



International Civil Aviation Organization

ICAO

**FIFTH MEETING OF SPECTRUM REVIEW WORKING
GROUP (SRWG/5)**

Video Teleconference, 15 – 17 March 2021

Agenda item 7: State and Regional updates

**PROTECTION OF INTERFERENCE TO RADIO ALTIMETERS
FROM 5G APPLICATIONS IN THE ASIA-PACIFIC**

(Presented by Boeing Australia Holdings)

SUMMARY

This paper presents industry information on the rollout of new 5G mobile communications devices in C band and consequential interference with the safe operation of aviation radio altimeters in the frequency ranges 4 200-4 400 MHz and the implications for the Asia-Pacific Region.

1. INTRODUCTION

1.1 The latest mobile communications technology known as fifth generation (5G) applications is being introduced globally. The nature of 5G devices is an ability to transmit vast amounts of data across multiple devices.

1.2 The technology requires many more base station installations and greater RF coverage than for earlier generational devices in order to concentrate coverage and provide optimum 5G service particularly in urban areas.

1.3 The 5G broader spectrum spread is well accommodated in parts of C Band spectrum that provides good propagation with wide band width.

1.4 Radio altimeters (also known as radar altimeters) that operate in, and are allocated to, the nearby 4 200-4 400 MHz frequency band are deployed worldwide on thousands of commercial and general aviation aircraft as well as helicopters.

1.5 The radio altimeter is a critical component to an aircraft's operations and safety; and the only sensor onboard an aircraft providing a direct measurement of the aircraft's clearance over the terrain or other obstacles (above ground level (AGL)). This is essential information for automated landing and collision avoidance systems.

1.6 The higher power and widespread terrestrial usage of 5G applications can cause harmful interference to the operation of aviation radio altimeters in the adjacent frequency band.

1.7 The key concern is that 5G transmissions can erroneously be detected by many radio altimeters as they scan the terrain for location and height readings and may lead to catastrophic results.

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1.8 The Asia-Pacific region already has extensive 5G operations across China, Japan, Australia, and South Korea with many other regional countries planning for the introduction of 5G across parts of C Band from 3 400-4 100 MHz. This poses a potential immediate threat to the safe operation of commercial aviation in some parts of the Asia-Pacific region.

2. DISCUSSION

2.1 ICAO in June 2020 issued a liaison statement to the European Commission Committee on ‘5G emissions and Radio Altimeters in the frequency band 4200 – 4400 MHz.’ The liaison statement raised concern with the ECC regarding their implementation of [Decision \(EU\) 2019/235](#) 24 January 2019 on ‘Amending Decision 2008/411/EC as regards an update of relevant technical conditions applicable to the 3 400-3 800 MHz frequency band.’ The new Decision ‘requires Member States to allow the use of 3 400-3 800 MHz band for terrestrial systems capable of providing next generation (5G) wireless broadband electronic communication services...’ The liaison statement expressed ‘strong concerns with regard to the increase of the wide band noise level in the frequency band 4 200-4 400 MHz, as may result from the aggregated effect of both the 5 dBm/MHz power from AAS and the -9 dBm/MHz power from non-AAS.’

2.2 On 8 October 2020 the United States Radio Technical Committee for Aeronautics (RTCA) released the white paper ‘Assessment of C-Band Mobile Telecommunications Interference Impact on Low Range Radar Altimeter Operations.’ The white paper was developed in response to the Federal Communication Commission (FCC) Report and Order, ‘Expanding Flexible Use of the 3.7 to 4.2 GHz Band’ March 3, 2020.

2.3 While the RTCA white paper focuses on the US rollout of 5G it does contain pertinent detail on issues of cross band interference to radio altimeters from the new 5G terrestrial applications. The report provides a quantitative evaluation of radio altimeter performance regarding radio frequency interference from expected 5G telecommunication emissions in the 3 700–3 980 MHz frequency range. The report notes the risk of harmful interference was present, widespread and has the potential for broad impacts on aviation operations.

