



September 7, 2011

**VIA ELECTRONIC FILING**

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

Re: **Notice of *Ex Parte* Presentation in LightSquared Subsidiary LLC  
Request for Modification of its Authority for an Ancillary  
Terrestrial Component, IB Docket No. 11-109;  
IBFS File No. SATMOD-20101118-00239**

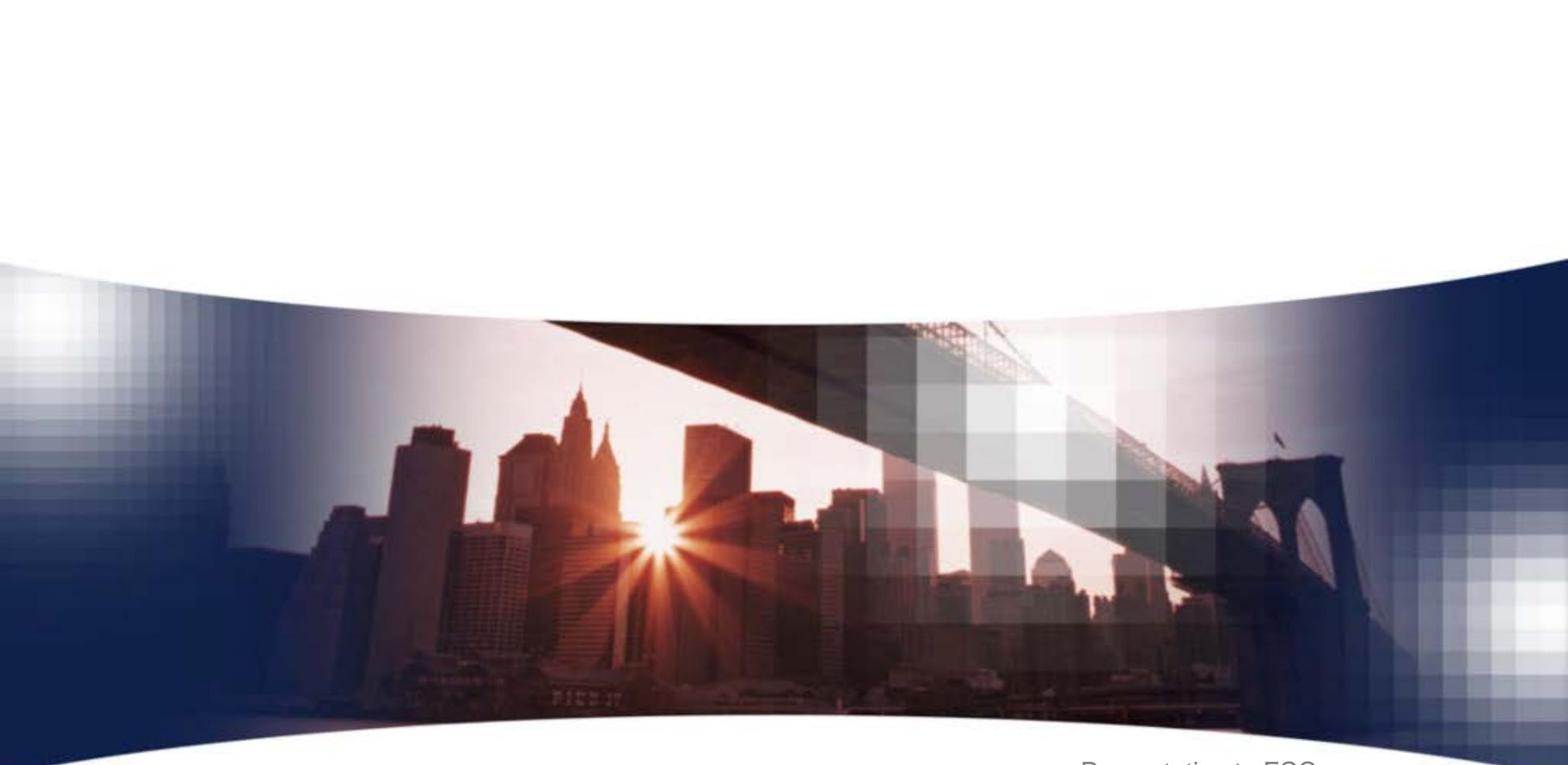
Dear Ms. Dortch:

On September 6, 2011, the undersigned, Martin Harriman, Douglas Smith, Geoffrey Stearn, and Michael Tseytlin all of LightSquared Subsidiary LLC ("LightSquared"), Richard Lee of Greenwood Telecommunications, and Henry Goldberg, outside counsel to LightSquared, met with Julius Knapp, Chief, and Ronald Repasi, Deputy Chief, of the Office of Engineering and Technology; Rick Kaplan, Chief, and John Leibovitz, Deputy Chief, of the Wireless Telecommunications Bureau; and Paul de Sa, Chief of Office of Strategic Planning & Policy Analysis to discuss issues regarding the above-referenced proceeding and application. During this meeting, LightSquared presented the material contained the attached slide deck.

Please direct any questions to the undersigned.

Respectfully submitted,

/s/Jeffrey Carlisle  
Executive Vice President  
Regulatory Affairs & Public Policy  
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Presentation to FCC  
September 6, 2011

## Operational and Design Solutions for GPS Devices

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# Meeting Overview

- LightSquared's Proposal to Further Ensure Operational Compatibility
- Evaluation based on TWG Test Results
- Filter Technology for High Precision and All GPS Devices

# Additional LightSquared Commitments

## Limit the Power-on-the-ground

- Sites will be deployed to result in no more than -30dBm at points on the ground
- -27 dBm after January 1, 2015
- -24 dBm after January 1, 2017

## Provide long-term, stable satellite signal for MSS-provided GPS augmentation link at frequency near top of the MSS Downlink Band

