



From: Michael Needham, Principal Engineer, Roberson and Associates, LLC
Subject: **Engineer Mike Needham Rebuts March 13th Bluetooth Blog Post**
Date: March 23, 2015

Summary

On March 6, 9 and 10, Globalstar conducted a demonstration of its Terrestrial Low Power Service (TLPS) at the Federal Communication Commission's Technology Experience Center. Globalstar showed that TLPS had no impact on the functionality of Bluetooth-enabled devices, including heart monitors, computer mice and wireless speakers, located in the same room with continuously transmitting access points operating on Wi-Fi Channels 1, 6, 11 and 14.

On March 13, Mark Powell from the Bluetooth Special Interest Group (who did not attend the demonstration) questioned Globalstar's findings¹. In rebuttal, the following points are made:

- The Globalstar demonstrations clearly show that under stressful but nonetheless reasonable real-world interference conditions, commercial off-the-shelf Bluetooth devices are not impacted by TLPS operation in any manner;
- Conversely, the two lone tests performed by Bluetooth SIG, by which they concluded there was impact, were done with non-standard devices used in unconventional fashion;
- Bluetooth SIG might choose to ignore Globalstar's results, and claim harmful impact based on the flawed and ultimately contrived tests they performed at the FCC, but those who witnessed firsthand the Globalstar demonstrations are convinced otherwise.

Analysis

The March 13 blog post by Mark Powell from the Bluetooth Special Interest Group (SIG), concerning the recent demonstrations of Globalstar's Terrestrial Low Power Service (TLPS) at the FCC Technology Experience Center, is full of misconceptions and factual errors. Detailed here are the more prominent problems with the posting.

First is the notion, expressed by Mr. Powell, that the unlicensed industrial, scientific, and medical (ISM) band at 2.4 GHz has so-called "guard bands" to prevent different services from using overlapping spectrum. Anyone who knows how the ISM band is constructed and used would realize the absurdity of this notion. The many services utilizing the 2.4 GHz ISM band – Wi-Fi, Bluetooth, cordless phones, baby monitors, and microwave ovens, among many others – all use the same spectrum in an overlapping manner. There are no "guard bands" separating these services; in fact, the services are designed to operate in overlapping fashion. Globalstar's

¹ "Bluetooth SIG Response to Globalstar Comments on FCC Technical Demonstrations," Mark Powell, March 13, 2015, <http://blog.bluetooth.com/bluetooth-sig-response-to-globalstar-comments-on-fcc-technical-demonstrations/>

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proposed TLPS would be just another service sharing the band, essentially identical to current Wi-Fi. Additionally, TLPS would only share a small fraction of the ISM band (roughly 10 MHz out of 80), as opposed to services like Bluetooth, which transmit over the entire ISM band.

Mr. Powell is correct in saying there are rules for using the unlicensed ISM spectrum, and it is in fact these rules which allow the existence of overlapping services. Where he is wrong is in his claim that somehow special rules would be applied to TLPS. In fact, Globalstar has always stated that TLPS will operate under the exact same rules as Wi-Fi and other unlicensed services within the ISM band, and the FCC, in its Notice of Proposed Rulemaking (NPRM) on the proposal, states the same thing: “We do not intend to grant Globalstar any additional or different interference protection rights than those that currently apply to existing unlicensed operations in the 2473-2483.5 MHz band under Part 15 ... Globalstar’s operations would also need to protect other licensed services from harmful interference to the extent required under current rules. We believe this approach addresses one of the concerns raised by commenters. Generally, commenters were concerned that Globalstar would obtain through its proposal superior status over other authorized users.”² This couldn’t be any clearer.

With regard to the actual tests performed by Bluetooth SIG, it is stated that “The demonstration sessions were held in a rather small space that meant we could not conduct some of the demonstration scenarios we had prepared.” This is rather hard to understand. The Bluetooth test plans filed with the FCC specified testing of devices such as Bluetooth headsets, portable speakers, hearing aids, blood glucose meters, and heart rate monitors.³ These are all small devices intended for operation only over short ranges – so why would they require a large amount of space for testing? In fact, representatives from Bluetooth SIG were seen operating several of these devices prior to the official demonstration periods – so it seems more likely that Bluetooth SIG decided to exclude these devices from its tests, based on better than expected performance seen during their preliminary test runs. At any rate, Globalstar was able to successfully operate several of these types of devices during its own demonstration in the same space that Bluetooth claims was insufficient.

