



We've come a long way



91% of American's Use Cell Phones





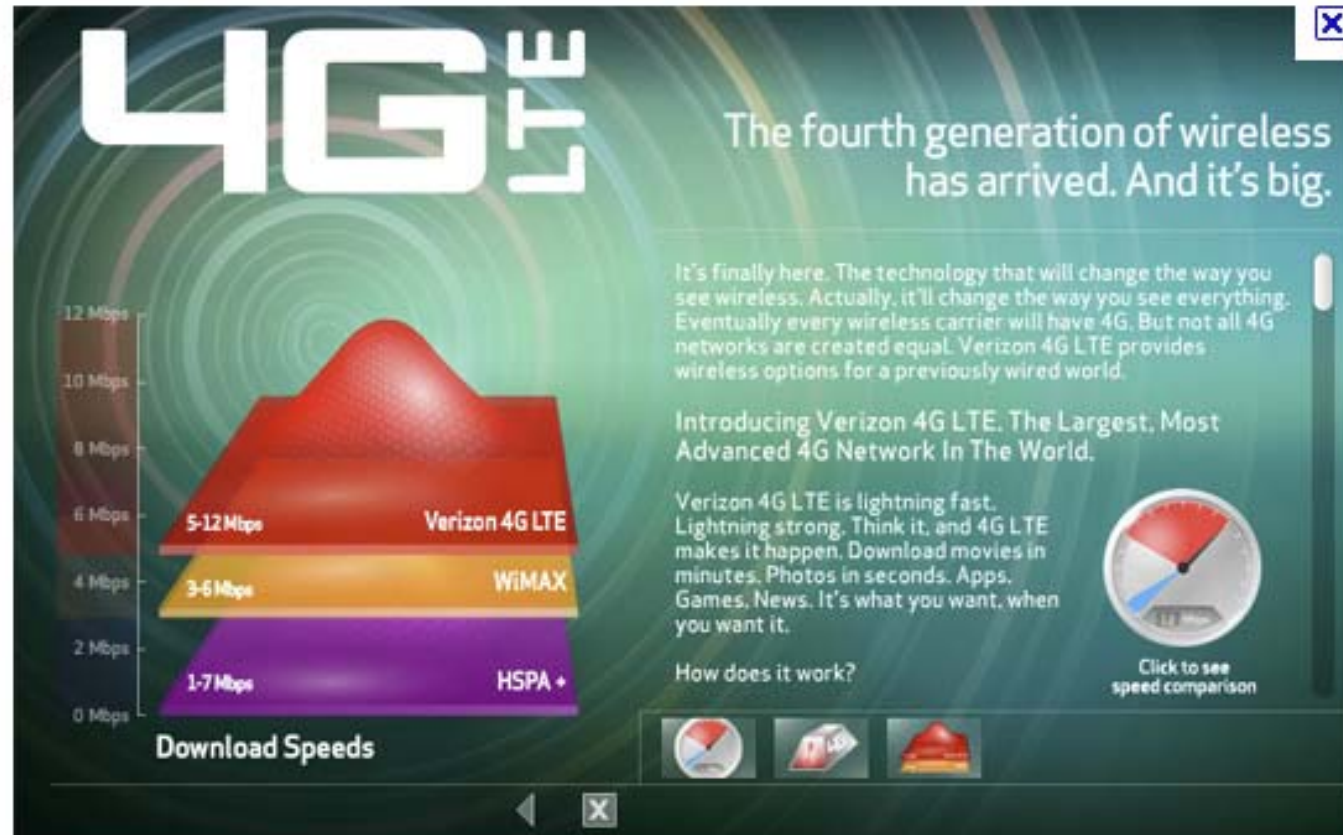
Too much of a good thing?



I in 4 have said Goodbye to Landlines



Along Comes 4G



LTE = Long Term Evolution

Extreme shortage of spectrum for mushrooming number of hand held devices.