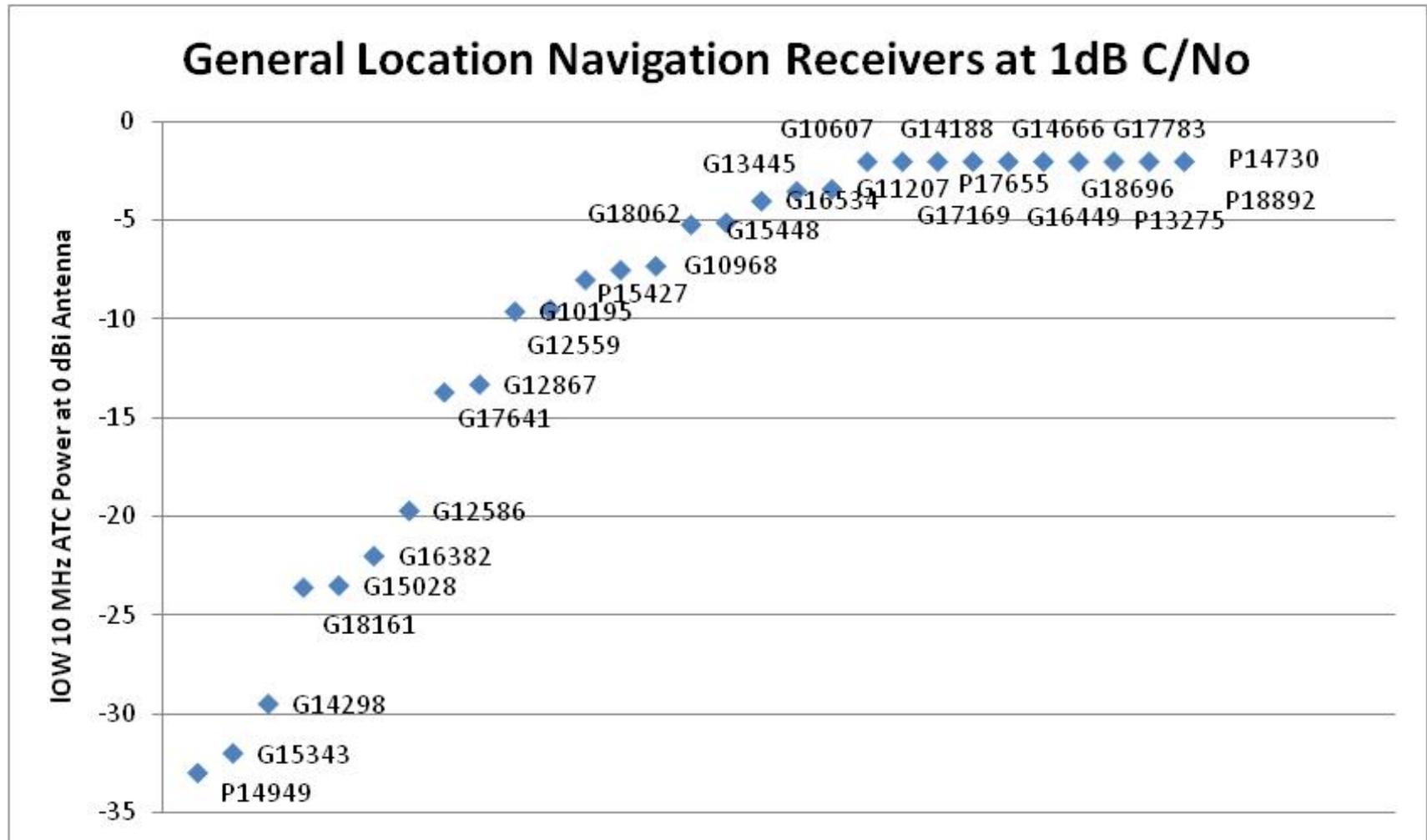
- 1555-1559 MHz

# LightSquared Commitment to On-Ground Power Levels

- Measurements will be performed at distances starting 50 m from the base of the antenna or at the closest practical point
- Log measurements will be taken with calibrated equipment, in a suitably equipped vehicle, with a roof-mounted antenna, and include locations up to 500 m from the base of the tower. Up to 5,000 power samples will be collected and recorded per base station drive route. The vehicle will have the ability to measure its own position and correlate it with the measured power samples.
- Once the point of highest power has been determined, a minimum of 10 measurement samples will be taken within a 10 meter x 10 meter area approximately centered on that point. The power values will be averaged in dB units to yield the measure of the maximum power.
- The power shall be measured with a reference antenna of calibrated 3D gain pattern, meeting the following requirements:
  - Measurement Bandwidth: 10MHz centered at 1531 MHz
  - Antenna Polarization: RHCP
- The power reported shall be referenced to an isotropic antenna (0 dBi gain). Suitable gain corrections shall be applied, considering the elevation angle from the measurement point to the radiation center of the base station and antenna cable losses.
- LightSquared will take immediate corrective action if it is determined that these power level commitments are exceeded, when measured as per the conditions below; such actions might include reducing power or modifying antenna downtilt.

