



August 22, 2008

Marlene H. Dortch, Secretary  
Federal Communications Commission  
Office of the Secretary  
445 12th Street, SW  
Washington, DC 20554

Re: ET Docket 04-186

Dear Ms. Dortch:

Pursuant to Section 1.1206(b)(2) of the Commission's Rules, this is to notify you that on August 21, 2008, Steve Sharkey, Stewart Overby, Dan Sawicki, Rob Kubik, Dave Gurney, Steve Kuffner, Randy Ekl, Dan Prysby and Yuri Fridman of Motorola, met with Julius Knapp, Rashmi Doshi, Bruce Romano, Alan Stillwell, Geraldine Matisse, Steve Jones, Tom Phillips, Bob Weller and Hugh Van Tuyl of the Office of Engineering and Technology regarding the above captioned proceeding. During the meeting we discussed the attached presentation.

Pursuant to the Commission's Rules, one copy of this notice is being filed electronically with the Commission. If you require any additional information please contact the undersigned at (202) 371-6953.

Sincerely,

/s/ Steve B. Sharkey

Steve B. Sharkey  
Senior Director, Regulatory and Spectrum Policy

Cc: Julius Knapp  
Rashmi Doshi  
Bruce Romano  
Alan Stillwell  
Geraldine Matisse  
Steve Jones  
Tom Phillips  
Hugh Van Tuyl  
Bob Weller



# **TV Whitespace: A Solution to Move Forward**

**August 21, 2008**

# Recommendation: Overview

- Move forward now with R&O allowing unlicensed TVWS Devices with geolocation
  - Testing demonstrates reliability of geolocation
  - Continue to consider parameters for sensing-only devices
- Accept applications for certification of TVWS devices as R&O effective date; allow sale and use of certified devices beginning 2/17/09
- Adopt rules for Fixed, Mobile and Portable TVWS Devices that enable useful operation and protection of TV reception
- Allow 4W EIRP, 2W conducted power for Fixed and Mobile TVWS Devices; 400 mW EIRP for portable TVWS devices
- Allow TVWS use on adjacent channels; protection through safe D/U ratios
- Use combination of Geolocation, Beacons and Database entry to accommodate authorized wireless microphones
  - FCC Broadway and stadium testing shows wireless mics today successfully operate co- channel with digital and analog TV stations
  - Motorola will demo low cost beacon operation at FCC Lab

# Power Limits; TV & LMR Protection

- Allow maximum power of 2 W Conducted, 4W EIRP for Fixed and Mobile Devices; 400mW EIRP for Portables
  - Necessary to enable a full range of uses
  - Potential Interference closely controlled through geolocation approach
- Require Fixed, Mobiles and Portables to have access to geolocation info, either directly or through connection to another device in the system
  - Details addressed in ex parte providing recommended rules, March, 2008.
- TVWS Failsafe:
  - On startup devices must obtain location information prior to transmitting
  - If location information is lost:
    - Fixed device – ceases operation after 24 hours without location
    - Mobile & Portable devices – 15 seconds after losing location, device may continue operations only on channels that are known to be vacant within  $t^*72$  km of the last known location to limit of database.
- Cochannel- Prohibit TVWS Device operation within protected service contour of DTV & LPTV stations and within 134 km of LMR systems

# Benefits of Fixed, Mobile and Portable Use TVWS

Utility,  
Public Works,  
Enterprise



## Cost-Effective Rural Broadband

- Service to the unserved/underserved Public
- Expanded range and capacity for competitive WiSP deployments
- Increased data rates for rural communities provides new opportunities for economic growth and learning

200mW

4W

Coverage circles not drawn to scale

Competitive WISP

## Mobile and Portable Broadband applications

- Improved safety, security and productivity at powerplants, manufacturing facilities and a wide variety of industrial operations
- Fulfill need for wide area mobile office/video solutions and vehicular area networks for local and state non mission-critical operations

