INTERNATIONAL CIVIL AVIATION ORGANIZATION

THE MIDDLE EAST AIR NAVIGATION PLANNING AND IMPLEMENTATION REGIONAL GROUP (MIDANPIRG)

REPORT OF THE TWELFTH MEETING OF CNS SUB-GROUP

(CNS SG/12)

(Amman, Jordan, 2-4 May 2023)

The views expressed in this Report should be taken as those of the MIDANPIRG CNS Sub-Group and not of the Organization. This Report will, however, be submitted to the MIDANPIRG and any formal action taken will be published in due course as a Supplement to the Report.

Approved by the Meeting
and published by authority of the Secretary General

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PART I – HISTORY OF THE MEETING

1. PLACE AND DURATION

1.1 The Twelfth meeting of the MIDANPIRG Communication, Navigation and Surveillance Sub-Group (CNS SG/12) was hosted by Jordan Civil Aviation Regulatory Commission (CARC) in Amman, Jordan, 2-4 May 2023.

2. OPENING

2.1 The meeting was opened by Mr. Mahmoud Al Lahem, Director of Air Traffic Management, Jordan CARC. Mr. Al Lahem welcomed the participants to Jordan.

2.2 Mr. Al Lahem highlighted that Jordan realizes the importance of hosting those activities at the time where traffic growth came as a result of sustainability by continues improvement to its safety, security, efficiency and collaborative effort and cooperation at national, regional and global levels. Furthermore, he stressed on the need to work together to identify challenges and propose actions/ solution to foster the implementation of important ASBU module related to CNS.

2.3 In closing, Mr. Al Lahem thanked the participants for their presence and wished the meeting every success in its deliberations and enjoyable stay in Amman.

3. ATTENDANCE

3.1 The meeting was attended by a total of Fifty two (52) participants, from Eight (8.) States (Bahrain, Egypt, Iraq, Jordan, Oman, Qatar, Saudi Arabia and UAE) and one (1) International Organizations/Industry (IATA) and Headquarters. The list of participants is at the **Attachment A**.

4. OFFICERS AND SECRETARIAT

4.1 The meeting noted that the CNS SG Chairman, Mr. Saleh Al Harthy, was not able to participate in the meeting, consequently, the meeting was chaired by H.E. Mr. Yaseen Hassan AlSayed, Director Air Navigation Systems, Bahrain.

4.2 Mrs. Muna Alnadaf, RO/CNS was the Secretary of the meeting.

5. LANGUAGE

5.1 The discussions were conducted in English. Documentation was issued in English.

6. AGENDA

6.1 The following Agenda was adopted:

Agenda Item 1: Adoption of the Provisional Agenda & Election of Chairpersons

Agenda Item 2: Review the outcome of CNS SG/11

Agenda Item 3: Global Developments related to CNS

Agenda Item 4:	CNS planning and implementation in the MID Region
Agenda Item 5:	ASBU Threads/ Elements related to CNS
Agenda Item 6:	Review of Air Navigation Deficiencies in the CNS Field
Agenda Item 7:	Future Work Programme

7. CONCLUSIONS AND DECISIONS - DEFINITIONS

7.1 All MIDANPIRG Sub-Groups and Task Forces record their actions in the form of Conclusions and Decisions with the following significance:

a) **Conclusions** deal with the matters which, in accordance with the Group's terms of reference, merit directly the attention of States on which further action will be initiated by ICAO in accordance with established procedures; and

b) **Decisions** deal with matters of concern only to the MIDANPIRG and its contributory bodies.

8. LIST OF DRAFT CONCLUSIONS AND DRAFT DECISIONS

DRAFT DECISION 12/1:	*UPDATE OF THE AMC ROUTING TABLES*
DRAFT CONCLUSION 12/2:	*VALIDATION ARINC ADDRESSEE*
DRAFT CONCLUSION 12/3:	*INTER-REGIONAL COMMUNICATION LINKS*
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DRAFT CONCLUSION 12/11:	*MID REGION SURVEILLANCE PLAN (ICAO MID DOC 013)*
DRAFT CONCLUSION 12/12:	*ANS CYBER SECURITY CAPACITY BUILDING ACTIVITIES*
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PART II: REPORT ON AGENDA ITEMS

REPORT ON AGENDA ITEM 1: ADOPTION OF THE PROVISIONAL AGENDA

1.1 The subject was addressed in WP/1 presented by the Secretariat.

1.2 The meeting reviewed and adopted the Provisional Agenda as at paragraph 6 of the History of the Meeting.

REPORT ON AGENDA ITEM 2: REVIEW THE OUTCOME OF CNS SG/11

2.1 The subject was addressed in PPT/2 presented by the Secretariat. The meeting recalled the Draft Conclusions and Decision emanated from the CNS SG/11 meeting. Based on global and regional developments, the meeting agreed to update several Draft Conclusions and Decisions to be presented to MIDANPIRG/20 for endorsement.

REPORT ON AGENDA ITEM 3: GLOBAL DEVELOPMENTS RELATED TO CNS

CNS Related outcomes of the 41st session of the ICAO Assembly

3.1 The subject was addressed in WP/3 presented by the Secretariat.

3.2 The meeting was apprised of the outcomes of the 41st Session of the ICAO Assembly held in Montréal; from 27 September to 7 October 2022, particularly Resolutions A41-6, A41-8 and A41-19 available at https://www.icao.int/Meetings/a41/Documents/Resolutions/a41_res_prov_en.pdf.

3.3 The meeting noted that the Assembly, through Resolution A41-6, endorsed the 2023-2025 edition of the Global Aviation Safety Plan (GASP) and the seventh edition of the Global Air Navigation Plan (GANP) as the global strategic directions for safety and the evolution of the air navigation system, respectively.

3.4 The meeting noted also that the progress in implementing PBN and ADS-B leads to an increasingly complex dependence on GNSS for both navigation and surveillance. Europe and many other regions of the world are moving towards a PBN-based navigation environment while reducing procedures based on conventional navigation aids. Similarly, the use of ADS-B and its integration in the wider surveillance chain is advancing, enabling the realization of associated advanced air traffic control (ATC) capabilities. Furthermore, many surveillance and trajectory management applications are designed to use GNSS timing to synchronize the associated air and ground systems.

3.5 To make it imperative that GNSS RFI is mitigated and that CNS system resilience is strengthened, in particular through improved integration of complementary positioning capabilities, the Assembly resolved through Resolution A41-8 that the Appendices attached to this resolution constitute the consolidated statement of continuing ICAO policies and practices related to CNS/ATM, as these policies exist at the close of the 41st Session of the Assembly.

3.6 The aviation sector is increasingly reliant on the availability, integrity and confidentiality of information, data, and systems; Mindful that cyber threats to civil aviation are rapidly and continuously evolving, that aviation continues to be a target for perpetrators in the cyber domain as in the physical one.

3.7 The assembly, through Resolution A41-19 urged States to implement the ICAO Aviation Cybersecurity Strategy, and make use of the ICAO Cybersecurity Action Plan as a tool to support the implementation of the Aviation Cybersecurity Strategy; and to designate the authority competent for aviation cybersecurity, and define the interaction between that authority and concerned national agencies.

3.8 Furthermore, the assembly called upon States to develop and implement a robust cybersecurity risk management framework that draws on relevant safety and security risk management practices, and adopt a risk-based approach to protecting critical civil aviation systems, information, and data from cyber threats.

3.9 The meeting urged States to implement the Assembly Resolutions, in particular Assembly Resolution A41-6, Assembly Resolution A41-8 and Assembly Resolution A41-19.

Global Developments related to CNS

3.10 The subject was addressed in PPT/4 presented by the Secretariat. The presentation provided information concerning ICAO documentation and ICAO activities that could be of interest to the meeting. In particular, the meeting noted the following:

- PfA to Annex 10 Volume II and Volume III , are expected from the Communication Panel related to IP Network;

- PfA preliminary review related to SATCOM class B systems is expected in Q1 2025;

- LDAC PfA preliminary review is expected in Q1 2025;

- adoption of Amendment 93 to Annex 10, Vol I regarding Dual Frequency Multi constellation GNSS; the provision will become effective on 31 July 2023 and applicable on 2 November 2023;

- Ongoing NAV developments (after Amendment 93):
    - ARAIM (Advanced RAIM)
    - SBAS authentication
    - DFMC GBAS
    - GNSS interference mitigation
    - APNT (alternative position, navigation and timing);

- PFA to Annex 10, Vol III related to 24 bits address has been circulated for comments, applicability date November 2024; and

- ICAO Circular on Guidance on Safeguarding measures to protect Radio Altimeter from potential harmful interference from Cellular 5G Communications is planned in 2023, this ICAO Circular has been developed based on the MID Guidance Material

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REPORT ON AGENDA ITEM 4: CNS PLANNING AND IMPLEMENTATION IN THE MID REGION

Outcome of the MIDAMC STG/8 Meeting

4.1 The subject was addressed in MIDAMC STG/8-WP/5 presented by the Secretariat. The meeting reviewed the Draft CNS Decision 11/2 related to the Update of the AMC Routing Tables, the meeting agreed to set a timeline for the action group's task to be completed by 1st November 2023.

DRAFT DECISION 12/1: UPDATE OF THE AMC ROUTING TABLES

That,

a) *AMC Routing Table Action Group be established to review and update AMC Routing Directory by* ***1 November 2023****;and*

b) *be composed of:*
   - *the MIDAMC Chairman*
   - *the MIDAMC Team Leader (Jordan)*
   - *Ali Darwish.(Bahrain)*
   - *Ali Jaber.(Saudi Arabia)*

4.2 The meeting was informed about the suspense of Routing Directory function for two months due to legal concerns. EUROCONTROL has replaced the old disclaimer with a new one which is now termed as the AMC Terms of Use. The new AMC Terms of Use can be found at the bottom of the AMC entry page. States were requested to review the new Terms and provide any object they may have before 31 May 2023. If no objections received at the end of this period, EUROCONTROL would consider the new Terms of Use accepted by all users.

4.3 Furthermore, with this new Terms of Use in place, EUROCONTROL will establish clear and well defined commitments between the parties. Consequently, EUROCONTROL will be able to re-open global routing function for external COM centres which has been suspended since 28th March 2023.

4.4 The meeting recalled the Draft CNS Conclusion 11/3 related to Validation of ARINC Addressee, the meeting urged the concerned States (Egypt, Libya and Sudan) to validate the ARINC Addressee by 1 August 2023.

DRAFT CONCLUSION 12/2: VALIDATION ARINC ADDRESSEE

That, States are urged to validate the ARINC Users addressee at Appendix 4C by ~~***1 November 2022***~~ *1 November 2023*.

AMHS Planning and Implementation Matters

- Status of AMHS implementation

4.5 The meeting reviewed and updated the ROC plan as at **Appendix 4A.**

4.6 The meeting noted the status of AMHS implementation in the MID Region and that all intra-regional CIDIN connections have been removed. However, inter-regional connection with Cyprus are still CIDIN link.

4.7 The meeting recalled MIDANPIRG Conclusion 18/34 related to the MIDAMC Operation Efficiency; the meeting urged States (Libya, Lebanon, Syria, Kuwait, Sudan, and Yemen) to update their focal points details, Systems capabilities and Connections on AMC.

4.8 The meeting received update on AMHS implementation Status in Bahrain, Iraq, Jordan and UAE.

4.9 The meeting reviewed the Status of implementation of priority 1 COMI Elements in the MID Region, it was noted that Iraq have fully implemented B0/7 & B1/1.

4.10 The meeting noted that Iraq established AMHS connection with Jordan and Kuwait, and planned to migrate AMHS with Iran, Lebanon and Syria. The meeting reviewed the regional requirements for AFS implementation for Iraq as per the MID ANP Vol II and encouraged Iraq to establish the required connection as per the regional plan. In this regard, the meeting was informed that ICAO MID Office will organize AMHS/AMC Workshop for Iraq, Libya and Yemen in 2023.

4.11 The meeting noted that Bahrain is planning to migrate all circuits to AMHS by Q4 2023.

4.12 The meeting discussed the need to rationalize AFTN/AMHS Network in the MID Region, based on operational requirements. The meeting agreed that States needs to review the need for bilaterally agreed connections. Accordingly, the meeting agreed to the following Draft Conclusion:

DRAFT CONCLUSION 12/3: INTER-REGIONAL COMMUNICATION LINKS

That, in order to enhance the AFS Network efficiency and performance, States are urged to:

a) *migrate inter-regional communication links to AMHS; and*

b) *rationalize the inter-regional connections established on bilateral basis, taking into consideration the regional requirements set in the MID ANP Vol II and operational needs.*

- AMHS/SWIM Gateway

4.13 The meeting received with appreciation a presentation and information paper (PPT/6 & IP/3) from the AMHS/SWIM Gateway Study Group (SWAMWAY Study Group). The meeting noted that SWAMWAY SG is a joint initiative undertaken by a group of organizations including several ANSPs and industries with a deep expertise in both, AMHS and SWIM. The Study Group aims at developing a core technical specification for the AMHS/SWIM Gateway that establishes a basic framework through a set of essential requirements.

4.14 The meeting was apprised of the technical specifications under development of the AMHS/SWIM Gateway.

4.15 The meeting noted that the AMHS/SWIM Gateway Technical specifications document encompasses of four (4) chapters, the meeting received detailed presentation on each chapter:

Chapter 1-> Introduction
Chapter 2-> System Level Provisions
Chapter 3-> Configuration and parameters
Chapter 4-> AMHS/SWIM Gateway Specification

4.16 The meeting was apprised of the use cases, functional model and informational model of the AMHS/SWIM Gateway.

4.17 The meeting noted that AFTN addressee will be used for naming and addressing use for the AMHS/SWIM Gateway.

4.18 The meeting was apprised of gateway configuration, parameters and components.

- AMC Web Application Functions and Tools

4.19 The meeting was apprised of the status of Inter-regional connections with EUR, AMHS connection between Nicosia and Amman COM Centres is planned in Q4 2023.

4.20 It was highlighted that new implementation of AMHS connections between the EUR & MID Regions will improve redundancy.

4.21 The meeting noted with concerns inconsistencies between the data held in the AMC and what it is implemented on AMHS switches, which cause addressing and routing problems within the global network. The meeting urged States to ensure updating their systems data at the end of each AIRAC cycle.

4.22 The meeting recalled the agreed procedure for AMC users' registration, States were encouraged to register three AMC users with different personal roles (Operator, External COM Operator, backup External COM operator).

Update on MID IP Network Project

4.23 The meeting received a presentation from the MIDAMC team on the Regional IP Network implemented in different ICAO regions; REDDIG, New PENS and CRV in SAM, EUR and APAC Regions, respectively.

4.24 The meeting noted the benefits, governance and administration of the three projects.

4.25 The meeting recalled that MIDANPIRG/18 agreed, through Conclusion 18/37, that the ICAO MID Office, with the support of concerned States, initiate discussions with EUROCONTROL, in order to explore the possibility of joining the NEWPENS project as an alternative solution for establishing a MID IP Network.

4.26 ICAO MID requested EUROCONTROL to extend the New PENS to MID States. New PENS Webinar conducted (10 November 2021). The meeting recalled that eight (8) States (Bahrain, Egypt, Jordan, Lebanon, Kuwait, Oman, Saudi Arabia and UAE) confirmed their interest to join the EUROCNTROL IP Network Project (New PENS) pending technical and financial proposals.

4.27 The meeting was informed that EUROCONTROL Member States should cast their vote on the project extension by April 28th. The results of the voting will be announced by 4th May 2023.

4.28 UAE requested ICAO MID Office to organize AMHS/AMC Workshop/Training for new AMC users, accordingly the meeting agreed that the training/Workshop should be organized in 2024.

Draft MIDAMC Decision 8/3: AMHS/AMC Workshop

That, AMHS/AMC Workshop be organised for new AMC users in 2024.

4.29 The meeting recalled that the MIDAMC STG requested SITA to establish 3rd connection the SITA/AMHS gateway in Saudi Arabia, however, no update received from SITA regarding the Group's request. The meeting requested the Secretariat to follow the matter up with SITA.

World Radiocommunication Conference 2023 (WRC23)

4.30 The subject was addressed in WP/6 presented by the Secretariat.

4.31 The meeting recalled that MIDANPIRG/19 urged States to participate in the WRC23 preparatory activity and to communicate the ICAO WRC-23 position to national Telecommunication Authorities. A WRC23 preparatory Workshop has been coordinated with ICAO FSMP to be conducted back-to back with the FSMP WG/17 meeting in Cairo, Egypt, 28 August to 7 September 2023.

4.32 The meeting noted that the ICAO Position, available in Arabic, Chinese, English, French, Russian and Spanish at this link: https://www.icao.int/safety/fsmp/documents/itu-wrc23 was approved by the ICAO Council and sent to all ICAO Contracting States and relevant international organizations under cover of ICAO State letter E 3/5-21/37 dated 18 August 2021.

4.33 Draft updates to the ICAO Position, as contained in **Appendix 4B** were developed by the Frequency Spectrum Management Panel (FSMP) of the Air Navigation Commission (ANC) of ICAO. These updates, which include clarifications and refinements to the ICAO Position in line with the outcome of relevant studies within ITU-R and ICAO, will be addressed by the ICAO ANC in May 2023 before their final approval by ICAO Council in June 2023. The final position might include small adjustment.

4.34 The meeting underlined that active support from States is deemed to be the only mean to ensure that the results of the WRC-23 reflect civil aviation's need for spectrum.

4.35 The meeting was apprised of coordination practice in UAE regarding the preparation for WRC, UAE established a national team composed of representatives from all relevant stakeholders (TRA, CAA, Telecommunication companies, Military, space agencyand other governmental entities). The team meet and discuss regularly different agenda items of the WRC. In this regard, the meeting invited States to establish national team for WRC preparatory actions.

4.36 The meeting reiterated the need to enhance coordination with the Arab Spectrum management group (ASMG) and Asia-Pacific Telecommunity (APT) for all spectrum matters, accordingly, the meeting agreed that the FM WG should include members from TRA and CAA.

Latest Update on ICAO FF Tool

4.37 The subject was addressed in WP/7 presented by the Secretariat. The meeting was apprised of latest update on ICAO Frequency Finder Tool.

4.38 The meeting noted that the latest revisions of the Handbook on Radio Frequency Spectrum Requirement for Civil Aviation (Doc 9718), Volume I and Volume II, which have been approved by the Secretary General for publication, were formally published in early 2022.