# General Location and Navigation Receivers

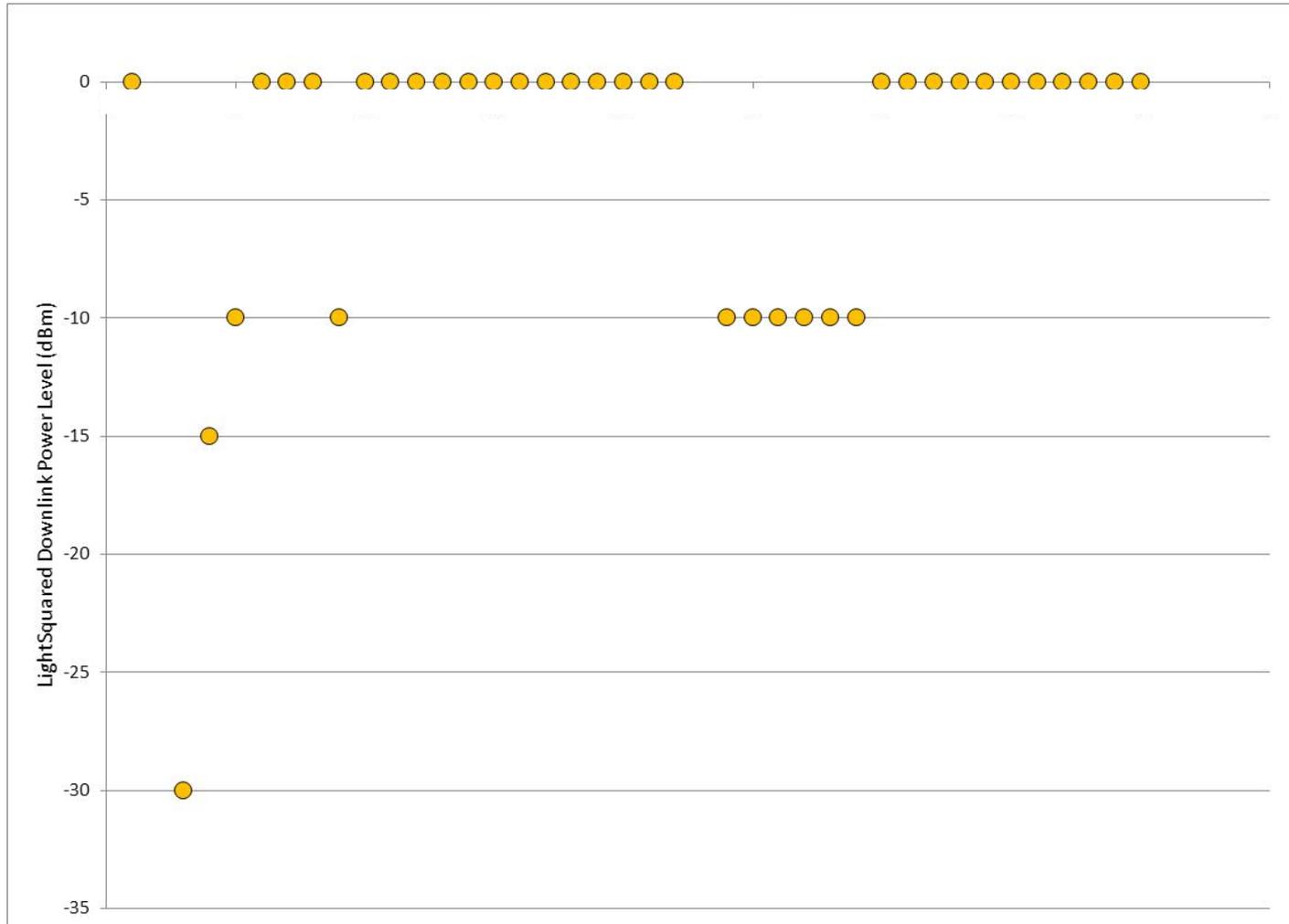
## Test Results for Lower 10MHz



# Cellular Receivers

## Test Results for Lower 10MHz

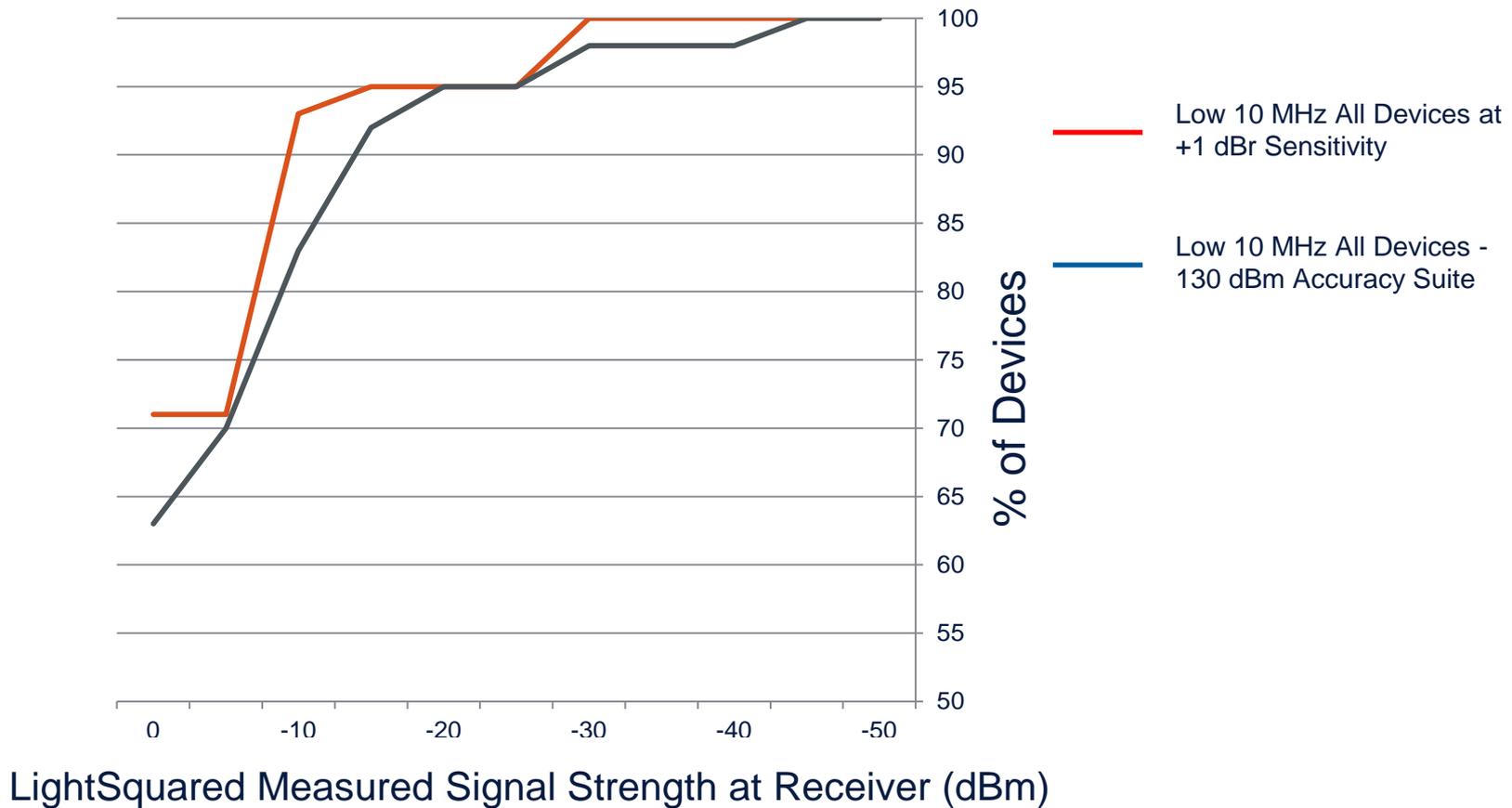
Max. Tolerable LightSquared Signal Level: Uniform SV Level at -135dBm (2.4.1.3-135/2.4.2.3-135)



