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April 23, 2015

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

Re: Written *Ex Parte*: *Terrestrial Use of the 2473-2495 MHz Band for Low-Power Mobile Broadband Networks* – IB Docket No. 13-213

Dear Ms. Dortch:

Globalstar, Inc. (“Globalstar”) through its counsel hereby submits into the record the attached declaration from Dr. Kenneth Zdunek of Roberson and Associates, LLC (“Roberson and Associates”), addressing (i) the April 14, 2015 report from CableLabs on the recent demonstrations of Globalstar’s Terrestrial Low Power Service (“TLPS”) technology, and (ii) the April 16, 2015 *ex parte* notice from the National Cable & Telecommunications Association (“NCTA”) making certain claims regarding Globalstar’s TLPS demonstration.¹ Dr. Zdunek and a Roberson and Associates team of technical experts participated in Globalstar’s TLPS/Wi-Fi demonstration at the Commission’s Technology Experience Center (“TEC”) on March 9, 2015, and observed CableLabs’ demonstration at the TEC on March 9-10, 2015.²

¹ See Letter from Rob Alderfer, CableLabs, to Marlene Dortch, Secretary, FCC IB Docket No. 13-213 (Apr. 14, 2015) (attaching *Measuring the Potential Impact on Wi-Fi of Channel 14 Terrestrial Low Power Service*, CableLabs (Apr. 14, 2015) (“CableLabs TLPS Demo Report”)); *Ex Parte* Letter from Paul Margie, Counsel to NCTA, to Marlene Dortch, Secretary, FCC, IB Docket No. 13-213 (Apr. 16, 2015) (“NCTA April 16 *Ex Parte* Letter”). Dr. Zdunek’s declaration also references an April 16, 2015 letter from the Consumer Electronics Association, which otherwise has not participated in this proceeding over the past two and a half years. See *Ex Parte* Letter from Julie Kearney, Consumer Electronics Association, to Marlene Dortch, Secretary, FCC, IB Docket No. 13-213 (Apr. 16, 2015).

² See, e.g., Letter from Regina M. Keeney, Counsel to Globalstar, Inc., to Marlene H. Dortch, Secretary, FCC, IB Docket No. 13-213 (Mar. 10, 2015) (attaching report of AT4 wireless, Inc. and Roberson and Associates, LLC, *Globalstar TLPS Operation Demonstration* (Mar. 6 and 9, 2015) (“Globalstar TLPS Demo Report”), and report of Michael Needham and Dr. Kenneth Zdunek, Roberson and Associates, LLC, *Bluetooth – TLPS Demonstrations at the FCC Technology Experience Center* (Mar. 10, 2015) (“Roberson TLPS-Bluetooth Demo Report”).

As Dr. Zdunek describes in his declaration, the compatibility demonstrations at the TEC confirmed that TLPS will be a good neighbor to Wi-Fi operations in the 2.4 GHz unlicensed ISM band, including IEEE 802.11 Channel 11. Dr. Zdunek explains that CableLabs' demonstration, which purportedly showed a detrimental impact on Wi-Fi Channel 11, was methodologically flawed and does not demonstrate negative effects from TLPS on adjacent-band Wi-Fi. The Commission should give no weight to this contrived attempt to produce a detrimental impact on Wi-Fi. Dr. Zdunek also de-bunks NCTA's claims regarding supposed problems with Globalstar's TLPS demonstration.

Specifically, the attached declaration of Dr. Zdunek includes the following information and findings, among other things:

- CableLabs' equipment configuration for its TEC demonstration was completely unrealistic for Wi-Fi and TLPS access point deployments in the 2.4 GHz ISM band. The access points in this demonstration were far too close together (five feet apart) and operated at excessive power levels given the indoor environment.³ These parameters were unrepresentative of real-world conditions.⁴
- Because of the limitations of CableLabs' demonstration, it is not possible to compare any effect of TLPS on Channel 11 with the impact of Channel 6 on Channel 11. CableLabs failed to run a "control" case that would have isolated the effect of Channel 6 on Channel 11 Wi-Fi performance and established a proper baseline for its analysis.
- Instead of submitting all of its quantitative results immediately to the Commission and participating parties, CableLabs appears to have spent over a month selecting specific data points that purportedly show a negative effect on Wi-Fi Channel 11.

³ CableLabs' assertion that its mix of access points and client devices spaced five feet from each other on tables is somehow representative of multi-dwelling units strains credulity. For example, most multi-dwelling units have walls between them.

⁴ NCTA's reference to the separation distances and power levels involved in testing in the H Block proceeding is irrelevant to the issue of appropriate power levels at the TEC or in other real-world TLPS or Wi-Fi deployments. NCTA April 16 Ex Parte Letter at 2 n. 2 (citing *Service Rules for Advanced Wireless Services H Block – Implementing Section 6401 of the Middle Class Tax Relief and Job Creation of 2012 Related to the 1915-1920 MHz and 1995-2000 MHz Bands*, Report and Order, 28 FCC Rcd 9483, ¶ 142 (2013)). Unlike the TLPS demonstration, the distances and power levels in the H Block tests were not a function of one another. In the H Block context, the separation distance at issue was between mobile units in different services operating in different frequency bands that might encounter one another in the field, while the power level for those mobile devices had to be sufficient to ensure a wireless connection with a base station facility. In the TLPS demonstration, the power level and separation distances were directly related; the access points' signal strength had to be strong enough only to ensure a connection with the client devices within the TEC.

