



# White Space Issues

NSMA Spectrum Management Conference  
May 19, 2009

**Bruce Franca, MSTV**

# Politics or Science

“The Union of Concerned Scientists says the Bush administration manipulates and suppresses science. The administration points out that the Union of Bought and Paid for Scientists disagrees.”

–[fark.com](http://fark.com)

# Proof of Concept



“Proof of concept” for intergalactic travel?

# Proof of Concept

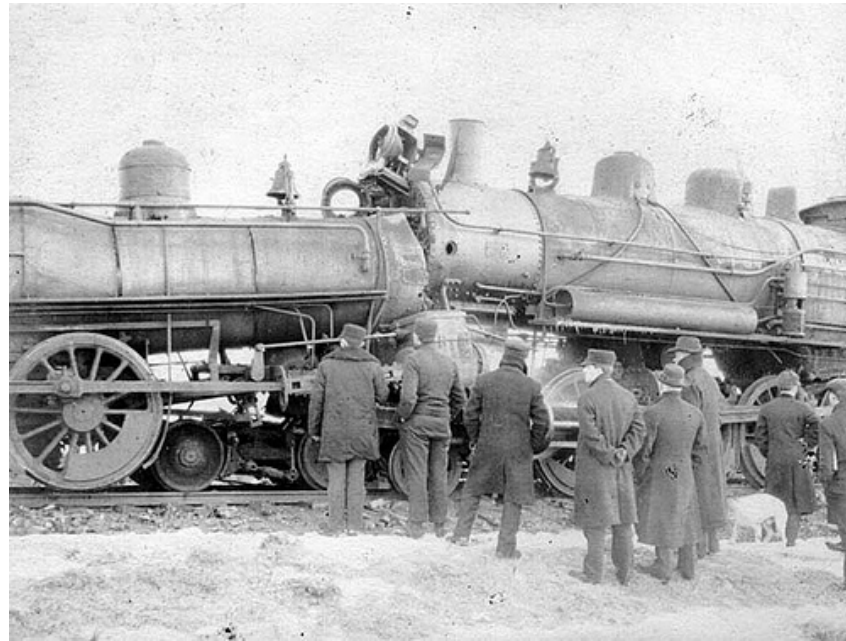
- ▶ Last 2 sentences in the first paragraph of Executive Summary of the Report on Phase II Testing

“At this junction, we believe that the burden of ‘proof of concept’ has been met. We are satisfied that spectrum sensing in combination with geo-location and database access techniques can be used to authorize equipment today under appropriate technical standards and that issues regarding future development and approval of any additional devices, including devices relying on sensing alone, can be addressed.”

# Proof of Concept

- ▶ MSTV FOIA Request
  - One Simple Question:
  - Was “proof of concept” language in the original OET Report and subject to required Peer Review?
- ▶ OET Response
  - We’re not going to tell you
- ▶ Petition for Review
  - Still waiting for response from FCC

# Sharing Possible But .....



# What Needs to be Protected

## DTV Reception

- ▶ Almost 30M NTIA coupons have been redeemed (> \$1.5B)



## Licensed Microphone Use

- ▶ Microphones used for programming production and ENG



## Mobile DTV



a — t — s — c  
MOBILE DTV

# What the FCC Got Right

- ▶ Despite “proof of concept” Conclusion, Lots of Good Data from Test Program
- ▶ Reliance on Geo-location not Sensing
- ▶ Protection of the TV Station’s Protected Contour
- ▶ Protection of TOV
  - Recognizing the signal strength can vary greatly with the protected contour and due to TV receive system
- ▶ Prohibiting co- and adjacent channel FIXED WSD operations within the protected contour
- ▶ Recognition of Need to Protect Cable Headends, LPTV and Translator Receive Sites

# What the FCC Got Wrong

## Decisions on Sensing

- ▶ Opening the Door to Sensing only Devices Despite Failed Test Results

# What the FCC Got Wrong

## Decisions on Sensing

- ▶ Opening the Door to Sensing only Devices Despite Failed Test Results
- ▶ Adopting an Inadequate Sensing Level of  $-114$  dBm
  - Doesn't Protect TV or Wireless Microphones

