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February 14, 2014

Via Electronic Filing

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

Re: *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:

The Federal Communications Commission ("FCC" or "Commission") cannot make a reasoned, record-supported finding in the above-captioned proceeding that unlimited Unlicensed National Information Infrastructure ("U-NII") devices can be deployed outdoors in the U-NII-1 band without causing harmful interference to Globalstar, Inc.'s ("Globalstar's") mobile satellite service ("MSS"). In light of the technical evidence in the record, rushing to permit outdoor, unlicensed deployment in the U-NII-1 band would violate the Commission's rules and the Communications Act.

There is a simple solution. Rather than adopting a new outdoor U-NII-1 rule unsupported by the record, the Commission should allow the productive ongoing discussions between Globalstar and the National Cable & Telecommunications Association ("NCTA") to continue toward a mutually-agreeable resolution of the outdoor U-NII-1 issues. The Commission should give these parties the necessary time to reach a positive outcome in this proceeding.

The Commission can and should adopt expeditiously the 5 GHz proposals that are supported by record evidence. There is support in the record, including from Globalstar, for the Commission's proposal to increase power limits for indoor U-NII-1 devices by 500%.[1] If the Commission increases the permitted indoor U-NII-1 power to 250 mW, it will enable the roll-out of indoor "Gigabit" Wi-Fi over a 160 megahertz channel spanning the U-NII-1 and U-NII-2A bands. Consistent with the record in this proceeding, the Commission can also expand the U-NII-3 band by 25 megahertz and consolidate all U-NII-3 equipment authorizations for

[1] Comments of Globalstar, ET Docket No. 13-49, at 6 n.18 (May 28, 2013).

digitally modulated devices under the U-NII rules.[2] These actions are supported by the record, will accelerate unlicensed operations in the 5 GHz band, and promote the public interest.

By contrast, a hastily-adopted rule permitting unlimited, unlicensed outdoor deployment in the U-NII-1 band would be counter to the record evidence and permit harmful interference to Globalstar's licensed MSS by unlicensed operations. Based on the available record, the Commission cannot make a reasoned, predictive judgment in favor of an unlimited, unrestricted deployment of outdoor U-NII-1 devices.[3] As demonstrated in the record by Globalstar and its nationally-recognized, independent experts, Roberson and Associates, LLC, unrestricted outdoor operations in the U-NII-1 band would have a substantial detrimental impact on Globalstar's MSS operations.[4] The Commission cannot reasonably rely on the technical materials submitted by NCTA,[5] because the evidence in the record demonstrates these submissions are flawed. As

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[2] *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, ¶¶ 27-28 (2013) ("*5 GHz NPRM*").

[3] Even within its field of expertise, an agency must provide some evidentiary support for its predictive judgments in order to avoid being found arbitrary and capricious. *See Cincinnati Bell Tel. Co. v. FCC*, 69 F.3d 752, 760 (6th Cir. 1995) (rejecting the FCC's predictive judgment regarding the potential for anticompetitive conduct in the wireless industry because the FCC provided "no statistical data or even a general economic theory" to support its conclusion and did not attempt "to justify its rule through the use of expert economic data, or by analogizing to related industries in which the claimed anticompetitive behavior has taken place"). It is elemental administrative law that the Commission "must examine the relevant data and articulate a satisfactory explanation for its action including a 'rational connection between the facts found and the choice made.'" *Motor Vehicle Manufacturers Association of the United States, Inc. v. State Farm Mutual Automobile Insurance Co.*, 463 U.S. 29, 43 (1983) (citation omitted). More generally, outside the context of a predictive judgment, agency action must not be based on speculative assumptions and must have adequate support in the record. *See Ariz. Cattle Growers' Ass'n v. United States Fish & Wildlife*, 273 F.3d 1229, 1244 (9th Cir. 2001) (finding that the Fish and Wildlife Service's decision to limit the use of land because of the presence of endangered species was arbitrary and capricious because evidence that the species inhabited the land was speculative and assumed that some fish could travel significantly upstream or survive unsuccessful repopulation programs).

[4] Before the Commission can authorize an unlicensed use, it must make an affirmative finding that such use would not have a significant potential to cause harmful interference. *See Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems*, Second Report and Order, 19 FCC Rcd 24558, ¶ 68, 70 (2004) (The Commission has long interpreted Section 301 of the Act to allow the unlicensed operation of a device that emits radio frequency energy as long as it does not "transmit[ ] enough energy to have a significant *potential* for causing harmful interference" to licensed radio operators.) (emphasis added).

[5] *5 GHz UNII-1: Wi-Fi and Globalstar Sharing Analysis*, Rob Alderfer, CableLabs, Dirk Grunwald and Kenneth Baker, University of Colorado ("NCTA Report"), attached to Letter from

Roberson and Associates demonstrated on the record, NCTA's technical reports are based on unrealistic assumptions, and represent neither a definitive nor reliable examination of the likely effects of the Commission's proposed U-NII-1 rule change.[6] With respect to NCTA's new "dynamic model,"[7] Roberson and Associates have pointed out that there has been no independent validation of the relevant inputs or the model itself, and, in any event, applying reasonable assumptions on the likely number of outdoor access points, this NCTA model predicts substantial harm to Globalstar.[8] If the Commission has its own internal technical data to support a finding that unlicensed, outdoor U-NII-1 operations would not cause harmful interference to Globalstar's licensed operations, it must share that analysis with the public.[9] It has not done so.[10]

There is a stark contrast between the evidence submitted for the record by Globalstar and NCTA on the critical issue of the likely number of outdoor U-NII-1 access points. In their technical submissions, Roberson and Associates estimated the deployment of 4.4 million outdoor U-NII-1 access points based on a representative, real-world urban density of approximately 16

Rick Chessen, NCTA, to Julius Knapp, FCC, ET Docket No. 13-49 (Jan. 22, 2014) ("NCTA *Ex Parte* Letter").

6 *See* Supplemental Comments of Globalstar, Inc., ET Docket No. 13-49 (Nov. 29, 2013) ("Globalstar Supplemental Comments"), attaching *Impact of U-NII-1 Rule Changes on Globalstar Operations*, Roberson and Associates, LLC, Chicago, Illinois (Nov. 27, 2013) ("Roberson Study"); Letter from Regina Keeney, Counsel to Globalstar, to Marlene Dortch, Secretary, FCC, ET Docket No. 13-49 (Feb. 7, 2014) ("Globalstar February 7 *Ex Parte*") attaching *Progress Report: Impact of Proposed U-NII-1 Rule Changes on Globalstar Operations*, Roberson and Associates, LLC, Chicago, Illinois (Feb. 5, 2014) ("February 5 Roberson Presentation").