- Even the data points CableLabs selected and highlighted in its report do not support a conclusion that Wi-Fi operations on Channel 11 would be degraded. CableLabs concedes that some of its throughput results during its demonstration were inconsistent and “counterintuitive.”
- NCTA’s claim of “bias” in Globalstar’s demonstration is meritless. Globalstar’s configuration of access points at the TEC was designed for an indoor enterprise environment. These access points were properly located high above the client devices and next to the ceiling in the TEC, and each client device had visibility to all access points. This set-up was appropriate to the physical space of the TEC venue and even intensive from an interference standpoint, with TLPS and Wi-Fi access points placed closer together than what would be expected in a real-world deployment.
- Globalstar’s demonstration at the TEC was open and transparent. All parties submitted their demonstration plans prior to the event and, following the demonstration, Globalstar immediately submitted its demonstration report to the Commission and provided all of its raw data files to CableLabs. The demonstrations were witnessed by numerous Commission staff, and all other participants in the TEC demonstration were free to attend all portions of the event and the FCC’s subsequent testing.⁵

NCTA also asserts in its April 16 letter that Commission rules for TLPS should limit Globalstar to the precise operational parameters seen in the TEC demonstration.⁶ The Commission should reject this argument. The purpose of the TEC demonstration was to assess the compatibility of a representative TLPS deployment with other unlicensed operations in the 2.4 GHz ISM band. The demonstration achieved that goal. Adopting such restrictive technical rules would be unsound public policy, undercutting the flexibility that is integral to developing innovative unlicensed offerings in the 2.4 GHz band.

It would also be bad policy and bad precedent for the Commission to require additional test data for every potential deployment scenario that would be possible under the Commission’s proposed TLPS rules. As NCTA and other parties are well aware, the Commission’s Part 15 rules do not protect unlicensed services from interference, and those services must accept interference from other rule-compliant licensed or unlicensed operations.⁷ Low barriers to entry in the 2.4 GHz ISM band and other unlicensed spectrum have encouraged creative, innovative, and efficient wireless services and devices. Mandated prior testing would empower incumbents to delay entry with demands for testing whenever a new technology or service was poised to

⁵ See Letter from Regina M. Keeney, outside counsel to Globalstar, Inc., to Marlene Dortch, Secretary, FCC, IB Docket No. 13-213, at 1 (Mar. 27, 2015).

⁶ NCTA April 16 *Ex Parte* Letter at 3.

⁷ 47 C.F.R. § 15.5(b). It is worth noting that any party is free today to deploy Wi-Fi systems on Channels 2, 5, 7, or 10, despite the high likelihood of a detrimental impact on non-overlapping Channels 1, 6, and 11 (which currently carry most U.S. Wi-Fi traffic).

compete in unlicensed spectrum.⁸ This technical gating requirement would raise the cost of entry for innovators and establish inappropriate and anti-competitive protections for incumbent unlicensed uses.⁹

* * *

The TLPS demonstrations at the TEC confirmed the compatibility of TLPS with other unlicensed services in the 2.4 GHz ISM band. Two and a half years after Globalstar filed its petition for rulemaking, a year and a half after the Commission's *NPRM*, and almost a year since the close of the comment cycle, it is time for the Commission to move forward with an order in this proceeding and realize the substantial public interest benefits of TLPS. Following the National Broadband Plan, the Commission has pursued multiple approaches to meeting consumers' burgeoning broadband demand. Innovative rules that maximize the use of adjacent licensed and unlicensed spectrum and enable managed TLPS are consistent with these ongoing Commission efforts. The Commission has applied an "all of the above" approach to increasing the nation's supply of broadband spectrum and promoting more intensive use of both unlicensed and licensed frequencies. This approach has produced increased terrestrial flexibility in the 2 GHz MSS band, a future groundbreaking incentive auction in the 600 MHz band, a creative spectrum sharing framework in the 3.5 GHz band, and greater unlicensed use at 5 GHz.¹⁰ Globalstar continues to support rapid progress in all of these proceedings, each of which promises increased competition, lower prices, and improved services for consumers.

The public interest benefits of the Commission's proposed TLPS rules are extensively documented in the record by Globalstar, other parties, and the Commission itself. The proposed rules protect MSS above 2483.5 MHz from harmful interference, add 22 megahertz to the nation's wireless broadband spectrum inventory, increase consumer choice and access to underutilized unlicensed spectrum, and ease the congestion that is diminishing the quality of Wi-Fi service at high-traffic 802.11 hotspots and other locations. At the TEC, activating TLPS on non-overlapping Channel 14, even in a quiet RF environment, yielded an approximately *forty percent* increase in aggregate data throughput across the 2.4 GHz 802.11-capable spectrum. In addition, Globalstar's commitment to provide 20,000 free TLPS access points would provide substantial benefits for perennially underfunded and under-connected schools, community

⁸ Incumbents' incompatibility claims are, of course, not new to the Commission and are a well-worn path for those who seek to hobble potential competitors.

⁹ Further undercutting parties' calls for additional testing is the fact that TLPS operations on Channel 14 are fundamentally consistent with the IEEE 802.11 standard, which specifically provides for the use of Channel 14 at 2473-2495 MHz. IEEE did not condition the use of Channel 14 on a showing that such operations will not cause interference to other unlicensed 802.11 operations, and the Commission's approach to operations on Channel 14 should be the same.

¹⁰ *See Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, First Report and Order, 29 FCC Rcd 4127 (2014).

