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SUBMITTED ELECTRONICALLY

September 23, 2015

Marlene H. Dortch  
Secretary  
Federal Communications Commission  
445 12<sup>th</sup> Street, S.W.  
Washington, DC 20554

**RE: Notice of *Ex Parte* Presentation  
IB Docket No. 11-109; IB Docket No. 12-340; IBFS File Nos. SAT-MOD-20101118-  
00239, SAT-MOD-20120928-00160, SAT-MOD-20120928-00161, SES-MOD-  
20121001-00872**

Dear Ms. Dortch:

On September 21, 2015, Scott Burgett, Director, GNSS and Software Technology of Garmin International, Inc. ("Garmin"), and I met with Philip Verveer, Counsel to the Chairman.

In the meeting, Mr. Burgett noted the continuing need to protect receivers using the Global Navigation Satellite System ("GNSS") including those using the Global Positioning System ("GPS") from desensitization by operations in adjacent bands. He stated that Garmin remains committed to working with the Commission staff, other federal stakeholders, and interested third parties to protect critical GNSS applications from interference while potentially exploring ways that currently underutilized spectrum in adjacent bands can be made more productive. He also touched upon GPS performance criteria and provided the enclosed hand-out.

Pursuant to Section 1.1206(b)(2) of the Commission's rules, an electronic copy of this letter is being filed for inclusion in each of the above-referenced dockets. A copy of this letter is being provided by email to Mr. Verveer. If you have any questions about this filing, please contact me.

Very truly yours,

M. Anne Swanson  
Counsel to Garmin

Enclosure

cc (via email): Philip Verveer, Esquire

# Accuracy, Integrity, Availability, and Continuity

Four Key GPS Performance Criteria

# Required GPS Performance Parameters

- There are four aspects to GPS performance that are critical in many existing and emerging applications
- They are Accuracy, Integrity, Availability, and Continuity
- These “Four Horsemen” are critical for the GPS system to provide the required level of service in such existing and emerging applications as
  - Safety of life aviation operations (e.g., precision approach and landing, Terrain Awareness and Warning Systems (TAWS), etc. )
  - Intelligent transportation systems and self driving cars
  - Unmanned aerial systems
  - Precision agriculture/construction
  - Earthquake monitoring
  - Public Safety/Disaster Relief
- Accuracy, Integrity, Availability, and Continuity are all affected by interference, and the lack of any one of these performance parameters can render an application unavailable

# Accuracy and Integrity

## Accuracy

- The difference between the indicated position/velocity/time (PVT) and the actual position/velocity/time at any given moment
- Accuracy requirements are use case dependent, and can vary from 10's of meters to less than a centimeter

But Accuracy in itself is not enough for many applications, what is also needed is an indication of the **Integrity** of the PVT

## Integrity

- The ability of the GPS system or equipment to provide a **timely** warning to a user or shut itself down when it cannot meet its accuracy requirements. In other words, can I trust that the PVT solution meets my requirements?
- If one can't trust a GPS solution, one cannot perform high risk/high value operations when the cost of an error is great (loss of life, loss of property, etc.)

# Availability and Continuity

## Availability

- The availability of GPS is simply how often the GPS system is available for use where it meets accuracy and integrity requirements.
- For example, the GPS system meets its Service Availability requirements nearly 100% of the time. The FAA publishes a report quarterly with these and other statistics
- A service that can only provide accurate PVT information with high integrity for short and unpredictable amounts of time is unsuitable for many applications

## Continuity

- The ability of the system to provide the required level of service without unscheduled interruptions
- For many applications, the time between unscheduled interruptions must be very long (e.g., navigation, surveying)
- Even momentary episodes of interference can significantly impact continuity for many applications

# Perspective

- These four performance parameters are internationally recognized and defined. For example the International Civil Aviation Organization (ICAO) has adopted definitions and requirements for accuracy, integrity, availability, and continuity in the International GNSS Standards and Recommended Practices (SARPS), which were first adopted in 2001.
- All GPS applications have differing requirements for accuracy, integrity, availability, and continuity
  - Many of these requirements are internationally agreed upon by the ITU, ICAO, and other world standards bodies.
- A small increase in the noise floor may impact any one of these parameters in unexpected or dramatic ways
- This is the principal reason why the 1 dB rise in the noise floor is applied as a harmful interference metric and has been internationally recognized for that purpose – to do otherwise would require analyzing many complicated use cases for interference impact to the four parameters.