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:
  - OFCOM DTT Receiver Selectivity Testing
  - [http://ebookbrowse.net/ofcom-dtt-receiver-selectivity-testing-pdf-d616006022](http://ebookbrowse.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.