4.39 The meeting recalled the outcome of the ACAO/ICAO Frequency Management Workshop (Casablanca, Morocco, 6-10 September 2022), that the Frequency Management Working Group should further review and amend, as deem necessary, the current MID allotment plan as at **Appendix 4C** to this WP (Appendix B-4. Regional frequency allotment plans – ICAO Doc. 9718, Vol. II refers), to increase the amount of spectrum that can be used for ATC Services. Accordingly, the meeting agreed to the following Draft Conclusion:

DRAFT CONCLUSION 12/4: REVIEW OF THE MID REGION ALLOTMENT PLAN

That, in order to increase the amount of spectrum that can be used for ATC Services, the FM WG should adopt the revised planning Principle for Aeronautical Frequency Bands of 117.975-137 MHz and review and update, as deem necessary, the current MID allotment plan by Q1 2024.

4.40 The increase of the expected VHF spectrum availability and with the expected changes in air traffic, the meeting recalled a recommendation formulated at the ACAO/ICAO Frequency Management workshop to conduct a simulation on VHF COM frequency assignment in the MID Region based on the new operational requirements of States to 2030 as necessary. The primary purpose of this simulation is to determine, if a congestion in the use of frequencies can be foreseen that would require the implementation of 8.33 kHz channel spacing in the MID Region.

4.41 The meeting agreed to request MID States to ensure that all frequency assignments that are in use are also registered in ICAO FF Tool. Only frequency assignments in the Frequency COM List 3 can be considered to be protected from harmful interference during future frequency assignment planning activities.

4.42 The meeting invites therefore States/Administrations to submit these requirements to the MID Regional Office by 1 August 2023 using the Guidance Doc. as at **Appendix 4D**. Once the requirements received, an analysis will be conducted. The analysis will be aimed at determining whether these requirements can be assigned a frequency within the available 25 kHz channels. In case not all frequency requirements until 2030 can be satisfied using 25 kHz channels, material for the introduction of 8.33 kHz channel will need to be developed or other viable solution in the MID Region.

4.43 Based on European experience, the introduction of 8.33 kHz channel separation would require a retrofit of airborne/ground equipment. If the MID States decide to reduce the number of frequencies allocated for the AOC, then there might not be a need for an immediate implementation of 8.33 kHz channel spacing.

4.44 In the connection with the above, the meeting underlined that States should, to the extent possible, use FF to coordinate for all frequency assignments that may affect the use of frequencies in other States. Not doing so, will ultimately result in less efficient and less flexible assignment coordination and planning in a congested environment, ultimately resulting in unforeseen interference. Furthermore, there will little possibility of optimizing assignments to solve congestion, or conducting a meaningful simulation at the regional level.

4.45 The meeting reiterated that States need to make certain of the accuracy of the information entered in the FF database. For example, missing or wrong coordinates can provide false results or mislead during the performance of the compatibility calculations and may result in showing inexact compatibilities/incompatibilities with adjacent States and wrong co- and adjacent channel calculations. Further, States are strongly encouraged and requested to use the FF tool to review all parameters (coverage, location, latitude, longitude, …, etc.) and test all frequencies.

4.46 Further, States were also reminded that ICAO frequency finder tool fully supports 50 kHz channel spacing; States who have not already implemented or planned to implement the 50 kHz channel spacing for ILS/VOR facilities are strongly encouraged to do so.

4.47 Accordingly, the meeting agreed to the following Draft Conclusion:

DRAFT CONCLUSION 12/5: OPTIMIZATION OF FREQUENCY ASSIGNMENT IN THE MID REGION

That, in order to optimize the frequency assignment planning and mitigate VHF frequency congestion at regional level, States are urged to:

i) coordinate with ICAO MID Office before assigning frequencies for aeronautical services (VHF COM, VHF NAV);
ii) perform an update/review of the data in the VHF-COM/NAV module; and
iii) Submit Frequency Requirements for the Period 2023 – 2030 using the Guidance Doc. at ***Appendix 4D*** *by 1 August 2023.*

4.48 The meeting requested ICAO to explore the possibility of developing a module on ICAO FF Tool to establish distance measuring equipment DME/DME positioning as a continuous ground-based back-up solution to the Global Navigation Satellite System (GNSS) for PBN. ICAO advised that they will certainly look at it and prioritize the requests as per the resources available. On the training subject on FF, States highlighted the benefits drawn from conducting the workshops, organize Frequency Management Workshop in 2025.

Outcome of the RADALT Action Group

4.49 The subject was addressed in WP/8 presented by the Secretariat. The meeting recalled that MIDANPIRG/19 acknowledged the safety concerns and potential operational impacts of the 5G & Radio Altimeter interferences. Consequently, the MIDANPIRG/19, through Decision 19/23, established a Radio Altimeter (RADALT) Action Group (AG) to develop guidance material to protect aircraft operations from potential Radio Altimeter interference.

4.50 The RADALT AG held several virtual meetings and developed Draft Guidance material on safeguarding measures to protect Radio Altimeter from potential harmful interference from Cellular 5G Communications as at **Appendix 4E**. The Draft Guidance Material Document encompasses four (4) chapters:

a) Background on 5G and Frequency Band allocation
b) Potential impact of 5G on Radio Altimeter during Aircraft operation
c) Short term safeguarding measures adopted at Regional and Global Levels/ Long term planning
d) Methodology for defining safeguarding measures for Aerodrome and Heliport

4.51 The meeting reviewed the Guidance material and agreed to present it to MIDANPIRG/20 for further review and endorsement. Accordingly, the meeting agreed to the following Draft Conclusion:

DRAFT CONCLUSION 12/6: GUIDANCE MATERIAL ON PROTECTING RADALT

*That, the Guidance material on safeguarding measures to protect Radio Altimeter from potential harmful interference from Cellular 5G Communications as at **Appendix 4E**, is endorsed.*

4.52 The meeting recalled MIDANPIRG, through Decision 19/24, agreed that the CNS SG coordinate with the RASG-MID relevant subsidiary bodies the 5G Safeguarding measures around the aerodromes to protect RADALT from any interference. In this regard, the CNS SG/11 meeting agreed to request RASG relevant Subsidiary body to include the 5G interference with RADALT in the RASG ASRT report, edition 12, as one of the emerging risks that will require close coordination between regulators and providers of telecommunication services and adherence to recommendations set to ensure protection of radio altimeter equipment on board aircraft.

4.53 In order to share successful implementation cases of safe 5G deployment near Airports, IATA proposed that a survey be conducted to collect information regarding deployment technical parameters (Transmitting power, antenna tilt, proximity to the runway, …etc).
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AIDC/OLDI Implementation

4.54 The subject was addressed in WP/9 presented by the Secretariat. The meeting recalled that the MSG/6 meeting agreed, through Conclusion 6/16, to include a requirement for AIDC/OLDI implementation (priority 1 interconnections) in the MID eANP Volume II, Part IV-ATM, under Specific Regional Requirements. Nevertheless, the implementation level of the AIDC/OLDI in the MID Region is still far below the target. The average regional implementation level is 26%. However, the meeting was informed that below AIDC/OLDI connections are being established among MID States and will be operational during the period of 2023-2024:

Bahrain – Saudi Arabia
Bahrain - Kuwait
Egypt – Jordan
Iraq - Turkey
Jordan – Saudi Arabia
Oman- Saudi Arabia
Saudi Arabia - UAE

4.55 The meeting recalled that the CNS SG/11 meeting requested that a Workshop on AIDC/OLDI be organised in 2023, to provide guidance to States on AIDC/OLDI implementation and to review and update the ICAO MID Doc 006 MID Region Guidance for the Implementation of AIDC/OLDI during the Workshop.

4.56 The meeting reviewed the outcome of AIDC/OLDI Workshop and supported its recommendations. Moreover, the meeting reviewed and updated the Draft ICAO MID Doc 006. Accordingly, the meeting agreed to the following Draft Conclusion:

DRAFT CONCLUSION 12/7: MID REGION GUIDANCE FOR THE IMPLEMENTATION OF AIDC/OLDI (ICAO MID DOC 006)

*That, the revised version of the MID Region Guidance for the Implementation of AIDC/OLDI as at **Appendix 4F**, is endorsed.*

Outcome of the NAV MON Action Group meetings

4.57 The subject was addressed in WP/10 and PPT/23 presented by the Secretariat and Jordan respectively.

4.58 The meeting noted that the ASBU element "Navigation Minimal Operating Networks" (NAVS B0/4) has been classified as priority 1 in the revised MID Region Air Navigation Strategy (MID Doc 002). This element aims to rationalize the conventional Navigational aids network through the increased deployment of the satellite based navigation system.

4.59 The meeting recalled that MIDANPIRG/18 meeting, through Decision 18/42, agreed on the need to develop a template for Navigation Minimal Operating Networks (Nav. MON) plan in line with ICAO SARPs and Regional requirements. The meeting was apprised of the progress made by the Action group in developing the NAV MON Plan Template. Furthermore, the meeting received a brief from Jordan on their NAV MON Plan.

4.60 The meeting agreed to share the Draft NAV MON plan template with the ATM and PBN Sub-groups to provide their feedback. Accordingly, the meeting agreed to the following Draft Decision:

DRAFT DECISION 12/8: NAV MON PLAN TEMPLATE

That, the ATM SG & PBN SG to provide feedback on the NAV MON Plan template to be presented to the CNS SG/13 for further review and improvement.

GNSS RFI

4.61 The subject was addressed in PPT/11 presented by IATA. The meeting was apprised on GNSS Interference trends in 2022.

4.62 The meeting note that the majority of incidents reported in Egypt, Iraq, Iran and Turkey. The meeting recalled the coordination meeting held between ICAO MID, ICAO EUR/NAT, IATA MENA, IATA EUR, Iraq and Turkey regarding the frequent GNSS interference reported in Ankara and Baghdad FIRs. The meeting agreed to conduct a follow-up meeting with all concerned States (Egypt, Iraq, Iran and Turkey).

4.63 The meeting recalled that MIDANPIRG/19 meeting tasked the AIM SG to develop a NOTAM Template to be used by States in case of GNSS outage. Therefore, a NOTAM template has been developed as at **Appendix 4G**.

4.64 The meeting was informed that during 2022, several States have not issued a NOTAM on possible GNSS interference. Therefore, the meeting discussed actions should be taken by States in case of GNSS incident reported. Accordingly, the meeting agreed that ICAO MID and IATA MENA to develop a checklist that States need to implement in such a case.

4.65 The meeting discussed lengthy the possible means to monitor GNSS signal and provide timely warning to Airspace users, in order to reduce the impact of the GNSS interference on Aviation operation. Therefore, the meeting requested States who have implemented GNSS monitoring system, to share their experience on GNSS interference monitoring with the CNS SG/13 meeting.

4.66 The meeting recalled that EUROCONTROL is working on a Concept of Operation to use ADS-B for GNSS RFI monitoring, the meeting requested ICAO MID to coordinate with EUROCONTROL and keep the CNS SG updated on the progress.

4.67 The meeting agreed to collaborate with ACAO to explore the possibility of initiating a Regional GNSS monitoring project and requested that the ICAO MID CNS RO present a Working Paper including project proposal to the coming ACAO ANC Meeting.

ILS Protection Zone

4.68 The subject was addressed in WP/12 presented by Jordan.

4.69 The meeting was apprised of a study conducted by Jordan to evaluate the impact of hangar on the Localizer signals in space for both sides of the Runway. The meeting noted the impact, study conclusion, possible solutions and consequences.

4.70 The meeting encouraged States to share their experience on theissue and requested ICAO MID to organize a Webinar on the Analysis of CNS facilities Building restricted areas (BRA). Accordingly, the meeting agreed to the following Draft Decision:

DRAFT DECISION 12/9: ANALYSIS OF CNS FACILITIES BRA WEBINAR

That, a Webinar on the Analysis of CNS facilities building restricted area be organized in 2024.

Outcome of Emerging Surveillance Technologies Symposium

4.71 The subject was addressed in PPT/13 presented by the Secretariat. The meeting reviewed the outcome of the ICAO Emerging Surveillance technologies symposium. The meeting discussed the recommendation and agreed on the need to update the MID Region Surveillance Plan accordingly.

Radar Data Sharing in MID Region

4.72 The subject was addressed in WP/17 presented by Jordan.

4.73 The meeting recalled that the ICAO Emerging Surveillance Symposium acknowledged the need to share Radar data among adjacent States and Military and noted associated challenges and potential solutions. Moreover, the MID Region Surveillance plan stated that "States to share SSR/ADS-B data to improve boundary coverage and enhance the surveillance services availability".

4.74 The meeting recalled that, the 1090 MHz activity results from both SSR Mode A/C and Mode S type interrogators, however SSR Mode A/C operation is less spectrum efficient than Mode S SSR. Therefore, managing interrogations in heavily surveilled airspace is very important, SSRs sharing surveillance data via networking, can eliminate redundant surveillance coverage in overlapping geographic regions.

4.75 The meeting was informed that Bahrain, Qatar and UAE have shared Radar data, consequently, the meeting supported Jordan's proposal and highlighted the need to define type of services to be used, study states' liability and many other aspects need to be considered.

4.76 Based on all the above, the meeting agreed that sharing Radar data among MID States will improve redundancy, enhance surveillance coverage and reduce 1090 RF congestions. Accordingly, the meeting agreed to the following Draft Conclusion and to supersede Draft Conclusion 11/8:

DRAFT CONCLUSION 12/10: RADAR DATA SHARING IN THE MID REGION

That, Radar Data Sharing Action Group (RDS AG) be:

a) *established to assess the feasibility of Radar data sharing among MID States, identify challenge(s) and possible solution(s)and implementation by* ***1 January 2024****; and*

b) *composed of :*

Ibrahim Faraj (Jordan)
Seyed Mirseed (Iran)
Loay Beshawri (Saudi Arabia)
Yousif Al Awadi (UAE)
Jehad Faqir (IATA)
ICAO MID RO/CNS

Bahrain's Upgrade of Surveillance System at Bahrain Flight Information Region Using ADS-B

4.77 The subject was addressed in IP/3 presented by Bahrain.

4.78 The meeting was provided with an overview of upgrading the surveillance system at Bahrain FIR by implementing Automatic Dependent Surveillance – Broadcast (ADS-B).

4.79 The meeting noted the benefits accrued out of ADS-B implementation in Bahrain and encouraged States to share information on the implementation of ADS-B and lessons learned.

Review the MID Region Surveillance Plan

4.80 The subject was addressed in WP/14 presented by the Secretariat.

4.81 The meeting recalled that MIDANPIRG/19 meeting, through Decision 19/26, tasked the CNS SG in coordination with the ATM SG to update the MID Region Surveillance Plan (MID Doc 013) with the outcome of the ADS-B Webinar and MID States' experience in ADS-B implementation.

4.82 The meeting noted that the CNS SG/11 meeting requested that the MID Region Surveillance plan be updated with the outcome of ICAO Emerging Surveillance Symposium (5-7 September 2022, Tunisia, Tunis). Accordingly, the ICAO DOC 013 was reviewed and updated by the meeting. Accordingly, the meeting agreed to the following Draft Conclusion:

DRAFT CONCLUSION 12/11: MID REGION SURVEILLANCE PLAN (ICAO MID DOC 013)

That, the revised version of the MID Region Surveillance plan as at ***Appendix 4H****, is endorsed.*

ANS Cyber Security Oversight

4.83 The subject was addressed in PPT/15 presented by the Secretariat.

4.84 The meeting noted that amendment 12 of the Annex 17 (effective 2011) included provisions to further strengthen Standards and Recommended Practices in order to address new and emerging threats to civil aviation including the security of air traffic service providers.

4.85 The meeting was apprised of the ICAO provisions related to the ATM Cyber Security. The meeting noted ATM security scope, ICAO security management system and risk management system.

4.86 The meeting discussed the qualification and training needs for ANS Cyber Security inspector. The meeting requested ICAO to organize capacity building activities on ANS Cyber security in 2024-2025. In this regard, the meeting noted that ICAO MID will organise cyber security and resilience symposium in Doha, Qatar, 6-8 November 2023, the meeting urged States to participate actively in this event. Accordingly, the meeting agreed to the following Draft Decision:

DRAFT DECISION 12/12: ANS CYBER SECURITY CAPACITY BUILDING ACTIVITIES

That, ICAO MID Office to organize capacity building activities on ANS Cyber Security in 2024.

Outcome of ACS WG/1 meeting

4.87 The subject was addressed in WP/16 presented by the Secretariat.

4.88 The meeting recalled that the 41st Assembly called upon States and industry stakeholders implement the ICAO Aviation Cybersecurity Strategy, and make use of the ICAO Cybersecurity Action Plan as a tool to support the implementation of the Aviation Cybersecurity Strategy.

4.89 The meeting noted that the CNS SG/11 meeting tasked the Air Navigation Service Cyber Security Working Group (ACS WG) to conduct in depth GAP analysis between ICAO Cyber Security Action plan and the current implementation level in the MID region. Accordingly, the ACS WG/1 has developed initial list of actions for 2023-2024 as at **Appendix 4I**.

4.90 The Draft MID Region ANS Cyber Security actions plan is a living document that will be reviewed and updated regularly, based on the global development and Regional implementation Status. The meeting tasked the ACS WG/2 to develop a survey to establish how States have implemented the identified actions.

4.91 The meeting was apprised of the outcome of the ANS Cyber Resilience Tabletop Exercise (TTX) was successfully conducted 13-15 November 2022. The meeting supported the following Tabletop exercise's recommendations:

a) States to develop disaster recovery plans as part of the resilient aviation ecosystem; the plan should consider communication, coordination and management oversight to support decision-making;
b) States to develop Cyber incidents management plan including defining clear lines of communication and escalation;
c) States to promote Cyber awareness training for all staff and in particular senior management recognizing that social engineering and Phishing continue to be a leading vector of attacks, humans are always the weakest link;
d) CAAs are encouraged to collaborate with their National Computer Emergency Response Team (CERT) for cross industry incident management, as appropriate;
e) Cyber Resilience is an evolving issue and States should include it in ANS contingency plan and to ensure that Contingency plan is known and practiced;
f) Cyber Resilience related procedures, risk analysis, exercises and trainings should be established and implemented;
g) An agreement on procedure on more timely coordination between FAS (ATSU) and airlines for abnormal flight plan submission is required;
h) States to perform drills, practice and have lessons learned on a regular basis, with the participation of all internal and external Stakeholders including senior management;
i) States to ensure regular coordination between regulators, ANSPs, airport operators and airlines regarding Cyber Resilience;
j) Contingency plan should be in place which including back up system and condition for manual procedure;
k) States to support implementation of Network monitoring, in particular monitoring of:
   - external links (external to the system)
   - security incidents specially during cases of cyber attacks; and
   - fault reporting and advance notification of maintenance activities; and
l) The experts to deal with cyber security/safety issues of ATM systems should be consisted of IT expertise as well as necessary knowledge on ANS and operational process.

