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Session 18:

Radio Altimeter Interference: What is the threat to aviation safety?



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Session 18

Radio Altimeter Interference: What is the threat to aviation safety?

Mr. Andrew Roy



Mr. Andrew Roy is the Director of Engineering Services at Aviation Spectrum Resources, Inc. (ASRI), acting as a focal point for US airlines and other commercial aviation operators on spectrum engineering and regulatory considerations.

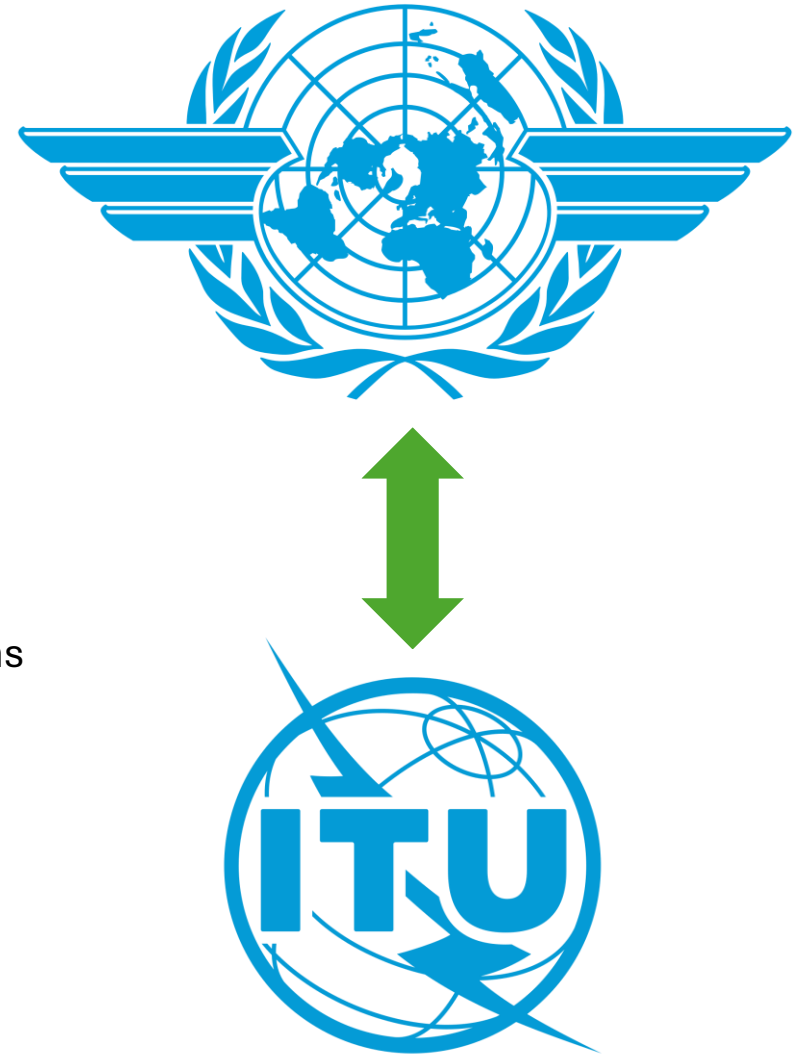
He is Chair of the ICAO Frequency Spectrum Management Panel and is a member of the RTCA Program Management Committee.

Roy is a veteran of the UK Royal Air Force with a background in RF battlespace management.

He earned his master's degree in systems engineering from Loughborough University and is a Chartered Engineer at the UK Institute of Engineering and Technology.

International Spectrum Management

- International spectrum governed by agreements at the International Telecommunication Union
  - UN agency based in Geneva
  - ICAO participates in the ITU process
- ITU Radio Regulations is a UN Treaty that regulates the function that each frequency is allocated to
  - E.g. 117.975 – 137 MHz is aeronautical A/G safety communications - AM(R)S
- Parts of the ITU Radio Regulations are revised every 3-5 years at World Radio Conference (WRC)
  - WRC-27 is the next conference (Shanghai, China – Oct 2027)
  - WRC-27 Agenda Item 1.7 concerns 4.4-4.8 GHz near the radio altimeter frequency band



Session 18

Radio Altimeter Interference: What is the threat to aviation safety?

- The rapid national rollout of 4G and 5G is intensifying concerns about radio altimeter (RA) interference
- Studies under ITU-R WRC-27 Agenda Item 1.7 are examining the potential introduction of new 6G systems adjacent to the radio altimeter frequency band.
- Assembly Resolution A42-7 that aviation stakeholders need to strengthen their engagement in ongoing spectrum studies

Session Aims:

- Examine the ongoing assessment of potential 4/5/6G interference to radio altimeters
- Address potential safety impacts and current operational and equipage challenges
- Discuss evolving national positions and available mitigation strategies

Mr. Jean-Luc Robin



Mr. Jean-Luc Robin is Radio Navigation Expert in AIRBUS Design Office (CNSS) and SC-239/WG-119 (Radar Altimeter) co-chair.

Mr. Aleksa Albijanic



Mr. Aleksa Albijanic is a RAN Planning Engineer at Mtel Montenegro and a PhD candidate at the University of Montenegro. His professional and academic background covers a broad range of wireless communication technologies, including mobile and satellite communications, IoT, and underwater acoustic networks.

For the past five years, he has worked in radio network planning and optimization at Mtel Montenegro, focusing on network performance, coverage, capacity, and technology evolution. He has been directly involved in the planning and implementation of 5G within the operator's network, as well as in the deployment and optimization of other advanced mobile technologies.

His interests include wireless systems, network optimization, emerging communication technologies, and next-generation connectivity solutions.

Mr. Khaled Eltanany



Mr. Khaled Eltanany is Senior Manager CNS Technology at the International Air Transport Association (IATA) in Montreal, where he represents airline positions in driving the cost-effective implementation of Communications, Navigation, and Surveillance (CNS) technologies.

In this role, he liaises closely with a broad range of aviation stakeholders to promote operationally driven technology deployment and safeguard aviation access to critical radio spectrum.

Khaled is an active member of several International Civil Aviation Organization (ICAO) expert groups and panels, contributing to the development of global aviation standards, policies, and guidance material. He has more than 16 years of experience in CNS systems, telecommunications, aviation safety and regulatory affairs, with extensive expertise in international standards and aviation modernization initiatives.

Khaled holds a bachelor’s degree in Telecommunications and Electronics Engineering and a master’s degree in Sustainable Air Transport Management, combining technical expertise with a strong understanding of strategic and sustainable aviation development.

Mr. Bogdan Petricel



ATC Senior Expert EUROCONTROL

Former Air Traffic Controller with a background in Aeronautical Engineering, with 10 years of operational experience in air traffic management. 25 years of contributions to the development, validation, and standardization of ADS-B IN applications, supporting the advancement of airborne surveillance and operational concepts. Extensive expertise covering ATM systems, ATC decision-support tools, and air traffic management solutions, with extensive involvement in European and international research, validation, and standardization initiatives.

Currently, manager of the EUROCONTROL Radio Frequency Function (RFF), aviation spectrum management focal point for frequency management activities within European airspace, responsible to support the aviation spectrum strategy, frequency planning, regulatory harmonization, and the protection of aviation radio services at European and international levels.