# What the FCC Got Wrong

## Decisions on Sensing

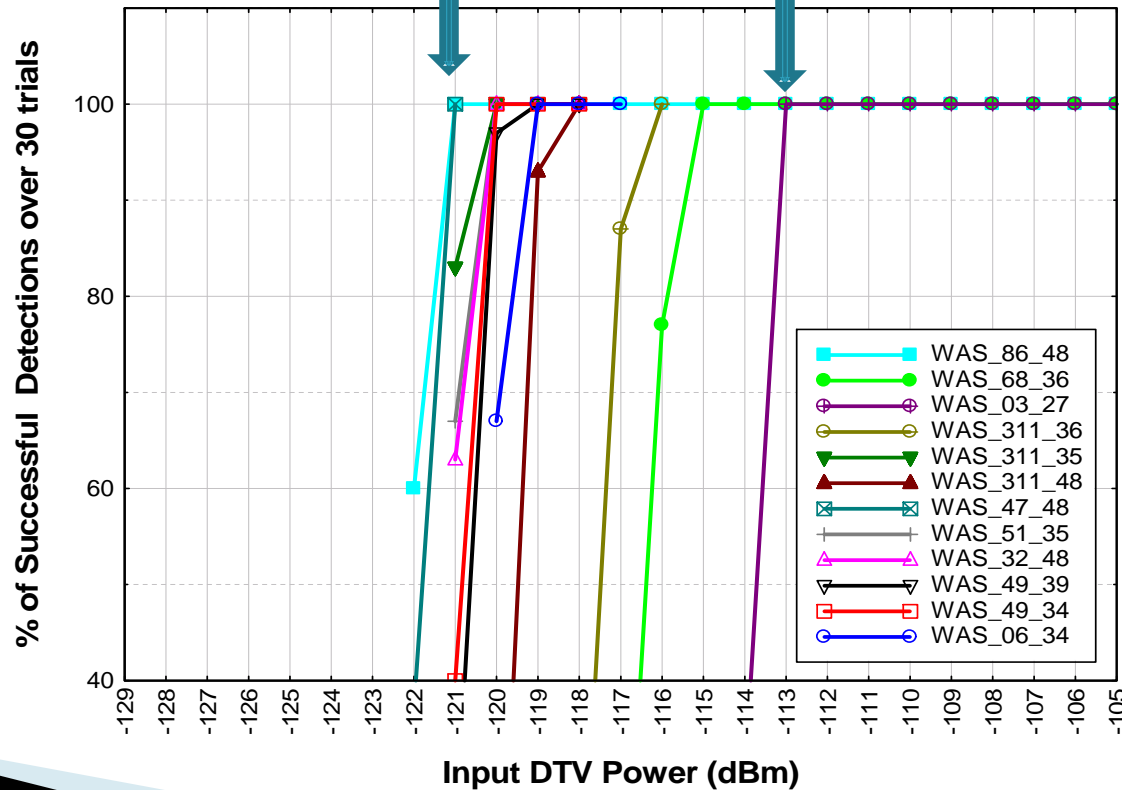
- ▶ Opening the Door to Sensing only Devices Despite Failed Test Results
- ▶ Adopting an Inadequate Sensing Level of  $-114$  dBm
- ▶ Failing to Define How Sensing Level is Measured
  - 60 dB+ Degradation in Strong Signal Conditions
  - Variation with RF Captures

# Sensing with DTV Captures

Or Measured Here?

Sensing Level Measured Here?

Adaptrum Prototype WSD Detection Sensitivity to RF Captures (Initial Design)



# Adjacent Channel Interference Analysis

“Torture numbers, and they'll confess to anything.”

