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November 22, 2013

Marlene H. Dortch, Secretary  
Federal Communications Commission  
445 Twelfth Street SW  
Washington, DC 20554

Re: *Ex Parte* Notice: Revision of Part 15 of the Commission's Rules to Permit  
Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz  
Band – ET Docket No. 13-49; *Ex Parte* Notice

Dear Ms. Dortch:

On November 20, 2013, L. Barbee Ponder IV, General Counsel & Vice President, Regulatory Affairs, for Globalstar, Inc. ("Globalstar"), Dennis Roberson, President and Chief Executive Officer of Roberson and Associates, LLC, ("Roberson and Associates"), Ken Zdunek, Vice President and Chief Technology Officer of Roberson and Associates, Steve Berman of Lawler, Metzger, Keeney & Logan, LLC, and I had separate meetings with Commissioner Ajit Pai and Jeffrey Neumann, Acting Legal Advisor to Commissioner Pai; Commissioner Michael O'Rielly and Erin McGrath, Legal Advisor to Commissioner O'Rielly; and Renee Gregory, Legal Advisor to Chairman Thomas Wheeler, regarding the Commission's above-captioned proceeding on its rules governing the use of the 5 GHz band by Unlicensed National Information Infrastructure ("U-NII") devices.<sup>1</sup>

At these meeting, Globalstar's representatives addressed the harm that the proposed operation of unlicensed outdoor equipment in the U-NII-1 band at 5150-5250 MHz would cause to Globalstar's licensed mobile satellite service ("MSS") operations, within the United States and throughout North America. In particular, Mr. Roberson and Dr. Zdunek described the results of a detailed, independent technical analysis that was recently conducted by Roberson and Associates. This technical analysis demonstrates that if the Commission amends its rules to permit outdoor operations in the U-NII-1 band, the projected outdoor deployments in this spectrum would cause significant harmful interference to Globalstar's licensed MSS feeder uplinks in the 5 GHz band. This analysis further demonstrates that this uplink interference would in turn have a substantial detrimental impact on Globalstar's licensed service to MSS end users, due to effects on satellite power availability, user capacity, and geographic service

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<sup>1</sup> See *Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, Notice of Proposed Rulemaking, 28 FCC Rcd 1769 (2013) ("*5 GHz NPRM*").

availability. These harms would occur not only in the United States, but also in Mexico and Canada. The key aspects of Roberson and Associates' technical analysis are included in the slide presentation attached to this *ex parte* notice. (This presentation was provided to the Commissioners and the legal advisors at these meetings.) Globalstar will soon file Roberson and Associates' complete technical report on these 5 GHz U-NII-1 interference issues into the record of this proceeding.

As indicated in its earlier comments in this proceeding, Globalstar appreciates the Commission's efforts to free up additional spectrum for mobile broadband applications in order to address consumers' increasing demand for more data-intensive applications.<sup>2</sup> With respect to the 5 GHz NPRM, Globalstar supports the Commission's proposed revisions to the operating rules for U-NII-2A and U-NII-3 equipment, as well as the Commission's proposal to make available an additional 195 MHz of spectrum for use by U-NII devices. Globalstar has shared its 5 GHz feeder uplink spectrum with indoor U-NII-1 devices since it began providing MSS in 2000, and, as stated in its comments, it would accept an increase in the U-NII-1 power limit to the level permitted in the U-NII-2A band.<sup>3</sup> The proposed operation of outdoor U-NII-1 devices represents an entirely different kind of rule change, however. As Roberson and Associates' technical analysis shows, these operations would result in substantial harm to an established MSS licensee and its customers, including rural consumers and public safety personnel. Consistent with its rules and policies protecting licensed services from harmful interference from unlicensed operations,<sup>4</sup> the Commission should maintain its prohibition on the outdoor operation of unlicensed devices in the U-NII-1 band.

Pursuant to section 1.1206(b)(2) of the Commission's rules, 47 C.F.R. § 1.1206(b)(2), this *ex parte* notification and the attached presentation are being filed electronically for inclusion in the public record of the above-referenced proceeding.

Respectfully submitted,

/s/ Regina M. Keeney  
Regina M. Keeney

cc: Commissioner Ajit Pai  
Commissioner Michael O'Rielly  
Renee Gregory  
Erin McGrath  
Jeffrey Neumann

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<sup>2</sup> See, e.g., Comments of Globalstar, Inc., ET Docket No. 13-49 (May 28, 2013).

<sup>3</sup> *Id.* at 6 n.18.

<sup>4</sup> See 47 C.F.R. § 15.5(b).