Actively engaged in international ADS B standardization activities and currently serves as Chair of EUROCAE WG-51 SG-3, contributing to the development of surveillance-related standards and applications that support future ATM operations.

Mr. Miles Bellman



Mr. Miles Bellman is an engineer in the Federal Aviation Administration's Spectrum Engineering Services Group, Planning and International Team and has dedicated his 15-year career to public service at the United States Department of Transportation.

Mr. Bellman is a technical advisor to the United States Surveillance and Frequency Spectrum Management panel members.

He also leads the ICAO SP Surveillance Spectrum Focus Team (SSFT) to develop technical solutions for the sustainability of surveillance spectrum.

Dr. Sai K. Kalyanaraman



Dr. Sai Kalyanaraman is a Principal Technical Fellow at Collins Aerospace where he supports GNSS and radio altimeter sensor development, standardization activities and PNT efforts. In addition, he leads the RTX Spectrum Advisory Committee and represents Collins Aerospace at a variety of navigation and spectrum management fora.

Dr. Kalyanaraman is the secretary of SC-239 that is currently chartered with developing new standards for Radio altimeters and he also chairs the GPS Interference and Antennas working groups within RTCA SC-159. His areas of interest and expertise encompass integrity monitoring, adaptive array processing, frequency references for navigation applications, receiver design and nav sensor integration.

Audience Interaction and Discussion

Poll Questions for Session 18

1) Radio altimeters operate in which protected aeronautical frequency band?

- ☐ 108 - 137 MHz
- ☐ 960 - 1 215 MHz
- ☑ 4200 - 4400 MHz
- ☐ 5030 – 5150 MHz

Audience Interaction and Discussion

Poll Questions for Session 18

2) Why have interference concerns been raised for some 5G deployments, while similar concerns were generally not associated with 4G services?

- ☐ Higher transmitter power
- ☐ Different radio technology
- ☑ Closer operating frequencies

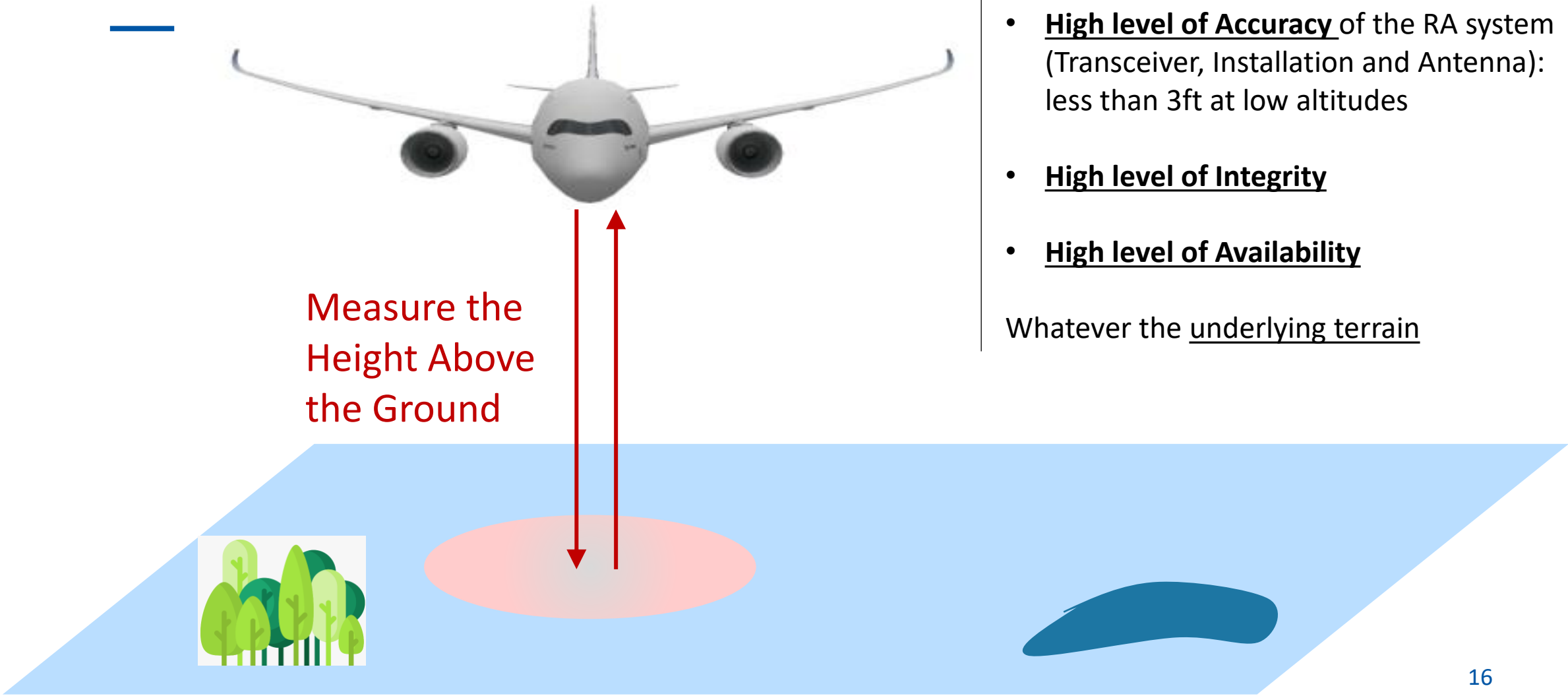
Please add discussion questions to Slido

Jean-Luc Robin

Radio Navigation Expert

AIRBUS

What is the function of a RA ?