It’s notable that the only two devices Bluetooth SIG decided to include in their final public tests are ones that use a special form of Bluetooth, namely Bluetooth Low Energy (BLE, also branded as “Bluetooth Smart”) – and moreover, which use the protocol in distinctly non-conventional fashion⁴. It is important here to understand the differences between standard Bluetooth and BLE. As explained in an article in Electronic News, “Classic Bluetooth technology is a connection oriented radio ... ideal for high activity connections like mobile phones linking with wireless headsets,” while “Bluetooth Low Energy technology ideally suits transmission of data from compact wireless sensors (exchanging data every half second) or other peripherals like remote controls ... These devices send low volumes of data (i.e. a few bytes) infrequently⁵.” So, what is one of the BLE applications that Bluetooth SIG chose to test? Why, a mobile phone linking with a wireless headset, of course (specifically, a hearing aid which links to an iPhone – shown in the photo below in test setup). And while such applications would typically have the phone and headset separated by at most a foot or two on one’s person, the SIG test was conducted with the

² *Notice Of Proposed Rulemaking*, IB Docket No. 13-213, RM-11685, released Nov. 1, 2013

³ *Globalstar TLPS Test Plan Overview*, Issued 2015-03-04, Document Number TLPS.TP.1.0.0r00, Group Prepared by Bluetooth SIG

⁴ In fact, in contrast to the devices demonstrated by Globalstar, the two device types used by Bluetooth SIG (hearing aids and smart lighting switches) are not even listed on their own website containing a comprehensive list of available BLE products – see <http://www.bluetooth.com/Pages/Bluetooth-Smart-Devices-List.aspx>

⁵ “Inside Bluetooth low energy technology,” 10 November, 2010, Kjartan Furset, <http://www.electronicnews.com.au/news/inside-bluetooth-low-energy-technology>

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devices separated by the entire length of a room crowded full of people, and with 4 operating access points at only 20% of the separation distance recommended by the manufacturer blaring away.



Figure 1 Hearing aid in test rig for audio recording

Under these contrived conditions it “could mean broken up, or significantly lower audio quality” stated Powell. Except that wasn’t the case. When audio recordings from the hearing aid tests were played, one with channel 14 operating and one without, there was general agreement that there was no discernable difference in the two recordings (Bluetooth SIG has said that it will release these recordings along with other data taken, so readers will be able to judge for themselves, though this has not yet happened).

The other BLE application that Bluetooth SIG decided to test is also an unconventional one – a so-called BLE “mesh” application from a company called CSR. Here, a BLE node sends out messages on one of the BLE “advertising channels” (i.e., channels not designated for data transfer, but for device discovery), which when received, are re-broadcast by subsequent nodes. It’s worth noting that the BLE standard does not currently support mesh topologies (the SIG is planning to address this in future revisions), so the technology used here is clearly “home-baked” (as was evident by the development boards used in the tests – see photo below). Additionally, the CSR representative stated that the tests were run using an unreliable mode of the protocol (i.e. a mode that does not use acknowledgements to ensure reliable message delivery), even though it could easily be configured to use such a reliable mode.

