Radio Altimeters
Eurocae and RTCA MOPS Standards
Status

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SAI SubCommittee and AEEC ExCom

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WHY RE-OPENING Radio Altimeters MOPS Standards (DO-155/ED-30) ?

CONTEXT

1. Broadband based system (e.g 5G) in the Radio Altimeter adjacent bands : 5G (3700–4200 MHz), DA2G China (4400–4900 MHz…). Moreover, 280 MHz bandwidth in the C band (3700–4200 MHz) has already been allocated by FCC to 5G telecommunication industries.

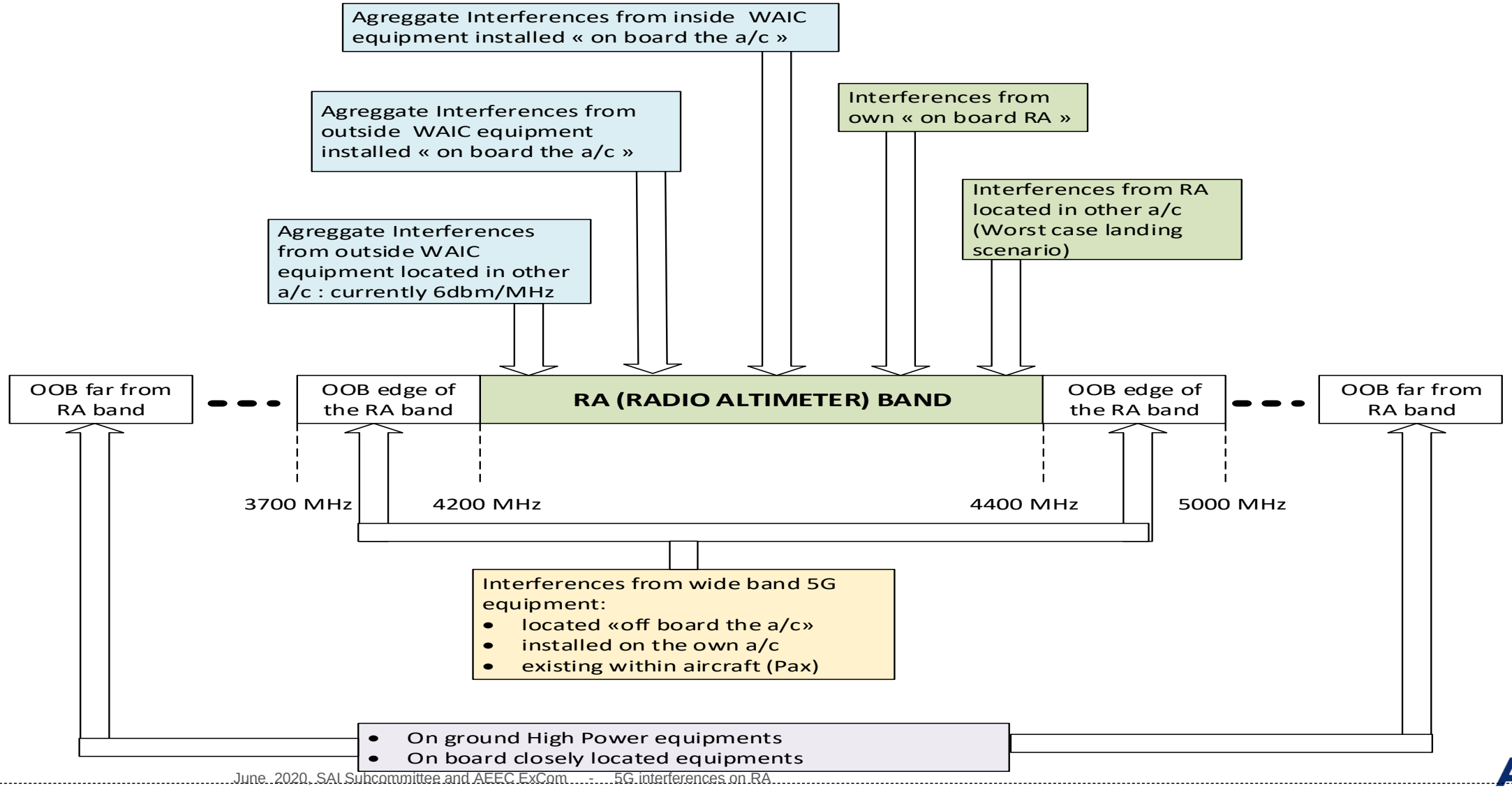
2. WAIC (Wireless Avionics Intra Communication) systems have been granted to share the RA band (4200–4400 MHz) as per 2015 World Radiocommunication Conference (Resolution 424)

