IEEE 802.11af and Locally Managed Databases

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IEEE 802.11af - About the standard

- Specifies radio and access control mechanisms for daily, hourly and even more timely sharing of TV broadcast bands with existing and future licensed operators
- Solved coordination for US TVWS, but have added concepts and capabilities not present in US TVWS rules

Can be generalized to solve other interference cases

- Co-located radio techniques depend on the radio characteristics of each radio and the regulatory requirements
- The weakest protected signals set the energy ceiling for sharing a channel or band

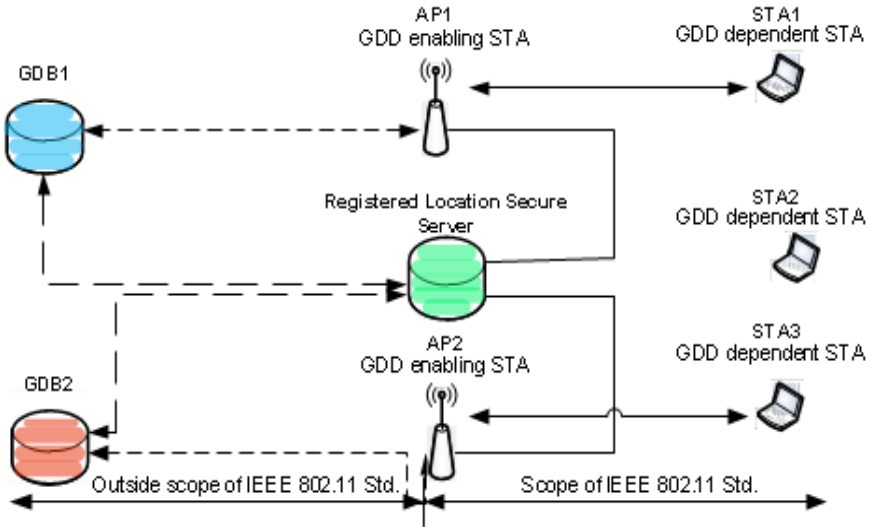
Sharing cases involving use of consumer electronics

- Consumer device economics, size and power limitations and the physics of the medium (available bandwidth, path loss, path delay-spread, atmospheric effects, and rate of change), many of the nomadic/portable systems (e.g., used in priority access or general authorized access), will have band-specific coordination requirements that are not faced in typical Part 90, Part 95 or Part 101 systems.

A database approach

Registered Location Secure Server (RLSS) caches the relevant portions of the geolocation database(s) and maintains the white space **maps, schedules, status, measurement reports** of all cooperating stations.

Similar to TV band, 3.5 GHz needs interoperable protocols for exchanging **maps/schedules /status/measurement reports** among databases; TV bands use IETF *Protocol to Access WS Database* ‘paws.’



IEEE 802.11af local database mechanisms enable:

- Channel availability query (map available channels for an area, venue or a geolocation)
- Channel schedule management (start/end times for each channel)
- **Geolocation database dependent (GDD)** network formation (the GDD enabling station forms & maintains a network under the control of a geolocation database)
- Network channel control, used to inform a local channel controller that has a view of nearby transmitters and their emissions' footprints
- White space map, used to retrieve the available white space channels and their transmit power restrictions

Coordination challenges at 3.5 GHz

Given that **each operator uses their own RAN security systems and firewalls**,

- below the approved databases and above the individual commercial base stations (SP, enterprise, residential) there will be many coordination systems.
- at a minimum, existence of signals and energy detected need to be communicated on a timely basis so other systems can coordinate channel access and channel clearing.
- the reliability and robustness of coordination systems depend on the reliability and robustness of the component systems.

APPENDIX

- References:
- IEEE 802.11af-2013 Published February, 2014 http://ieeexplore.ieee.org/Xplore/home.jsp
- IEEE 802.11af Primer http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=6619571
- **IETF** *Protocol to Access WS database (***paws)** http://tools.ietf.org/wg/paws/
- **OFCOM DTT Receiver Selectivity Testing**
- http://ebookbrowsee.net/ofcom-dtt-receiver-selectivity-testing-pdf-d616006022

APPENDIX - 802.11af radio

- IEEE 802.11af-2013 TV White Spaces Operation specifies radio and access control mechanisms
- Based on the IEEE 802.11ac gigabit radio, it supports multiple concurrent downlink transmissions utilizing MU MIMO (multi-user multiple-input, multiple-output)
- More efficient spectrum use with smart antenna technology, enables
  - More efficient spectrum use, Higher system capacity,
  - Reduced latency by supporting up to four simultaneous user transmissions
- Multiple operating modes in 6, 7 and 8 MHz channels, scaled by
  - W (1x channel width), 2W (2x channel width), 4W (4x channel width)
  - W + W (non-contiguous), 2W + 2W (non-contiguous)
- 40 MHz Channels divided by 7.5 for 6 MHz and 7 MHz unit channels and by 5.625 for 8 MHz channels.
- For operation in the 3550-3700 MHz band, 5-, 6-, 7-, 8-, 10- or 20-MHz modes of 802.11 radios are possible.