# Cellular Receivers

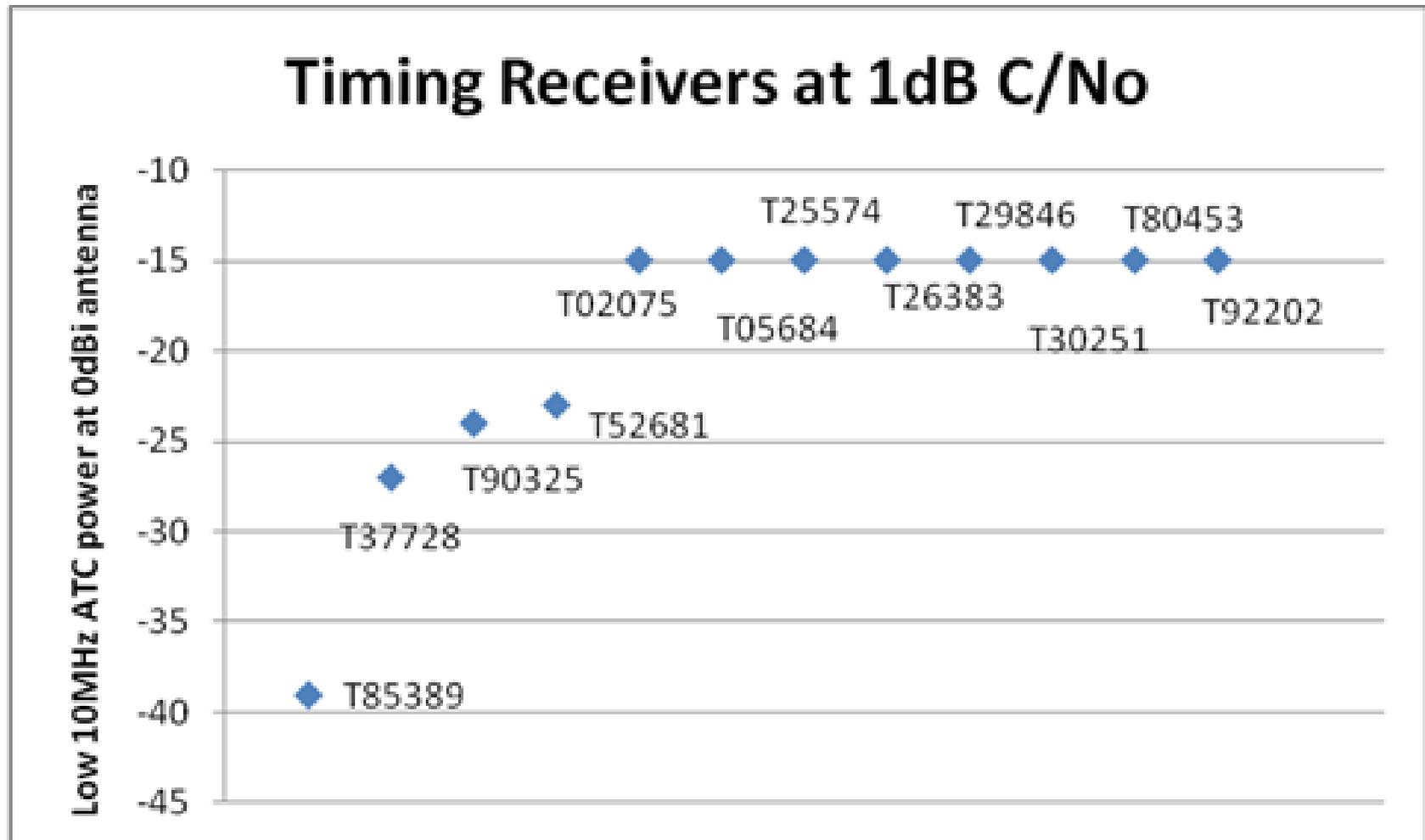
## Test Results for Lower 10MHz

Cumulative Distribution of All Devices Passing at Each Level for 30m Tower; EIRP=62 dBm, Gant GPS=-5dBi



# Timing Receivers

Test Results for Lower 10MHz



# Timing Receivers

## GPS Timing Receiver Findings, Results

- 8 of 12 were insusceptible up to the limit of the test system (-15 dBm) using 1 dB C/No degradation criteria; 11 of 12 were insusceptible at levels up to -27 dBm
- One device susceptible at -39 dBm
- PCTEL antenna filter offers more than 60dB rejection at 1536MHz
- Enables all external-antenna receivers with susceptibilities as low as -60dBm to work at LightSquared collocated sites

# Timing Receivers

## Mitigation Solution

- Commercial solutions available from PCTEL and Panasonic
- Many in service
- PCTEL Antennas were successfully utilized by Sprint, Verizon and Clearwire during the Las Vegas TWG field test
- Works with all narrowband timing receivers configured with separate, external antenna

PCTEL Specifications Sheet for model GPS-TMG-HR-26N

### GPS/AVIATION SPECIAL PURPOSE ANTENNAS

#### GPS Timing Reference Antennas

#### GPS-TMG-HR-26N, 26 dB Internal Amplifier With Enhanced Narrow Band Filtering

The GPS-TMG-HR-26 timing reference antennas feature a 26 dB amplifier and narrow band high rejection filtering specifically designed to support long-lasting, trouble-free deployments in congested cell-site applications.

