LightSquared Update

Federal Geodetic Control Subcommittee Meeting January 10, 2012

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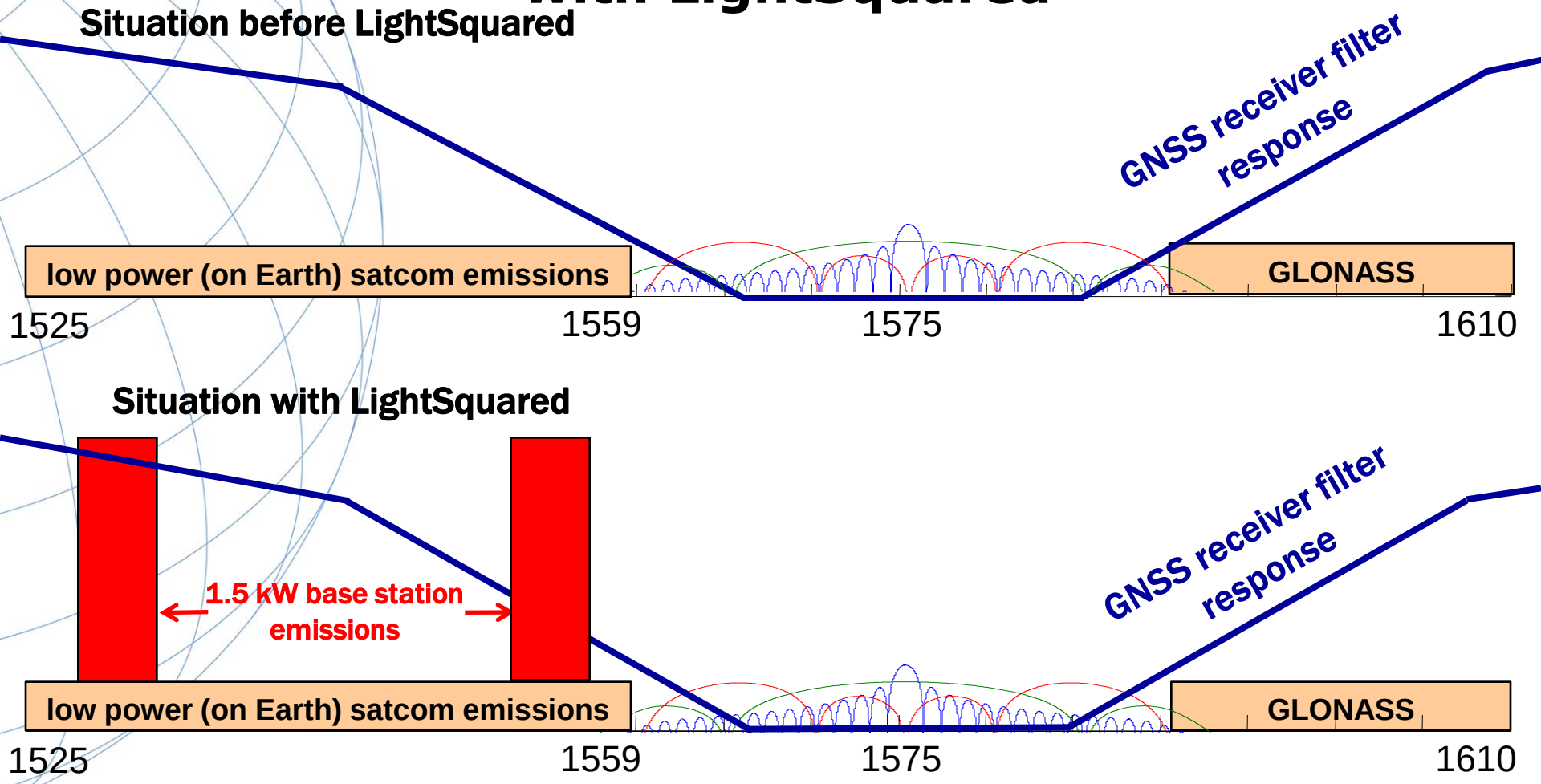
Presentation Overview

- LightSquared Background & Spectrum Issues
- NOAA Summary Testimony
- NOAA Anechoic Chamber Test Results
- The Way Forward

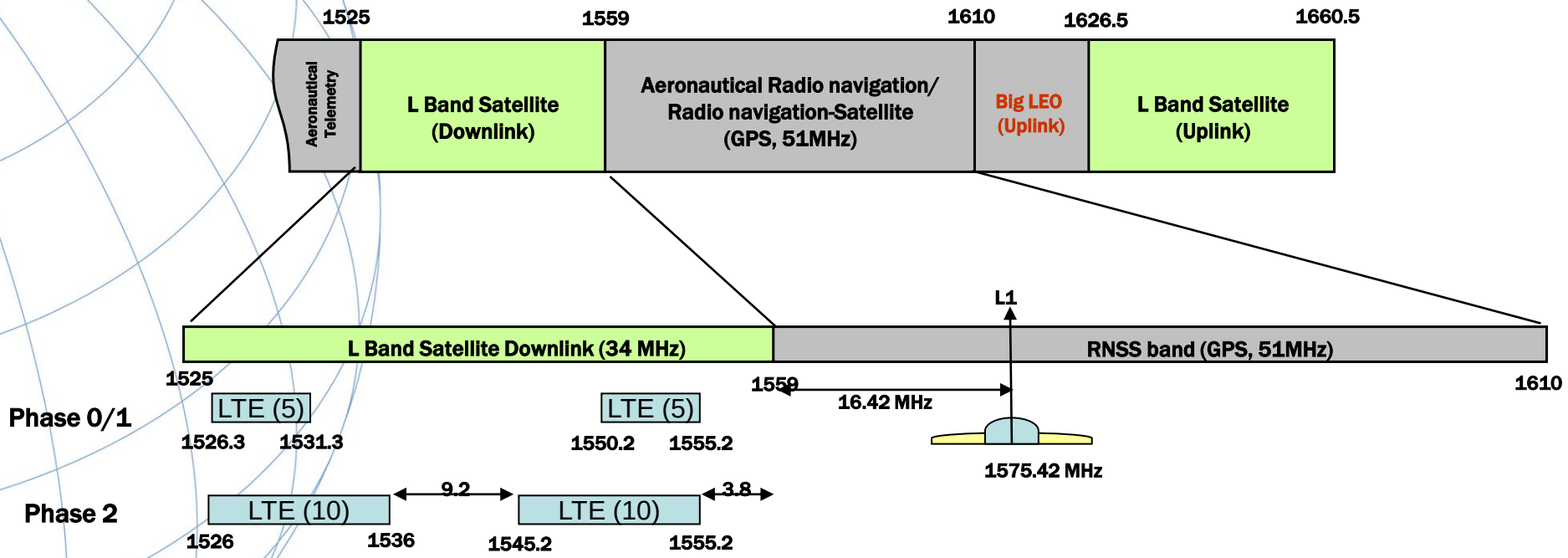
What is LightSquared?