4.92 The meeting agreed that States should share experience on cyber threats and incidents, in this regard, the meeting recalled that UAE developed and hosted ATM data cyber security portal (ADCS Portal). The meeting tasked the ACS WG to review the portal function and propose solution(s) to enhance its use in the MID Region. Accordingly, the meeting propose the following Draft Conclusion:

DRAFT CONCLUSION CNS 12/13: ENHANCEMENT ATM DATA CYBER SECURITY (ADCS) PORTAL

That, States be urged to:

i. review and update, as deem necessary, ANS Cyber Security focal point(s);

ii. provide feedback to the ADCS to Admin by ***1 October 2023*** *for further enhancements; and*

iii. use the ADCS effectively, share their experience related to cyber security, through the ADCS Portal

Tower Simulator for Air Traffic Control Project

4.93 The subject was addressed in PPT/22 presented by Bahrain.

4.94 The meeting noted that Bahrain has installed Tower simulation for ATC. The meeting was apprised of the challenges and implementation benefits. Furthermore, the meeting encouraged States to exchange information on the implementation of Tower Simulators and lessons learned.

REPORT ON AGENDA ITEM 5: ASBU THREADS/ELEMENTS RELATED TO CNS

Outcome of GANP/NANP Workshop

5.1 The subject was addressed in WP/18 presented by the Secretariat.

5.2 The meeting was informed that the ICAO assembly 41, through Resolution A41-6, endorsed the 2023-2025 edition of the Global Air Navigation Plan (GANP) as the global strategic directions for safety and the evolution of the air navigation system.

5.3 It was noted that the seventh edition of the GANP includes an update to the safety key performance area of GANP performance framework, as well as a maintenance process to keep it current. The GANP 7th edition highlights the importance of a robust air navigation system for achieving the expected levels of safety and resilience, and maps the essential services outlined in the Basic Building Block (BBB) framework to the Protocol Questions (PQs) of the Universal Safety Oversight Audit Programme (USOAP). Minor updates to the BBB and the Aviation System Block Upgrade (ASBU) frameworks are also included.

5.4 The meeting reviewed the Summary of discussion of the GANP/NANP Workshop and supported the recommendations emanated from the Workshop.

5.5 The meeting reviewed the proposed Draft MID Region Air Navigation Strategy (ICAO MID Doc 002) and the Draft MID Air Navigation Plan, Vol III. The meeting agreed on the proposed changes.

5.6 The meeting was apprised of the performance management process (6-step approach). It was noted that the eANP tool and NANP template are under development.

Web-based MID AN Report for 2022

5.7 The subject was addressed in PPT/19 & WP/24 presented by the Secretariat and Jordan respectively.

5.8 The meeting reviewed the status of implementation of ASBU threads/elements related to CNS in the Web-based MID Air Navigation Report for 2022.

5.9 The meeting noted the low implementation level of the FICE B0/1 (AIDC/OLDI) & NAVS (B0/1 & B0/4).

5.10 The meeting received update from Iraq & UAE regarding the fully implementation of SNET B0/3 (APW), ASUR B0/2 (MLAT), respectively.

5.11 The meeting noted the status of implementation of ASBU threads/elements related to CNS in Jordan. Furthermore, the meeting reviewed priority 2 CNS Threads /Elements in the MID Air Navigation Strategy, it was agreed that no changes to priority 2 Thread/elements need to be done during this meeting.

REPORT ON AGENDA ITEM 6: REVIEW OF AIR NAVIGATION DEFICIENCIES IN THE CNS FIELD

6.1 The subject was addressed in WP/20 presented by the Secretariat. The meeting reviewed and updated the list of deficiencies in the CNS field as reflected in the MID Air Navigation Deficiency Database (MANDD) at: https://mandd.icao.int.

6.2 The meeting noted that the total number of CNS deficiencies is four (4); two (2) priority "A" and two (2) priority "B". Two (2) deficiencies are related to ATS Direct speech circuits, one (1) related to Inter-Regional Communication link with ICAO EUR/NAT Region and one (1) for HF service.

6.3 The meeting reviewed the CNS related deficiencies and urged States to implement the provisions of the MIDANPIRG/15 Conclusion 15/35 and provide updates on the status of their deficiencies using MANDD.

REPORT ON AGENDA ITEM 7: FUTURE WORK PROGRAMME

7.1 The subject was addressed in WP/21 presented by the Secretariat.

7.2 The meeting reviewed the CNS SG Terms of References (TORs) and agreed that they are still valid and current.

7.3 Taking into consideration, the planned ICAO MID Regional events, which are of relevance to the activity of the CNS Sub-Group, in particular the MIDANPIRG/21 meeting, it was agreed to hold the second meeting of the Frequency Management Working Group (FM WG/2) back-to-back with the CNS SG/13 to review mainly the outcome of assessment of the spectrum congestion of VHF COM in the MID Region study.

7.4 The meeting agreed that the CNS SG/13 meeting be held during the first Quarter of 2024 (before Ramadan). The venue will be the ICAO MID Regional Office in Cairo, unless a State is willing to host the meeting.

7.5 Further to the agreement to organise AMHS/AMC Workshop in February 2024, the meeting agreed to hold the Ninth meeting of the MIDAMC STG/9 back-to-back with the AMHS/AMC Workshop. The venue will be the ICAO MID Regional Office in Cairo.

REPORT ON AGENDA ITEM 8: ANY OTHER BUSINESS

8.1 Nothing has been discussed under this Agenda Item.

APPENDICES

APPENDIX 4A

MID ROC Plan

AMHS Plan for ROC in Jeddah and Bahrain					
	Task	**Timeframe**	**Assigned to**	**Champion**	**Status**
	AMHS Intra-regional Trunk Connections				
1	Establish Jeddah – Beirut IP Network.	Jul 2015	Saudi Lebanon	IM MS	Completed
2	Establish Bahrain – Beirut IP Network.	Feb 2016	Bahrain Lebanon	YH MS	Completed
3	Establish Cairo – Beirut IP Network.	July 2016	Egypt Lebanon	AF//MR MS	Completed
4	Establish Bahrain – Jeddah IP Network.	Mar 2016	Bahrain Saudi	IM YH	Completed
5	Perform the Interoperability test between Jeddah and Beirut COM Centers.	July 2015	Saudi Lebanon	IB MS	Completed
6	Perform the Interoperability test between Bahrain and Beirut COM Centers.	July 2016	Bahrain Lebanon	MS YH	Completed
7	Perform the Interoperability test between Cairo and Beirut COM Centers	July 2016	Egypt Lebanon	AF/TZ/MR MS/EK	Completed
8	Perform the Interoperability test between Bahrain and Jeddah COM Centers.	15 October 2020	Bahrain Saudi	YM AA	Completed
9	Perform the Pre-operational test between Jeddah and Beirut COM Centers.	July2015	Saudi Lebanon	IM MS	Completed
10	Perform the Pre-operational test between Bahrain and Beirut COM Centers.	July 2016	Bahrain Lebanon	YH MS	Completed
11	Perform the Pre-operational test between Cairo and Beirut COM Centers.	March 2017	Egypt Lebanon	AF/ /MR MS/EK	Completed
12	Perform the Pre-operational test between Bahrain and Saudi COM Centers.	25 October 2020	Bahrain Saudi	YM IM	Completed
13	Place the AMHS link into operation between Jeddah and Beirut COM centers, and updating the Routing tables.	July 2015	Saudi Lebanon MID AMC	IM MS/EK MN	Completed July, 2015
14	Place the AMHS link into operation between Bahrain and Beirut COM centers, and updating the Routing tables.	July 2016	Bahrain Lebanon MID AMC	YH MS/EK MN	Completed On 3/5/2016
15	Place the AMHS link into operation between Cairo and Beirut COM centers, and updating the Routing tables.	April 2017	Egypt Lebanon MID AMC	AF/TZ/MR MS/EK MN	completed

AMHS Plan for ROC in Jeddah and Bahrain					
	Task	**Timeframe**	**Assigned to**	**Champion**	**Status**
	AMHS Intra-regional Trunk Connections				
16	Evaluate the Trunks connections bandwidth and increase it if required between (Bahrain, Beirut, Cairo and Jeddah).	Q4 2021	Bahrain Beirut Cairo Jeddah	YH MS/EK AF/TZ IM	
	The AMHS Interconnection with EUR Region Depends on Nicosia and Athens				
17	Establish Cairo – Tunis IP Network.	*March2016* *July 2016*		AF/TZ/MR IB/MA	completed
18	Establish Nicosia – Beirut IP Network.	Q3 2021		MS/EK	Lebanon is ready to connect
19	Establish Nicosia – Jeddah IP Network.	Q3 2021		IM	Saudi Arabia is ready to connect
20	Establish Bahrain – Nicosia IP Network.	Q3 2021		AD	Bahrain is ready to connect
21	Establish Cairo – Athens IP Network.	Dec 2016		AF/TZ/MR	completed
22	Perform the Interoperability test between Cairo and Tunis COM Centers.	*April 2016* *August 2016*		AF/ /MR IB/MA	Completed
23	Perform the pre operational test between Cairo and Tunis COM Centers.	*Q3 2016*		AF/ /MR IB/MA	Completed
24	Place the AMHS link into operation between Cairo and Tunis COM Centers, and updating the Routing tables.	*Aug 2016*		AF/ /MR IB/MA	completed
25	Perform the Interoperability test between Athens and Cairo COM Centers.	Mar 2017		AF/TZ/MR IB/MA	completed
26	Perform the Interoperability test between Bahrain and Nicosia COM Centers.	Q3 2021		AD	Bahrain is ready to connect
27	Perform the Interoperability test between Nicosia and Jeddah COM Centers.	Q3 2021		IM	Saudi Arabia is ready to connect
28	Perform the Interoperability test between Nicosia and Beirut COM Centers.	Q3 2021		MS/EK	Lebanon is ready to connect
29	Perform the Pre-operational test between Athens and Cairo COM Centers.	Mar 2017		AF/TZ/MR	Completed
30	Perform the Pre-operational test between Bahrain and Nicosia COM Centers.	Q3 2021		YH	Bahrain is ready to connect
31	Perform the Pre-operational test between Nicosia and Beirut COM Centers.	Q3 2021		MS/EK	Lebanon is ready to connect

AMHS Plan for ROC in Jeddah and Bahrain					
	Task	**Timeframe**	**Assigned to**	**Champion**	**Status**
	AMHS Intra-regional Trunk Connections				
32	Perform the Pre-operational test between Nicosia and Jeddah COM Centers.	Q3 2021		IM	Saudi Arabia is ready to connect
33	Place the AMHS link into operation between Athens and Cairo COM Centers, and updating the Routing tables.	Q1 2017		MIDAMC AF/ /MR	Completed
34	Place the AMHS link into operation between Bahrain and Nicosia COM Centers, and updating the Routing tables.	Q3 2021		MID AMC YH	
35	Place the AMHS link into operation between Nicosia and Jeddah COM Centers, and updating the Routing tables.	Q3 2021		MID AMC IM	
36	Place the AMHS link into operation between Nicosia and Beirut COM Centers, and updating the Routing tables.	Q3 2021		MS/EK	
37	Evaluate the inter-region connections bandwidth and increase it if required.	Q3 2021		MID AMC	
38	Transition of all regional AFTN/CIDIN Connections to AMHS.	Q3 2021	Bahrain UAE		3 intra-regional CIDIN connection remains

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APPENDIX 4B

ICAO position for the International Telecommunication Union (ITU)

World Radiocommunication Conference 2023 (WRC-23)

SUMMARY

This paper reviews the agenda for the International Telecommunication Union (ITU) World Radiocommunication Conference 2023 (WRC-23), discusses points of aeronautical interest and provides the ICAO Position for these agenda items.

The goal of the ICAO Position is to ensure aeronautical access to appropriately protected spectrum for radiocommunication and radionavigation systems that support current and future safety-of-flight applications. In particular, it describes the safety considerations necessary to ensure adequate protection against harmful interference.

Support of the ICAO Position by ITU Member States is required to ensure that the position is supported at the WRC-23 and that aviation requirements are met.

1) Introduction
2) ICAO and the international regulatory framework
3) Spectrum requirements for international civil aviation
4) Aeronautical aspects on the agenda for WRC-23.

1 Introduction

1.1 The ICAO Position on issues of interest to international civil aviation to be addressed at the 2023 ITU World Radiocommunication Conference (WRC-23) is presented below. The agenda of this Conference is contained in the attachment. The ICAO Position is to be considered in conjunction with sections 7-II and 8 of the Handbook on Radio Frequency Spectrum Requirements for Civil Aviation, Volume I — ICAO spectrum strategy, policy statements and related information (Document 9718, Second Edition, 2018). Document 9718 is available on http://www.icao.int/safety/fsmp (see webpage: Documents). It should be noted that the Handbook contains a long-term policy based on a snapshot in time and, as such, it may lag behind the ICAO WRC Position. As a result, when there is conflict between the Handbook and a current ICAO WRC Position, the Position should be seen as being the guiding document.

1.2 ICAO supports the working principle within the ITU, as established during studies for WRC-07, that ICAO will ensure the compatibility of ICAO standard systems with existing or planned aeronautical systems operating in accordance with international aeronautical Standards. Compatibility of ICAO standard systems with non-ICAO standard aeronautical systems (or non-aeronautical systems) will be addressed in the ITU.

2 ICAO and the International Regulatory Framework

2.1 ICAO is the specialized agency of the United Nations providing for the international regulatory framework for civil aviation. The *Convention on International Civil Aviation* is an international treaty providing required provisions for the safety of flights over the territories of the 193 ICAO Member States and over the high seas. It includes measures to facilitate air navigation, including international Standards and Recommended Practices commonly referred to as SARPs.

2.2 The ICAO Standards constitute the rule of law through the ICAO Convention and form a regulatory framework for aviation, covering personnel licensing, technical requirements for aircraft operations, airworthiness requirements, aerodromes and systems used for the provision of communications, navigation and surveillance, as well as other technical and operational requirements.

3 Spectrum requirements for International Civil Aviation

3.1 Air transport plays a major role in driving sustainable economic and social development worldwide. Since the mid-1970s and until the end of 2019, air traffic growth has consistently defied economic recessionary cycles, expanding two-fold once every 15 years. It is estimated that in 2019 air transport directly and indirectly supported the employment of 87.7 million people, contributing USD 3.5 trillion to the global gross domestic product (GDP), and carried over 4.5 billion passengers and over 52 million tonnes of cargo.

3.2 While the COVID-19 outbreak did significantly impact the global air transport industry, the industry continues to play a critical role in supporting humanity's fight against the global pandemic. The industry contributions have included delivering medical equipment and medicines, supporting traveller repatriations and medical evacuations, and maintaining crucial global supply chains through increased air cargo operations.

3.3 The safety of air operations is dependent on the availability of reliable communication and navigation services. Current and future communication, navigation, and surveillance/air traffic management (CNS/ATM) systems are highly dependent upon the availability of sufficient, suitably protected radio spectrum that can support the high integrity and availability requirements associated with aeronautical safety systems. Spectrum requirements for current and future aeronautical CNS systems are specified in the ICAO Spectrum Strategy[1], as addressed by the Twelfth Air Navigation Conference, and as approved by the ICAO Council.

3.4 In support of the safety aspects related to the use of radio frequency spectrum by aviation:

- Article 40 of the ITU Constitution states, "*international telecommunication services must give absolute priority to all telecommunications concerning safety of life at sea, on land, in the air or in outer space, as well as to epidemiological telecommunications of exceptional urgency of the World Health Organization*".
- No**. 4.10** of the Radio Regulations states, "Member States recognize that the safety aspects of radionavigation and other safety services require special measures to ensure their freedom from harmful interference; it is necessary therefore to take this factor into account in the assignment and use of frequencies."

In particular, compatibility of aeronautical safety services with co-band or adjacent band aeronautical non-safety services or non-aeronautical services must be considered with extreme care in order to preserve the integrity of the aeronautical safety services.

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[1] The ICAO spectrum strategy is included in the ICAO Handbook on Radio Frequency Spectrum Requirements for Civil Aviation, Volume I — ICAO spectrum strategy, policy statements and related information (Document 9718).

3.5 The continuous increase in air traffic movements as well as the additional requirement for accommodating new and emerging applications such as unmanned aircraft systems (UAS[2]) and commercial sub-orbital vehicle flights are placing an increased demand on both the aviation regulatory and air traffic management mechanisms. As a result, the airspace is becoming more complex and the demand for frequency assignments (and consequential spectrum allocations) is increasing. While some of this demand can be met through improved spectral efficiency of existing radio systems in frequency bands currently allocated to aeronautical services, it is inevitable that these frequency bands may need to be increased or additional aviation spectrum allocations may need to be agreed upon to meet this demand.

3.6 In addition, it is noted that there is a general trend toward the development of new terrestrial mobile communications networks with higher radiated power base stations, in particular IMT base stations using active antennas. A review of unwanted emission levels of these stations should be considered to ensure continued compatibility with other systems and services, particularly aviation safety systems.

3.7 The ICAO Position for the ITU WRC-23 was initially developed in 2020 with the assistance of the Frequency Spectrum Management Panel (FSMP) and was reviewed by the Air Navigation Commission at the seventh meeting of its 215th Session on 27 October 2020. Following the review by the Commission, it was submitted to ICAO Contracting States and relevant international organizations for comment. After a further review of the ICAO Position in light of the comments received by the Commission on 29 April 2021, the ICAO Position was reviewed and approved by the ICAO Council on 14 June 2021. [Editorial Note: Update the following when/as appropriate.] Taking into account the results of studies within the ITU and ICAO, the ICAO Position was updated and approved by the ICAO Council on XX June 2023. This document contains that updated ICAO WRC-23 Position

3.8 States and international organizations are requested to make use of the ICAO Position, to the maximum extent possible, in their preparatory activities for the WRC-23 at the national level, in the activities of the regional telecommunication organizations[3] and in the relevant meetings of the ITU.

4 Aeronautical aspects on the agenda for WRC-23

Note 1 – The statement of the ICAO Position on an agenda item is given in a text box at the end of the section addressing the agenda item, after the introductory background material.

*Note 2 – WRC-23 agenda items **1.6, 1.7, 1.8, 1.9**, **1.10** and **9.2** address issues where aviation is seeking action by the WRC.*

*Note 3 – WRC-23 agenda items **1.1, 1.2, 1.3, 1.4, 1.11, 1.13, 1.15, 1.16, 1.17, 4, 8, and 9.1 topics a)** and **b), and 10** could potentially affect aviation use of spectrum and hence aviation should participate in studies to ensure there is no undue impact. As a result, they are included in this position.*

*Note 4 – No impact on aeronautical services has been identified from WRC-23 agenda items **1.5**, **1.12**, **1.14**, **1.18, 1.19**, **2**, **3**, **5**, **6**, **7**, **9.1 topic c), 9.1 topic d)** and **9.3** which are therefore not addressed in this position.*

Note 5 – When in this document reference is made to "No. X.YYY", it means "No. X.YYY of the ITU Radio Regulations".