2.4 Subsequent to the RTCA report actions taken by spectrum regulators internationally include:

The French Radio Regulator established a two-level action plan including implementing precautionary zones around airports of civil aviation. These zones prohibit 5G operators from directing their beams upward and have measures implemented to avoid configurations in which “network lobes” appear in active antennas. Pending further studies.

The European Radio Regulators agreed to establish a draft Working Item that calls for compatibility studies between 5G in the 3 400-3 800 MHz frequency range with radio altimeters in the 4 200-4 400 MHz frequency band.

Australian spectrum regulators proposed, in their re-planning of the 3 700-4 200 MHz frequency range, a 200 MHz separation (4 000-4 200 MHz) to protect the safety of life aeronautical radio altimeter operations in the adjacent 4 200-4 400 MHz frequency band from interference through the introduction of new terrestrial applications. The Australian spectrum regulator is in discussion with aviation stakeholders to consider possible additional protection conditions and mitigation options below 4 000 MHz to protect radio altimeters from harmful interference.

2.5 Actions taken by international aviation agencies include:

The European Union Aviation Safety Agency (EASA) published a Continuation Airworthiness Review Item (CARI) ‘Investigation into vulnerability of Radio Altimeter to interference from 5G Telecommunications Base Stations.’ They request that Type Certificate (TC) holders and OEMs providing information about radio altimeters for further studies on the vulnerability of a 5G environment.

The New Zealand Civil Aviation Authority released a safety message to operators 17 November 2020 ‘Do not use 5G devices inflight if you have a radar altimeter.’ The message advises to turn off all electronic devices in checked baggage and transmitting devices (including modems) carried onboard should be switched to flight mode or turned off. Only 3G/4G devices to be used for essential communication operations and any interference to their radar altimeters should report it immediately.

In August 2020, the Canadian regulator, Innovation, Science and Economic Development (ISED) opened a Public Consultation on repurposing parts of the C-band (3 800-4 200 MHz) for 5G terrestrial services. ISED’s proposal largely mirrors the US FCC decision. Specifically, ISED also proposes to allow terrestrial 5G up to 3 980 MHz and then apply a 220 MHz separation band to protect radio altimeters. Transport Canada and several aviation industry stakeholders submitted comments to support ISED’s recognition to protect radio altimeters. A 220 MHz separation band was necessary but an insufficient measure to fully avoid harmful interference, according to the RTCA report. The aviation industry, therefore, urged ISED to consider implementing additional means to protect the flying public.

The General Civil Aviation Authority (GCAA), United Arab Emirates (UAE) published [Safety Alert 2021-01](#), ‘Requirements to mitigate 5G Interference Operational Risks’ The safety alert outlines the potential safety and operational impact of 5G telecommunication signals transmitted on frequencies near the 4 200-4 400 MHz frequency band.

2.6 The rollout of 5G telecommunications networks across the world may introduce new threats to the aviation sector and flight safety. Boeing is actively contributing, as part of an industry taskforce led by the US RTCA, on the worldwide impact of these potential 5G interferences, with the objective to ensure the continued safe operation of flight.

2.7 However, this is not simply a European/USA issue - it is global and consequently necessary to address this risk for the Asia-Pacific region.

2.8 The Boeing objective is to ensure the continuous safe operations of airplanes in assessing and addressing potential interference between the 5G networks and aircraft systems, while allowing future 5G deployment once potential risks are mitigated.

2.9 Boeing seeks the cooperation of ICAO Asia-Pacific administrations in the dissemination of the information to support airworthiness authorities and inform operators with respect to the impact of this issue.

2.10 While the long-term goal is to build new radio altimeters, and where possible modify existing susceptible devices, to operate without harmful interference from 5G applications near the radio altimeter frequency band.