7 *See* NCTA Report at 16-30.

8 Globalstar February *7 Ex Parte* at 3; February 5 Roberson Presentation at 9.

9 *Am. Radio Relay League, Inc. v. FCC,* 524 F.3d 227, 237 (D.C. Cir. 2008) ("It would appear to be a fairly obvious proposition that studies upon which an agency relies in promulgating a rule must be made available during the rulemaking in order to afford interested persons meaningful notice and an opportunity for comment."). As a general matter, in informal rulemakings such as the instant proceeding, "the most critical factual material that is used to support the agency's position must have been made public in the proceeding and exposed to refutation," and courts are required to "strike down, as arbitrary, agency action that is devoid of needed factual support." *Association of Data Processing Service Organizations v. Bd. of Governors of the Federal Reserve System*, 745 F.2d 677, 683-84 (D.C. Cir. 1984) (Scalia, J.);

10 Nor did the Commission in the *5 GHz NPRM* provide a clear standard for measuring harmful interference or seek comment on an appropriate interference threshold. Thus, to the extent the Commission adopts an order based on the existing record, it will not have provided interested parties an adequate opportunity to comment on the reasonableness of whatever threshold it ultimately selects.

access points per square kilometer.[11] This estimate conservatively assumed a U-NII-1 access point deployment by just a single commercial operator in urban areas and did not include any deployments in outer suburban or rural areas. Multiple outdoor deployments are more likely, given the tremendous growth in mobile data traffic and the needs of other communications carriers to offload such traffic from their macro networks.[12] While NCTA has made unsupported assertions that these estimates are too high, it has failed even to provide data regarding its members' own deployment plans.[13] The fervor with which it is pursuing authority for outdoor U-NII-1 deployment suggests its members will deploy widely. NCTA's members have, in fact, publicly announced aggressive, expansive plans to deploy outdoor 5 GHz access points.[14] Also, just yesterday, the two largest cable operators announced their intention to merge in a $45 billion transaction, a development likely to serve as the impetus for even greater growth in outdoor U-NII-1 infrastructure.[15] The only reasonable conclusion that the Commission can reach is that

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[11] Roberson Study at 7. The Roberson Study's estimate was based on Google's deployment of 500 routers throughout Mountain View, CA in an area of 31 square kilometers, not just on Google's access deployments on its own "campus." See *Google WiFi,* http://en.wikipedia.org/wiki/Google_WiFi.

[12] *See* Globalstar February 7 *Ex Parte* at 2-3. Wireline providers, wireless carriers, commercial entities, educational institutions, municipalities and other government facilities, and residential users are also likely to deploy substantial numbers of outdoor access points nationwide. In addition, if the Commission permitted outdoor U-NII-1 deployment, other national administrations might follow and cause an even greater detrimental impact on Globalstar's licensed services.

[13] If the cable industry is correct that the number of outdoor U-NII-1 access points will be limited, it should have no trouble accepting a limit on the number of such deployments. Neither NCTA nor its member operators have indicated that they would consider such a restriction, however, and have not proposed any specific number.

[14] *See, e.g.,* NCTA Position, *In the (Not So) Distant Future*, http://www.ncta.com/positions/unlicensed-spectrum?utm_source=InH&utm_medium=stor&utm_content=full1&utm_campaign=tiles (viewed Feb. 7, 2014); Roberson Study at 6 & n.10; Map of over 500,000 XFINITY WiFi Hotspots, http://www.comcast.com/wifi/default.htm?SCRedirect=true (viewed Feb. 7, 2013). Significantly, at a House hearing in November, Thomas Nagel of Comcast stated that "Comcast's efforts are really only beginning. . . . We are rolling out a new neighborhood hotspot initiative that has the potential to add millions of additional Wi-Fi access points throughout our footprint, thereby significantly enhancing consumers' ability to stay connected. *Importantly, all of our outdoor access points – and all the outdoor access points installed by our cable partners – include the ability to access the 5 GHz band*." Thomas Nagel, "Testimony Before the House Committee on Energy and Commerce Subcommittee on Communications and Technology," *Hearing On Challenges and Opportunities in the 5 GHz Spectrum Band*, at 4 (Nov. 13, 2013), http://democrats.energycommerce.house.gov/sites/default/files/documents/Testimony-Nagel-CT-5-GHz-Spectrum-Band-2013-11-13.pdf (emphasis added).

there will be dramatic unlicensed growth within this band, including, if permitted, outdoor deployment.[16]

Just as the Commission should assume the success of cable operators' plans, it should assume the success of Globalstar's reemerging MSS duplex business in its licensed spectrum. Just five months ago, Globalstar completed its seven-year, $1 billion campaign to design, build, launch, and deploy the world's first second-generation LEO constellation and restore its industry-leading duplex capabilities. Globalstar's global MSS system will support highly reliable, crystal-clear CDMA-quality voice and data satellite services to the millions of consumers, public safety personnel, and other potential customers covered by the new network beyond 2025. Globalstar is enjoying growth across its various business lines, with greater minutes of use, rising average revenue per user, increased subscribership, and expanding equipment sales. Last month, Globalstar introduced a product that is likely to accelerate these trends. The "Sat-Fi" is a revolutionary voice and data technology that provides seamless integration between any Wi-Fi enabled device (*i.e.*, smartphones, tablets, laptops, etc.) and Globalstar's second-generation MSS constellation. With Sat-Fi, Globalstar subscribers can use their existing smartphones and existing phone numbers to send and receive communications over Globalstar's global MSS network, offering voice and data connectivity when beyond the range of cellular networks or when terrestrial networks are temporarily unavailable due to natural or man-made disasters.[17]

If, as the Commission should assume, outdoor unlicensed 5 GHz operations and Globalstar's MSS network are both commercially successful and enjoy substantial growth, a decision to reallocate a significant portion of Globalstar's capacity to unlimited outdoor U-NII-1

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[15] Press Release, Comcast, *Time Warner Cable to Merge with Comcast Corporation to Create a World-Class Technology and Media Company* (Feb. 13, 2014), http://corporate.comcast.com/news-information/news-feed/time-warner-cable-to-merge-with-comcast-corporation.

