5G and Spectrum Interference Concerns for Aviation

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Background

In recent years, the FCC has taken actions to clear additional spectrum for use by terrestrial 5G operators. Unfortunately, as 5G becomes more widespread, misinformation about 5G technology and potential interference with these other bands has led to concerns in the market that need to be clarified.

In April of 2020, the FCC approved Ligado Network's application to deploy a nationwide network in the L-band to support 5G and Internet of Things services (IoT) under ATC (Ancillary Terrestrial Component) use of their spectrum, which is adjacent to the spectrum used for GPS.

In late 2020, the FCC began pursuing a similar effort as part of the Facilitate America's Superiority in 5G Technology (the 5G FAST Plan), opening C-band frequency spectrum which is adjacent to that used by aircraft Radio Altimeters (RadAlts).

In both cases, industry aviation groups have raised concerns about interference to these critical aircraft subsystems.

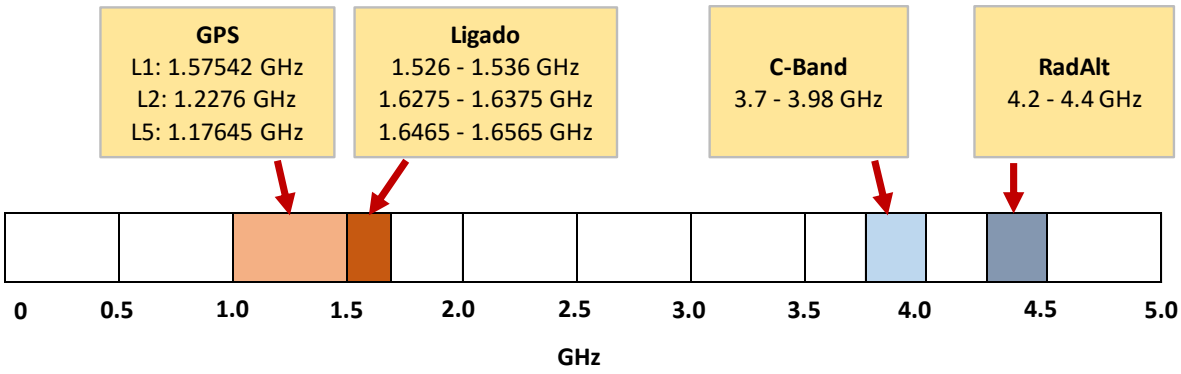

Figure 1 – RF Frequency Bands

What is 5G?

5G is the 5th generation of the mobile networks and promises to not only provide faster download speeds and lower latency, but by taking advantage of the higher bandwidth and more comprehensive coverage, it will open up various new use cases for connectivity including laptops and handheld Internet of Things (IoT) devices, automobiles and large-scale industrial implementations.

5G requires a new transmission infrastructure, including thousands of cell towers, tens

of thousands of antennas, fiber backhaul to support the new antennas, upgrades of dense network Radio Access Network (RAN) infrastructure and equipment on macro cell towers.

Once all of the 5G components are fully deployed and operational, you will not need wire or cable to deliver communications or entertainment service to your mobile device, to any of your fixed devices (HDTV, security system, smart appliances) or your automobile. There will also be applications for Aviation, such as improved sharing of data between owners, managing ancillary systems on aircraft, bolstering safety and maintenance operations, processing data streams in near real time and, of course, providing improved in-flight entertainment and connectivity (IFEC) service to passengers.

The 3rd Generation Partnership Project (3GPP) unites seven Standards Development Organizations from around the globe to define protocols for mobile telecommunications. The 3GPP has divided 5G frequencies in 2 parts:

Frequency Range 1 (FR1): 450 MHz – 7.125 GHz
Frequency Range 2 (FR2): 24.25 GHz – 52.6 GHz.

The interference concerns being raised for other aircraft subsystems reside within the Frequency Range 1 spectrum.