# **Impact of Proposed U-NII-1 Rule Changes on Globalstar**

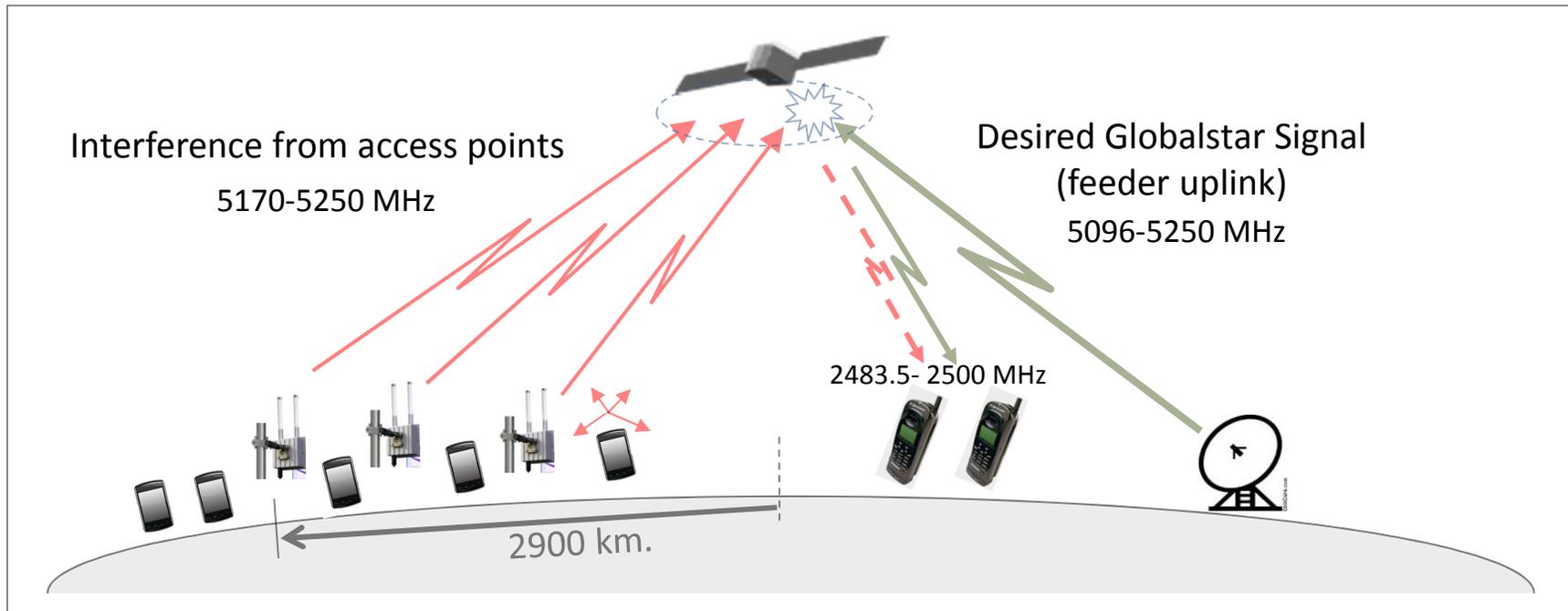
Prepared for Globalstar, Inc.  
by Roberson and Associates, LLC  
November 20, 2013

# Overview

- **Technical Assessment of Impact of Proposed U-NII-1 Rule Changes**
  - Would Allow Outdoor Operation, and Either U-NII-2 or U-NII-3 Power Limits
- **Assessment Approach**
  - Use number of unlicensed access points that will be deployed
  - Use realistic access point operational characteristics
  - Calculate impact on Globalstar feeder uplink and downlinks
  - Calculate impact on Globalstar Capacity, RF Power, and Quality of Service
- **Compare to Previous NCTA analysis: Identify and Correct Errors**
- **Results**
  - Millions of outdoor access points will be deployed in U-NII-1 band
  - 27 dB greater interference than ITU-R recommendation S.1426 for U-NII-2 rules
  - 10 dB increase in Uplink (Interference + Noise) also degrades Downlink
  - ~50% Reduction in Capacity to Maintain Downlink User Quality
  - OR:
  - 40% Degradation in Available Satellite User Transmit Power (40% Capacity Reduction)
- **U-NII-1 Rule Changes Not Recommended**

# UNII-1 Band Interference Scenario

- All unlicensed access points visible to satellite create interference at satellite receiver (all access points within a circle of 5800 km diameter on earth's surface)
- Desired Signal-plus-Interference is Repeated on the Downlink



# Impact of U-NII-1 Unlicensed Access Point Interference on Licensed Globalstar Operations

## 1. Increased Downlink Interference Degrades Downlink Quality (Signal-to-Interference Ratio), Reducing User Quality of Service (geographic availability)

- If Increase Downlink Power to Maintain Quality , then RF Power Wasted...  
→ Capacity Reduction

**OR**

- If Reduce Globalstar Intra- and Inter- beam Interference to Maintain Quality ...  
→ Capacity Reduction

