



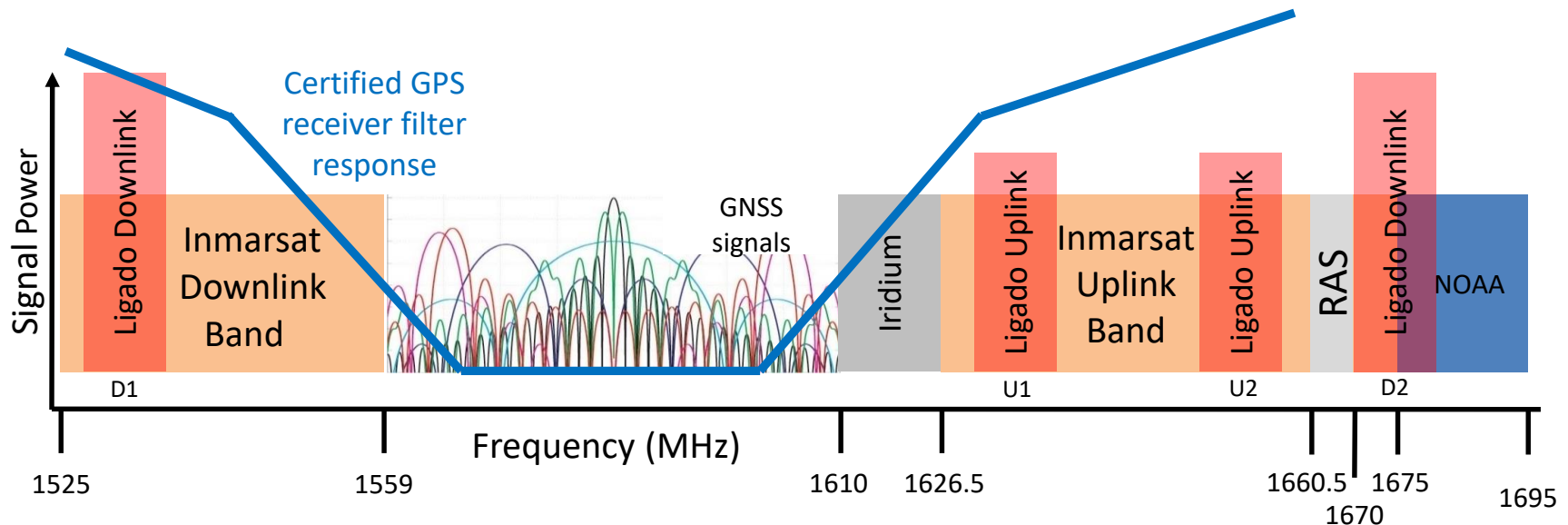
Aviation Spectrum Update

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- Ligado (GPS and SATCOM)
- C-band (radio altimeters)
- Other spectrum issues
- Summary
- Questions?

- Ligado planning for two downlinks & two uplinks (5G?)



- Systems affected
 - GPS (certified aviation and non-certified) – D1
 - SATCOM (Inmarsat) – D1
 - SATCOM (Iridium) – U1
 - NOAA feeds – D2

- FAA Certified GPS
 - 500ft cylinder of unreliable GPS operation around each Ligado cell tower
- Commercial GPS
 - Potential degradation up to 3000 ft from a Ligado cell tower
- Inmarsat
 - Retrofit of all aviation terminals with new DNLA (and potential wiring issues for SSB)
- Iridium
 - Interference up to 2 NM away from a single handset (greater for more handsets)
- Weather data
 - Reduced reliability from direct SATCOM feed and potential bill to pay for replacement could based system