200mW

4W

Coverage circles not drawn to scale

Higher power (4W EIRP) is essential to meet coverage requirements

- Coverage for 200mW increases site requirements by 4 - 6X over 4W coverage
- Increased infrastructure costs and requirements for low power limits jeopardizes rural benefits

# Adjacent Channel Usage is Critical for TVWS Operation

- **Eliminating adjacent channel use significantly reduces available WS spectrum**
  - Downtown Chicago goes from 8 available channels to 0
  - NYC goes from 3 available channels to 0
  - Los Angeles goes from 2 available channels to 0
- **There is no technical reason to prevent adjacent channel TVWS use**
  - Geolocation database provides full protection based on appropriate D/U ratio
- ***There is no reason to limit adjacent channel use to accommodate wireless microphones***
  - Proposed TVWS usage of adjacent channels is much more restrictive than current wireless microphone use
    - Wireless microphones already allowed up to 250mW *unrestricted* use of adjacent channels
    - no significant interference reported, even when operating co-channel...
  - Many adjacent channels still available for microphones due to inherent TVWS geo-location operating restrictions
    - e.g., at Fed Ex field, only 1 utilized adj. ch. practical for TVWS use – *all other mic channels (10/11) unused...*
    - e.g., at Broadway, *all six utilized mic channels would not be utilized by geo-location enabled TVWS devices...*

# Adjacent Channel TV Protection

- Motorola has recommended *very conservative* adjacent channel protection
  - **Motorola supports separately modeling both TVWS device in-band and out-of-band emissions (OOBE)**
    - **TVWS device OOBE (TX splatter falling co-channel into TV rcvr.) limits allowable TVWS device TX power level**
      - *Typically the dominant interference effect that affects TV receiver performance*
      - Currently limited to 23 dB D/U (for DTV), even though *practical adjacent channel usage supports D/U closer to 16 dB*, since adj. ch. TV signal must be strong (i.e., *is not noise limited*) for viable TVWS usage
    - **TVWS device in-band signal level also limited by TV receiver adjacent channel performance**
      - Major studies show DTV receiver adjacent channel D/U better than -38 dB (incl. OET DTV & ATTC rcvr. reports)
      - Studies assume negligible adjacent channel splatter of interfering signal source and no input overload
      - *Due to separate modeling of splatter effects (as proposed by Motorola), higher DTV adj. channel D/U ratios (-33dB) should be utilized*
  - **Numerous other effects limit practical interference from TVWS devices**
    - e.g., 3-dimensional antenna gains/polarization/height, body effects, building penetration, TX duty cycle, etc.
    - Again, wireless mics (up to 250mW) have not been reported to cause significant interference on adj. channels, even though they have been in widespread use for years...
    - *Adaptrum TVWS device TX testing strongly supports these conclusions...*
      - Proposed geolocation calculations would only allow ~ -20dBm max. EIRP in weak DTV signal cases...

# Wireless Mics Have Multiple Options

- Testing demonstrated that wireless mics today operate co-channel within protected contours of digital and analog TV stations
  - TVWS devices would not operate inside of protected contours of co-channel TV
  - Each TV channel provides 12 to 15 wireless mic channels – provides 120-150 mic channels in an area with 10 TV stations
- Wireless mic operations on adjacent TV channels would be relatively unaffected by TVWS devices based on TVWS protection requirements
- Beacons can be used to supplement channels for wireless mics, for a specific location and time period, e.g., for remote news operations or a concert venue
  - All TVWS Devices should be capable of detecting beacons; decoding of supplemental beacon info should be optional
  - Authorized wireless mic users can deploy beacon transmitters
- If the Commission believes alternative/additional channels are required, we recommend R&O direct SBE and TVWS Manufacturers to identify 2 channels, varying by market, that could be entered into the database for protection
- If needed, channels for wireless mic usage at specific permanent venues or significant pre-planned events (e.g., Superbowl) could be added to the database for protection.
- Any wireless mic entries in database should be channel, location, time and power level-specific to avoid wasting spectrum.

