

# Regulatory Considerations for GPS Adjacent Band Terrestrial Services

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# Discussion Topics

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- **History and Precedents for 1 dB IPC**
- **Regulatory Status of Adjacent Band uses and Proposals (MSS ATC, Terrestrial Broadband)**
- **Comparison of FCC Actions in MSS ATC Conversions**
- **Bottom Line**

# History and Precedents for the 1 dB IPC

- In June 2017, the Air Force produced a white paper on the 1 dB Interference Protection Criterion (IPC) that explained the relationship between harmful interference (levels that affect GPS receiver performance) and the 1 dB IPC (keeps interference below a level that would cause harmful interference). <https://www.gps.gov/spectrum/ABC/1dB-background-paper.pdf>
  - Use of the 1 dB IPC is consistent with 2010 National Space Policy direction to sustain the radiofrequency *environment* in which critical US space systems, such as GPS, operate.
- **Extensive domestic and international precedents:**
  - Domestic: NTIA comments in 2002 in MSS ATC rulemaking; 2003 in Ultrawideband proceeding; 2004 in Low Power TV (LPTV) proceeding; and 2011 NTIA direction for NPEF testing of the proposed LightSquared terrestrial use and potential impacts to GPS.
  - International: ITU-R Recommendations M.1462-0 (2000); M.1490-1 (2006); M.1739 (2006); M.1465-1 (2007); M.1800 (2007); M.1903 (2012); M.1904 (2012); M.1463-3 (2013); M.2059 (2014) all use the 1 dB IPC or, equivalently, an I/N of -6 dB.

# Support for the 1 dB IPC

- **The PNT Advisory Board listed strict adherence to the 1 dB IPC as the first criterion to be used in testing aimed at assessing compatibility with GPS.**
  - **"Accept and strictly apply the 1 dB degradation Interference Protection Criterion (IPC) for worst case conditions. (*This is the accepted, world-wide standard for PNT and many other radio-communication applications*)"**
  
- **In comments on the April 2016 FCC Public Notice regarding the proposed license modification for terrestrial use of the MSS L-band, the majority of commenters support use of the 1 dB IPC, support the DOT ABC study (which is based on the 1 dB IPC), or both;**
  - **Four of the five parties that reached agreements with Ligado (except for Topcon Positioning) support the 1 dB IPC in comments filed in response to this Public Notice.**

# The 1 dB IPC is Central to the Discussion of Adjacent Band Terrestrial Services

- **The 2011 National PNT Systems Engineering Forum (NPEF) test and analysis and the 2016 DOT Adjacent Band Compatibility (ABC) test and analysis (preliminary results), showed the adjacent band terrestrial service being proposed exceeded the 1 dB IPC for many receivers.**
  
- **Arguments have been made against the use of the 1 dB IPC for adjacent band interference sources, but it's worth noting:**
  - Stand-alone terrestrial broadband services are specifically prohibited under FCC's MSS ATC rules in the MSS L-band spectrum.
    - FCC actions in proceeding 10-142 did not change the underlying MSS ATC rules prohibiting stand alone terrestrial service or make any new allocations for terrestrial services (e.g., Mobile Service) in the MSS L-band.
  
  - All receivers take in some power from adjacent band transmissions, which is why sustaining the *environment* for GPS/GNSS is crucial.
    - Sustaining the environment is important for accommodating the other GNSS services that use the RNSS band at 1559-1610 MHz.

# L-band Band Terrestrial Services Overview

- **Domestically, only MSS Ancillary Terrestrial Component (ATC) service is permitted in the MSS L-band spectrum.** MSS ATC is satellite service augmentation by terrestrial fill-in stations in areas of poor reception.
  - FCC MSS ATC rules specifically preclude stand-alone or independent terrestrial service (e.g., in Para. 1 of the 2003 MSS ATC Order, FCC stated: **“We do not intend, nor will we permit, the terrestrial component to become a stand-alone service.”**)
  
- **FCC, in April 2011 (after conditional waiver grant to LightSquared), adopted an Order in ET Docket 10-142 that "authorized" undefined terrestrial services in MSS ATC bands under spectrum leasing arrangements and secondary market provisions.**
  - Other MSS spectrum conversions covered under the same Order, (e.g., for the 2 GHz and Big LEO MSS bands) required additional rulemaking actions for terrestrial services.

# Regulatory Status of MSS L-band Terrestrial Services

- **An MSS ATC station (ATC base station or ATC mobile station) derives its regulatory standing from the primary MSS allocation because the integrated service rule “ties” the terrestrial augmentation use to the MSS.**
  - If the integrated service rule is waived and the “tie” to the MSS severed, it can be argued the proposed terrestrial service would not have any regulatory standing via the primary MSS allocation and would be a “non-conforming use” of the MSS L-band.
  - Domestically, there is no other service allocated in the band (the Mobile Service, under which terrestrial broadband is normally provided, is not allocated in the band).
- **If the terrestrial service is considered part of the MSS, then Part 25.255 of the MSS ATC rules applies, which places the burden for mitigating interference to other in-band and adjacent band users on the MSS ATC service provider.**
  - FCC confirmed, in a letter to Congress, Part 25.255 applies to protection of GPS (see letter from FCC Chairman Genachowski to Representative Walden dated March 23, 2012).