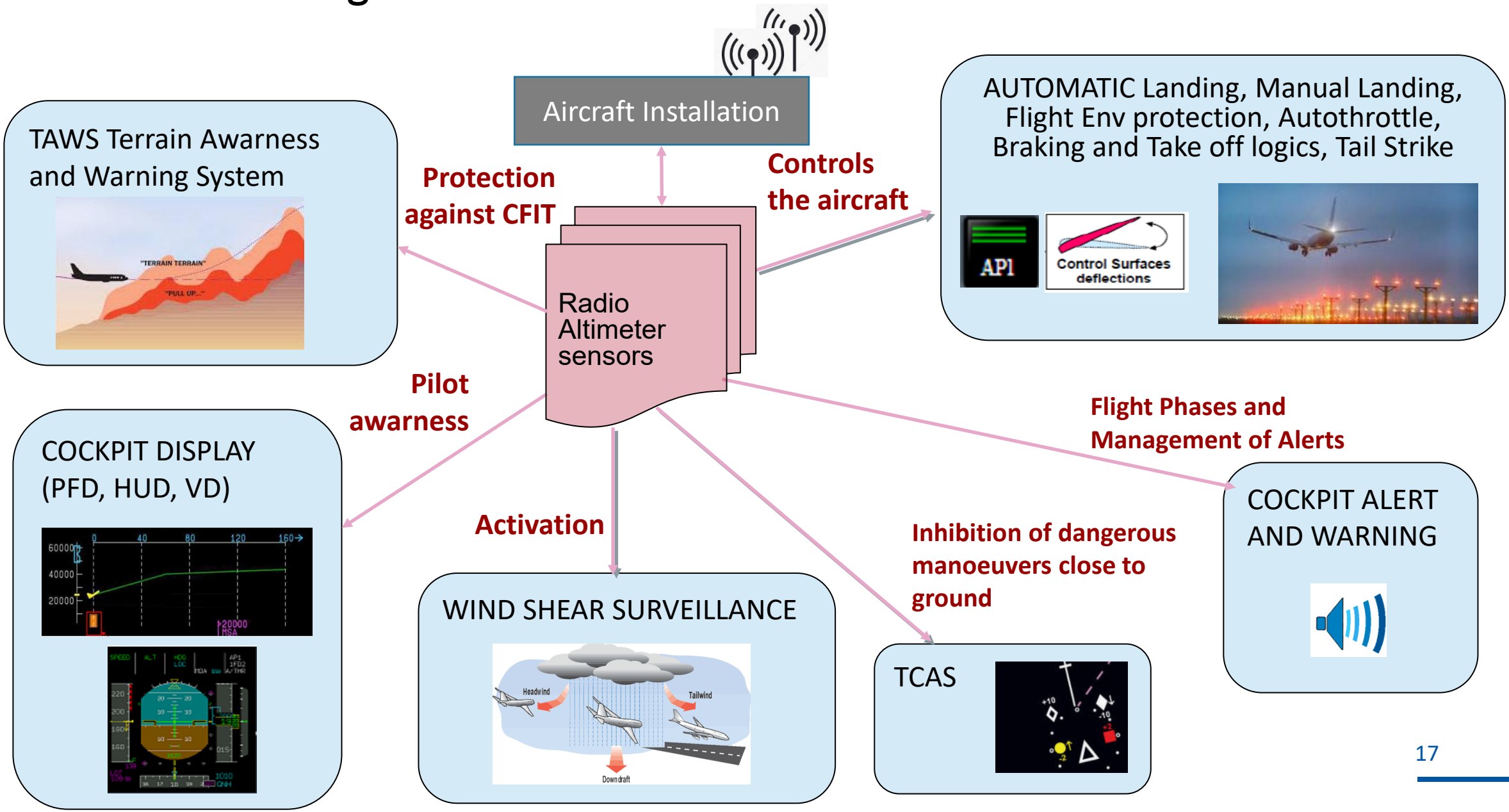


RA (Radar Altimeter) supports the most critical operations, it requires:

- **High level of Accuracy** of the RA system (Transceiver, Installation and Antenna): less than 3ft at low altitudes
- **High level of Integrity**
- **High level of Availability**

Whatever the underlying terrain

How does the RA integrate on the aircraft?



Airframe plans for new RA integration ?

- More than 3,500 aircraft operated by US airlines must be retrofitted by December 2030.
- Airframers aim to avoid redundant developments, successive retrofits, and fragmented RF resilience standards for the RA.
- Consequently, a single, definitive RF resilience standard (ITM: Interference Tolrance Mask) for the RA is expected to remain consistent globally and set in stone for the next 30 years (FAA, MOPS, ICAO)