**AND**

## 2. Repeated Interference “Steals” from Finite RF Power Available on the Downlink

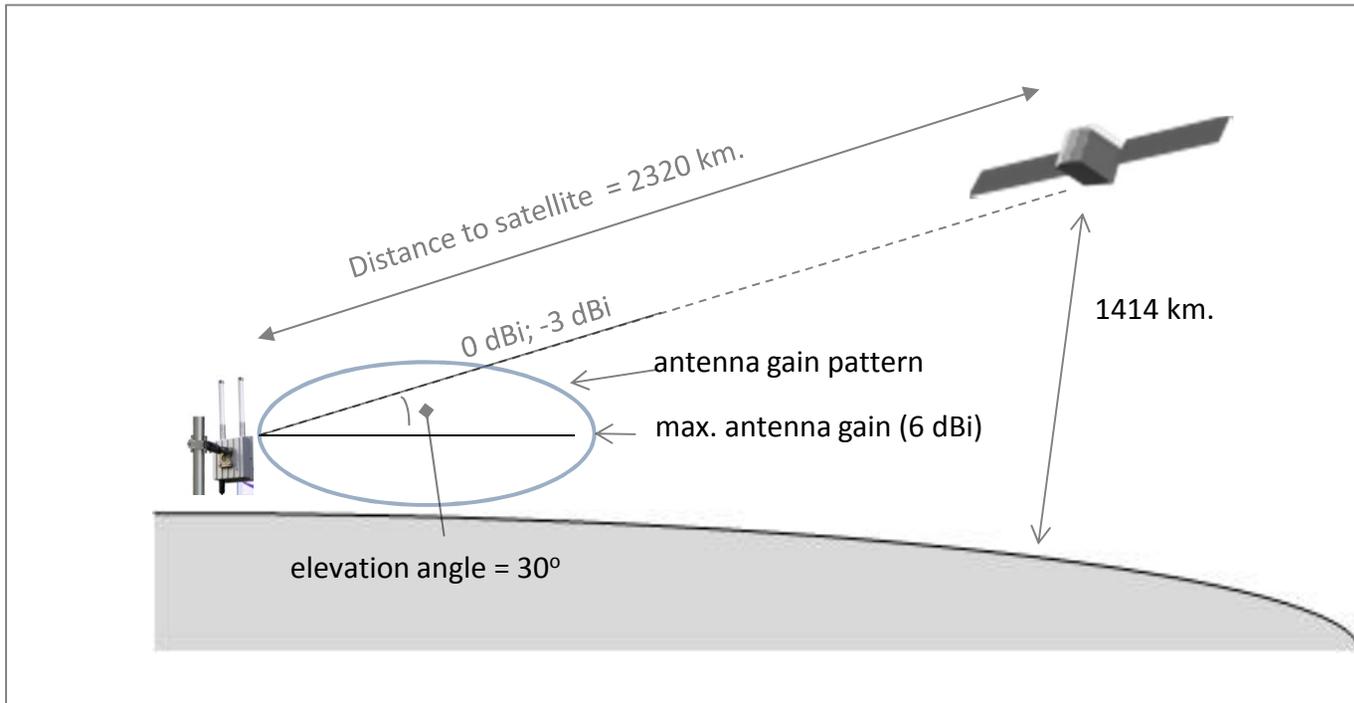
- Less Power Available for User Transmissions → User Capacity Reduction

