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March 13, 2015

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

Re: *Ex Parte* Notice: *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 responds to claims from the Bluetooth Special Interest Group ("Bluetooth SIG") that the recent demonstrations of Terrestrial Low Power Service ("TLPS") technology at the Commission's Technology Experience Center ("TEC") showed a detrimental impact on Bluetooth devices operating within the unlicensed ISM band at 2400-2483.5 MHz.[1] Rather, these compatibility demonstrations confirmed that TLPS does not have qualitative effects on Bluetooth that will be discernible to real-world consumers and end users.

The demonstrations conducted by Bluetooth SIG had serious flaws, and its preliminary characterization of its results should be accorded no weight in this proceeding. Bluetooth SIG claims that Bluetooth-enabled hearing aid devices were significantly affected by TLPS access point operations, but audio recordings captured by Bluetooth's own hearing aid system showed no difference once TLPS on IEEE 802.11 Channel 14 was activated. As demonstration participants observed, there was no real-world impact from TLPS on the Bluetooth hearing aid. The Bluetooth SIG's two audio recordings of classical musical playing in the TEC – one with and one without TLPS activated – exhibited no discernible difference. Globalstar has requested copies of these audio files along with the other data obtained. While Globalstar has been promised access to the data by the Bluetooth SIG, no such data has thus far been provided.

The Commission should also dismiss Bluetooth SIG's assertion that TLPS transmissions caused harm to Bluetooth-enabled smart lighting devices. This portion of Bluetooth SIG's demonstration suffered from fundamental methodological flaws. In fact, one of the individuals conducting the demonstration on behalf of the Bluetooth SIG explicitly noted weaknesses in their methodology. First, these Bluetooth-enabled lighting devices employed an unreliable data

[1] *Ex Parte* Notice for TLPS & Bluetooth Demonstrations, Bluetooth SIG, IB Docket No. 13-213 (Mar. 13, 2015). The TLPS demonstrations at the TEC began on March 6 and concluded on March 10, 2015.

communication protocol in which there is no acknowledgement by the receiving devices that the messages were received. According to the individual conducting the tests, an unreliable protocol is appropriate only where the user does not care if every message is received, which was not the case in this demonstration. A more reliable protocol could have been utilized. In addition, this portion of the demonstration did not include the necessary baseline cases. Transmission errors were observed prior to the activation of TLPS, and there should have been additional scenarios to determine if errors would have also occurred in the absence of Channels 1, 6, and/or 11.

This lack of a baseline test is consistent with the haphazard way in which this demonstration was performed. Calculation of the results was dependent on observation of the performance of these lights throughout the TEC, and the manner in which this process was conducted makes any claimed results entirely unreliable. Bluetooth SIG's observations of the lights and assessments of "failure" were rushed, informally documented, disputed by others present at the TEC, and hindered by the movement of individuals throughout the room. It appears unlikely that anything in the Bluetooth SIG's upcoming "detailed" report will improve the reliability of these demonstration results and, notably, whereas Globalstar provided all of its data to the other demonstration participants, the Bluetooth SIG has refused to provide the data from this demonstration to Globalstar.

Finally, it is worth noting that these smart lighting tests were performed not using commercial off-the-shelf devices that are representative of real-world equipment and performance, but with prototype development boards that use a proprietary protocol not yet sanctioned or incorporated into any standard by the Bluetooth SIG.[2]

The absence of any material real-world effects from TLPS operations was confirmed by Globalstar's own demonstrations in the TEC. As described in the attached report from Roberson and Associates, LLC, the activation of TLPS access points had no qualitative impact on either (i) a Bluetooth link between a wireless speaker and a tablet computer with a music player, (ii) a Bluetooth Low Energy link between a wrist-worn heart rate monitor and a smart phone running a heart rate monitor application, or (iii) two different Bluetooth wireless computer mouses operating in the presence of TLPS (one Bluetooth, one Bluetooth Low Energy). At no point did any Bluetooth representative even attempt to dispute the setup or results of Globalstar's demonstration. With a TLPS access point operating on Channel 14, the classical musical recording playing on the Bluetooth wireless speaker was entirely unaffected. Similarly, TLPS transmissions had no impact on the performance of the Bluetooth heart monitor or the operation of the computer mouses. A video recording of a TLPS-Bluetooth demonstration conducted by Globalstar in the TEC is available at http://www.globalstar.com/en/index.php?cid=6202&from=sidenav.

With the successful conclusion of the TLPS compatibility demonstration on March 10, the Commission should now move expeditiously to adopt its proposed rules to add 22 megahertz to the nation's wireless broadband spectrum inventory and ease the congestion that is reducing

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[2] Bluetooth brought other Bluetooth-enabled devices but chose not to use them during the live demonstration, including wireless speakers and 3D glasses.

the quality of Wi-Fi service at high-traffic 802.11 hotspots and other locations.[3] As the recent demonstrations confirm, American consumers will benefit greatly from the provision of TLPS across this additional broadband spectrum in the 2.4 GHz band.