- New Telecom company formed Mid 2010
  - Formerly SkyTerra and before that Mobile Satellite Ventures
- Company formed to create a nationwide 4G LTE (Long Term Evolution) open wireless broadband network
- First wholesale-only broadband network
- Intends to provide coverage to 92% of USA by 2015
- Key Asset
  - Mobile Satellite Service /Ancillary Terrestrial Component license for 1525–1559 MHz; 1626.5-1660.5 MHz

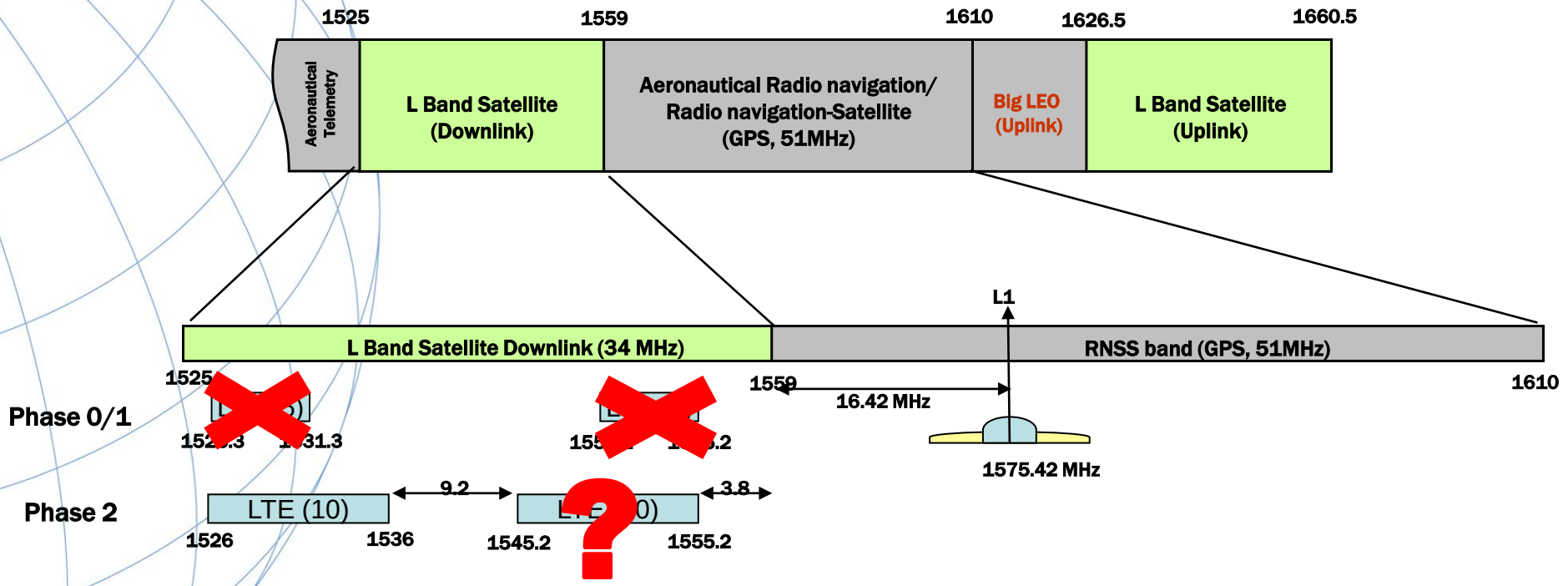
Illustration of Concerns with LightSquared



Original LightSquared Spectrum Plan



Current LightSquared Spectrum Plan
End Spectrum State Undefined



Congressional Hearings

- 23 June: House Transportation and Infrastructure Committee
- 8 Sept: House Science Committee
  - Mary Glackin / Deputy Under Secretary for Operations at NOAA Testified
- 15 Sept: House Armed Services Committee, Strategic Forces Subcommittee
- More Hearings Likely

Summary NOAA Testimony on LightSquared's Original Spectrum Plan

- NOAA GPS based systems impacted by original spectrum plan:
  - Ground stations that control GOES and POES spacecraft depend on GPS for accurate system timing.
  - NOAA's satellite-based search and rescue system, SARSAT uses multiple GPS receivers at ground stations to determine and maintain precise time.
  - Future satellites, including NPOESS Preparatory Project (NPP) and GOES-R will use on-board GPS receivers for timing and orbit determination.
  - NOAA has deployed over 23,000 environmental sensor platforms that depend critically for accurate geo-referencing and time stamping of data.

Summary NOAA Testimony (Continued)

- NOAA GPS based systems impacted by LightSquared's original spectrum plan:
  - NOAA's network of NEXRAD weather radars and sea surface radar altimeters require GPS-based time synchronization to enable sharing of radio frequencies
  - NOAA's fleet of 19 ships employs a variety of GPS and differential GPS receivers for navigation and scientific use.
    - If GPS service becomes unavailable or unreliable along U.S. coasts and waterways, NOAA vessels will be unable to perform many operations and missions.
  - NOAA's radiosondes and dropsondes (attached to weather balloons or deployed from aircraft) are entirely dependent on GPS for accurate position and velocity.