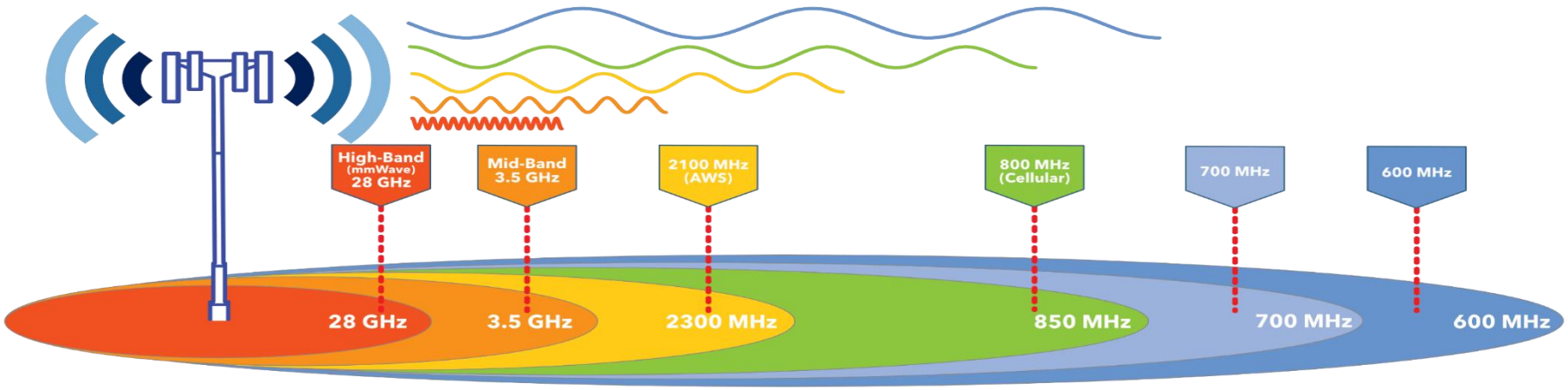
Aleksa Albijanić

RAN planning engineer



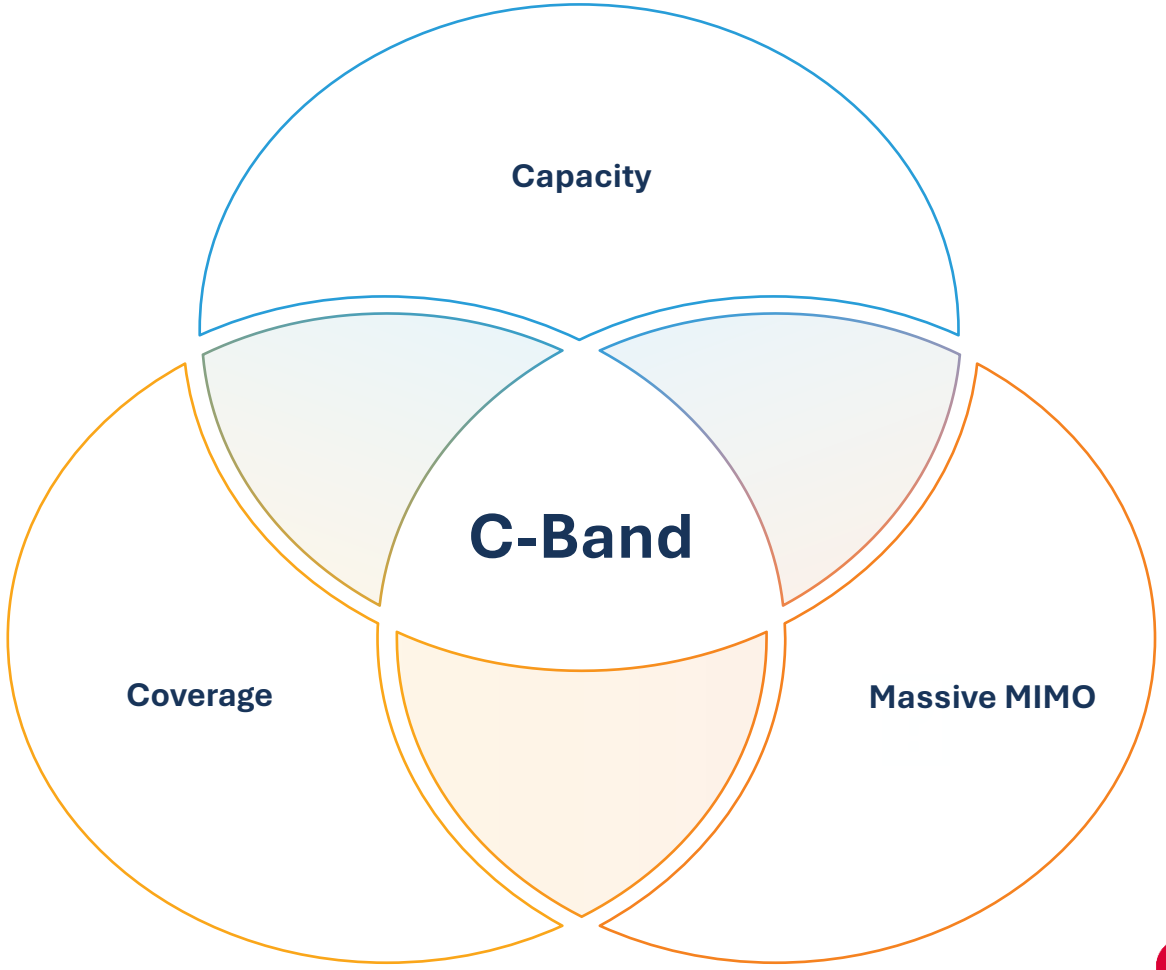
MNO perspective

- Network planning fundamental tradeoff - **Coverage vs. Capacity**
- Why do we aim for higher RF bands?



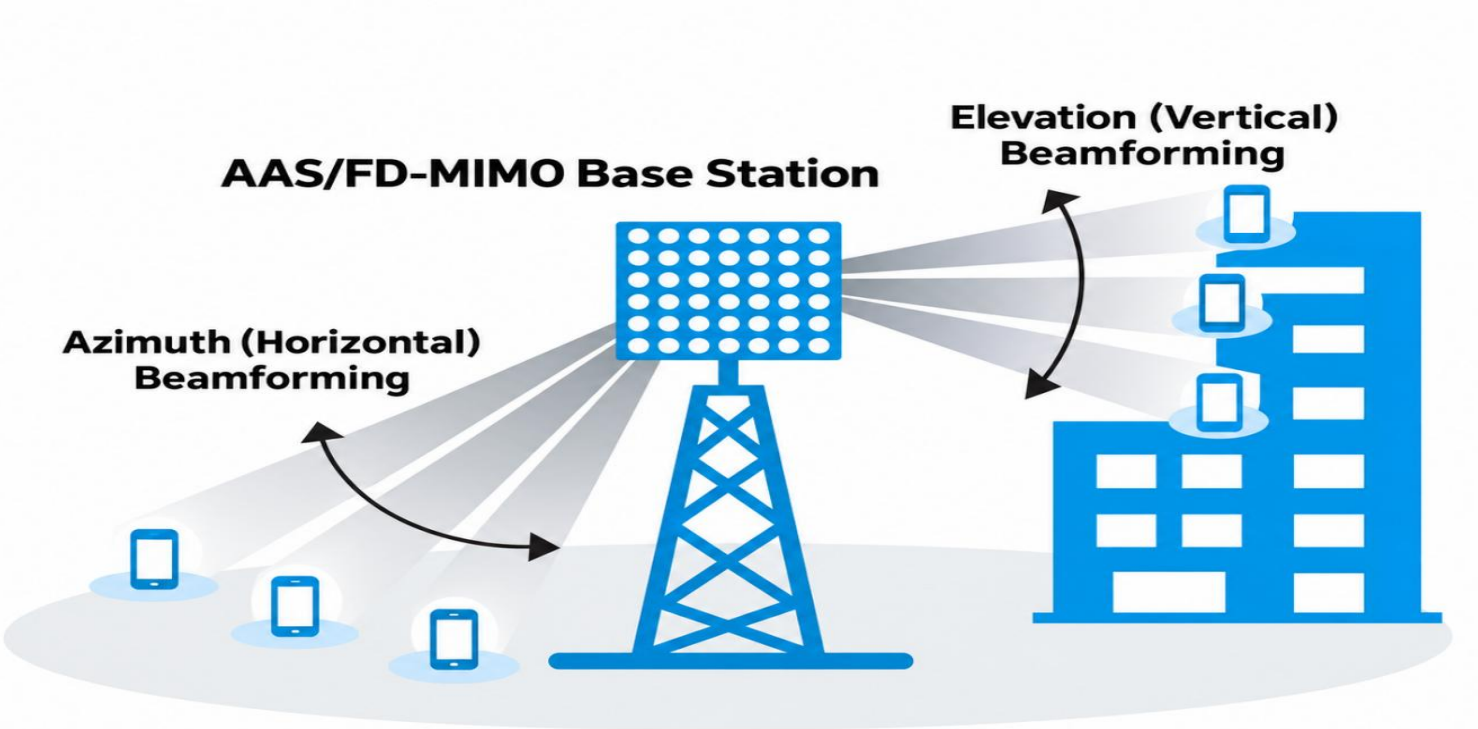
C-band benefits

- Huge channel bandwidth
- Existing macro-site infrastructure
- Beamforming / Massive MIMO gains



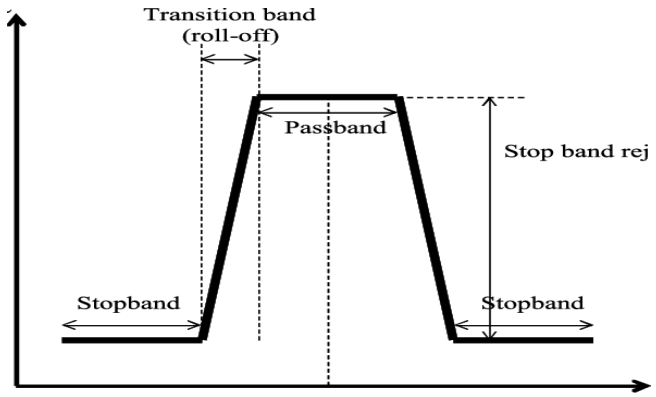
Beamforming / Antenna design changes





5G C-band / Radio Altimeter Interference Mechanisms





Out-of-band interference	
Cause	RA receiver desensitization / saturation
Cause	Insufficient RA receiver frequency selectivity