3. Some other systems operating OOB (Out of Band) especially installed onboard aircraft have shown that they can cause adverse effect on RA like EAN European Aviation Network system (operating in 1980–1995 MHz band).

Such RF environment did not exist at the time of DO-155/ED-30 MOPS release (45 years ago).

WHY RE-OPENING RA MOPS Standards ?

WORST CASE RF INTERFERENCES SCENARIO ON RA BAND (4200-4400 MHz)



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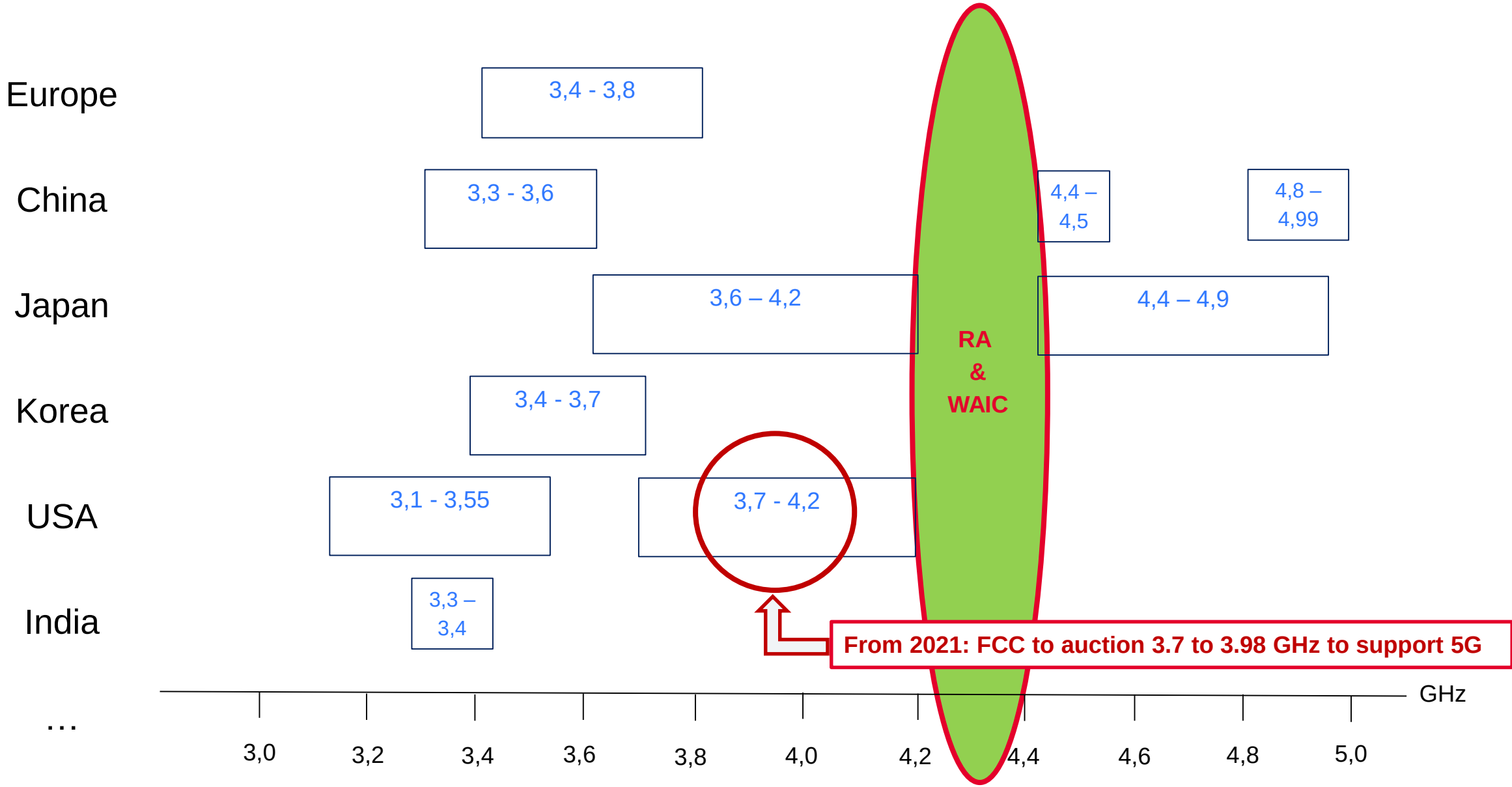
International Mobile Telecom pressure on the 4,2-4,4 GHz frequency band



