

LightSquared Interference

November 2011

v5

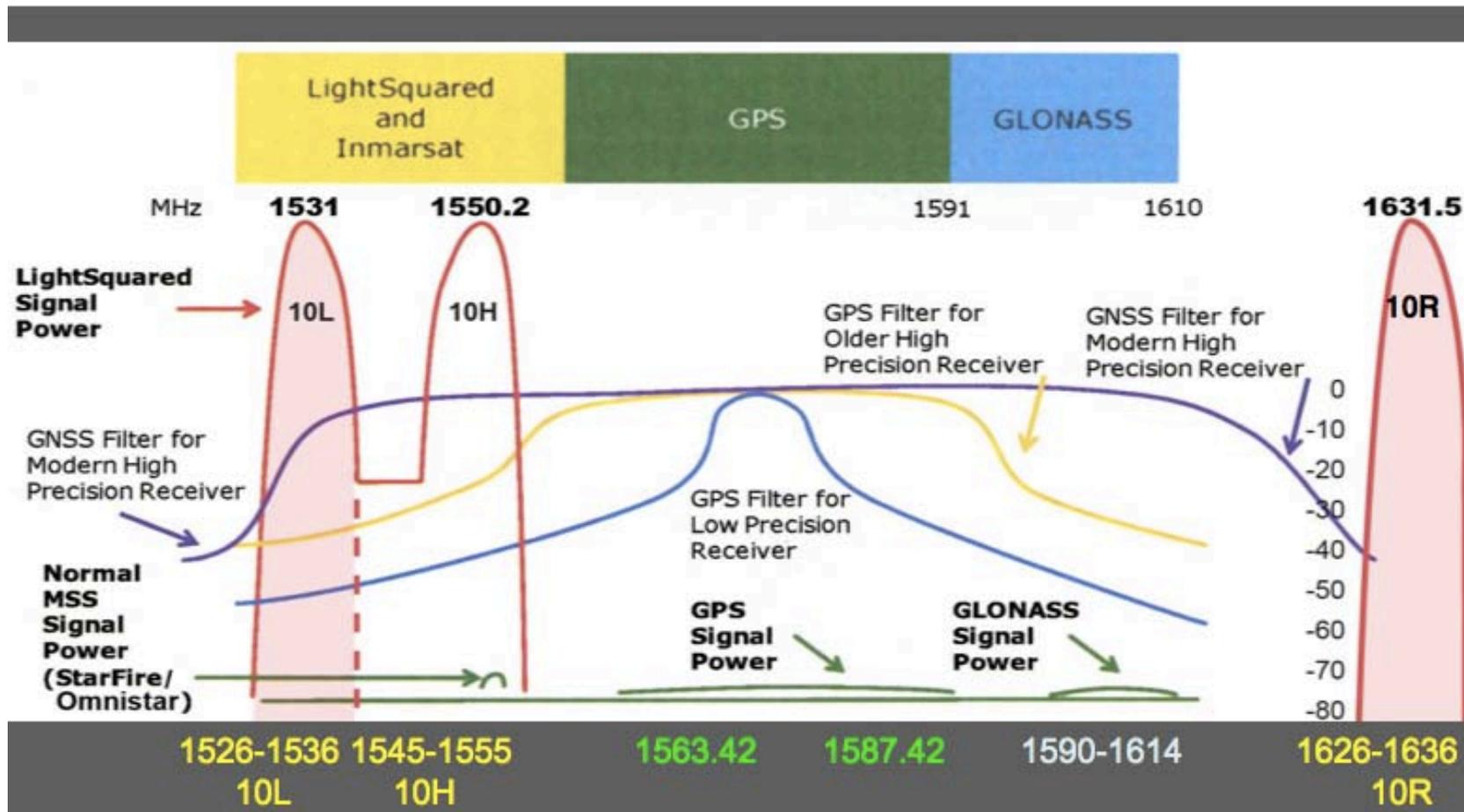
Abbreviated History

- 2003 (“Eight Years Ago”)—ATC **first authorized** as LSQ advertises in press releases
 - **Does not resemble current proposed network**
 - **Placed responsibility for resolving harmful interference on ATC operator**
- 2005 Reconsideration of ATC order
 - Removed limit on number of base stations
 - Upped allowable power to 1.5 KW
 - **Reiterated satellite “gating” criteria and promised, in very strong terms, no stand-alone terrestrial service**
- 2010 “Harbinger” Order
 - Transfer order to allow LightSquared ATC authority
 - Power increased to 15 KW
 - ***GPS Community assumed “no stand-alone terrestrial service ever” still applied***

Triggering Event

- 2011 Conditional Waiver
 - Granted waiver of requirement for dual-mode handsets
 - **Granted permission for terrestrial stand-alone service conditioned on resolution of GPS overload interference problem**
 - LightSquared proposed up to 40,000 transmitters – all could be 15 KW
 - FCC stated “no limit to number of transmitters”

Spectrum



Current matrix of alternatives to be considered - *All still on the plate*

	Lower Power 1.5 Kilowatts	Higher Power 15 Kilowatts	Multiple Transmitters	Handheld Sets
Lower LSQ Band	?	?	?	?
Upper LSQ Band (Closer to GPS)	?	?	?	

Initial Testing

- DOD and Other Agencies, Manufacturers, and Users expressed strong concerns