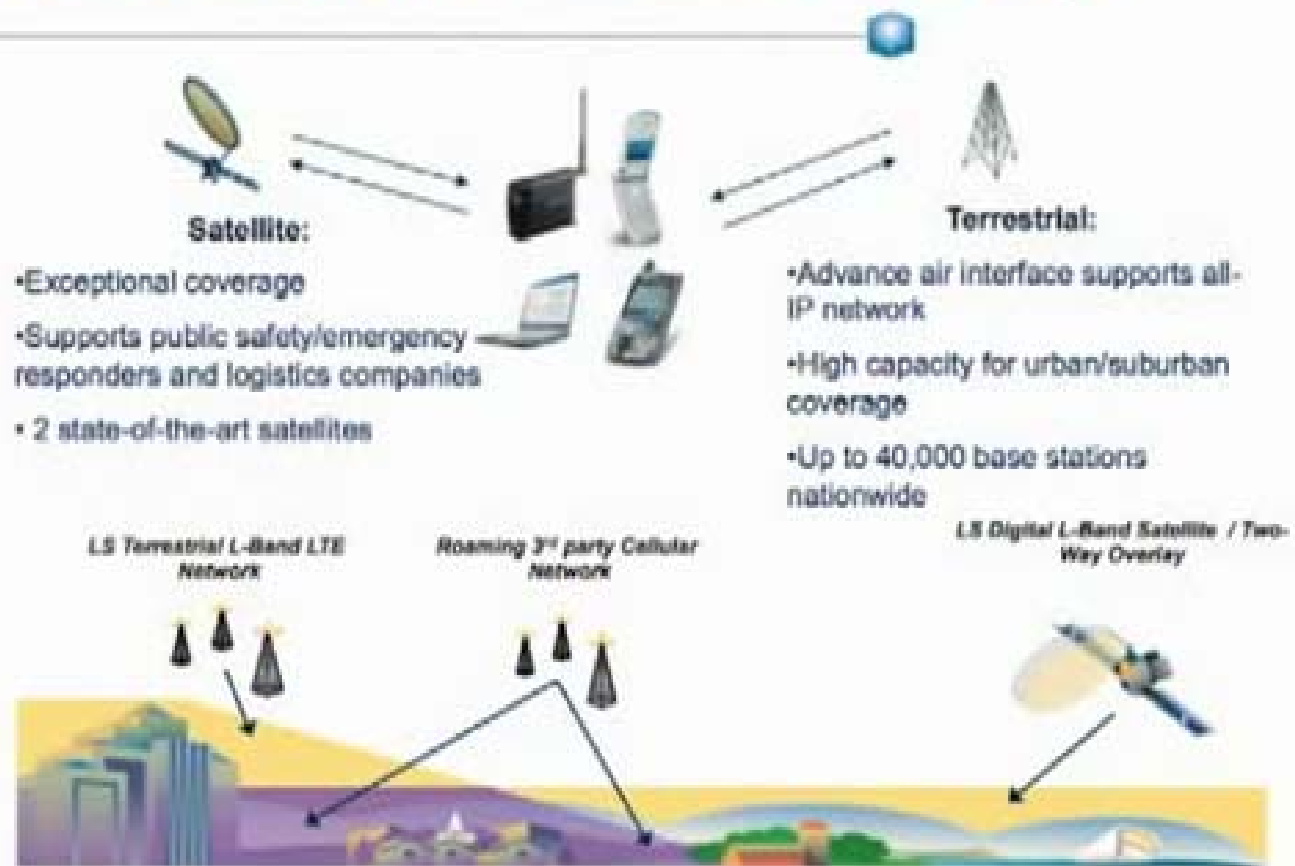
- FCC's National Broadband Initiative
- To facilitate broadband internet access for all U.S. citizens no matter where they are.
- FCC says there is a dire need for more spectrum for cutting edge mobile applications.
- FCC Plan includes reducing the number of over-the-air TV channels by 21 channels (down from current 51 channels.)
- Broadcast industry up in arms about the potential loss of service to the public.



LightSquared under sub-prime billionaire Phillip Falcone buys troubled Skyterra and its asset of **satellite** spectrum. Falcone then convinces the FCC to rewrite the former Skyterra license to allow the construction of a network that relies almost exclusively on **ground based** stations.