# Motorola Beacon Recommendations

**Should transmit when the channel is *not* available for unlicensed use (disabling beacon)**

**Should be continuous for high probability of intercept with short quiet periods**

**Should be more reliably detectable than a typical wireless microphone signal**

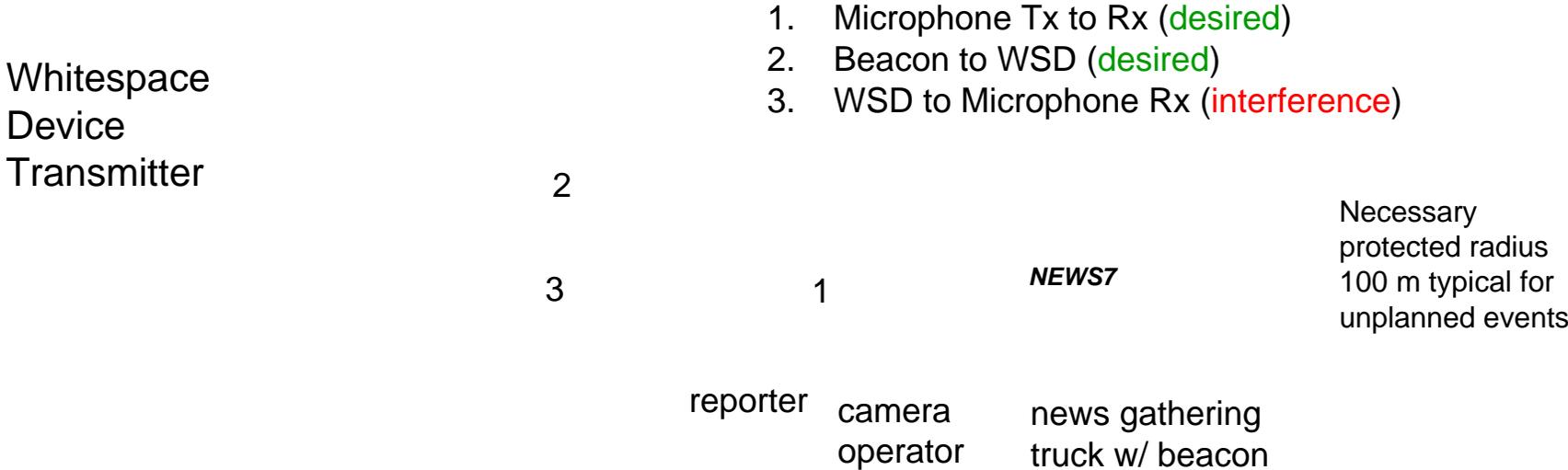
**Should protect microphones via simple detection, with decoding optional**

## Recommended Technical Parameters

- Detection Sensitivity -128 dBm in a clear channel (7 dB NF/-10 dB SNR)
- Detection Time = 30 sec, Channel Move Time = 10 sec
- 77 kcps ; 8x data spreading (IEEE 802.22.1 parameters)
- ~115 KHz 20 dB BW, with ETSI 300 422 V1.2.2 mask-- much tighter than Part 74 mask
- Up to 250 mW TPO
- DQPSK modulation, I & Q bits:
  - In-phase *sync channel* which constantly transmits a 4 byte “sync burst” pattern
  - Quadrature *beacon channel* that carries the “payload” information
  - 8-chip complex spreading sequence can provide significant processing gain