[16] The Commission has in other contexts acknowledged the validity of interference concerns "given the potential ubiquitous and uncontrolled deployment of unlicensed devices." *Unlicensed Operation in the TV Broadcast Bands; Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band*, Notice of Proposed Rulemaking, 19 FCC Rcd 10018, ¶ 21 (2004).

[17] *Globalstar Introduces Sat-Fi, A Groundbreaking MSS Solution*, Globalstar Press Release (Jan. 29, 2014), http://www.globalstar.com/en/index.php?cid=7010&pressId=804. Through a convenient app and Sat-Fi satellite hot spot, subscribers will be able to easily send and receive calls, email, and SMS text messages anywhere within Globalstar's footprint from their own device. Like all Globalstar mobile satellite solutions, Sat-Fi is built and priced to appeal to a broad market, including enterprise and government customers as well as the mass consumer market.

operations would lead to substantial harmful interference to Globalstar's MSS operations.[18] This violation of Globalstar's rights as a primary licensee would likely be apparent during and after earthquakes, hurricanes and other disasters, when Globalstar's MSS network provides critical resiliency for public safety personnel.[19] After such disasters, when Globalstar's usage spikes, the unlimited operation of U-NII-1 access points around the United States (and potentially Canada and Mexico) could impair Globalstar's service to affected regions – just when that licensed satellite service is needed the most.

Neither NCTA nor any other party in this proceeding has identified an effective way to mitigate harmful interference to Globalstar and its customers. If millions of outdoor U-NII-1 access points were permitted to operate throughout the United States, it would be virtually impossible to "put the toothpaste back in the tube" and repair the harm to Globalstar and those who rely on its licensed services.

At meetings with the FCC in November 2013, Commission staff strongly encouraged Globalstar to reach out to the cable industry to resolve these U-NII-1 technical issues through a collaborative process. Globalstar promptly engaged in discussions with NCTA and cable operators and has identified a means of measuring actual uplink interference from outdoor U-NII-1 devices *at the satellite*. Globalstar's ability to measure *actual* aggregate interference could moot the need for projections of future interference levels based on the number of U-NII-1 access points, duty cycles, signal propagation, power levels, and other disputed parameters. Significantly, Globalstar's recent tests confirm the accuracy of its noise level measurements at

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[18] The high likelihood of such harmful interference was demonstrated on the record by Roberson and Associates in their November 2013 Roberson Study and is shown again in the slide presentation attached to this *ex parte* letter. Globalstar will soon file Roberson and Associates' full analysis of the January 22, 2014 NCTA Report into the record of this proceeding. This analysis will address not only the likely number of outdoor access points in the U-NII-1 band, but also such technical parameters as access point duty cycle, clutter effects, and signal propagation. Their analysis will also address the "dynamic" model described in the January NCTA Report.

[19] In the United States, Globalstar's MSS network played a vital role during and after the devastating Hurricanes Sandy and Katrina. Following Hurricane Sandy in the fall of 2012, Globalstar's network provided seamless communications in the Mid-Atlantic and Northeast regions of the United States where terrestrial communications systems were damaged and rendered unavailable. For instance, New York Power Authority ("NYPA") employees at the Flynn Power Plant in Holtsville, New York, relied exclusively on Globalstar MSS devices for their communications during the three-day period that terrestrial telephone and wireless systems were out of service. NYPA has stated that "during and immediately after Hurricane Sandy, our only means of communication into or out of our facilities located on Long Island was via satellite, over Globalstar's network." Letter from Frank A. Miller, New York Power Authority, to Acting Chairwoman Mignon Clyburn, FCC, RM-11685, at 1 (May 20, 2013, filed May 23, 2013).

the satellite. Globalstar has noise floor measurements in its feeder link spectrum that span the past two years, and the constant, baseline noise level during this period should enable the measurement and assessment of any future service degradation due to U-NII-1 outdoor access points. Globalstar believes this capability can serve as the foundation of a spectrum sharing framework – including a standard for harmful interference in the band – that allows the outdoor deployment of unlicensed U-NII-1 access points while protecting Globalstar's primary operations from harmful interference as required by the Communications Act and the Commission's rules.

The Commission has traditionally preferred industry-defined solutions and Chairman Thomas Wheeler has expressed his commitment to such efforts.[20] The Commission should encourage these voluntary industry efforts and allow the parties time to agree on the definition of potential harmful interference to Globalstar, the means of measuring that interference, and appropriate mitigation options to address such harm. Globalstar urges the Commission not to undercut these voluntary efforts with a premature, unsupported, and unreasonable decision on the future of the U-NII-1 band.[21]

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[20] The Commission generally favors voluntary industry solutions over regulatory mandates. Last year, the Commission allowed wireless licensees to coordinate an industry solution to provide interoperable LTE service in the Lower 700 MHz band rather than intervene to mandate interoperability. *Promoting Interoperability in the 700 MHz Commercial Spectrum; Requests for Waiver and Extension of Lower 700 MHz Band Interim Construction Benchmark Deadlines*, Report and Order and Order of Proposed Modification, 28 FCC Rcd 15122 (2013). In addition, Chairman Wheeler has repeatedly expressed his support for voluntary industry solutions. Just last month, he stated that "[w]hen the marketplace works, the reasons for regulation are diminished. Part and parcel with that belief, I also have said that the Commission should encourage multi-stakeholder solutions to network responsibilities. Inherent in the regulatory see-saw is the reality that if voluntary solutions don't work, we must be willing to pivot rapidly to a regulatory response." *See Improving 911 Reliability; Reliability and Continuity of Communications Networks, Including Broadband Technologies*, Statement of Chairman Thomas E. Wheeler, PS Docket Nos. 13-75; 11-60 (Jan. 30, 2014), http://transition.fcc.gov/ftp/Daily_Releases/Daily_Business/2013/db1212/DOC-324662A2.pdf.