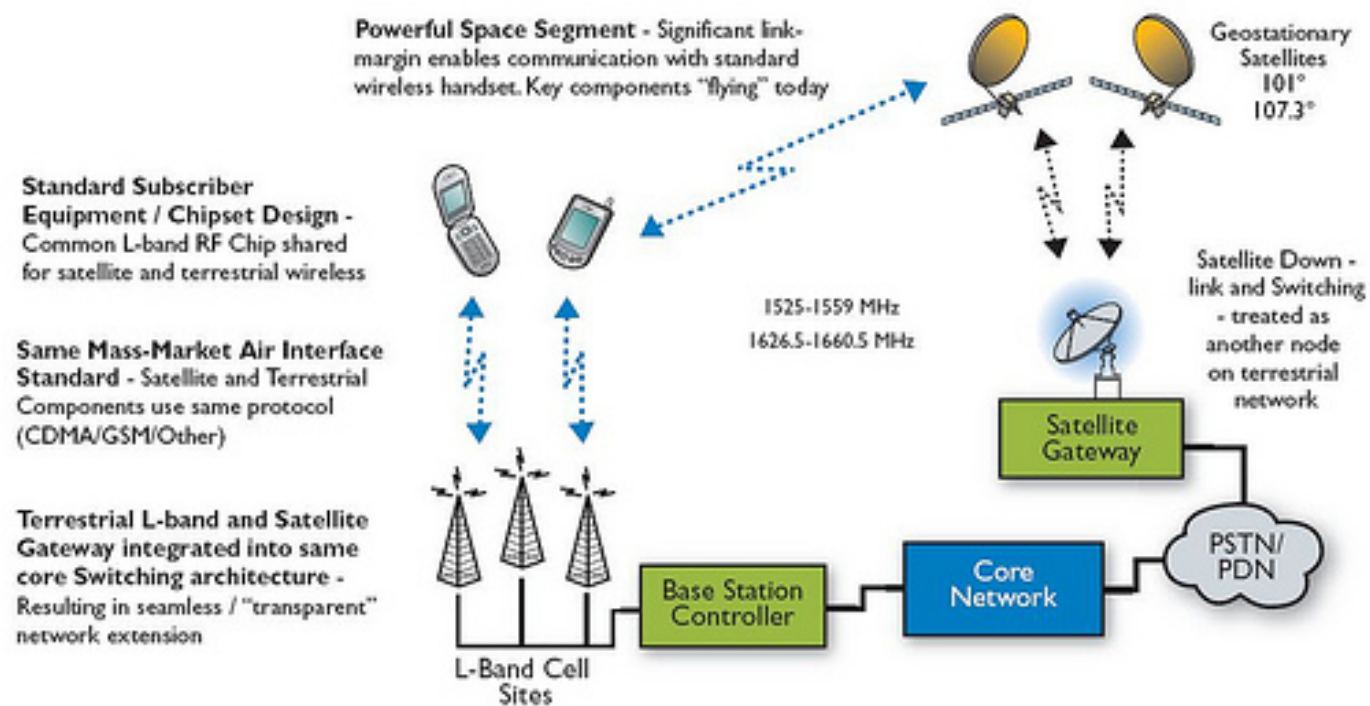
This unusual FCC waiver gave LightSquared conditional approval to operate with high power in the low power satellite L band which was intended only for low power transmissions from orbiting satellites.

4G LTE Network Will Provide Seamless Coverage



4G LTE Network Topography

Figure 1 – Hybrid Terrestrial/Satellite Wireless Network



LightSquared mobile devices

GPS v. MSS



ATCt Mobile Terminal

L-band (1626.5 MHz -1660.5 MHz)

Maximum fundamental EIRP: -7 dBW** (0.2 watts)

Maximum unwanted EIRP: -90 dBW/MHz (1559-1605 MHz)

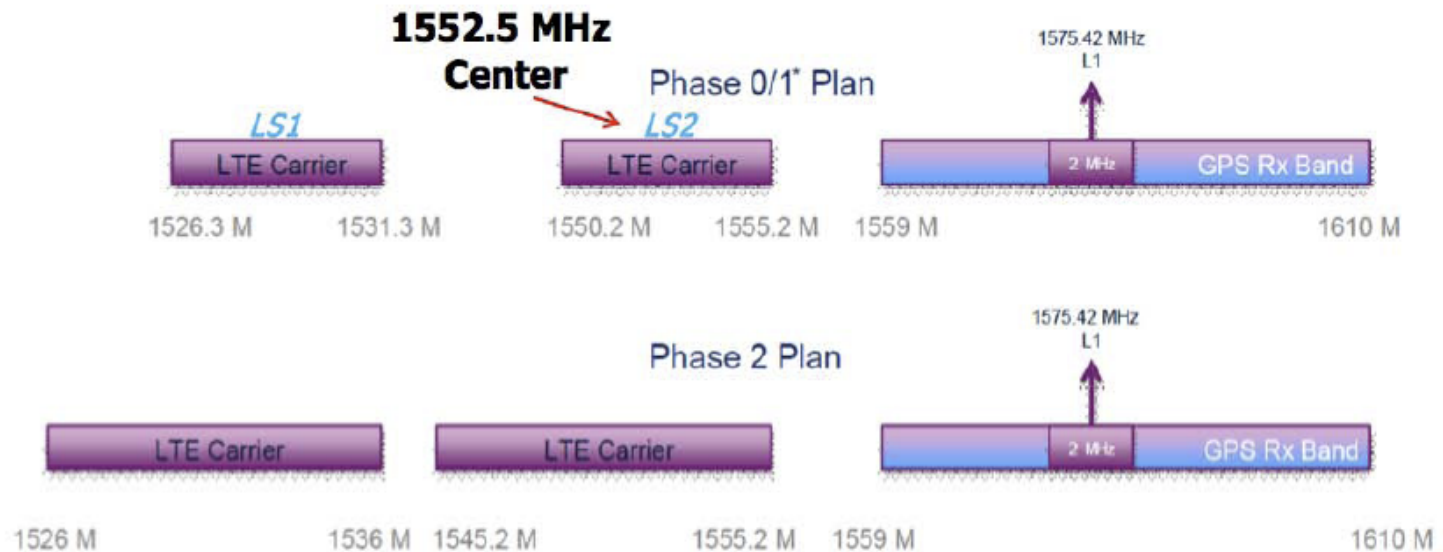
Modulation: LTE (OFDM)**, 5 MHz occupied bandwidth

Carrier frequency: 1654.2 MHz**

Antenna height: 1.8 m (est.)

