



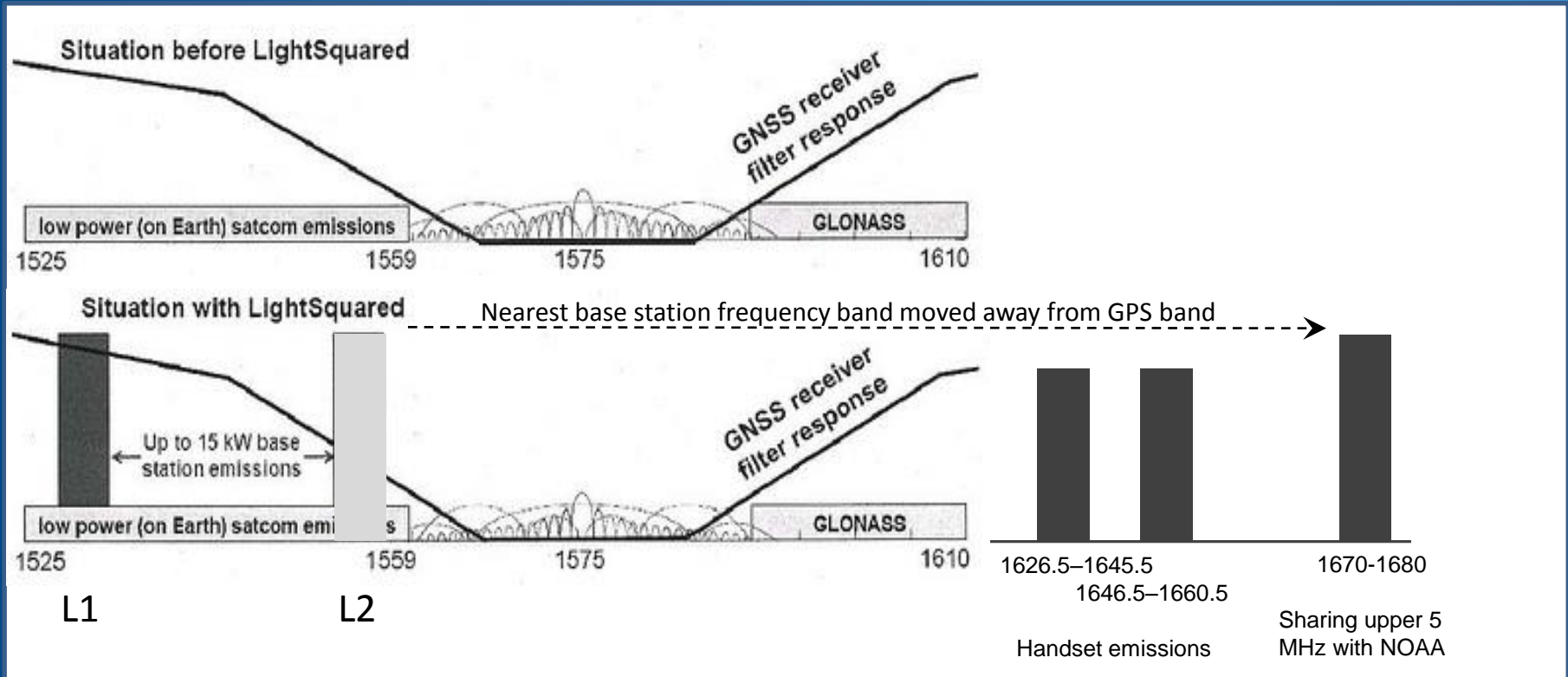
# Ligado Networks and GPS Update

AFC Fall 2015 – Montreal

# Overview

- Summary of the Ligado situation
- DoT GPS Study
- FCC Ligado Filings

# The Ligado Situation



- Base station (BS) down links overload GPS receiver AGC
  - Residual power also detected inside the GPS band from BS and User Equipment (UEs)

# The Legal Chapter



- Ligado struggling after FCC delays
  - Went into bankruptcy on \$1.7bn of debt
  - Power struggle between shareholders
  - Received cash injection start of 2015
- Tried to sue GPS IC for \$1.9bn
  - Judge rejected most claims on 5 Feb 2015, but still left open negligent misrepresentation and constructive fraud
  - Garmin, Deere and Trimble settled case end of 2015
- Also sued US government for FCC actions
  - Claims FCC did not live up to their part of the agreement
  - Withdrawn as part of manufacturer agreements