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2.11 In the short-term Asia-Pacific aviation interests and ICAO regional administrations are encouraged to work with respective national spectrum regulators to build awareness, recommend temporary precautionary mitigation measures (French example cited above) and collaborate with 5G operators to share technical characteristics and consider adoption of temporary limitations.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

- a) note the information contained in this paper; and
- b) support national efforts to ensure radio altimeter systems are protected from 5G deployments in the bands 3 400-4 200 MHz.

PROTECTION OF INTERFERENCE TO RADIO ALTIMETERS FROM 5G APPLICATIONS IN THE ASIA-PACIFIC

**ICAO Asia-Pacific
Spectrum Review Working Group**
March 2021

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The Problem and Impacts

- Governments and spectrum regulators have, or are to allocate, 5G cellular systems to operate in parts of the frequency ranges 3.4-4.2 GHz and 4.4-4.9 GHz (adjacent to the frequency band for radio altimeters 4.2-4.4 GHz)

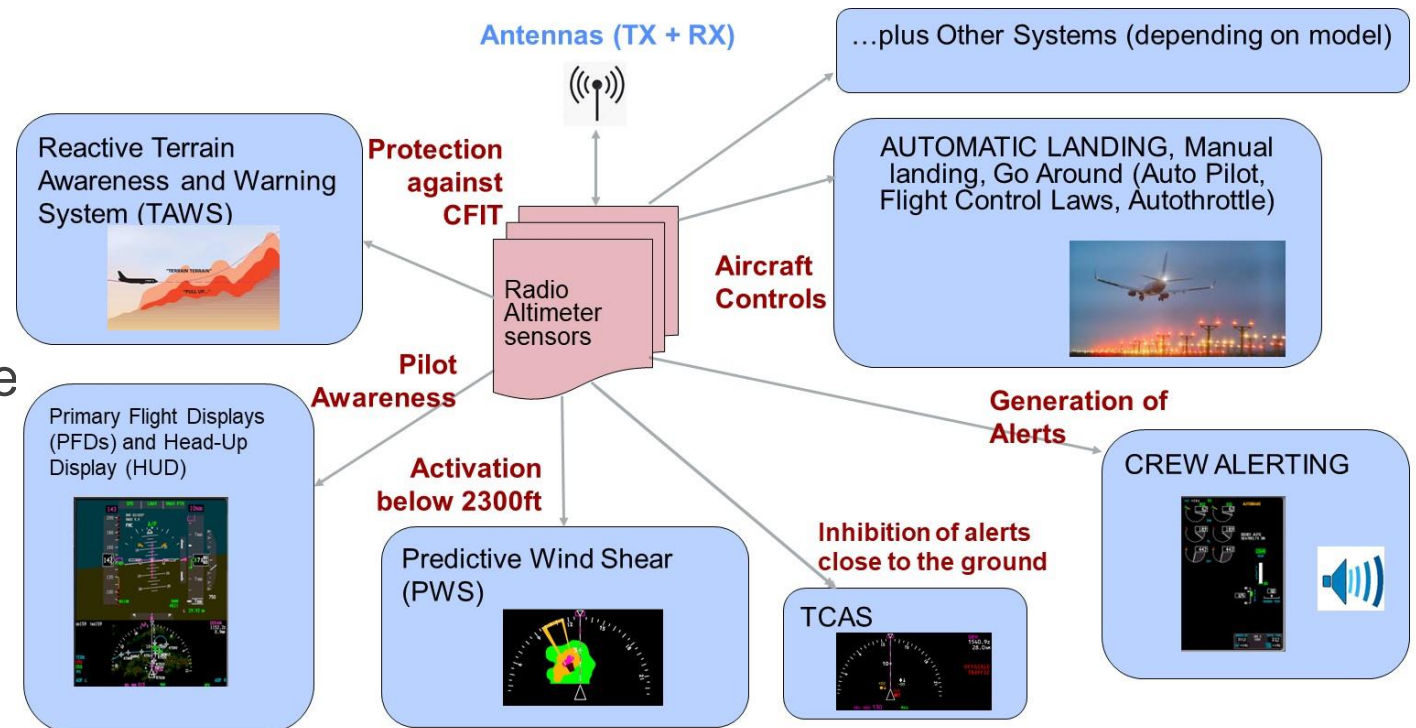
- Impacted aircraft potentially include

- commercial aircraft
- military aircraft
- Helicopters
- larger UAS with radio altimeters