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colleges, and hospitals. Given these crucial and varied benefits, the Commission's rules will encourage investment in innovation, enhance competition in wireless broadband, and provide consumers with additional choice in broadband service offerings. Importantly, the Commission's TLPS framework will provide consumers with benefits almost immediately, more rapidly than other ongoing Commission spectrum proceedings.

Accordingly, Globalstar urges the Commission to add to its recent line of successful spectrum decisions by moving forward with the unique TLPS opportunity at 2.4 GHz. This action will provide consumers with additional wireless broadband capacity throughout the United States without delay.

Respectfully submitted,

/s/ Regina M. Keeney

Regina M. Keeney

cc: Mark Settle

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554**

In the Matter of)	
)	
Terrestrial Use of the 2473-2495 MHz Band for)	IB Docket No. 13-213
Low-Power Mobile Broadband)	
Networks; Amendments to Rules for the)	
Ancillary Terrestrial Component of Mobile)	
Satellite Service Systems)	

DECLARATION OF KENNETH J. ZDUNEK, Ph.D.

1. I am Vice President and the Chief Technology Officer of Roberson and Associates, LLC.

I received BSEE and MSEE degrees from Northwestern University, and a Ph.D. EE degree from Illinois Institute of Technology. I have over 35 years of experience designing, analyzing, and measuring the performance of wireless systems in both lab and operating environments.

2. Prior to joining Roberson and Associates, I was Vice President of Networks Research at Motorola. While at Motorola I was an architect of cellular and public safety wireless networks, and was awarded 17 patents in the wireless field. I was elected a Fellow of the IEEE (Institute of Electrical and Electronic Engineers), and am a Registered Professional Engineer in the State of Illinois.

3. Concurrent with my position at Roberson and Associates, I am an Adjunct Professor in the Electrical and Computer Engineering Department at the Illinois Institute of Technology, where I do research in the areas of RF spectrum sharing, measuring and optimizing spectrum utilization, and cognitive radio; I teach a graduate course in wireless systems design.

4. In this declaration I provide a statement regarding the facts concerning the demonstration and measurements performed by Globalstar at the Federal Communications Commission (“FCC”) Technology Experience Center (“TEC”) on March 9, 2015, and the statements and conclusions reached in the filings made by CableLabs, the National Cable & Telecommunications Association (“NCTA”), and the Consumer Electronics Association (“CEA”) concerning Globalstar’s measurements, and measurements made by CableLabs at the FCC TEC on March 9 and 10, 2015.

Introduction

5. In February 2015, Globalstar tasked Roberson and Associates to oversee the demonstrations of Terrestrial Low Power Service (“TLPS”) to be performed at the FCC TEC. I personally participated in the selection of demonstration scenarios and parameters of the Globalstar demonstrations conducted at the FCC with Globalstar, Globalstar’s contractor AT4 wireless, and Jarvinian.
6. I witnessed and participated in the set-up and demonstrations of TLPS and Wi-Fi, and TLPS and Bluetooth performed by Globalstar, Roberson and Associates, AT4 wireless, and Jarvinian.
7. I witnessed the set-up, demonstration, and measurements of TLPS and Bluetooth performed by the Bluetooth Special Interest Group (“Bluetooth SIG”), and the set-up, demonstration, and measurements of TLPS and Wi-Fi performed by CableLabs.
8. Globalstar has provided me with recent *ex parte* filings of CableLabs,¹ NCTA,² and CEA³ regarding the demonstrations at the FCC. These filings make statements regarding

¹ Letter from Rob Alderfer, CableLabs, to Marlene H. Dortch, Secretary, FCC, IB Docket No. 13-213 (Apr. 14, 2015) (attaching the CableLabs report titled *Measuring the Potential*

the openness of the demonstrations at the FCC and the relevance and appropriateness of Globalstar's demonstration to the FCC Proposed Rulemaking⁴ that would allow Globalstar to provide TLPS. They criticize Globalstar's demonstration as being biased, and dismiss the results of Globalstar's demonstrations that show that TLPS has no negative impact on Wi-Fi. These criticisms are unfounded for reasons that I will explain in detail below.

9. The filings also make statements and draw conclusions regarding the measurements and demonstrations conducted by CableLabs, relying on measurements that allegedly show that TLPS will cause harm to Wi-Fi operations. In fact, due to the deficiencies in the procedures and execution of those measurements by CableLabs, such conclusions are not supported.
10. Globalstar has requested that I provide a statement regarding the facts concerning the demonstration and measurements performed by Globalstar, and the statements and conclusions reached in the filings made by CableLabs, NCTA, and CEA.

Impact of Wi-Fi on Channel 14 Terrestrial Low Power Service) (“CableLabs Filing” or “CableLabs Report”).

² Letter from Paul Margie, Counsel to the National Cable & Telecommunications Association, to Marlene H. Dortch, Secretary, FCC, IB Docket No. 13-213 (Apr. 16, 2015).

³ Letter from Julie M. Kearney, Consumer Electronics Association, to Marlene H. Dortch, Secretary, FCC, IB Docket No. 13-213 (Apr. 16, 2015).

⁴ *Terrestrial Use of the 2473-2495 MHz Band for Low-Power Mobile Broadband Networks; Amendments to Rules for the Ancillary Terrestrial Component of Mobile Satellite Service Systems*, Notice of Proposed Rulemaking, 28 FCC Rcd 15351 (2013) (“NPRM”).