**These effects are evaluated separately**

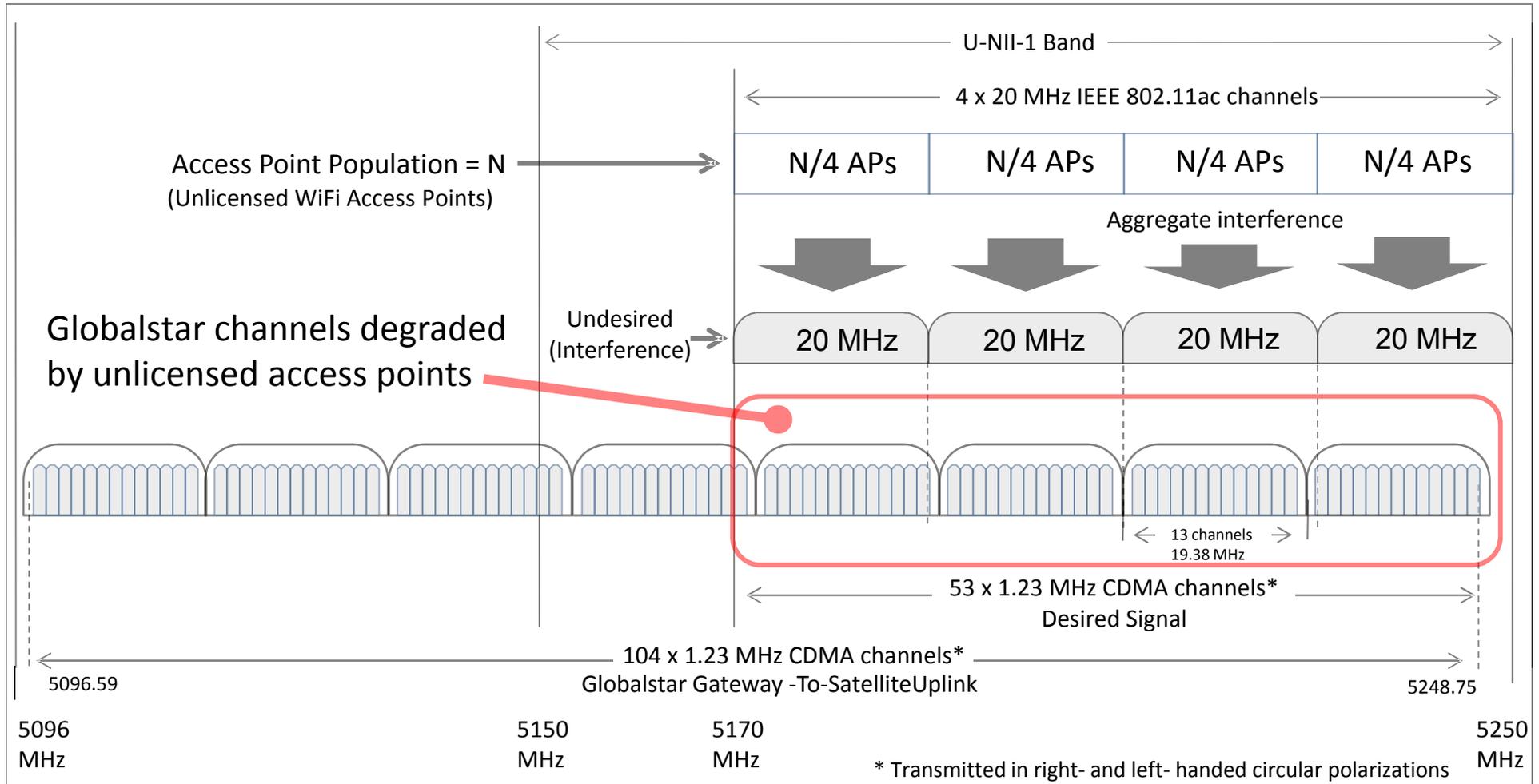
# Expected Number of Access Points

- Google WiFi Deployment (Mountain View, CA)
  - 500 access points / 31 km<sup>2</sup> = 16 ap's /km<sup>2</sup>
  - U.S. Urban Area = 276,000 km<sup>2</sup>
    - ~ 4.4 Million AP's ( 1 provider in U-NII-1 band)
    - ~ 1.1 Million AP's per 20 MHz IEEE channel
- Time Warner
  - “Thousands” of AP's in 40 mi<sup>2</sup> → ~20 AP's/km<sup>2</sup>
- COMCAST plans
  - 200,000 as of Oct. 1 → “...millions additional”

# Access Point Characteristics Used in Analysis



# UNII-1 Band Interference Scenario (bandplan)



# Capacity Reduction on Globalstar Downlink

1) Access point interference  $I_a$  degrades uplink

$E_b/(N_0+I_0)$   
relationship  
for satellites  
acting as  
Repeaters\*

$$\frac{E_b}{N_0 + I_0}_{MIN, ovr} = \left[ \left( \frac{E_b}{N_0 + I_0 + I_a} \right)_{up}^{-1} + \left( \frac{E_b}{N_0 + I_{o,red}} \right)_{dn}^{-1} \right]^{-1}$$

2) Since overall performance must be maintained

3) Inherent CDMA interference  $I_0$  on downlink must be reduced.

4) Reducing CDMA inherent interference  $\rightarrow$  Capacity Reduction

\*Satellite Communication Systems, p. 117, M. Richharia, McGraw Hill, Second Edition, 1999.

# Capacity Degradation Calculation

Relative Capacity as a Function of Number of Access Points

Number of Access Points U-NII-2 Rules Outdoor (6 dB antenna elevation loss) in 20 MHz BW	Uplink Degradation (dB)	Uplink Eb/(No+Io+Ia) (dB)	Required Downlink Eb/(No+Io,red) (dB)	Overall Eb/No+Io) (dB) Required [Eb/(No+Io)min]	Incr = Increase in downlink (Eb/No+Io) needed to maintain Eb/(No+Io)MIN, ovr (db)	Io, downlink dBW/Hz	Reduces in Downlink Io (dB) Required	Relative Capacity
-	0	19.9	1.063	1.01	0	-209.60	0.00	1
32,000	1	18.9	1.077	1.01	0.0145	-209.67	0.07	0.985
72,000	2	17.9	1.095	1.01	0.0325	-209.75	0.16	0.965
185,000	4	15.9	1.150	1.01	0.0875	-210.03	0.43	0.906
365,000	6	13.9	1.235	1.01	0.1725	-210.48	0.88	0.816
650,000	8	11.9	1.375	1.01	0.3125	-211.32	1.72	0.673
1,100,000	10	9.9	1.610	1.01	0.5475	-213.15	3.55	0.442
1,820,000	12	7.9	2.000	1.01	0.9375	-220.32	10.72	0.085