- Some altimeters appear to be vulnerable to high power terrestrial systems

- Aircraft systems impacted include:

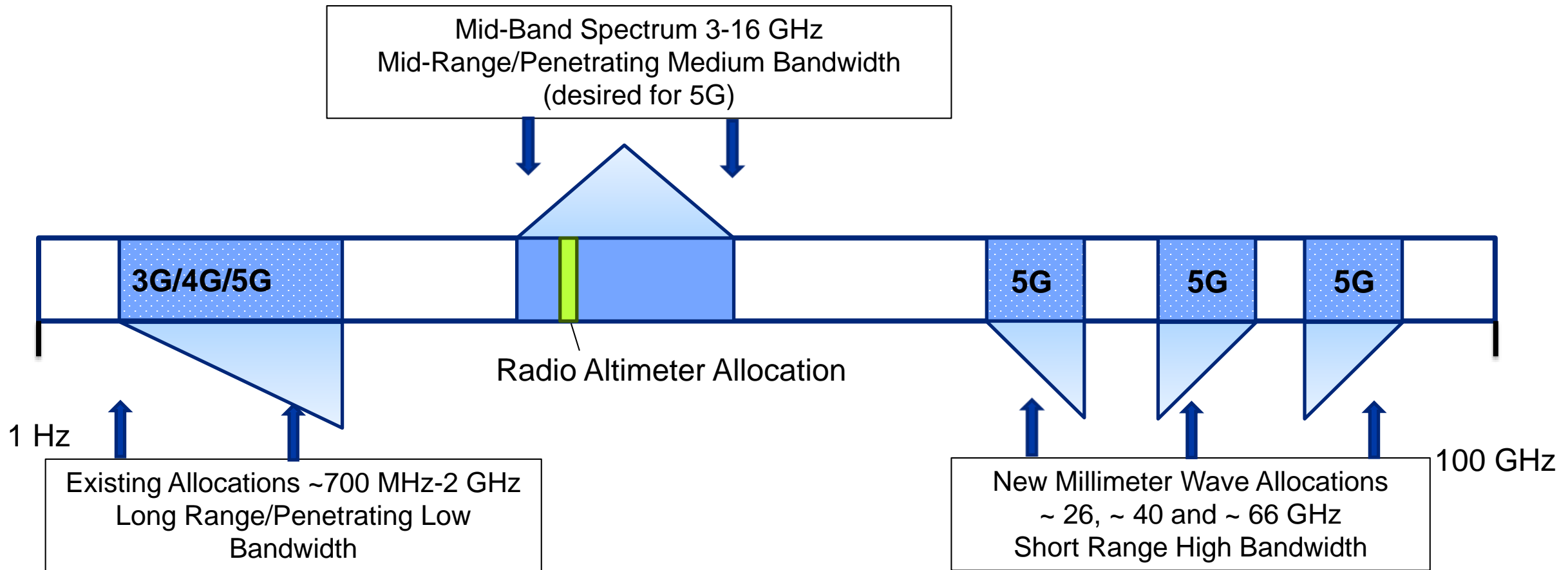
- Aircraft Controls
- Primary Displays & Crew Alerting
- Surveillance (TAWS/PWS/TCAS)