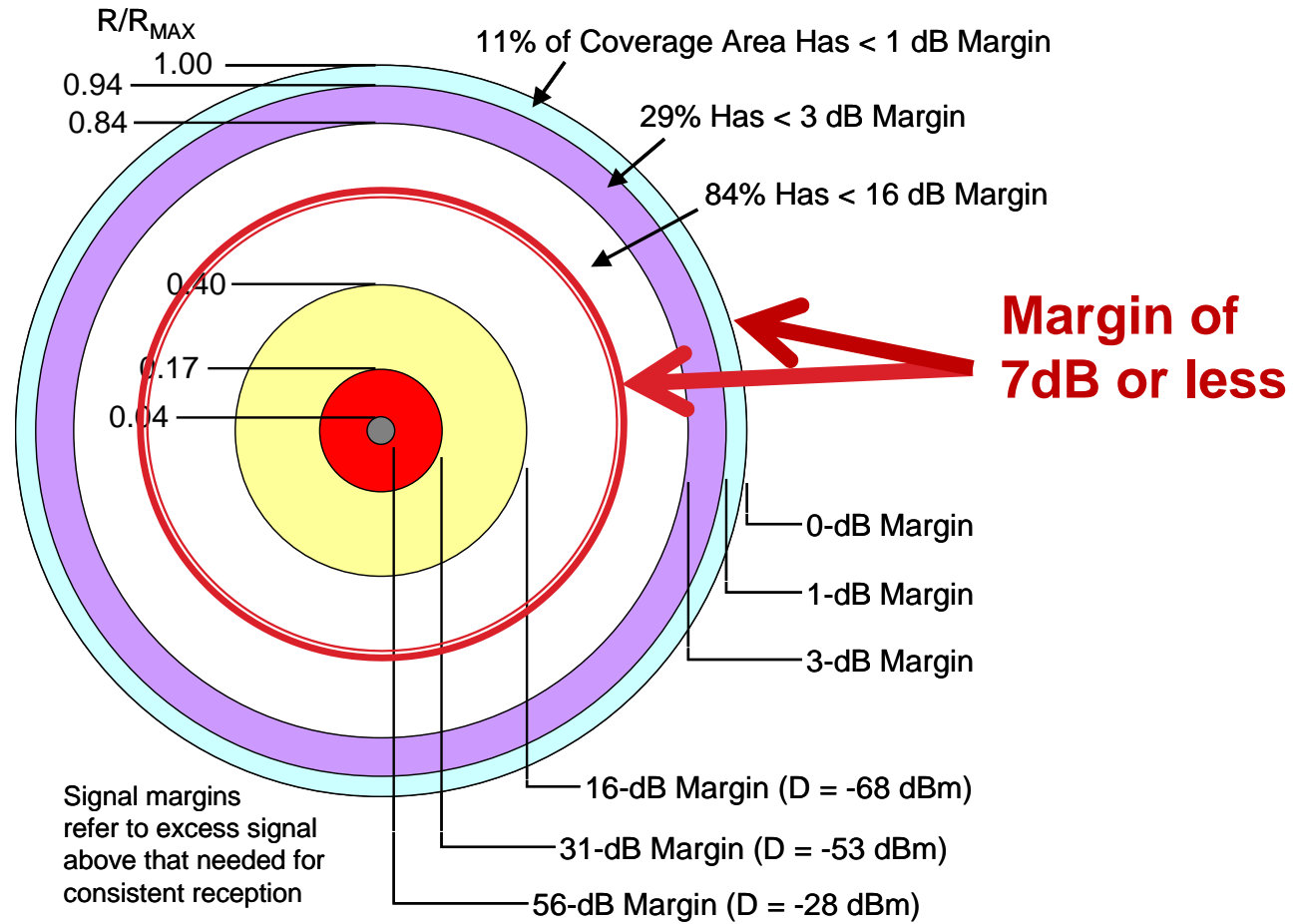
— *Greg Easterbrook*

# What the FCC Got Wrong

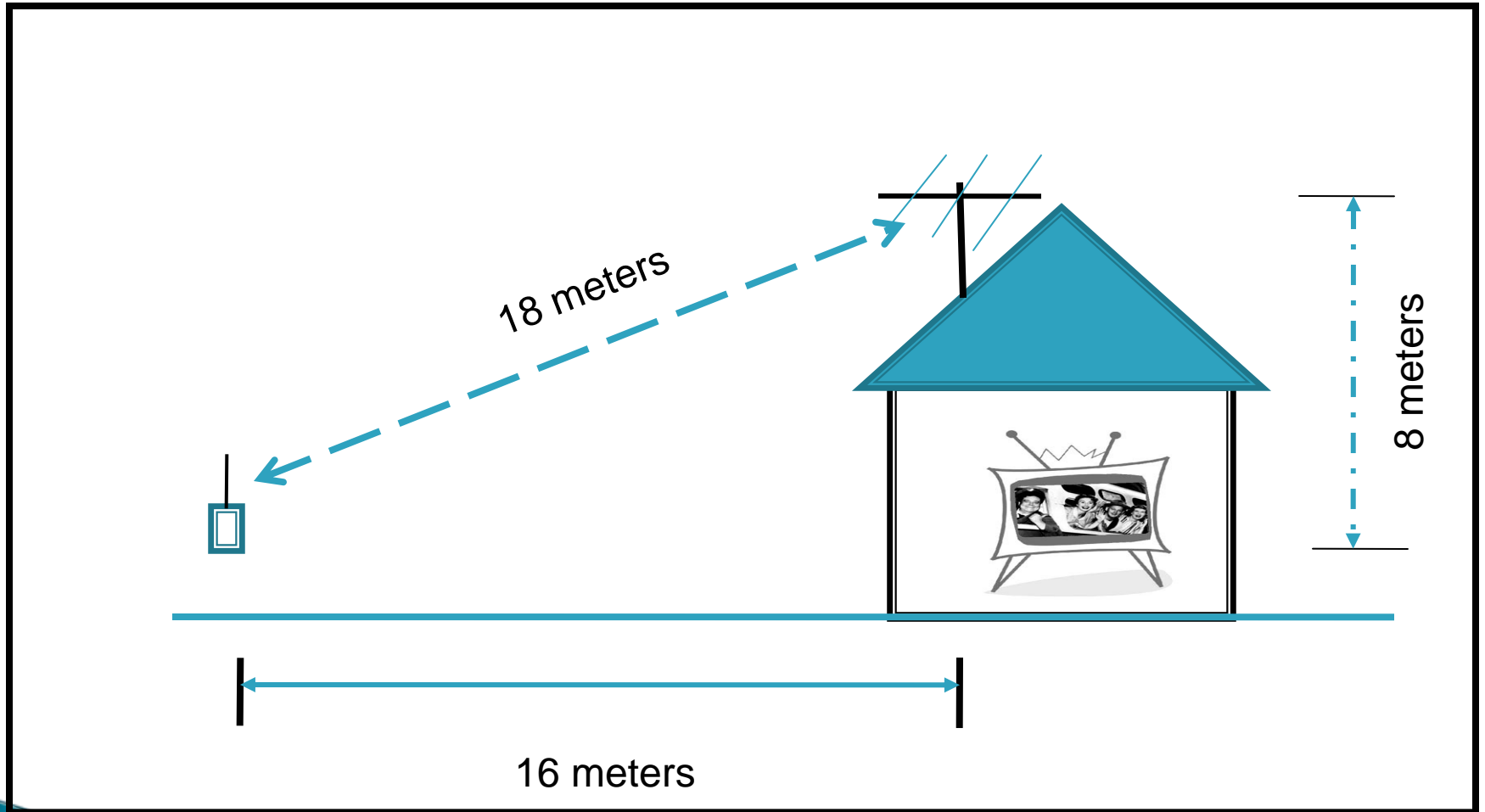
## Adjacent Channel Interference Analysis

- ▶ FCC Interference Analyses Suggest that Personal/Portable WSDs Operating at 40 mW on Adjacent Channels will provide “adequate protection” for indoor reception and “marginal protection” for outdoor DTV reception. (at para. 176)
- ▶ FCC Outdoor Analysis has protection shortfall of 7 dB

# Impact of 7 dB Shortfall



# Outdoor Interference Model



# Adjacent Channel Interference

- ▶ Factors in the FCC Analysis
  - Adjacent Channel D/U Protection Ratio
  - Antenna Discrimination
  - Polarization Discrimination
  - Interference Distance

# D/U Protection Ratios

- ▶ “We will require TV band devices to protect full service and low power TV reception within their own contours using the proposed (Part 74) D/U ratios.”
- ▶ “We believe it is reasonable and appropriate to continue to apply these same service rights definitions with respect to unlicensed devices.”
- ▶ “None of the commenting parties argue that we should use less stringent standards for protection.” (para. 167)

# OOPS!

- ▶ “We therefore use the A/74 value (a ratio of **-33 dB**) in our analysis of the interference potential of TVBDs.” para. 167
- ▶ FCC analysis provides 5 to 7 dB less protection for DTV than required

Type of Station	Protection ratios	
	Channel separation	D/U ratio (dB)
Analog	Co-ch.	34
	Upper Adj.	-17
	Lower Adj.	-14
Digital	Co-ch.	23
	Upper Adj.	<b>-26</b>
	Lower Adj.	<b>-28</b>

# OPPS!

- ▶ “We therefore use the A/74 value (a ratio of **-33 dB**) ...” para. 167
- ▶ FCC analysis provides 16 to 19 dB less protection for analog LPTV and translators than required