# Testing and Impact Studies



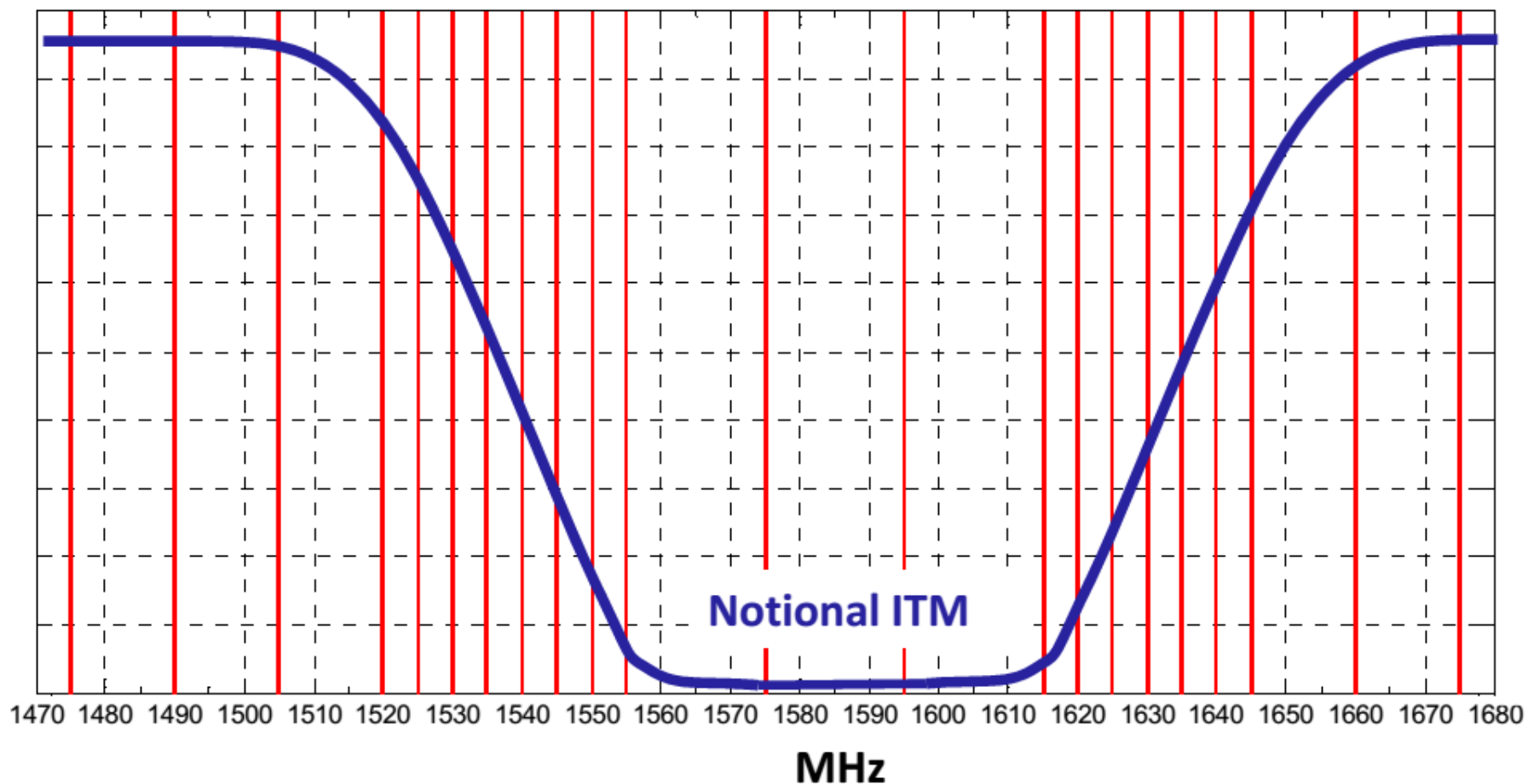
- FAA Study in 2012 on L1 band impact
  - Primary cause was L1 in-band emission being received by GPS receiver
  - GPS services below 300' not viable
  - Strong concern for below 1800'
  - FAA Administrator
    - *'there appears to be no practical solutions or mitigations that would permit the LightSquared broadband service, as proposed, to operate in the next few months or years without significantly interfering with GPS. As a result, no additional testing or analysis is warranted at this time.'*