- The level of the problem depends on the platform and radio altimeter

5G Spectrum

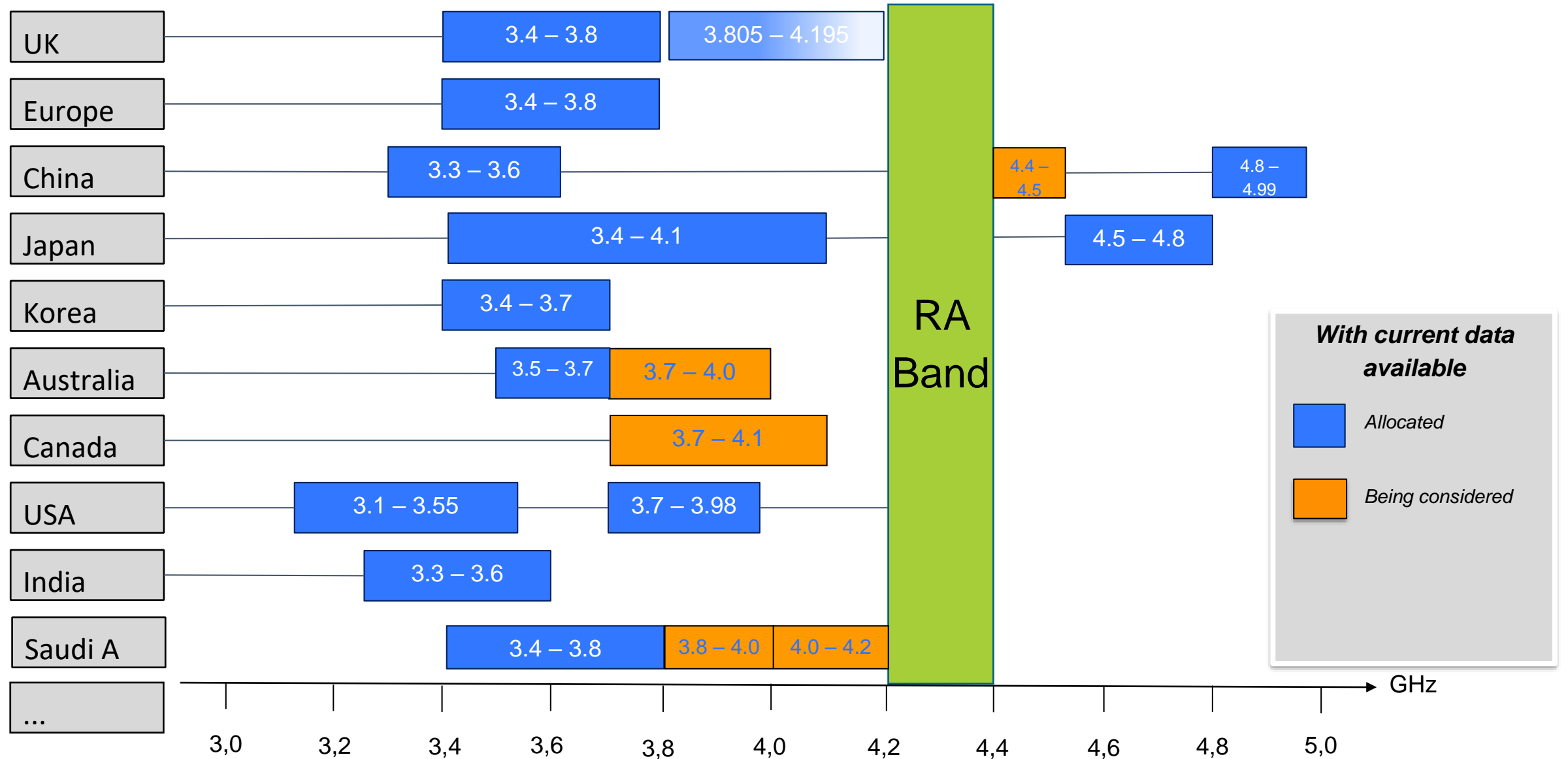
- Network of Networks
- Ongoing Allocation Process
- Mixture of Long Range/ Low Bandwidth with Penetration and Short Range/High Bandwidth with No Penetration



International Mobile Telecommunication (IMT) / 5G Industry are seeking access to 'Mid-Band' spectrum, which impacts the radio altimeter