(** from LightSquared RTCA brief (McCall), 10 Feb 2011)

LightSquared Phase 1 and Phase 2 Build-out Plans in the MMS (Mobile-Satellite Service) Band

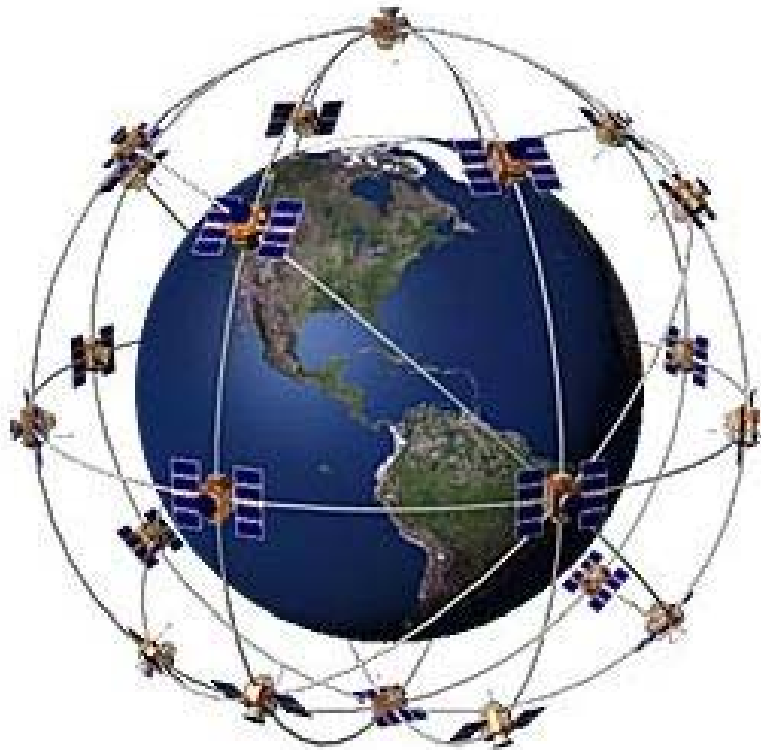


* Only upper 5-MHz LTE carrier is used in Phase-0. Both 5-MHz carriers are used in Phase-1