Respectfully submitted,

/s/ *Regina M. Keeney*
Regina M. Keeney

cc: Renee Gregory
Priscilla Delgado Argeris
Brendan Carr
Erin McGrath
Louis Peraertz

[3] *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).

BLUETOOTH – TLPS DEMONSTRATIONS AT THE FCC TECHNOLOGY EXPERIENCE CENTER

MICHAEL NEEDHAM, DR. KENNETH ZDUNEK

MARCH 10, 2015

1 BACKGROUND

A demonstration of the impact of Terrestrial Low Power Service (TLPS) operation on the performance of Bluetooth (BT) and Bluetooth Low Energy (BLE - also known as Bluetooth Smart) devices was presented on the afternoon of March 6, 2015, at the Federal Communications Commission (FCC) Technology Experience Center (TEC) in Washington, D.C. The demonstration was provided by Globalstar, Inc. and their partners, including the technology consulting firm of Roberson and Associates, LLC, the technology firm AT4 Wireless, and Jarvinian. The demonstrations were attended by several members of the FCC, as well as representatives from the Bluetooth Special Interest Group (BT SIG), Bluetooth technology provider CSR, Starkey Hearing Technologies, and CableLabs.

2 DEMONSTRATION GOALS

The goal of the demonstrations was to assess the performance of various BT and BLE devices operating in the 2.4 GHz ISM band, in the presence of TLPS devices operating on IEEE-

designated Wi-Fi channel 14 (2473 to 2495 MHz) in conjunction with other IEEE 802.11 Wi-Fi devices also operating on other channels in the 2.4 GHz band. The demonstrations focused on the impact of such operation on real-world user experiences using the BT and BLE devices.

3 TLPS AND WI-FI SETUP

The details of the basic arrangement of the TLPS and Wi-Fi access point (AP) and client setup may be found in the description of the TLPS and Wi-Fi demonstration also held at the FCC TEC on March 6 – 10, 2015. Those details specific to the BT / BLE demonstrations, consistent with the request of the organizations representing Bluetooth, are as follows:

- One client device was used per AP, with AP-client pairs operating on Wi-Fi channels 1, 6, 11, and 14, the channels being used depending on the stage of the demonstration. The APs were set to operate at 20 dBm (100 mW), representative of an indoor deployment.

- The Wi-Fi traffic generated between each AP-client pair consisted of emulated high-definition (HD) video streaming at a nominal rate of 3.75 Mbps. The emulated video stream was provided by the AT4 performance tool. The network protocol used over the wireless link was UDP over IP. The streaming traffic was in the downlink (AP to client) direction.

4 BT AND BLE DEVICES AND USER EXPERIENCES

Four specific BT and BLE devices and corresponding user experiences were provided in the demonstrations:

1. A wireless speaker connected via a BT link to a tablet computer with a music player. The tablet was located near the center of the room. The user experience demonstrated was the sound quality of the music played through the speaker, as the speaker was located at various positions in the room as the TLPS and Wi-Fi devices were operating.

- Speaker: Sony SRS-X5 Personal Audio System portable Bluetooth speaker

- Laptop: Microsoft Surface Pro 3 tablet with i7 processor, 8 GB RAM running Windows 8.1

- Music Player: Xbox Music player pre-installed on Surface Pro 3

- Music: Mozart Serenade in G, K.525 “Eine kleine Nachtmusic”, Allegro - 145 kbps mp3

2. A wrist-worn heart rate monitor connected via a BLE link to a smart phone running a heart rate monitor application. The smart phone was located on a shelf along one edge of the room where it could be observed by all parties. The user experience demonstrated was the constant reading of heart rate as displayed on the smart phone, as the user wearing the monitor moved throughout the room as the TLPS and Wi-Fi devices were operating.

- Heart Rate Monitor: Adidas Fit Smart Band - Model: M33705

- Smart Phone: Motorola Droid Mini running Android 4.4.4, 2 GB RAM, 16 GB ROM

- Heart Rate Monitor Application: Bluetooth Heart Rate Monitor ver. 1.61 (published by Jeremiah Huston on Google Play Store)

- Heart Rate Source: Michael Needham of Roberson and Associates

3. A wireless mouse connected via a BT link to a laptop computer running a web browser. The laptop was located near the center of the room, positioned so the screen could be observed by all parties, while the mouse was located a couple of feet away. The user experience demonstrated was the operation of the mouse in opening and closing a browser window, scrolling through the window, and clicking on links, as the TLPS and Wi-Fi devices were operating.