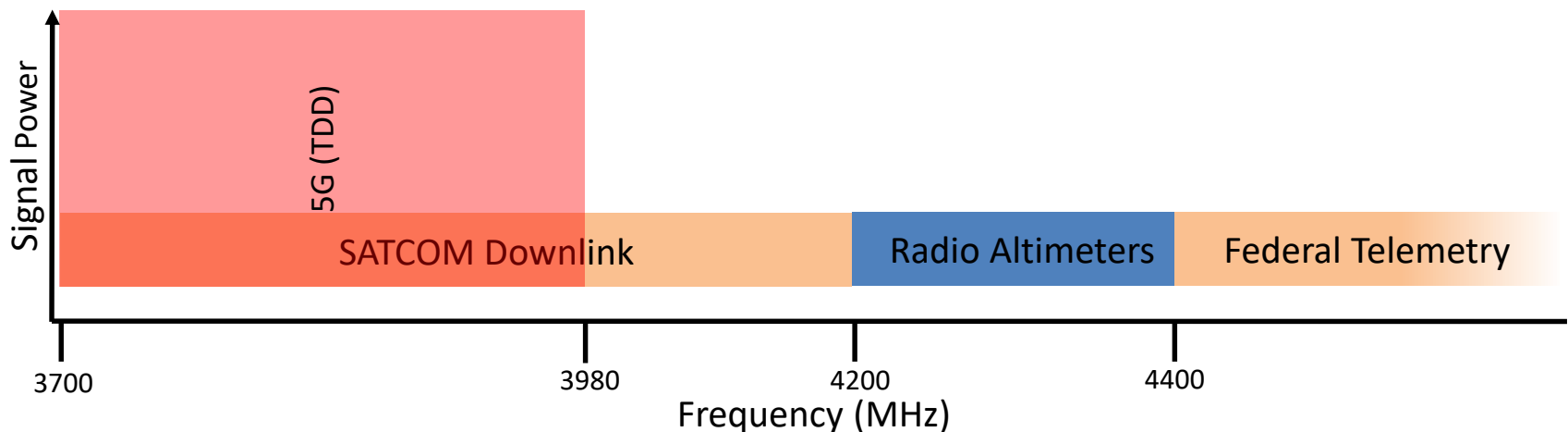
- FCC has voted to approve the Ligado proposal as of 20 Apr
 - 5-0 vote confirmed decision
 - Order ignored GPS arguments from DOT and instead adopted Ligado rationale
 - It did keep Ligado's power limited to 9.8 dBW with no option to increase, but all other concerns still stand
- Not many options left to overturn
 - Petition for reconsideration
 - Congress
 - Legal challenge

- FCC petition for reconsideration filed 22 May
 - Requested FCC reverse decision given aviation issues with how Ligado had sold its proposal
 - Aviation certified GPS receivers, non-certified GPS receivers, and Inmarsat issues
 - Accompanied by petitions from ALPA, AEM, Iridium, Lockheed, RNTFnd, Trimble and.... NTIA(!)
 - All attacking different areas of interest
- Ligado filed comments 1 June and reply comments submitted 8 June
 - Very much a ‘he said, she said’ position right now
 - Ligado keeps repeating the same mischaracterizations on the FAA study and the aviation industry’s views on the subject

- Multiple industries have joined congressional push against Ligado
 - Agriculture, truckers, maritime users, automobile manufacturers, SATCOM companies, GPS interests and aviation/aerospace
 - A 73-organization letter sent to congress in support of SASC hearing to overturn FCC decision
- Multiple views being heard in congress on this topic
- Recent NDAA bill has language that would make Ligado implementation difficult
 - Still uncertain if it can pass

- Aviation and other industries keeping up pressure on congress
 - SATCOM and GPS industries very active
- Awaiting to see how FCC addresses petitions for recon, especially NTIA's
 - 20 Aug is (technically) the formal deadline for decision
- Ligado's future also uncertain
 - Not a very lucrative piece of spectrum and company has had financial difficulties before
 - Possible sale to Verizon being rumored

- C-Band refers to FCC rulemaking on 3700-4200 MHz
 - Existing SATCOM band (mainly backhaul and TV distribution)
- 5G community has pressured both regulators and lawmakers to convert C-band SATCOM to 5G
 - Lower frequency that has high bandwidth (100 MHz channels)
 - Estimated at approx. \$50 bn in proceeds if all spectrum sold
- FCC began the proceeding in 2017
 - Aviation has been active in its concerns for adjacent band radio altimeters
 - But limited by unknown radio altimeter performance



- FCC approved a final report and order late Feb/Early March for 5G in C-band
 - Significant aviation and aerospace engagement with FCC Bureaus and Commissioners
 - But final report did not adopt the protections required
- However, FCC appeared to recognize that it could not entirely ignore aviation concerns
 - Left a crack in the door that an industry Multi-Stakeholder Group (MSG) can assess industry issues for ‘industry best practices’
 - Would not result in any regulatory protections
 - Also noted that aviation should ensure they are protected if an issue is found

- RTCA has created a special group to assess the work
 - Special task force of SC-239 with a short-term objective to complete by July (?) 2020
 - Open public invite for all to participate (even non-RTCA members)
 - Subsequently the wireless industry has also setup their own group
- RTCA work is progressing well
 - Awaiting the 5G characteristics needed to accurately map the interference
 - Need to consider both cell towers and handsets