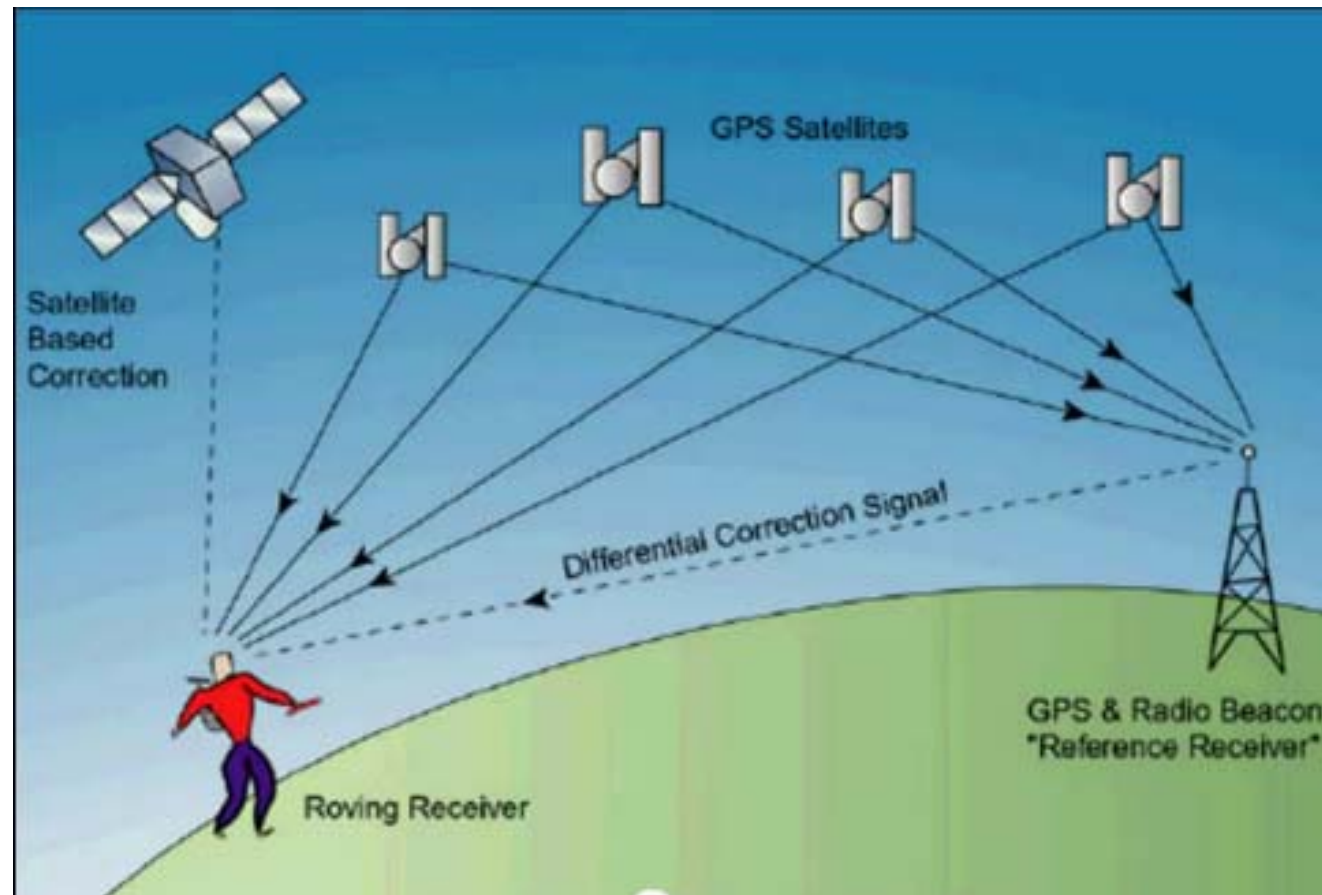
GPS is Ubiquitous - Critical



GPS System – 24 Satellites



6 to 11 are visible at any one time



RTK Differential Correction Accuracy Distances





Uses for GPS Among Many

- Direction finding, both consumer and military
- City and farm planning and maintenance
- Time locking for synchronization
- Weather and atmospheric research
- Geographic surveying
- Airline industry – airport approach
- Emergency response fire and ambulances
- Law Enforcement
- Fleet management, trucking
- Buses and taxis
- Kids and pets
- Camera and photography



LightSquared Build-out Phases

LightSquared plans for three spectrum phases:

Phase 0: One 5 MHz channel : 1550.2 MHz- 1555.2 MHz, 62 dBm (6,400 watts) EIRP per 5 MHz channel

Phase 1: Two 5 MHz channel : 1526.3 MHz -1531.3 MHz & 1550.2 MHz - 1555.2 MHz, 62 dBm EIRP per 5 MHz channel

Phase 2: Two 10 MHz channel : 1526 MHz -1536 MHz & 1545.2 MHz - 1555.2 MHz, 62 dBm EIRP per 10 MHz channel

Ground based stations will transmit with 1 billion times the signal power of that received by a GPS device from a GPS satellite.

(Trimble Navigation's testimony before the Commerce, Justice, Science Subcommittee House Appropriation Committee)