The proprietary quadrifilar helix design, coupled with multi-stage filtering provides superior out-of-band rejection and lower elevation pattern performance than traditional patch antennas.

Their unique radome shape sheds water and ice, while eliminating problems associated with bird perching. The antenna may be purchased by itself or with pipe mounting hardware. Custom models or site kits options are also available.

This antenna is made of materials that fully comply with provisions stipulated by EU directives RoHS 2002/95/EC.



#### Antenna Element Electrical Specifications

Frequency Band	Antenna Gain	Nominal Impedance	VSWR	Polarization	Connector
1575.42 +/- 10 MHz	3.5 dBiC	50 ohms	≤1.5:1	Right hand circular	N, female (one - bottom fed)

#### Mechanical Specifications

Antenna Dimensions	Shipping Dimensions	Antenna Weight	Shipping Weight	Radome Color
5.0" H x 3.2" D (126 H x 81 mm)	7.5" L x 4.4" W x 3.8" D (190 L x 112 x 96 mm)	0.6 lbs (0.3 kg)	1.9 lbs (0.9 kg)	White

#### Environmental Specifications

Temperature Range	Humidity
-40° C to +85° C	95%

#### Mounting

All mounting options fit pipes of 1"-1.45" (25 mm-37 mm) maximum diameter.

Model	Options
GPS-TMG-HR-26N	Does not include mounting hardware.
GPS-TMG-HR-26NMS	Includes universal mounting hardware consisting of collar (GPS-TMG-MNT) and pipe clamp (GPS-TMG-LMNT).
GPS-TMG-HR-26NCS	Includes economy collar mount (GPS-TMG-MRNMNT).
GPS-TMG-HR-SPI-26NCB**	Integrated on-board surge protected version. Includes approved mounting and grounding components.

\*Final specification subject to change

\*\*Special order. Please contact PCTEL customer service for ordering detail.

#### Low Noise Amplifier Specifications\*

Frequency Band (MHz):	1575.42 +/- 1.2 MHz
Amplifier Gain:	26.5 dB +/- 3 dB
Nominal impedance:	50 ohms
Output VSWR:	< 2.0:1
Maximum Noise Figure:	≤ 4.5 dB @ +25° C including pre-selector
Operating DC Voltage:	3.3- 12.0 V (regulated)
Survival DC Voltage:	24V
DC Current:	≤ 40 mA @ 5V
Filtering:	4-stage filtering including pre-selector
Out-of-Band Rejection:	≥ 60 dB @ 1559 MHz ≥ 60 dB @ 1625 MHz

PCTEL, Inc.

WEB: [www.antenna.pctel.com](http://www.antenna.pctel.com)

