

GOES R

Spectrum Management Update

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NOAA ~ NASA



Agenda

- DCS Uplink Interference in 402 MHz
 - 401-403 MHz Frequency Usage and Regulations
 - Interference from Canadian Satellite Uplink – Current Status
 - Central & South American Sources
 - Regulatory Considerations
- L-band: Ligado and AWS-3 Update
- Interference and Detection

Frequency Usage in the DCS Uplink Band

DCS Uplink Spectrum: 401.7 – 402.4 MHz, including the International Band

Rest of World – International Use

		NTIA Federal Use	FCC Non-federal Use
401 - 402	METEOROLOGICAL AIDS SPACE OPERATION (space-to-Earth) EARTH EXPLORATION-SATELLITE (Earth-to-space) METEOROLOGICAL-SATELLITE (Earth-to-space) Fixed Mobile except aeronautical mobile	401-402 METEOROLOGICAL AIDS (radiosonde) US70 SPACE OPERATION (space-to-Earth) EARTH EXPLORATION- SATELLITE (Earth-to-space) METEOROLOGICAL-SATELLITE (Earth-to-space) US64 US384	401-402 METEOROLOGICAL AIDS (radiosonde) US70 SPACE OPERATION (space-to-Earth) Earth exploration-satellite (Earth-to-space) Meteorological-satellite (Earth-to-space) US64 US384
402 - 403	METEOROLOGICAL AIDS EARTH EXPLORATION-SATELLITE (Earth-to-space) METEOROLOGICAL-SATELLITE (Earth-to-space) Fixed Mobile except aeronautical mobile	402-403 METEOROLOGICAL AIDS (radiosonde) US70 EARTH EXPLORATION- SATELLITE (Earth-to-space) METEOROLOGICAL-SATELLITE (Earth-to-space) US64 US384	402-403 METEOROLOGICAL AIDS (radiosonde) US70 Earth exploration-satellite (Earth-to-space) Meteorological-satellite (Earth-to-space) US64 US384

US frequency usage modified by footnote: Limits non-Federal use to transmitters to GOES, a US federal space station

US384 In the band 401-403 MHz, the non-Federal Earth exploration-satellite (Earth-to-space) and meteorological-satellite (Earth-to-space) services are limited to earth stations transmitting to Federal space stations.

Usage Outside the United States and Possessions

- The other countries in the Americas do not have a limiting footnote in their rules, therefore, there is nothing to prohibit use of 401-403 MHz for uplink transmissions to satellites (Space Operations)
- With the growth of small satellites, this could become a very popular uplink frequency to command the satellites
- If those satellite uplinks point in the direction of a GOES satellite, their signals will be seen by GOES-DCS, and transpond into the L-band downlink spectrum of DCS. Strong signals would interfere with the assigned DCP uplinks in a given channel or channels.

GHGSat – Canadian Greenhouse Gas Satellites

- After some investigation, it was determined that one of the signals that could interfere with the DCS uplink, had the characteristics of an Earth station tracking an orbiting satellite.
 - GHGSat's first three satellite vehicles were being commanded in this spectrum by several Earth stations, that a few times a day would point in the direction of a GOES satellite, creating detectable interference.
- GHGSat had plans to move their uplink frequency to a different band starting with their third operational satellite. This leaves their developmental satellite and two operational satellites that were launched previously to still use the 402 MHz uplink

Cooperative Testing

- With assistance from ECCO / Meteorological Service of Canada, NOAA entered into discussions with GHGSat to search for some potential solution to the interference from the D-1, C-1 and C-2 satellites
 - GHGSat proposed a cooperative test where their uplinks would switch to the opposite circular polarization from that used by GOES, hopefully attenuating the GHGSat uplink by a significant result.
 - Such a cooperative test was conducted earlier this month.
 - GHGSat uplink, once switched from right-hand to left-hand circular polarization only yielded a signal reduction of about 3 to 4 decibels – which is much less of a change than was expected.
 - It is unlikely that modifying the GHGSat uplink antenna by changing the polarization will be of much help in resolving this problem.

GHGSat

- Flying GHGSat Satellites with 402 MHz uplinks

- GHGSat-D “Claire” launched 22 June 2016
- GHGSat-C1 “Iris” launched 2 September 2020
- GHGSat-C2 “Hugo” launched 24 January 2021



- Next 3 GHGSats C-3 “Luca”, C-4 “Penny”, C-5 “Diako” moved to a new uplink band. No more transmissions to these satellites at 402 MHz
 - Summer 2022 launch planned on SpaceX
- Company plans a full constellation of 10 satellite by end of 2023

Other Interference Sources at 401-402 MHz

- Only a few of the most prominent signals were noted during the data gathering phase where the GHGSat uplink signals was identified.
 - Other signals noted were in either South or Central America
 - Identifying the source of those signals will be much more complex than that of the GHGSat uplink.
- We were unable to see all sources at any time that DCS may have been experiencing radio frequency interference, and the interference environment changes over time – what one might see today could differ from what was detected one or two years ago.
- With the rapid growth of small satellites in countries that may not have controlled or launched satellites before, the potential for other satellite uplinks in 401-402 MHz in the Americas always exists.

