# SDARS/WCS Rulemaking

**Sirius Satellite Radio Inc. & XM Radio Inc.**

**Technical Presentation to FCC Wireless Bureau**

May 9, 2008

# Agenda

- Background
- What the WCS Coalition Got **Right**
- What the WCS Coalition Got **Wrong**
- Summary and Next Steps

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- Supplement: Response to WCS Coalition's May 5, 2008 Ex Parte Outline

# BACKGROUND

- SDARS is a tremendous success story for the commission – over 17 million American subscribers.
- Sirius and XM invested billions of dollars in satellites and terrestrial repeaters to provide nationwide, uninterrupted service.
- FCC crafted WCS and SDARS service rules in parallel to protect adjacent satellite radio downlinks – with WCS intended for fixed or broadcast services.
- Since 1997, the FCC has warned potential WCS licensees that restrictions to protect satellite radio could **"*make mobile operations in the WCS spectrum technologically infeasible*".**
- Accordingly, WCS licenses sold for a fraction of the prices of most auctions, as low as $1.00 in some markets.

# <u>SDARS</u>: TECHNICAL ISSUES FOR THE COMMISSION

- Since the beginning of SDARS, the Commission has recognized the need for terrestrial repeaters.

- <u>But</u>… the WCS Coalition wants to limit repeater power in ways that would force the construction of thousands of additional facilities.

  - The technical record confirms that these limits are not needed to protect anticipated WCS uses.

# <u>WCS</u>: TECHNICAL ISSUES FOR THE COMMISSION

- WCS licensees in the 2.3 GHz band already have deployed valuable services, including fixed wireless broadband.

- <u>But</u>… some WCS Coalition members seek to provide mobile WiMax, despite FCC's pre-auction warnings that mobile would not be feasible in band.

  - The technical record confirms the serious harm to the more than 17 million SDARS subscribers threatened by the Coalition's proposals.

# THE QUALITY OF THE TECHNICAL RECORD

- XM and Sirius:
  - engaged in ***extensive testing***,
  - based on ***well-accepted engineering***,
  - presented their results in detail so that the ***findings can be replicated*** by the Commission,
  - creating ***a strong record that adoption of WCS proposal would result in significant harm to SDARS service***.

- The WCS Coalition:
  - offered ***limited data***,
  - based on ***flawed or unexplained assumptions***,
  - presented in a manner ***lacking transparency,***
  - that ***falls far short of justifying its own proposal***.