In-band interference	
Cause	Unwanted 5G emissions within the RA band

5G & Aviation – Safe Coexistence

Operator actions to minimize the risk of interference with radio altimeters



1. **Airport-aware network planning**
2. **Antenna tilt & beamforming control**
3. **Transmit power optimization**
4. **Unwanted emission control**
5. **Coordination with aviation authorities**

m:tel

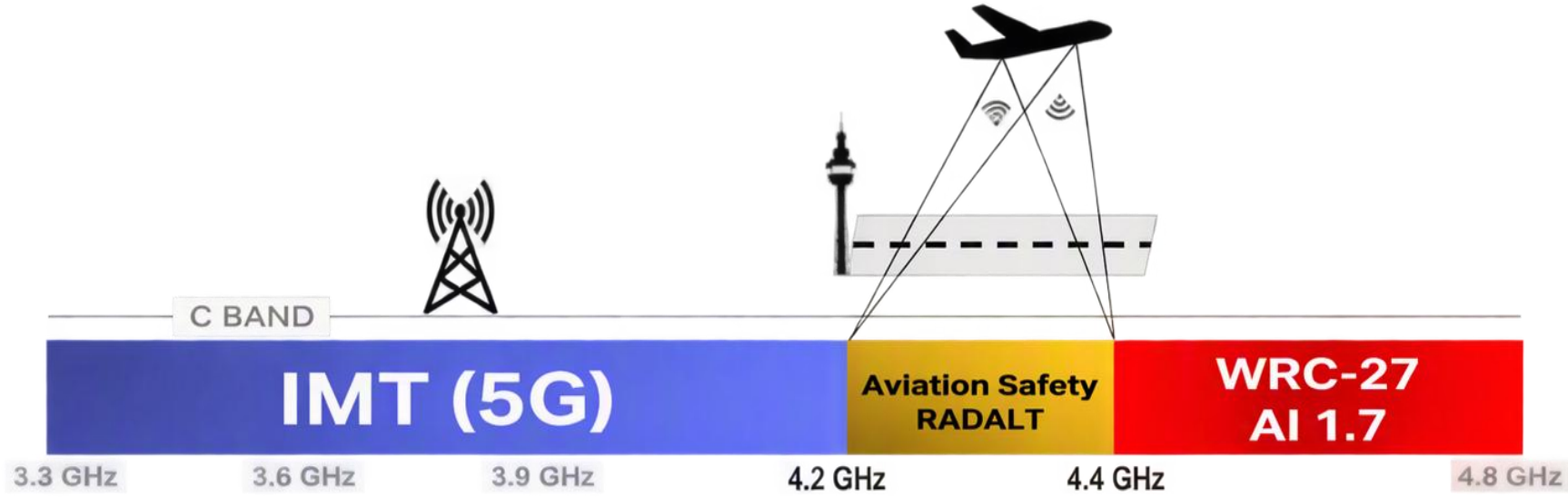
Khaled Eltanany

Senior Manager CNS Technology

IATA

Why WRC-27 Agenda Item 1.7 matters to airlines

The technical focus is adjacent-band coexistence, but the operational consequences arise onboard the aircraft.



Safety-critical dependency

Radio-altimeter data supports low-visibility operations during critical flight phases and is embedded in multiple aircraft systems.

Global fleet reality

Aircraft operate internationally with the same certified equipment; coexistence conditions cannot be treated as purely national.

Early aviation Input

Past 5G deployments confirm the value of reflecting aviation safety and operational realities from the outset.

Airline view: What should ITU work under AI1.7 deliver?

AIRLINE LENS

Incomplete consideration of real-world operational conditions may understate aviation risk and provide an insufficient basis for spectrum decisions.

01 Operationally complete studies

Include critical, off-nominal scenarios near the ground, not only simplified nominal cases.

02 Protection demonstrated

The study outcome should demonstrate that radio altimeters remain capable of performing their intended functions.

03 Globally usable conditions

Establish conditions that support international aircraft operations and avoid inconsistent national requirements.

04 Certified fleet baseline

Do not assume avionics refits or aircraft changes as a substitute for demonstrated protection.

Today’s reality: one global fleet, many national regimes

The global picture remains fragmented - The direction is converging toward tolerant equipment, but the transition path is different in each market



AIRCRAFT CROSSES THE BORDER
CERTIFIED ALTIMETER DOES NOT CHANGE

Different 5G deployment conditions
National deployments vary in frequency, proximity, base-station configuration, and timing.

Different mitigation frameworks
Measures may include power limits, antenna constraints, exclusion zones, or operational restrictions.

Different fleet requirements
Approved-altimeter lists, retrofits, filters, notices, and transition dates can differ by state.

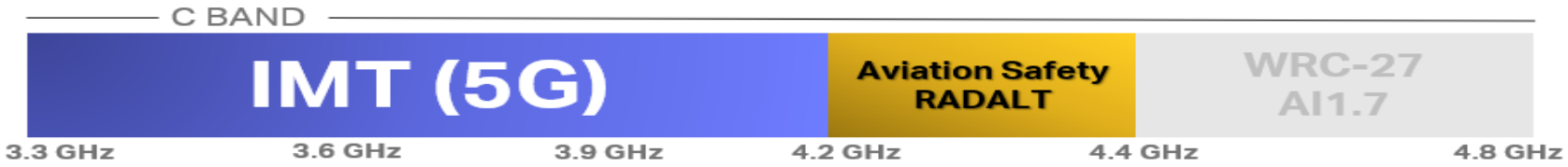


OPERATIONAL CONSEQUENCE

Technical spectrum issues become a continuous airline operational and fleet-management challenge

How have airlines responded globally?

There is no single global response — airlines are managing a mix of operational, aircraft and network measures.



ASSESS → **PLAN** → **OPERATE** → **MODIFY** → **REVALIDATE**

ASSESS	PLAN	OPERATE	MODIFY	REVALIDATE
Assess aircraft, installation, and operational susceptibility.	Match fleet eligibility to routes, airports, dispatch conditions, and dates.	Apply required procedures, restrictions, and operational notices.	Modify aircraft where required.	Update plans when conditions, approvals, or deadlines change.

ONGOING AIRLINE BURDEN

The airline ask: safe coexistence without fragmentation

A balanced outcome should protect aviation safety while supporting efficient spectrum use.

Support shared growth	Connectivity and aviation both enable economic activity, mobility, and global trade.
Preserve safety	Aviation safety must remain the primary boundary for any coexistence outcome.
Design coexistence upfront	Demonstrate compatibility before deployment to avoid reactive restrictions and corrective action.
Respect assurance	Aircraft changes require rigorous validation, certification, and sufficient implementation time.

Airlines support innovation and connectivity

But coexistence must be proven before global aviation risk is created.