Req'd For User QoS

1.1 million APs cause 10 dB Uplink Degradation

Downlink Quality Must Increase 0.6 dB To Maintain User QoS

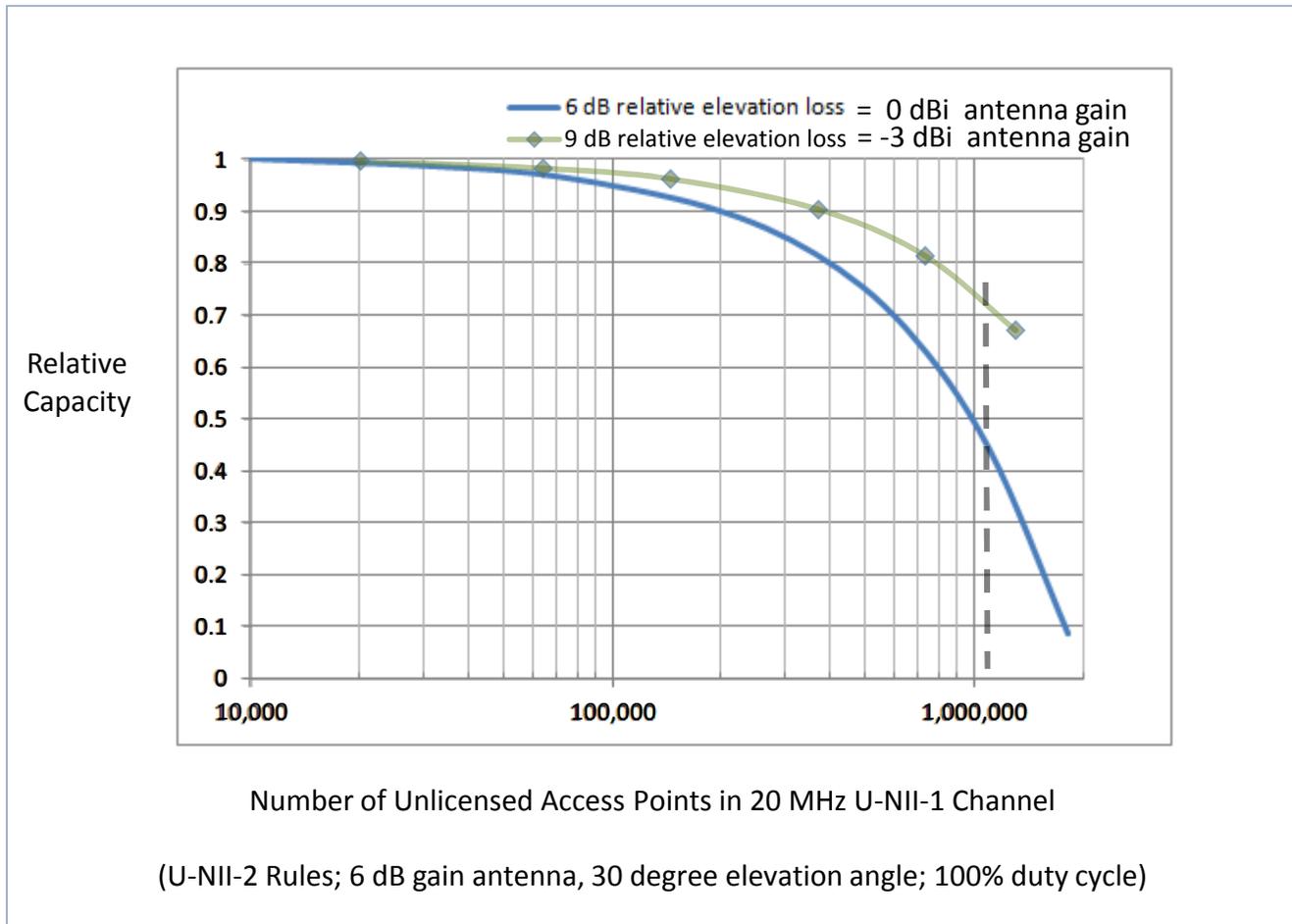
Downlink Power Must Increase 0.55 dB To Maintain User QoS (see RF Power Impact)

OR Downlink CDMA Interference Must decrease 3.55 dB to Maintain User QoS

User Capacity Is Reduced by 56% (next chart)