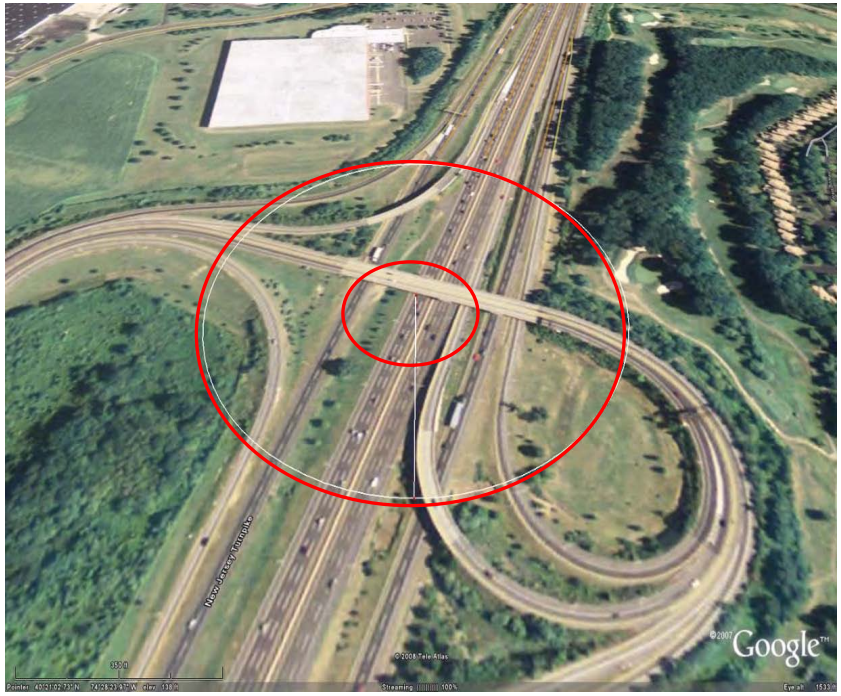
# Discussion

# What the WCS Coalition Got Right

- ***The Coalition admits that 2 Watt WCS mobile terminals will cause interference to SDARS receivers up to 66 meters away***
  - SDARS experiments show interference *actually will be within 51 to 163 meters* of the WCS terminal depending on WCS block and satellite service conditions
- Three meters is the maximum distance at which SDARS is willing to tolerate interference from WCS
  - Greater interference potential than the typical 1-2 meter distance employed in other FCC analysis, but Sirius and XM are willing to accept this compromise.

# Interference Zones Will Impact Many Vehicles

160 m



Approximately 35m

NJ Turnpike, exit 8A
approximately 130,000 vehicles per day
travel one way between EXIT 8A and EXIT 9 (NJ 18),
(http://www.nycroads.com/roads/nj-turnpike/)

# Top 10 Things WCS Got Wrong

## *Incorrect, Incomplete and Vague*

1. Completely Ignored Critical Impact of Signal Overload
2. OOBE Test Methodology Overly Narrow and Fundamentally Flawed
3. Incorrectly Analyzed SDARS Receiver Noise Floor
4. Significantly Overstated Path Loss
5. Flip-flopped to Reject 1 dB OOBE Interference Threshold
6. Erroneously Claimed SDARS Receivers are Overly Sensitive
7. Substantially Overestimated Potential Interference from SDARS Repeaters to WCS Base Stations
8. Ignored Inherent Guard Band Protection in SDARS-Proposed Street Level Field Strength Limits
9. Offered Distorted Views of Other Allocations & Proceedings
10. Vaguely Described Burst Power Level Measurements

# What The WCS Coalition Got Wrong

## *1. Completely Ignored Critical Impact of Signal Overload*

- No Examination of Overload – Coalition's test submission limited to OOBE absent an associated WCS in-band carrier
  - Signal overload and OOBE must be analyzed in combination for complete interference impact model.
  - WCS models both overload and OOBE when analyzing alleged interference from SDARS repeaters.
  - Despite OET-approved test plan to examine overload to SDARS receiver from WCS band signals, the coalition filed ***no*** such results.
- *In contrast, Sirius and XM both provided extensive experimental data demonstrating the potential harmful effects of signal overload from WCS transmitters on SDARS consumer receivers*

# What The WCS Coalition Got Wrong

## *2. OOBE Test Methodology Overly Narrow and Fundamentally Flawed*

- Never measured interference to XM satellite channels located closest to WCS band (testing limited to "free" channel in Ensemble A)
  - Underestimated interference levels by 12 dB
  - Stepped OOBE mask inappropriate, because it sanctions added interference to half of SDARS downlink channels.

  In contrast, accurate tests should have a flat OOBE mask.

- Best-case interference measurements result in overly-optimistic conclusions
  - Clear line-of-sight to SDARS satellites (no link margin sacrificed for foliage, terrain or other blockage)
  - Stationary receiver (no link margin sacrificed for fading)
  - Best case geographical test locations for strongest satellite signal (strongest possible sat signals for high S/(I+N))

- In contrast, normal, real-world conditions with reduced link budget due to foliage, mobility, location, etc., will expand the WCS-generated muting zones.