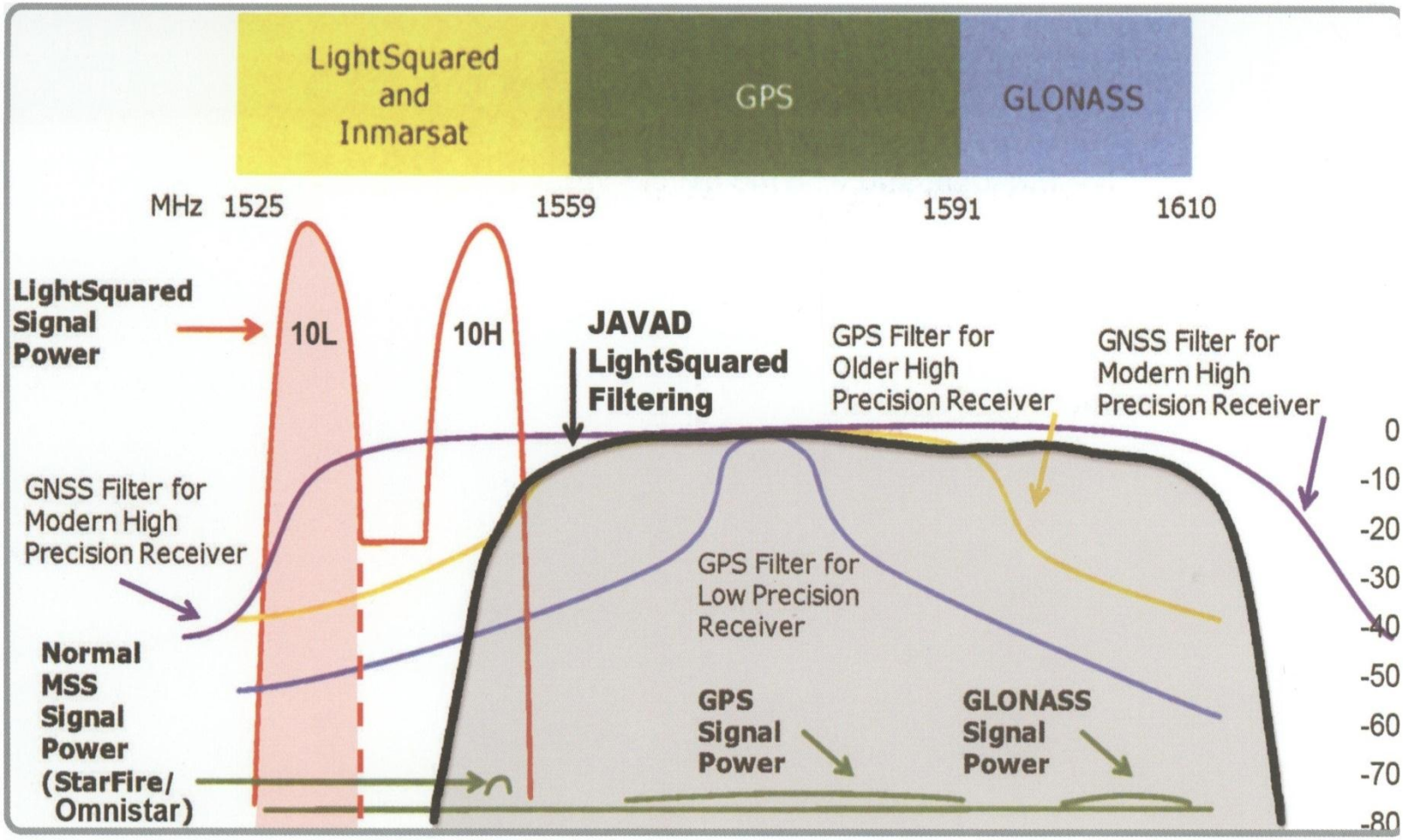
Five Major NOAA Systems or Functions that Require Wideband GPS Equipment

- Six-satellite COSMIC system that observes the Earth's atmosphere
- Monitoring sea level trends to protect natural and human communities
- Ground –Based Meteorology (GPS-Met) project which measures atmospheric moisture
- Total Electron Content (US-TEC) product to inform users about space weather conditions
- Maintenance of the National Spatial Reference System to insure compatibility among geospatial products.

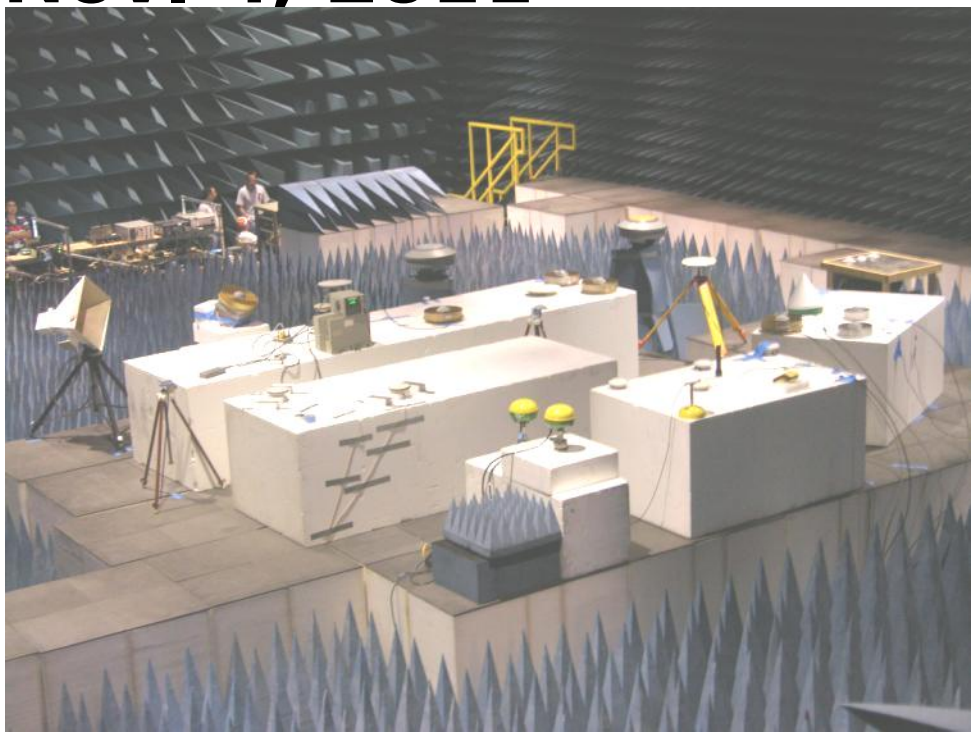
LightSquared Modified Spectrum Plan (Continued)

- LightSquared has proposed to commence terrestrial commercial operations only on the lower 10 MHz portion of its spectrum in the near term.
  - ❖ They have coordinated and shared the cost of testing with GPS manufacturers of legacy precision measurement devices that may be at risk.
  - ❖ A filter solution for the Lower 10 MHz band has been tested by Javad and other manufacturers in partnership with LightSquared for high precision receivers.