Type of Station	Protection ratios	
	Channel separation	D/U ratio (dB)
Analog	Co-ch.	34
	Upper Adj.	<b>-17</b>
	Lower Adj.	<b>-14</b>
Digital	Co-ch.	23
	Upper Adj.	-26
	Lower Adj.	-28

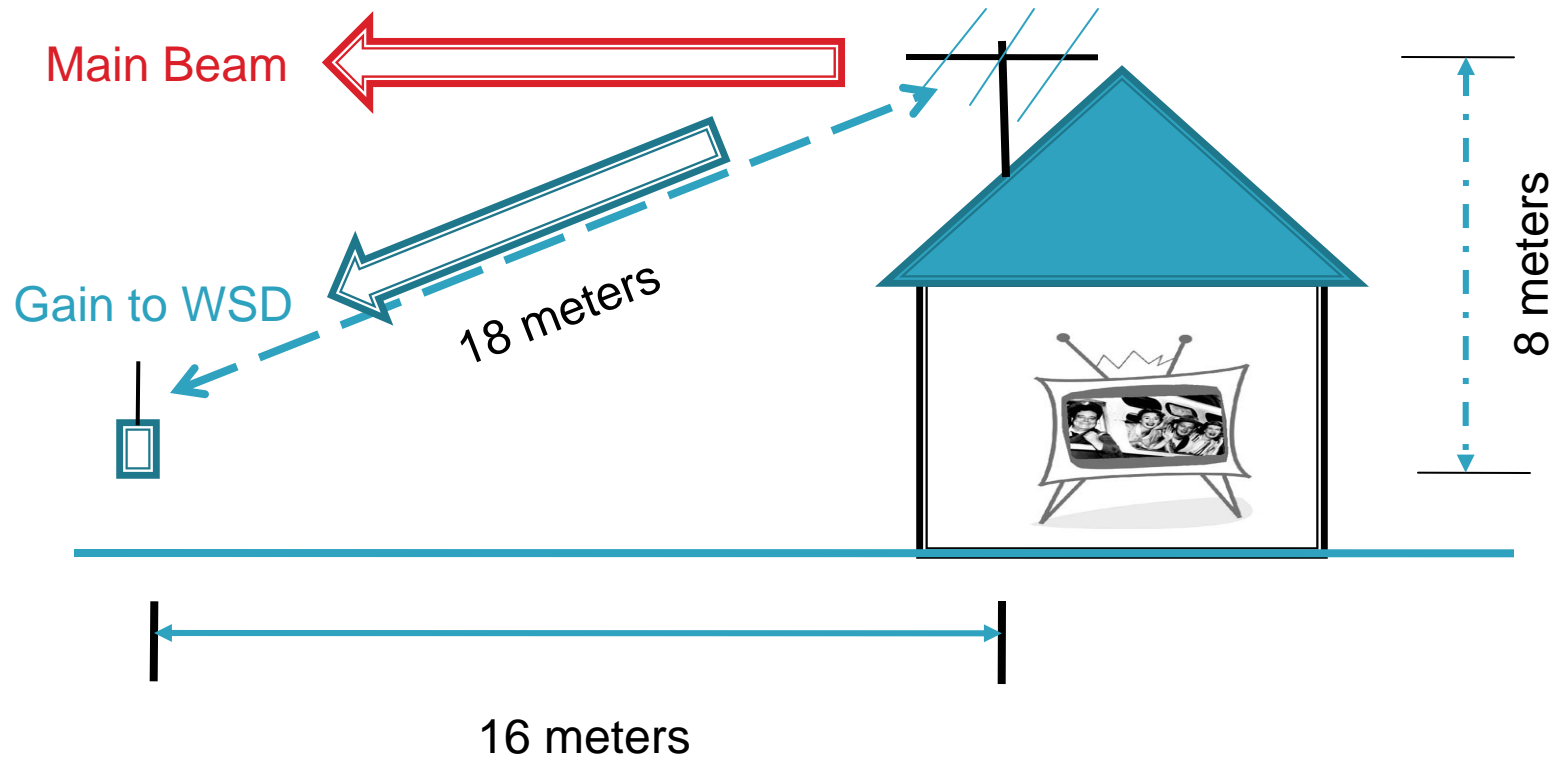
# Antenna Discrimination

## TV Antenna Discrimination

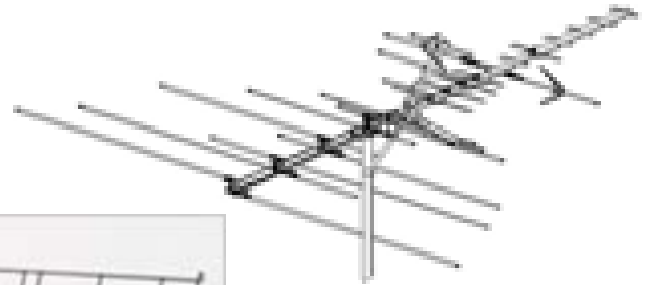
- ▶ FCC Analysis Uses 12 dB of Antenna Discrimination
- ▶ FCC Analysis also Includes 3 dB of Cross-Polarization Discrimination

# Outdoor Interference Model

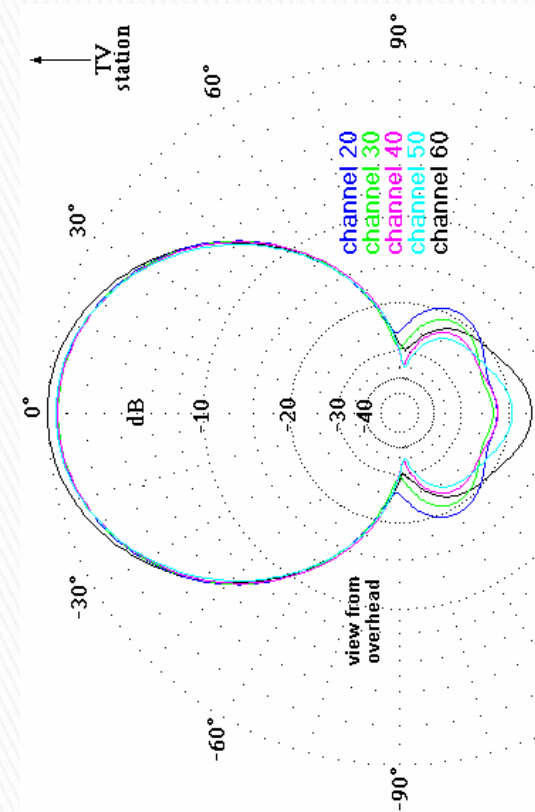
WSD at about 26 degrees off Main Beam Axis



# Some Consumer DTV Antennas



# Some Actual DTV Antenna Performance



Winegard SquareShooter

Average 3dB Beamwidth of 61 degrees (~1.5 dB discrimination at 26 degrees)

# Adjacent Channel Interference

Value	FCC Analysis	Added Protection Required	Difference
D/U	-33 dB	-26 or -28 dB	5 - 7 dB
Antenna Discrimination	12 dB	0 to 5 dB	7-12 dB
Interference Distance	16 meters	10 meters	4 dB
Polarization Discrimination	3dB	0-3 dB	0-3 dB
<b>TOTAL</b>			<b>16 - 26 dB</b>