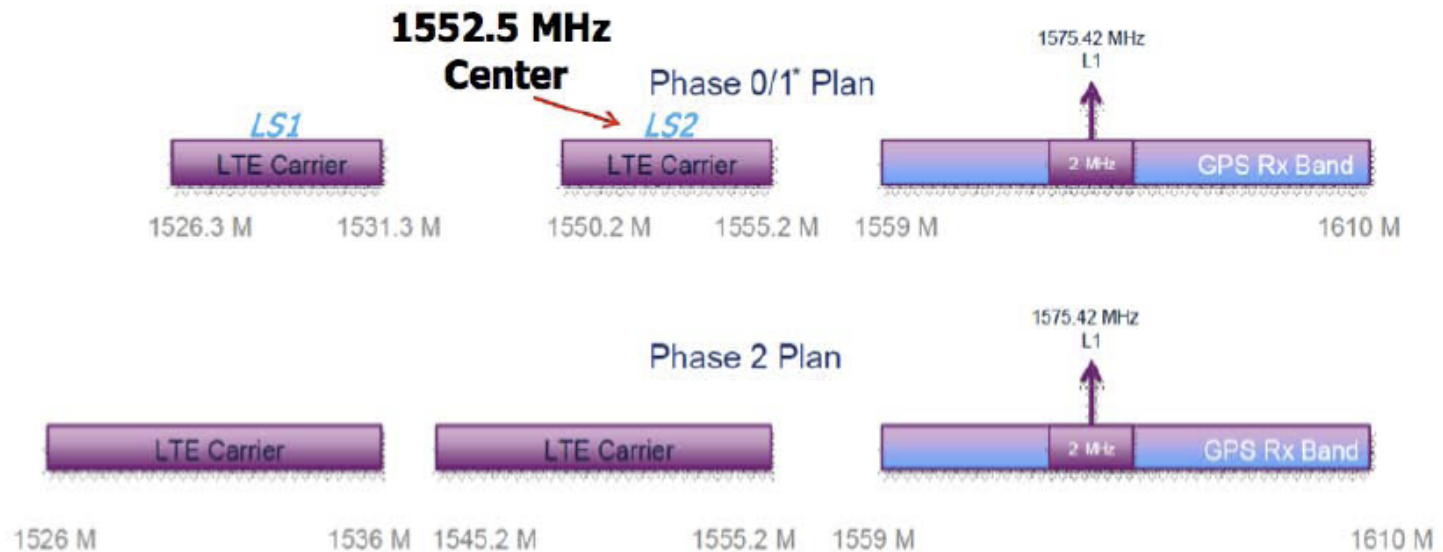


Model Characterization of Typical Phase 2 LightSquared Network

For the LightSquared Network deployment of ATC (Ancillary Terrestrial Component) base stations by 2015, LightSquared expects that the distance between base stations would typically be:

- Dense urban environment: 0.4-0.8 km
- Urban environment: 1-2 km
- Suburban environment: 2-4 km
- Rural environment: 5-8 km

LightSquared Phase 1 and Phase 2 Build-out Plans in the MMS (Mobile-Satellite Service) Band

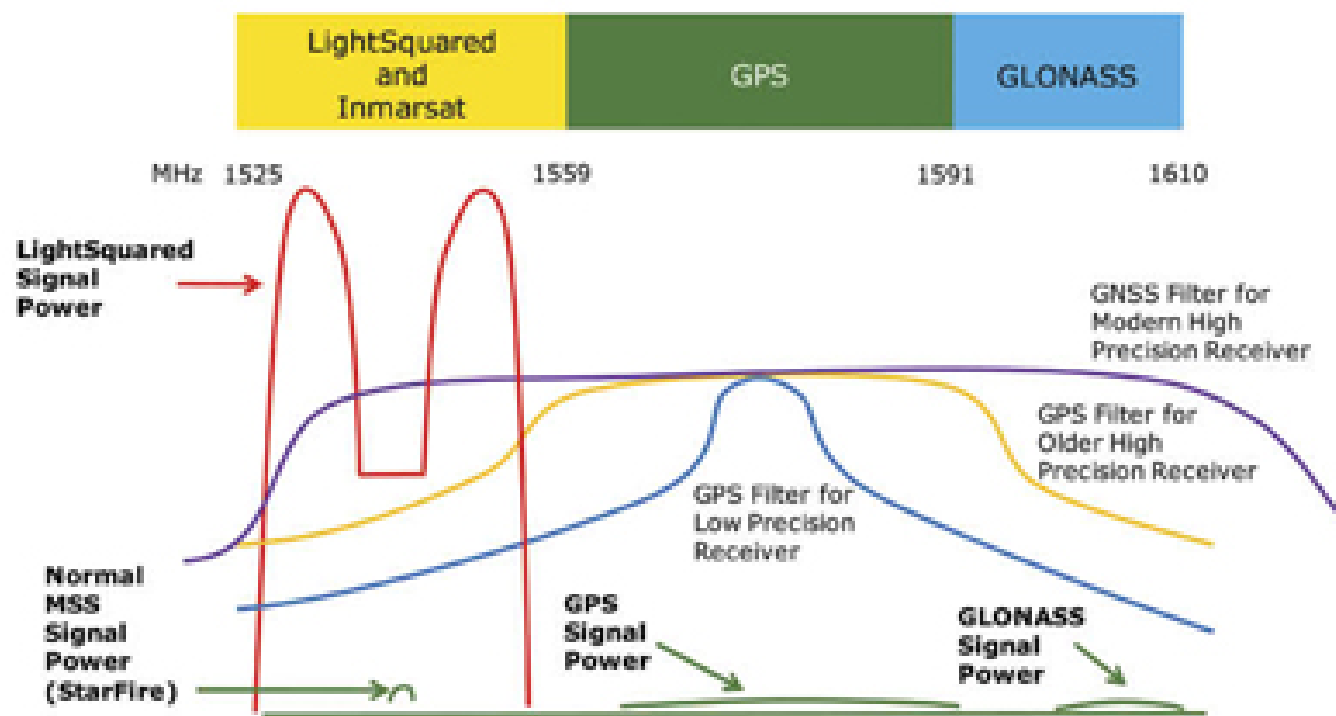


* Only upper 5-MHz LTE carrier is used in Phase-0. Both 5-MHz carriers are used in Phase-1

Land Based ATV stations will affect GPS Reception

LIGHTSQUARED SIGNAL'S POSSIBLE EFFECT ON RECEIVERS

LightSquared's signal is 90 dB stronger than the Mobile Satellite Service signal used by GPS augmentation services, more than a filter can handle.