[21] On February 11, 2014, 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 John Leibovitz from the Wireless Telecommunications Bureau; Erin McGrath, Legal Advisor to Commissioner Michael O'Rielly; Mindel De La Torre, Roderick Porter, Jose Albuquerque, Jennifer Gilsenan, Robert Nelson, Karl Kensinger, and Chip Fleming from the International Bureau; and Julius Knapp, Navid Golshahi, Geraldine Matise, Karen Rackley, Bruce Romano, Mark Settle, Bryant Wellman, and Aole Wilkins from the Commission's Office of Engineering and Technology, to discuss the key issues raised by the above-captioned proceeding on the use of the 5 GHz band by U-NII devices. In particular, as discussed in this *ex parte* letter, Globalstar's representatives

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:

Julius Knapp	Karl Kensinger
Erin McGrath	Geraldine Matise
Mindel De La Torre	Mark Settle
John Leibovitz	Navid Golshahi
Roderick Porter	Karen Rackley
Jose Albuquerque	Bruce Romano
Jennifer Gilsenan	Bryant Wellman
Robert Nelson	Aole Wilkins
Chip Fleming	

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addressed the harm that the unlimited deployment of outdoor U-NII-1 devices would cause to Globalstar's licensed MSS operations within the United States and throughout North America. The key elements of Roberson and Associates' assessment of NCTA's January 22 *ex parte* filing are included in the slide presentation attached to this *ex parte* notice. This presentation was provided to Commission staff at these meetings.

Roberson and Associates, LLC
Technology and Management Consultants

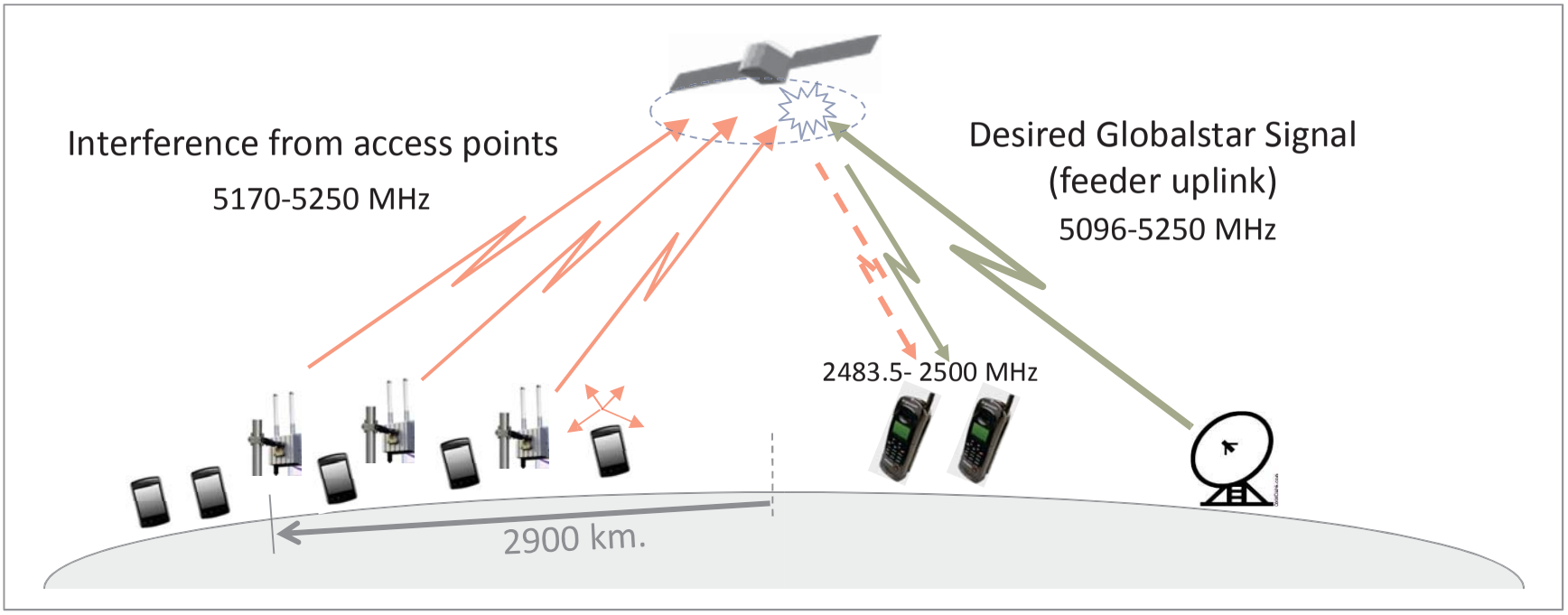
Progress Report: Impact of Proposed U-NII-1 Rule Changes on Globalstar Operations

Prepared for Globalstar, Inc.
by Roberson and Associates, LLC
February 11, 2014

Recap: U-NII-1 Band Interference Scenario

- **All** outdoor unlicensed access points visible to Globalstar's satellites create interference at satellite receiver
  (all access points within a circle of 5800 km diameter on earth's surface)

- Access point interference generated in the uplink degrades:
  1) Available satellite RF power
  2) Downlink capacity
  3) User handheld device service quality



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Technology and Management Consultants

Summary-1

- **NCTA January Ex Parte**
  - **Nothing in NCTA Report Changes Previous Conclusion that Unlimited, Unlicensed Outdoor Deployment of Access Points in U-NII-1 Band Will Cause Substantial Harm to Globalstar**
  - **Is Not Definitive or Reliable**
    - Unrealistic assumptions
    - Dynamic model's outputs have not been validated
    - Underestimates the number of outdoor APs in the U-NII-1 band, contradicting the push for outdoor operation
    - Errs in binomial probability calculation regarding AP duty cycle
  - **Ignores Degradation to Globalstar Satellite RF Power**
    - Ignores unavoidable, harmful reduction to Globalstar's capacity
  - **Contains Flawed Reasoning**
    - Asserts that a capacity and performance degradation potential to Globalstar is acceptable, because Globalstar has not yet loaded its network to its design capacity
    - Asserts the number of APs operating in the U-NII-1 band will be small, because of large amount of spectrum available for unlicensed use
  - **Abandoned Previous NCTA Position that 2 Billion Outdoor Access Points Would Not Harm Globalstar**