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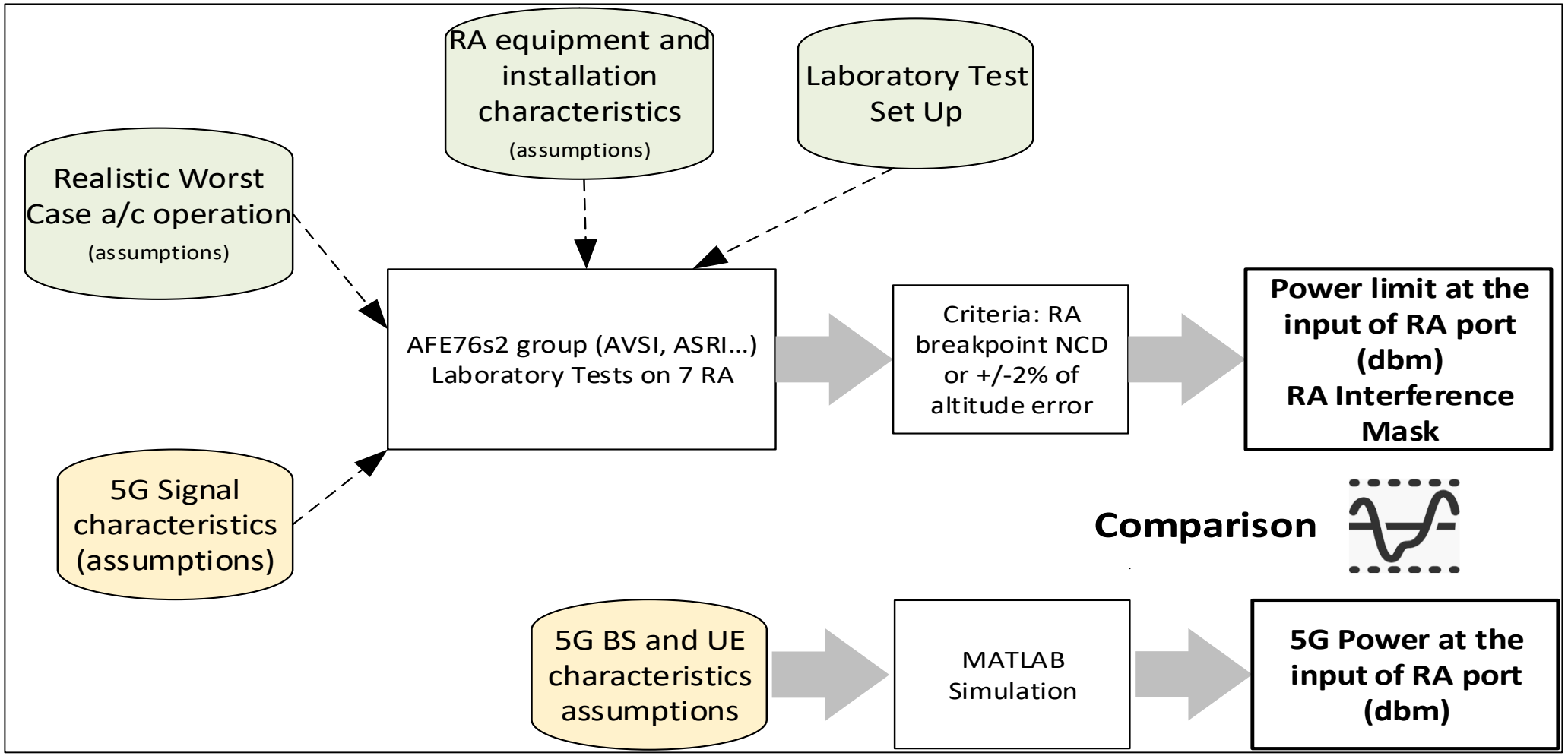
First Laboratory tests show harmful interference