Javad Filter Response to Mitigate the Lower 10 MHz LightSquared Signal



New NPEF Testing at WSMR Oct. 31 – Nov. 4, 2011



- Targeted Testing
  - Navigation/Cellular Devices
  - Low 10 MHz
  - Handset (LSQ Cell Phone) simulation to be included
  - NOAA Participants
    - NOS / NGS – 4 Precision survey /geodetic receivers
    - NOS / Office of Coast Survey – 4 marine navigation receivers
    - NWS – 3 general location / navigation receivers and 1 timing receiver

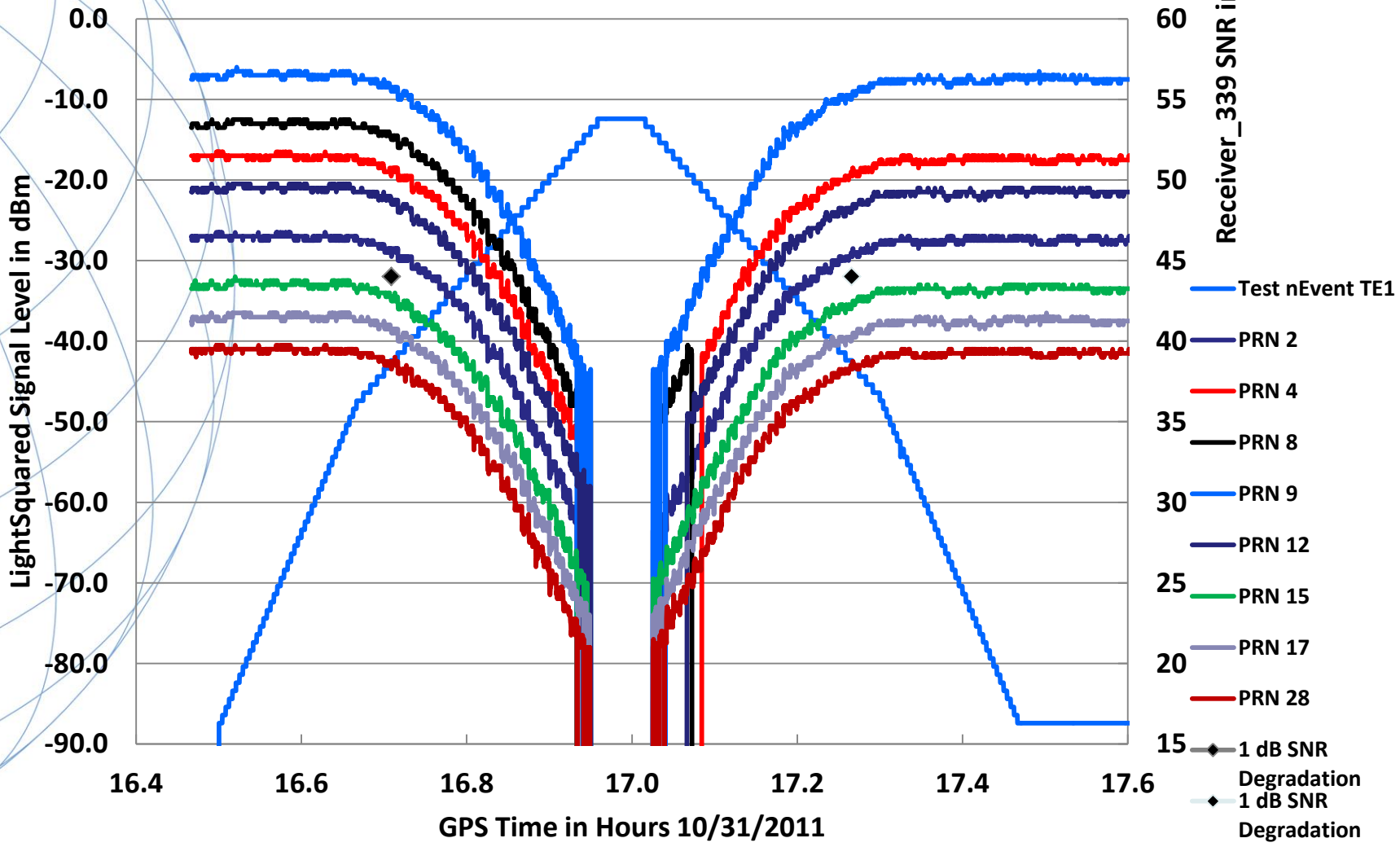
NPEF Testing at WSMR
Oct. 31 – Nov. 4, 2011

- Testing focused on General Navigation / Location receivers and Cellular Devices
- 37 other receivers (including high precision receivers) were also tested
- NGS objective in participating in the White Sands Missile Range (WSMR) testing was to:
  - Test the best and worst performing receiver with a legacy "robust" antenna from the Live Sky tests (Holloman, April 2011 and Las Vegas, May 2011)
    - CORS management requested another receiver be added to the test suite
  - A Javad receiver from the NGS CORS Foundation network was also added with the possibility of testing a modified JAVAD antenna to mitigate the LightSquared lower 10 MHz signal
  - A total of six receivers were tested (four different manufacturers and two spares)