Source: John Deere

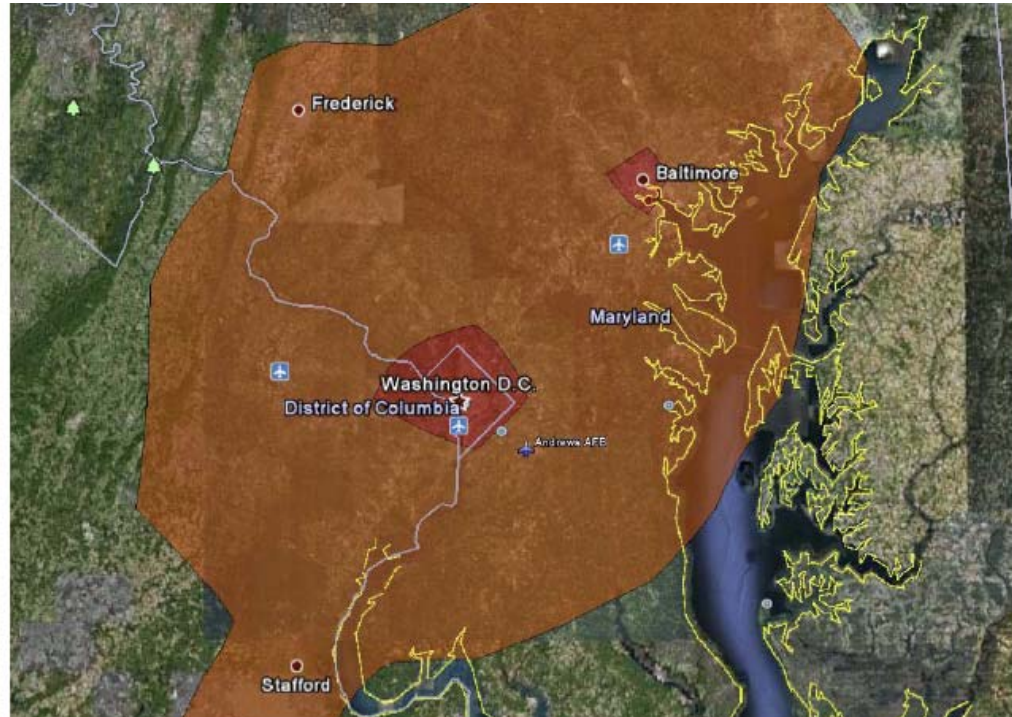


National Space-Based Positioning, Navigation, and Timing Systems Engineering Forum (NPEF)

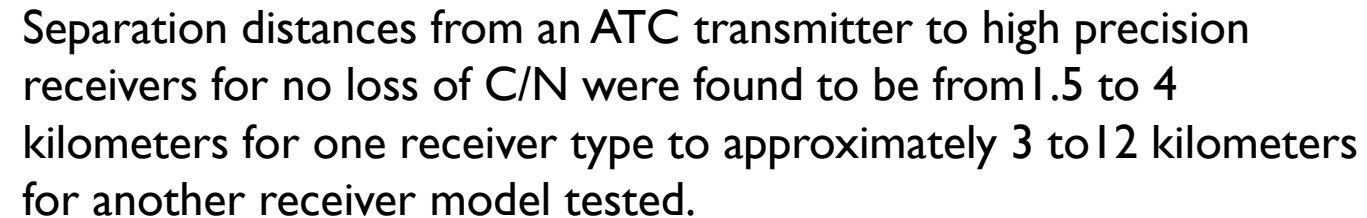
Purpose of Study:

To conduct an assessment of the effects of LightSquared's planned deployment of a terrestrial broadband network to Global Positioning System (GPS) receivers and GPS-dependent systems and networks

LAAS – Local Area Augmentation System used in Aviation.
NPEF report: For phase I and II, considering LightSquared's upper channel received power levels 500 feet above the ground in the Baltimore-Washington area.



A common airborne receiver would be unable to track any GPS satellites in the dark orange region and a popular general aviation airborne receiver would be unable to track any GPS satellites in the red region.).



Separation distances from an ATC transmitter to high precision receivers for no loss of C/N were found to be from 1.5 to 4 kilometers for one receiver type to approximately 3 to 12 kilometers for another receiver model tested.



