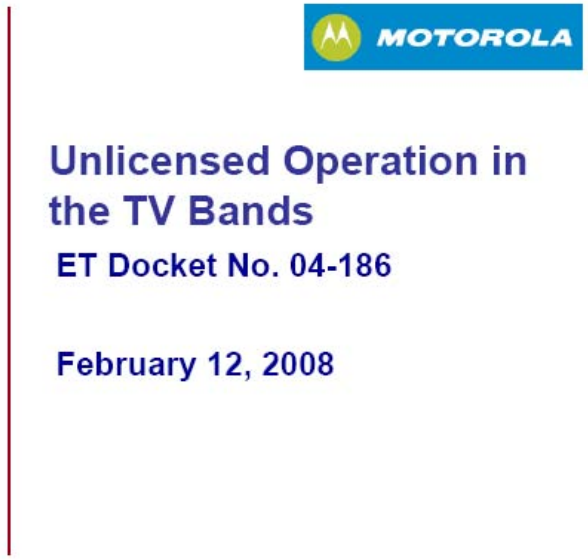
MSTV
MAXIMUM SERVICE TELEVISION

Presentation to OET

How Motorola Proposal Fails to Protect TV Viewers

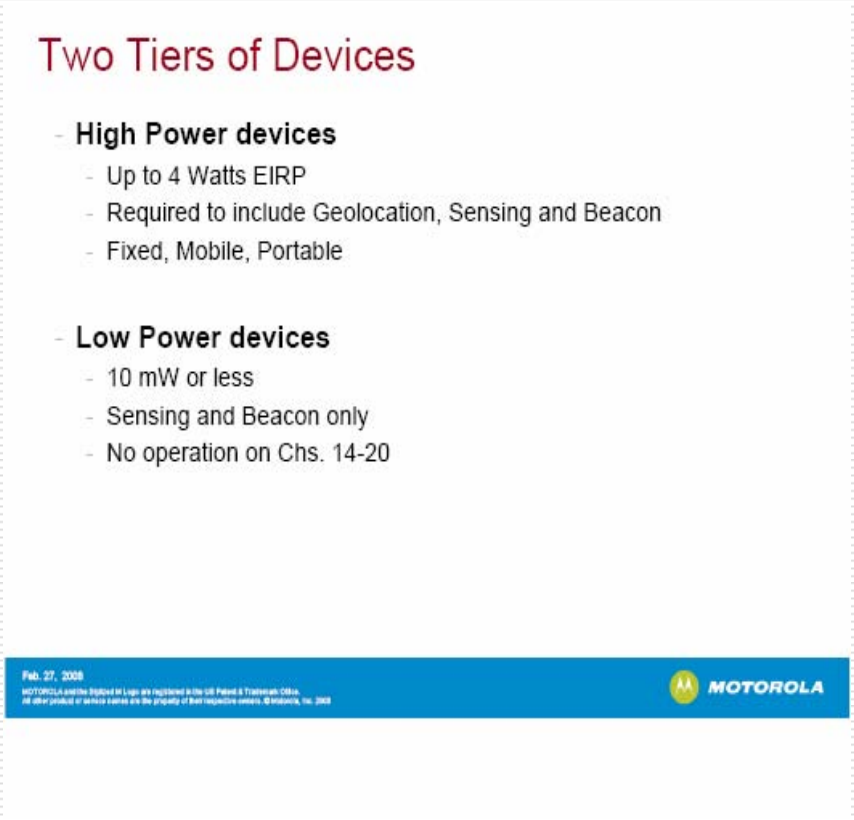
March 12, 2008

Motorola Proposal



- Two presentations made to OET and 8th Floor

Motorola Proposal

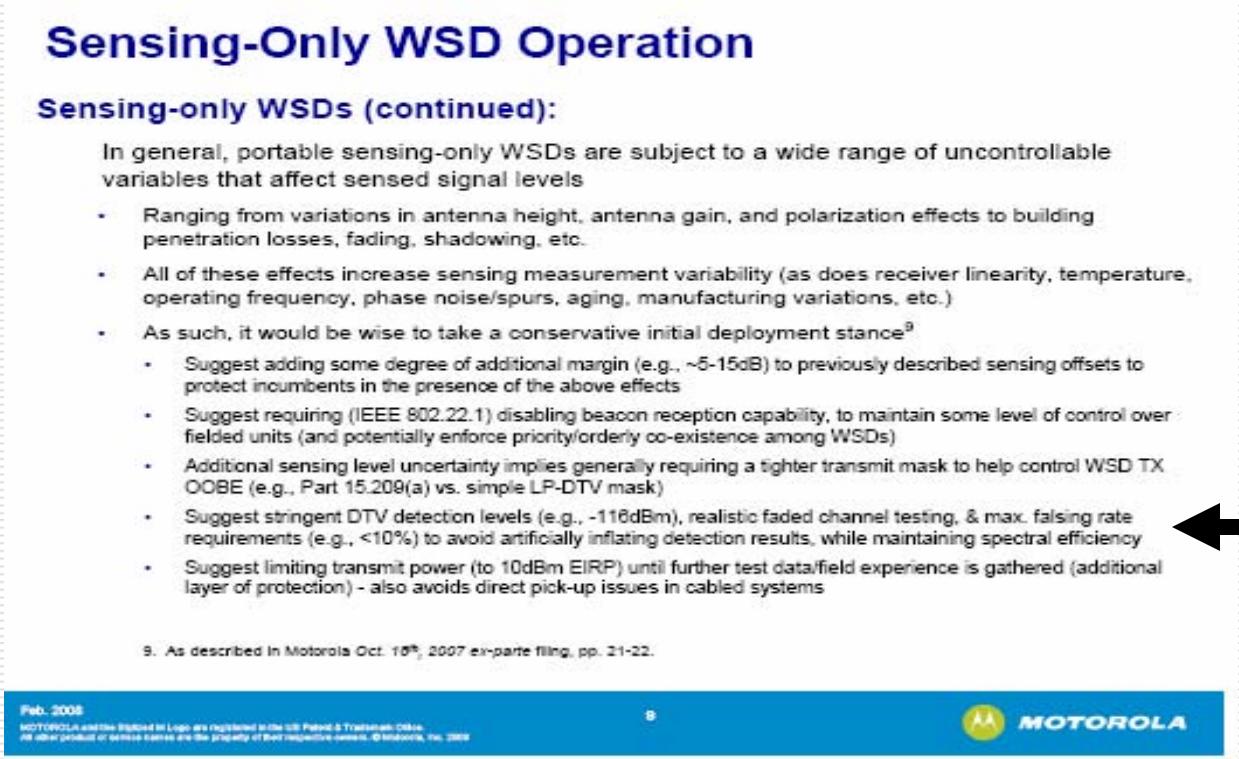


- MSTV Concerns:
  - Sensing only devices
  - Sensing level of -116 dBm
  - Adjacent channel operation within TV station contour based on sensing and D/U ratio

Motorola Whitepaper

- Motorola suggests that its proposals are based on October 2007 Whitepaper
- Motorola implies MSTV failed to consider this technical analysis in its presentation to the FCC
  - MSTV disagrees
  - MSTV supports Motorola's analysis suggesting that sensing is flawed
  - MSTV believes Motorola's proposed use of adjacent channels and personal portable operation is unsupported by its Whitepaper analysis and technically flawed

Motorola's Proposed "Stringent" Detection or Sensing Level



Sensing-Only WSD Operation

Sensing-only WSDs (continued):

In general, portable sensing-only WSDs are subject to a wide range of uncontrollable variables that affect sensed signal levels

- Ranging from variations in antenna height, antenna gain, and polarization effects to building penetration losses, fading, shadowing, etc.
- All of these effects increase sensing measurement variability (as does receiver linearity, temperature, operating frequency, phase noise/spurs, aging, manufacturing variations, etc.)
- As such, it would be wise to take a conservative initial deployment stance[9]
  - Suggest adding some degree of additional margin (e.g., ~5-15dB) to previously described sensing offsets to protect incumbents in the presence of the above effects
  - Suggest requiring (IEEE 802.22.1) disabling beacon reception capability, to maintain some level of control over fielded units (and potentially enforce priority/orderly co-existence among WSDs)
  - Additional sensing level uncertainty implies generally requiring a tighter transmit mask to help control WSD TX OOBE (e.g., Part 15.209(a) vs. simple LP-DTV mask)
  - Suggest stringent DTV detection levels (e.g., -116dBm), realistic faded channel testing, & max. falsing rate requirements (e.g., <10%) to avoid artificially inflating detection results, while maintaining spectral efficiency
  - Suggest limiting transmit power (to 10dBm EIRP) until further test data/field experience is gathered (additional layer of protection) - also avoids direct pick-up issues in cabled systems

9. As described in Motorola Oct. 15th, 2007 ex-parte filing, pp. 21-22.

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- Motorola presentation suggests -116 dBm sensing level for personal/portable devices