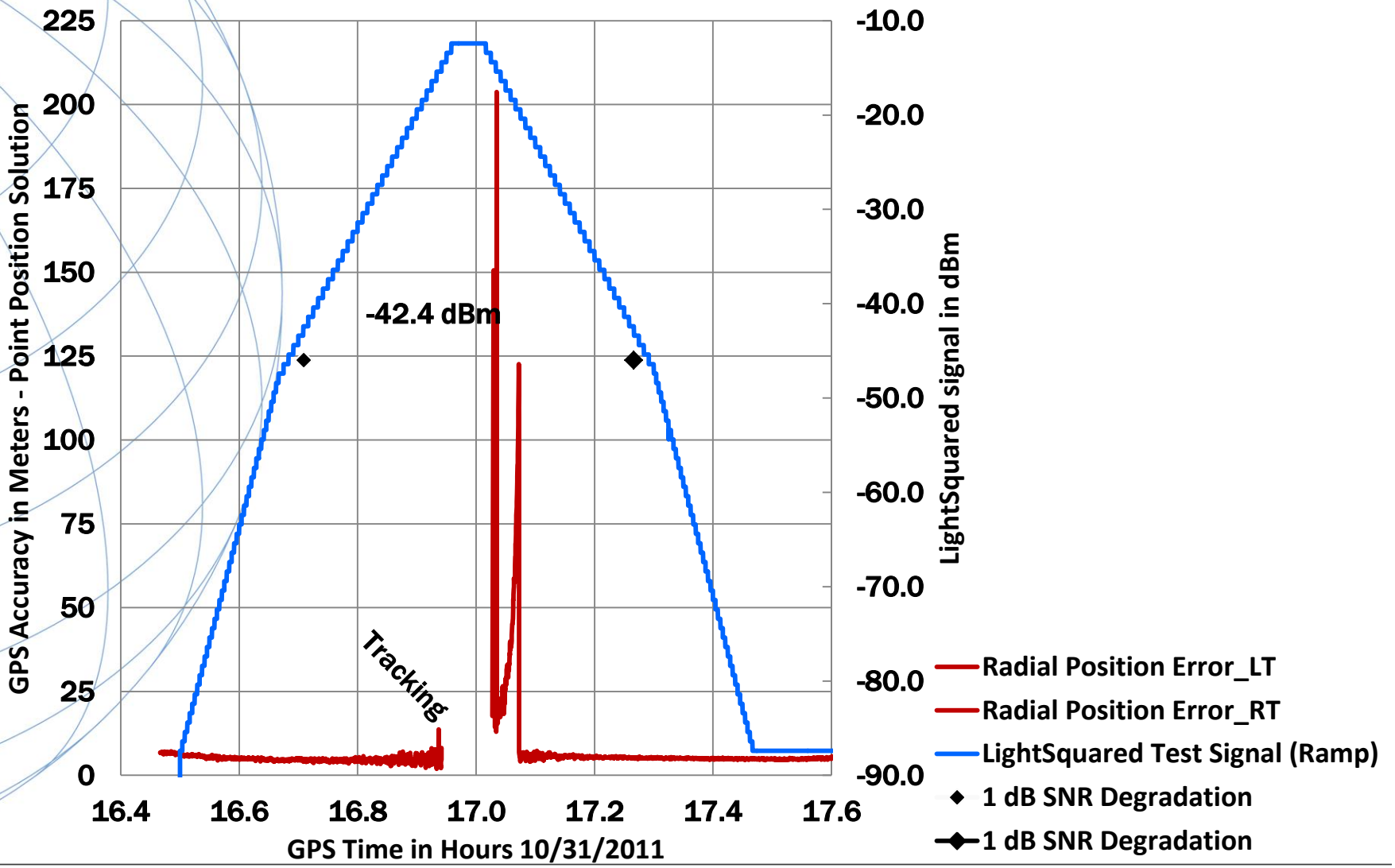
NOAA /NGS Configuration for the Lower 10 MHz at WSMR on Day One (10/31/2011) of Testing

- Five high precision geodetic / survey GPS receivers connected through an eight way splitter to a "robust" legacy geodetic antenna in the Anechoic Chamber
- A single survey receiver with the manufacturer recommended geodetic antenna at a different grid location in the chamber

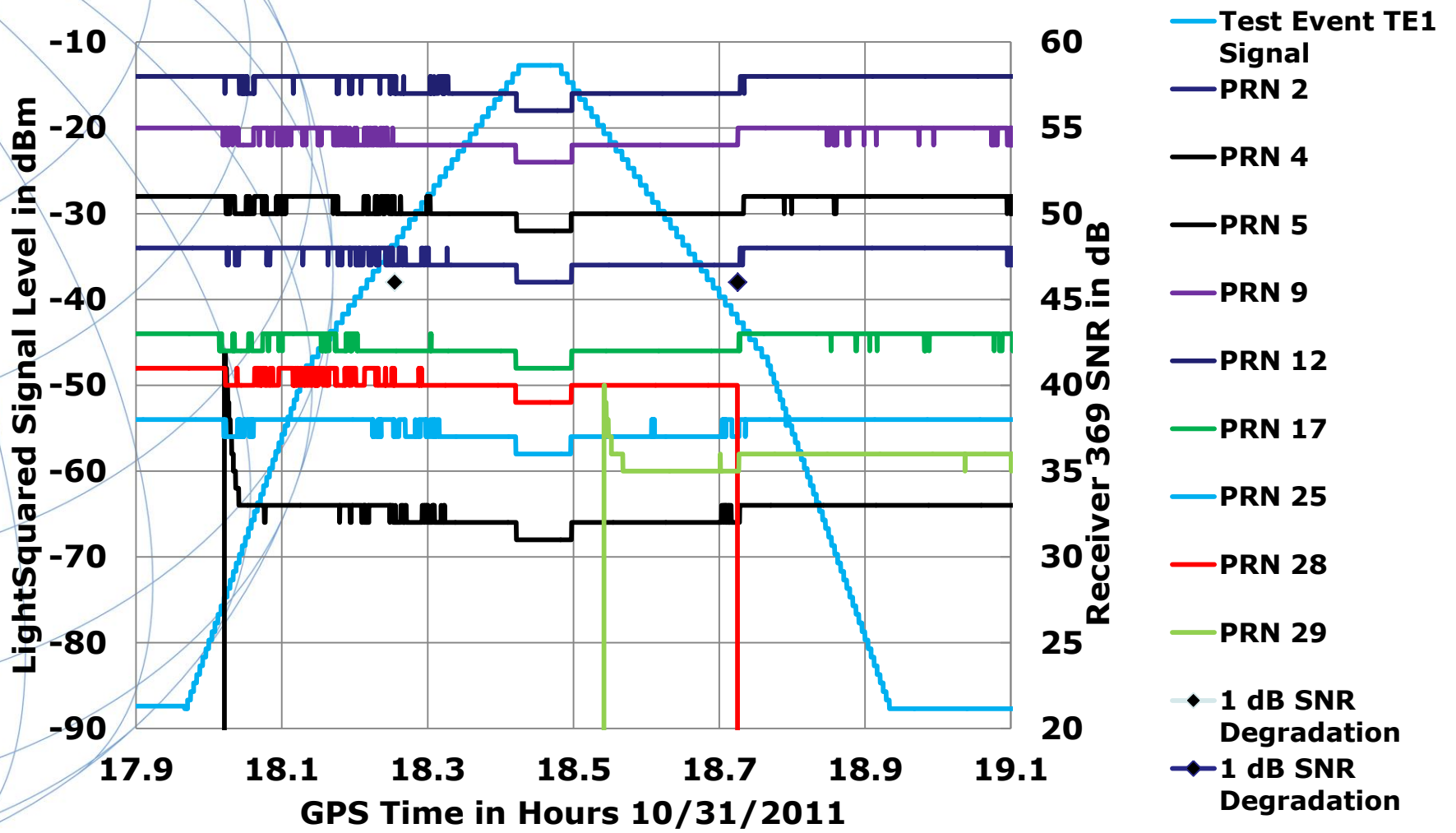
Receiver 339 / Ant. # 369 /SNR Degradation Re: LightSquared Lower 10 MHz Signal / Cycle # 1 / WSMR Anechoic Chamber Tests