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2 For the purposes of this document, UAS is referred to in ICAO as remotely piloted aircraft systems (RPAS).

3 African Telecommunication Union (ATU), Asia-Pacific Telecommunity (APT), European Conference of Postal and Telecommunications Administrations (CEPT), Inter-American Telecommunication Commission (CITEL), Arab Spectrum Management Group (ASMG) and the Regional Commonwealth in the Field of Communications (RCC).

WRC-23 agenda item 1.1

Agenda item title

1.1 to consider, based on the results of ITU-R studies, possible measures to address, in the frequency band 4 800-4 990 MHz, protection of stations of the aeronautical and maritime mobile services located in international airspace and waters from other stations located within national territories, and to review the power flux-density criteria in No. 5.441B in accordance with Resolution 223 (Rev.WRC-19);

Discussion

This agenda item seeks to study the technical and regulatory provisions necessary to ensure the protection of aeronautical and maritime mobile services, located either in or above international waters, from other stations located within national territories and operating in the frequency band 4 800-4 990 MHz. Additionally, the agenda item calls for the review of the pfd criteria contained in RR No. **5.441B**.

The frequency bands 4 800-4 825 MHz and 4 835-4 950 MHz are allocated to the aeronautical mobile service worldwide in accordance with the Table of Frequency Allocations and RR No. **5.442**. In addition, in parts of Region 2 and Australia as well as adjacent international airspace the frequency bands 4 400-4 940 and 4 825-4 835 MHz are used for aeronautical mobile telemetry for flight testing in accordance with the provisions of RR Nos. **5.440A**, **5.442** and Resolution **416 (WRC-07)**. According to Resolution **416 (WRC-07)** the aeronautical mobile telemetry emissions are limited to transmission from aircraft stations only.

Flight testing is key to maintaining and enhancing the safety of aircraft operation. Analysis of data gathered during flight testing is used to evaluate the aerodynamic flight characteristics of the vehicle and the performance of the systems onboard that vehicle in order to validate the design and its safety. The flight test phase allows any identified design issues to be addressed and resolved, as well as verifying and documenting the vehicle's performance for government certification and customer acceptance. It is key to ensure the integrity of the flight test data. Any interference to the transmission or reception of flight test data, if spotted, may invalidate the test data gathered during that flight and hence require a repetition of that flight test or if not spotted cause nugatory work to be carried out to address an issue that does not exist.

However, assignments to certain types of aeronautical systems, for example radio links between aircraft, are not registered in the MIFR. The absence of such recording together with RR No. **8.1**, which states that *rights and obligations of administrations in respect of frequency assignments shall be derived from the recording of those assignments in the MIFR*, could lead to questions being raised as to why the protection of the aeronautical mobile service is required. Unfortunately, although the Radio Regulations require assignments to be registered in order to be internationally recognized (RR Nos. **11.2** & **11.8**), provision RR No. **11.14** precludes the notification and registration of frequency assignments to aeronautical mobile stations that do not have associated aeronautical land stations. This apparent discrepancy should be resolved in a manner that ensures recognition and protection of aviation systems when they are operated in international airspace.

Though this agenda item is limited to the frequency band 4 800-4 990 MHz, its considerations might have influence on a general regulatory mechanism of protection of the aeronautical mobile service in international airspace. It is essential to ensure that the proposed methods to satisfy this agenda item would not have a negative impact on the use of aviation systems in other frequency bands.

ICAO Position

To support any measures based on the results of studies taken to ensure the protection of flight testing in international airspace, especially those stations operated in accordance with RR No. **5.440A**.

To oppose any proposed measure that is not in line with the results of studies and reduces the level of protection of flight test operations in international airspace and above international waters, especially those operated in accordance with RR No. **5.440A**.

To ensure that the proposed methods to satisfy this agenda item do not have a negative impact on the use of aviation systems in other frequency bands.

WRC-23 agenda item 1.2

Agenda item title

1.2 to consider identification of the frequency bands 3 300-3 400 MHz, 3 600-3 800 MHz, 6 425-7 025 MHz, 7 025-7 125 MHz and 10.0-10.5 GHz for International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution 245 (WRC-19);

Discussion

The agenda item, based on the called for studies, seeks additional IMT identification, and possible new allocations to the mobile service identified for IMT on a primary basis in the frequency bands:

- 3 300-3 400 MHz (Region 1 & 2);
- 3 600-3 800 MHz (Region 2);
- 6 425-7 025 MHz (Region 1);
- 7 025-7 125 MHz (globally);
- 10.0-10.5 GHz (Region 2).

In parts of Region 2, as well as adjacent international airspace, the frequency band 5 925-6 700 MHz is used for aeronautical mobile telemetry for flight testing in accordance with the provisions of Resolution **416 (WRC-07)**.

Flight testing is key to maintaining and enhancing the safety of aircraft. Analysis of data gathered during flight testing is used to evaluate the aerodynamic flight characteristics of the vehicle and the performance of the systems onboard that vehicle in order to validate the design and its safety. The flight test phase allows any identified design issues to be addressed, as well as verifying and documenting the vehicles performance for government certification and customer acceptance.

It is key to ensure the integrity of the flight data. Any interference to the transmission or reception of flight test data, if spotted, may invalidate the test data gathered during that flight and hence require a repetition of that flight, or if not spotted, cause unnecessary work to be carried out to address an issue that does not exist.

Parts of the frequency bands 3 600-3 800 MHz and 6 425-7 025 MHz are allocated to the fixed satellite service (FSS) are used by FSS feeder links (downlinks and uplinks) of GSO mobile satellite service (MSS) networks to support the transmission of AMS(R)S communications in the 1.6/1.5 GHz bands, which is used to support ATC and aircraft operations by many ANSPs and airlines. GSO satellites have visibility over a very wide area (about one third of the Earth surface), so any interference to MSS feeder uplinks operated in the band 6 425-6 575 MHz could endanger aircraft operations over a similar-sized area.

Some GSO very small aperture terminals (VSAT) may operate in the FSS in some countries of Region 1 and Region 2 in the frequency bands 3 600-3 700 MHz and 6 425-6 525 MHz for the provision of aeronautical services.

ITU-R studies identified under Resolution **245 (WRC-19)** will need to be completed to determine the potential for sharing of IMT with the FSS. In advance of results of these studies, ITU-R Report S.2368 contains sharing studies between IMT-Advanced systems and GSO FSS in the 3 400-4 200 MHz and 4 500-4 800 MHz frequency bands in the WRC study cycle leading to WRC-15[4].

The report summarises the required separation distances presented in the individual technical studies to protect GSO FSS earth stations. The separation distances vary depending on the study and range from approximately ten to well over a hundred km for protection of the FSS interference criteria.

Studies have been conducted by the ITU-R to assess the aggregate interference from IMT systems to FSS satellites in the band 6 425-7 075 MHz. The studies show a range of results, in some cases showing interference below the FSS protection criterion, and in other cases showing interference above the criterion. The differences are mainly related to the scenarios used and to different assumptions on the number of IMT base station operating and their characteristics.

Recently ICAO has received several studies regarding the interference potential to radio altimeters from new mobile service systems planned to operate in frequency bands adjacent/nearby to that used by those altimeters. The radio altimeter is a mandated critical aircraft safety system operating in the 4 200-4 400 MHz frequency band and used to determine the aircraft's height above terrain, enabling several safety related flight operations and navigation functions on all commercial aircraft and a wide range of other civil aircraft types. Such functions and systems include terrain awareness, aircraft collision avoidance, wind shear detection, flight controls, and functions to automatically land an aircraft. Harmful interference to the function of the radio altimeter during any phase of flight would pose a serious safety risk. It is important to note, however, that the issues raised by the radio altimeter studies are not with the regulatory allocation and identification to the mobile service (i.e., it is not pertinent to WRC-23 agenda item 1.2 discussions), rather to how new systems are being authorized for deployment within that service. Work continues to assess any possible measures that might be needed, both near-term and in the future, to ensure compatible operation of radio altimeters and these new mobile service systems.

ICAO Position

To ensure that any IMT identification in the Region 2 in the frequency bands 3 600-3 800 MHz would include technical conditions to protect FSS in order to continue the use of these bands by the FSS for the provision of aeronautical services.

In case of any IMT identification in the frequency band 6 425-6 575 MHz in Region 1, regulatory provisions would be required for protecting FSS uplinks in order to continue the use of these bands by GSO FSS networks used for the provision of aeronautical services.

In case of any IMT identification in the frequency band 6 425-6 700 MHz in Region 1, to ensure that the flight test operations in accordance with Resolution **416 (WRC-07)** would not be affected in Region 2.

[4] Report ITU-R S.2368-0: Sharing studies between International Mobile Telecommunication-Advanced systems and geostationary satellite networks in the fixed-satellite service in the 3 400-4 200 MHz and 4 500-4 800 MHz frequency bands in the WRC study cycle leading to WRC-15 (https://www.itu.int/pub/R-REP-S.2368)

WRC-23 agenda item 1.3

Agenda item title

1.3 to consider primary allocation of the band 3 600-3 800 MHz to the mobile service in Region 1 and take appropriate regulatory actions, in accordance with Resolution 246 (WRC-19);

Discussion

The agenda item, based on the called for studies, seeks to upgrade the secondary allocation to the mobile service identified for IMT in the frequency band 3 600-3 800 MHz in Region 1.

Systems operating under the allocation to the fixed satellite service (FSS) in the frequency range 3 400-4 200 MHz provide ground infrastructure for the transmission of critical aeronautical and meteorological information. These systems are also used for feeder links to support systems providing an aeronautical mobile satellite (route) service. Reports ITU-R M.2109 & ITU-R S.2199 contain sharing studies between systems operating under an allocation to the FSS and international mobile telecommunication (IMT) systems and broadband wireless access systems respectively in the frequency range 3 400-4 200 MHz. Studies show a potential for interference from IMT and broadband wireless access stations into Earth station in the FSS at distances of up to several hundred kilometres. Such large separation distances would impose substantial constraints on both mobile and satellite deployments. The studies also show that interference can occur when IMT systems are operated in frequency bands adjacent to those used by the FSS.

In addition, WRC-12 adopted Resolution **154** (revised at WRC-15) to support existing and future operation of Earth stations in the FSS within the frequency band 3 400-4 200 MHz, as an aid to safe operation of aircraft and reliable distribution of meteorological information in some countries, mainly in Africa, of Region 1

Recently ICAO has received several studies regarding the interference potential to radio altimeters from new mobile service systems planned to operate in frequency bands adjacent/nearby to that used by those altimeters. The radio altimeter is a mandated critical aircraft safety system operating in the 4 200-4 400 MHz frequency band and used to determine the aircraft’s height above terrain, enabling several safety related flight operations and navigation functions on all commercial aircraft and a wide range of other civil aircraft types. Such functions and systems include terrain awareness, aircraft collision avoidance, wind shear detection, flight controls, and functions to automatically land an aircraft. Harmful interference to the function of the radio altimeter during any phase of flight would pose a serious safety risk.

It is important to note, however, that the issues raised by the radio altimeter studies are not with the regulatory allocation and identification to the mobile service (i.e., it is not pertinent to WRC-23 agenda item 1.3 discussions), rather to how new systems are being authorized for deployment within that service. Work continues to assess any possible measures that might be needed, both near-term and in the future, to ensure compatible operation of radio altimeters and these new mobile service systems.

ICAO Position

To ensure that any mobile allocation in Region 1 in the frequency bands 3 600-3 800 MHz would include technical conditions to protect FSS in order to continue the use of these bands by the FSS for the provision of aeronautical services, including GSO MSS feeder links for the purpose of supporting aeronautical services.

WRC-23 agenda item 1.4

Agenda item title

1.4 to consider, in accordance with Resolution 247 (WRC-19), the use of high-altitude platform stations as IMT base stations (HIBS) in the mobile service in certain frequency bands below 2.7 GHz already identified for IMT, on a global or regional level;

Discussion

At WRC-2000, the frequency bands 1 885-1 980 MHz, 2 010-2 025 MHz and 2 110-2 170 MHz in Regions 1 and 3, and the frequency bands 1 885-1 980 MHz and 2 110-2 160 MHz in Region 2 were identified in RR No. **5.388A** for possible use by high-altitude platform stations as international mobile telecommunications (IMT) base stations (HIBS) within the mobile service allocation. Resolution **221 (Rev.WRC-07)** referred to in RR No. **5.388A** stipulates technical conditions for HIBS necessary for the protection of ground-based IMT stations in neighbouring countries and other services based on the sharing and compatibility studies with IMT-2000.

In view of increasing demand to provide mobile broadband services to underserved areas and noting the increase in the number of frequency bands within which ground based IMT is deployed, there is a need to review the existing regulations for HIBS with a view to providing flexibility for the operators to deploy HIBS in all frequency bands below 2.7 GHz that are identified for IMT. This review should include the fact that HIBS are expected to be used as a part of terrestrial IMT networks and may use the same frequency bands as ground-based IMT base stations. As a result, this agenda item considers appropriate technical conditions and regulatory actions for HIBS in certain frequency bands below 2.7 GHz that are already identified for IMT, i.e.:

- 694-960 MHz;
- 1 710-1 885 MHz (1 710-1 815 MHz to be used for uplink only in Region 3);
- 2 500-2 690 MHz (2 500-2 535 MHz to be used for uplink only in Region 3, except 2 655-2 690 MHz in Region 3).

In accordance with *resolves* 2 of Resolution **247 (WRC-19)**, the sharing and compatibility studies under this agenda item should ensure the protection of services having allocations in the same and adjacent frequency bands.

One of the frequency bands considered for HIBS is 694-960 MHz, which is adjacent to the band 960-1 164 MHz allocated to AM(R)S and ARNS and heavily used by aeronautical systems, e.g., ADS-B, DME, LDACS, SSR etc.

Another frequency band being considered is 2 500-2 690 MHz which is close to the frequency band 2 700-2 900 MHz used for the provision of primary approach radars. Regarding that latter band, in order to enable the deployment of ground based IMT below 2 690 MHz the existing radars had to be modified to increase the receiver front end filter rejection in order to cope with the power in the IMT fundamental signal. The design of those modifications was based on a specific set of assumptions about the deployment of IMT base stations, the antenna characteristics including height and directivity, and the use of a specific terrestrial propagation model (Recommendation ITU-R P.452). Placing the IMT base station on a high-altitude platform changes the assumptions used in determining the modifications required to the radar receiver front ends to accommodate ground based IMT. It is essential to ensure that by placing the base station on a high-altitude platform the maximum level of signal received by the radar both in-band and out of band from IMT does not exceed those predicted during the studies on ground based IMT and on which the radar modifications were designed.

ICAO Position

To ensure that any identification of frequency bands for high-altitude platform stations as IMT-base stations (HIBs) should include provisions for the protection of aeronautical systems operating in the frequency bands 960-1 164 MHz and 2 700-2 900 MHz. To oppose the use of HIBS within the frequency band 2 500-2 690 MHz or parts thereof if agreed studies have not demonstrated the protection of aeronautical systems.

WRC-23 agenda item 1.6

Agenda item title

1.6 to consider, in accordance with Resolution 772 (WRC-19), regulatory provisions to facilitate radiocommunications for sub-orbital vehicles;

Discussion

Sub-orbital vehicles have been developed to reach altitudes and velocities that are much higher than conventional aircraft. Re-usable sub-orbital vehicles that launch like traditional rockets have become routine. Furthermore, with the advances in technology, re-useable sub-orbital vehicles that take off and land on a traditional runway are close to becoming a reality with companies testing such vehicles. These vehicles are intended to perform various missions, such as deploying satellites, conducting scientific research, or carrying passengers and cargo, and then returning to the Earth's surface. As one example, such vehicles could lead to hypersonic travel from Europe to Australia in 90 minutes, down from the current 24 hours.

The integration of sub-orbital vehicles into airspace managed by Member States will create various challenges for spectrum usage and frequency management. A sub-orbital vehicle could share airspace with conventional aircraft during certain portions of its flight, or be separated procedurally to maintain aviation safety. Therefore, there is a need, in some cases, for that vehicle to communicate with other airspace users and air traffic control, as decided by the **Member States**. These sub-orbital vehicles may use a number of different terrestrial and space services, some standardized by ICAO, in various ranges of frequency bands.

With respect to spectrum for systems and applications related to aviation safety, ICAO standardized systems are necessary for harmonization and interoperability with the air traffic management system. However, sub-orbital vehicles are intended to achieve altitudes and velocities that are much higher than conventional aircraft and hence do not always perform as an aircraft. Also, the way that on-board ICAO-standard terrestrial or satellite systems operate may not necessarily be consistent with the definitions in the RR. Therefore, in the current Radio Regulations, there is not a clear regulatory understanding as to how stations on board sub-orbital vehicles should be addressed and hence no clear understanding as to the radio service(s) under which they should operate.

Studies have shown that in principle from a technical perspective, some of the current ICAO standardized systems should have the capability, although potentially not the capacity, to provide suitable radio links for sub-orbital vehicles to operate safely. RR modifications (e.g., a WRC Resolution) may be required at WRC-23 to address the outcome of the studies under Resolution **772 (WRC-19)**. Any such changes to the Radio Regulations shall not create constraints on aeronautical operations.

ICAO Position

> To support the regulatory provision for terrestrial stations and earth stations required onboard a suborbital vehicle to safely integrate it into air traffic service airspace, as decided by the responsible Member State(s), to maintain the services under which these stations are classified.
>
> Any such changes to the Radio Regulations shall not create constraints on aeronautical operations.

WRC-23 agenda item 1.7

Agenda item title

1.7 to consider a new aeronautical mobile-satellite (R) service (AMS(R)S) allocation in accordance with Resolution 428 (WRC-19) for both the Earth-to-space and space-to-Earth directions of aeronautical VHF communications in all or part of the frequency band 117.975-137 MHz, while preventing any undue constraints on existing VHF systems operating in the AM(R)S, the ARNS, and in adjacent frequency bands;

Discussion

The use of low-Earth orbiting satellites for VHF aeronautical safety and regularity of flight messages between the pilot and controller have a potential to augment, but not replace, coverage of existing terrestrial VHF communications facilities. Several proposals currently being studied would provide complementary service to oceanic and remote regions that already exist for global navigation satellite systems and satellite-based surveillance systems. These implementations would all use existing on-board aircraft VHF radios without any needed modification.