- A joint aviation/aerospace Petition for Reconsideration at FCC filed on the 26 May
 - Requested MSG output be formally accounted for by FCC in license rules for 5G
 - ASRI joined by AIA, ALPA, AVSI, GAMA, Garmin, Honeywell, HAI, IATA, NATA
- Expecting opposition comments 26 June
 - 6 July deadline for joint aviation/aerospace reply comments

C-Band a Worldwide Issue for Aviation

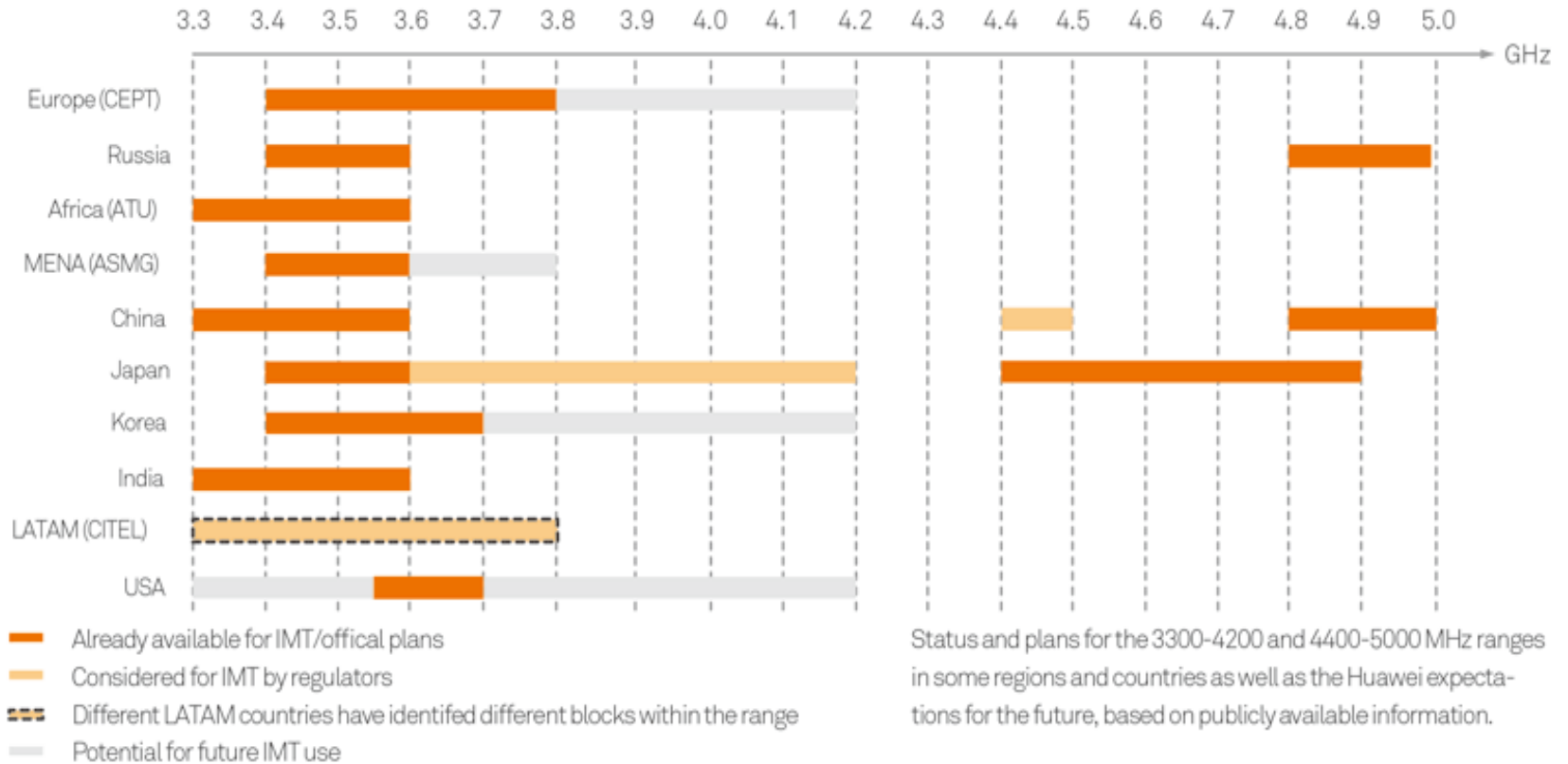


Figure: Global availability and planning of the 3300-4200 MHz and 4400-5000 MHz frequency ranges
 Source: Huawei

- On the back foot given FCC decision, but aviation coming together well in the opposition to it
- Still in long shot territory about if decision can be changed (significantly narrower interest than Ligado)
- Level of impact to altimeters is still an unknown