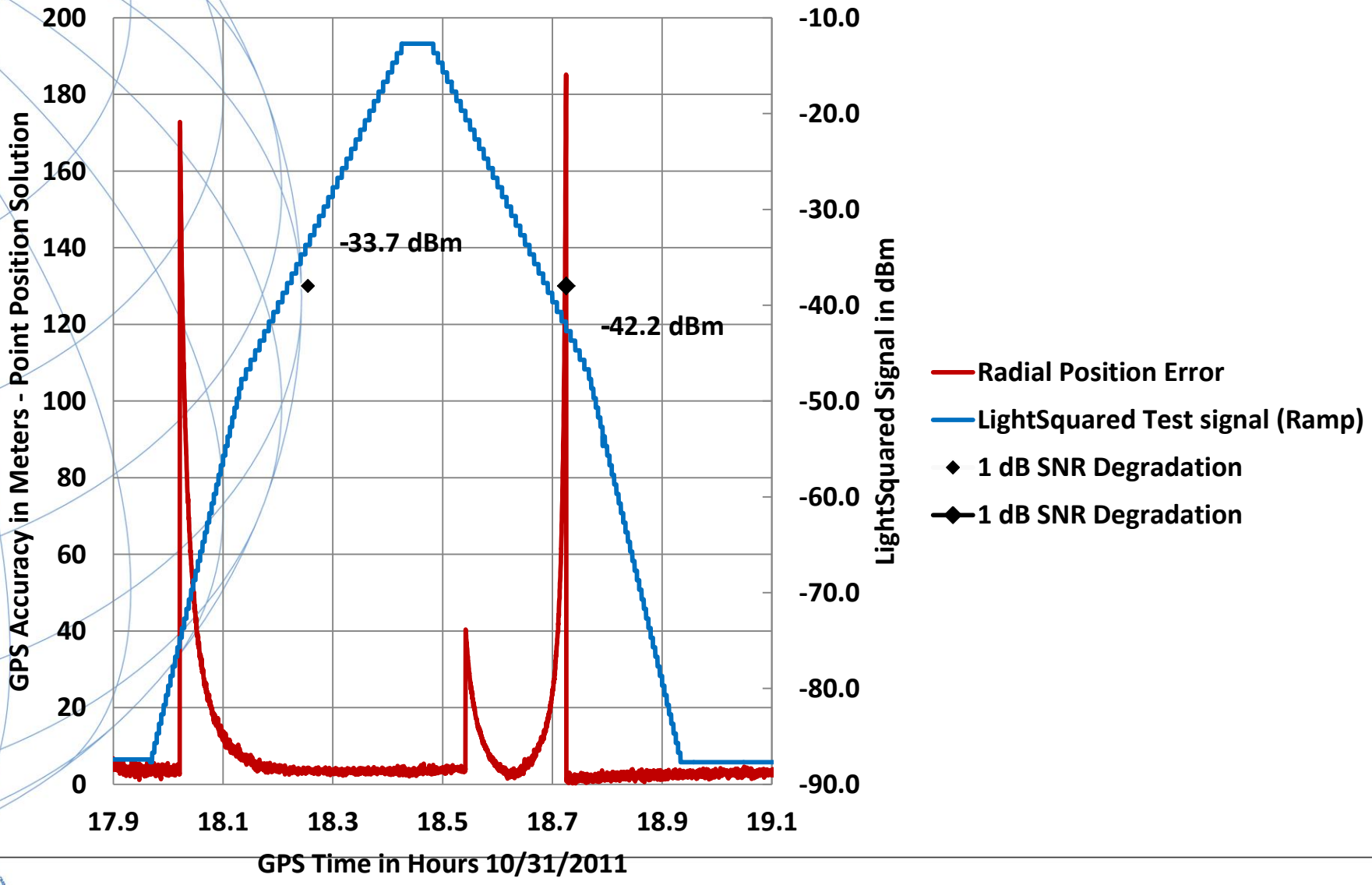
Receiver 339 W/ Ant. #369 / Radial Position Error
Test Event TE1 Cycle #1/ WSMR Anechoic Chamber Tests