Radio Altimeters and C-band

Radio Altimeters have successfully operated on civil aircraft since their introduction in the 1970s, providing direct measurement of the clearance height between the aircraft over terrain, and the introduction of mobile telecommunication networks did not initially pose any risk of harmful interference because of their operating frequency being well below the Radio Altimeter operating frequencies of 4.2 – 4.4 GHz band.

In recent years, US and international regulators have worked to make available additional “mid-band” spectrum, including portion of the C-band (3.7 - 3.98 GHz), to support the development and roll-out of 5G networks.

This 5G mid-band proposal has led the aviation industry to have significant interference concerns due to the closeness of C-band to the Radio Altimeter frequency range and the lack of test data availability, with 15 aviation associations (including the Aerospace Industries Association, Airborne Public Safety Association, Airline Pilots Associations, RTCA and many others) issuing a letter of opposition to the FCC in December of 2020

urging a rethinking of the C-band auction.

Currently, there is a dispute on the testing done to date, with the FCC believing that the rules issued will protect Radio Altimeters used on aircraft and that 5G operation in the C-band will not cause harmful interference, primarily due to the 200 MHz of separation. However, the RTCA and others feel that the separation band is insufficient due to spurious emission risk in the 4.2 – 4.4 GHz band.

An important item to note is that there are no interference concerns arising from 5G user equipment on the ground.

The FCC acknowledged that further analysis is warranted to evaluate the potential interference to Radio Altimeters, including the testing of multiple Radio Altimeter models to determine their tolerance to C-band signals. Despite these ongoing concerns and the desire for further testing, the FCC completed the C-band auction in February 2021.

Ligado L-Band and GPS

In 2010, LightSquared (now Ligado Networks) proposed to deploy a nationwide satellite/terrestrial network to carry mobile phone and broadband traffic. GPS users and equipment manufacturers objected, claiming it would interfere with GPS services. Based on this, the FCC withdrew approval in Feb 2012.

After reconfiguring the use of its L-band frequencies to use bands further away from GPS, the FCC unanimously approved Ligado's updated plan to use L-band (1526 – 1536 MHz, 1627.5 – 1637.5 MHz, 1646.5 – 1656.5 MHz) for a 5G mobile network following a four-year proceeding, but with conditions including reduced power limits and a requirement that part of it be used as a "guard band" near adjacent operations such as GPS (L1 – 1575.42MHz, L2 – 1227.6MHz, L5 – 1176.45MHz).

Despite these changes, there is a strong coalition of industries, including the US Department of Defense, Iridium, Garmin, the GPS Innovation Alliance (GPSIA) and some commercial airlines, who are dependent upon and dedicated to protecting GPS who view the FCC protections as impractical.

To date, these concerns have not slowed Ligado's push into L-band and 5G, and they announced in June 2021 that they had received approvals from the 3GPP for new technical specifications that will enable L-band spectrum to be deployed in 5G networks.

FANS

Future Air Navigation (FANS) is an integrated aviation telecommunications network that was developed by the International Civil Aviation Organization (ICAO) in collaboration with OEMs such as Boeing and Airbus and industry partners such as Honeywell.

FANS 1/A has several key components:

- Data Comm enables a reduction in workload on behalf of both pilots and air traffic controllers by moving from a solely audio communication method to digital text messaging that appears on a cockpit display
- Automatic Dependent Surveillance-Contract (ADS-C) will automatically send information such as aircraft position, altitude and speed to ATC from the aircraft upon an ATC request

The goal of FANS is to improve safety and communications and to allow for reduced aircraft separation, thereby safely increasing traffic volume over highly congested tracks that have poor radio and/or radar service.

A key required aircraft component of FANS 1/A is a compliant L-band satcom terminal, either from Iridium or Inmarsat, to provide a robust, redundant method of communication when HF or VHF radios are unavailable. It should be noted that broadband satcom systems in both Ku (12 – 18 GHz) and Ka (17.7 – 21.2 GHz and 27.5 – 31 GHz) are not certified for safety services (required in order to be compliant with FANS 1/A).

As can be seen in Figure 2 below, the L-band spectrum begins to get very crowded when you consider the Iridium and Inmarsat operations in conjunction with the Ligado L-band authorization.