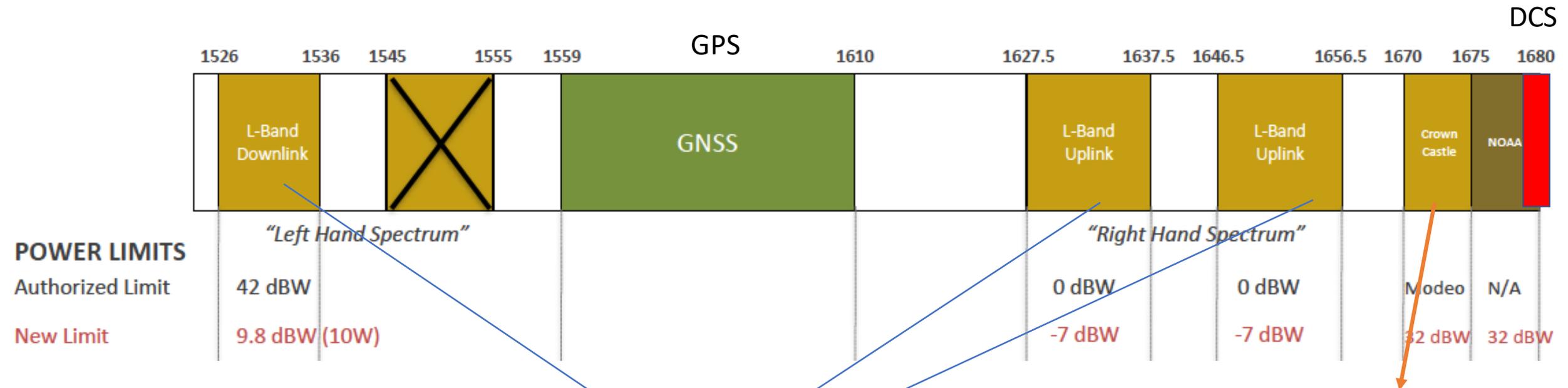
From DCS Uplink to DCS Downlink

Discussions related to the L-band signals into a DRGS
or into a Federal Data Acquisition (Ground) Station

1679.7 – 1680.4 MHz DCPR Downlink

- As I think most of you know, the satellite subsystem that receives and relays the original DCP telemetry is a simple transpond.
 - In other words, it is a straight mathematical relationship that determines where an uplink channel appears in the downlink
- Interference on the uplink certainly can appear in the downlink – and a strong enough signal can cause a failure to intercept the desired downlink signal
- Additionally, strong terrestrial signals can cause interference in the ground station receiver, whether they are terrestrial broadband wireless signals in a band just sold for auction, or a wireless signal like that requested by Ligado, where they desire some allocation, that overlaps some of the DCS downlink spectrum

Ligado Spectrum: Authorized or Requested



These 3 blocks constitute 75% of the spectrum needed for the original proposed service by Ligado
 Notice the downlink from base station to user equipment is operating at reduced power 10W

1670-1680 MHz would be the remaining downlink, operating at about 1500 W

Current Status

- For the “other 30 MHz”, not near DCS
 - FCC approved that use two years ago, and Ligado is suggesting that it may begin some operations in 1526-1536 MHz on or after Sept in some areas
 - A Congressionally-mandated study was undertaken by the National Academies of Science on GPS impacts. Do not believe it has published it's results yet
 - Several Federal agencies and the Federal regulator petitioned the FCC to review that order and stay the use. FCC has taken no action on those requests.
- For 1675-1680 MHz
 - FCC has taken no action to date and there is no indication of when they may do so.

Dish Network to use 1695-1710 MHz licenses

- We have not seen any activity in the 1695-1710 MHz band above GOES, from the AWS-3 auction that was concluded in 2015
 - That seems about to change
 - Dish Network is working on rollout 5G service and has a June 14, 2022 regulatory buildout milestone to meet.
 - Dish intends to rollout in 25 major markets and 100 smaller cities before the June deadline.
 - They must cover 20% of US Population by June 2022 and expand to 70% by June 2023
 - Details: <https://www.fiercewireless.com/5g/dish-marks-5g-progress-plans-launch-5g-25-major-markets-june#:~:text=Dish%20promises%205G%20launch%20in%2025%20major%20markets%20before%20June%20deadline,-By%20Bevin%20Fletcher&text=Dish%20Wireless%20is%20gearing%20up,of%20its%20June%20buildout%20deadline.>

Summary

Questions?