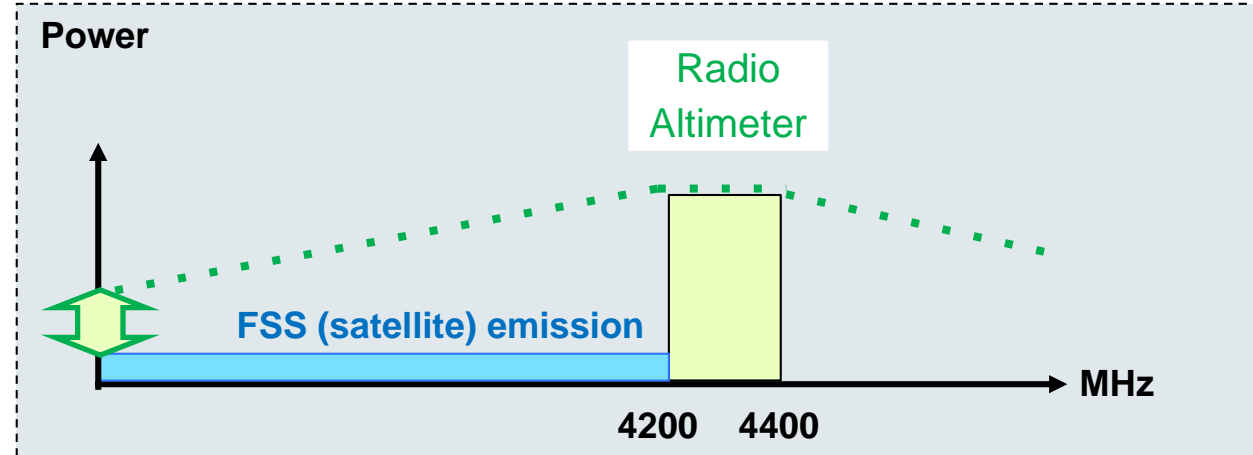
Global Context and Spectrum Overview

Snapshot of 5G roll-out in mid-band spectrum

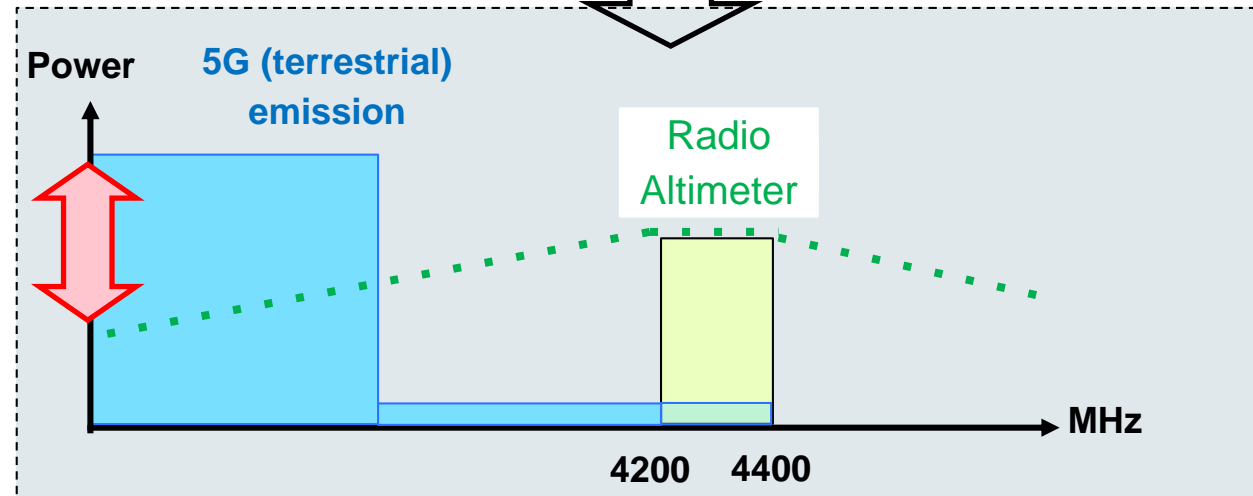


Principle of interference, example:

Existing satellite downlink emissions do not impact radio altimeters



Fundamental Terrestrial 5G emissions may impact radio altimeters



Current radio altimeters, while being compliant with applicable regulations when certified, are not designed to operate with high terrestrial power levels in adjacent and nearby bands previously allocated to satellite downlinks

Actions by international aviation agencies post RTCA Report

- European Union Aviation Safety Agency (EASA) - Continuation Airworthiness Review Item request Type Certificate (TC) holders and OEMs provide information about radio altimeters for further studies of the 5G impact to radio altimeters
- New Zealand Civil Aviation Authority safety message to operators 'Do not use 5G devices inflight if you have a radar altimeter.' Advises turn off all electronic devices in checked baggage. Transmitting devices onboard switched to off or flight mode. Only 3G/4G for essential comms operations - interference to radar altimeters reported immediately
- Canadian regulator Innovation, Science and Economic Development (ISED) Public Consultation on repurposing 3 800-4 200 MHz for 5G largely mirrors US FCC decision. Terrestrial 5G up to 3 980 MHz and a 220 MHz guard band to protect radio altimeters. 220 MHz separation band now thought insufficient to fully avoid harmful interference (RTCA report). Aviation industry, urged ISED to consider additional means to protect the flying public
- The General Civil Aviation Authority (GCAA), United Arab Emirates (UAE) Safety Alert 2021-01, 'Requirements to mitigate 5G Interference Operational Risks' outlines potential safety and operational impact of 5G near the 4 200-4 400 MHz frequency band

One contemporary approach

- French Autorité de Régulation des Communications Électroniques et des Postes on 12 November 2020 Authorized the frequency band 3.4-3.8 GHz for 5G/MFCN
- Taking into account concerns expressed by the civil aviation from the RTCA Report some immediate measures were defined in France until more information becomes available
- Interim measures include:
 - Mobile operators must implement only downward tilting
 - Mobile operators have to take measures to avoid grating lobes as far as practicable
 - Two special protection zones have been defined around airports (different mitigation for each)
 - ‘safety zone’ around the airport for the protection of the RA where the aircraft is below 200 ft (61 m)
 - ‘precautionary zone’ on each side of the ‘safety zone’ to protect the landing approach below 1000 ft (305 m)
- The situation after implementation as of December 2020
 - Approximately 96% of 3.5 GHz 5G stations declared by the operators have been accepted
 - Work is ongoing with each operator to take into account further efforts to accept more stations in the precautionary zones

Summary and Boeing Objective

- The global rollout of 5G telecommunication networks in Mid C-Band frequencies may introduce new threats to aviation and flight safety
- Boeing is actively supporting RTCA and EUROCAE efforts to assess worldwide impacts and develop standards to address the problem
- The Boeing objective is to ensure continuous safe operations of airplanes in assessing and addressing potential interference between 5G networks and aircraft systems, while supporting future 5G deployment once potential risks are mitigated

Asia-Pacific implications

- Problem is not restricted to Europe and USA
- A global issue and necessary to address the risk for the Asia-Pacific region
- Boeing encourages cooperation of ICAO Asia-Pacific administrations in dissemination of information to support airworthiness authorities and inform operators of the potential impact of interference to radio altimeters

Long and short term view

Long term

- To build new radio altimeters, and where possible modify existing susceptible devices, to operate without harmful interference from 5G applications near the radio altimeter frequency band
- Industry developing new standards (MOPS/SARPS) via RTCA/EUROCAE/ICAO
 - New standards are needed to make radio altimeters more robust against interference from terrestrial signals

Short term

- Asia-Pacific aviation interests and ICAO regional administrations are encouraged to work with respective national spectrum regulators to build awareness, recommend temporary precautionary mitigation measures e.g. French initiative
- Collaborate with 5G operators to share technical characteristics and consider viable implementation of temporary limitations

Thank you for the opportunity
to address the meeting

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