- https://ecfsapi.fcc.gov/file/102214765103/AVSI%20RA%20Interim%20OOB%20Interference%20Report.pdf
- https://ecfsapi.fcc.gov/file/10204213574734/AFE%2076s2%20Supplemental%20Report.pdf
- https://ecfsapi.fcc.gov/file/1022047147775/Erratum%20-%2020200214%20Ex%20Parte%20Meeting%20OET%20and%20WTB%20GN%2018%20122%20(FINAL).pdf

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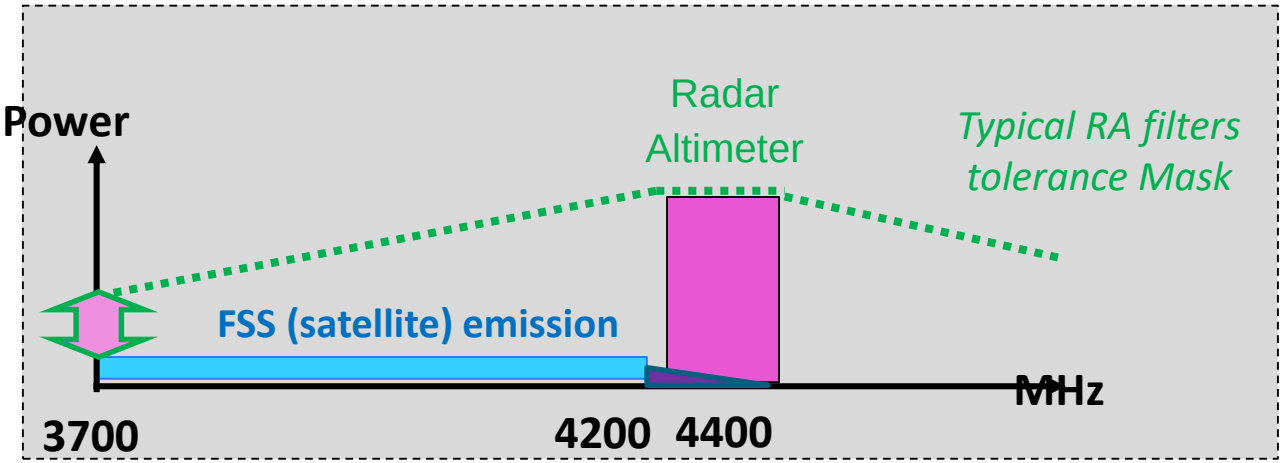
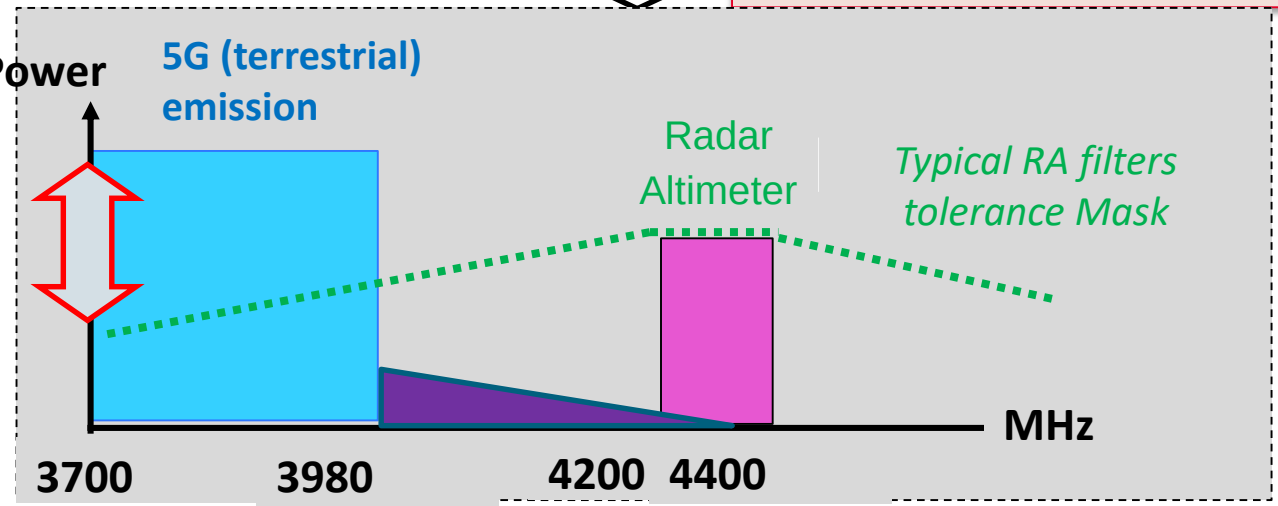
TECHNICAL CONCERN