Impact of 0.55 dB on User QoS → 5% degradation of availability

# Globalstar Capacity Degradation Due to Outdoor Unlicensed Access Points (U-NII-2 Rules)

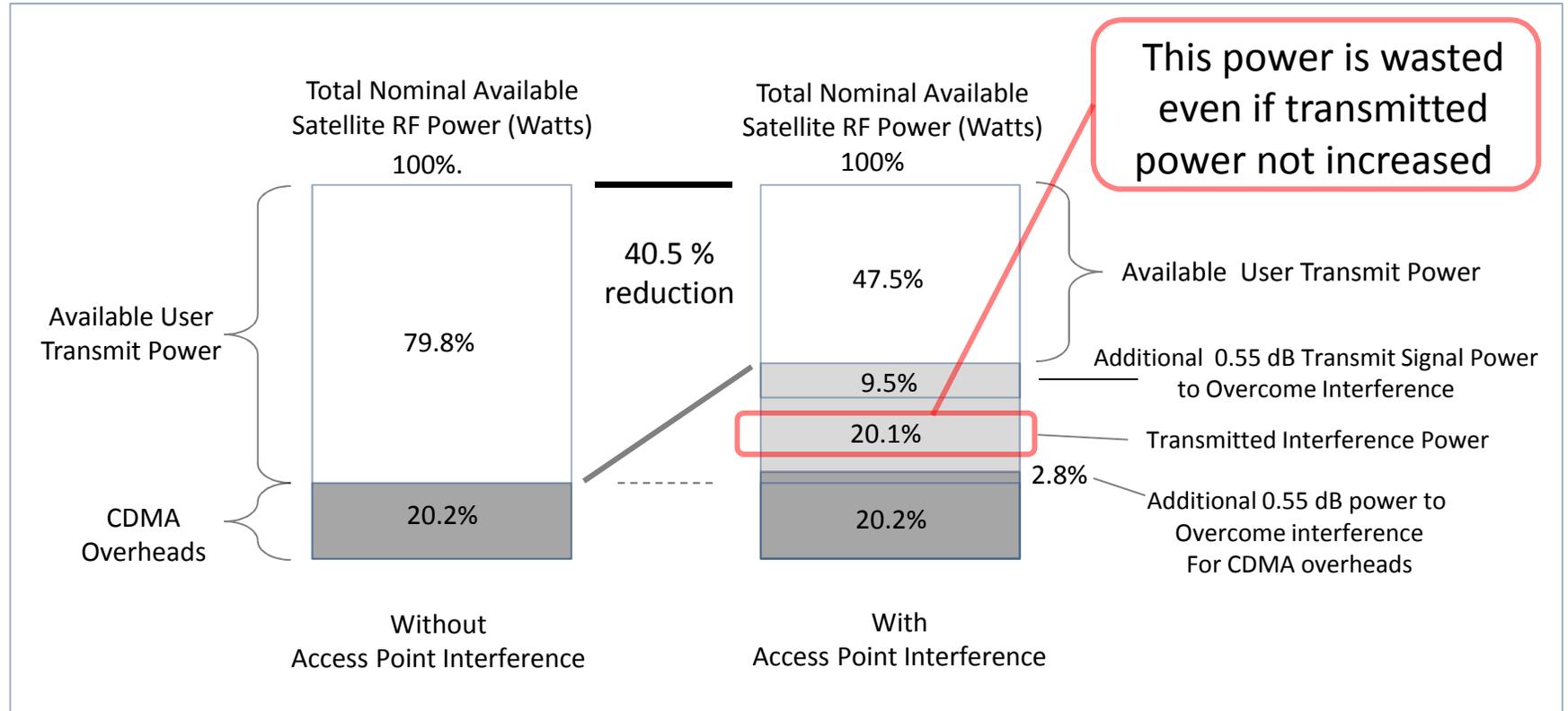


1.1 million access points in a 20 MHz IEEE channel cause a 55% capacity reduction

# Impact on RF Power Available for User Communications

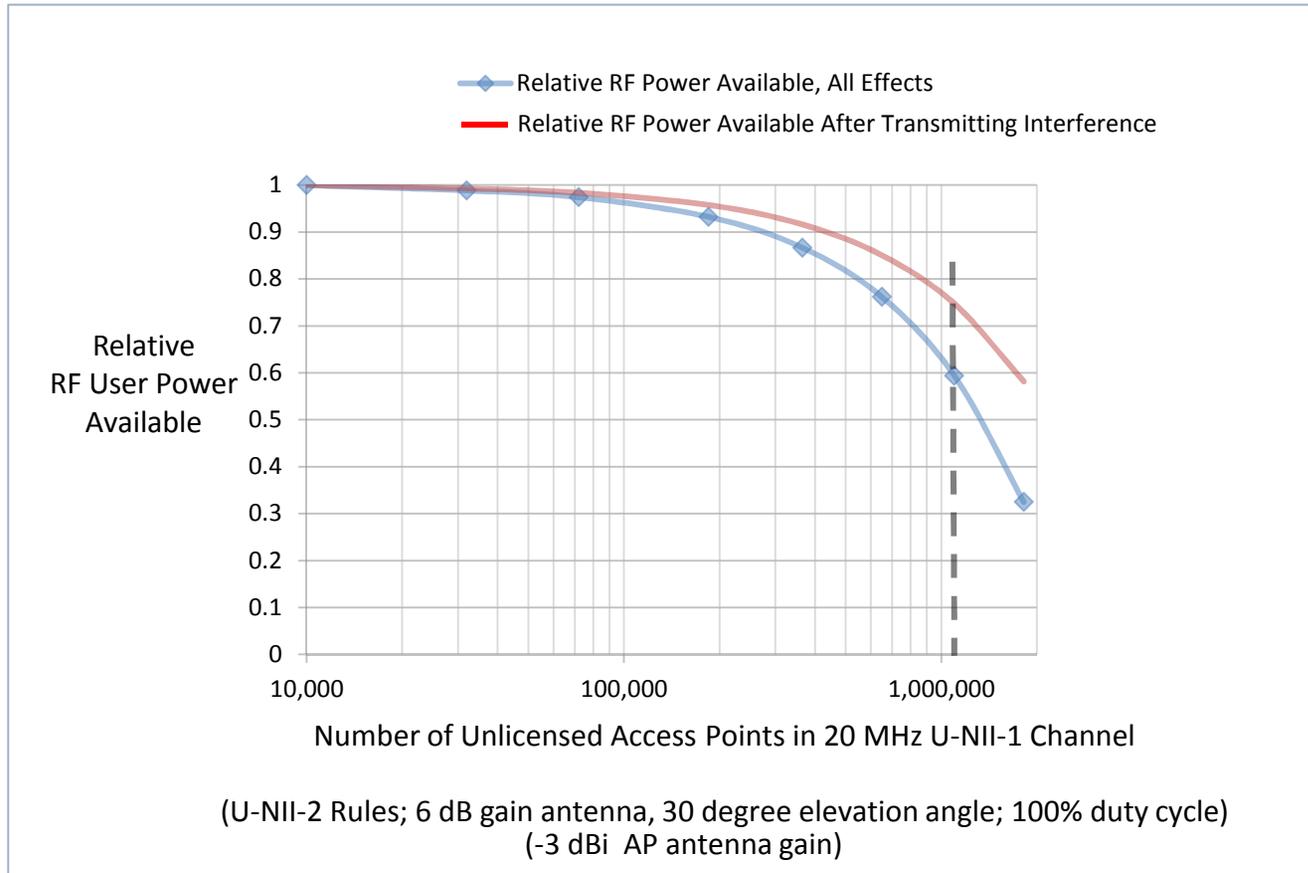
- Total RF Power Available on a Satellite is Limited, Divided Between
  - *User Communications* (CDMA) to Handheld Devices
    - # users supported directly related to RF power available
  - *CDMA Communications Overheads* (fixed)
    - Pilots, Synchronization, Paging Channels
- Additional Uplink Interference “Steals” RF Power Available on Downlink
  - Additional RF power required to overcome degraded downlink Signal to Noise plus Interference
    - Additional RF power required to transmit CDMA overheads
    - Additional RF power required to transmit user communications
  - Additional interference power is retransmitted on downlink (*this power always wasted, even if RF power not increased*)