Roberson and Associates, LLC
Technology and Management Consultants

Summary-2

- **Progress: Areas of Agreement with NCTA's Jan. 22 ex parte**
  - Access Points Can Cause Harm to Globalstar
  - Relationship Between Uplink Interference Levels at Satellite, and Globalstar Degradation
  - Necessary to Establish Interference Protection Criteria for Globalstar
- **At Issue**
  - Number of Outdoor Access Points that Will be Deployed in the U-NII-1 Band
- **Continuing Talks with NCTA**
  - Globalstar Uplink Interference Protection Criteria – Setting Noise Rise Threshold at Satellites Would Moot Need to Estimate/Agree On the Number of Outdoor Access Points
  - Methods to Insure that Interference Limit is Met
  - NCTA Reviewing Confidential Information in Roberson Analysis per NDA
  - Globalstar Has Requested Additional Information to Clarify Jan 22 ex parte

Progress: NCTA Relies on the Capacity Degradation Calculation in the 2013 Roberson Analysis (Table 7)

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	Reducs 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

Example: 10 dB Uplink Degradation Produces 56% Capacity Degradation

cf. Jan 22 NCTA analysis

However:

- NCTA grossly underestimates the equivalent number of outdoor access points to be deployed in the U-NII-1 band, without limit under unlicensed rules, considering all operators and unlicensed users: non-carrier commercial, educational, and government entities.
- NCTA disagrees with the number of unlicensed access points that will produce a given level of uplink degradation

Assessment of Number of Unlicensed Access Points and WiFi Channels

- 4 Nationwide Deployment Entities
  - Operators
    - (1) Cable
    - (2) National Wireless Operator-1
    - (3) National Wireless Operator-2
  - (4) Non-Operator Entities
    - Non-DoD Federal Government Agencies (e.g. Dept of Interior)
    - Dept of Defense
    - State and Local Government (e.g. Law Enforcement, Muni-WiFi)
    - Commercial, Industrial (e.g. theme parks, business campus) 4 Nationwide Equivalent Deployments
  - 16 AP/km-sq (urban area) for each deployment (density of OUTDOOR APs in city of Mountain View)
  - 4.4 Million APs for each deployment (Roberson Nov. ex parte)

- 20 MHz Channels Available at 5 GHz and 2.4 GHz
  - 4 channels in U-NII-1
  - 8 additional non-U-NII-1 channels (3@ 2.4 GHz; 5@ U-NII-3)

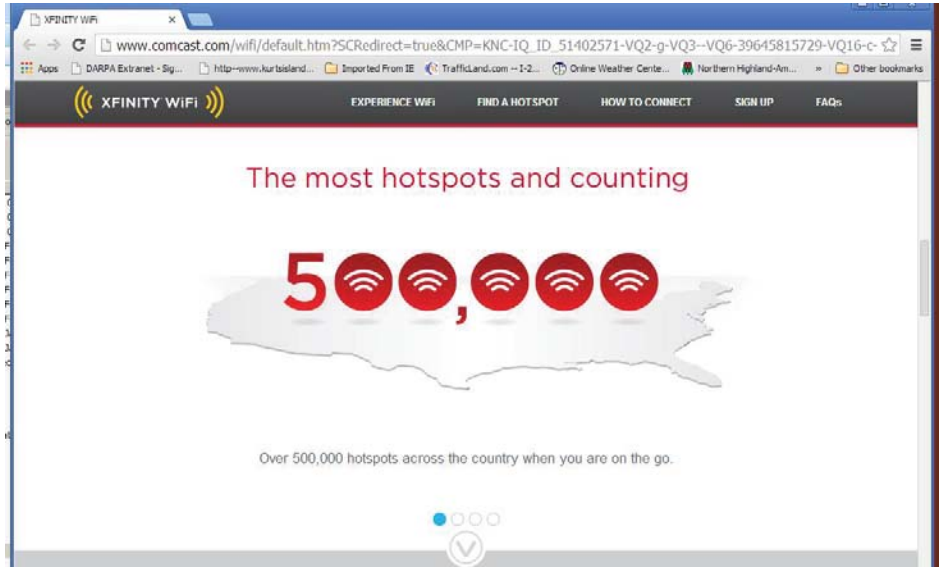
AP in U-NII-1 = 5.8 million or (1.4 m per 20 MHz)

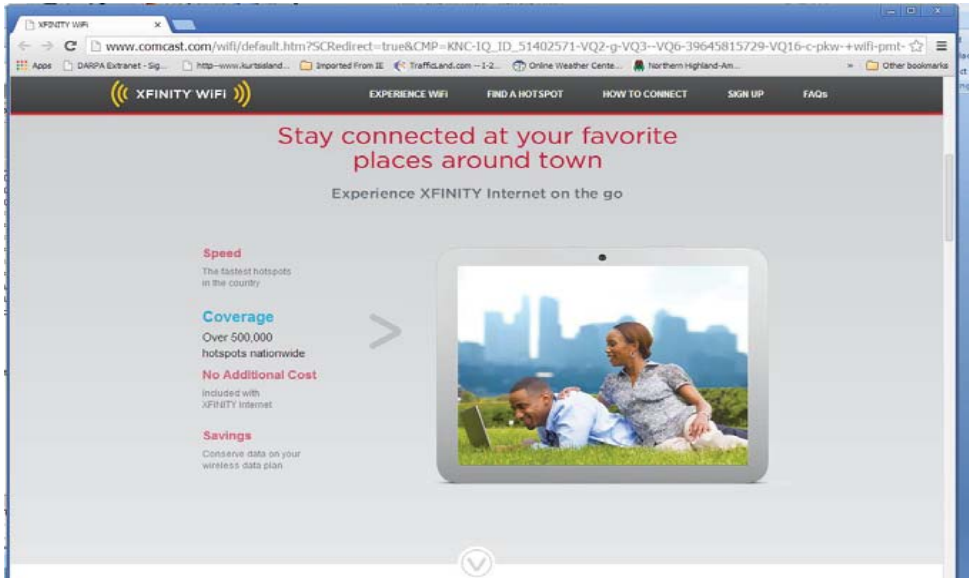
$= 4.4M_{\text{per deployment}} \times 4_{\text{deployments}} \times 0.33_{\text{fraction of AP in U-NII-1}}$

