Radio Altimeters and 5G C-Band Deployment

Federal Aviation Administration

Date: April 2022

Discussion Topics

- Synopsis of Radio Altimeter and 5G C-band Spectrum Interference
- Mitigations
- NOTAMs
  - Current situation
  - Long term plan

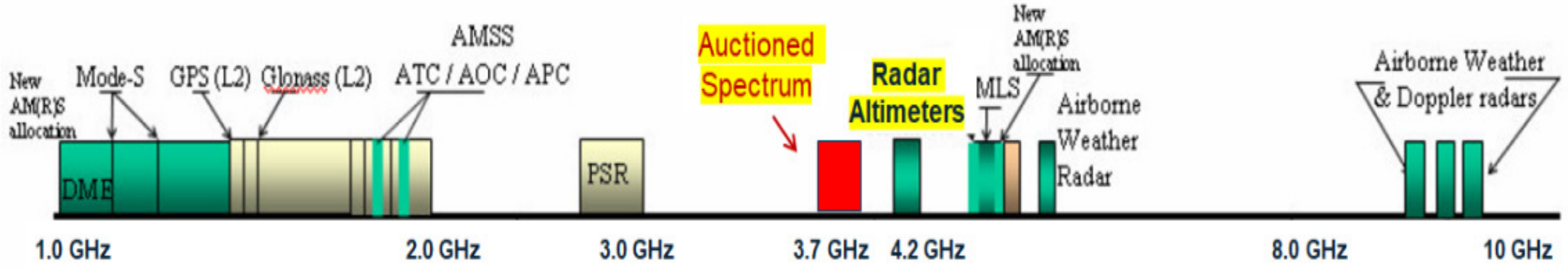
Radio Altimeter and 5G C-Band Synopsis

- The FCC Report and Order dated February 28, 2020, established a new and unknown operating environment for aircraft operating in areas where 5G (3.7-3.98 C-Band) emissions will be present.
- RTCA/SC-239 published a report that assessed 5G telecommunications interference impact on low range radio altimeter operations in the United States:
  - Concluded that telecommunications can cause harmful interference
  - Emissions can degrade radio altimeter to the point of loss and/or erroneous data
  - Threat is from base station emissions and on-board user equipment
- FCC Auctioned 3.7-3.98 GHz frequency band spectrum for use for 5G application effective Dec 5, 2021 (delayed to Jan 19, 2022).
- RTCA report, public comments to the RTCA report, and analyses from radio altimeter manufacturers and aircraft manufacturers were used in support of the safety risk determination and development if the FAA ADs.

Intra-Agency and Industry Coordination

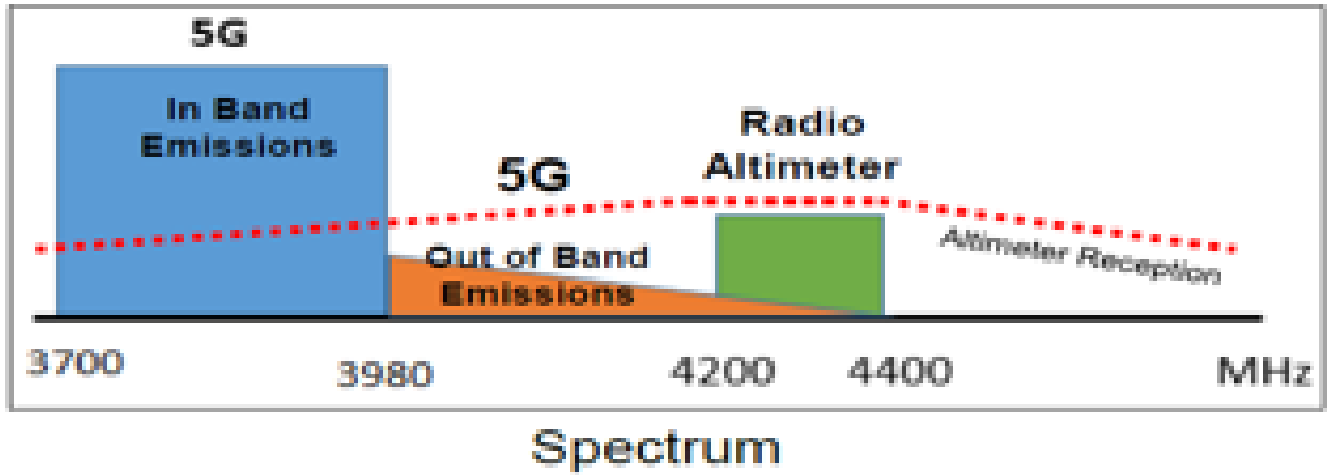
- The Federal Aviation Administration (FAA) believes the expansion of 5G C-band and aviation will safely co-exist.
- The FAA continues to work closely with the Federal Communications Commission (FCC) and wireless companies, and we are making progress toward safely implementing the 5G C-band expansion.
- We are confident with ongoing collaboration, and we will reach this shared goal.