# Globalstar RF Power Availability Degradation (Capacity Impact)



1.1 million access points in a 20 MHz IEEE channel cause a 40% reduction in available RF power at the satellite, "stealing" power and reducing capacity.

# Globalstar RF Power Degradation Due to Outdoor Unlicensed Access Points (U-NII-2 Rules)



- 1.1 million access points in a 20 MHz IEEE channel cause a 40% RF power reduction
  - A 25% RF power and capacity reduction is unavoidable
- 300,000 devices cause a 10% reduction

# References

- **Number of Access Points**

“Comcast to expand number of neighborhood Wi-Fi hotspots,” *USA Today*, June 10, 2013.  
<http://www.usatoday.com/story/tech/2013/06/10/comcast-wifi-hotspots/2407219/>

*Testimony of Thomas F. Nagel, Senior Vice President, COMCAST Corporation, before the U.S. House Committee on Energy and Commerce Subcommittee on Communications and Technology, Hearing on “Challenges and Opportunities in the 5 GHz Spectrum Band, Oct. 1, 2013, page 4, accessed at*  
<http://democrats.energycommerce.house.gov/sites/default/files/documents/Testimony-Nagel-CT-5-GHz-Spectrum-Band-2013-10-1.pdf>

*Comments of Time Warner, In the Matter of Revision of Part 15 of the Commission’s Rules To Permit Unlicensed National Information Infrastructure (U-NII) Devices in the % GHz Band., ET Docket No. 13-49, May 28, 2013, accessed at*  
<http://apps.fcc.gov/ecfs/document/view;jsessionid=K3m5RpwBRyFvp3bXDp1rfj8qHZMQXtgTxc4DRJYhvbvQh31g2F6!-477673473!1084688677?id=7022418894>

*Google WiFi*, accessed at [http://en.wikipedia.org/wiki/Google\\_WiFi](http://en.wikipedia.org/wiki/Google_WiFi). 500 routers in Mountain View, CA have been deployed in an area of 31 sq km., or 16 routers per sq km

- **Globalstar Satellite Characteristics**

*Application for Modification of Nongeostationary Mobile Satellite Service System License (S2115) to Launch a Second Generation System*

- **User Quality of Service Impact**

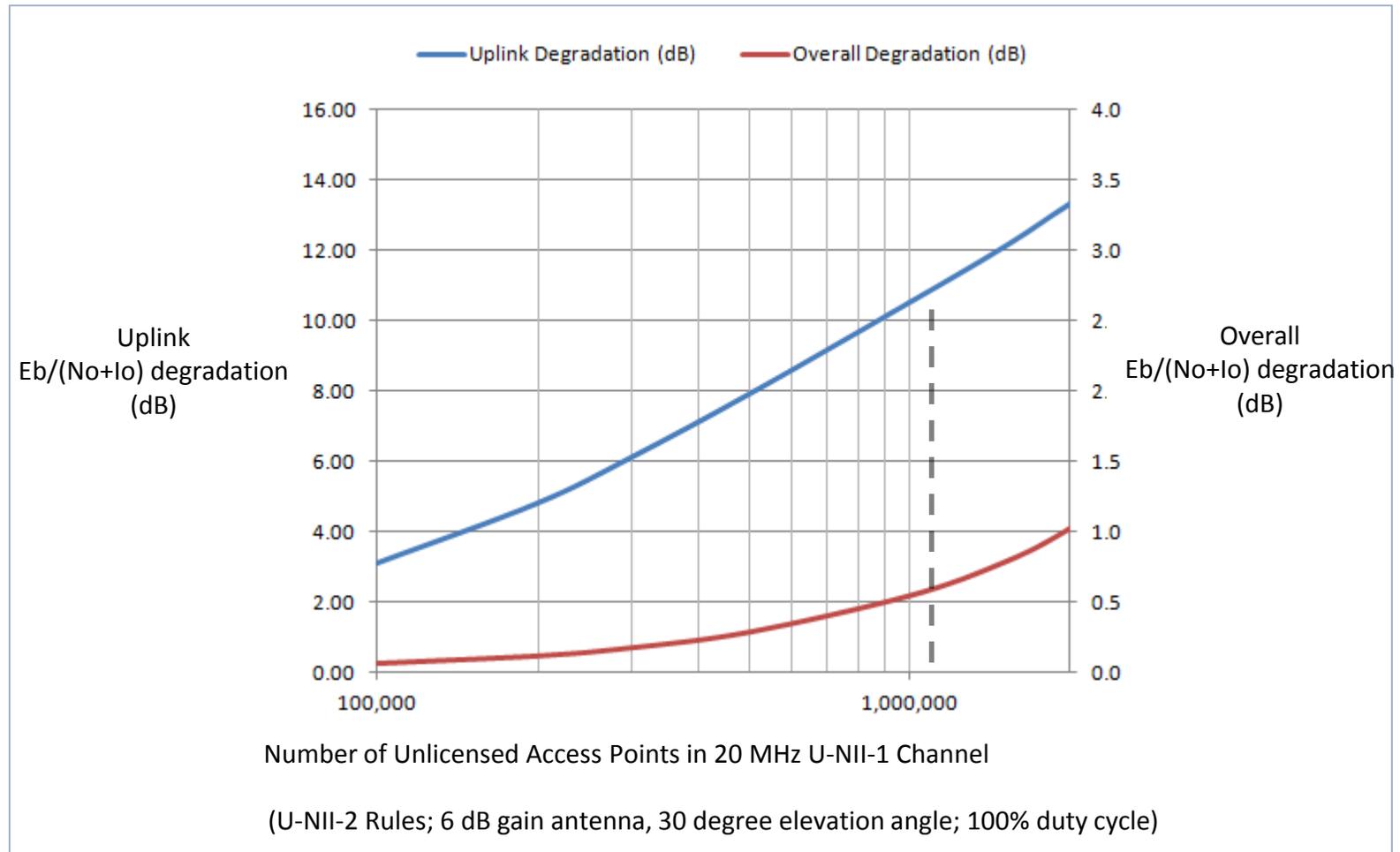
Giovanni E. Corazza and Francesco Vatalaro, “A Statistical Model for Land Mobile Satellite Channels and Its Application to Nongeostationary Orbit Systems,” *IEEE Transactions on Vehicular Technology*, Vol. 43, No. 3, August, 1994, Figure 1, p. 739.