TLPS Demonstrations at the FCC TEC

Background

11. In November 2013, the FCC issued a Notice of Proposed Rulemaking⁵ that would authorize low-power ATC operations by Globalstar in its licensed spectrum 2483.5-2495 MHz under proposed Part 25 rules, and with specific technical limitations, also allow concurrent use of the adjacent spectrum at 2473-2483.5 MHz under Part 15 rules applying to unlicensed operations in that band. In the NPRM, the FCC established deadlines for comments and replies and requested that any parties potentially concerned about interference from the proposed operation submit detailed technical analyses and detailed assessments of costs arising from any interference, within the comment period. No party did so within the Commission's comment cycle.
12. In order to create a path forward to address differences regarding the potential impact of TLPS on Wi-Fi and Bluetooth, in February 2015 the FCC's Office of Engineering & Technology ("OET") hosted a meeting with technical representatives from Globalstar and other stakeholders, including CableLabs, NCTA, the Wi-Fi Alliance, the Wireless Internet Service Providers Association ("WISPA"), and the Bluetooth SIG.
13. Globalstar agreed to provide a real-world environment for outside parties to demonstrate the impact of TLPS on Wi-Fi and Bluetooth. CableLabs, NCTA, Bluetooth SIG, and the FCC agreed to Globalstar's offer to participate in such a demonstration.
14. Subsequent to this meeting and in order to facilitate participation by all stakeholders, the FCC further agreed to host the demonstrations at the FCC TEC in Washington, D.C. Globalstar, CableLabs, NCTA, and the Bluetooth SIG agreed to participate in these

⁵ *Id.*

demonstrations, to be held in early March 2015. These demonstrations occurred on March 6 and March 9-10, 2015.

Suitability of the TEC

15. In their recent filings, CableLabs and NCTA claim that the FCC TEC was not a suitable place for these demonstrations, that it was impossible to control the demonstration environment, and that more testing is necessary.
16. The claims that the FCC TEC was not a suitable environment are false. CableLabs and NCTA claim that the background RF energy in the FCC TEC limits the usefulness of any demonstration results. This statement is not true. The received signal levels inside the TEC, primarily due to FCC access points and personal hotspots located outside the TEC, were many orders of magnitude (10's of dBs) below the signal levels generated by the demonstration access points within the TEC. This is clearly shown in Figures 3 and 4 of the CableLabs Report. This level of background activity, representative of a relatively benign real-world enterprise environment, did not affect the Globalstar TLPS demonstrations and would not affect the outcome of the CableLabs demonstrations conducted inside the TEC. The measurements performed by Globalstar during the set-up period at the TEC (which CableLabs did not take advantage of) and during the actual demonstrations produced consistent results. While CableLabs claims that this background interference was a cause of their inconsistent demonstration results, those results were the product of variable and uncontrolled measurement configurations and uncontrolled measurement parameters.

17. The purpose of the demonstrations at the FCC was to show, in a real-world environment, what the experience of Wi-Fi and Bluetooth users would be in the presence of TLPS.

The TEC environment was entirely suitable for such a demonstration.

18. As will be described in further detail below, the demonstrations and measurements of Globalstar and CableLabs conducted at the FCC TEC provide more than a sufficient basis for the FCC to adopt its proposed rules for TLPS.

Openness of the Demonstrations

19. CEA has alleged that Globalstar's demonstrations at the TEC were not transparent or "open." This allegation is false. The FCC invited participation by engineering representatives of key unlicensed interests, including CableLabs, NCTA, and Bluetooth SIG.⁶ The Globalstar demonstrations were witnessed by FCC staff (including staff from OET and the International Bureau), and representatives from CableLabs, NCTA, and Bluetooth SIG.

20. The FCC, Globalstar, and Globalstar's consultants and contractors disclosed all the demonstration parameters and details before, during, and after the demonstrations. The Globalstar demonstration scenarios were submitted to the FCC and made available to the stakeholders prior to the demonstration. All Globalstar demonstrations and measurements were fully described and were witnessed by the stakeholders present at the TEC, and these results were displayed in the FCC TEC immediately afterwards. Measurement parameters, including client device throughputs, throughputs on individual channels, and Received Signal Strength Indications ("RSSIs"), were displayed in real time by client software on the user devices at the TEC. I personally pointed out these

⁶ CEA filed nothing during the comment or reply periods that ended seven months after the FCC's NPRM requesting comment.

operating parameters to the observers. Spectrograms of the Wi-Fi and TLPS emissions were prominently displayed in real time on large video displays. FCC personnel at the TEC independently made field strength measurements of the emissions from the Wi-Fi and TLPS access points used in the Globalstar demonstrations. Following the TEC demonstration, Globalstar submitted a detailed filing to the FCC describing the quantitative measurements recorded during the demonstration.⁷

21. CableLabs did not conduct its demonstration with similar openness. CableLabs personnel did not describe its measurements while they were being performed at the TEC. As an observer, I had to ask CableLabs personnel to confirm the test scenarios they were executing. CableLabs did not provide any quantitative results of their measurements until weeks after these demonstrations, and, in its April 14, 2015 demonstration report, it selectively discussed only those results and measurements that it could claim were unfavorable to Globalstar.
22. Subsequent to the demonstration, FCC personnel performed two days of measurements on Globalstar's demonstration access points to confirm those access points' operating characteristics, including transmit power and emission spectra. The FCC personnel performed these measurements in a shielded lab facility at the FCC test lab in Columbia, Maryland. The FCC invited all stakeholders present at the TEC to witness the measurements. CableLabs, NCTA, and Bluetooth SIG members chose not to witness these measurements.