ALSO MUST ADD 7 dB FCC SHORT FALL

# What FCC Ignored

**a — t — s c**  
**M O B I L E D T V**

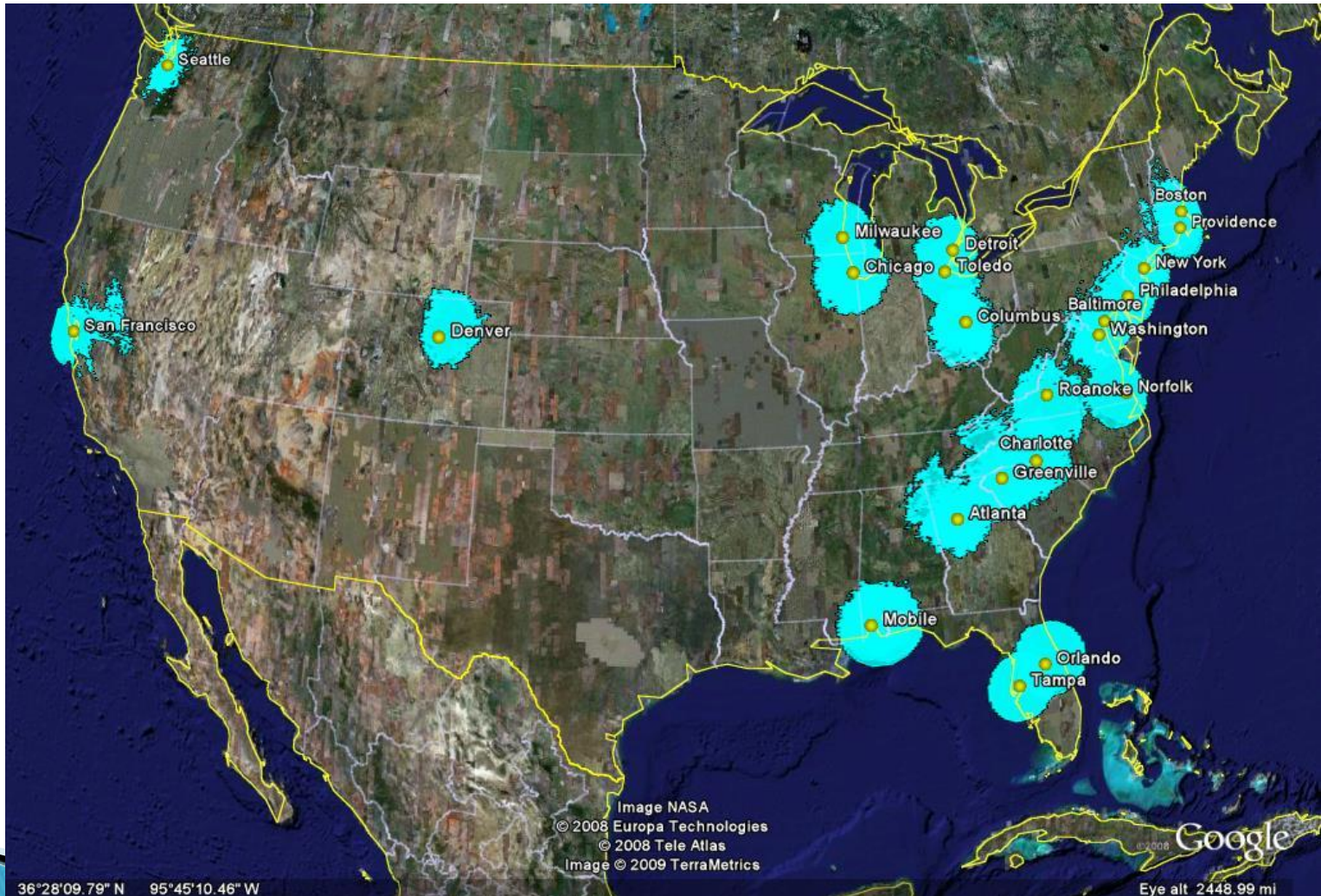
# What the FCC Ignored

- ▶ Interference to Mobile DTV
  - 1 to 2 Meter Separation
  - Free Space Propagation
  - No Wall/Building Attenuation
- ▶ WSD at 40 mW likely to Interfere with Mobile DTV Device at 1 or 2 Meters



a t s c  
MOBILE DTV

# Mobile DTV Rollout



a — t — s c

M O B I L E D T V

- ▶ Atlanta and Seattle model R&D stations
- ▶ Market studies to begin in Washington DC
- ▶ WRAL begins first commercial deployment
- ▶ 70 stations in 28 markets by end of 2009
- ▶ ATSC A/153 from CS to Proposed Standard
- ▶ Consumer equipment from LG, Samsung, Dell, Kenwood, Visteon,
- ▶ Broadcast equipment from Harris, Rhode Schwarz, Trevini available

# Geolocation / Database Approach

*Crash programs fail because they are based on the theory that, with nine women pregnant, you can get a baby in a month.*

Werner von Braun

# Geolocation/Database Approach

- ▶ MSTV supports geolocation/database approach
- ▶ Despite claims approach not tested
- ▶ Motorola device had no geolocation capability
  - Coordinates input manually to separate PC
  - Simple look up to Washington TV database on separate PC
- ▶ Protection of wireless microphones?

# Geolocation / Database Approach

- ▶ MSTV is a member of the Whitespace database group started by Google
- ▶ Group is working to develop a database architecture that will allow WS devices to operate and protect TV viewers and wireless microphone operations
- ▶ Still lots of issues to be resolved!

# Thank You

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“God Help Us; We're In The Hands Of Engineers”

–Dr Ian Malcolm, [in Jurassic Park](#)