# WCS Proposed Stepped OOBE Noise Mask
## with
# XM's A & B Ensembles

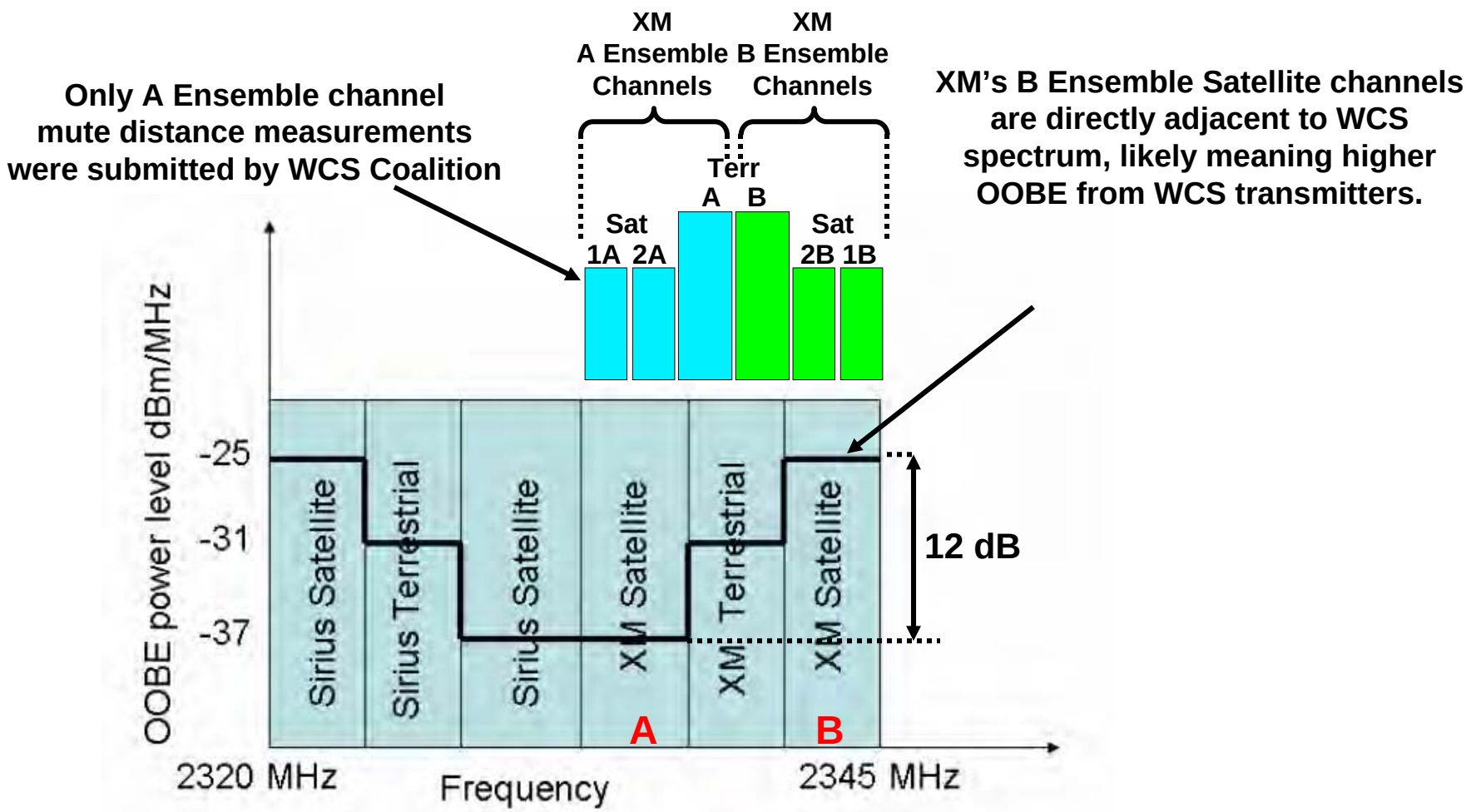



Figure 1. WCS Coalition proposed OOBE mask for mobile CPE

# What The WCS Coalition Got Wrong

## *3. Incorrectly Analyzed SDARS Receiver Noise Floor*

- Coalition's claimed experimental errors in SDARS noise floor measurements are simply incorrect and unsupported.
  - Fundamental differences between satellite and cellular reception
- SDARS receivers require low input noise levels to maximize link margin (= signal – noise) of relatively weak satellite signals
  - SDARS antennas pick up low sky noise levels (40 Kelvin), below the earth's thermal noise level (290 Kelvin) typical for cellular handset antennas
  - SDARS receivers employ low-noise amplifiers with 0.7 db noise figure vs noise figure of 4 - 7 db for LNAs typical in cellular handset receivers
- *In contrast, Sirius and XM presented independent test results based on calibrated equipment and accurate measurements, consistent with routine antenna development and production tests.*