# Beacon Protection Scenario

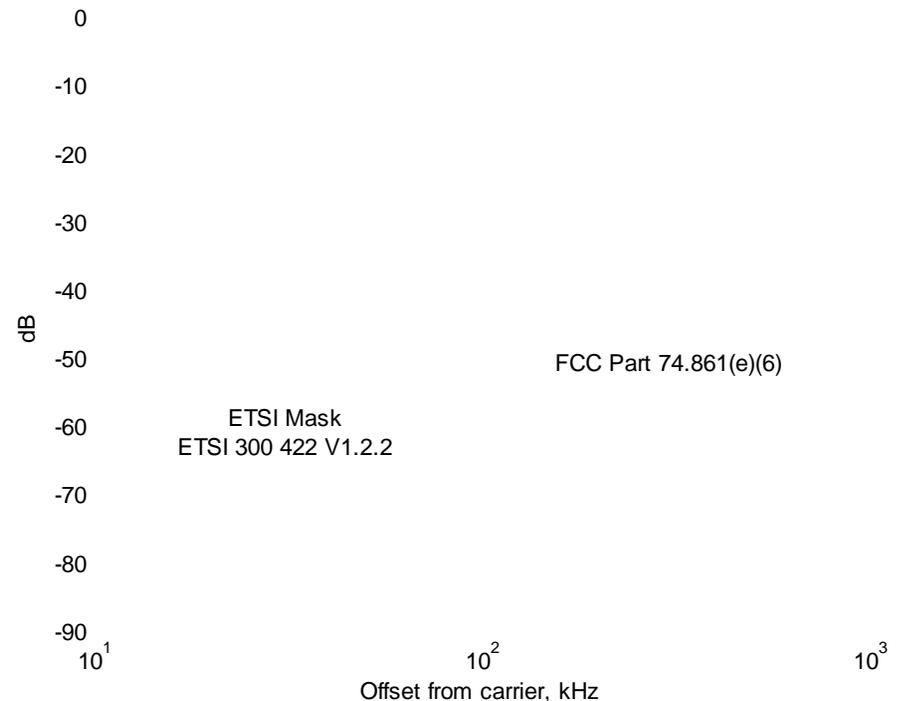
For temporary, unplanned events, such as a licensed wireless microphone used by a news organization to cover a story, a beacon could be utilized



# Benefits of a Tighter Beacon Mask

- Up to 250 mW TPO (*but much lower OOB due to tighter mask... more than makes up for potential increased power*)
- The beaconing device is intended to be operated under Part 74 rules. However, since 802.22.1 is a worldwide standard, the most stringent spectral mask should be followed. *The ETSI mask (from ETSI 300 422 V1.2.2) is much more stringent than the Part 74 mask (from Part 74.861)*

A tighter mask enables higher beacon power and therefore high reliability detection



# Beacon Sensitivity Provides Sufficient Protection Even in Presence of Strong Adjacent Channel Signals

-28 dBm TV (9 m h-pol)

