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Reston, June 15, 2016

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Attention: Marlene H. Dortch, Secretary

u-blox response to FCC proceeding 11-109,

2nd response, follow-up to the one submitted by u-blox May 20th 2016

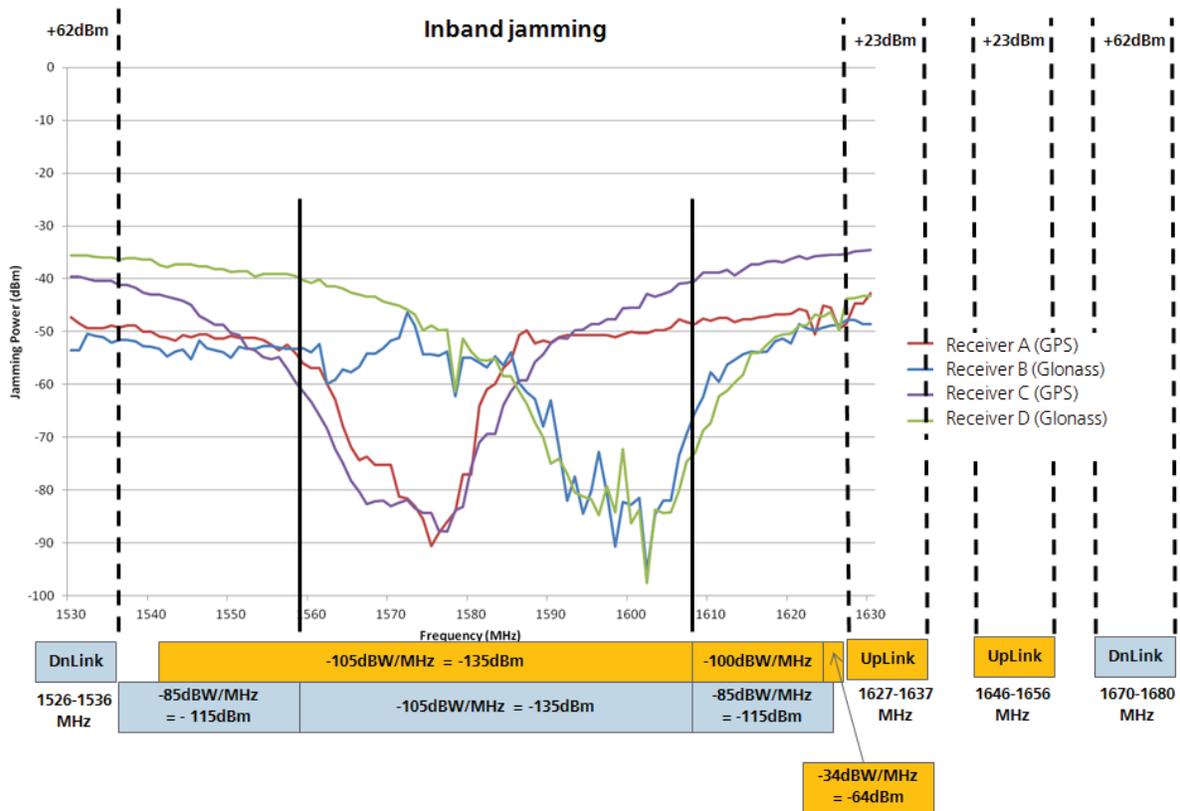
The recently published filings (11-109 05-11-2016 Ligado Networks LLC (1 of 2) 60001841466.pdf and 11-109 05-11-2016 Ligado Networks LLC (2 of 2) 60001841467.pdf) by Ligado show that some commercial receivers have issues with the interference tests. All of the receivers tested were complete, commercially available receivers (end-user-equipment), mostly in the consumer domain. No OEM receivers were tested (modules or chipsets).

The discussion around the 1dB limit is also irrelevant as the major problem is the UpLink power on 1627-1637MHz and 1646-1656 MHz causing major interference to GNSS receivers used by customers in the field as described below.

u-blox is the leading GNSS receiver component manufacturer. Our GNSS products (chips and modules) are OEM components intended for a multitude of applications needing positioning functionality. u-blox' product range support all GNSS signals within L1 band including Beidou B1I on 1561MHz, GPS/Galileo on 1575.42MHz and Glonass on 1598-1608MHz) in various combinations including GPS only devices. We sell products for basically all GNSS markets with the exception of mobile phones. Automotive and vehicle telematics are our biggest market segments, followed by GNSS time synchronization for cellular networks and telecom infrastructure, all of these segments needing a robust solution against external interference.

There are tens of millions of these receivers out in the field spanning several generations of GPS and GNSS platform, sold in the last 15 years to thousands of customers, including US government agencies. A big portion of the receivers (20% in US) are used in cost-sensitive applications where a passive antenna without any kind of SAW filtering is used. In practice it means that these applications are vulnerable to new, external interference such as Ligado although they work perfectly well in today's environment. Retrofitting these devices is impossible. Forward-looking, new devices could be equipped with protection against out-of-band jamming; however, this would impose cost for a very cost-conscious industry.

The figure below shows in-band jamming levels of popular u-blox OEM receivers (plain receiver IC). In this example they will saturate roughly @ -47dBm signal level on the 1627-1637MHz UpLink. At 1646-1656 MHz the saturation level is slightly better but still in the order of magnitude -40dBm. The current inband jamming test setup goes from 1530-1630MHz.



f/MHz	distance/m	fspl/dB	Ptx/dBm	Prx/dBm	RXmax/dBm	RXMargindB
1627	10	56,7	23	-33,7	-47	-13,3
1627	1	36,7	23	-13,7	-47	-33,3
1627	50	70,7	23	-47,7	-47	0,7

The table above calculates the distance needed between a LTE TX (UpLink) and a GNSS receiver. The required distance is about 50m so that the UpLink does not interfere with GNSS. The other way around: the signal level is 33dB too high at 1m distance, 13dB too high at 10m distance.

Similar receiver architecture is used in new market segments such as V2X, ADAS, autonomous driving, to name a few where functional safety and integrity play a vital role.

The table above explains that millions of receivers out in the field will potentially be affected by the Ligado signals close to L1 band as they are from our receiver point-of-view in-band interference. Therefore, we require further tests to be conducted with OEM receivers configured as described above:

- passive antenna, typically small patch element
- No external SAW/LNA
- OEM receiver (No integrated SAW/LNA)

u-blox will be glad to provide a number of various GPS receivers for those tests.

Best Regards,

A handwritten signature in purple ink that reads "Mr Papadopoulos". The signature is written in a cursive style with a large initial "M" and "P".

Nikolaos Papadopoulos
President
u-blox America, Inc.