# Comparison of Satellite Noise Floor Measurement Procedures

| Mesurement Parameter | System | SDARS Tests (FAU EMI Lab) | WCS Coalition Test (NextWave) |
|---|---|---|---|
| Frequency Span | Sirius | 2320 - 2324 MHz | Not Specified |
| | XM | 2341 - 2345 MHz | Not Done |
| Resolution Bandwidth | Sirius | 3 kHz | Not Specified |
| | XM | 3 kHz | Not Done |
| Video Bandwidth | Sirius | 3 kHz | Not Specified |
| | XM | 3 kHz | Not Done |
| Satellite Signal Blocking | Sirius | Building | Not Specified |
| | XM | Building | Not Done |
| Measurement Method | Sirius | Max Hold Avg 25 Sweeps | Spectrum Analyzer Marker |
| | XM | Max Hold Avg 25 Sweeps | Not Done |
| Noise Floor Calculation | Sirius | Provided in Report | Not Specified |
| | XM | Provided in Report | Not Done |

# What The WCS Coalition Got Wrong

## *4. Significantly Overstated Path Loss*

- WCS submission overstates path loss by nearly 10dB
  - WCS findings inconsistent with published literature from NTIA, CTIA and Verizon.
  - Coalition's vague description of its own measurement procedure limits ability to test their findings.
- *In contrast, Sirius and XM path loss measured data are validated by published literature.*

# What The WCS Coalition Got Wrong

***5. Flip-flopped to Reject 1 dB OOBE Interference Threshold***

- A measured 1 dB rise in the noise floor is routinely used in regulatory interference assessment proceedings
  - Use of 1dB threshold is consistent with ITU standards (ITU-R F.758.3)
  - Coalition used this 1dB threshold in their own filings
  - Use of audio muting as threshold further understates OOBE interference contribution in isolation of other interference mechanisms
- *In contrast, Sirius and XM used standard impairment measure.*

## What The WCS Coalition Got Wrong

### *6. Erroneously Claimed SDARS Receivers are Overly Sensitive*

- For adjacent channel overload, SDARS production receivers perform at same “state of the art” as coalition’s representative WiMax receiver (-44 dBm)
- Ignores practical reality that consumers rely on embedded base of millions of receivers
- *In contrast, Sirius and XM use most common receivers in real-world testing*

# What The WCS Coalition Got Wrong

***7. Substantially Overestimated Potential Interference from SDARS Repeaters to WCS Base Stations***

- Overstated coverage of SDARS repeater networks
- Underestimated SDARS repeater OOBE filtering.
- Assumed victim and SDARS repeater antenna main beams perfectly aligned.
- Used below thermal noise floor interference threshold as impairment criteria.
- Presumed sub-standard WCS base station filter specification.

- *In contrast, XM and Sirius demonstrated that* WCS *proposals would increase interference potential due to larger number of SDARS repeaters required.*

# What The WCS Coalition Got Wrong

## *8. Ignored Inherent Guard Band Protection in SDARS-proposed Street Level Field Strength Limits*

- Coalition opposes Sirius and XM's proposal to protect WCS receivers up to -35 dBm — Ignoring that WCS is protected by guard bands from SDARS repeaters
  - A, B block separated from SDARS terrestrial transmission by at least 11 MHz
  - C, D block separated from SDARS terrestrial transmission by at least 6 MHz
- WiMax receivers will tolerate -35 dBm alternate channel signal levels
- *In contrast, XM and Sirius analysis accounts for guardbands*