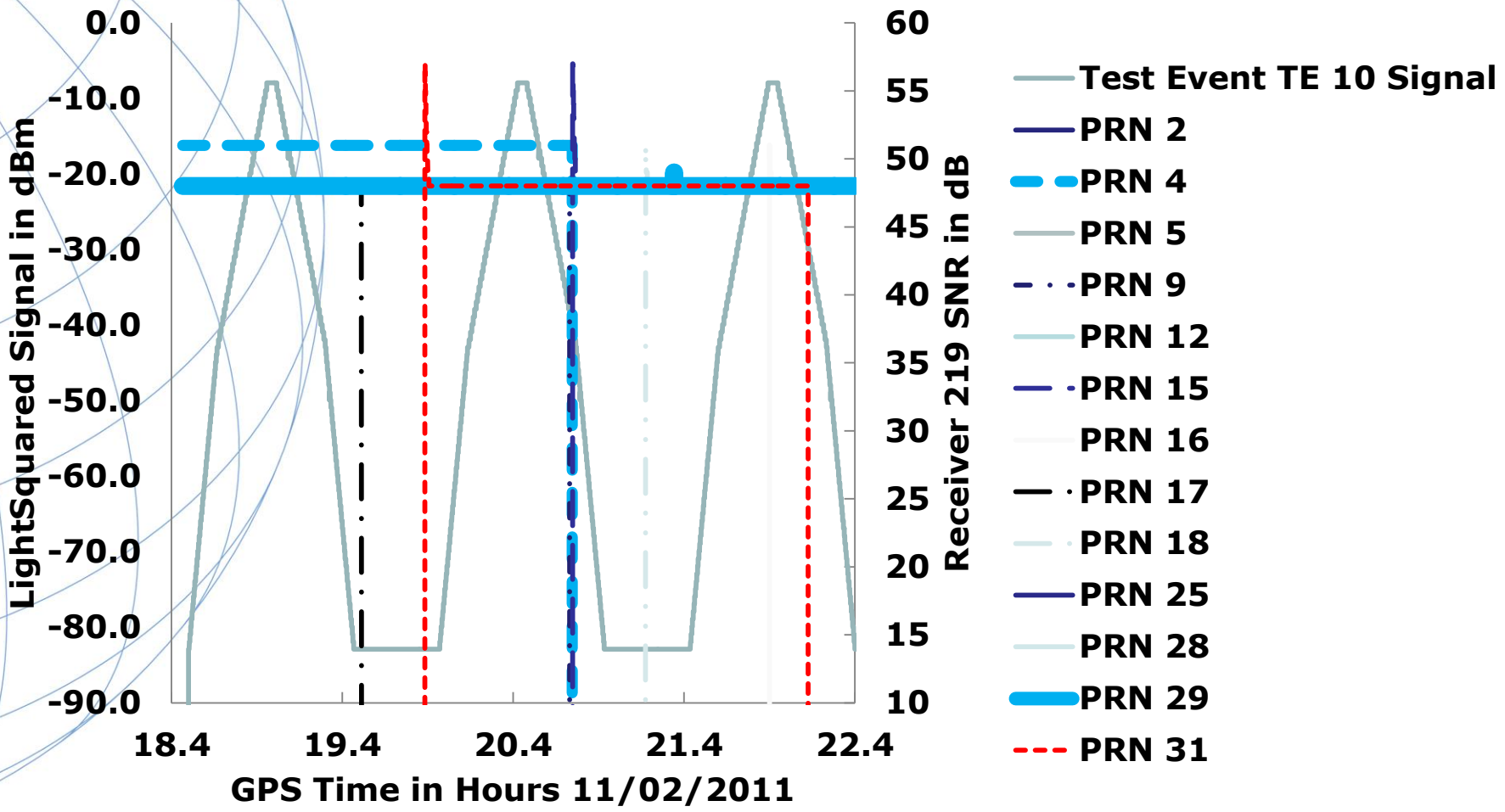
Receiver 369 / Ant. #369 / SNR Degradation / LightSquared Lower 10 MHz Signal / Test Event TE1 /Cycle # 2 / WSMR Anechoic Chamber Tests



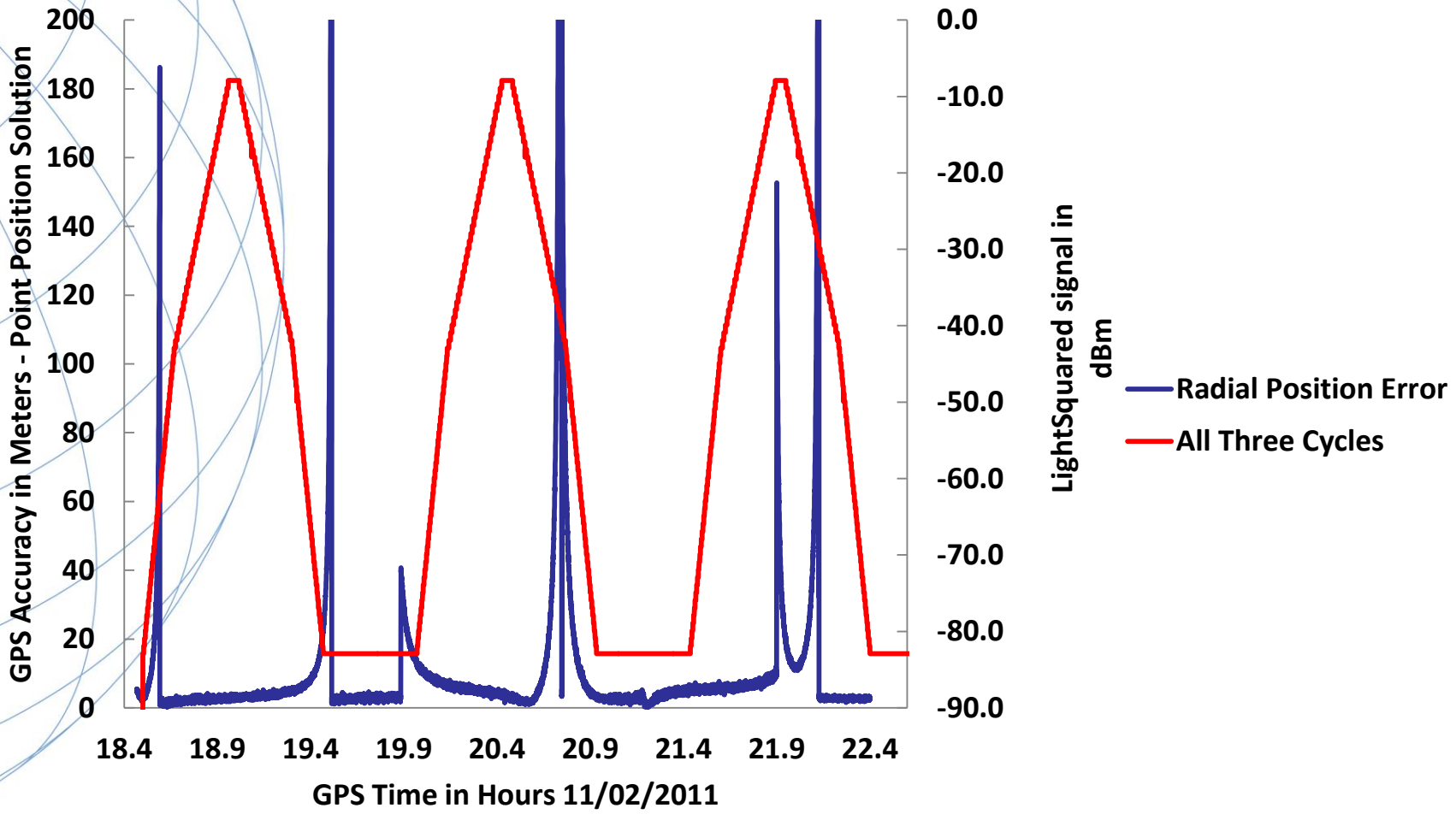
Receiver 369 / Ant. # 369 / Radial Position Error / Test Event TE1
Cycle #2 / WSMR Anechoic Chamber Tests