5G C-Band Relative to Radar Altimeters

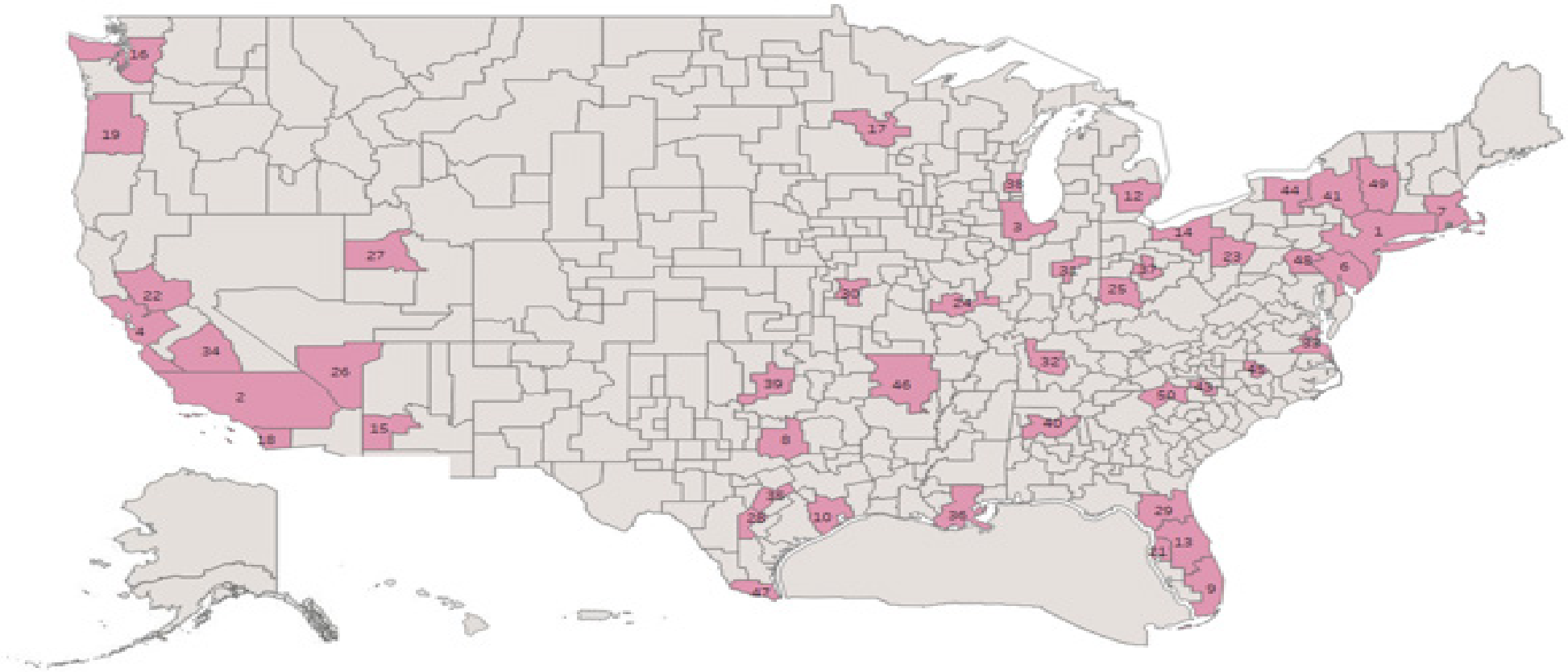


International Civil Aviation Uses of Microwave Spectrum

Source: ICAO (2009), Author's Notes



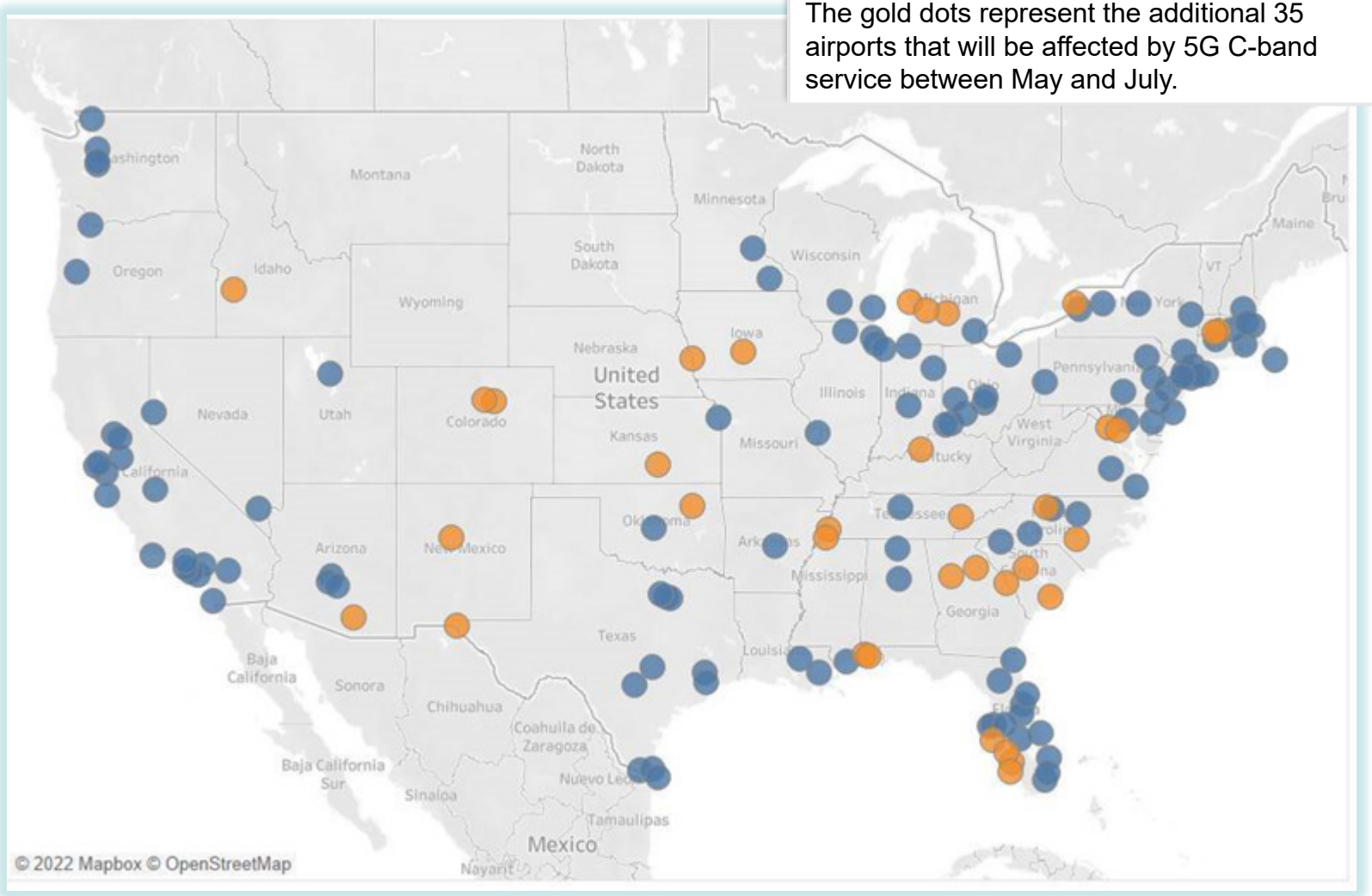
5G C-Band Wireless Broadband Deployment



Wireless broadband deployment will occur in phases in 46 markets beginning January 5, 2022. The FCC defines these areas as Partial Economic Areas (PEAs) 1-4, 6-10, 12-19, 21-41, and 43-50.

Expanded Verizon Service Area

The gold dots represent the additional 35 airports that will be affected by 5G C-band service between May and July.



Mitigations

- Airworthiness Directives (AD)
  - Transport
  - Rotorcraft
  - 6 aircraft specific
- NOTAMs
- Alternative Methods of Compliance (AMOC)
- Voluntary Actions by ATT and Verizon
  - Reduced power levels
  - Lower frequency
  - Partial protection of 114 airports
- Additional guidance (SAIB, SAFO)

Radio Altimeter Airworthiness Directives

- When operating in U.S. airspace, the following operations requiring radio altimeter are prohibited in the presence of 5G C-Band wireless broadband interference **as identified by NOTAM** (NOTAMs will be issued to state the specific airports where the radio altimeter is unreliable due to the presence of 5G C-Band wireless broadband interference):