Motorola Whitepaper

- “Motorola generally supports the proposed -116 dBm sensing levels for fixed access CR devices with professionally installed (horizontally polarized) externally mounted roof-top sensing antennas.” – page 16

Motorola Whitepaper

- Portable Device Sensing Level discussed in section 3.2
  - "Portable devices (with smaller antennas, possibly indoor) face much wider range of potential operating conditions. According to Hata models (referenced below), antenna height differences for portable units (compared to 9m fixed access devices) could easily result in 10-15 dB of signal reduction, in addition to antenna polarization and building penetration losses (with equally wide ranges). Therefore, it is likely necessary to reduce maximum allowed transmit power levels for sensing-only CR models, and it may be *necessary to decrease the required detection levels (to below -116 dBm) to account for these differences.*" – page 17 (Empasis added)

Motorola Whitepaper

- Portable Device Sensing Level discussed in section 3.2
  - "The incumbent detection problem is made much more difficult due to low portable antenna heights and gains (and polarization losses). *A portable CR EIRP of +10 dBm would have an interference range of 2.3 km*. … E-field strength at the CR interference range of 2.3 km …would drop to about 13.7 dBu at a 2m height …based on Longley-Rice height and reliability adjusted to F(96,96) reliability used for fixed access. Additionally assuming a realistic 3 dB polarization mismatch drops the available sensing down to about 10.7 dBu field strength at 2 m antenna height (*e.g., roughly -122 dBm)* …"
  - *"For portables that operate indoors, the signal to be sensed is further reduced by building penetration values of perhaps 5-20 dB more,* depending on the building construction and the depth into the building. *This would push the threshold for sening further down …"* page 18 (Empasis added)

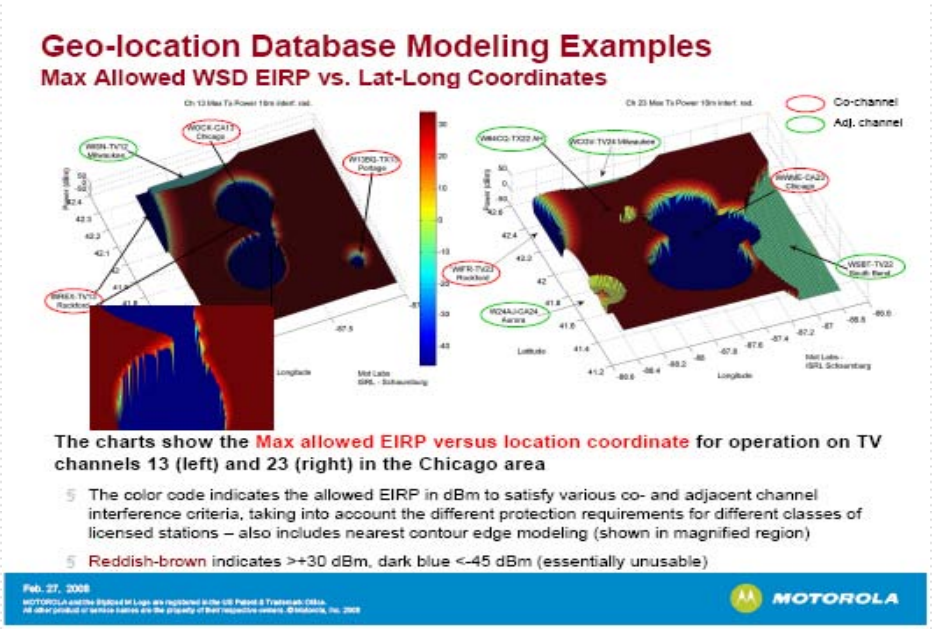
Motorola Whitepaper

- Sensing-only CR Conclusions designed to protect Motorola's customers Land Mobile and cable set-top box customers only
  - "*Due to uncertain nature of sensing-only CR devices*, and the need for further testing, Motorola strongly recommends that sensing-only CR devices be prohibited from operating in TV channels 14-20 … CR devices that are aware of their location … may operate … as long as LMR/CMR … are adequately protected from interference."
  - *"Due to the proximity of TVWS devices in the home cable environment* we believe that allowed EIRP levels of sensing-only portable CR's of 10 dBm EIRP (for UHF)is needed to protect from direct-pick up effects." page 22 (Empasis added)