Receiver 219 / Ant. #369 / SNR Degradation/ Test Event TE 10 / All Cycles / WSMR Anechoic Chamber Tests



Receiver 219 / Ant. #369 / Radial Position Error / Test Event TE 10 All Cycles / WSMR Anechoic Chamber Tests



Anechoic Chamber Conclusions

- Preliminary Test Results indicate that the legacy "robust" antenna combined with a number of high precision receivers is not sufficient to mitigate the LightSquared lower 10 MHz signal

  - Significant degradation to point position accuracy during all cycles of the LightSquared ramp test signal

  - A filter solution developed specifically for the lower 10 MHz is required and needs to be independently tested
    - Javad modified filter was not available for WSMR Anechoic Chamber testing
    - Filter will be tested when and if the federal high precision testing phase is scheduled

The Way Forward

- The NPEF test report focusing on General Location and Navigation devices is under review and there are a number of issues that need to be resolved

- Until the interference issues for General Location / Navigation receivers are resolved, high precision receiver testing has been delayed

Questions?

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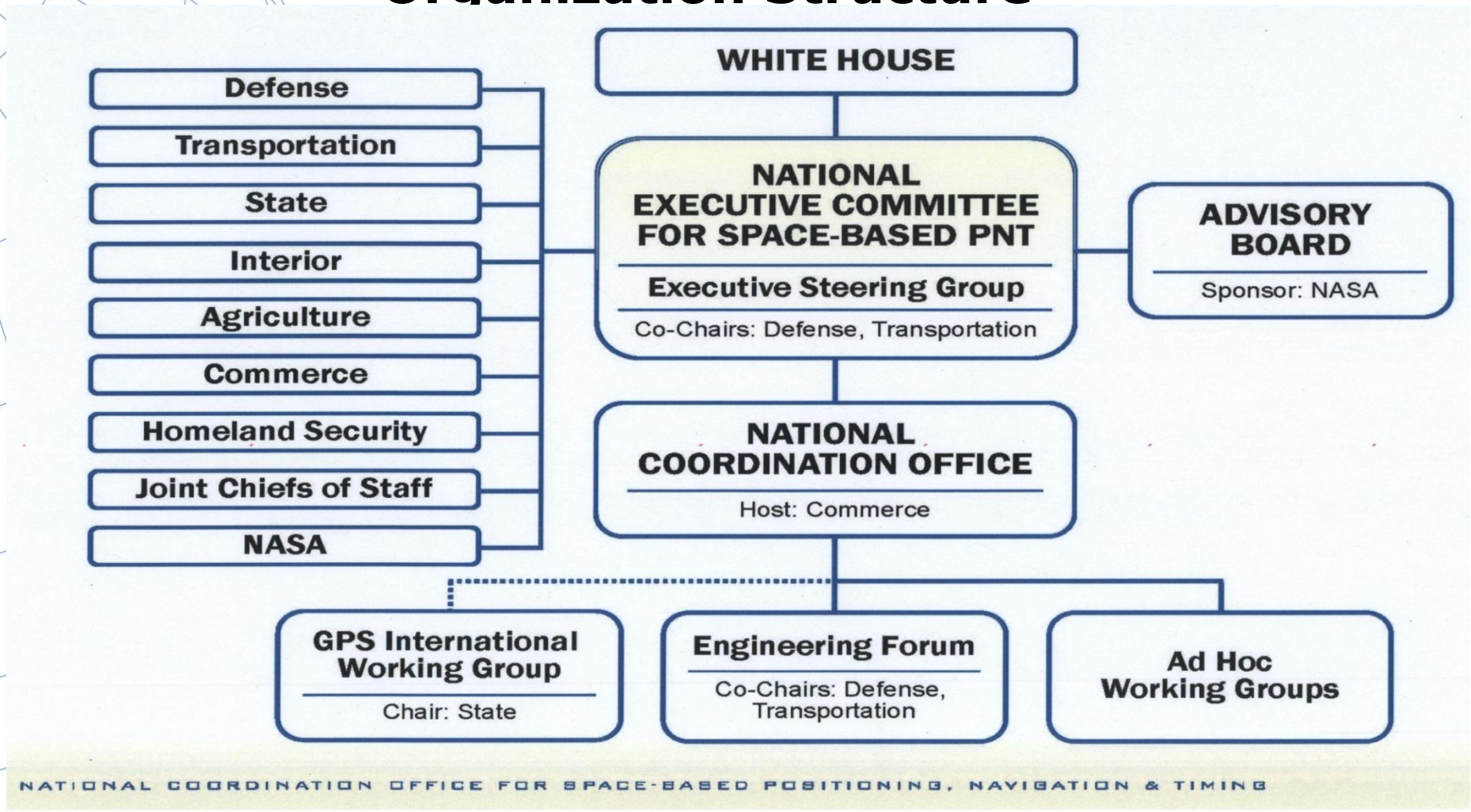
Backup Slides

US Space-Based PNT Organization Structure



JAVAD & TOPCON Filter Results Alcatel Lucent Bell Labs