

# 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)

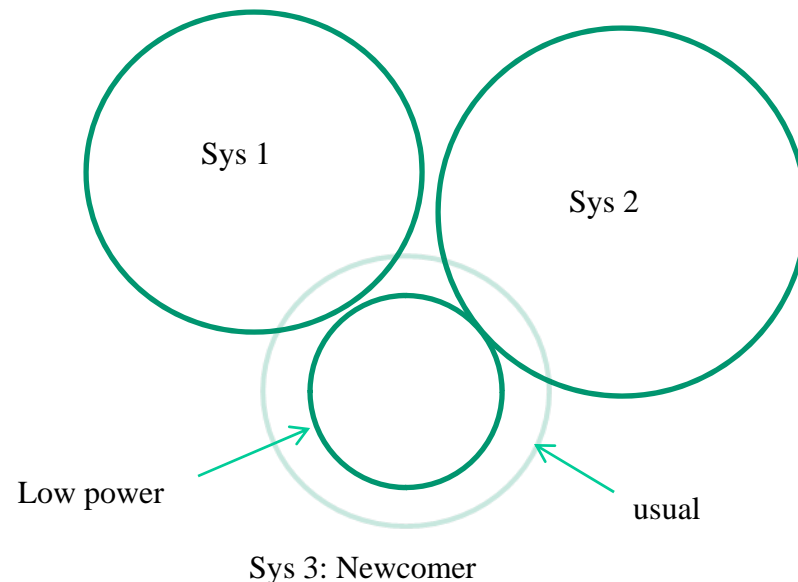
- *Seems to be no problem, since*
- **P802.22**
  - Self coexistence is supported by
    - Self-coexistence window in each frame for network discovery
    - Spectrum etiquette
    - Coexistence beacon protocol (CBP)
    - On demand frame contention (ODFC)
- **802.16h**
  - Self coexistence supported 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

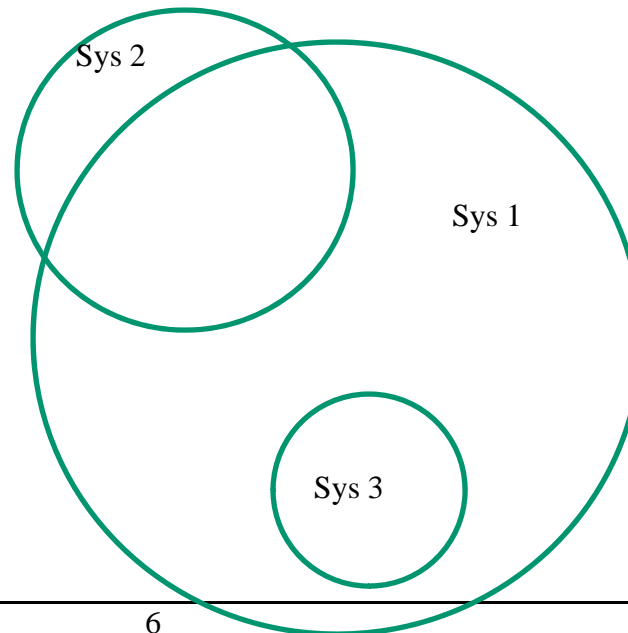
- Consider Sys 1 and Sys 2 are already there and Sys 3 wishes to start
- Understanding the presence of Sys 1 and Sys2 helps the newcomer system Sys 3 to decide if any un-coordinated and hence simpler method can be applied for coexistence. For instance, if there is no open channel and if Sys 3 can manage to operate with reduced power not to interfere with the nearby systems, it need not request for resource sharing to the nearby systems.