⁷ Letter from Regina M. Keeney, Counsel to Globalstar, Inc., to Marlene H. Dortch, Secretary, FCC, IB Docket No. 13-213 (Mar. 10, 2015) (attaching report of AT4 wireless, Inc. and Roberson and Associates, LLC, *Globalstar TLPS Operation Demonstration* (Mar. 6 and 9, 2015), and report of Michael Needham and Dr. Kenneth Zdunek, Roberson and Associates, LLC, *Bluetooth – TLPS Demonstrations at the FCC Technology Experience Center* (Mar. 10, 2015) (“Globalstar March 10 Filing”).

23. For all of these reasons, CEA, stakeholders, and other parties cannot legitimately claim that Globalstar’s demonstrations at the FCC were anything less than “open and transparent.”

Methodological Soundness of Globalstar’s TLPS Demonstrations

24. NCTA and CableLabs have stated that the demonstration scenarios and plans executed by Globalstar were not appropriate to evaluate the effect of TLPS on Wi-Fi. In fact, Globalstar’s methodology for the TEC demonstration was sound.

25. Key considerations for Globalstar in designing its demonstration were that the demonstration be a) representative of a real-world deployment of TLPS, rather than an unrealistic science experiment; b) appropriate to the physical space of the TEC venue and even intensive from an interference standpoint, with TLPS and Wi-Fi access points placed closer together than what would be expected in a real-world deployment; and c) efficient and allow adequate demonstration time to the other stakeholders. Globalstar performed its demonstrations in approximately one hour on March 6 and four hours on March 9. CableLabs performed its measurements over approximately eleven hours on March 9 and March 10.

26. With respect to the appropriateness of the parameters selected by Globalstar for its demonstration, including access point power levels, these parameters were representative and appropriate for deployment in the indoor, enterprise environment of the TEC. The higher EIRP limits specified in the FCC-proposed rules in its Notice of Proposed Rulemaking (4 W EIRP) would have been totally inappropriate for an indoor application in general and specifically for a relatively confined environment like the TEC. The access point power levels utilized by Globalstar at the TEC demonstration (100 mW conducted and 200 mW EIRP) produced very high received signal levels at the client

devices in the TEC and would result in sufficient received signal levels in the vast majority of indoor enterprise environments.

27. In its recent letter, NCTA asserted that Globalstar's configuration of equipment at the TEC demonstration was "biased" in favor of a showing that TLPS would have no impact on Wi-Fi. NCTA makes a number of specific claims about Globalstar's demonstration configuration, including that the client devices were located closer to their associated access points, that a metal partition isolated the client devices operating on the Wi-Fi channels from potentially interfering signals from the TLPS access points, that no uplink measurements were done, and that the beamforming technology inherent in the access points provided isolation between Channel 11 and TLPS operating on Channel 14.
28. NCTA's baseless criticism contains misleading and factually incorrect information about the configuration. First, the tables in the TEC had very low panels (see Photograph 1 in the Appendix) and each client device had visibility to all access points. The access points were located high above the client devices and next to the ceiling in the TEC. This configuration is recommended and typical of an actual deployment in an indoor enterprise environment. Thus, contrary to NCTA's claim, the low partition was of no consequence to the demonstration. With respect to the positioning of the client devices at the TEC, to the extent that any of these devices were closer to their associated access points, the relevant distance "differential" was only one to two feet, not a meaningful distance from a performance perspective.
29. Moreover, Globalstar's demonstration also included a scenario where *three* access points in three corners of the TEC were simultaneously operated on TLPS Channel 14, and one access point was operated on IEEE Channel 11. Clearly, this scenario could not isolate

the receiving client devices operating on Channel 11 from the TLPS access points, with or without the partition or beamforming. Even in this scenario, no degradation to throughput on Channel 11 was observed. Any claim that Globalstar's demonstration set-up was biased is without merit.

30. Regarding the impact of beamforming, the access point manufacturer's data reveals that any beam formed by the access points would be of such width as to encompass all the clients located in the center of the TEC.⁸ As a result, this beamforming capability was irrelevant to the impact of TLPS on Wi-Fi Channel 11 at the TEC.
31. Regarding uplink scenarios, Globalstar and its consultants carefully considered whether the uplink or downlink represented the most stressful configuration for adjacent channel interference from TLPS. Since access points typically contain receivers with higher performance characteristics and better interference rejection than client devices, and client devices transmit at lower power levels than access points, it was determined that downlink tests with access points at higher power transmitting to client receivers presented the most stressful TLPS scenario and the greatest likelihood of a negative impact on Channel 11 Wi-Fi.
32. As further evidence of the soundness of Globalstar's demonstration configuration and its results showing no detrimental effect on Channel 11, a photograph is provided (see Photograph 3 in the Appendix) of an RF spectrogram measured and displayed during Globalstar's throughput demonstration scenario with Channels 1, 6, and 11 operating

⁸ See *Using All the Tools You Can*, Ruckus Whitepaper, 8, Figure 10: Typical BeamFlex antenna system pattern, available at <http://c541678.r78.cf2.rackcdn.com/wp/wp-using-all-the-tools-you-can.pdf>.

simultaneously with TLPS Channel 14.⁹ RF frequency is on the horizontal axis, time is on the vertical axis, and the relative power level is indicated by color, with the dark background indicating lowest power. This spectrogram clearly shows the power levels and the level of download traffic on each of these channels. Also in evidence is the spectral separation between Channel 14 (far right spectral band) and Channel 11 (second band from the right). Given the spectral gap between TLPS and Channel 11, it is expected that TLPS would not interfere with Channel 11. The absence of any TLPS impact on Channel 11 was confirmed by the throughput measurements reported by Globalstar.