Fundamental Satellite signals are properly filtered by RA



In 2021, FCC is going to re-allocate the [3700-4200 MHz] C-band

Fundamental Terrestrial 5G energy appears to be not properly filtered by RA



Air Transport **RA transceivers have not been designed to support such level of terrestrial interferences** in its adjacent band (previously allocated to satellites). MOPS and TSO does not require any limit for RA interference tolerance Mask (MOPS ED-30 and DO-155 dates from 80's)

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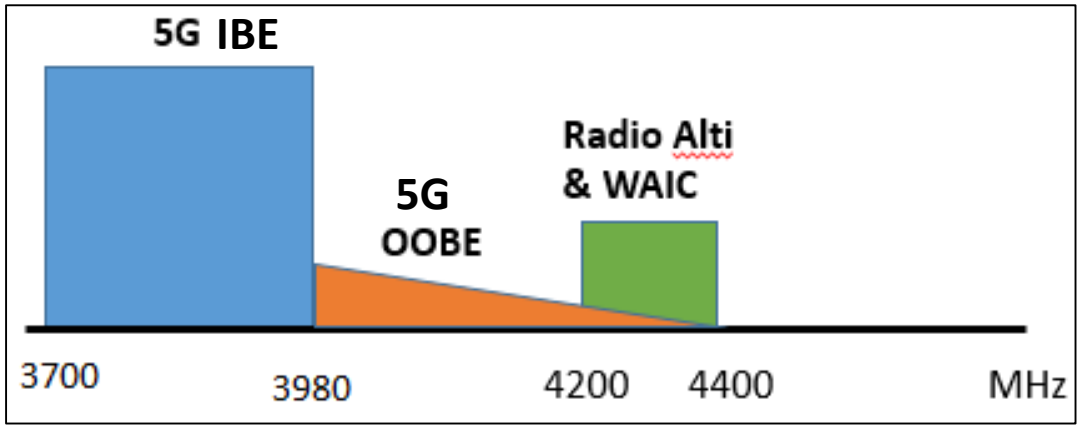
Telecom 5G Network characteristics (US example)