Number of APs
Can be Higher Than 4.4 M

if 12 total WiFi channels

Example: Current Cable Operator Deployment





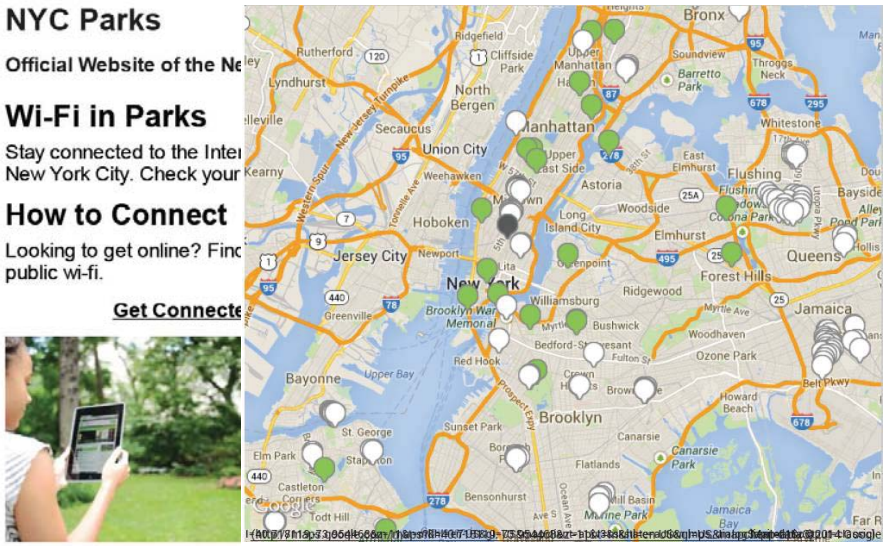
Example: Non-Operator Outdoor Deployments

University Campus

Outdoor Coverage Map

http://it.stonybrook.edu/services/wi-fi-wolfienet

City Parks



Outdoor AP Locations, NYC

http://www.nycgovparks.org/facilities/wifi

Roberson and Associates, LLC
Technology and Management Consultants

At Issue: Number of Access Points that will be deployed in U-NII-1

Globalstar performance degradation is significant if "Middle Ground" assumptions used

Parameter	Jan 22 NCTA Ex Parte: NCTA Reported Roberson Worst Case	Jan 22 NCTA Ex Parte: NCTA Claimed Actual Worst Case from Recent Ex Parte	Corrected: Proposed "Middle Ground" Assumptions
AP Density	4.4M APs	Half of public AP **MAY** be indoors	Half of public AP **MAY** be indoors
Duty Cycle	100%	10%	40% (peak traffic hour)
Channelization	All APs use only UNII-1	8 additional channels	8 additional channels
Equivalent Outdoor APs at 100% Duty Cycle in Single UNII-1 Channel	1.1 M	18,150	290,000
Capacity Degradation	56%	1.50%	15%
Number of Network Operators, Private and Gov't Entities Assumed	1	Not Stated	4
Conclusion	**Unacceptable**	**Acceptable? According to NCTA**	**Unacceptable**

(No guarantee of this, with unrestricted deployment under unlicensed rules)

15% Globalstar degradation is significant, result of:

1) Considering ALL entities deploying national level networks (3 operators and 1 "operator equivalent" consisting of all private, non-operator commercial, and government entities; plus Canada and Mexico).
2) Peak traffic hour duty cycle of 40% (used by NCTA in its subsequent analysis)
3) Capacity loss could be much higher since NO LIMIT to number of unlicensed APs

* Roberson AP Density was based on ***one*** operator's deployment

Capacity Degradation Calculation Comparison (Previous Chart)

- NCTA Claimed Worst Case ➡ 1.5% degradation

$$1{,}100{,}000_{APs} * 0.5_{outdoor} * 0.1_{duty\ cycle} * 0.33_{channels} = 18{,}150_{AP\ equivalents}{}^{20}$$

Calculation in NCTA Jan 22 ex parte

- "Middle Ground" Assumptions ➡ 15% degradation

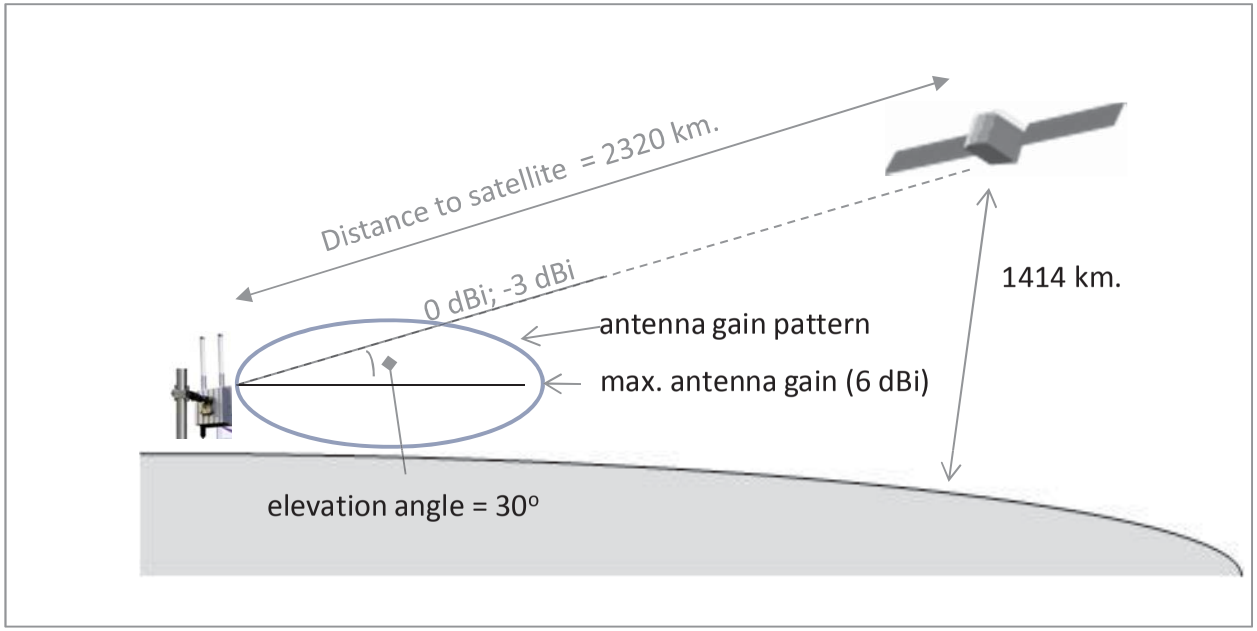
$$1{,}100{,}000_{APs} * 0.5_{outdoor} * 0.4_{dutycycle} * 0.33_{channels} * 4_{deployments} = 290{,}000_{AP\ equivalents}$$

Calculation with "Middle Ground" Assumptions

Actual number could be far greater with unlicensed rules, no deployment restrictions

The issue of number of AP could be moot with agreed-upon interference protection criterion on the uplink based on noise threshold at satellites.