Sensing Level Summary

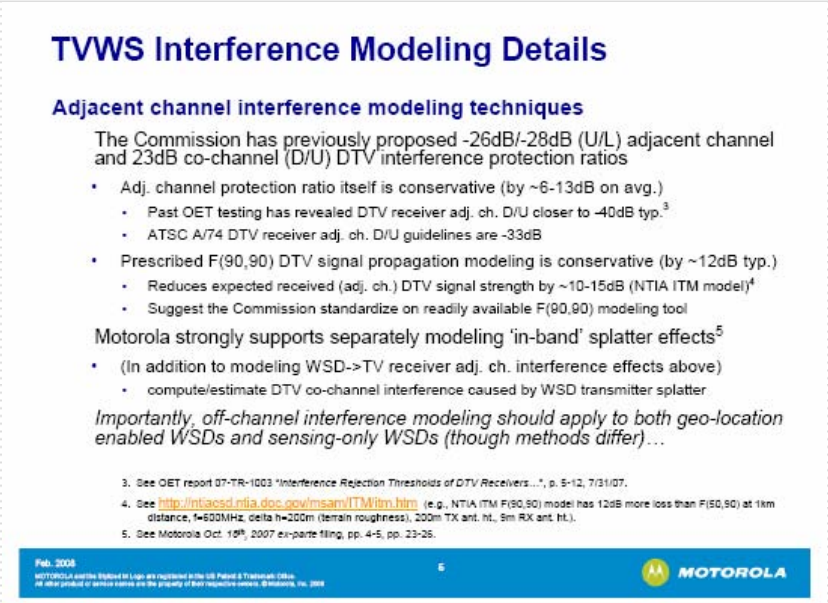
- Motorola recent presentations propose “stringent” sensing level for sensing only devices of -116 dBm
- Motorola Whitepaper actually suggests sensing levels of -127 to -142 dBm needed to protect TV viewers

Adjacent Channel Proposal



- Motorola proposes adjacent channel use within TV station protected contour based on D/U ratios -- applies to both fixed and sensing only devices

Motorola's Adjacent Channel Proposal



TVWS Interference Modeling Details

Adjacent channel interference modeling techniques

The Commission has previously proposed -26dB/-28dB (U/L) adjacent channel and 23dB co-channel (D/U) DTV interference protection ratios

- Adj. channel protection ratio itself is conservative (by ~6-13dB on avg.)
  - Past OET testing has revealed DTV receiver adj. ch. D/U closer to -40dB typ.[3]
  - ATSC A/74 DTV receiver adj. ch. D/U guidelines are -33dB
- Prescribed F(90,90) DTV signal propagation modeling is conservative (by ~12dB typ.)
  - Reduces expected received (adj. ch.) DTV signal strength by ~10-15dB (NTIA ITM model)[4]
  - Suggest the Commission standardize on readily available F(90,90) modeling tool

Motorola strongly supports separately modeling 'in-band' splatter effects[5]

- (In addition to modeling WSD->TV receiver adj. ch. interference effects above)
  - compute/estimate DTV co-channel interference caused by WSD transmitter splatter

Importantly, off-channel interference modeling should apply to both geo-location enabled WSDs and sensing-only WSDs (though methods differ)…

3. See OET report 07-TR-1003 *"Interference Rejection Thresholds of DTV Receivers…"*, p. 5-12, 7/31/07.
4. See http://ntiacsd.ntia.doc.gov/msam/ITM/itm.htm (e.g., NTIA ITM F(90,90) model has 12dB more loss than F(50,90) at 1km distance, f=600MHz, delta h=200m (terrain roughness), 200m TX ant. ht., 9m RX ant. ht.).
5. See Motorola *Oct. 15th, 2007 ex-parte* filing, pp. 4-5, pp. 23-26.

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- Motorola proposes F(90,90) propagation or NTIA model to reduce received DTV signal by -10 to 15dB
- Motorola suggests -26dB/-28dB adjacent channel D/U protection ratios conservative
  - States FCC measured closer to -40 dB
  - ATSC value -33 dB

Motorola's Adjacent Channel Proposal

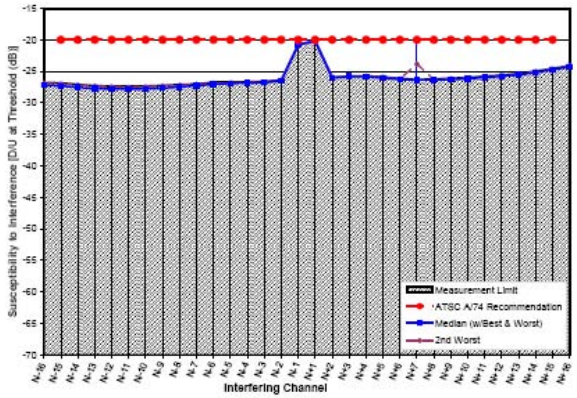


Figure 5-6. D/U Statistics at D = -28 dBm on Channel 30

ATSC Recommended Performance

The ATSC Receiver Guidelines[1] recommend that DTV receivers achieve the interference rejection capabilities shown in Table 4-3. The performance thresholds are specified at three different desired signal levels, which the ATSC designates as "weak", "moderate", and "strong".