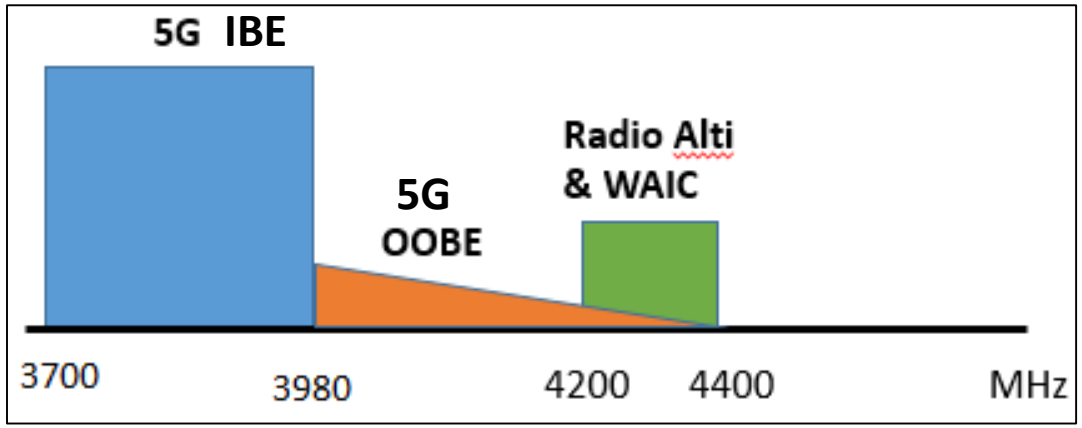
5G Base Station

5G User Equipment



RA OOB interference

RA IB interference



RA OOB interference

RA IB interference

OOBE Out Of Band Emission
IBE In Band Emission

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Potential impact on Continued Airworthiness

RF environment is now changing.

SAFETY AND OPERATIONAL IMPACT

Anywhere close to terrain

- Could inhibit some functionalities of the TAWS reactive modes which would remove a safety net in case against CFIT (controlled flight into terrain).

Impact if 5G base stations are located too close to Airports

- Could induce Hard Landing (manual and auto flare below 50ft)
- Risk of Go Around as landing laws are affected
- Diversion: No possibility to land in low visibility conditions
- Spurious message in the cockpit, RA display

BUSINESS IMPACT

Up to 30 000 aircraft to retrofit (Airbus & Boeing sharing same manufacturers).
Need more than a decade

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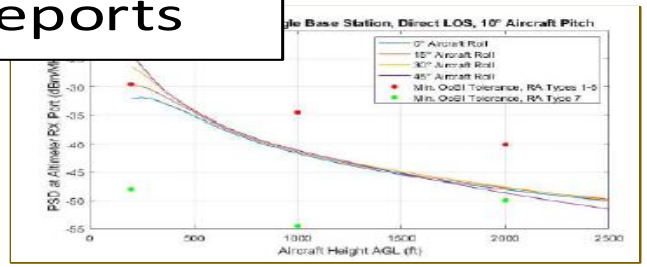
5G SC-239 TASK FORCE

AFE76s2 group (AVSI, ASRI...) Laboratory Tests and Reports

Demonstration of adverse effect on RA with against a single 5G BS



FCC R&O Rebuttal

FCC has encouraged to create a multistakehold er group of adjacent band

RTCA ICC and PMC decided to rely on SC-239 RA

SC-239 RA REPORT before July 2020

Impact on aircraft and delay needed to adapt RA fleet (X years)

Near Term
FCC Auction

Summer 2020

Middle Term
RTCA DO-155 MOPS and EUROCAE ED-30 update

Sept/Oct 2020

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MOPS RA STANDARD

MOPS DO-155 and ED-30 planned to be updated for September 2022
Goal is “no retrofit expected” once new TSO/eTSO will be defined.

Short term action: RTCA Task force Kick off April 22 , 2020 ,Report planned in August

-Eurocae kick off May 27, 2020

-Joint Eurocae/RTCA kick off planned in September 2020

RA suppliers (Air transport), Airframers, Authorities, Airlines …are main contributors.
General Aviation , Helicopters and Military are also encouraged to participate

>>>>> Joint activities

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SC-239 TOR – RTCA TASK FORCE TARGET - Short Term :

SC-239 RTCA Multi Stakeholder REPORT: Assessment of 5G Telecommunications Interference Impact on LRRA Operations – August 2020

The 5G interference report shall assess the potential for interference to radar altimeter operations due to 5G telecommunication signals transmitted on frequencies near to the 4200-4400 MHz band. The report may include recommendations for needed mitigations to protect existing radar altimeters in operational service from such interference sources.