# What The WCS Coalition Got Wrong

## *9. Offered Distorted Views of Other Allocations & Proceedings*

- Coalition points to allocations in other countries that are irrelevant.
  - No adjacent satellite downlink to protect in other countries cited by coalition
  - Harmonization already exists in North America
    - Canadians adopted same rules as U.S. for WCS and similarly warned of difficulty for providing mobile services
  - Ample spectrum for WiMax is available and being deployed elsewhere (2.5 GHz, 2.4 GHz, 700 MHz) by established wireless industry entities

- Coalition ignores record established in AWS-3 rulemaking
  - Potential for similar interference from AWS-3 mobile devices into aws-1 and AWS-2 mobiles has been demonstrated

# What The WCS Coalition Got Wrong

## *10. Vaguely Described Burst Power Level Measurements*

- Coalition filings provide little insight into test methodologies and how burst power levels were measured
  - Lack of transparency prevents analysis of conflicts between coalition's results, Sirius and XM's filings, and published literature
- *In contrast, XM and Sirius provided details of measurement techniques and test setups*
  - *Transparency allows Commission independently to validate test Results*

# Summary

- The Commission was ***right*** when it warned that mobile broadband was unlikely to work in the WCS spectrum without harming satellite radio reception.

- The use of a field strength limit for both SDARS repeaters and WCS fixed transmitters is the ***best*** method to eliminate the risk of overload interference to both SDARS and WCS receivers.

- Fixed WiMax broadband in the WCS spectrum is compatible with SDARS, but mobile WiMax belongs in other spectrum bands.

# Next Steps

- The Commission should act promptly on this record.
  - Though further testing could confirm these conclusions, current record is sufficiently complete to support an order implementing the proposals of XM and Sirius.

# SUPPLEMENT:

# Response to WCS Coalition's May 5, 2008 Ex Parte Outline

# THE LATEST WCS COALITION “EX PARTE” ADDS NOTHING NEW

- On May 5 the WCS Coalition filed their “perspective” on proposed rules for SDARS repeaters and WCS band operations.
- That ex parte does not attempt to rebut the XM/Sirius Technical Presentation highlighting what the WCS Coalition got wrong and right.
- That filing is consistent with the Coalition’s prior erroneous and conclusory statements.

## 1. *The Coalition* -- incorrectly argues that it is unfair to restrict use of WCS for mobile WiMax to protect SDARS consumers.

- Does not address express FCC warnings that mobile operations "technologically infeasible" given SDARS reception issues.
- Ignores other spectrum available for mobile WiMax.
- Ultimately ignores impact on 17 million SDARS subscribers served by multi-billion dollar satellite networks built in reliance on protection in FCC rules.

## 2. *The Coalition* -- fails to present any new technical data.

- Does not provide any new support or explanation for own data.
- Does not respond to flaws identified by XM and Sirius.
- Continues to rely on incorrect and/or opaque technical assertions.

# 3. *The Coalition* -- erroneously criticizes even the most basic engineering principles.

- Criticizes XM and Sirius for relying on “irrelevant” path loss literature -- even though this literature is directly on point and prepared by NTIA (among others).

- Gratuitously attacks XM and Sirius noise floor analysis with bare -- and unsupported -- assertion that the independent third party testers must have used incorrect processes.