- Wireless Mouse: Logitech - M557 Bluetooth Mouse - Model: 910-003971

- Laptop Computer: HP Envy with 2.4 GHz i7 processor, 16 GB RAM running Windows 8.1

- Web Browser: Mozilla Firefox ver. 35.0.1

4. Identical to demonstration 3, except a wireless mouse utilizing a BLE link was used.

- Wireless Mouse: HP - Wireless Bluetooth Smart Laser Mouse - Model: z8000

5 Demonstration Stages and Results

Stage 1 – Three of the AP-client pairs were run on channels 1, 6, and 11. The observed received signal strength indication (RSSI) at each of the client devices was observed to be roughly -30 dBm, plus or minus a few dB, which is a high Wi-Fi signal level. The observed received data rate at the client devices was observed to be nominally 3.75 Mbps. The demonstrations described above were performed. No audible degradation of the music from the speaker was noted by observers in the room, and no interruption of the heart rate monitor display was observed during the demonstration. Several operations were performed using both the BT and BLE mouse, with no errors in operation. The demonstration lasted approximately 10-15 minutes.

Stage 2 – Same as stage 1, but with four AP-client pairs running on channels 1, 6, 11, and 14. The results observed were the same: With TLPS operating, no audible degradation of the Bluetooth stereo speaker audio quality was detected by the observers as the speaker was moved to various locations within the room. No interruption of the heart rate monitor was observed as the wearer of the heart-rate wrist-band moved throughout the room. No errors or interruption of the Bluetooth and Bluetooth LE mouse were observed when the TLPS access point was operated.

6 Conclusions

The operation of Wi-Fi AP-client pairs on channels 1, 6, and 11 in the 2.4 GHz band, as described above, had no observable impact (visual or audible) on BT and BLE devices operating in the same room as the AP-client pairs. The addition of TLPS operating on channel 14 additionally had no observable impact on the operation of the BT and BLE devices. The conclusion is that TLPS operation has no impact on real-world user experiences using the BT and BLE devices.

APPENDIX: COMPANY PROFILE

Profile: Roberson and Associates, LLC

Roberson and Associates, LLC, is a technology and management consulting company serving government and commercial customers that provides services in the areas of RF spectrum management, RF measurements and analysis, strategy development, and technology management. The organization was founded in 2008 and is composed of a select group of individuals with corporate and academic backgrounds from Motorola, ARRIS, Bell Labs (AT&T, Bellcore, Telcordia, Lucent, Alcatel-Lucent), Cisco, Google, IBM, IITRI (now Alion), ITW, NCR, Nokia, S&C Electric, independent consulting firms, and Illinois Institute of Technology. Together the organization has over 400 years of high technology management and technical leadership experience with a strong telecommunications focus.

Profiles: Roberson and Associates, LLC, Staff

Dennis Roberson, President and CEO

Mr. Roberson is the Founder, President and CEO of Roberson and Associates, LLC. In parallel with this role he serves as Vice Provost for Research, and Research Professor in Computer Science at Illinois Institute of Technology where he has responsibility for IIT's corporate relationships including IIT's Career Management Center, Office of Compliance and Proposal Development, Office of Sponsored Research and Programs, and Technology Transfer efforts. He also supports the development and implementation of IIT's Strategic Plan, the development of new research centers, and the successful initiation and growth of IIT related technology-based business ventures. He is an active researcher in the wireless networking arena and is a co- founder of IIT's Wireless Network and Communications Research Center (WiNCom). His specific research focus areas include dynamic spectrum access networks, spectrum occupancy measurement and spectrum management, and wireless interference and its mitigation and of which are important to the Roberson and Associates mission. He currently serves on the governing and / or advisory boards of several technology-based companies. Prior to IIT, he was EVP and CTO at Motorola and he had an extensive corporate career including major business and technology responsibilities at IBM, DEC (now part of HP), AT&T, and NCR. He is and has been involved with a wide variety of Technology, Cultural, Educational and Youth organizations currently including the FCC Technical Advisory Council and Open Internet Advisory Committee, the Commerce Spectrum Advisory Committee, and the National Advisory Board for the Boy Scouts of America and its Information Delivery Committee, and the Board of HCJB Global. He is a frequent speaker at universities, companies, technical workshops, and conferences around the globe. Mr. Roberson has BS degrees in Electrical Engineering and in Physics from Washington State University and a MSEE degree from Stanford.