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WORKING GROUP 1 (Simu group) - Interference Simulation Model Development

GOAL: to come to an agreement on the MATLAB script (including the density, propagation model)

WORKING GROUP 2 (5G group)- 5G Operational Characteristics

GOAL: To define in priority:

1. 5G Waveform (roll off)
2. 5G bandwidth (channelization, Network deployment, density)
3. 5G BS Antenna Patterns (Beamwidth, downtilt, mastheight)

WORKING GROUP 3 (Test group) - Interference Testing Coordination

GOAL: to agree on Procedures and Plans for AVSI Testing (including Waveform roll-off representativity and pass fail criteria). To perform Results Review

WORKING GROUP 4 (UE group) -5G User Equipment Onboard Aircraft

GOALS: to define the risk

- Identify coupling effects
- UE in aircraft (5G In band power landing out of RA band & 5G spurious landing in the RA band)
- UE BS MIMO beamforming pointing toward the aircraft
- UE in RA antenna pattern

Airbus coordinated effort

- Airbus Commercial lead at RTCA, coordinate a large Industry effort to assess risks and identify mitigations means

- Assumptions taken by RTCA cover Commercial Aircraft types (Boeing & Airbus) but hardly neither small aircraft nor Helicopters, thus require:
  - RA equipment on-board Airbus Group fleet
  - Generalized Operational scenarios coverage
  - Coupling assumptions between 5G User Equipment in cabin and RA

- Airbus information and lobbying actions towards various Administrations regarding the development of 5G networks on ground and their potential impact on Radio Altimeters operations in particular near airport areas.