Such an AMS(R)S system will provide significant operational benefits to many different regions globally, but may not be viable in all areas given the extensive usage of existing AM(R)S systems in some Administrations. Therefore, in addition to any applied ITU coordination procedures, complementary coordination procedures in the ICAO will need to be established to ensure that all relevant entities are consulted before any frequency is used and not constrain the current or future AM(R)S systems in the same band.

ICAO Position

To support a global primary allocation to the aeronautical mobile-satellite (route) service for both the Earth-to-space and space-to-Earth directions in all or part of the frequency band 117.975-137 MHz subject to the following conditions:

- The use of any new AMS(R)S allocation be limited to aeronautical VHF communications for safety and regularity of flight.
- Ensure the protection of existing primary terrestrial aeronautical systems in the 117.975-137 MHz band, and not constrain the planned usage of those systems.

The systems shall be implemented, operated, and planned, in accordance with international Standards and Recommended Practices and procedures established in accordance with the Convention on International Civil Aviation.

WRC-23 agenda item 1.8

Agenda item title

1.8 to consider, on the basis of ITU R studies in accordance with Resolution 171 (WRC-19), appropriate regulatory actions, with a view to reviewing and, if necessary, revising Resolution 155 (Rev.WRC-19) and No. 5.484B to accommodate the use of fixed-satellite service (FSS) networks by control and non-payload communications of unmanned aircraft systems;

Discussion

Resolution **155 (Rev.WRC-19)** was initially developed at WRC-15 and modified by WRC-19, with the aim of enabling the use of geostationary-satellite networks operating in the fixed-satellite service (FSS) to be used for the provision of unmanned aircraft control and non-payload communication (CNPC) in the following frequency bands:

– For downlink (space-to-Earth):
  - 10.95-11.2 GHz,
  - 11.45-11.7 GHz,
  - 11.7-12.2 GHz in Region 2,
  - 12.2-12.5 GHz in Region 3,
  - 12.5-12.75 GHz in Regions 1 and 3,
  - 19.7-20.2 GHz,

– For uplink (Earth-to-space):
  - 14-14.47 GHz,
  - 29.5-30.0 GHz.

Resolution **155 (Rev.WRC-19)**, in its *resolves*, contains the conditions under which an unmanned aircraft can use a satellite network operating in the FSS for CNPC. However, it was recognized when the Resolution was originally developed that:

- ICAO had yet to complete the development of the relevant international aeronautical Standards and Recommended Practices (SARPs);
- additional work would be required to assess the feasibility of using the satellite networks under the conditions contained in Resolution **155 (Rev.WRC-19)**;
- there may be inconsistencies between some of the ***resolves***;
- Resolution **155 (Rev.WRC-19)** was originally developed during WRC-15, and modifications may be required once the further study work and relevant ICAO SARPs material had been completed to ensure that the provisions of the Resolution meet the ICAO requirements.

Therefore, the Resolution as developed by WRC-15, contained a clause requiring WRC-23 “to consider the results of the above studies referred to in this Resolution with a view to reviewing and, if necessary, revising this Resolution, and take necessary actions, as appropriate”. It also precluded operational use of the FSS by UAS CNPC before the review by WRC-23.

At WRC-19 Resolution **155** was revised and WRC-23 agenda item 1.8 adopted that through Resolution **171 (WRC-19)** *resolved to invite the ITU Radiocommunication Sector* to:

- continue and complete in time for WRC-23 relevant studies of the technical, operational and regulatory aspects, based on the frequency bands mentioned in *resolves* 1 of Resolution **155 (Rev.WRC-19)**, in relation to the implementation of Resolution **155 (Rev.WRC-19)**, taking into account the progress obtained by ICAO in the completion of SARPs on use of the FSS for the UAS CNPC links;

- review RR No. **5.484B** and Resolution **155 (Rev.WRC-19)** taking into account the results of the above studies.

Additionally, Resolution **171 (WRC-19)** *invites the 2023 World Radiocommunication Conference* to revise, if necessary, RR No. **5.484B** and Resolution **155 (Rev.WRC-19)** and take other necessary actions, as appropriate, on the basis of the studies conducted under Resolutions **155 (Rev.WRC-19)** and **171 (WRC-19)**. Work on the ITU-R studies is continuing, and the final outcome of the work has not yet been reached in order to allow WRC-23 to make decisions.

In this context, ICAO is invited to develop aeronautical Standards and Recommended Practices (SARPs) identifying how UAS CNPC operates under the existing FSS primary allocation, based on Resolution **155 (Rev.WRC-19**). As a basis for developing these SARPs, since CNPC is a safety-of-life aeronautical system, ICAO is expecting that the decision of WRC-23 results in a Resolution that;

- clearly provides primary status;
- removes the apparent inconsistencies;
- acknowledges that in accordance with the Annexes of the Convention of the International Civil Aviation Organization (ICAO), ensuring the safety-of-life aspects of the use of UAS CNPC is the role of the responsible States;
- provides sufficient information to support and/or validate safety cases;
- ensures that the UAS CNPC operator is notified prior to any change in the service provision performance being implemented as a result of the satellite coordination process;
- ensures that any change as a result of a satellite coordination process does not adversely affect the initial service level agreement.

Within the ITU during the last study period work has made substantive progress on Document ITU-R M.[UA_PFD] - Review of power flux-density limits in accordance with *resolves* 16 of Resolution **155 (WRC-15)**, which addresses the various *resolves* within Resolution **155**, however this work has not been formally completed. It has to be noted that this document will contain critical information that will be used for assessing the feasibility of UAS CNPC for different operational conditions, by ICAO, under Resolution **155**.

Within ICAO work has progressed on the development of Standards and Recommended Practices (SARPs) material. The first package of SARPs, dealing with the identification of frequency bands (including those listed in *resolves* 1 of Resolution **155 (Rev.WRC-19)** and C2 Link procedures, has been adopted and became effective on 12 July 2021, following a review of comments received from States. The second package of SARPs, endorsed by the RPAS Panel in November 2022 and now proceeding to State letter review, addresses the technical solutions for the FSS systems and the other relevant *resolves* of Resolution **155**. ICAO will be responsible for the safety-of-life aspects of UAS CNPC under the existing RF environment given by Resolution **155**.

The Director of the Radiocommunication Bureau will decide if the conditions included in the *instructs the Director of the Radiocommunication Bureau* 4 of Resolution **155 (Rev.WRC-19)** have been met. If they have, satellite network filings submitted by administrations with a new class of station can then be considered for processing.

It should be noted that work under WRC-23 agenda item 1.16 (Resolution **173 (WRC-19)**) and WRC-23 agenda item 1.17 (Resolution **773 (WRC-19)**) may have impacts on the use of the FSS by UAS CNPC during the WRC-23 cycle. The implications of any proposed amendment under these agenda items to the Radio Regulations need to be assessed and action taken, if necessary, to ensure that the radio regulatory provisions established during WRC-23 do not adversely impact the use of the frequency bands 19.7-20.2 GHz and 29.5-30.0 GHz by unmanned aircraft for CNPC.

ICAO Position

To support the modification of RR No. **5.484B** and Resolution **155 (Rev.WRC-19)**.

ICAO is expecting that the decision of WRC-23 will result in a Resolution that:

- clearly provides primary status;
- removes any apparent inconsistencies;
- acknowledges that in accordance with the Annexes of the Convention of the International Civil Aviation Organization (ICAO), ensuring the safety-of-life aspects of the use of UAS CNPC is the role of the responsible States;
- provides sufficient information to support and/or validate safety cases; and
- ensures that the UAS CNPC operator is notified prior to any change in the service provision performance being implemented as a result of the satellite coordination process;
- ensures that any change as a result of a satellite coordination process does not adversely affect the initial service level agreement.

WRC-23 agenda item 1.9

Agenda item title

1.9 to review Appendix 27 of the Radio Regulations and consider appropriate regulatory actions and updates based on ITU-R studies, in order to accommodate digital technologies for commercial aviation safety-of-life applications in existing HF bands allocated to the aeronautical mobile (route) service and ensure coexistence of current HF systems alongside modernized HF systems, in accordance with Resolution 429 (WRC-19);

Discussion

HF is the only terrestrial service with means of providing ubiquitous global communication coverage for aircraft, and is still the long-range system required by many aviation regulators for the provision of safety and regularity of flight communications in oceanic, polar and remote areas. Access to the various frequency bands in the range 2 850-22 000 kHz assigned to the aeronautical mobile (route) service (AM(R)S) is therefore essential. Since the last substantive review of Appendix **27** at the 1979 World Administrative Radio Conference, use of HF by aviation has continued to evolve and grow, especially with the introduction of HF datalink in the 1990s; now used by many airlines.

To date, operational capacity has been limited by the number of 3 kHz channels available in the HF band. However, the development of advanced digital techniques, including new waveforms, allows the aggregation of independent 3 kHz channels (either contiguous or non-contiguous) into wideband links. This opens the possibly for simultaneous transmission of voice and data, thus improving capacity, connectivity, and quality of HF communication systems. Aviation would like to take advantage of these developments to provide aircraft with additional capabilities and to improve the reliability, availability and continuity of communications especially when used in conjunction with existing L-band aviation SATCOM systems.

In order to take advantage of the various benefits that a modern wideband HF communication system could offer, Appendix **27** of the Radio Regulations needs to be modified to allow the introduction of new digital wideband systems in accordance with Resolution **429 (WRC-19)**. For the purpose of this agenda item, the term “wideband” in HF communications may refer to a combination of multiple 3 kHz channels to provide improved data rates. With the availability of advanced digital technologies and the demonstrated capabilities of aeronautical wideband HF, including contiguous or non-contiguous channel aggregation, faster data rates and digital voice communications are possible.

Studies have identified minor changes to Appendix **27** that would both protect current users of aeronautical HF, and allow for the aggregation of narrowband channels into wideband links to support growing aviation need.

ICAO Position

To support modification of Appendix **27** to the Radio Regulations for explicitly recognizing digital HF wideband aeronautical communication systems in a manner fully compatible with existing aeronautical HF assignments, and without modifying the Appendix **27** allotment plan. Those systems shall be operated in accordance with international Standards and Recommended Practices and procedures established in accordance with the Convention on International Civil Aviation.

WRC-23 agenda item 1.10

Agenda item title

1.10 to conduct studies on spectrum needs, coexistence with radiocommunication services and regulatory measures for possible new allocations for the aeronautical mobile service for the use of non-safety aeronautical mobile applications, in accordance with Resolution 430 (WRC-19);

Discussion

As technology has developed and miniaturization has advanced, it has become possible to use aircraft as platforms for payload applications such as fire and border surveillance, air quality and environment monitoring, video surveillance, terrain mapping, and imagery such as film-making. As a result, the number of aircraft equipped with sensors and the demand for associated communication links to offload large amounts of data has also grown and is expected to continue to grow. Those communication links, whilst not associated with aeronautical safety, can be mission critical in providing data or sensor control for the application that they are supporting.

At the same time, there is no clear identification of the frequency bands in which non-safety aeronautical mobile applications can operate, due in-part to the limitations often placed on existing mobile allocations that either preclude or place technical/operational restrictions that are not compatible with aeronautical use. This has stifled further development due to a lack of confidence within the industry of long-term spectrum access and stability.

In consequence, there is a need for adaptation of the current regulatory framework in order to clearly identify spectrum that could only be used for aeronautical payload communication, giving the industry the stability it needs to allow it to develop innovative applications that can deliver tangible benefits. However, it is important that there is a clear distinction between such systems and those used to provide safety and regularity of flight communications, including UAS command and control functions.

The objective of this agenda item is to assess spectrum requirements for new non-safety aeronautical mobile service applications and seek:

- possible new primary allocations to the aeronautical mobile service in frequency band 15.4-15.7 GHz for such non-safety aeronautical applications; and
- possible revision of the “except aeronautical mobile” in the frequency band 22-22.21 GHz, already allocated on a primary basis to the mobile, except aeronautical mobile, service.

ICAO Position

Based upon the agreed results of studies, not to oppose new allocations to the aeronautical mobile service for use by non-safety aeronautical mobile applications on a primary basis in the frequency bands 15.4-15.7 GHz and 22-22.21 GHz.

To ensure that any such modification does not adversely affect the status or provision of aeronautical safety services.

WRC-23 agenda item 1.11

Agenda item title

1.11 to consider possible regulatory actions to support the modernization of the Global Maritime Distress and Safety System and the implementation of e-navigation, in accordance with Resolution 361 (Rev.WRC-19);

Discussion

Aircraft, of which helicopters are a subset, are an integral part of the global maritime distress and safety system, providing a rapid search capability that can affect a rescue or direct surface vessels to the scene of the incident. As such, they are fitted with appropriate Global Maritime Distress and Safety System (GMDSS) radio equipment to facilitate such activities. It is therefore essential to ensure that any change to the regulatory provisions and spectrum allocations resulting from this agenda item do not adversely impact on the capability of search and rescue aircraft to effectively communicate with vessels during disaster relief operations.

In addition, ICAO requires, inter alia, that satellite systems supporting aeronautical satellite safety communications (aeronautical mobile-satellite (route) service), must comply with priority requirements contained in ICAO Standards and Recommended Practices (SARPs). Therefore, if a system which already carries such communications were to be approved by the International Maritime Organization and identified to carry GMDSS, any resultant changes to the Radio Regulations should not adversely impact that, or other, system's SARPs compliance.

ICAO Position

To ensure that any change to the regulatory provisions and spectrum allocations resulting from this agenda item do not adversely impact on the capability of search and rescue aircraft, including helicopters, to effectively communicate with vessels during disaster-relief operations.

With respect to Resolution **361 (Rev.WRC-19)**, *resolves* 3, to ensure that any regulatory provisions in response to this agenda item do not adversely affect the compliance of aeronautical mobile-satellite (route) service systems in the frequency band 1 610-1 626.5 MHz with international standards and recommended practices and procedures established in accordance with the Convention on International Civil Aviation.

WRC-23 agenda item 1.13

Agenda item title

1.13 to consider a possible upgrade of the allocation of the frequency band 14.8-15.35 GHz to the space research service, in accordance with Resolution 661 (WRC-19);

Discussion

Under this agenda item, the following studies are to be conducted:

a) to investigate and identify all relevant scenarios between data relay satellites, non-geostationary satellites and manned flights in the space research service operating in the frequency band 14.8-15.35 GHz, to investigate and identify all relevant scenarios that need to be considered in compatibility and sharing studies, taking into account the latest relevant ITU Radiocommunication Sector (ITU-R) Recommendations;

b) to conduct and complete in time for WRC-23 sharing and compatibility studies in order to determine the feasibility of upgrading the SRS allocation to primary status in the frequency band 14.8-15.35 GHz, with a view to ensuring protection of the primary services;

c) to determine the technical and regulatory conditions according to the results of the studies necessary to ensure b) above.

Currently, the frequency band 14.8-15.35 GHz is allocated to the generic mobile and fixed services on a primary basis. According to Recommendations ITU-R M.2089 mentioned in *noting a)* of Resolution **661** (**WRC-19**), systems operating in the aeronautical mobile service in the frequency range 14.5-15.35 GHz are used by airborne data links to support remote sensing applications on board either manned or unmanned aircraft. In addition, in some States systems operating under the fixed service allocation are used to support air traffic operations. Neither of these applications use ICAO standardized systems.

ICAO Position

To ensure that any radio regulatory action taken as a result of agreed studies does not adversely affect the provision of aeronautical services.

WRC-23 agenda item 1.15

Agenda item title

1.15 to harmonize the use of the frequency band 12.75-13.25 GHz (Earth-to-space) by earth stations on aircraft and vessels communicating with geostationary space stations in the fixed-satellite service globally, in accordance with Resolution 172 (WRC-19);

Discussion

This agenda item seeks to harmonize the use of the frequency band 12.75-13.25 GHz (Earth-to-space) by earth stations on board an aircraft or vessel communicating with geostationary space stations in the fixed satellite service operating in accordance with the provisions of RR Appendix **30B** (No. **5.441**). It resolves that such earth stations shall not be used or relied upon for safety-of-life applications nor result in changes or restrictions to existing Plan allotments and List assignments made under RR Appendix **30B**.

Resolution **172 (WRC-19)** calls for studies to:

- Identify the technical and operational characteristics and user requirements of earth stations on aircraft and vessels that communicate or plan to communicate with geostationary (GSO) space stations in the FSS in the frequency band 12.75-13.25 GHz (Earth-to-space) under the envelope of RR Appendix **30B** Article 6 recorded in the List or the Master International Frequency Register (MIFR) with favourable finding only;
- address the sharing and compatibility issues between earth stations on aircraft and vessels communicating with GSO space stations in the fixed satellite service with current and planned stations of existing services as well as services in adjacent frequency bands;
- to study the responsibility of the entities involved in the operation of the earth stations on aircraft and vessels;
- to develop the criteria to ensure that earth stations on aircraft and vessels, as a new FSS application in this frequency band, shall not claim more protection nor cause more interference than filed earth stations in RR Appendix **30B**.

Once consensus has been reached on those studies the Resolution calls on the ITU-R to develop technical conditions and regulatory provisions for the harmonised operation of earth stations on aircraft and vessels communicating with GSO space stations in the FSS operating in the frequency band 12.75-13.25 GHz (Earth-to-space). Those technical conditions and regulatory provisions shall ensure the protection of and not impose undue constraints on, the existing services in that frequency band. Additionally, they shall not adversely affect the criteria contained in Annex 4 to RR Appendix **30B** including the cumulative effect of multiple earth stations on aircraft and vessels nor limit access of other administrations to their national resources in RR Appendix **30B**.

WRC-23 should then consider the relevant regulatory action necessary based on the work, as detailed above, undertaken during this study period whilst ensuring that any action taken does not result in any additional status than that of the GSO satellite networks with which these stations are communicating.

The introduction of earth station in motion operations into a frequency band that is subject to RR Appendix **30B** restrictions could provide a welcome additional capacity for non-safety passenger/payload communication. Additionally, given the restriction that such use shall not be or relied upon for safety-of-life communication this agenda item should not adversely affect the provision of aeronautical safety service. However, how this agenda item develops needs to be monitored to ensure that modifications are not introduced that change that expectation.

See also WRC-23 agenda item 1.16.

ICAO Position

To ensure that any radio regulatory action, taken as a result of this agenda item, does not adversely affect the provision of aeronautical safety-of-life services.

WRC-23 agenda item 1.16

Agenda item title

1.16 to study and develop technical, operational and regulatory measures, as appropriate, to facilitate the use of the frequency bands 17.7-18.6 GHz, 18.8-19.3 GHz and 19.7-20.2 GHz (space-to-Earth) and 27.5-29.1 GHz and 29.5-30 GHz (Earth-to-space) by non-geostationary fixed-satellite service earth stations in motion, while ensuring due protection of existing services in those frequency bands, in accordance with Resolution 173 (WRC-19);

Discussion

This agenda item seeks to extend the concept of earth stations in motion (ESIMs) communicating with geostationary space stations, to operation of ESIMs with non-geostationary space stations in the fixed-satellite service (FSS) to the 17.7-18.6 GHz, 18.8-19.3 GHz, 19.7-20.2 GHz (space-to-Earth), 27.5-29.1 GHz and 29.5-30 GHz frequency bands.