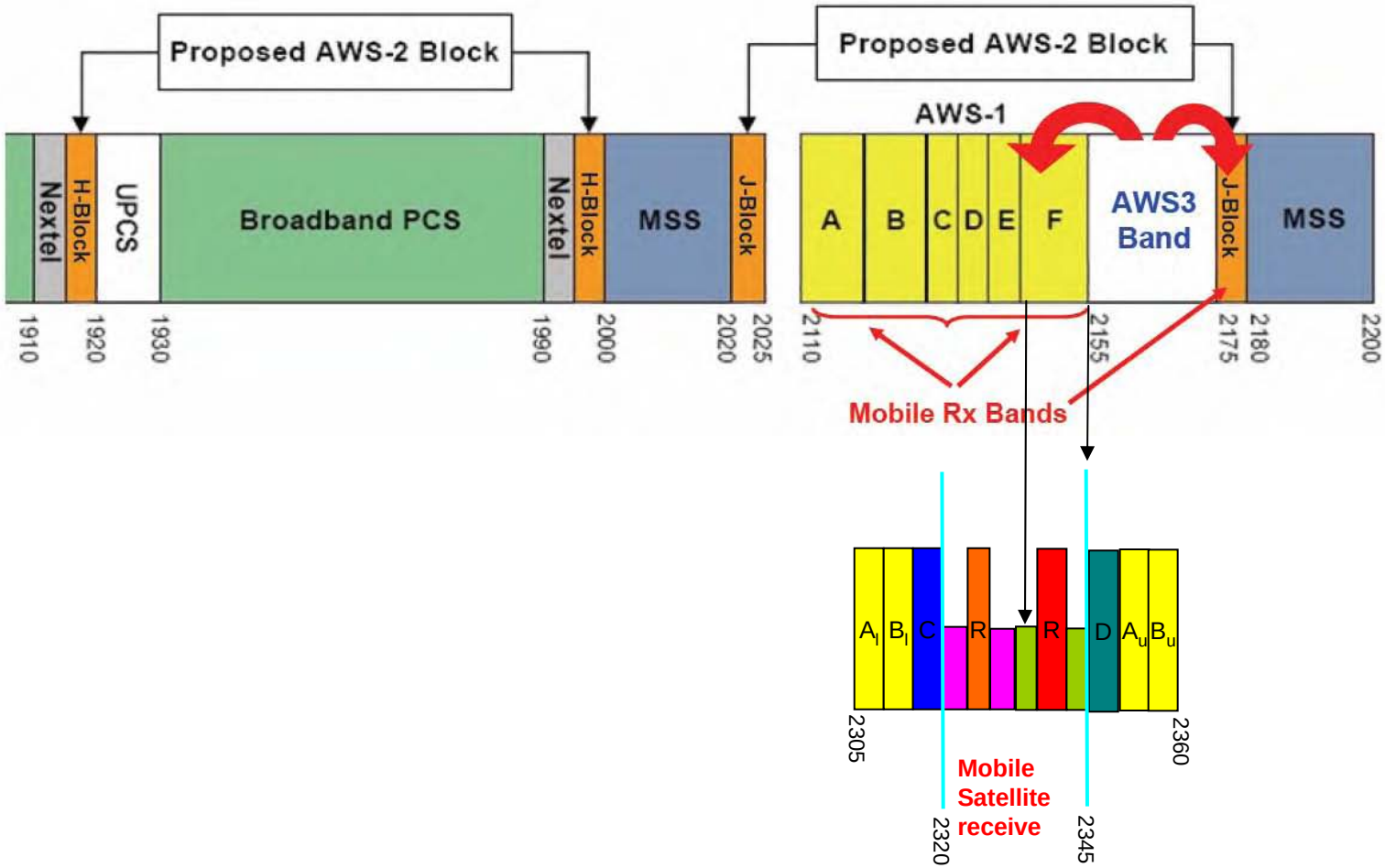
- Erroneously suggests that interference is relevant only when it fully kills SDARS reception, ignoring impact on SDARS system reliability short of muting.

# 4. *The Coalition* -- continues to ignore the record in the AWS-3 Rulemaking.

- Potential for similar interference from AWS-3 mobile devices into AWS-1 and AWS-2 mobiles has been demonstrated.

- WCS Coalition position inconsistent with those of AWS spectrum holders who also own WCS spectrum.