  - Instrument Landing System (ILS) Instrument Approach Procedures (IAP) SA CAT I, SA CAT II, CAT II, and CAT III.
  - Required Navigation Performance (RNP) Procedures with Authorization Required (AR), RNP AR IAP.
  - Automatic Landing operations.
  - Manual Flight Control Guidance System operations to landing/head-up display (HUD) to touchdown operation.
  - Use of Enhanced Flight Vision System (EFVS) to touchdown under 14 CFR 91.176(a).
- The AD requires limitations be added into the Airplane Flight Manual.

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  - Performing approaches that require radio altimeter minimums for rotorcraft offshore operations. Barometric minimums must be used for these operations instead.
  - Engaging hover autopilot modes that require radio altimeter data.
  - Engaging Search and Rescue (SAR) autopilot modes that require radio altimeter data.
  - Performing takeoffs and landings in accordance with any procedure (Category A, Category B, or by Performance Class in the Rotorcraft Flight Manual or Operations Specification) that requires the use of radio altimeter data.
- The AD requires limitations be added into the Rotorcraft Flight Manual.

Notice to Air Missions

NOTAMs will be maintained to identify locations with 5G C-band base station deployments.

An *airspace NOTAM* will delineate a three-dimensional area where the radio altimeter is unreliable due to the presence of 5G C-Band wireless broadband interference. Operations identified by AD 2021-23-13 are prohibited in this airspace, unless the operator has an FAA-approved AMOC.

ZHU AIRSPACE RDO ALTIMETER UNREL WI AN AREA DEFINED AS 310325N0905515W (MCB244037.1) TO 311603N0903639W (MCB260018.2) TO 311556N0900034W (MCB097013.0) TO 302701N0890304W (GPT025002.9) TO 284408N0903612W (LEV223037.2) TO 292225N0913830W (LLA110042.0) TO POINT OF ORIGIN SFC-5000FT AGL. HEL OPS REQUIRING RDO ALTIMETER DATA TO INCLUDE OFFSHORE INSTRUMENT OPS, HOVER AUTOPILOT MODES, SAR AUTOPILOT MODES, AND CAT A/B/PERFORMANCE CLASS TKOF AND LDG NOT AUTHORIZED EXC FOR ACFT USING APPROVED ALTERNATIVE METHODS OF COMPLIANCE DUE TO 5G C-BAND INTERFERENCE PLUS SEE AIRWORTHINESS DIRECTIVE 2021-23-13

Notice to Air Missions, continued

An *aerodrome - airport NOTAM* will identify any public airport (with an instrument approach procedure) where the radio altimeter is unreliable due to the presence of 5G C-Band wireless broadband interference, and the operations at that airport that are prohibited by the ADs, unless the operator has an FAA-approved AMOC.