WRAN-WRAN  
Or, WMAN-WMAN  
Or, WLAN-WLAN case

# 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.

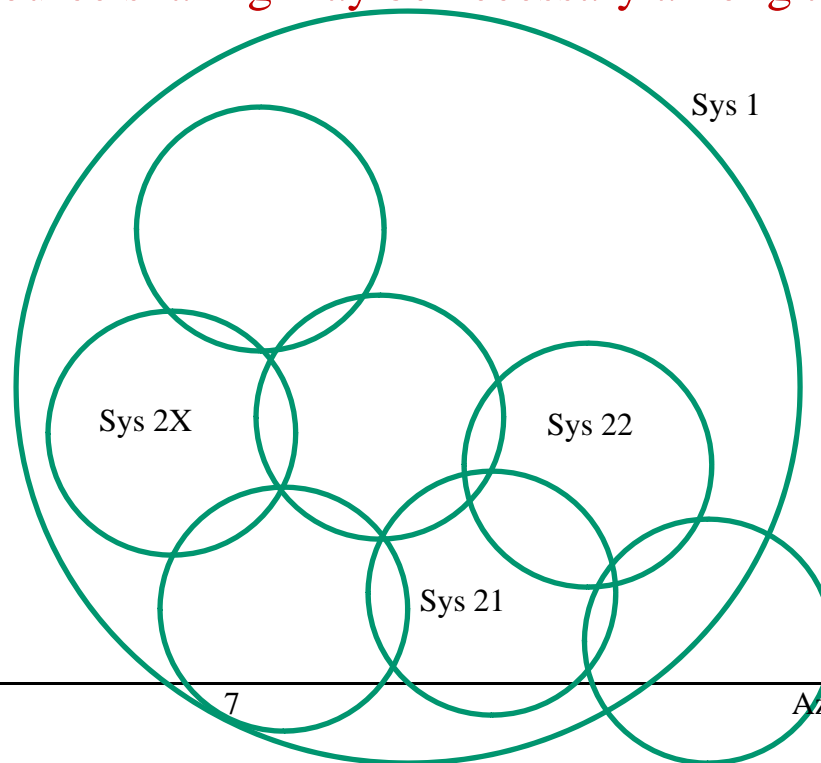


WRAN-WMAN-WLAN Case Or  
WMAN-WLAN-WPAN case

# 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



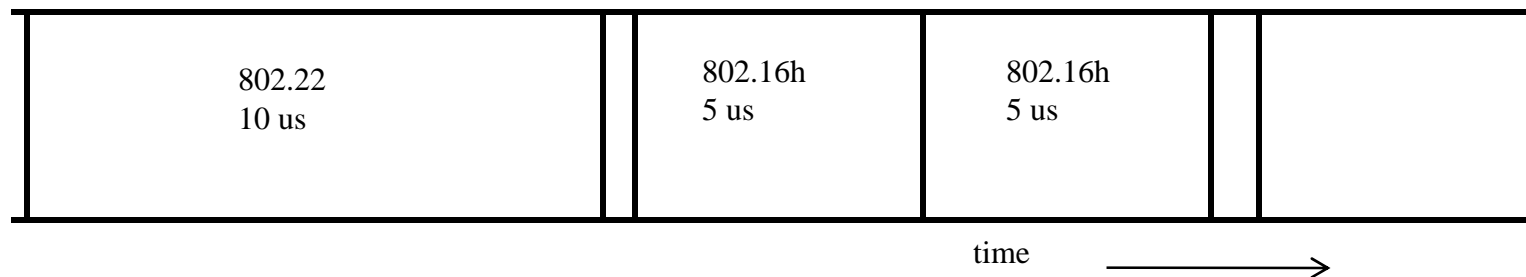
# Frame Share Between 802.22 and 802.16h

- **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**

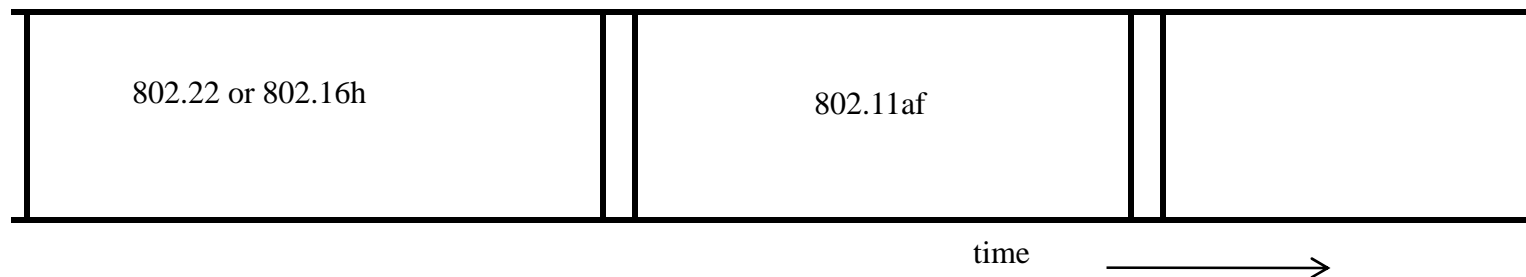
- They exchange their synchronization information
- They exchange intent for coexistence by frame sharing
- 802.22 may release one frame to accommodate 2 frames of 802.16h
- Quiet periods still can be there
- One can become the Leader to have more privileges to decide