Resolution **173 (WRC-19)** calls for studies to:

- identify the technical and operational characteristics and user requirements of the different types of ESIMs that plan to operate within non-geostationary (non-GSO) satellite systems operating in the FSS in the frequency bands or parts thereof identified;
- address the sharing and compatibility between ESIMs communicating with non-GSO FSS systems and current & planned stations of primary services allocated in the frequency bands identified as well as in the adjacent frequency bands.

The Resolution also calls on the ITU-R to develop technical conditions and regulatory provisions for the operation of aeronautical and maritime ESIMs communicating with non-GSO space stations operating in the FSS in the frequency bands identified. Those technical conditions and regulatory provisions shall ensure the protection of and not impose additional constraints on the existing services in the frequency bands identified.

ITU-R should also consider the relevant regulatory action necessary based on the work, as detailed above, undertaken during this study period.

It should be noted that the frequency bands 19.7-20.2 GHz and 29.5-30.0 GHz are identified within Resolution **155 (Rev.WRC-19)** for the provision of unmanned aircraft systems (UAS) control and non-payload communication (CNPC). However, both Resolution **156 (WRC-15)** that regulates the use of these frequency bands for ESIMs communicating to GSO satellites and Resolution **173 (WRC-19)** that seeks to facilitate the use of ESIMs communicating to non-GSO satellites in these frequency bands preclude the use of the relevant ESIMs from being used or relied upon for safety-of-life applications. The implications of any proposed amendment under WRC-23 agenda item 1.16 to the Radio Regulations need to be assessed and action taken if they:

- could adversely affect the provision of UAS CNPC under Resolution **155 (Rev.WRC-19)**;
- do not make a clear regulatory distinction between satellite networks or satellite network resources providing UAS CNPC and those providing non-safety ESIMs applications such that it does not set a precedent that could adversely affect the provision of aeronautical safety-of-life services.

See also WRC-23 agenda items 1.8, 1.15 and 1.17.

ICAO Position

To ensure that any radio regulatory action taken as a result of this agenda item:

- do not adversely affect the provision of UAS CNPC under Resolution **155 (Rev.WRC-19)**;
- make a clear regulatory distinction between satellite networks or satellite network resources providing UAS CNPC and those providing non-safety ESIMs applications such that it does not set a precedent that could adversely affect the provision of aeronautical safety-of-life services.

WRC-23 agenda item 1.17

Agenda item title

1.17 to determine and carry out, on the basis of ITU-R studies in accordance with Resolution 773 (WRC-19), the appropriate regulatory actions for the provision of inter-satellite links in specific frequency bands, or portions thereof, by adding an inter-satellite service allocation where appropriate;

Discussion

Inter-satellite links have traditionally been used to relay communication between space stations, normally situated on non-geostationary satellites, and an earth station where direct communication is impeded for some reason such as being beyond visual line of sight. With the planned expansion in the use of low earth orbit satellites the demand for inter-satellite links and associated spectrum is also increasing. This agenda item seeks to develop the technical conditions and regulatory provisions, including potential new allocations to the inter-satellite service, by which the different types of space station can operate inter-satellite links in the frequency bands 11.7-12.7 GHz, 18.1-18.6 GHz, 18.8-20.2 GHz and 27.5-30 GHz.

Resolution **773 (WRC-19)** calls for studies to:

- identify the technical and operational characteristics, including spectrum requirements, for transmissions between space stations in the frequency bands 11.7-12.7 GHz, 18.1-18.6 GHz, 18.8-20.2 GHz and 27.5-30 GHz;
- address the sharing and compatibility between satellite-to-satellite links intending to operate between space stations in the frequency bands 11.7-12.7 GHz, 18.1-18.6 GHz, 18.8-20.2 GHz and 27.5-30 GHz and current and planned stations of the FSS and other existing services allocated in same frequency bands and adjacent frequency bands,

Based on those studies the Resolution calls on the ITU-R to develop, for different types of space stations, the technical conditions and regulatory provisions for satellite-to-satellite operations, including potential new inter-satellite service allocations, in the frequency bands identified.

WRC-23 should then consider the relevant regulatory action necessary based on the work, as detailed above, undertaken during this study period whilst ensuring the protection of the fixed and mobile services allocated on a primary basis within the identified frequency bands.

It should be noted that the frequency bands 19.7-20.2 GHz and 29.5-30.0 GHz are identified within Resolution **155 (Rev.WRC-19)** for the provision of unmanned aircraft systems (UAS) control and non-payload communication (CNPC). It is therefore important that the implications of any proposed amendment under WRC-23 agenda item 1.17 to the Radio Regulations are assessed and action taken if they could adversely affect the provision of UAS CNPC under Resolution **155 (Rev.WRC-19)**,

See also WRC-23 agenda items 1.8 and 1.16.

ICAO Position

> To ensure that, given the overlap in frequency bands, any radio regulatory action taken as a result of this agenda item does not adversely affect the protection of the GSO stations in the frequency bands listed in Resolution **155 (Rev.WRC-19)**.

WRC-23 agenda item 4

Agenda item title

4 in accordance with Resolution 95 (Rev.WRC-19), to review the Resolutions and Recommendations of previous conferences with a view to their possible revision, replacement or abrogation;

ICAO Position

Resolutions:

Resolution No.	Title	Action recommended
18 *(Rev.WRC-15)*	Relating to the procedure for identifying and announcing the position of ships and aircraft of States not parties to an armed conflict.	No change
20 *(Rev.WRC-03)*	Technical cooperation with developing countries in the field of aeronautical telecommunications.	No change
26 *(Rev.WRC-19)*	Footnotes to the Table of Frequency Allocations in Article **5** of the Radio Regulations.	No change
27 *(Rev.WRC-19)*	Use of incorporation by reference in the Radio Regulations.	No change
63 *(Rev.WRC-12)*	Protection of radiocommunication services against interference caused by radiation from industrial, scientific and medical (ISM) equipment.	No change
76 *(Rev.WRC-15)*	Protection of geostationary fixed-satellite service and geostationary broadcasting-satellite service networks from the maximum aggregate equivalent power flux-density produced by multiple non-geostationary fixed-satellite service systems in frequency bands where equivalent power flux-density limits have been adopted.	No change
95 *(Rev.WRC-19)*	General review of the resolutions and recommendations of world administrative radio conferences and world radiocommunication conferences.	No change
114 *(Rev.WRC-15)*	Studies on compatibility between new systems of the aeronautical radionavigation service and the fixed-satellite service (Earth-to-space) (limited to feeder links of the non-geostationary mobile-satellite systems in the mobile-satellite service) in the frequency band 5 091-5 150 MHz.	No change

Resolution No.	Title	Action recommended
140 *(Rev.WRC-15)*	Measures and studies associated with the equivalent power flux-density (epfd) limits in the band 19.7-20.2 GHz.	No change
154 *(WRC-15)*	Consideration of technical and regulatory actions in order to support existing and future operation of fixed-satellite service earth stations within the band 3 400-4 200 MHz, as an aid to the safe operation of aircraft and reliable distribution of meteorological information in some countries in Region 1.	No change
155 *(Rev.WRC-19)*	Regulatory provisions related to earth stations on board unmanned aircraft which operate with geostationary-satellite networks in the fixed-satellite service in certain frequency bands not subject to a plan of Appendices **30**, **30A** and **30B** for the control and non-payload communications of unmanned aircraft systems in non-segregated airspaces.	Subject to WRC-23 agenda item 1.8.
156 *(WRC-15)*	Use of the frequency bands 19.7-20.2 GHz and 29.5-30.0 GHz by earth stations in motion communicating with geostationary space stations in the fixed-satellite service	Modify if necessary to ensure clear distinction between ESIMs providing non-safety applications and unmanned aircraft control and non-payload communication covered in Resolution
160 *(WRC-15)*	Facilitating access to broadband applications delivered by high-altitude platform stations.	Suppress based on the results of studies carried out under WRC-19 agenda item 1.14.
165 *(WRC-19)*	Use of the frequency band 21.4-22 GHz by high-altitude platform stations in the fixed service in Region 2	No change
166 *(WRC-19)*	Use of the frequency band 24.25-27.5 GHz by high-altitude platform stations in the fixed service in Region 2	No change
167 *(WRC-19)*	Use of the frequency band 31-31.3 GHz by high-altitude platform stations in the fixed service	No change

Resolution No.	Title	Action recommended
168*(WRC-19)*	Use of the frequency band 38-39.5 GHz by high-altitude platform stations in the fixed service	No change
171 *(WRC-19)*	Review and possible revision of Resolution **155 (Rev.WRC-19)** and No. **5.484B** in the frequency bands to which they apply	Subject to WRC-23 agenda item 1.8.
172 *(WRC-19)*	Operation of earth stations on aircraft and vessels communicating with geostationary space stations in the fixed-satellite service in the frequency band 12.75-13.25 GHz (Earth-to-space)	Subject to WRC-23 agenda item 1.15.
173 *(WRC-19)*	Use of the frequency bands 17.7-18.6 GHz, 18.8-19.3 GHz and 19.7-20.2 GHz (space-to-Earth) and 27.5-29.1 GHz and 29.5-30 GHz (Earth-to-space) by earth stations in motion communicating with non-geostationary space stations in the fixed-satellite service	Subject to WRC-23 agenda item 1.16.
176 *(WRC-19)*	Use of the frequency bands 37.5-39.5 GHz (space-to-Earth), 40.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) by aeronautical and maritime earth stations in motion communicating with geostationary space stations in the fixed-satellite service	Modify or suppress as necessary based on the results of studies carried out (preliminary WRC-27 agenda item 2.2).
205 *(Rev.WRC-19)*	Protection of the systems operating in the mobile satellite service in the band 406-406.1 MHz.	No change
207 *(Rev.WRC-15)*	Measures to address unauthorized use of and interference to frequencies in the bands allocated to the maritime mobile service and to the aeronautical mobile (R) service.	No change
217 *(WRC-97)*	Implementation of wind profiler radars.	No change
222 *(Rev.WRC-12)*	Use of the frequency bands 1 525-1 559 MHz and 1 626.5-1 660.5 MHz by the mobile-satellite service, and procedures to ensure long-term spectrum access for the aeronautical mobile-satellite (R) service.	No change

Resolution No.	Title	Action recommended
223 *(Rev WRC-19)*	Additional frequency bands identified for International Mobile Telecommunications	Modify, retain, or suppress, *invites the ITU Radiocommunications Sector* 1 to Resolution **223**, as appropriate, reflecting the need for continued studies, based on the results of the studies called for by that provision.
225 *(Rev.WRC-12)*	Use of additional frequency bands for the satellite component of IMT.	No change
229 *(Rev.WRC-19)*	Use of the frequency bands 5 150-5 250 MHz, 5 250-5 350 MHz and 5 470-5 725 MHz by the mobile service for the implementation of wireless access systems including radio local area networks	No change
240 *(WRC-19)*	Spectrum harmonization for railway radiocommunication systems between train and trackside within the existing mobile-service allocations.	Monitor studies and ensure protection of aeronautical systems.
245 *(WRC-19)*	Studies on frequency-related matters for the terrestrial component of International Mobile Telecommunications identification in the frequency bands 3 300-3 400 MHz, 3 600-3 800 MHz, 6 425-7 025 MHz, 7 025-7 125 MHz and 10.0-10.5 GHz	Subject to WRC-23 agenda item 1.2.
246 *(WRC-19)*	Studies to consider possible allocation of the frequency band 3 600-3 800 MHz to the mobile, except aeronautical mobile, service on a primary basis within Region 1	Subject to WRC-23 agenda item 1.3.
247 *(WRC-19)*	Facilitating mobile connectivity in certain frequency bands below 2.7 GHz using high-altitude platform stations as International Mobile Telecommunications base stations	Subject to WRC-23 agenda item 1.4.

Resolution No.	Title	Action recommended
249 *(WRC-19)*	Study of technical and operational issues and regulatory provisions for space-to-space transmissions in the Earth-to-space direction in the frequency bands [1 610-1 645.5 and 1 646.5-1 660.5 MHz] and the space-to-Earth direction in the frequency bands [1 525-1 544 MHz], [1 545-1 559 MHz], [1 613.8-1 626.5 MHz] and [2 483.5-2 500 MHz] among non-geostationary and geostationary satellites operating in the mobile-satellite service	Modify or suppress as necessary based on the results of studies carried out for WRC-27 (preliminary WRC-27 agenda item 2.8)
250 *(WRC-19)*	Studies on possible allocations to the land mobile service (excluding International Mobile Telecommunications) in the frequency band 1 300-1 350 MHz for use by administrations for the future development of terrestrial mobile-service applications	Modify or suppress as necessary based on the results of studies carried out for WRC-27 (preliminary WRC-27 agenda item 2.9)
251 *(WRC-19)*	Removal of the limitation regarding aeronautical mobile in the frequency range 694-960 MHz for the use of International Mobile Telecommunications user equipment by non-safety applications	Modify or suppress as necessary based on the results of studies carried out for WRC-27 (preliminary WRC-27 agenda item 2.12)
339 *(Rev.WRC-07)*	Coordination of NAVTEX services.	No change
354 *(WRC-07)*	Distress and safety radiotelephony procedures for 2 182 kHz.	No change
356 *(WRC-07)*	ITU maritime service information registration.	No change
361 *(Rev.WRC-19)*	Consideration of regulatory provisions for modernization of the global maritime distress and safety system and related to the implementation of e-navigation.	Subject to WRC-23 agenda item 1.11.
405 *(Geneva 1979)*	Relating to the use of frequencies of the aeronautical mobile (R) service.	Subject to WRC-23 agenda item 1.9.
413 *(Rev.WRC-12)*	Use of the band 108-117.975 MHz by aeronautical service.	No change
417 *(Rev.WRC-12)*	Use of the frequency band 960-1 164 MHz by the aeronautical mobile (R) service.	No change

Resolution No.	Title	Action recommended
418 (*Rev.WRC-15*)	Use of the band 5 091-5 250 MHz by the aeronautical mobile service for telemetry applications.	No change
422 *(WRC-12)*	Development of methodology to calculate aeronautical mobile-satellite (R) service spectrum requirements within the frequency bands 1 545-1 555 MHz (space-to-Earth) and 1 646.5-1 656.5 MHz (Earth-to-space).	Suppress as a result of the approval of Recommendation ITU-R M.2091.
424 *(WRC-15)*	Use of wireless avionics intra-communications in the frequency band 4 200-4 400 MHz.	No change
425 *(Rev.WRC-19)*	Use of the frequency band 1 087.7-1 092.3 MHz by the aeronautical mobile-satellite (R) service (Earth-to-space) to facilitate global flight tracking for civil aviation.	No change
428 *(WRC-19)*	Studies on a possible new allocation to the aeronautical mobile-satellite (R) service within the frequency band 117.975-137 MHz in order to support aeronautical VHF communications in the Earth-to-space and space-to-Earth directions	Subject to WRC-23 agenda item 1.7.
429 *(WRC-19)*	Consideration of regulatory provisions for updating Appendix 27 of the Radio Regulations in support of aeronautical HF modernization	Subject to WRC-23 agenda item 1.9.
430 *(WRC-19)*	Studies on frequency-related matters, including possible additional allocations, for the possible introduction of new non-safety aeronautical mobile applications	Subject to WRC-23 agenda item 1.10.
608 *(Rev.WRC-19)*	Use of the frequency band 1 215-1 300 MHz by systems of the radionavigation satellite service.	No change
609 *(Rev.WRC-07)*	Protection of aeronautical radionavigation systems from the equivalent power flux-density produced by radionavigation satellite service networks and systems in the 1 164-1 215 MHz band.	No change
610 *(Rev.WRC-19)*	Coordination and bilateral resolution of technical compatibility issues for radionavigation satellite networks and systems in the band 1 164-1 300 MHz, 1 559-1 610 MHz and 5 010-5 030 MHz.	No change

Resolution No.	Title	Action recommended
612 (*Rev.WRC-12*)	Use of the radiolocation service between 3 and 50 MHz to support oceanographic radar operations.	No change
660 (*WRC-19*)	Use of the frequency band 137-138 MHz by non-geostationary satellites with short-duration missions in the space operation service.	No change
661 *(WRC-19)*	Examination of a possible upgrade to primary status of the secondary allocation to the space research service in the frequency band 14.8-15.35 GHz	Subject to WRC-23 agenda item 1.13.
705 *(Rev.WRC-15)*	Mutual protection of radio services operating in the band 70-130 kHz.	No change
729 *(Rev.WRC-07)*	Use of frequency adaptive systems in the MF and HF bands.	No change
748 (*Rev.WRC-19*)	Compatibility between the aeronautical mobile (R) service and the fixed satellite service (Earth-to-space) in the band 5 091-5 150 MHz.	No change
762 *(WRC-15)*	Application of power flux density criteria to assess the potential for harmful interference under No. **11.32A** for fixed-satellite and broadcasting-satellite service networks in the 6 GHz and 10/11/12/14 GHz bands not subject to a plan.	No change
772 *(WRC-19)*	Consideration of regulatory provisions to facilitate the introduction of sub-orbital vehicles.	Subject to WRC-23 agenda item 1.6.
773 *(WRC-19)*	Study of technical and operational issues and regulatory provisions for satellite-to-satellite links in the frequency bands 11.7-12.7 GHz, 18.1-18.6 GHz, 18.8 20.2 GHz and 27.5-30 GHz	Subject to WRC-23 agenda item 1.17.
774 *(WRC-19)*	Studies on technical and operational measures to be applied in the frequency band 1 240-1 300 MHz to ensure the protection of the radionavigation-satellite service (space-to-Earth)	Subject to WRC-23 agenda item 9.1 topic b).

Recommendations:

Recommendation No.	Title	Action recommended
7 *(Rev.WRC-97)*	Adoption of standard forms for ship station and ship earth station licences and aircraft station and aircraft earth station licences.	No change
9	Relating to the measures to be taken to prevent the operation of broadcasting stations on board ships or aircraft outside national territories.	No change
71	Relating to the standardization of the technical and operational characteristics of radio equipment.	No change
75 *(Rev.WRC-15)*	Study of the boundary between the out-of-band and spurious domains of primary radars using magnetrons.	No change
401	Relating to the efficient use of aeronautical mobile (R) worldwide frequencies.	No change
608 *(Rev.WRC-07)*	Guidelines for consultation meetings established in Resolution **609 (WRC-07)**.	No change

WRC-23 agenda item 8

Agenda item title

8 to consider and take appropriate action on requests from administrations to delete their country footnotes or to have their country name deleted from footnotes, if no longer required, taking into account Resolution 26 (Rev.WRC-19);

Discussion

Allocations to the aeronautical services are generally made for all ITU regions and normally on an exclusive basis. These principles reflect the global process of standardization within ICAO for the promotion of safety and to support the global interoperability of radiocommunication and radionavigation equipment used in civil aircraft. In some instances, however, footnotes to the ITU Table of Frequency Allocations allocate spectrum in one or more countries to other radio services in addition or alternatively to the aeronautical service to which the same spectrum is allocated in the body of the table.