# Regulatory Status and Interference Apportionment

- **The total GPS/GNSS interference budget is apportioned to various interference sources and is related to the regulatory status of the interfering sources.**
  - **If existing ITU Recommendations or Reports (e.g., S.1432) are used as guidance, the allowance for the proposed adjacent band use could be as little as a 1% increase in the total system noise (I/N of -20 dB).**
- **The 1 dB IPC is an allowance of a 25% increase in the total system noise (I/N of -6 dB).**
- **Use of the 1 dB IPC for adjacent band interference preserves margin for other stresses that receivers experience.**

# Process Issues that Contributed to the Uncertainty in Regulatory Status of the MSS L-band Terrestrial Services

- **February 26, 2010 Business Confidential Letter to FCC from Harbinger:** “Harbinger plans to develop a nationwide terrestrial broadband mobile 4G LTE network, which, without regard to satellite coverage, will provide wireless data on a nationwide basis.” and “Without regard to satellite coverage, the terrestrial network will achieve population coverage of at least 260 million by 2015, which is comparable to the coverage provided by other nationwide terrestrial carriers.”
- **March 26, 2010 Harbinger Acquisition Order:** “Without regard to satellite service, SkyTerra shall construct a terrestrial network to provide coverage to at least 100 million people in the United States by December 31, 2012; to at least 145 million people in the United States by December 31, 2013; and to at least 260 million people in the United States by December 31, 2015.”
  - The 2010 Harbinger Acquisition Order requiring provision of stand-alone terrestrial services appears to be inconsistent with FCC MSS ATC rules and was issued before FCC proposed relaxing its rules to permit undefined terrestrial service via lease arrangements in MSS L-band in July 2010.

# Process Issues that Contributed to the Uncertainty in Regulatory Status of the MSS L-band Terrestrial Services (concluded)

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- **January 26, 2011 FCC Grants a Conditional Waiver to LightSquared:** FCC did not, in the March 26, 2010 Harbinger Acquisition Order, the March 26, 2010 SkyTerra MSS ATC License Modification Order, or the January 26, 2011 Conditional Waiver Order, explain why a public rulemaking process for conversion of the MSS L-band spectrum wasn't followed or why the "notice and public procedure thereon are impracticable, unnecessary, or contrary to the public interest", which are typically required under the Administrative Procedure Act (APA).
- A Notice of Proposed Rulemaking (NPRM) specific to terrestrial services in the MSS L-band could have explored the myriad technical and policy issues that have surrounded the conversion of this satellite service spectrum in an open and transparent fashion.

# Comparison of FCC Actions on MSS ATC Conversions

Missing element for MSS L-band conversion is an NPRM, which is typically required under the APA.

	2 GHz MSS Band	Big LEO MSS Band	MSS L-band
Allocation Change NPRM	YES	TLPS NPRM*	NO
Public Notice and Comment	YES	YES	NO
Change Allocation Table	YES	NO*	NO
Service Rules NPRM	YES	YES-In NPRM	NO
Public Notice and Comment	YES	YES	NO
Adopt Service Rules	YES	YES	NO
License Modification	YES	YES	YES
Public Notice and Comment	YES	YES	YES
FCC Order and Issue License	YES	YES	TBD

\* FCC proposed to modify Part 25 MSS ATC rules rather than add new Fixed and Mobile Services and allow terrestrial services under Part 27 (Misc. Wireless Services) as the applicant had requested.

# Bottom Line

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- The use of the 1 dB IPC for assessing compatibility with GPS and other GNSS systems has significant public support based on comments in the FCC record, extensive precedent domestically and internationally, and is an appropriate metric by which to assess adjacent band terrestrial service currently under consideration by the FCC.
- The use of the 1 dB IPC is not antiquated or overly conservative.
  - It is higher than guidance in ITU-R recommendations would suggest given the regulatory status of the proposed adjacent band use;
  - Allowing adjacent channel interference that exceeds the 1 dB IPC risks not leaving adequate margin for other stresses that receivers experience.