NPEF Findings

- Percentage of time spaced based occultation measurements could be disrupted was from 5-10% over a ten day period.
- Recommendation 1: *LightSquared should not commence commercial services per its plan due to harmful interference to GPS operations.*
- Recommendation 2: *The U.S. Government should conduct more thorough studies on the operational, economic and safety impacts of operating the LightSquared Network.*



Garmin Testing Findings

- LightSquared plans the operation of 40,000 land based stations. Severe Jamming to GPS will occur.
- Garmin's common GPS automotive receiver began to be jammed at 3.6 km from ATC ground-based station. At 0.66 miles complete tracking was lost.
- GNS 430W, a common FAA certified GPS receiver began to be jammed at 13.8 miles. Total loss of fix came at 5.6 miles.



Deere company files Petition for Reconsideration of FCC granted waiver to LightSquared

- FCC failed to consider devastating interference that LightSquared proposed service will likely cause to high precision locating systems using GPS receivers... such as the Deere StarFire Service in widespread use by major agricultural, construction and survey customers nationwide.



DoD and DoT Objections and LightSquared Response

In a letter to Federal Communications Commission Chairman Julius Genachowski, the U.S. Departments of Defense (DoD) and Transportation (DoT) have issued the strongest message yet opposing LightSquared's proposal to build a network of high-powered terrestrial transmitters broadcasting near the GPS L1 and other Global Navigation Satellite System frequencies.

LightSquared has written to the FCC accusing the GPS industry of failing to comply with the Department of Defense standards. It blames the problem on the GPS receivers



Others filing Against LightSquared's proposal

- Airline Pilots Association
- Wisconsin Dept of Natural Resources
- OnStar LLC
- University of New Mexico
- Trimble Navigation LTD
- Lockheed Martin Corporation
- Motorola Inc.
- Agribusiness Association of Iowa
- National Public Telecommunications Safety Council



Some of those who filed favoring LightSquared's Proposal

- Arkansas House of Representatives
- City of Phoenix
- Ohio Pharmacists Association
- T-Mobile USA
- Arizona State Senate
- Nevada State Democratic Party
- Alchemy Associates
- Rolling Meadows PD



Mitigation Techniques

- Additional filtering – adding filtering to GPS user equipment to suppress the LightSquared signals.
- Adaptive antennas – using adaptive array antennas to spatially suppress the LightSquared signals.
- GPS changes – increasing GPS and WAAS broadcast signal strength to compensate for the signal-to-noise degradation caused by the LightSquared Network.
- Operational solutions – keeping GPS users separated from LightSquared base stations.



Mitigation Techniques Applied to LightSquared

- 1) Increasing the frequency separation of LightSquared's transmitted signal relative to the lower edge of the RNSS (GPS) allocated band a
- 2) Reducing the transmitted power
- 3) Modifying the base station antenna (either by narrowing the vertical beamwidth or increasing the antenna tilt so that less area is covered by each transmitting antenna)
- 4) Using exclusion zones to maintain a minimum separation distance where the installation is fixed;
- 5) Relocating the proposed LightSquared operating frequencies to a band more suitable for high power terrestrial operations. (FCC has been asked to help in doing this.)

(LightSquared has since modified its proposal to use only the lower portion of the proposed frequency band near GPS as well as to reduce satellite power by one-half. It also has agreed to help fund filters for high precision GPS units.)

LightSquared Announces 9 billion dollar deal with Sprint.



Bifurcation of Spectrum Responsibility



The NTIA has told the FCC that several federal agencies including Homeland Security are concerned that LightSquared's satellite-terrestrial LTE network will interfere with government communications services.

Sen. Chuck Grassley (R-Iowa), ranking member of the Judiciary Committee, said he still hasn't received the answers he wants from the Federal Communications Commission on why the agency fast-tracked a regulatory step for LightSquared.



In late July, the FCC told Grassley that it doesn't have to reveal documents requested by the Judiciary committee. Only the Commerce Committee can force the agency to reveal correspondence between the FCC and LightSquared officials.

FCC Chairman Julius Genachowski instead told Grassley to file a freedom of information act request.

"What is the FCC hiding?" Grassley said in a statement.



Where are we now?

- FCC has put a hold on the LightSquared waiver until allegations of interference can be sorted out.
- LightSquared met with the House Science, *Space* and Technology Committee
- FCC criticized for not using their own engineers for testing.
- The controversy has become politically charged.
- LightSquared says it would help finance GPS industries receiver improvement and amends its plan to use lower power
- Scott Pace, director of the Space Policy Institute at George Washington University says; “There is no viable or verifiable technological solution that has been identified to date that would allow a ground-based broadband communications network to operate in close proximity to GPS signals.”

Discussion...

