large coverage. Sys 21…Sys 2X have smaller cellular coverage. Many overlaps.

- In such a case,
  - Frequency reuse might have been implemented by the cellular WMANs. Hence, the probability that at least some WMAN cells use the same frequency as the WRAN is high.
  - Time/frequency domain resource sharing may be necessary among a large number of systems/networks

WRAN-Cellular WMAN case
Frame Share Between 802.22 and 802.16h

- **Coexistence of 802.22 and 802.16h**
  - 802.16h uses 5 us frame and 802.22 uses 10 us frame.
  - Both are synchronized to GPS or IEEE 1588
  - Both support quiet period

- **Coexistence**
  - They exchange their synchronization information
  - They exchange intent for coexistence by frame sharing
  - 802.22 may release one frame to accommodate 2 frames of 802.16h
  - Quiet periods still can be there
  - One can become the Leader to have more privileges to decide
TDM Between (802.22 and 802.11af) or (802.16h and 802.11af)

- Both 802.22 and 802.16h systems can schedule themselves to be quiet for some time
- This opens the opportunity for TDM based coexistence with other systems, such as 802.11af
- Quiet period for incumbent sensing can still be used
TDM/FDM Between (802.22 and 802.16h) or (802.22 and 802.11af) or (802.16h and 802.11af)
Topics to be Considered in 802.19.1

- **Media independent coexistence**
  - Easy to implement requiring minimum modification in existing systems

- **Methods to facilitate coexistence**
  - Need to decide the direction
  - A unified approach will be better

- **Protocols in support of the methods**

- **Recommended modifications in existing systems**
  - Service access points (SAP) and primitives
  - Possibly no PHY/MAC modifications

- **Algorithms for coexistence**
  - Varieties corresponding to the methods, to facilitate various coexistence scenarios
References

- IEEE 802.21 standard
- IEEE P802.16h v10
- IEEE P802.22 draft v2