- Began a series of tests of all types of receivers

	Lower Power 1.5 Kilowatts	Higher Power 15 Kilowatts	Multiple Transmitters	Handheld Sets
Lower LSQ Band	Partially Tested	Analysis Only	Not Tested	Not Available for Testing
Upper LSQ Band (Closer to GPS)	Tested	Analysis Only	Not Tested	

First Phase Test Results

Reported by All Agencies Concerned

(Testing April/May 2011 –Results Reported Late June 2011)

- Many **Military, Precision-Civil, Public Safety, Aviation Receivers and others** were severely affected at the **lower power levels**

	Lower Power 1.5 Kilowatts	Higher Power 15 Kilowatts	Multiple Transmitters	Multiple Handheld Sets
Lower LSQ Band	Many receivers failed (30/32 Hi-Precision)	Analysis Only	No Live Tests	Not Available for Testing
Upper LSQ Band (Closer to GPS)	Most Sets Failed	Analysis Only	No Live Tests	

LSQ Modified Proposal

(FCC Posted 30 June 2011)

- Low band, Low power initially
 - **LSQ Has *not abandoned the higher power and upper band***
- Number of Transmitters unchanged but increased density

	Lower Power 1.5 Kilowatts	Higher Power 15 Kilowatts	Handheld Sets
Lower LSQ Band	Current Testing	Later ?	?
Upper LSQ Band (Closer to GPS)	Later ?	Later ?	

- Another Round of Testing has begun – two phases –
 - First: General Location and Navigation Receivers and cellular devices
 - Second: Exploring Potential of further Filtering with high precision Rcvr's