DTV mask

- 10 dB  
SNR

- 47 dB<sub>r</sub>/500 kHz shelf  
= - 75 dBm/500 kHz  
= - 83 dBm/77 kHz

beacon  
- 93 dBm

**Adjacent Channel  
Interferer Present**

7 dB NF noise floor  
= - 118 dBm/77 kHz

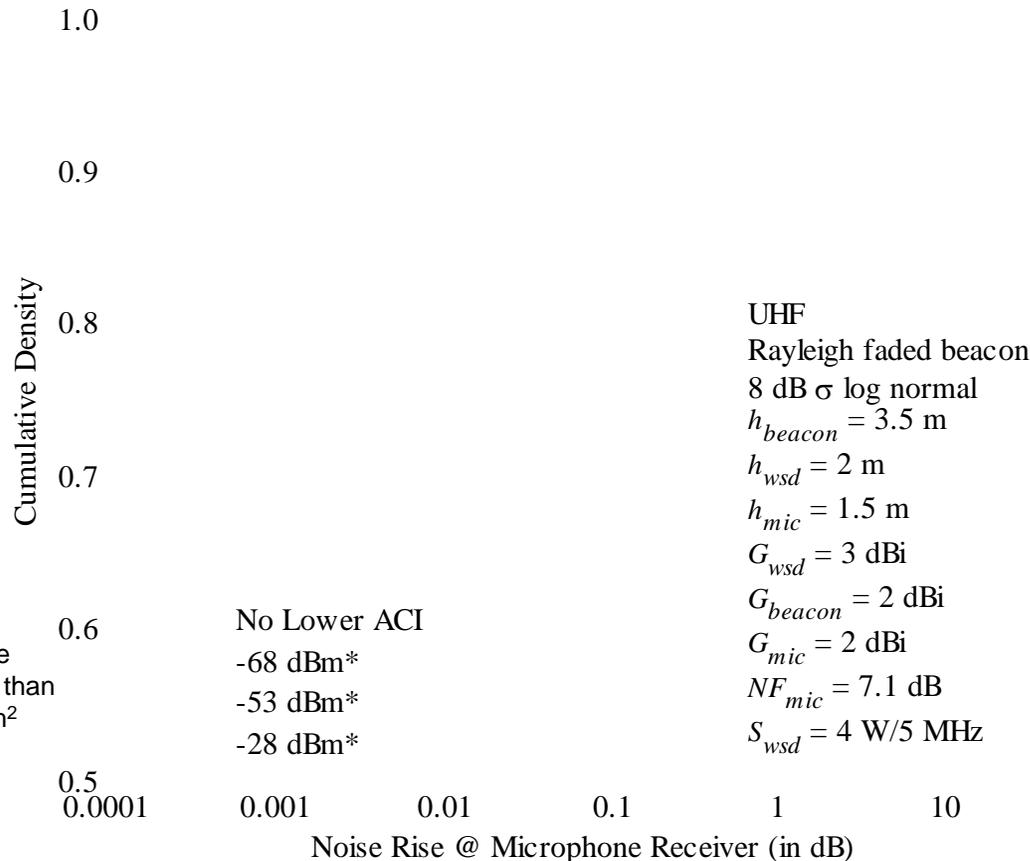
- 10 dB  
SNR

beacon  
- 128 dBm

**Clear Channel Case**

# Statistical Analysis of Lower Adjacent Channel Microphone Interference

- Assumes 100 m protected radius
- TVWS device distance random, up to 5 km from beacon (5 km is nominal detection range for -128 dBm sensitivity)



-28 dBm @ 9m TV antenna height corresponds to -41 dBm @ 2m.

For thermal noise, probability that microphone receiver desense is less than 3 dB (interference = noise) is 95%

For 10 dB environmental NF at microphone Rx, probability that desense is less than 3 dB is 98% (not shown)

For 15 dB environmental NF at microphone Rx, probability that desense is less than 3 dB is 99.1% (not shown)

\* 2m power levels are typically 13 dB lower than 9m power levels for  $h^2$  dependence

-68 dBm\*  
-53 dBm\*  
-28 dBm\*

# Beacon DEMO

# Motorola TVWS Beacon Detection Sensitivity Curves

## 802.22 Beacon Detection - clean channel



# Summary / Motorola Recommendations

Move forward to allow unlicensed TVWS Devices with Geolocation capabilities  
4W EIRP TVWS power level will enable many beneficial and cost-effective services without impacting TV reception or wireless mic usage.

Geolocation will provide reliable protection for both co- and adjacent-channel TV stations and wireless mics

Beacons and/or channel/location/time/power-specific database entries can be used to accommodate additional mic channels if/where needed

Motorola recommends the following regarding Beacons:

- Detection Sensitivity -128 dBm in a clear channel (7 dB NF/-10 dB SNR)
- Detection Time = 30 sec, Channel Move Time = 10 sec
- 77 kcps ; 8x data spreading (IEEE 802.22.1 parameters)
- ~115 KHz 20 dB BW, with ETSI 300 422 V1.2.2 mask-- much tighter than Part 74 mask
- Up to 250 mW TPO
- DQPSK modulation, I & Q bits:
  - In-phase *sync channel* which constantly transmits a 4 byte “sync burst” pattern
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