# DOT GPS adjacent band compatibility assessment



- Initiated after NTIA And FCC discussions following LS process
- Intended to:
  - *‘Provide a framework to define the processes and assumptions for development of GPS spectrum protection criteria on behalf of GPS civil users’*
- Deriving adjacent-band power limits to create Interference Tolerance Mask (ITM)
  - Assessing AGC overload for adjacent bands
  - Measures when 1 dB degradation in C/N is recorded from devices
    - Current GPS industry metric

# Expected ITM Output Example



# DoT Timeline

- GPS/GNSS receiver testing: Mar 2016
- Results: Q3 2016



# DoT Test Plan Summary



- Generally supported by manufacturers and GPS industry
  - 1 dB degradation to C/N is already standard industry practice
  - NDA's providing assurance
- Could be more precise
  - Simplified to AGC to prevent in depth discussions
  - 3<sup>rd</sup> order IM at Tx missing

# FCC and Ligado



- LS proposing its own test plan
  - Focuses on KPIs for devices
  - Increase interference until KPI is affected
    - Will then define interference limit for each device
  - Will test certified aviation devices
- Roberson and associates working on LS' behalf
  - Not part of DoT plan, only in FCC
  - No support from manufacturers, but will go ahead anyway
- Heavily referencing the FCC TAC's harm claim threshold
  - Could be seen as a test case for the concept
    - Note that concept still not approved in the FCC

# Ligado FCC Filings



- LS pushing the plan heavily in the FCC
  - Selling it as more realistic than DoT plan
  - Will cloud the issue in a public manner
- Several statements made concerning aviation use of GPS
- More LS lobbying expected
  - Expected that ASRI will need to file
  - If LS not successful by end of year, bigger corporation may buy the spectrum

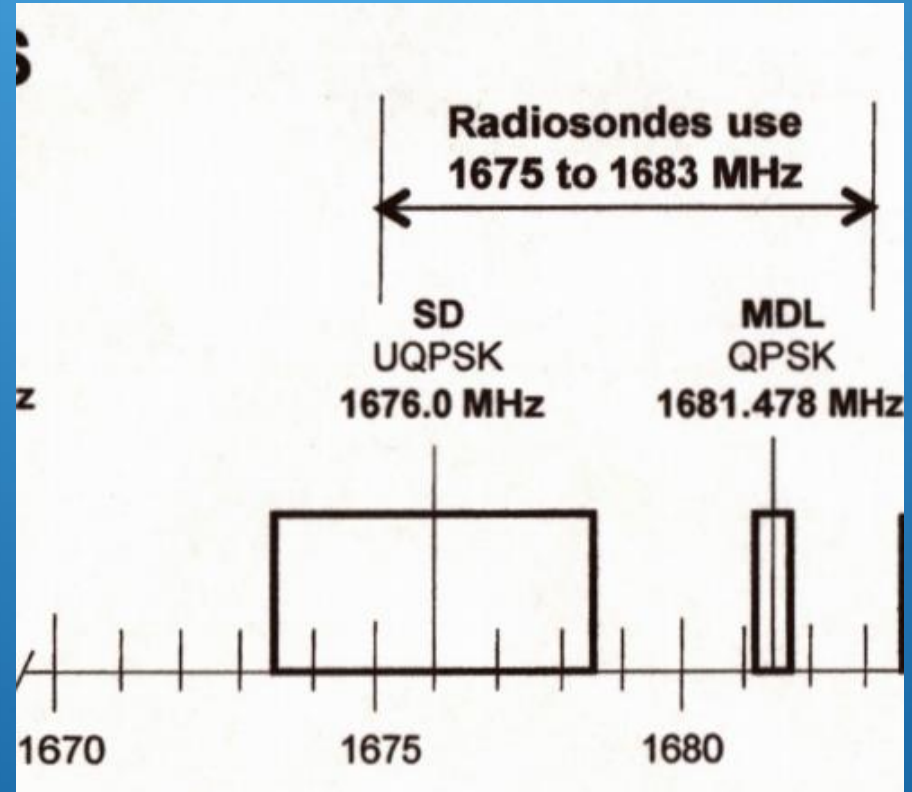
# NOAA Weather Datalinks



- Geostationary Operational Environmental Satellite Systems (GOES)
  - NOAA operated satellite system
- Various airline functions
  - GOES GVAR antennas
    - Registered users - Fed Ex, American, Universal Aviation & Weather
    - Create SIGMETs, AIRMETs and PROG Charts and used by Volcanic Ash Advisory Centers and National Hurricane Center
  - Warn over the pole flights of high natural radiation levels