The use of country footnote allocations to non-aeronautical services in aeronautical bands is generally not recommended by ICAO, on safety grounds, as such use may result in harmful interference to safety services. Furthermore, this practice generally leads to an inefficient use of available spectrum to aeronautical services, particularly when the radio systems sharing the band have differing technical characteristics. It also may result in undesirable (sub-) regional variations with respect to the technical conditions under which the aeronautical allocations can be used. This can have a serious impact on the safety of aviation.

The following footnotes in aeronautical bands should be carefully reviewed by administrations in order to preserve the safety and efficiency of aeronautical services for the reasons as discussed below:

a) In the frequency bands used for the ICAO instrument landing system (ILS), (marker beacons 74.8-75.2 MHz; localizer 108-112 MHz and glide path 328.6-335.4 MHz) and the VHF omnidirectional radio range system (VOR); 108-117.975 MHz, RR Nos. **5.181**, **5.197** and **5.259** allow for the introduction of the mobile service on a secondary basis and subject to agreement obtained under No. **9.21** of the Radio Regulations when these bands are no longer required for the aeronautical radionavigation service. The use of both ILS and VOR is expected to continue. In addition, WRC-03, as amended by WRC-07, has introduced RR No. **5.197A** stipulating that the band 108-117.975 MHz is also allocated on a primary basis to the aeronautical mobile (R) service (AM(R)S), limited to systems operating in accordance with recognized international aeronautical standards. Such use shall be in accordance with Resolution **413 (Rev.WRC-12)**. The use of the band 108-112 MHz by the AM(R)S shall be limited to systems composed of ground-based transmitters and associated receivers that provide navigational information in support of air navigation functions in accordance with recognized international aeronautical standards. ICAO encourages administrations listed in RR Nos. **5.181**, **5.197** and **5.259** to review their use and if no longer required, to remove their country's name from these footnotes.

b) RR Nos. **5.201** and **5.202** allocate the frequency bands 132-136 MHz and 136-137 MHz in some States to the aeronautical mobile (off-route) service (AM(OR)S). Since these frequency bands are heavily utilized for ICAO-standard VHF voice and data communications, ICAO encourages those concerned administrations to review their use and if no longer required, to remove their country's name from these footnotes.

c) In the frequency band 1 215-1 300 MHz, which is used by civil aviation for the provision of radionavigation services through RR No. **5.331**. RR footnote No. **5.330** allocates the band in a number of countries to the fixed and mobile service. Given the receiver sensitivity of aeronautical uses of the frequency band, ICAO does not support the continued inclusion of an additional service through country footnotes. ICAO would therefore encourage administrations to review their use and if no longer required, to remove their country's name from RR No. **5.330**.

d) In the frequency band 1 525-1 530 MHz, which is used by civil aviation for the provision of satellite services RR No. **5.352A** specifies that stations in the mobile-satellite service, except stations in the maritime mobile-satellite service, shall not cause harmful interference to, or claim protection from, stations of the fixed service in a number of countries that were notified prior to 1 April 1998. As of August 2020, the ITU Master International Frequency Register shows out of 20 administrations listed in this footnote, only 4 Administrations have fixed stations notified prior to 1 April 1998. ICAO would therefore encourage Administrations listed in the footnote to review their use of fixed service assignments in 1 525-1 530 MHz, and if no longer required, to remove their country's name from RR No. **5.352A**.

e) In the frequency bands 1 540-1 559 MHz, 1 610.6-1 613.8 MHz and 1 613.8-1 626.5 MHz, within which some portions are assigned to or used by the aeronautical mobile-satellite (R) service, RR No. **5.355** also allocates the band on a secondary basis to the fixed service in a number of countries. Given that portions of these bands are utilized by a safety-of-life service, ICAO does not support the continued use of RR No. **5.355** country footnote. ICAO encourages those concerned administrations to review their use and if no longer required, to remove their country's name from RR No. **5.355**.

f) In the frequency bands 1 550-1 559 MHz, 1 610-1 645.5 MHz and 1 646.5-1 660 MHz which are assigned to mobile-satellite services, including in some portions assignment to or use by the aeronautical mobile-satellite (R) service, RR No. **5.359** also allocates the bands to the fixed service on a primary basis in a number of countries. Given that portions of these bands are utilized by a safety-of-life service, ICAO does not support the continued use of RR No. **5.359** country footnote. ICAO would therefore encourage those concerned administrations to review their use and if no longer required, to remove their country's name from No. **5.359**.

g) In the frequency band 4 200-4 400 MHz, which is reserved for use by airborne radio altimeters and wireless avionics intra-communications (WAIC), RR No. **5.439** allows the operation of the fixed service on a secondary basis in some countries. Radio altimeters are a critical element in aircraft automatic landing systems and serve as a sensor in ground proximity warning systems. WAIC provides aircraft safety communications between points on an airframe. Interference from the fixed service has the potential to affect the safety of both of these systems. ICAO would therefore encourage those concerned administrations to review their use and if no longer required, to remove their country's name from RR No. **5.439**.

ICAO Position

To encourage administrations listed in the footnotes to review RR Nos. **5.181, 5.197** and **5.259**, as access to the frequency bands 74.8-75.2, 108-112 and 328.6-335.4 MHz by the mobile service is difficult and could create the potential for harmful interference to important radionavigation systems used by aircraft at final approach and landing as well as systems operating in the aeronautical mobile service in the frequency band 108-112 MHz.

To encourage administrations listed in the footnotes to review RR Nos. **5.201 and 5.202**, as use by the AM(OR)S of the frequency bands 132-136 MHz and 136-137 MHz in some States may cause harmful interference to current and future aeronautical safety communications.

To encourage administrations listed in the footnote to review RR No. **5.330** as access to the frequency band 1 215-1 300 MHz by the fixed and mobile services could potentially cause harmful interference to services used to support aircraft operations.

To encourage administrations listed the footnote to review RR No. **5.352A** as access to the frequency bands 1 525-1 530 MHz by the fixed services could potentially constrain aeronautical use of this frequency band.

To encourage administrations listed in the footnote to review RR No. **5.355** as access to the frequency bands 1 540-1 559, 1 610.6-1 613.8 and 1 613.8-1 626.5 MHz by the fixed services could potentially constrain aeronautical use of these frequency bands.

To encourage administrations listed in the footnote to review RR No. **5.359** as access to the frequency bands 1 550-1 559 MHz, 1 610-1 645.5 MHz and 1 646.5-1 660 MHz by the fixed services could potentially jeopardize aeronautical use of those frequency bands.

To encourage administrations listed in the footnote to review RR No. **5.439** to ensure the protection of the safety critical operation of radio altimeters and WAIC systems in the frequency band 4 200-4 400 MHz.

ICAO would encourage administrations to take appropriate actions under this agenda item to remove their country's name from these footnotes if no longer required.

Note 1.— Administrations indicated in the footnotes mentioned in the ICAO Position above which are urged to remove their country names from these footnotes are as follows:

No. ***5.181*** *Egypt, Israel and Syrian Arab Republic No.*

No. ***5.197*** *Syrian Arab Republic*

No. ***5.201*** *Armenia, Azerbaijan, Belarus, Bulgaria, Estonia, the Russian Federation, Georgia, Hungary, Iran (Islamic Republic of), Iraq (Republic of), Japan, Kazakhstan, Mali, Mongolia, Mozambique, Uzbekistan, Papua New Guinea, Poland, Kyrgyzstan, Romania, Senegal, Tajikistan, Turkmenistan and Ukraine*

No. ***5.202*** *Saudi Arabia, Armenia, Azerbaijan, Bahrain, Belarus, Bulgaria, the United Arab Emirates, the Russian Federation, Georgia, Iran (Islamic Republic of), Jordan, Mali, Oman, Uzbekistan, Poland, the Syrian Arab Republic, Kyrgyzstan, Romania, Senegal, Tajikistan, Turkmenistan and Ukraine*

No. ***5.259*** *Egypt and Syrian Arab Republic*

No. ***5.330*** *Angola, Bahrain, Bangladesh, Cameroon, Chad, China, Djibouti, Egypt, Eritrea, Ethiopia, Guyana, India, Indonesia, Iran (Islamic Republic of), Iraq, Israel, Japan, Jordan, Kuwait, Nepal, Oman, Pakistan, the Philippines, Qatar, Saudi Arabia, Somalia, Sudan, South Sudan, the Syrian Arab Republic, Togo, the United Arab Emirates and Yemen*

No. ***5.355*** *Bahrain, Bangladesh, Congo (Rep of the), Djibouti, Egypt, Eritrea, Iraq, Israel, Kuwait, Qatar, Syrian Arab Republic, Somalia, Sudan, South Sudan, Chad, Togo and Yemen*

No. ***5.352A*** *Algeria, Saudi Arabia, Egypt, Guinea, India, Israel, Italy, Jordan, Kuwait, Mali, Morocco, Mauritania, Nigeria, Oman, Pakistan, the Philippines, Qatar, Syrian Arab Republic, Viet Nam and Yemen*

No. ***5.359*** *Germany, Saudi Arabia, Armenia, Azerbaijan, Belarus, Cameroon, the Russian Federation, Georgia, Guinea, Guinea-Bissau, Jordan, Kazakhstan, Kuwait, Lithuania, Mauritania, Uganda, Uzbekistan, Pakistan, Poland, the Syrian Arab Republic, Kyrgyzstan, the Dem. People's Rep. of Korea, Romania, Tajikistan, Tunisia, Turkmenistan and Ukraine*

No. ***5.439*** *Iran (Islamic Republic of)*

WRC-23 agenda item 9.1

Agenda item title

9 to consider and approve the Report of the Director of the Radiocommunication Bureau, in accordance with Article 7 of the Convention;

9.1 on the activities of the Radiocommunication Sector since WRC-19:

Note **—** *The subdivision of WRC-23 agenda item* ***9.1*** *into topics, such as a), b), etc. was made at the first session of the Conference Preparatory Meeting for WRC-23 (CPM23-1) and is summarized in the BR Administrative Circular CA/251, 19th December 2019. In addition, a topic d) was added which was not part of Resolution* ***811 (WRC-19)*** *(the WRC-23 agenda), however was agreed by WRC-19 (see WRC-19 Document 573 §§ 35.2 to 35.4).*

Topic 9.1-a

In accordance with Resolution 657 (Rev.WRC-19), review the results of studies relating to the technical and operational characteristics, spectrum requirements and appropriate radio service designations for space weather sensors with a view to describing appropriate recognition and protection in the Radio Regulations without placing additional constraints on incumbent services;

Space weather observations from ground-based networks of space weather sensor systems are becoming more and more important for the detection of solar activity that can harmfully affect the operation of international civil aviation. Solar events, such as large solar flares and coronal mass ejections (CMEs), produce magnetic storms that can present serious aviation safety risks. These events can cause major disruptions to the communications, navigation, and surveillance (CNS) systems critical to the operation of aircraft electronic systems and the aeronautical systems necessary to the safe operation of the airspace.

Data from Space Weather Sensors are provided to space weather forecast and warning centers around the world for many applications. Space weather advisories for international air navigation are provided to aircraft operators for planning mitigations to any potential risks. These forecasts and warnings also allow operators of aeronautical systems the opportunity to put in place mitigations to protect their systems and services. The Sun is the primary source of space weather of interest for spectrum management of civil aviation CNS systems. In addition, there are experimental research activities and other users of space weather sensor data that are not used by aviation.

Currently, space weather sensor systems are deployed in some countries and operate over a very large frequency range of approximately 10 kHz – 10 GHz based on existing ITU-R Reports. While space weather sensors systems may operate in a variety of frequency bands, these may not be the same between different countries as there is not a harmonized approach to the use of space weather sensors worldwide.

Within the ITU, some space weather sensors have been reported to operate in frequency bands that are critical to aircraft aeronautical communications, navigation, and surveillance. There are also active systems that operate in frequency bands used by aviation safety services on a non-interference basis. Some systems may not be used by ICAO to serve the purpose of space weather observation for flight planning and forecasting purposes.

ICAO Position

To support continuation of ITU-R studies and support appropriate recognition in the Radio Regulations of space weather sensors, provided that space weather systems do not impact current or planned aeronautical systems or applications.

Topic 9.1-b

Review the amateur service and the amateur-satellite service allocations in the frequency band 1 240-1 300 MHz to determine if additional measures are required to ensure protection of the radionavigation-satellite service (space-to-Earth) operating in the same band in accordance with Resolution 774 (WRC-19);

The amateur service has a secondary allocation in the frequency band 1 240-1 300 MHz (known as the “23 cm band” by the amateur community) and is currently used for amateur voice, data and image transmission. The frequency band is also allocated on a primary basis to the following services:

– Table Allocation
  - Earth exploration-satellite (active)
  - Radiolocation
  - Radionavigation Satellite (space-to-Earth) (space-to-space)
  - Space research(active).

– Footnote Allocation within various countries
  - 5.330 Fixed
  - 5.330 Mobile
  - 5.331 Radionavigation.

In the frequency band 1 240-1 300 MHz radionavigation satellite service (RNSS) systems such as GLONASS, Galileo, Beidou & QZSS are either operational, or becoming operational in various parts of the world with the expectation of enhancing the accuracy, reliability and positional accuracy of the current systems as well as offering additional features. However, there have been confirmed reports of harmful interference to the RNSS being caused by amateur service systems. This agenda item seeks to identify additional technical and operational measures that could be implemented to improve the protection of those RNSS from amateur and amateur-satellite systems operating under the secondary allocations to the amateur and amateur-satellite service without removing those amateur allocations.

Within the frequency band 1 240-1 300 MHz aviation currently operates primary surveillance radars used in the provision of air traffic control services. Past research has indicated that RNSS systems such as those indicated above can cause harmful interference to radars. The concern is that action taken under this agenda item could adversely affect the provision of those primary radar services with a consequential impact on air traffic control.

ICAO Position

To ensure that any mitigation measures taken under this agenda item will not impact the protection of aeronautical radar systems operating under the existing aeronautical radionavigation or radiolocation service allocations.

WRC-23 agenda item 9.2

Agenda item title

9 to consider and approve the Report of the Director of the Radiocommunication Bureau, in accordance with Article 7 of the ITU Convention;

9.2 on any difficulties or inconsistencies encountered in the application of the Radio Regulations;[1]

The relevant ITU-R working parties are invited to carry out the requested studies, indicated below, and to report the results of the studies to the Director of the Radiocommunication Bureau to be considered as the Director deems appropriate.

From Resolution **427 (WRC-19)** "Updating provisions related to aeronautical services in the Radio Regulations – *resolves to invite ITU-R* states "to study the Articles, limited to Chapters IV, V, VI and VIII of Volume I of the Radio Regulations and their associated Appendices, as appropriate, in order to identify outdated aeronautical provisions with respect to ICAO Standards and Recommended Practices and to develop examples of regulatory texts for updating these provisions, while ensuring that potential changes to such provisions will not impact any other systems or services operating in accordance with the Radio Regulations". (Responsible Group: WP 5B).

ICAO Position

Any potential regulatory actions taken under this agenda item, should not affect current or planned aeronautical systems or applications.

[1] This agenda sub-item is strictly limited to the Report of the Director on any difficulties or inconsistencies encountered in the application of the Radio Regulations and the comments from administrations. Administrations are invited to inform the Director of the Radiocommunication Bureau of any difficulties or inconsistencies encountered in the Radio Regulations.

WRC-23 agenda item 10

Agenda item title

10 to recommend to the Council items for inclusion in the agenda for the next WRC, and items for the preliminary agenda of future conferences, in accordance with Article 7 of the Convention and Resolution 804 (Rev.WRC-19)

Discussion

Resolution **812 (WRC-19)** contains the preliminary agenda for the 2027 World Radiocommunication Conference (WRC-27). Section 2.9 resolves: "*to consider possible additional spectrum allocations to the mobile service in the frequency band 1 300-1 350 MHz to facilitate the future development of mobile-service applications, in accordance with Resolution **250 (WRC-19)***".