Eliminate inadvertent fragmentation of fleets and avionics equipage

Build safety and global operability into a balanced approach from the start

Bogdan Petricel

ATC Senior Expert
EUROCONTROL

European Aviation position

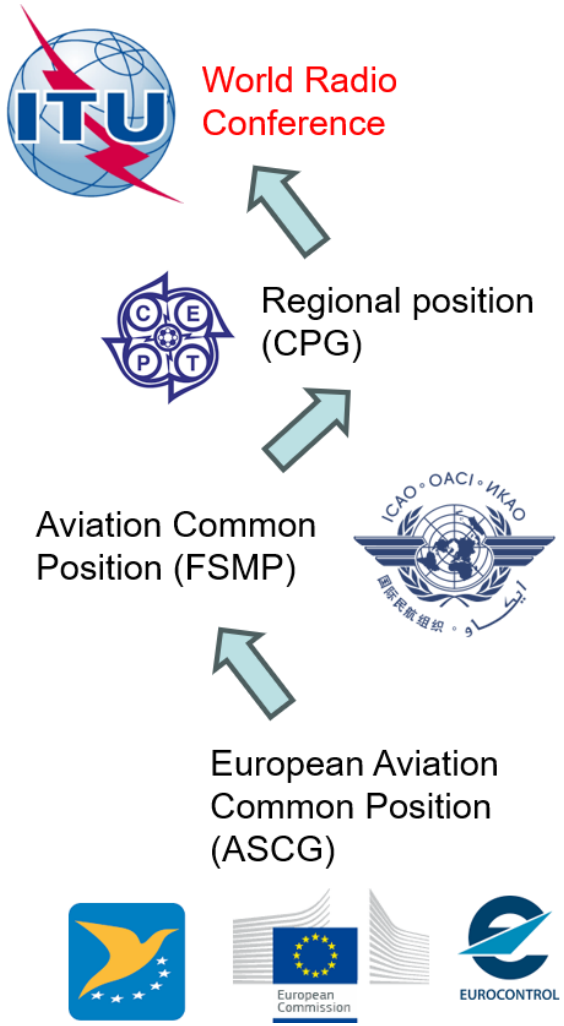
Protect safety-critical systems

Aeronautical Spectrum Consultation Group: ICAO FSMP members, telecommunication regulators, CAAs, ANSPs…

Oppose any IMT identification in 4 400–4 800 MHz that reduces protection or adds constraints for radio altimeters and WAIC in 4 200–4 400 MHz.

Ensure Agenda Item 1.7 does not constrain ground surveillance, airborne weather radar or DAA systems operating in 15.4–15.7 GHz.

Aligned with ICAO position



Civil aviation perspective (Europe)

1

4 400–4 800 MHz

Opposed — protect military links, radio altimeters and adjacent 4.2–4.4 GHz services.

2

7 125–7 250 MHz

Conditional — a potential compromise if sharing studies confirm coexistence.

3

7 250–8 400 MHz

Opposed — safeguard satellite, Earth-observation, meteorology and science services.

4

14.8–15.35 GHz

Opposed — defence reliance is high and a credible mobile-use case remains unproven.

Approaching Agenda Item 1.7 with significant caution, opposing expanding commercial mobile (IMT) allocations across most of the targeted bands due to heavy incumbent use by defense, science, and space services in Europe

Telecom roadmap

DG CNECT / CEPT



Late 2024 (delayed)

CEPT compatibility criteria finalized.



End 2025

EC decision planned for local/medium-power use in 3.8–4.2 GHz.



2025–Q1 2027

Member State rollout; CEPT update reflects new altimeter standards.

Aviation roadmap

DG MOVE / EASA



Late 2024–Q1 2025 (delayed)

EUROCAE MOPS and EASA specifications updated.



2028–2029

Industrialization and initial certification of hardened altimeters.



2029–2030+

First certified aircraft types; voluntary or phased fleet retrofits.

EC's DG MOVE (Directorate-General for Mobility and Transport) and DG CNECT (Directorate-General for Communications Networks, Content and Technology) joint roadmap ensures safe coexistence between mobile networks (5G/6G) and aircraft radio altimeters in the 3.4–4.4 GHz frequency range without blocking telecom progress

Military concerns

EDA and NATO on Agenda Item 1.7

Protection: Maintain Resolution 674 (WRC-23)—IMT operates without protection from existing or adjacent-band services.

Safeguard: Prevent technical or regulatory constraints on active defence capabilities and deployments.



4.4–4.8 GHz

Military links



7.9–8.4 GHz

Satellite networks



8.5–10.5 GHz

Defence systems



4.2–4.4 GHz

Radio navigation

European trajectory for IMT spectrum

Upper 6 GHz is Europe’s primary expansion path for 5G and 6G

700 MHz opportunity

6 425–7 125 MHz is prioritised for high-capacity 5G and future 6G, easing pressure on the 5 GHz range.

Regional alignment

WRC-23 identified the upper 6 GHz band for IMT across ITU Region 1, including Europe.

Policy to delivery

RSPG prioritises 6 585–7 125 MHz; CEPT states are developing frameworks, including shared mobile/Wi-Fi models.

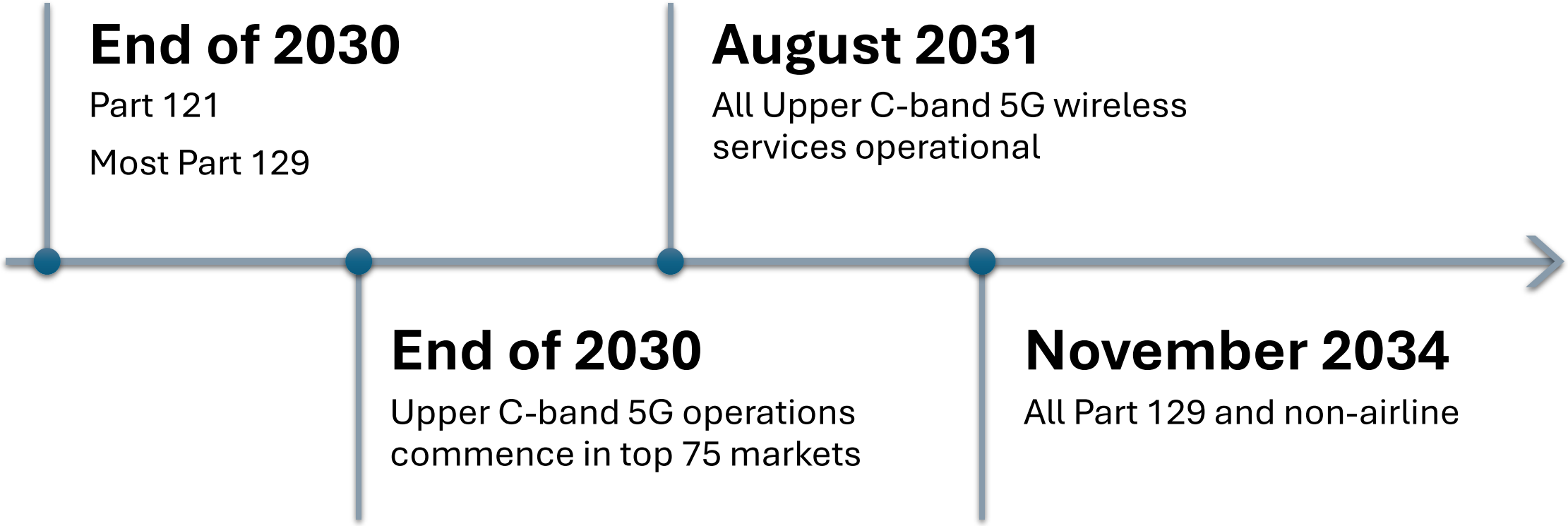
Miles Bellman

USA FAA

FAA Rulemaking for Interference-Tolerance Radio Altimeter Systems

- US law to develop wireless telecom services closer to RA
- New FAA regulations for RA interference tolerance
- Timeline for compliance

RA Equipage and Wireless Service Timelines



Collaboration for Compatibility

- Lessons learned from Lower C-band
- Aviation and spectrum regulators worked together
- Developed complimentary rulemakings

Sai K. Kalyanaraman, Ph.D.