July NCTA Filing Used Representative Access Point Characteristics:
Roberson Associates adopted these for its November analysis.



However

- NCTA has <u>Abandoned</u> this Approach Due to Calculation Errors Made While Using It (which it does not dispute)
- Now Presents Results of a Dynamic Simulation Model
  - Uses flawed assumptions on AP deployment (only 1 nationwide deployment)
  - Accuracy has not been validated, nor internal calculations revealed

Perspective on NCTA Dynamic Model

- Dynamic Model vs Representative (static) Model (used in July NCTA ex parte and Roberson analysis)
  - A representative static model should produce conclusions consistent with dynamic model
- AP Assumptions: are consistent with Roberson analysis, if parameters correctly applied
  - Power
  - Access Point Antenna Gain
  - Duty Cycle
  - Indoor / Outdoor
- Validation of Dynamic Model Operation/Outputs
  - Independent validation has not been provided – unable to test conclusions
  - Dynamic model can provide erroneous outputs if not validated
- (Unvalidated) Dynamic Model Output Result: 1 dB Globalstar Uplink Degradation (250,000 APs visible)
  - Correcting this result for 4 national deployments, then **1 million** APs visible
  - Then the actual Globalstar uplink degradation is 7 dB, or a **25 % Globalstar capacity reduction**, a significant amount
  - With corrected inputs, Dynamic Model shows a significant impact to Globalstar
- Conclusion
  - NCTA dynamic model cannot be relied on without validation / ability to validate

Rebuttal to Jan 22 NCTA Characterization of Roberson Analysis

NCTA Critique of Roberson Analysis	Roberson Analysis Facts
Overall Approach	Roberson Analysis: >Realistic Access Point Density , similar to NCTA assumption >Uses end-to-end model >Evaluates Globalstar Capacity, RF Power Degradation >Evaluates end-user degradation
Density of Access Points	>NCTA ex parte produces similar AP number for 1 national deployment (3M vs 4.4M), but ignores reality of multiple operators, non-operator, and int'l deployments >Roberson analysis (16 AP/km sq) applies to only one national operator
Access Point Duty Cycles	>Roberson analyzes several duty cycle values (100%, 80%, 50%) to show sensitivity >NCTA errs in applying binomial probability theorem—Roberson use is correct >NCTA ignores that PEAK (busy hour) duty cycle, not average, will create harm
Channelization	>NCTA ignores that Roberson analysis applied to only one national operator
Dynamic Simulation Model Needed (AP Antenna Gain / Satellite Elevation Angle / Clutter)	>Roberson analysis uses July 2013 NCTA static model >NCTA Dynamic Simulation Model outputs not yet verified >Dynamic Model outputs should be consistent with Representative Static Model >Roberson analyzes variety of different blocking, clutter factors

Jan 22 NCTA Critique of Roberson Analysis is Without Basis

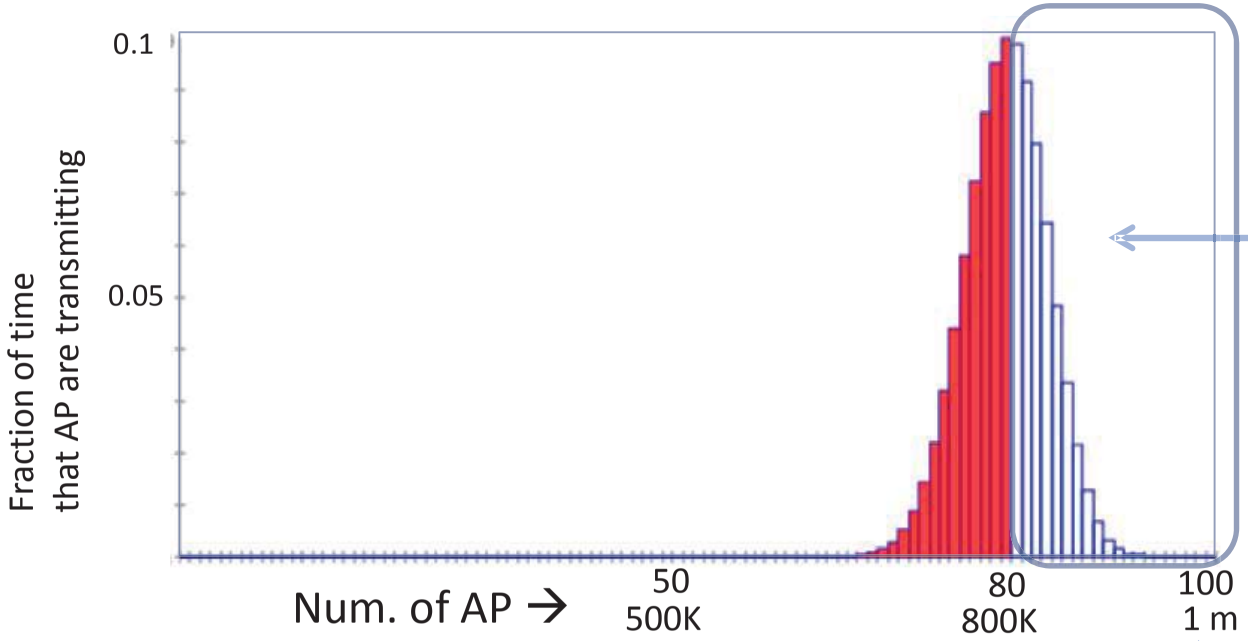
Access Point Duty Cycle

NCTA Incorrectly Applies Binomial Probability Theorem

- NCTA States that for 80% duty cycle, probability that all APs are active is 0.000 001 (accurate but not relevant)
  - *Correct* application: 80% or more APs are simultaneously active HALF the time
- Theorem on Binomial Probabilities States
  - If each AP has X % duty cycle → X % or more of the APs are active 50% of time (30 minutes out of an hour)
- Example:
  - 1 Million access points, each with 40% duty cycle, means that half the time, 400,000 or more access points (40%) are simultaneously active
  - 1 Million access points, each with 80% duty cycle, means that 50% of the time, 800,000 or more access points (80%) are simultaneously active.
- Conclusion
  - Roberson characterization of access point duty cycles is correct
  - High access point duty cycles during peak traffic times create periods of harmful impact to Globalstar: Capacity Reduction, Denial-of-Service to Users, and Degraded Quality of Service