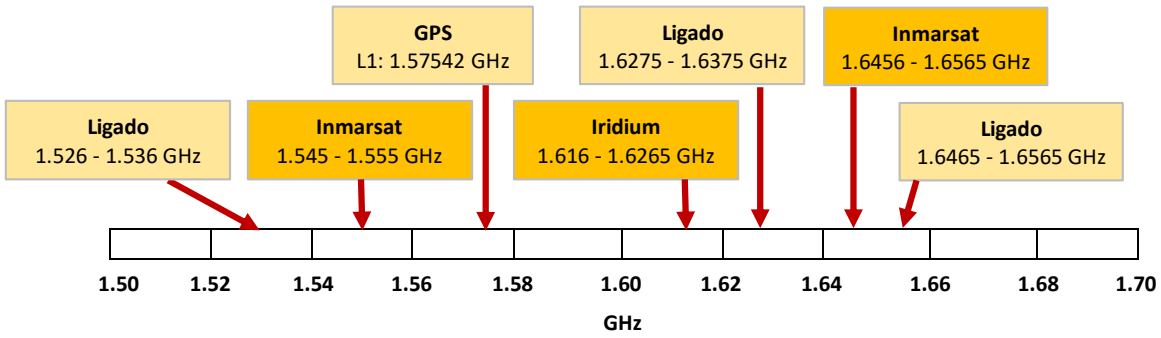

Figure 2 – L-band Frequency Users

Gogo 5G

In the cases of Radio Altimeters, GPS and FANS, it is not the inherent 5G technology, which may meet all 3GPP and FCC 5G standards, that is of concern, rather it is the frequencies it is being applied to. In other words, the companies looking to use the Ligado L-band or C-band frequencies for their 5G service will use a 5G radio but tune it to the L-band or C-band spectrum.

Gogo 5G hardware also complies with 3GPP and the FCC standards, but the *application* of that hardware is well away from these areas of concern. Gogo does not operate in, nor have any plans to operate in, either L-band or C-band. Rather, Gogo 5G is designed to operate in the 2.4GHz unlicensed spectrum band (2.423 – 2.475 GHz), which has sufficient spacing from both the Radio Altimeter and GPS operating ranges to preclude any interference being introduced by the Gogo 5G system, as shown in Figure 3 below.

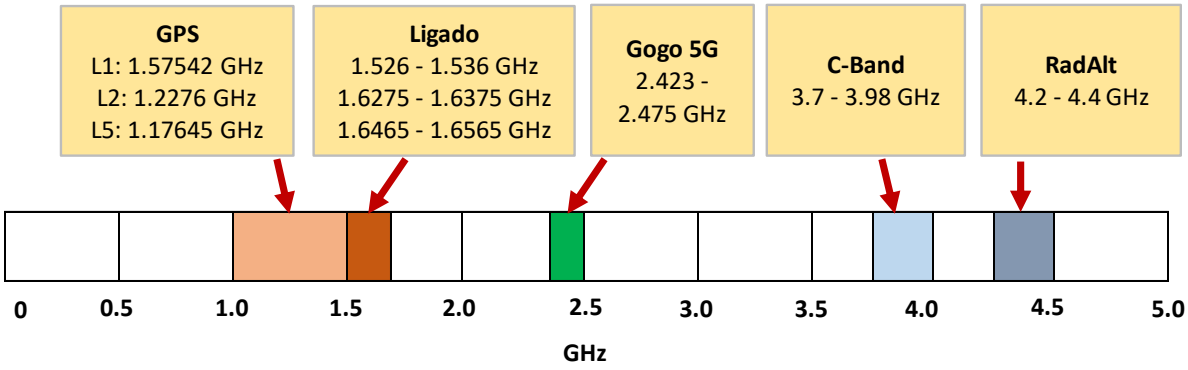

Figure 3 – RF Frequency Bands with Gogo 5G

With the almost 1 GHz of spacing to GPS and almost 2 GHz of spacing with Radio Altimeters, there is no potential for Gogo 5G to interfere with these critical aircraft subsystems.