Critique of CableLabs Demonstrations

33. NCTA, CableLabs, and CEA have asserted that CableLabs' report on its measurements at the FCC TEC shows that TLPS would cause harm to Wi-Fi operations. The FCC should reject this conclusion. CableLabs' demonstration was methodologically flawed and does not support the conclusion that TLPS will negatively affect adjacent-band Wi-Fi.

CableLabs' Flawed Methodology – Demonstration Set-up and Procedure

34. CableLabs' set-up and procedures for its demonstration were methodologically unsound, resulting in flawed data supporting its claims of a detrimental impact on Channel 11 Wi-Fi. Direct observation and analysis of the measurement scenarios, devices, and device configurations chosen by CableLabs for the demonstration reveal an unrealistic and unusual access point deployment configuration, with many uncontrolled or variable parameters.

⁹ The photograph is a screenshot of the Anritsu MS2712E spectrum analyzer with an omnidirectional antenna that was located in the FCC TEC during the demonstrations.

35. First, CableLabs placed the TLPS and Wi-Fi access points in very close proximity – approximately five feet apart from one another on a table, and five feet away from the client devices. This configuration is neither representative of a real-world deployment nor a configuration recommended by manufacturers.¹⁰ Deployment of access points in such close proximity is unsound because, at a minimum, this configuration can cause interference between the internal electronic components of the access points, degrading performance. This access point to access point degradation has no relationship whatsoever to the impact of signals radiated from the antennas of the access points at a client receiver, which is the impact sought to be assessed. Degradation in performance due to close proximity of access points has previously been observed in Roberson and Associates’ own measurements of Wi-Fi performance. Even without the use of Channel 14, CableLabs would have found a reduction in total 2.4 GHz Wi-Fi capacity if Wi-Fi access points operating on Channels 1, 6, and 11 were operated at full power and in close proximity to one another, as they were deployed in the FCC TEC.
36. In its demonstration, CableLabs also operated the TLPS Channel 14 access points at their highest power settings. Such power levels are not recommended by manufacturers and would be highly unlikely in practice, particularly in an indoor enterprise environment like the FCC TEC.¹¹ Reducing the transmit power in high density, high capacity deployments

¹⁰ “The majority of modern WLAN deployments are at the ceiling level,” and “[a] capacity-based deployment might consist of AP’s placed roughly 45 to 60 feet and operated at 25-50% or 50-75% of power.” *Indoor 802.11n Site Survey and Planning*, Ver. 1, Aruba Networks, 13, available at <http://community.arubanetworks.com/t5/Validated-Reference-Design/Indoor-802-11n-Site-Survey-and-Planning/ta-p/155136>.

¹¹ “Turning down transmit power is a prudent and proven technique for maximizing throughput for an access point and its neighbors in a high density deployment. This makes it a best practice for a WLAN designer[.]” *Coverage or Capacity—Making the Best Use of 802.11n*,

from the maximum level is recommended for best performance.¹² Operation of the TLPS access points at maximum power in the TEC appears to have been intended to increase the likelihood of a detrimental impact on Channel 11 Wi-Fi. The other non-TLPS access points in CableLabs' demonstration were operated at their default power levels, which have not been specified by CableLabs.

37. Conspicuously absent from the CableLabs demonstration approach was a measurement scenario comparing (i) the effect of Wi-Fi Channel 6 operating alone at maximum power on Channel 11 Wi-Fi to (ii) the impact of TLPS Channel 14 at maximum power on Channel 11 Wi-Fi. This comparison is important because it is highly relevant whether TLPS would produce a lesser or greater impact on Channel 11 than would existing Wi-Fi Channel 6. Similarly, a baseline measurement of Channel 11 throughput with two Channel 6 access points operating on either side would provide a reference for the CableLabs throughput scenario of a Channel 11 access point with two Channel 14 TLPS access points and two Channel 6 access points on either side.

Overview of CableLabs' Measurements and Results

38. In its report, CableLabs states that it measured the effect of TLPS on Channel 11 employing six different Wi-Fi clients, four different access point types, and two different data transfer protocols (HTTP and RTP), for both downlink and uplink configurations. Complete quantitative results for Channel 11 throughput, however, are only discussed in that report for two downlink scenarios using two different access point types, each with a single client type on Channel 11, and with different Wi-Fi clients on the other Wi-Fi

Juniper Networks White Paper, 13 (2011), <http://www.adtechglobal.com/Data/Sites/1/marketing/juniper-whitepaperwlancoverageorcapacity.pdf>.

¹² See *id.*

channels. The file transfer protocol for the results is not specified. CableLabs did not describe the RSSI of the signal received at the client devices.