Ken Zdunek, Vice President & CTO

Dr. Zdunek is Vice President and the Chief Technology Officer of Roberson and Associates. He has over 30 years of experience in wireless communications and public safety systems. Concurrently he is a research faculty member in Electrical Engineering at the Illinois Institute of Technology, in Chicago, Illinois, where he conducts research in the area of dynamic spectrum access and efficient spectrum utilization, and teaches a graduate course in wireless

communication system design. He is a Fellow of the IEEE, recognized for his leadership in integrating voice and data in wireless networks. He was recently a contributor to the FCC's Emergency Response Interoperability Center Public Safety Advisory Committee (ERIC PSAC). Prior to joining Roberson and Associates, he was VP of Networks Research at Motorola. Dr. Zdunek was awarded Motorola's patent of the year award in 2002 for a voice-data integration approach that is licensed and extensively used in cellular communications. He holds 17 other patents, included patents used in public safety trunked systems and cellular and trunked systems roaming. He directed the invention and validation of Nextel's iDENR voice-data air interface and IP based roaming approach, and was the principal architect of Motorola's SmartNetR public safety trunking protocol suite. In the 1990's, he directed a Spectrum Utilization and Public Safety Spectrum Needs Projection submitted to the FCC in support of the 700 MHz spectrum allocation for Public Safety. He was awarded the BSEE and MSEE degrees from Northwestern University, and the Ph.D. EE degree from the Illinois Institute of Technology. He is a registered Professional Engineer in the State of Illinois. He is past president, and on the board of directors of the Chicago Public Schools Student Science Fair, Inc.

Mike Needham, Principal Engineer II

Mr. Needham joined Roberson and Associates in November of 2013 with more than 28 years of experience in corporate research and development. His most recent position was Distinguished Member of the Technical Staff in the Applied Research Center at ARRIS (formerly Motorola Mobility / Google). He has worked in a broad range of technologies in the areas of wireless communication and media delivery systems, including: network architecture design, specification, and analysis; data protocol design; radio system modeling; and media analytics. He has 25 issued U.S. patents, with several more pending, and many years of experience in intellectual property assessment and management. Mr. Needham also has numerous publications in technical journals and conferences. He holds B.S. and M.S. degrees in electrical engineering from the University of Illinois in Urbana-Champaign.

Nat Natarajan, Principal Engineer III

Dr. Natarajan earned his B.Tech. from the Indian Institute of Technology (Chennai), ME with Distinction from the Indian Institute of Science (Bangalore) and Ph.D. from the Ohio State University, Columbus, OH. Nat joined Roberson and Associates in 2014 with over 25 years of industry experience in wireless communication and networking systems. Previously he has worked as a Mobility Network Consulting engineer and architect at Cisco Systems (2010-2013), Fellow of the Technical Staff at Motorola (1993-2009) and Research Staff Member at IBM Thomas J. Watson Research Center in Yorktown Heights, NY (1983-1993). Nat is a creative network architect, problem solver and an accomplished master network innovator with work experience covering the entire technology life cycle - pioneering technology research, industry standardization, system architecture, design and analysis, prototyping and trials, product development and commercial deployment. He began his wireless career at IBM with fundamental contributions to WLAN architecture concepts and specs of the baseline 802.11 standard that have been acknowledged by the IEEE. After joining Motorola he developed the routing algorithms for Iridium, a LEO satellite communication system. He subsequently pioneered and advocated All-IP Packet switching for mobile wireless networks starting with Motorola 4G research (1997). He led the early customer demonstrations of such systems, including VoIP, SIP, Mobile IP and seamless inter-technology handoffs (WiFi and cellular RAN) through a sequence of trials (2000-2002). Nat has 38 issued US patents including several implemented in commercial wireless systems. During 2004-09, he led early research and standardization of 802.16e/WiMAX as well as LTE (FDD and

TDD). He contributed to development teams in prototyping early implementations of WiMAX and LTE prior to commercial release. His most recent experiences at Cisco (2010-13) include commercial customer deployment of UMTS Femto and Macro LTE systems. Through much of his career, Nat has served as a trusted advisory consultant to C-level executives, network planners and senior technologists of major operator customers across the globe. Nat has 35+ refereed technical publications, 3 Cisco Achievement Awards, Motorola Science Advisory Board Associate recognition, Global Standards Awards for Outstanding Performance and 5 IBM Achievement Plateau awards. Nat is an IEEE Senior Member and its communication society. Additional publication details can be found at: https://www.linkedin.com/in/natnatarajan(external link)

Edward Porrett, Sr. Engineer I

Mr. Porrett is a Senior Engineer I for Roberson and Associates. He has 35 years experience in the research, design and testing of prototype radio communications equipment. Prior to joining Roberson and Associates, he was a Senior Staff Research Engineer at Motorola working in the Research and Development Labs. His experience ranges from working on the first cellular telephone prototype and demonstration system, making early cell system propagation measurements, to managing and operating an antenna test range with international customers. While at Motorola he developed three patents covering diverse fields of RF transmitter improvement, Infra-Red communications, and propagation measurement systems. His expertise is in making and analyzing RF measurements and working with and developing measurement systems. He has an Associate in Applied Science, Electrical Engineering Technology Degree from Michigan Technological University.