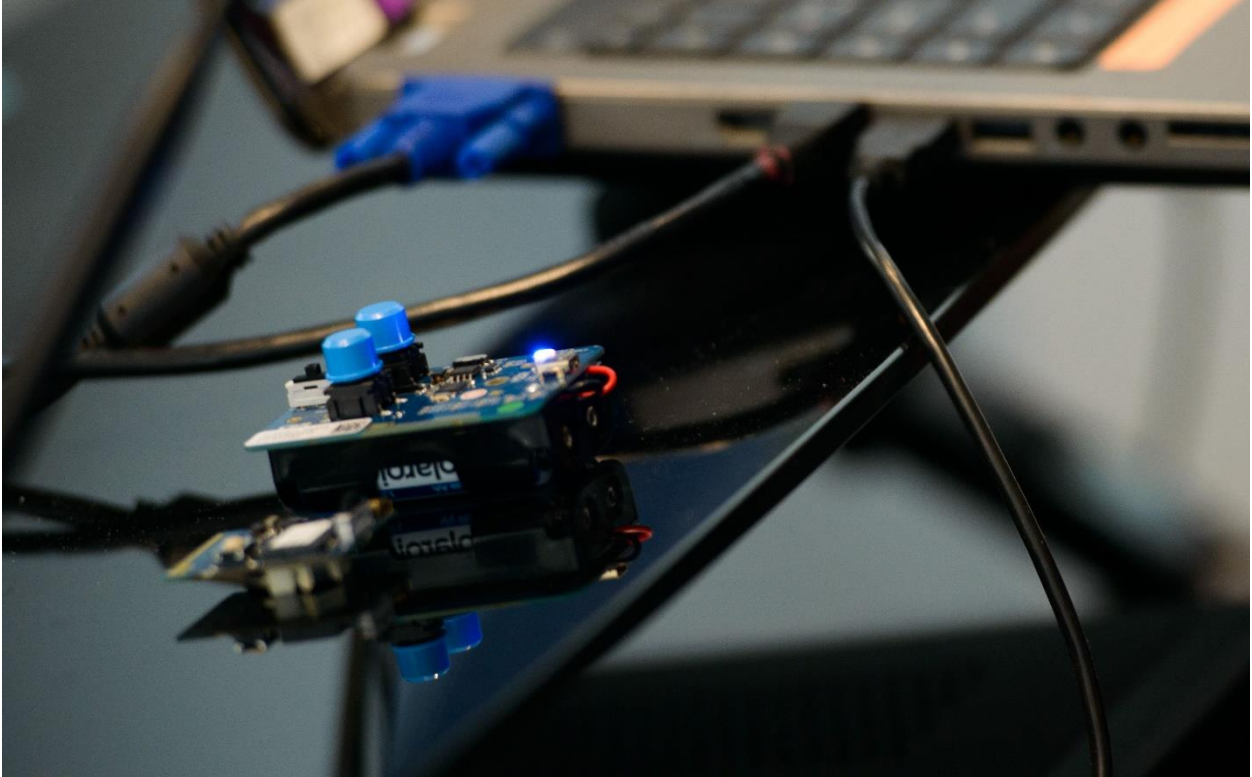


Figure 2 BLE mesh proto-board device from CSR

And that's it. These are the tests that Bluetooth SIG uses to come to the sweeping conclusion that TLPS causes unacceptable interference to Bluetooth operation. Never mind that Globalstar earlier that same day successfully demonstrated a number of Bluetooth and BLE devices operating concurrently with both TLPS on channel 14 and standard Wi-Fi on channels 1, 6, and 11 broadcasting simultaneously. The devices included a wireless speaker, a heart monitor, and two types of computer mice – all standard off-the-shelf devices running familiar applications, and all performing flawlessly⁶. Mr. Powell's blog neglects to mention this fact, leaving the impression that the only demonstrations of Bluetooth were the two questionable demonstrations they performed themselves, as described above. And of course, Mr. Powell did not attend the demonstrations in person, and so is relying on second hand information.

So is Globalstar justified in its conclusion that TLPS does not cause harmful interference to Bluetooth? The demonstrations do show that under stressful but nonetheless reasonable real-world interference conditions (with access points in an enclosed space broadcasting continuously on contiguous channels), commercial off-the-shelf Bluetooth devices are not impacted by TLPS operation in any manner. Bluetooth SIG might choose to ignore these results, and claim harmful impact based on the flawed and ultimately contrived tests they performed at the FCC, but those who witnessed firsthand the Globalstar demonstrations are convinced otherwise.

About the Author:

Michael Needham joined Roberson and Associates in November of 2013 with more than 28 years of experience in corporate research and development at Motorola, Google, and Arris. He has

⁶ See video of a Bluetooth demonstration without and with TLPS operation at <http://www.globalstar.com/en/index.php?cid=6202> under the "Bluetooth Demonstration" links

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worked in a broad range of technologies in the areas of wireless communication and media delivery systems, and has 25 issued U.S. patents, along with numerous publications in technical journals and conferences.