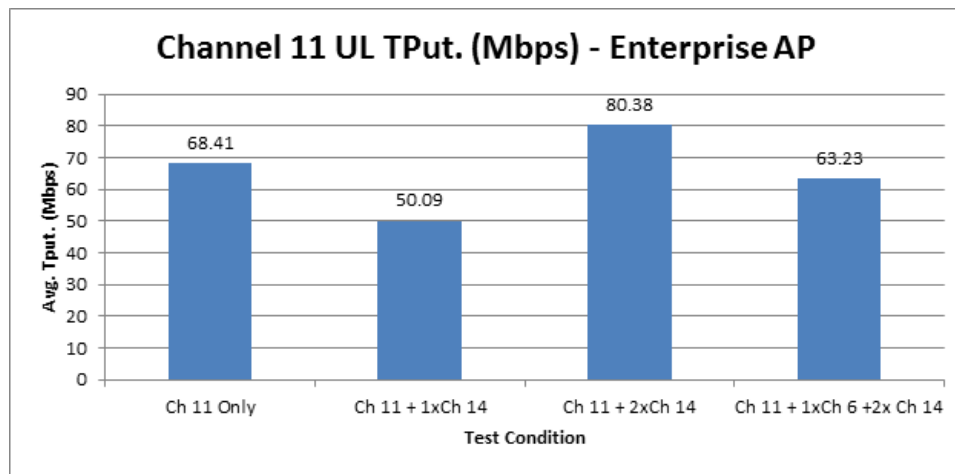
39. As indicated in the CableLabs report, the Wi-Fi and TLPS scenarios designed by CableLabs with unrealistic equipment configurations produced varying results – positive and negative – with respect to the purported impact of TLPS on Channel 11 Wi-Fi. In one of the two downlink scenarios for which CableLabs presented quantitative results (consumer access point with smartphone),¹³ CableLabs claims that TLPS negatively affected the throughput of Channel 11, although the Channel 11 throughput at nearly 40 Mbps was still substantial enough for useful operations. Significantly, in this scenario, the addition of a single Channel 6 access point when TLPS was already present produced a *larger* reduction in Channel 11 throughput (reduced to 4.6 Mbps) than did the addition of a second TLPS access point, indicating that existing Wi-Fi operations can affect Channel 11 even more than TLPS in certain circumstances. For the other downlink scenario where CableLabs presented comprehensive quantitative results (enterprise access point with laptop),¹⁴ small reductions of approximately 10% in Channel 11 throughput, to 92 Mbps and 91 Mbps, were observed when two Channel 6 access points and two Channel 14 access points were in operation. Highly usable throughput levels – 76 Mbps and 45 Mbps – were measured when either one or two TLPS access points were in operation.
40. For uplink measurements, CableLabs in its report indicated that both positive and negative effects of TLPS on Wi-Fi Channel 11 were observed during its demonstration.¹⁵

¹³ CableLabs Filing at Figure 5.

¹⁴ *Id.* at Figure 6.

¹⁵ *Id.* at 15, 17.

CableLabs’ report, however, only mentioned a few quantitative results without a full description of the scenarios under which these were observed. The table below, however, has been developed based on throughput measurement data that CableLabs has provided on a website specified in its report.¹⁶ This table shows that the uplink throughput on Channel 11 varied in response to the activation of both TLPS Channel 14 and Channel 6 Wi-Fi in CableLabs’ unrealistic equipment configuration at the TEC. These results clearly show that TLPS does not have an overall negative effect on Channel 11, as Channel 11 throughput was highest (80.38 Mbps) when Channel 14 was active on two client devices.



41. CableLabs also states that it measured end-to-end delay and jitter, but the text of its demonstration report does not contain any specific quantitative results for these measurements. CableLabs indicates only that these measurements were “inconsistent.” Examination of the delay and jitter measurements found on CableLabs’ website shows no meaningful differences between the values measured with TLPS and without TLPS operating.

¹⁶ *Id.* at Appendix B (making Cablelabs’ demonstration measurement data available for download at <https://owncloud.cablelabs.com/public.php?service=files&t=491a240129fc46ed2e1463b551a969f8>).

Analysis of CableLabs' Measurement Results

42. CableLabs claims that TLPS caused significant degradation of Wi-Fi Channel 11 in several measurement configurations at the TEC. The degradation to Wi-Fi throughput observed in the case of a consumer access point operating on Channel 11, however, was due to the entirely unrealistic configuration of equipment during CableLabs' demonstration: access points operating in close proximity (within five feet) to TLPS access point(s) transmitting at maximum power, and also operating within five feet of the client devices. Any measured effect on Channel 11 Wi-Fi does not reflect an inherent impact of Channel 14 TLPS on Channel 11 at a client receiver.
43. This explanation for CableLabs' results is supported by the observation that the addition of a single access point operating on existing Channel 6 caused a significantly *greater* degradation to the Channel 11 consumer access point throughput (38.9 Mbps to 4.6 Mbps, or 88% reduction) when Channel 14 was also present, compared to the degradation to Channel 11 that occurred when only Channel 14 was operating (67.9 Mbps to 38.9 Mbps, or 42% reduction). It is also worth noting that the 38.9 Mbps throughput achieved in CableLabs' unusual, unrealistic test configuration is sufficient to support useable broadband service; TLPS cannot be viewed as undermining Wi-Fi operations on Channel 11.
44. CableLabs concedes in its report that the measurement results for its demonstration at the TEC were inconsistent (a reality further highlighted by the uplink throughput data available on CableLabs' website, discussed above at paragraph 40). CableLabs claims that the inconsistency of its results is likely due to the limited and uncontrolled nature of the TEC demonstration environment, but, in fact, as described above in paragraph 16, the

FCC TEC represented a quiet and reasonably controlled background Wi-Fi environment, characteristic of what would be encountered in many real-world office/enterprise deployment situations. Further, the power levels of the signals from the FCC wireless network access points and personal hotspots located outside the TEC were observed to be many orders of magnitude (10's of dB's) below the power levels generated by the demonstration access points inside the TEC, many of which were operated at full power.¹⁷ The relative low level of the background RF environment – the conditions for both the Globalstar and CableLabs demonstrations – did not have a significant effect on the outcome of the TLPS and Wi-Fi measurements being conducted at much higher power levels in the TEC.