Table 4-3. ATSC A/74 Recommended Thresholds for Receiver Interference Rejection

Interfering Channel Number	Threshold D/U for Specified Desired Signal Level (dB)		
	Weak (-68 dBm)	Moderate (-53 dBm)	Strong (-28 dBm)
N+/-1	-33	-33	***-20***
N+/-2	-44	-40	***-20***
N+/-3	-48	-40	***-20***
N+/-4	-52	-40	***-20***
N+/-5	-56	-42	***-20***
N+/-6 to N+/-13	-57	***-45***	***-20***
N+/-14 to N+/-15	-50	***-45***	***-20***

Notes
Channel "N" is the channel number of the "desired" signal—to which the DTV receiver is tuned.
***Bold Italics** denote D/U thresholds that correspond to an undesired signal level of -8 dBm.*

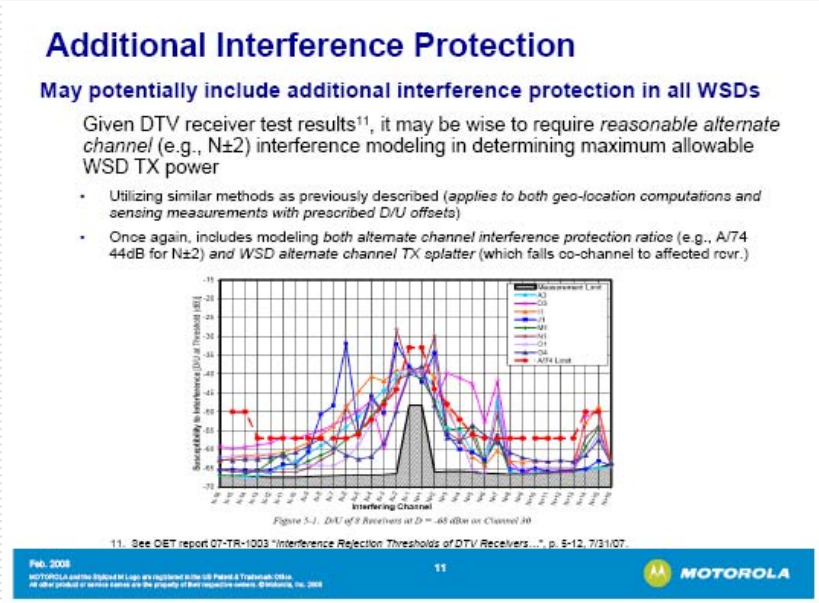
It should be noted that the ATSC-designated "weak" and "strong" levels do *not* bound the range of expected signal levels. The document recommends that receivers be able to operate with DTV signals ranging from -83 dBm to -8 dBm in level.

- Whitepaper suggests signal reductions can be much greater than -10 to -15 dB
- To meet D/U adjacent channel use would generally occur under strong signal conditions
  - -26dB/-28dB adjacent channel D/U protection ratios <u>not</u> conservative
  - FCC measured -20 dB <u>not</u> -40 dB
  - ATSC value is -20 dB not -33 dB for higher signal levels

Adjacent Channel Summary

- Whitepaper suggests much larger signal differences can occur in practice
  - F(90,90) or NTIA model not “conservative” enough to protect DTV viewers
- FCC proposed D/U adjacent channel ratios not appropriate for operation within a TV station’s contour

Second Adjacent Channel Protection



Additional Interference Protection

May potentially include additional interference protection in all WSDs

Given DTV receiver test results[11], it may be wise to require *reasonable alternate channel* (e.g., N±2) interference modeling in determining maximum allowable WSD TX power

- Utilizing similar methods as previously described (*applies to both geo-location computations and sensing measurements with prescribed D/U offsets*)
- Once again, includes modeling *both alternate channel interference protection ratios* (e.g., A/74 44dB for N±2) *and WSD alternate channel TX splatter* (which falls co-channel to affected rcvr.)

Figure 5-1. D/U of 8 Receivers at D = -65 dBm on Channel 30

11. See OET report 07-TR-1003 "*Interference Rejection Thresholds of DTV Receivers ...*", p. 5-12, 7/31/07.

- MSTV agrees with Motorola's suggestion that additional N±2 protections should be considered based on FCC receiver test results