- Not only a 5G problem for aviation spectrum...
 - Ultra-Wide Band
 - VHF CubeSats
 - Space based VHF
- But proactive aviation components being developed
 - ICAO ICNSS Task Force
 - RTCA focus on spectrum issues

- Several major decisions have gone against aviation recently
 - Could have a lasting impact to operations
- Not just a 5G issue, but all industries seeking new spectrum
 - Aviation will benefit from other elements of 5G
- Need for a more proactive approach to spectrum planning
 - Not able to react as quickly as other industries to spectrum changes
 - Many legacy systems designed for an older spectrum environment
- Continued support and promoting of spectrum critical to maintain aviation's position
 - More a political game than a technical one
 - Will always be new challenges

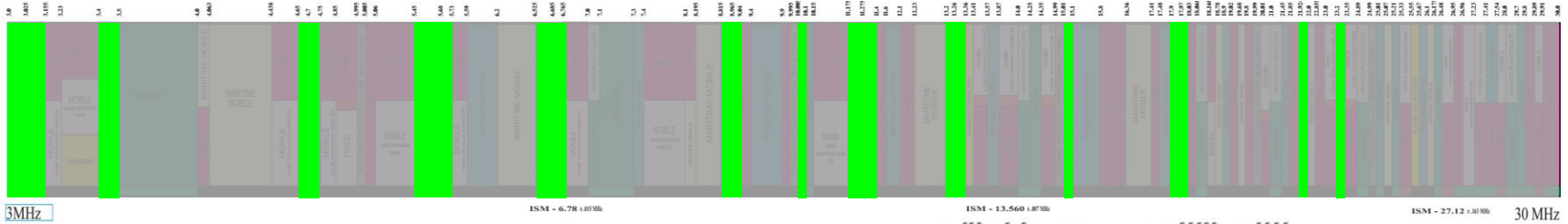


Questions?



Backup - Aviation Spectrum in the US

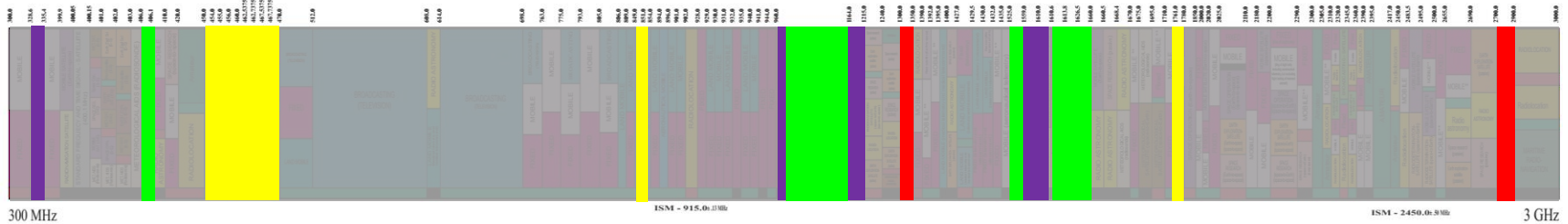
HF
3-30 MHz



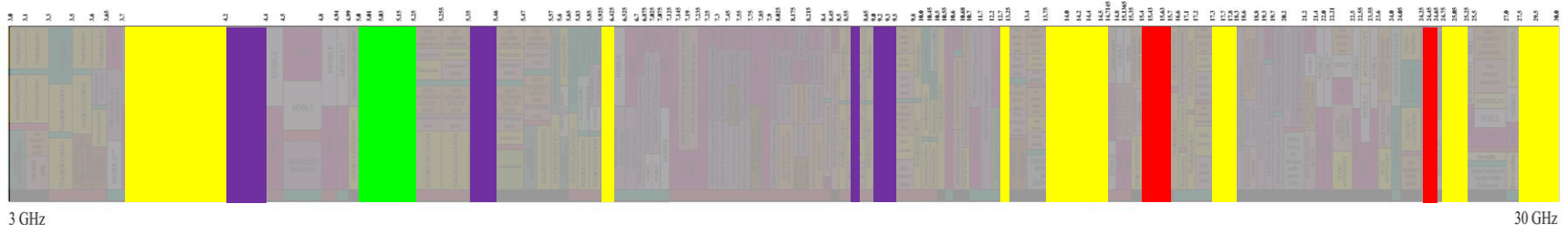
VHF
30-300 MHz



UHF
300 MHz - 3 GHz



SHF
3-30 GHz



■ Communications ■ Navigation ■ Surveillance ■ Supporting Systems