TVWS
Spectrum Utilization with IEEE802.11af

Starting from UHF Band
02/25/2015
Agenda

- IEEE802.11af characteristics in UHF Band
- Why IEEE802.11af in UHF Band is applicable
- Timing is right for IEEE802.11af in UHF Band
- Database & IEEE802.11af
- Why IEEE802.11af – Chipset vendor point of view
IEEE 802.11af Characteristics

- First wireless LAN standard using geo-location databases for access to spectrum
- Adapted state-of-the-art the 802.11ac PHY to maximize performance
- Operates in 6, 7 or 8 MHz channels to include international TV channels
- Two channels, contiguous or non-contiguous
  - Each may be one or two channels wide
  - $W(idth)$, $2W$, $W+W$, $2W+2W$ or $4W$ (e.g. 8, 16, 2x8, 2x16 or 32 MHz)
- **Supports a Registered Location Secure Server**
  - Enables enterprises management of database access
  - Maintains a local copy of local white space map
- **Database protocol independent**
  - Most will use IETF PAWS
  - Others can be used as well
- **Can utilize SW to have mobility & roaming capability**
IEEE 802.11af Network
Why IEEE802.11af in UHF Band

- **Spectrum shortages will slow the growth of the Wi-Fi industry**
  - Radio technology advances can take many years; spectrum clearing even longer
  - No more wide bandwidth is available
  - Without additional spectrum resources, the Wi-Fi industry growth will stall

- **Internet-of-Things will put huge demand on finding usable spectrum**
  - Billions of new devices will soon be competing for the limited RF spectrum

- **Geo-temporal database technology can evolve rapidly to open spectrum with shorter delays than any other known method**
  - Exclusion zones will shrink as the databases tighten true protection contours
  - In-network devices can provide databases with accurate measures of RSSI and control interference on a real-time basis
  - Over time, the databases can maximize the efficient use of spectrum...anywhere in the RF spectrum!

- **IEEE 802.11af is the first major step towards better spectrum utilization for UHF band**
  - Rules are in place and are being revised to enhance the ability to access spectrum
Timing is right for IEEE802.11af in UHF Band

- **Spectrum availability**
  - Worldwide Harmonized spectrum 470 ~ 790MHz

- **Regulation trend**
  - Key countries ready in 2015
    - US, UK, Canada, Singapore, ...

- **Standard**
  - P802.11af - Unlicensed WLAN operation in the TVWS (2009 - 2014)
  - IETF PAWS - Developing the device to database protocol (Version 19 is ready and finalized)
802.11af Project Timeline

- **White Spaces (WS-MTG)**
  - MRD approved December 10, 2012
  - Passed Blind Poll July 20, 2014
  - SRD approved September 23, 2014

- **White Spaces (WS-TTG)**
  - Formation meeting 9/23/14
  - Initial schedule estimate

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- TTG Formation
- TSoW Approved
- Tech Spec
- Test Plan
- Plugfest Blind Poll
- Test Event and Plugfests
- NPI
- Test Bed & ATL Qual
- Program Launch

### Timeline

- **First Draft**
- **Market Window from MRD (if applicable)**

**Green - Completed**

**Blue – future Milestone**

**Black – Task Duration**
Database & IEEE802.11af

- **Geo-location databases provide software control over where & when radios operate**
  - UHF Band spaces
  - Duplex gaps with other technology
  - Where spectrum allocations are geo-specific
  - Where spectrum licensees have yet to build out

- **Available spectrum maps can be dynamic**
  - React quickly to regulatory changes
  - Provide Wi-Fi networks in disaster-stricken areas when other networks have been damaged

- **Regulators can do database spectrum sharing**
  - Allows them to make modifications where new rules may need to be adjusted to protect incumbents
  - Enables highly controllable experimental licenses
Why IEEE802.11af Standards & Cost of Development

- IP Portfolios
  - Easy to obtain, less license fee or no patent trap ...

- Standards availability
  - Complexity of PHY/MAC design
  - Ready to use or need to wait until ...

- Cost of Development depends on IP availability, design complexity ...
TVBD Mode I

TVBD Mode II

TVWS Set Top Box

- Support HEVC
- RJ45 port
- TV White Space Module

Internet Access and Database query

Internet

Base Station