## Impact of Proposed U-NII-1 Rule Changes on Globalstar Operations

- Aggressive unlicensed access point deployment plans in U-NII-1 band
  - Millions of outdoor devices to be deployed
- Significant Interference to Globalstar Uplink (+10 dB)
  - Degrades Capacity 25% Due to Re-transmitted Interference
  - **AND**
  - User Quality of Service Degradation (5% geographic coverage reduction)
    - OR
      - Additional 15% Capacity Reduction by Increasing User and Overhead Power
    - OR
      - Additional 25% Capacity Reduction to Reduce Intra- and Inter beam interference
- Changes to U-NII-1 Rules Not Recommended

# Analysis Detail

# Uplink and Overall Globalstar Link Degradation vs Number of Access Points



# Link Budget Capacity Reduction Calculation

Ref.	Parameter			Note
	Forward Link Budget			
A	Uplink Eb/(Io+No)	19.9	dB	Globalstar filing
B				
C				
D	Rx signal/user/satellite	-168	dBW/1.23 MHz	Globalstar filing
E	Log Bandwidth	60.90		
F	Rx signal density	-228.90	dBW/Hz	
G				
H	Downlink No	-203.9	dBW/Hz	Globalstar filing
I	Avg data rate (2400 bps)	33.80	dB bit/sec	Globalstar filing
J	Eb/No = (D -I- H)	2.10		
K				
L	Downlink Interference Io per chl	-148.7	dBW	Globalstar filing
M	Downlink Io density	-209.60	dBW/Hz	
N	Downlink No + Io	-202.9	dBW/Hz	
O	Down linkEb/(No+Io)	1.06	dB	Globalstar filing
P	Overall Eb/(No+Io) [= Overall Eb/(No+Io)MIN]	1.01		Globalstar filing; Overall Eb/No equation
Q	Coh combining gain	2.5	dB	Globalstar filing
R				
S	Resulting Overall Eb/(Io+No) [= P+Q (after coh comb)]	3.5		Globalstar filing
T	Overall Eb/(Io+No)MIN needed, after coh comb	3.5		Globalstar filing
U				
V	Degradation in Uplink Eb/(No+Io)	10	dB	from access point calculation. Table 1, row V
W	Uplink Eb/(No+Io+Ia) [= A-V]	9.9	dB	
X	Overall Eb/(No+Io+Ia) (Degraded)	0.53	dB	Equation for overall Eb/No
Y	Degradation in Overall Eb/(Io+No) [= P-X]	0.48	dB	
Z				
AA	Increase (Incr) in <b>Downlink</b> Eb/(No+Io) to maintain 1.01 overall, since uplink is degraded.	0.55	dB	Equation for overall Eb/No
AB	Increase (Incr) in <b>Downlink</b> Eb/(No+Io) to maintain 1.01 overall, since uplink is degraded.	1.134	linear	
AC				
AD				
AE	New reduced downlink Io required = Io, red, to maintain 1.01 overall	-213.1		dBW/Hz, Equation for Io,red
AF	Reduction in downlink Io required to maintain Eb/(Io+No)MIN [= M-AE]	3.55	dB	for 1.1 M access points, U-NII-2 rules, outdoor
AG	Relative Capacity	0.44		Linear
AH	Capacity Reduction	56%		

Table 2