BDL AD AP RDO ALTIMETER UNREL. AUTOLAND, HUD TO TOUCHDOWN, ENHANCED FLT VISION SYSTEMS TO TOUCHDOWN NOT AUTHORIZED EXC FOR ACFT USING APPROVED ALTERNATIVE METHODS OF COMPLIANCE DUE TO 5G C-BAND INTERFERENCE PLUS SEE AIRWORTHINESS DIRECTIVE 2021-23-12

An *aerodrome - heliport NOTAM* will identify any public heliport (with an instrument approach procedure) where the radio altimeter is unreliable due to the presence of 5G C-Band wireless broadband interference, and the operations at that heliport that are prohibited by the ADs, unless the operator has an FAA-approved AMOC.

JRA AD HLP RDO ALTIMETER UNREL. HEL OPS REQUIRING RDO ALTIMETER DATA TO INCLUDE HOVER AUTOPILOT MODES AND CAT A/B/PERFORMANCE CLASS TKOF AND LDG NOT AUTHORIZED EXC FOR ACFT USING APPROVED ALTERNATIVE METHODS OF COMPLIANCE DUE TO 5G C-BAND INTERFERENCE PLUS SEE AIRWORTHINESS DIRECTIVE 2021-23-13

Notice to Air Missions, continued

An *aerodrome - VFR NOTAM* will identify any public airport (without an instrument approach procedure and at least a 5000 foot runway) where the radio altimeter is unreliable due to the presence of 5G C-Band wireless broadband interference, and the operations at that airport are prohibited by the ADs, unless the operator has an FAA-approved AMOC.

> 49X AD AP RDO ALTIMETER UNREL EXC FOR ACFT USING APPROVED ALTERNATIVE METHODS OF COMPLIANCE DUE TO 5G C-BAND INTERFERENCE PLUS SEE AIRWORTHINESS DIRECTIVES 2021-23-12, 2021-23-13.

Notice to Air Missions, continued

An *IAP NOTAM* will identify the public and special IAPs affected by 5G C-Band interference, and prohibited by the ADs unless the operator has an FAA-approved AMOC.

> BDL IAP BRADLEY INTL, WINDSOR LOCKS, CT. ILS RWY 06 (SA CAT I), AMDT 38B ... ILS RWY 06 (CAT II - III), AMDT 38B ... ILS RWY 24 (SA CAT I - II), AMDT 13B ... RNAV (RNP) Z RWY 06, AMDT 1… RNAV (RNP) Z RWY 24, AMDT 1… PROCEDURE NA EXC FOR ACFT USING APPROVED ALTERNATIVE METHODS OF COMPLIANCE DUE TO 5G C-BAND INTERFERENCE PLUS SEE AIRWORTHINESS DIRECTIVES 2021-23-12, 2021-23-13

Notice to Air Missions, continued

A *special IAP – fix wing NOTAM* will identify an IAP (except SA CAT I / II, CAT II, III, or RNP AR), at a private landing location, affected by 5G C-Band wireless broadband interference, and the operations prohibited by the ADs unless the operator has an FAA-approved AMOC.