# GOES-NOP

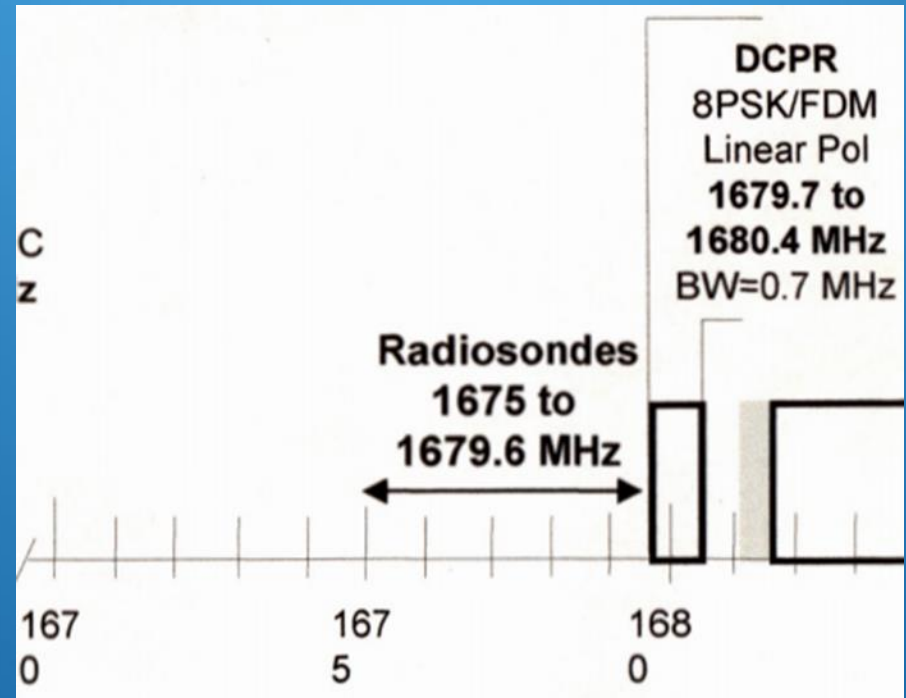
- Existing NOAA satellite system
- Multiple systems affected
  - Sensor Data (SD)
    - Raw science data from satellite that is then calibrated and georeferenced before use
  - Radiosondes
    - Weather balloons tracked from ground stations
  - Multi-Use Data Link (MDL)
    - Contains near-Earth space weather radiation data used to warn over-the-pole flights about radiation hazards to crew and passengers





# GOES-R

- Planned replacement system
  - Estimated for Oct 2016
- Data Collection System downlink (DCPR)
  - flood prediction, wildfire weather information for firefighters (and slurry planes), earthquake and volcanic eruption deformations used to tip the Volcanic Ash Advisory Centers
- GOES-Rebroadcast (GRB)
  - Replacement for the GVAR



# Going forward



- DoT test plan comments deadline of 9 Oct
- FCC process ongoing
- AFC should prepare to file in the FCC
  - Counter LS claims on GPS performance
    - KPI not an appropriate metric
  - Support DoT test plan as the definitive version
  - Question of LS' ability to lower OOB E for handsets
- Single filing with supporting signature?
  - ASRI will begin coordination in next few weeks
  - AFC members requested to forewarn their management of possibility

# ASRI Preliminary Position



- Certified Aviation receivers
  - Still have serious concerns based on existing technical studies that recent LS license proposals do not change.
    - Any decision on compatibility (if possible at all) should be joint FAA and industry.
- Non-certified receivers
  - Aviation uses non-certified receivers extensively for ground based operations.
  - ASRI supports the DoT ABC testing program and the 1 dB protection criteria metric as standardized in the GPS industry.
  - Ligado testing submitted to the FCC does not use recognized, or even established, testing methodology or metrics. ASRI opposes this type of testing, and the results generated.
  - Settlements made with Garmin, Trimble and Deere do not represent all of the GPS industry, and therefore cannot be claimed as an industry-wide agreement with Ligado's plan.
- NOAA spectrum
  - ASRI reserving its position on NOAA frequency band 1675-1680 MHz until extent of weather information usage is understood.
  - Several initial reservations at this time on assumptions made in Ligado study on NOAA band.



# Questions?