Access Point Duty Cycle: Binomial Distribution

- 80% Access Point duty cycle shown for 100 and 1 million APs
- Height of each bar is the fraction of time that a certain number access points are simultaneously transmitting



- 80% of Access Points are transmitting 50% of time (sum of heights of bars = 0.5)
- On average, 80% of APs are transmitting simultaneously

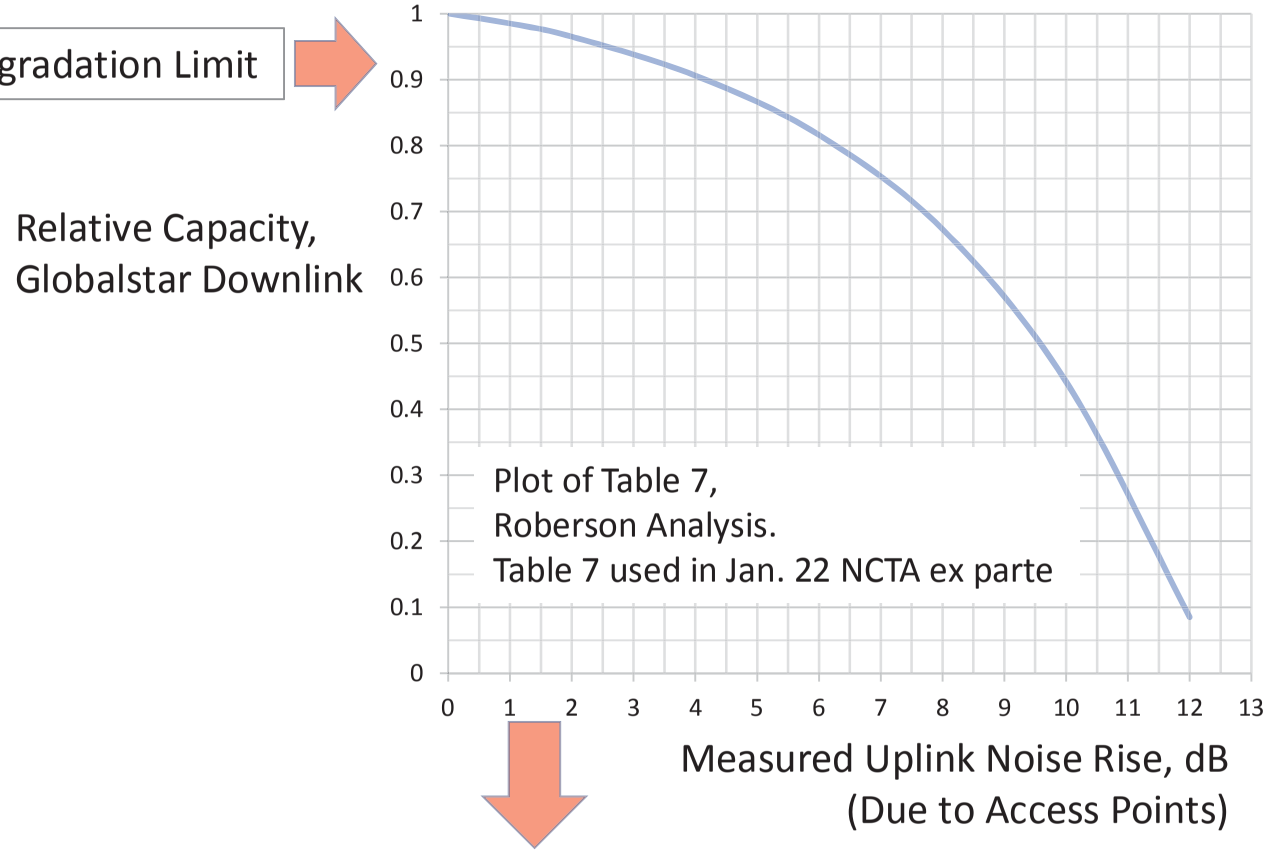
It is irrelevant that the fraction of time that ALL access points are active is very low

cf. http://www.math.uah.edu/stat/applets/SpecialCalculator.html

Globalstar Proposal For Interference Protection Criteria

Set Uplink Interference Protection Criterion (dB Noise Rise Measured at Satellite)
(Based on End-to-End –uplink/downlink– Approach)

1. Set Capacity Degradation Limit



2. Interference Protection Criterion Based on End-End Approach

Conclusions:

- **Progress to Date**
  - In Jan. 22 ex parte, NCTA No Longer Claims that 2 Billion APs Would Not Affect Globalstar
  - NCTA Agreement that Globalstar Operations Need to be Protected
  - Agreement with NCTA on End-to-End Model
  - Jan. 22 NCTA ex parte Relied on the Level of Globalstar Degradation Created by RF Interference Level in the Uplink, Based on the Roberson Analysis:

    e.g. 10 dB rise in noise floor degrades capacity by 56%

- **Work in Progress:** Ongoing discussions with NCTA
  - What Constitutes Harmful Interference to Globalstar
  - How to Measure Interference
  - Action to Take if Interference Threshold is Exceeded

- **At Issue**
  - The Number of Outdoor Access Points that Will be Deployed in U-NII-1 by Nationwide Operators, Private, Non-operator, and Government Entities, and in Canada and Mexico Under Unlicensed rules that Allow Unlimited Deployment
  - This Issue Can be Rendered Moot if an Uplink Interference Protection Limit Can Be Established with a Threshold at Satellites

Takeaways

- **Nothing in January 22 NCTA Ex Parte Changes Previous Conclusion That Unlimited, Unlicensed Outdoor Deployment of Access Points in U-NII-1 Band Will Cause Substantial Harm to Globalstar**

- **NCTA Misinterprets Roberson Analysis, and NCTA Critique of the Roberson Analysis is Unsubstantiated**

- **Globalstar Initiated Discussions with NCTA, Now Ongoing, in order to Reach Agreement on How to Protect Globalstar**