SPECIAL COOK CANYON RANCH, RANGER, TX. RNAV (GPS) RWY 17, ORIG...RDO ALTIMETER UNREL. AUTOLAND, HUD TO TOUCHDOWN, ENHANCED FLT VISION SYSTEMS TO TOUCHDOWN NOT AUTHORIZED EXC FOR ACFT USING APPROVED ALTERNATIVE METHODS OF COMPLIANCE DUE TO 5G C-BAND INTERFERENCE PLUS SEE AIRWORTHINESS DIRECTIVE 2021-23-12

A *special IAP - rotorcraft NOTAM* will identify an IAP (except SA CAT I / II, CAT II, III, or RNP AR), at a private landing location, affected by 5G C-Band wireless broadband interference, and the operations prohibited by the ADs unless the operator has an FAA-approved AMOC.

SPECIAL MAYO CLINIC HEALTH SYSTEM – ALBERT LEA, ALBERT LEA, MN. COPTER RNAV (GPS) 222, ORIG… RDO ALTIMETER UNREL EXC FOR ACFT USING APPROVED ALTERNATIVE METHODS OF COMPLIANCE DUE TO 5G C-BAND INTERFERENCE PLUS SEE AIRWORTHINESS DIRECTIVE 2021-23-13

Notice to Air Missions, continued

Current NOTAM totals (Effective April 30, 2022)

- Airspace: 59 Areas in May
- Aerodrome: 1,572 (includes 5 heliports and 25 VFR airports)
- Instrument Approach Procedures (IAP):
  - 97 Public IAP NOTAMs
  - 60 Special IAP NOTAMs

Notice to Air Missions, continued

- Long Term Plan
- Domestic Notice
  - May Need Chart Symbol (i.e. Trouble T) for IAPs
- If Unable
  - TFR Website for airspace NOTAMs
  - Chart Supplement Back Matter
  - Chart Symbol for IAPs

FAA Website

- FAA Statements on 5G: https://www.faa.gov/5g
- Map of Airports with Low-Visibility Landings in 5G Deployment
- DOT and FAA Letters
- Airworthiness Directives (AD)
- Special Airworthiness Information Bulletin (SAIB) AIR-21-18R1
- Safety Alert for Operators (SAFO) 21007
- FCC Partial Economic Areas (PEA)
- Questions and Answers

Questions

Radio Altimeter Airworthiness Directives

- On December 9, 2021, FAA issued two ADs (transport category airplanes and helicopters) prohibiting certain operations in the presence of 5G (3.7-3.98 GHz C- Band) emissions.
  - Notices to Air Missions (NOTAMs) were issued to limit the impact of the AD to areas and airports where 5G C-Band will be deployed.
- Six aircraft-specific ADs have been issued to date:
  - Boeing 787 (AD 2022-02-16) published on January 19, 2022.
  - Boeing 747/Boeing 777 (AD 2022-03-05) published on January 27, 2022.
  - Boeing 737 MAX (AD 2022-03-20) published on January 31, 2022.
  - Boeing 757/Boeing 767 (AD 2022-04-05) published on February 14, 2022.
  - Boeing 737 Classic and 737 NG (AD 2022-05-04)published on February 18, 2022.
  - Boeing 747 (AD 2022-06-16) published on March 16, 2022.

Additional Guidance

- Special Airworthiness Information Bulletin (SAIB): AIR-21-18
  - Issued November 2, 2021.
  - Provides recommendations for radio altimeter manufacturers, aircraft manufacturers, and operators and pilots.
- SAIB: AIR-21-18R1
  - Issued December 23, 2021.
  - Provides a website for operators to report radio altimeter anomalies: https://www.faa.gov/air_traffic/nas/RADALT_reports/
- Safety Alert for Operators (SAFO): 21007
  - Issued December 23, 2021
  - Provides information and guidance to operators regarding the risk of potential adverse effects on radio altimeters when operating in the presence of 5G C-band wireless broadband signals.
  - Provides the role of NOTAMs in identifying the geographic areas where certain operations requiring a radio altimeter are prohibited in the presence of 5G signals.
  - Provides a list of possible affected systems that rely on radio altimeter data.

Global 5G C-band Deployment-Regulatory Power Limits