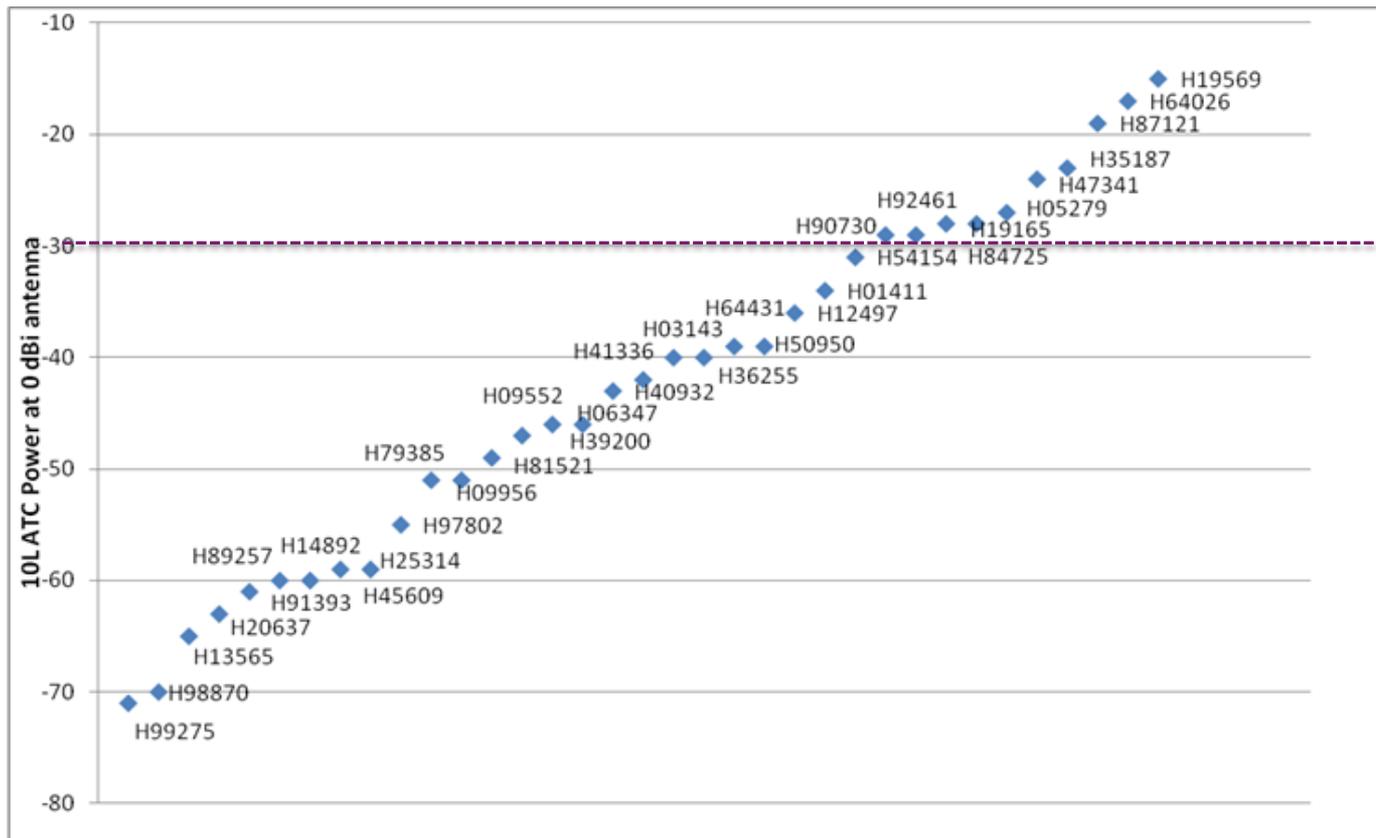
# Solutions for High Precision Devices

## Legacy Precision Receivers

- 10 of 38 precision receivers tested appear compatible at Lower 10MHz, -30dBm power on the ground managed
- Lower 10 MHz operation is compatible with WAAS augmentation as well

# Precision GPS Test Results

- TWG testing used a combination of Construction/Ag and Survey receivers
- 43 tested, 38 disclosed Lower 10MHz tracking results; 1 dB C/No degradation impact



These receivers currently compatible with -30dBm operation at Lower 10MHz

These receivers require either geographic separation or further attenuation, more filtering

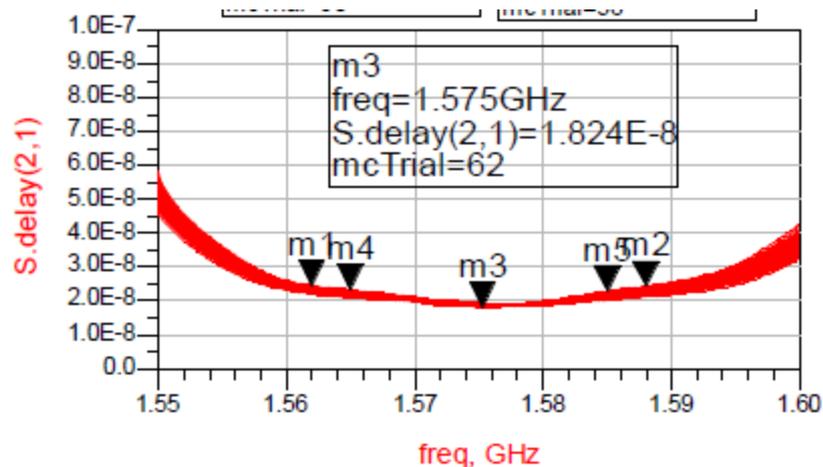
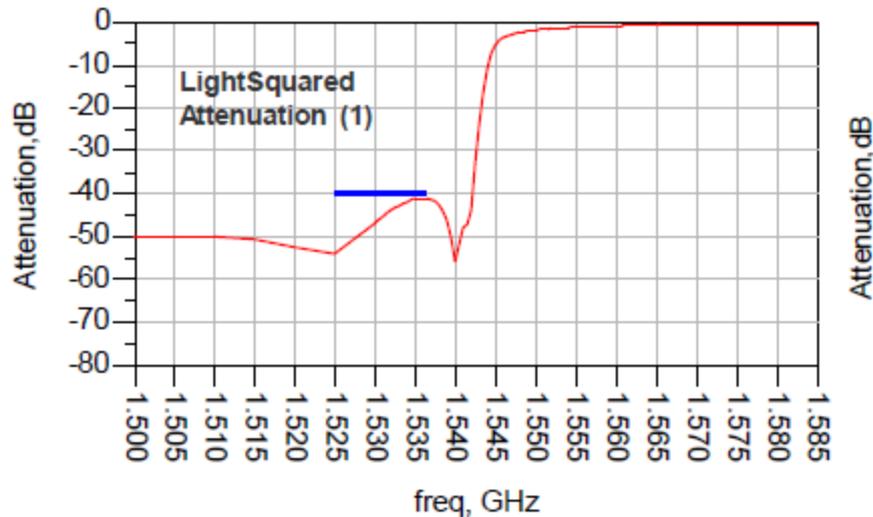
# Additional Precision Compatibility Measures

## Roadmap to retrofit or upgraded new-build receivers

- Development of universal GPS filter solution (next)
  - Performance requirements and theoretical limits
  - Operates exclusively on Receiver front-end for fastest updates, feasible retrofits (where packaging permits)
  - Objective: Commercial feasibility, not optimization of individual receiver products
  - Commercial relationships with two receiver suppliers started; one major solid state filter supplier
- Address future MSS-augmentation service needs and solution (later)