Conclusion

45. Globalstar's TLPS demonstration at the TEC relied on a structured and consistent measurement procedure using access points and clients with consistent and known technical parameters.¹⁸ This demonstration was conducted in an unbiased and open manner in the real-world environment of the FCC TEC. This demonstration showed that TLPS does not degrade adjacent-band Wi-Fi operations and can successfully co-exist with Wi-Fi at 2.4 GHz.
46. Contrary to its claims, CableLabs' demonstration results do not support a finding that TLPS would have a detrimental impact on Wi-Fi on Channel 11. The reduced

¹⁷ *Id.* at Figures 3 and 4.

¹⁸ Globalstar March 10 Filing.

throughput on Wi-Fi Channel was due to the faulty and entirely unrealistic set-up for CableLabs' demonstration at the TEC, including the close proximity and high power levels for access points and client devices. No further measurements or tests are required for the FCC to reach a final decision adopting its proposed TLPS rules.

Pursuant to 28 U.S.C. § 1746, I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct to the best of my knowledge, information, and belief.

Executed this 23rd day of April, 2015.



Kenneth J. Zdunek

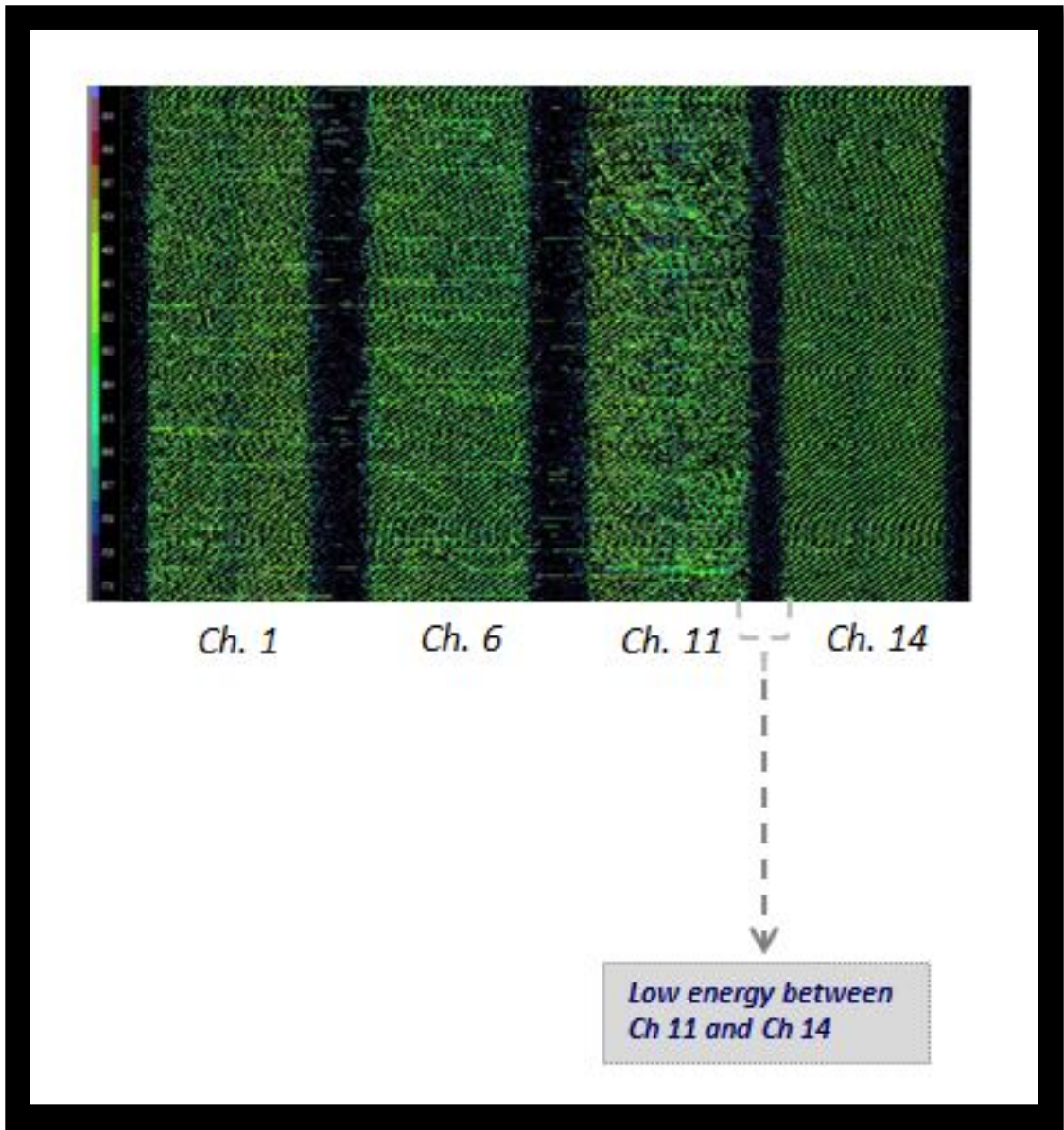
APPENDUM



Photograph 1: Photograph of client devices in FCC TEC. One access point visible on pole at upper left. Other access points located at corners of the room with clear visibility to client devices.



Photograph 2: Photograph of Nexus tablet client devices showing display of measurement conditions during Bluetooth SIG demonstration. 3.73 Mbps download to clients.



Photograph 3: RF spectrogram measured and displayed on Anritsu analyzer during Globalstar throughput demonstration scenario with Channels 1, 6, and 11 operating simultaneously with TLPS Channel 14.