Collins Aerospace

Current Status

- 5G/IMT has rolled out in many parts of the world on either side of the RA band

- The US has some of the most challenging (to RA) 5G rollouts (in terms of maximum power)
  - 5G rolled out in the US up to 3.98 GHz
    - Aviation upgraded (as needed) Radio Altimeters in 2023 to address the ask for spectrum compatibility with this band (as indicated in FAA AD's 2023-10-02 (fixed wing) and 2023-11-07 (Rotorcraft)).
    - Telecom put in place voluntary mitigations to support spectrum compatibility needs (mitigations expire 1 Jan 2028).

- In Asia, Japan has 5G on either side of the RA band
  - Till 4.1 GHz on the lower side and above 4.5 GHz on the upper side of the RA band.

- Europe has 5G rollouts at higher power till 3.8 GHz
- The UK has Low and Medium Power (LMP) 5G/IMT rollouts up to 4.195 GHz
- Australia has 5G rollouts till 4.0 GHz
- Canada has 5G rollouts up to 4.0 GHz
- Brazil has 5G rollouts till 3.8 GHz
- India has 5G rollouts till 3.7 GHz
- …

RTX Corporation (Corporate) - Company Use

Evolution of spectrum utilization around the RA band

- Spectrum usage is actively evolving.
  - US plans to auction more spectrum close to the RA band (i.e. 3.98 – 4.14 GHz) within one year (in line with US law).
    - This will impose a higher onus on RA's from a spectrum compatibility standpoint and the currently fielded RA's will need to be updated.

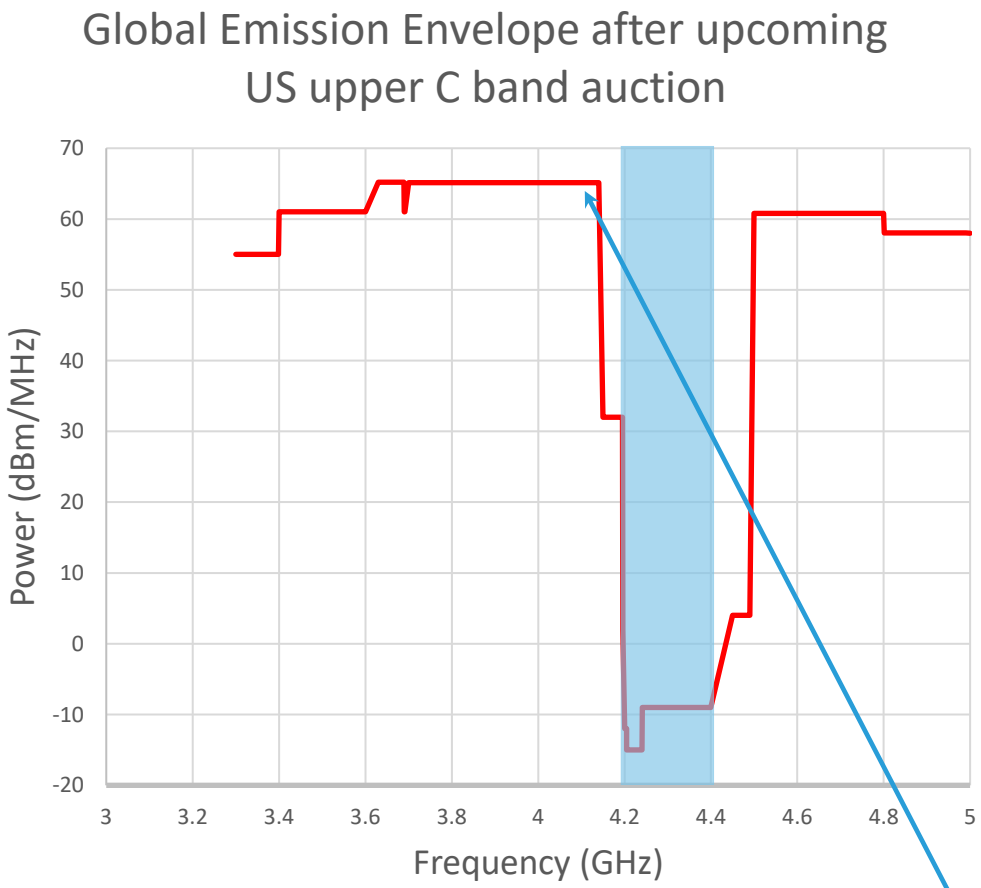
- FAA, through its rule 14 CFR § 91.220(b) , has issued new regulations requiring all Radio Altimeters (RA's) to meet specific minimum performance requirements:
  - Achieve spectrum compatibility with wireless signals in neighboring bands
  - Maintain continued operational safety by providing accurate RA readings to pilot and aircraft

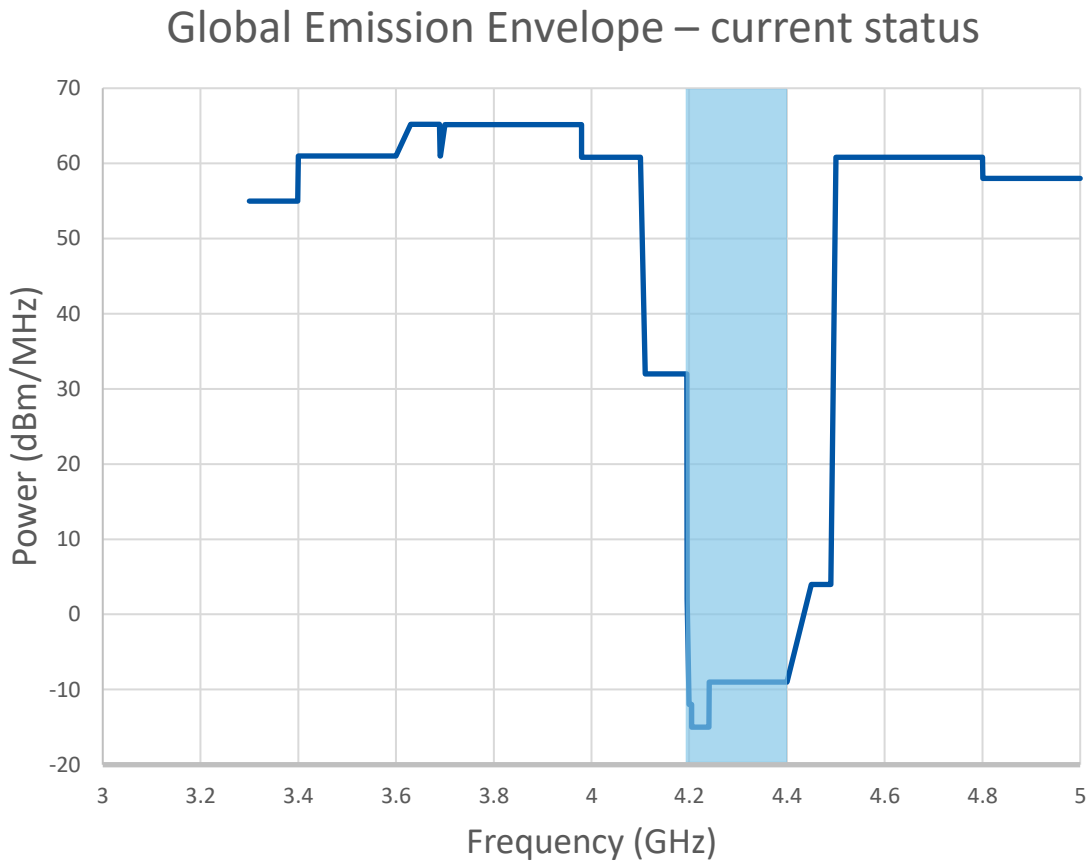
- FAA rule requires air transport and regional A/C (part 121 and 129) RA's to be updated in the field by 30 Dec 2030
  - All other aircraft under part FAA 91 need to retrofit by 31 October 2034
  - The rule in conjunction with FAA AC 20-199, provides the basis to demonstrate compliance.