# Backups and Additional Details

# Additional Details: Support for the 1 dB IPC

- **Garmin, Trimble, and Deere, which reached settlement agreements to end litigation against their companies, all support the 1 dB IPC.**
  - Note that the Harbinger lawsuit against the US was dismissed without reason given, without a responsive pleading from the US, and without prejudice.
- **NovAtel agreed not to oppose Ligado's proposal, but supports the 1 dB IPC.**
- **Topcon Positioning reached a cooperation agreement with Ligado, but has neither supported nor opposed the 1 dB IPC in publicly filed comments.**
- **No authoritative regulatory agency or body has objected to the use of the 1 dB IPC, or supported an alternative IPC, for the compatibility analysis.**
  - Domestically, the 1 dB IPC has been used extensively in FCC and NTIA compatibility analyses, including the NTIA directing this IPC be used in the 2011 assessment of the LightSquared proposal impacts to GPS.
  - Internationally, the 1 dB IPC has been widely used in the ITU to assess compatibility with GPS and other Radionavigation-Satellite Service (RNSS) systems...and for numerous other radio services (including for mobile services such as those proposed for the MSS L-band).
- **In addition to the 4 GPS manufacturers noted above, other supporters of the 1 dB IPC have included: Airlines for America, Aircraft Owners and Pilots Association, Helicopter Association International, International Air Transport Association, Aviation Spectrum Resources, Inc., Rockwell Collins, Cargo Airline Association, Southwest Airlines, Delta Airlines, United Parcel Service, Resilient Navigation and Timing Foundation, AGCO Corporation, Veripos, Aerospace Industries Association.**

# Additional Details: L-band Band Terrestrial Services Overview

- **Integrated service rule (part of the “gating criteria”)**: Adopted in the 2003 Order to, among other reasons, ensure MSS service providers couldn’t compete unfairly with terrestrial service providers who had to pay billions at auction (competitive bidding process) for their spectrum whereas spectrum for most satellite services is not auctioned.
  - PUBLIC LAW 106–180—MAR. 17, 2000 (“Orbit Act”): “SEC. 647. SATELLITE AUCTIONS. “Notwithstanding any other provision of law, the Commission shall not have the authority to assign by competitive bidding orbital locations or spectrum used for the provision of international or global satellite communications services. The President shall oppose in the International Telecommunication Union and in other bilateral and multilateral fora any assignment by competitive bidding of orbital locations or spectrum used for the provision of such services.”
  
- **It may have been possible, as happened with Globalstar, to reallocate portions of the MSS spectrum for terrestrial services (e.g., to the Mobile Service) had the FCC decided to explore that possibility in a Notice of Proposed Rulemaking (NPRM), and to assign any MSS L-band spectrum reallocated to terrestrial service through competitive bidding (auctions).**
  - FCC did not issue an NPRM for terrestrial services in the MSS L-band as it did in the Big LEO and 2 GHz MSS bands (MS and Fixed Service (FS) service allocation at 2 GHz; TLPS in the Big LEO downlink band).
  - Spectrum leasing authorization under Part 1.9000 of FCC’s rules did not change the MSS ATC rules prohibiting stand-alone terrestrial services and no FS or MS allocation was made. The regulatory status of terrestrial services for the MSS L-band is undefined.

# Additional Details: Regulatory Status of MSS L-band Terrestrial Services

- **§25.255** Procedures for resolving harmful interference related to operation of ancillary terrestrial components operating in the 1.5/1.6 GHz and 1.6/2.4 GHz bands. If harmful interference is caused to other services by ancillary MSS ATC operations, either from ATC base stations or mobile terminals, the MSS ATC operator must resolve any such interference. If the MSS ATC operator claims to have resolved the interference and other operators claim that interference has not been resolved, then the parties to the dispute may petition the Commission for a resolution of their claims.
- The terrestrial service (“ancillary terrestrial mobile service”) mentioned in the April 2016 Public Notice doesn’t exist in FCC rules.
  - The cited 2011 Order in the April 2016 Public Notice was a waiver...and didn’t mention “ancillary terrestrial mobile service”.

# Additional Details: Regulatory Status of MSS Terrestrial Services

- **FCC has sought to treat the independent terrestrial service as an MSS ATC service and in 2011 conditionally waived the integrated service rule that ties the terrestrial service to the MSS;**
  - There are unanswered regulatory questions regarding how severing the tie to the MSS still enables the terrestrial service to claim regulatory status via the primary MSS allocation.
  - Unclear why a NPRM for terrestrial services in the MSS L-band wasn't issued as was the case in the 2 GHz and Big LEO MSS bands.
- **In proceeding 10-142** (Fixed and Mobile Services in the Mobile Satellite Bands at 1525-1559 MHz and 1626.5 1660.5 MHz, 1610-1626.5 MHz and 2483.5-2500 MHz, and 2000-2020 MHz and 2180-2200 MHz),
  - Spectrum leasing rules require compliance with existing rules for the underlying service (MSS ATC).
  - No MS or FS allocation was added for the MSS L-band spectrum.

# Additional Detail on Comparison of FCC Actions on MSS ATC Conversions

- The conversion of Dish Network's MSS spectrum in the 2 GHz MSS band followed the more typical regulatory path.
  - FCC went through a rulemaking process that included making an allocation for Fixed and Mobile Services (Notice of Proposed Rulemaking (NPRM) 7/15/2010, Report and Order 4/4/2011), developing service rules to use the allocations (NPRM 3/21/2012, Order 1/30/2013) then modifying the Dish licenses after the public comment period to comply with the service rules (4/3/2013).
  - AWS-4 spectrum was not auctioned, but conversion of Dish's MSS spectrum was conditioned on Dish bidding at least 1.564 billion dollars in the H-block spectrum auction.