Thank you

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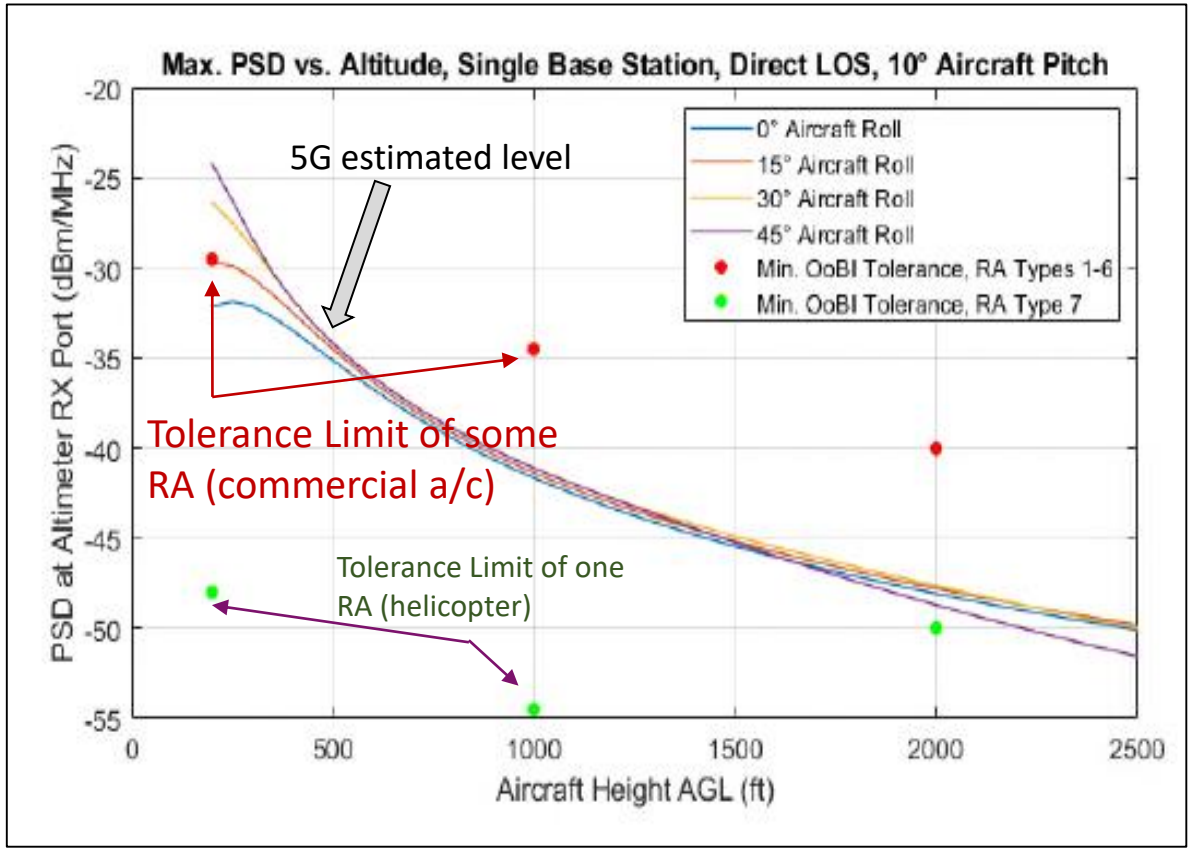
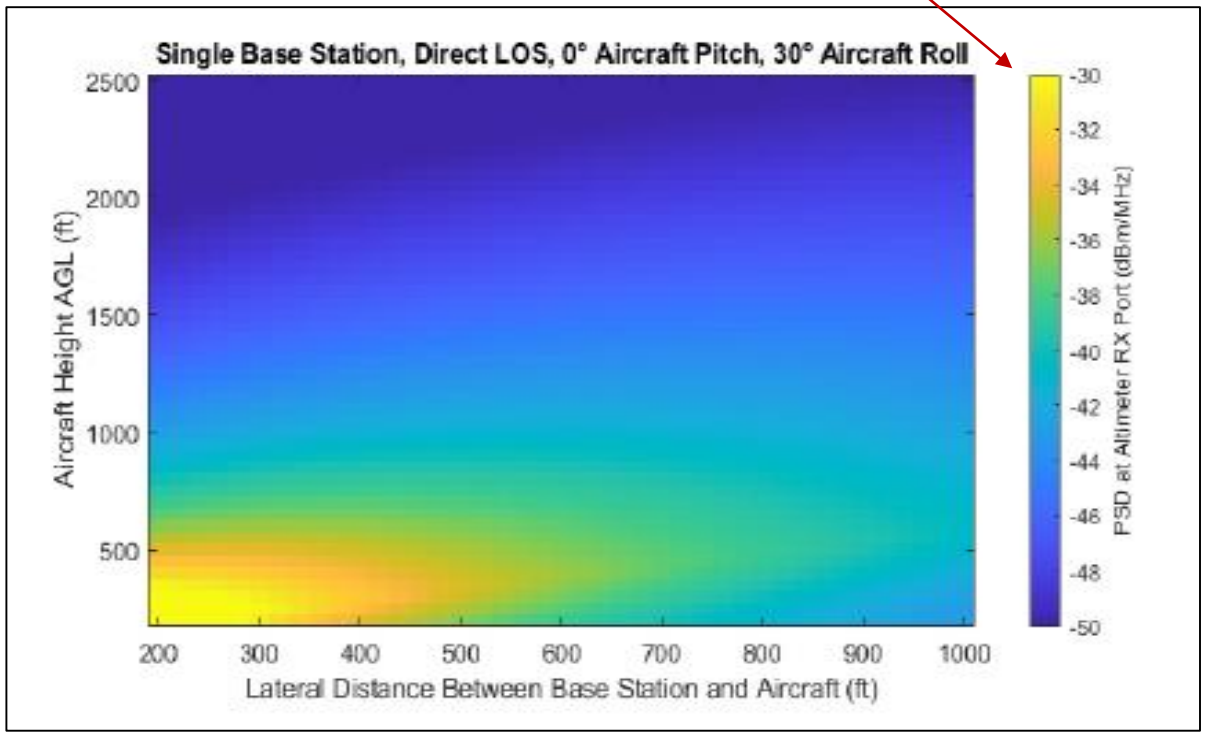
First Laboratory tests show harmful interference

Based on current 5G Base Station assumptions, the level of 5G interference has been modeled



Tolerance Limit of some RA (commercial a/c)



In absence of 5G emissions mitigations, RA equipment would become inoperative or exhibit erroneous altitude when aircraft flying at low altitude in the most critical phase (e.g. Flare).
This assessment does not consider yet 5G emissions from User Equipment (mobile phone)