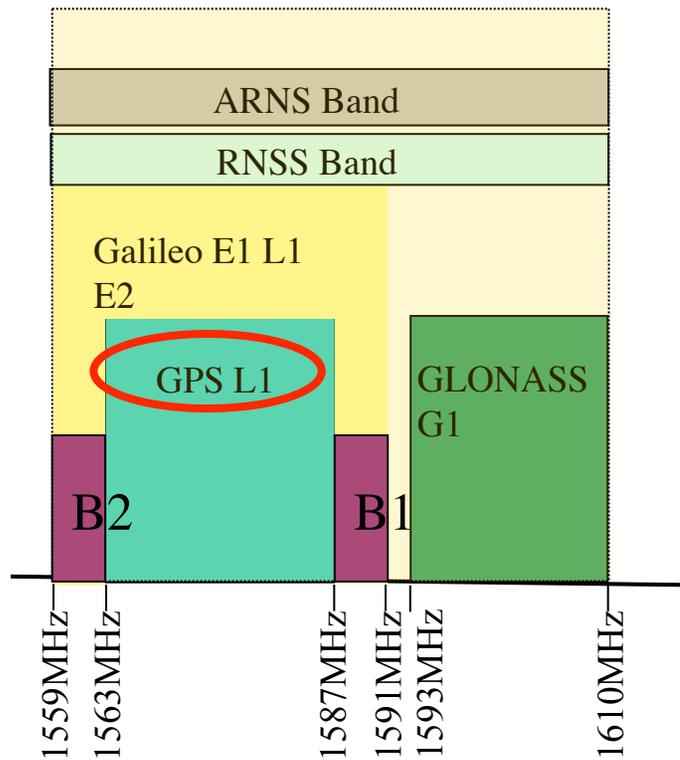
Status of Quest for A Filter Solution

	High Precision	Aviation	Military	Emergency Services	Space Corrected Agriculture
Lower LSQ Band	Several Manufacturers Pursuing - One Demoed, No Independent Tests				
Upper LSQ Band (Closer to GPS)					

Complications

- New Signals
 - Lm
 - L1C
 - Compass etc
- International Agreements
 - ITU
 - Emergency Beacons
 - Defense Communications Applications

Many GNSS Signals



Options to mitigate interference

- Simplest: FCC Rescind the waiver
- Less burden: on the Government: Move LSQ to a more compatible band
- Alternative: Help LightSquared find a solution that will not interfere with GPS
- Several manufacturers are working to determine if there is a technical solution, but ***none have been independently verified***
 - ***Solutions to be verified in the later portions of second round of testing***
 - *Upper band is much more difficult*
 - ***Must consider the newer GPS signals (i.e. Military, and International)***
 - ***Must particularly explore performance issues: Sensitivity, Multipath rejection and timing uncertainty This relates to sharpness of correlation peak...***

	Lower Power 1.5 Kilowatts	Higher Power 15 Kilowatts	Multiple Transmitters	Handheld Sets
Lower LSQ Band	Technical Feasible for new equip*	Filter <i>may</i> be feasible	Difficult to “Analyze” – Major Issue for Aviation	Unknown, no hardware to test
Upper LSQ Band (Closer to GPS)	Feasible Technical Solution not known	No known technical solution		

Issues - Lower Band Only

- Unknown extent of all GPS uses and probable unknown and unintended impacts
- Retro-fitting current receivers is not a realistic option
 - Cost (New Front-end?)
 - Sequencing
 - Duration of transition

New Receivers would probably be Required

Verification Issues

- Are there **verified** Technical Solutions that do not affect current or future GPS performance and are affordable (what band and power level)?
- **If so:**
 - What is the phase-in timing **and**
 - Who will pay for what?
- If **not**, the best alternative **may be** to find another operating band for LSQ

The Right Process: The USAF conducted an extensive fact finding with all users for time to abandon support of “Codeless” receivers.

Decision reached - allow 12 years (2020) – this satisfied all stake holders.

Principal Rationale – Allow the high-precision GPS users time to phase in a solution ***that was already understood and accepted.***

Overarching Issue

- No known solution for Hi Performance GPS if High LSQ band is Activated
- Hi-Band is still in the LSQ plan
- No real point in seeking or implementing a Low LSQ band Solution
 - GPS users would have to retrofit a second time in 5 (?) years

Bottom Line

- If FCC allows “waiver” to proceed
 - Effects will be immediate and disastrous
 - Aviation
 - Precision Agriculture
 - Survey
 - Machine Control
 - Public Safety Providers (helicopters)
 - Transition time should be at least 8 to 10 years for Lower Band
- Upper Band must be Immediately Prohibited
- Whole MSS Band should be reserved for Satellite to Ground