- Standardization activities:
  - Activity underway within FSMP to help compile RA SARPS
  - Aviation (RTCA/Eurocae) is working on updating standards for Radio Altimeters (RA) in the 4.2 – 4.4 GHz operating band
    - Goal: provide the most robust RA solutions possible (address spectrum compatibility with systems on both sides of RA band: from 3 – 5.6 GHz).
    - The new standards will address the long-term evolution of RA certification basis
      - New RA standards indicated here do not specifically targeting the 2030 FAA retrofit deadline.

New RA MOPS is not required to achieve and demonstrate spectrum compatibility with IMT/other systems and not required to ensure continued aviation operational safety based on the FAA rule.

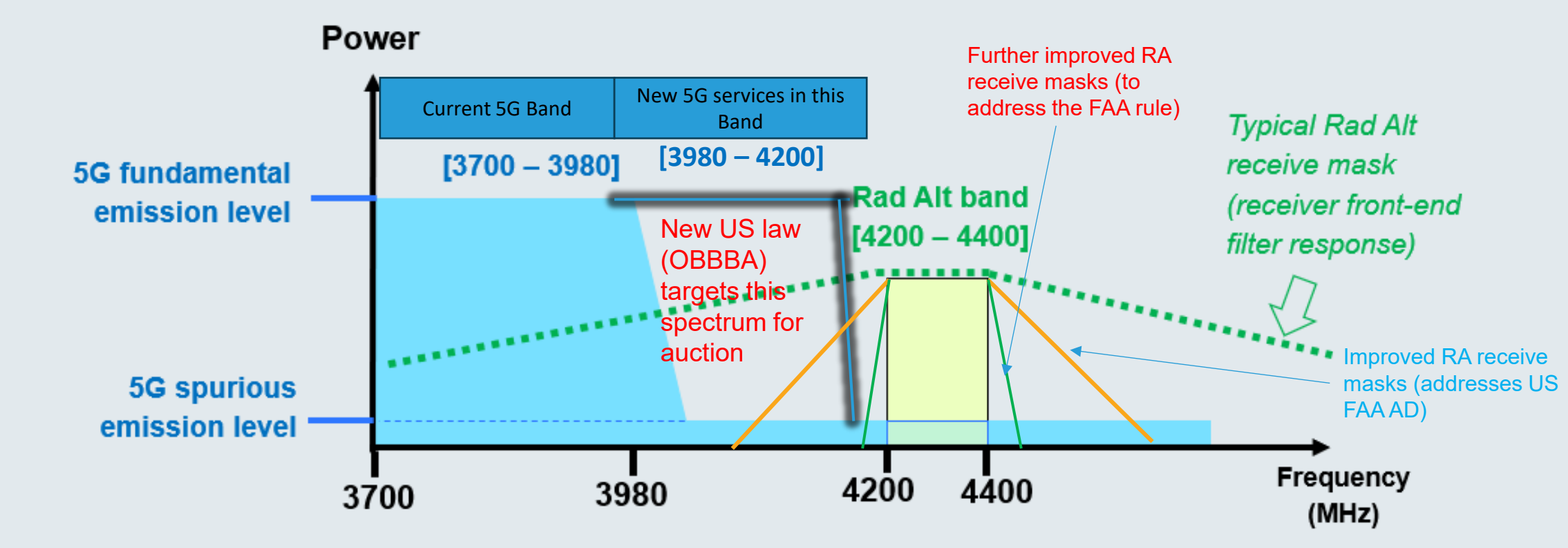
RTX Corporation (Corporate) - Company Use





Very high power from 5G in the US - right below the RA band

New Spectrum auction per US Law



Picture template credit - Airbus

ITM (Interference Tolerance Mask) Levels

Frequency range (MHz)	Power flux density, single polarization, RMS (dBW/m ^{2} /MHz)
3000 ≤ f < 4000	9.5
4000 ≤ f < 4100	9.5
4100 ≤ f < 4150	9.5
4150 ≤ f < 4160	6.5
4160 ≤ f < 4170	−1
4170 ≤ f < 4180	-7
4180 ≤ f < 4190	−17
4190 ≤ f < 4200	−34
4200 ≤ f ≤ 4400	−82
4400 < f ≤ 4410	−33
4410 < f ≤ 4430	−21
4430 < f ≤ 4440	−8
4440 < f ≤ 4450	−1
4450 < f ≤ 4460	6.5
4460 < f ≤ 4500	9.5
4500 < f ≤ 4600	9.5
4600 < f ≤ 5600	9.5

To ensure Continued Operational Safety RA's need to meet its functional requirements under these levels of RF Interference as seen at the phase center input to the RA receive antenna (as installed on aircraft)

Proposed In Band Interference Tolerance Mask (ITM) – In band to the RA

Safety case

ITM (In-Band tolerance)	-82 dBW/m^2/MHz
Minimum Separation Distance (MSD) (loss)	35 ft. (-31.6 dB)
Safety margin	6 dB
Emitter Aggregation	6 dB
Safe level of wireless emission into RA band (EIRP per polarization)	-33dBm/MHz
Safe level of wireless emission into RA band (EIRP for dual polarization)	-30 dBm/MHz

Path Forward

- ITM in the FAA rule is viewed as a Global solution for spectrum compatibility
  - Ongoing process to harmonize the ITM in the FAA rule with ICAO SARPS
  - Per FAA rule, new RA MOPS ***is not required*** to address the continue operational safety or functional need at the platform level

- In the US, FAA Final rule addresses TC/STC holders that will have to demonstrate compliance via AFM
  - Collins and other RA manufacturers will provide RA solutions that provide a MoC to ITM requirements
  - In support of achieving compliance against the final rule, FAA allows for minor changes to RA under existing TSOA
  -

QUESTIONS?

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Question for the panelists:

Name one lesson learnt or improvement that you would advise if we could go back in time before the 5G/RA issue started?

QUESTIONS?

Scan the QR code to join Slido ask questions, and participate in interactive activities

Thank You


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