# Solid State Filter Technology

## Specifications Realistic from Latest Simulation by Avago

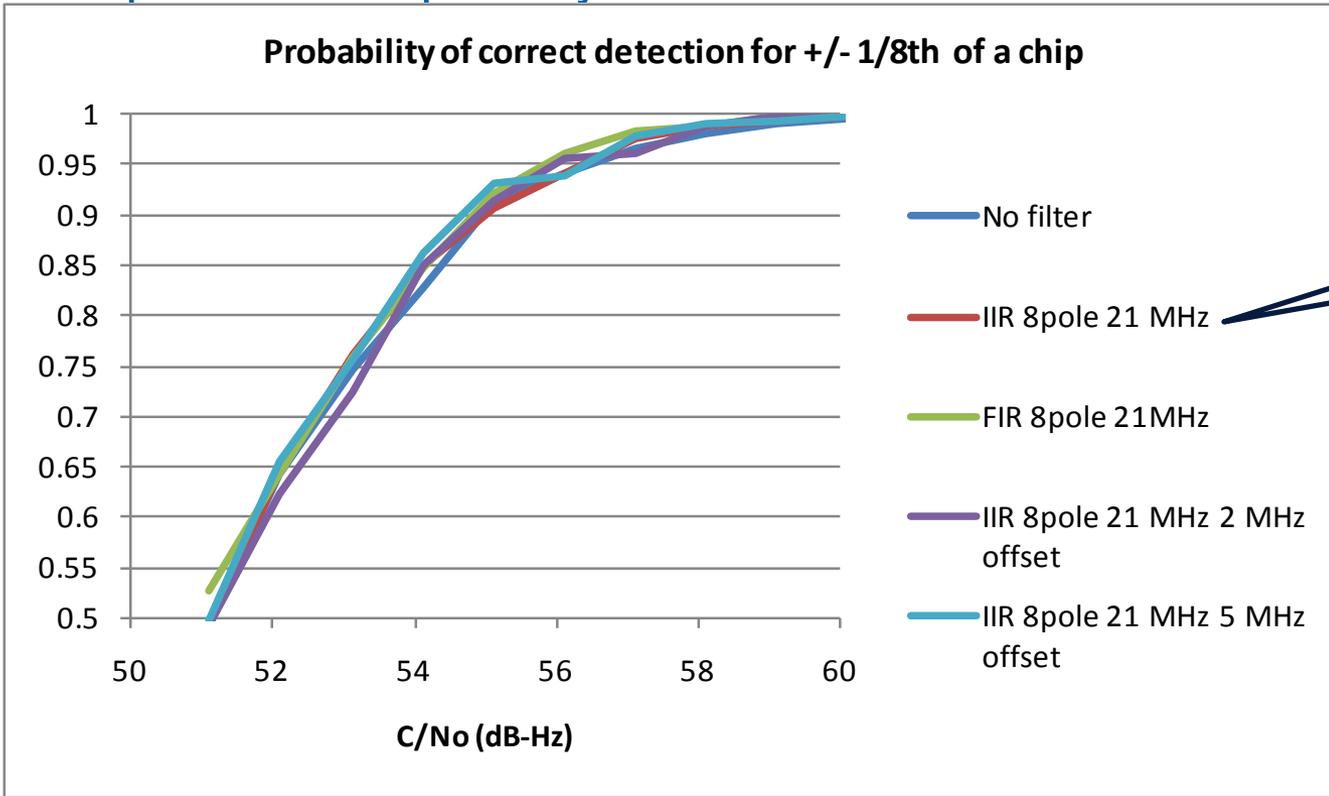


- Attenuation 40dB min at 1536 MHz ( requirement)
- Average attenuation (1526 to 1536 MHz) is 45dB
- Maximum group delay variation over temperature range and make tolerance is 7ns
- Model this with 8-pole Butterworth BW/2=21MHz with 11.6ns group delay distortion at 15MHz

The simulations provided express capability of the Avago FBAR filtering process. There is no intention to imply existence of a product or future existence of a product.

# Initial Estimate of Group Delay Performance

## Evaluate Impact of Group Delay on Code Phase Performance



- Group delay was evaluated for comparable filter performance initially for 1/8<sup>th</sup> of a P-Code chip (10 MHz P-Code was a random ensemble pattern in order to test all possible symbol states)
- These curves represent a detector with a 100usecond integration time. (1mSec or 10 mSec integration times will have same probability of correct detection thresholds 10dB, 20 dB below these curves.)
- For purposes of initially estimating tolerable group delay distortion performance, up to 11.6ns can be tolerated which represents a 5 MHz temperature and make tolerance. Avago claims a total of 7nSec make and temperature distortion.

# Conclusions

## Technical conclusions

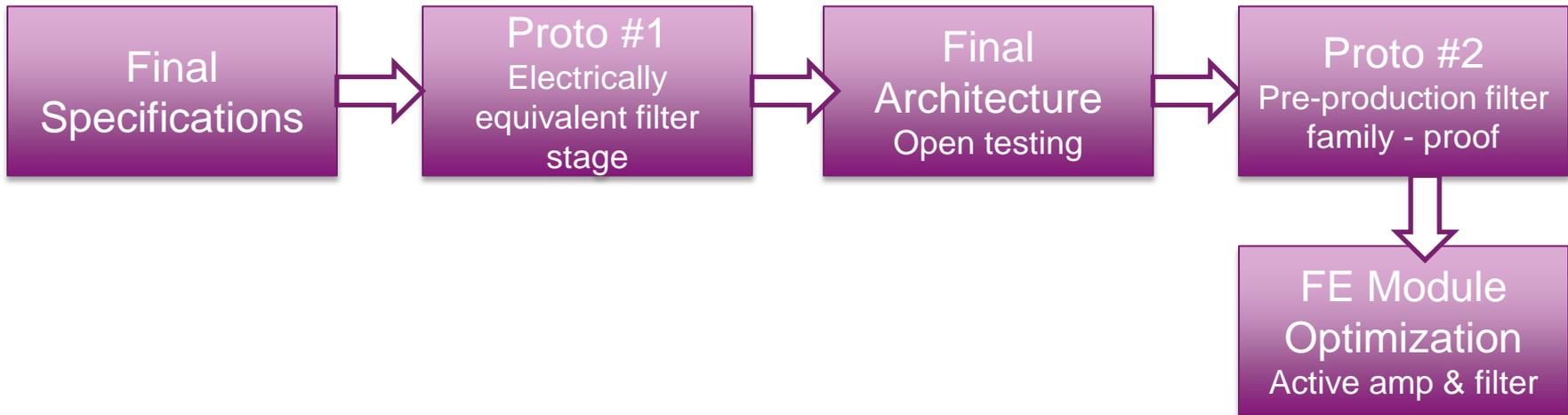
- Group delay distortion within normal ranges does not affect probability of detection for (resolutions of  $1/8^{\text{th}}$  of a chip or less)
- The FBAR filter model of a Filter  $BW/2 = 21\text{MHz}$  for an 8 pole Butterworth indicate that the group delay of this filter is tolerable *for detection* and carrier phase.
  - The FBAR model using a 16MHz filter may also be tolerable.
- A possible group delay distortion limit based on correlation is 11.6ns