# AWS-3 Bandplan Comparison



| Company | OOBE Recommendation (normalized to 3 m and 1MHz) | Maximum Mobile EIRP Recommended (normalized to 3m) | Conclusion |
|---|---|---|---|
| **Sirius/ XM (for WCS band)** | **103+10log(P)** | **10 dBm (A,B)**<br>**0 dBm (C,D)** | |
| AT&T[1]<br>(WCS Coalition Member) | 86+10log(P)<br><br>For H block<br>96+10log(P) | 9.5 dBm | "Based on the record and its own analysis, AT&T has concluded that the downlink only model represents the highest and best use of the AWS-3 spectrum. Provision of uplink transmissions in the band would require stringent restrictions on operating power and out-of-band emissions ("OOBE") and render deployment of a commercial mobile network impractical." |
| Motorola[2] | n/r | n/r | "Based on recent test performed by Motorola, allowing mobile use in the 2110-2155 MHz band may require power and out of band emissions restrictions on AWS-3 operations that are more restrictive than those applied in other mobile bands" |
| Verizon Wireless[3] | 96+10log(P) | 9.5 dBm | "To prevent interference and efficiently utilize the spectrum, AWS-3 should be designated for downlink only transmissions or fixed services" |
| Nextwave Wireless<br>(WCS Coalition Member) | | 10 dBm[4] | |
| Tmobile | 86+10log(P) | | |
| **WCS Coalition (for WCS band)**<br>**(e.g. AT&T, Nextwave Wireless, Horizon,)** | **55+10log(P)** | **33 dBm (all blocks)** | |

[1] Reply Comments of AT&T Inc. WT 07-195, Jan 14 2008.
[2] Comments of Motorola, Inc. WT 07-195, December 17 2007.
[3] Verizon Wireless ex parte presentation, WT 07-195, February 19 2008.
[4] Reply comments of Nextwave Wireless Inc., WT 07-195, and January 14 2008.

## 5. *The Coalition* -- mistakenly suggests that SDARS proposals would limit fixed and other WiMax services.

- Fails to acknowledge that fixed WiMax WCS service is in place today.
- Ignores other uses of WCS spectrum consistent with SDARS reception requirements.
- Does not address fact that Canada has adopted similar WCS rules that also limit mobile broadband to protect SDARS reception.
- In general, the Coalition continues strategy of conflating fixed and mobile services despite different characteristics of the two.

## 6. *The Coalition* -- misleadingly suggests that the Commission should ignore interference to SDARS reception because risk is “probablistic.”

- Ignores even Coalition's own technical analysis demonstrating that mobile WiMax operations in WCS will impact SDARS for up to 66 meters.

- Implies that millions of SDARS consumers should accept interference simply to facilitate new business plans of Coalition members not contemplated by long-standing rules.

- Even the most conservative assumptions of WCS mobile WiMax and SDARS operations result in substantial interference to SDARS consumers.

# "Risk of interference is probabilistic" -- Representative Coalition Errors

***Receiver overload from WCS mobile is being ignored***

- The risk of OOBE interference from a WCS mobile to a SDARS receiver is probabilistic
  - Are WCS device and SDARS receiver in close proximity?
    *WCS devices & SDARS receivers operate along streets & roads, sharing same traffic patterns*
    *Need FCC definition for proximity*
  - Is WCS device transmitting?
    *VoIP traffic will result in continuous prolonged transmissions from WCS mobiles*
  - Is the SDARS device receiving?
    *SDARS OEM receiver is **always on** receiving data, even if audio is off*
  - At what power is WCS device transmitting?
    *APC used to maximize system capacity … mobile power may be high to boost "S" in low (S/(I+N)) scenarios, where I = other WCS interferers*
  - Are there obstructions between transmitter and receiver?
    *Few, if any, obstructions in mobile-to-mobile close-in environment*
  - Do WCS antenna and SDARS antenna have high degree of mutual coupling?
    *Included in our testing*
  - Are both devices stationary?
    May be stationary in traffic jam, or mobile but moving together along route
  - What frequency block is WCS transmitting on?
    SDARS must have equal interference protection from all WCS blocks
  - What service is the SDARS receiver subscribed to?
    All SDARS services must have equal protection
  - Is SDARS receiver served by terrestrial repeater?
    >= -60 dBm repeater serving level is required to overcome 250 mW WCS mobile at 3 meter separation
    area with repeater serving level >= -60 dBm is small relative to total repeater service area