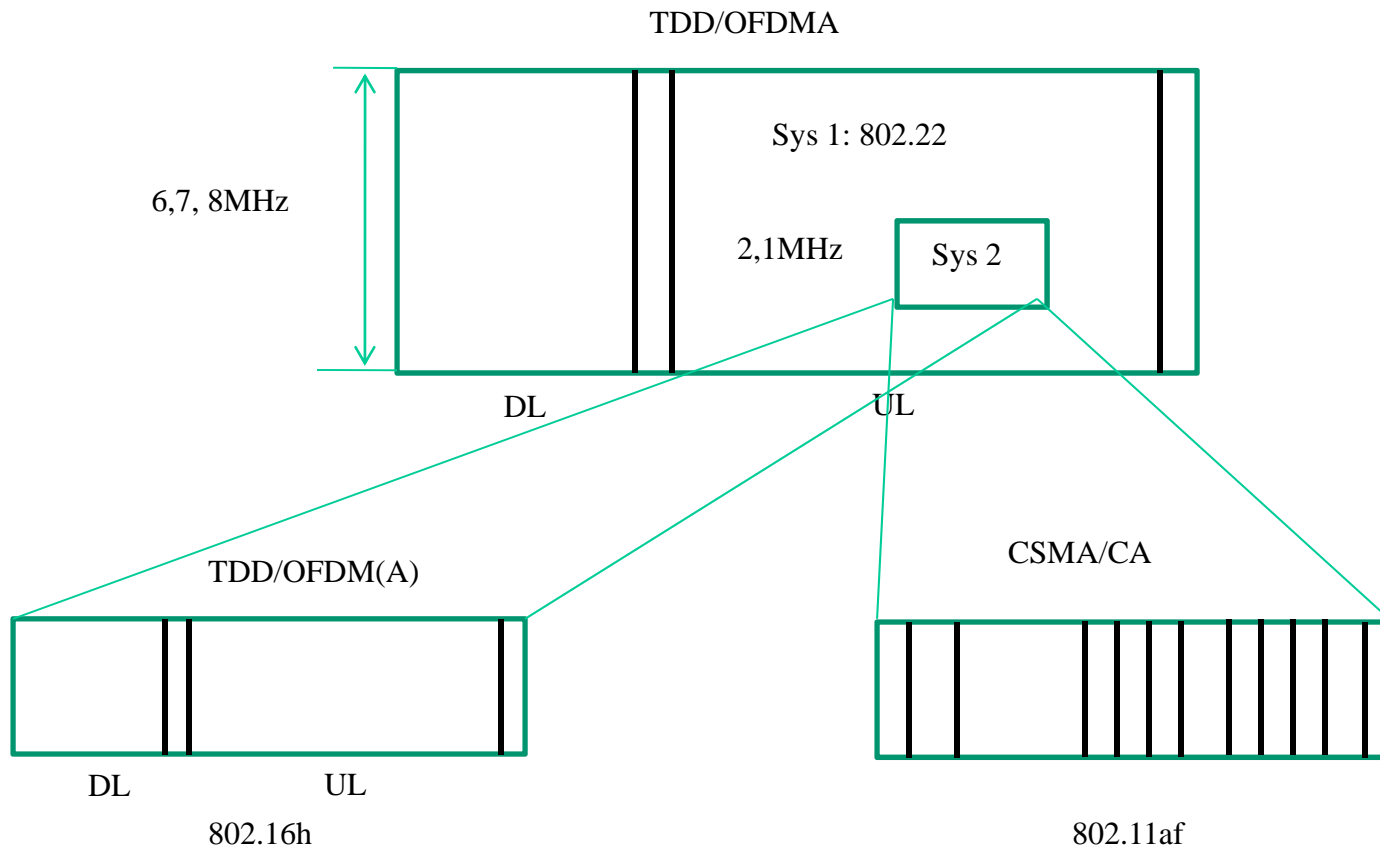


## TDM Between (802.22 and 802.11af) or (802.16h and 802.11af)

- 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**