## Key Take away

- Can meet requirements using a front-end RF modification.
  - Filter technologies exist to protect wideband GPS receivers from LightSquared LTE signals in the 1526-1536MHz band is realizable without compensation techniques

# Program to Develop Compatible Solution

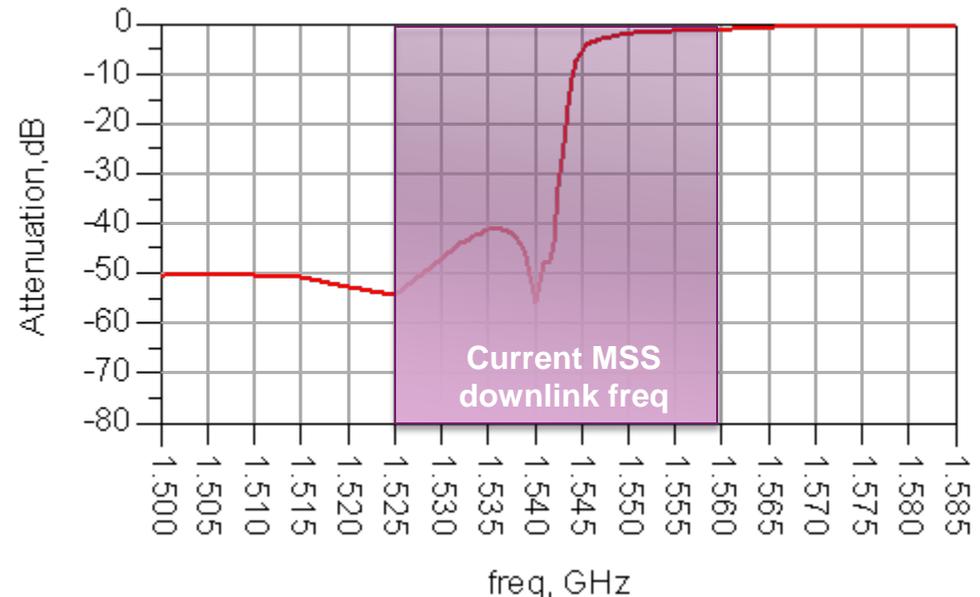
- Objectives: Confirm commercial/technical feasibilities, encourage full industry participation, common filter technology to exploit economies and reduce cross-industry R&D efforts
- This effort includes both GPS and MSS front end stages
- Leads to cross-company participation by GPS receiver suppliers
- Commercial relationships with two receiver suppliers started; one major solid state filter supplier



# Solutions for Precision Receivers

## L Band MSS Augmentation - Legacy Situation

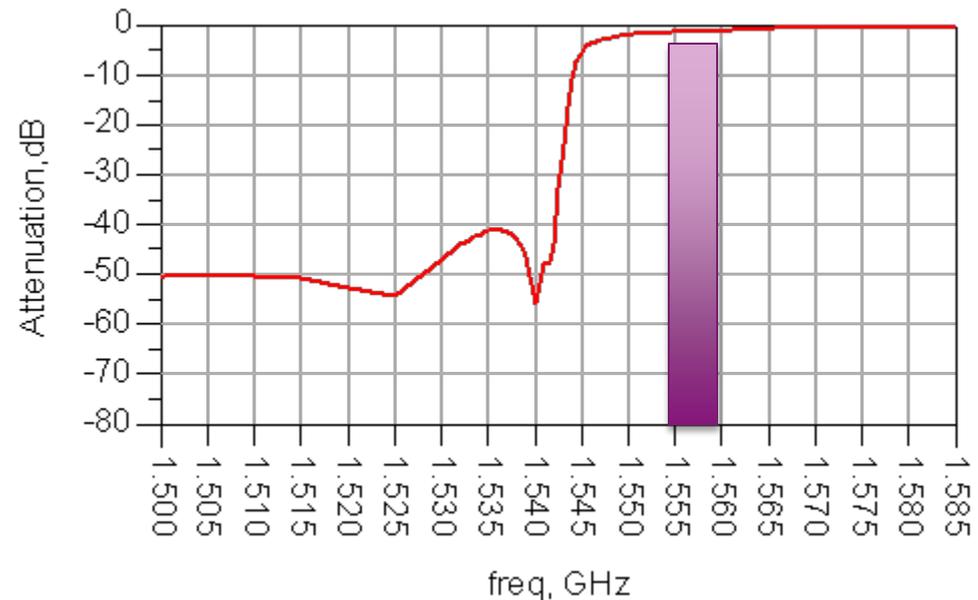
- Legacy receivers expect MSS augmentation signals anywhere in the MSS downlink band: 1525 – 1559 MHz
- Thus current rationale to make a very wideband receiver front end, *primarily* to receive a relatively few set of narrowband augmentation signals over a swath of 34MHz spectrum.
- These characteristics make L Band augmented precision GPS receivers incompatible with LTE carrier signals if left as-is.
- A new reference design addresses LTE presence, while remaining backward compatible with present, common front end architecture.



# Solutions for Precision Receivers

## L Band MSS augmentation service solution

- #1: Shifting augmentation signals to a common part of MSS band, between 1555-1559MHz
- #2: Retains compatibility with common front end for Inmarsat and LightSquared frequencies.



# Solutions for Precision Receivers

## L Band MSS augmentation service solution (con't.)

- #3: Filter MSS signal separately after suitable LNA and LTE-rejecting preselection filtering stage
- #4: Offer stable, long term commitment on MSS augmentation signal availability

New design addresses both GPS/LTE compatibility and Present/Future L Band Augmentation Delivery

Front end filter will have a lower (less than 1 dB) insertion loss, higher rejection (more than 40 dB) at LTE frequencies, and acceptable pass band group delay variation.

As shown in figure 1, the design will provide adequate rejection of 1526-1536 MHz ground stations .