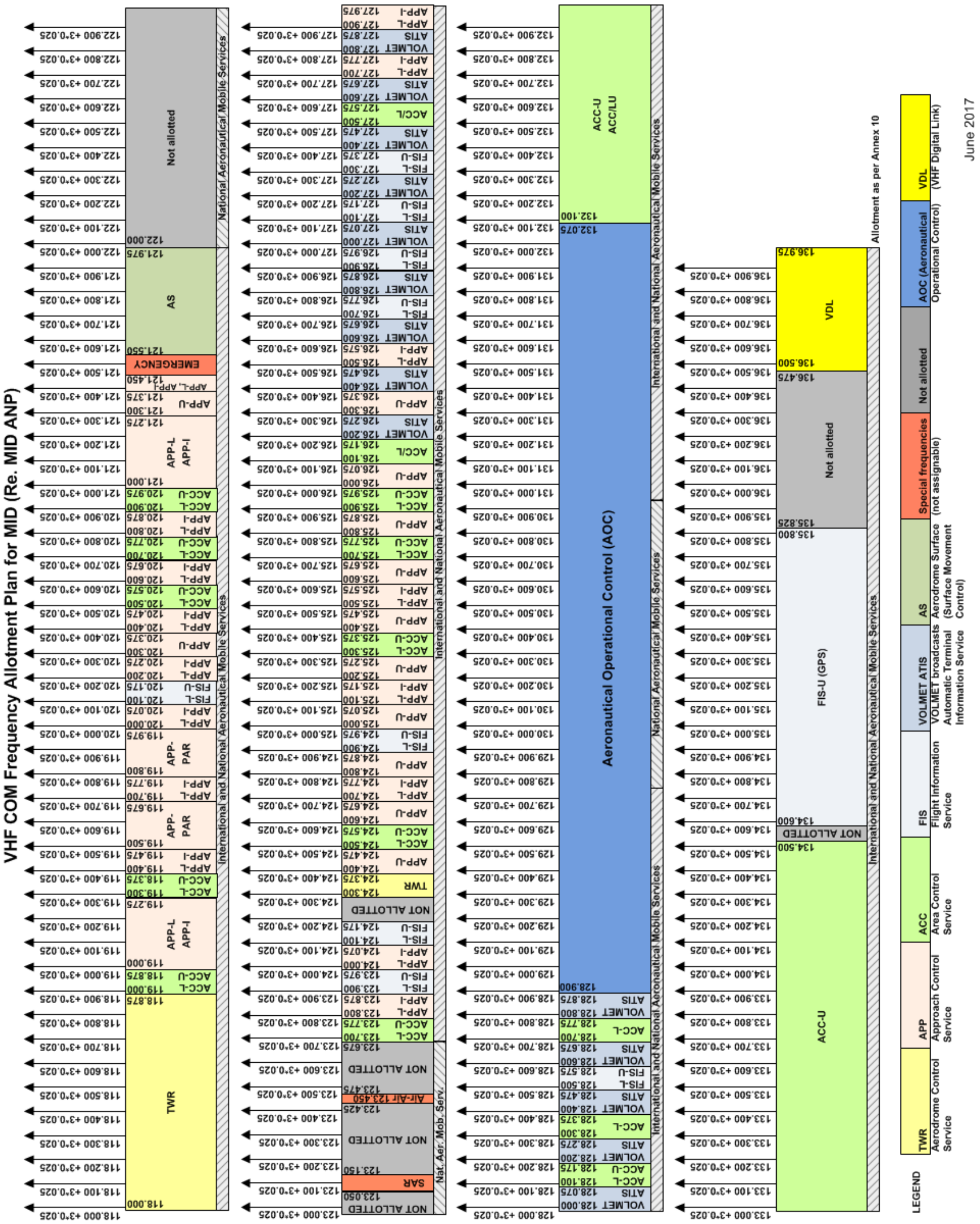
The frequency band 1 300-1 350 MHz is used by multiple ICAO Member States for various types of long-range radar systems that measure range, bearing, and velocity of aircraft, and perform missions critical to safe and reliable air traffic control (ATC) as considered in Resolution **250 (WRC-19)**. These radar systems ensure the safe transportation of people and goods, encourage the flow of commerce, and provide for State air surveillance requirements. Long-range radars are operated in this frequency band due to the minimal atmospheric effects such as loss from rain and fog, and the low external background noise levels.

While Resolution **250 (WRC-19)** resolves to conduct sharing and compatibility studies to ensure protection of existing services to which the frequency band is allocated on a primary basis, the studies performed to date have not shown any potential for compatibility with the systems operated in this band. Furthermore, studies under WRC-15 agenda item 1.1 with IMT and the same incumbent radar systems demonstrated that co-frequency sharing was not possible. Therefore, there is significant concern for a new WRC-27 agenda item to add a Mobile Service allocation to the 1 300-1 350 MHz band that causes harmful interference to these incumbent radar systems and the potential for harm to public safety.

ICAO Position

To oppose a new agenda item for WRC-27 for an additional spectrum allocation to the mobile service in the frequency band 1 300-1 350 MHz.

-END-


VHF COM Frequency Allotment Plan for MID (Re. MID ANP)
LEGEND
TWR Aerodrome Control Service
APP Approach Control Service
ACC Area Control Service
FIS Flight Information Service
VOLMET ATIS VOLMET broadcasts Automatic Terminal Information Service
AS Aerodrome Surface (Surface Movement Control)
Special frequencies (not assignable)
Not allotted
AOC (Aeronautical Operational Control)
VDL (VHF Digital Link)
Allotment as per Annex 10
June 2017

APPENDIX 4D

SUBMISSION OF FREQUENCY REQUIREMENTS FOR THE PERIOD 2023 – 2030

1.1 The primary purpose of this simulation is to determine if a congestion in the use of frequencies can be foreseen that would require the implementation of 8.33 kHz channel spacing in any parts of the MID Region.

1.2 With the view to determine the medium-term spectrum requirements for VHF communication services, States are invited to submit these requirements to the MID Regional Office (RO) by 1 August 2023. On the basis of these requirement, the RO will undertake an analysis that is aimed at determining whether these requirements can be assigned a frequency within the available 25 kHz channels.

1.3 In this case, States can introduce the requirements in the local version of Frequency Finder and generate with the button "Export Submissions" an Excel file that can be submitted to the RO.

1.4 States are able to download the Frequency Finder tool from Frequency Spectrum Management Panel (FSMP) webpage at: https://www.icao.int/safety/FSMP/Pages/Documents.aspx , and the RO will provide assistance for any difficulties in installation and use of this ICAO tool.

1.5 Precise details not available

1.5.1 When precise details are not available for future frequency requirements, States can submit such requirements in any format.

1.5.2 Example 1: For a new airport, States can submit the (approximate) coordinates and specify the need for:

x TWR frequencies
x Aerodrome surface frequencies
x APP-U frequencies
x APP-L frequencies
x ACC-U frequencies
ATTM.- 2
x ACC-L frequencies
x VOLMET frequencies
x ATIS frequencies
x VDL frequencies

MID Doc 01X

INTERNATIONAL CIVIL AVIATION ORGANIZATION

MIDDLE EAST AIR NAVIGATION PLANNING AND IMPLEMENTATION REGIONAL GROUP (MIDANPIRG)

Guidance on safeguarding measures to protect Radio Altimeter from potential harmful interference from Cellular 5G Communications

Edition 0.8 | November 2022

Acknowledgements

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The following individuals are recognized for their valuable contributions:

Ridha Dridi, Saudi Arabia (Rapporteur);

Fares A. Alzahrani (Saudi Arabia)

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Hecham Bennani (ACAO);

Gerlof E Osinga, (Boeing)

Kim Kolb, (Boeing)

Muna Alnadaf, ICAO MID RO/CNS

Contents

Record of Amendments

Edition	Revision number	Date	Change description
0.8	Final Draft	22 November 2022	New document structured in four chapters: describing the background, 5G bands, technical and operational concerns, activities, and measures deployed by States and International Organization to protect RADALT operations, and recommendation to States on short terms measures and actions to mitigate any source of interference that may be caused by 5G IMT networks. This Guidance Material will be presented for MIDANPIRG/20 for review and endorsement.

Abbreviations

CITC	Communications and Information Technology Commission
CNS SG	Communication, Navigation, and Surveillance Sub-Group
dBi	decibel isotropic
dBm	decibels relative to one milliwatt
EIRP	Effective Isotropic Radiated Power
EUROCAE	European Organization for Civil Aviation Equipment
FCC	Federal Communications Commission
FMCW	Frequency Modulated Carrier Wave
FMSP	Frequency Spectrum Management Panel
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IMT	International Mobile Telecommunications
ITU	International Telecommunications Union
ITU-R	International Telecommunications Union-Radiocommunications sector
LFMCW	Linear Frequency Modulation Continuous Wave
MIDANPIRG	Middle East Air Navigation Planning and Implementation Regional Group
NCD	No Computed Data
NFAT	National Frequency Allocations Tables
PPT	PowerPoint Presentation
RADALT	Radio Altimeter
RASG-MID	Regional Aviation Safety Group for the Middle East
RF	Radio Frequency
RO/CNS	Regional Officer CNS
RTCA	Radio Technical Commission for Aeronautics
SDO	Standards Developing Organizations
TAWS	Terrain Awareness Warning System
TCAS	Traffic Collision Avoidance System
TX/RX	Transmitter/Receiver
WP	Working Paper
WRC	World Radio-communication Conference.

Executive Summary

The radio altimeter[1], operates in the frequency band 4.2-4.4 GHz. It is a mandated critical aircraft safety system used to determine an aircraft's height above terrain and obstacles. Its information is essential to enable safety-related flight operations and navigation functions on all commercial aircraft as well as a wide range of other civil aircraft. Such functions and systems include terrain awareness, aircraft collision avoidance, wind shear detection, flight controls, and functions to automatically land an aircraft. If not properly mitigated, harmful interference to the function of the radio altimeter during any phase of flight may pose a serious safety risk to passengers, crew and people on the ground.

ICAO has received studies from several States and organizations regarding the interference potential to radio altimeters. These studies generally conclude that several makes, and models of radio altimeters will not operate as required if new cellular broadband technologies (5G) are deployed in frequency bands close to the radio altimeter's frequencies of operation (4.2-4.4 GHz). Several States have already implemented temporary technical, regulatory, and operational mitigations on new 5G systems to protect radio altimeters while the aviation industry is working on long-term solutions to update and retrofit altimeters in order to ensure compatibility between cellular broadband technologies (5G) and aviation systems.

The MIDANPIRG/19 meeting held in Riyadh, Saudi Arabia from 14 to 17 February 2022 was apprised of the ICAO State Letter (dated 25 March 2021) on the potential impact of 5G on radio altimeters in the MID Region. The meeting also acknowledged the safety concerns and potential operational impacts. Based on WP/62 presented by IATA; and WP/69 and PPT/71 presented by Saudi Arabia, the meeting agreed to:

- update the Frequency Management Working Group Terms of Reference to include tasks related to the issue of 5G & Radio Altimeter interferences.
- establish a Radio Altimeter (RADALT) Action Group (AG) to develop guidance material to protect aircraft operations from potential Radio Altimeter interference (*MIDANPIRG DECISION 19/23*[2]*).*
- task the CNS SG to coordinate with the RASG-MID relevant subsidiary bodies the 5G Safeguarding measures around the aerodromes to protect RADALT from any interference. (*MIDANPIRG DECISION 19/24)*

The AG held several virtual/online meetings and developed this guidance which is composed of:

a) Chapter 1 - Background on 5 G and frequency band allocation. This chapter describes the working arrangements and regulatory framework managed by Radio communications sector of the International Telecommunications Union for the allocations of radiofrequency (RF) spectrum and adoption of radio regulation. It also provides an overview on the current allocations of 5G at global level including in the Middle East
b) Chapter 2 - Potential impacts of 5G on Radio Altimeters during aircraft operations provides an overview on RADALT characteristics, its critical safety functions, the technical concerns raised following the allocations of 5G bands close to RADALT frequency band. This chapter also provides a list of potential operational safety hazards and their severity that may be caused by interference associated with the deployment of cellular broadband 5G ground infrastructure
c) Chapter 3 – Short Term Safeguarding measures adopted at regional and global levels/Long Term Planning provides a summary on the safeguarding measures adopted by States at regional and global

[1] *In some aviation publications it is also known as the radar altimeter or Low Range Radar Altimeter.*

[2] https://www.icao.int/MID/MIDANPIRG/Documents/MID19%20and%20RASGMID9/Final%20Report%20Full.pdf *– Page 53*

levels to protect Radio Altimeter from potential harmful interference from Cellular 5G Communications. It also summarizes the on-going and planned activities by regional organizations and SDOs to define new RADALT specifications

d) Chapter 4 - Methodologies for defining safeguarding measures for aerodromes & heliports: provides a summary on approach and methodology that can be used to set protection zones considering aircraft height/altitude during the approach to reduce the probability of interference occurring by imposing limitations on the deployment of 5G base stations at aerodromes and in areas surrounding aerodromes. It also provides a set of requirements and guidance that should be implemented by aircraft operators to restrict use of 5G user equipment and devices on board an aircraft.

Note: This guidance will be kept under review by RADALT Action Group considering the last development on 5G network deployment, protection measures, and progress made in the development of RADALT specifications allowing sustainable protection from any external radio frequency interference.

____

Chapter 1 - Background on 5 G and frequency band allocation

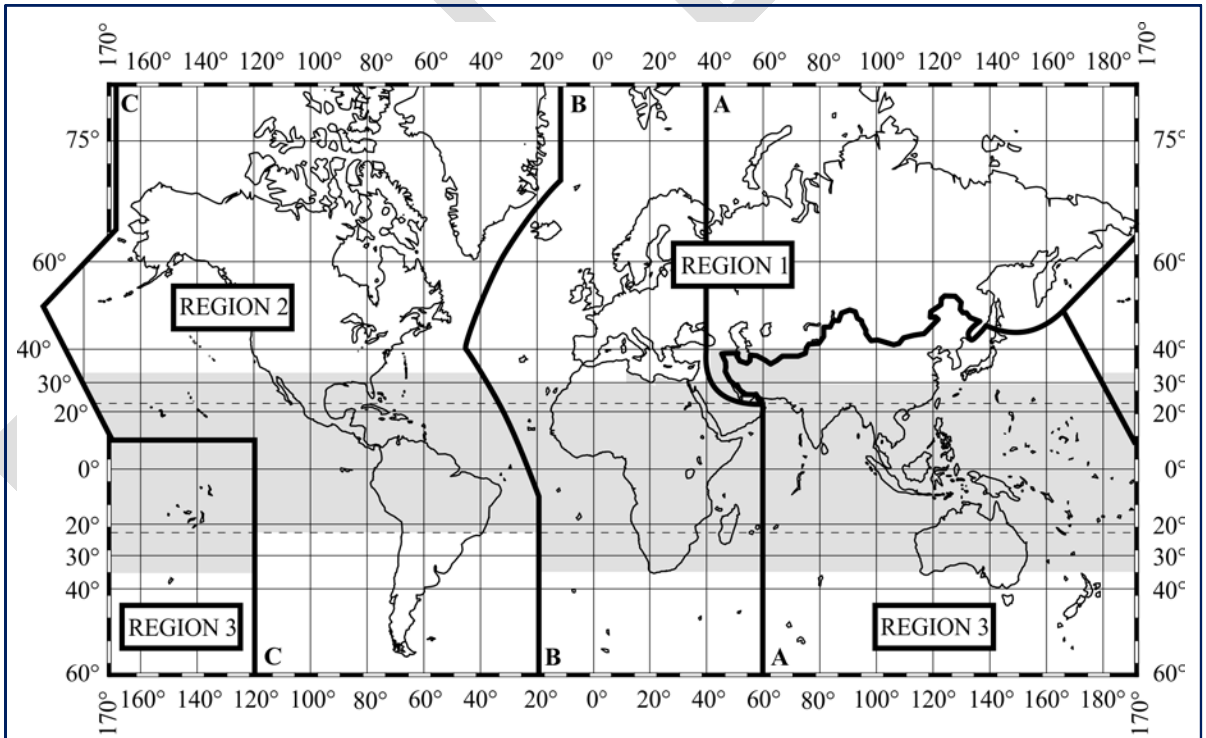
1.1. The Role of ITU-R

1.1.1. ITU-R is the Radio communications sector of the International Telecommunications Union. ITU-R is responsible for ensuring efficient and economical use of the radiofrequency (RF) spectrum by all radio communication services. It develops and adopts the international spectrum allocations and associated regulations on the use of the RF spectrum ("Radio Regulations" or "RR").

1.1.2. The Radio Regulations are an internationally binding treaty on Member States regulating how RF spectrum is used. It is the basis for the global harmonization of RF spectrum use for all users of spectrum, including aviation and International Mobile Telecommunications (IMT) users. To enable new technologies and changes in spectrum usage, an ITU World Radiocommunication Conference (WRC) is held every 4 years where the Radio Regulations are revised and updated.

1.1.3. The radio regulations allow use of 5G in the frequency range 3400 – 4200 MHz. In Region 1, radio regulations allocate the frequency band 3400-3600 MHz to the mobile, except aeronautical mobile, service, and is identified for International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations.

1.1.4. For the allocation of frequencies in the RR, the world is divided into three Regions as shown in Figure 1 below:



The shaded part represents the Tropical Zones

(Figure 1)

1.2. Global Spectrum Situation for 5G

1.2.1. The growth in demand from mobile broadband requires access to regionally or globally harmonized spectrum to provide additional IMT services including higher data rates.

1.2.2. The frequency ranges 3300–4200 MHz and 4400-4900 MHz provide good propagation and data rates and are of global interest to IMT proponents. Variations of usage are seen regionally. The main band used in Europe is 3400–3800MHz, while China and India are planning for 3300–3600MHz and in Japan 3600–4100MHz is considered. Similar frequency ranges are considered in North America (3450–3980MHz), Latin America, the Middle East, Africa, India, Australia, etc. A total of 45 countries signed up to the IMT identification of the 3300–3400MHz band at ITU WRC-15. There is also interest in China to utilize the 4800– 5000 MHz frequency range and the 4500–4900 MHz frequency range in Japan. The following table provides the bands that were identified by some of the MID States for 5G deployments.

Country	Operator	5G network status	Commercial launch	Frequency bands
Bahrain	Batelco	5G deployed in network (2019)	Yes, 2019	2496-2690 MHz
	STC[13]	5G deployed in network (2019)	Yes, 2019	2496-2690 MHz
	Zain	5G deployed in network (2019)	Yes, 2020	2496-2690 MHz
Kuwait	Ooredoo	5G deployed in network (2018)	Yes, 2019	4400-5000 MHz
	STC[14]	5G deployed in network (2019)	Yes, 2019	3300-3800 MHz
	Zain	5G deployed in network (2018)	Yes, 2019	3300-4200 MHz
Oman	Omantel	5G deployed in network (2019)	Yes, 2020	3300-3800 MHz
	Ooredoo	Licensed (2018)	Yes	3300-3800 MHz
Qatar	Ooredoo	5G deployed in network (2018)	Yes, 2019	3300-3800 MHz
	Vodafone	5G deployed in network (2018)	Yes, 2019	3300-3800 MHz
Saudi Arabia	Mobily	5G deployed in network (2019)	Yes, 2019	2496-2690 MHz 3300-3800 MHz
	STC	5G deployed in network (2018)	Yes, 2019	2300-2400 MHz 3300-3800 MHz
	Zain	5G deployed in network (2019)	Yes, 2019	2496-2690 MHz 3300-3800 MHz
UAE	Du	5G deployed in network (2019)	Yes, 2019	3300-3800 MHz
	Etisalat	5G deployed in network (2018)	Yes, 2019	3300-3800 MHz[15]

Source: Roadmaps for awarding 5G spectrum in the MENA region – GSMA Document, January 2022

1.2.3. Each State has responsibility to develop spectrum management policies and regulations that comply with the international treaty obligations of the Radio Regulations while meeting national spectrum needs. One of the main tools to manage the spectrum is National Frequency Allocations Tables (NFAT). NFAT shows how the spectrum can be utilized for each radio frequency service.

1.2.4. States and national spectrum regulators all over the world are considering (or have considered) allowing 5G cellular systems to operate in parts of the frequency ranges 3.4-4.2 GHz and 4.4 -4.9 GHz ("C-band"). These potential allocations are adjacent to the band used by radio altimeters and pose potential safety hazard if no mitigations are implemented. It is of paramount importance that, in support of safety of aircraft operations, member States and national regulators, note Article 4.10 of the ITU Radio Regulations which states, "ITU Member States recognize that the safety aspects of radionavigation and other safety services require special measures to ensure their freedom from harmful interference. It is necessary therefore to take this factor into account in the assignment and use of frequencies."

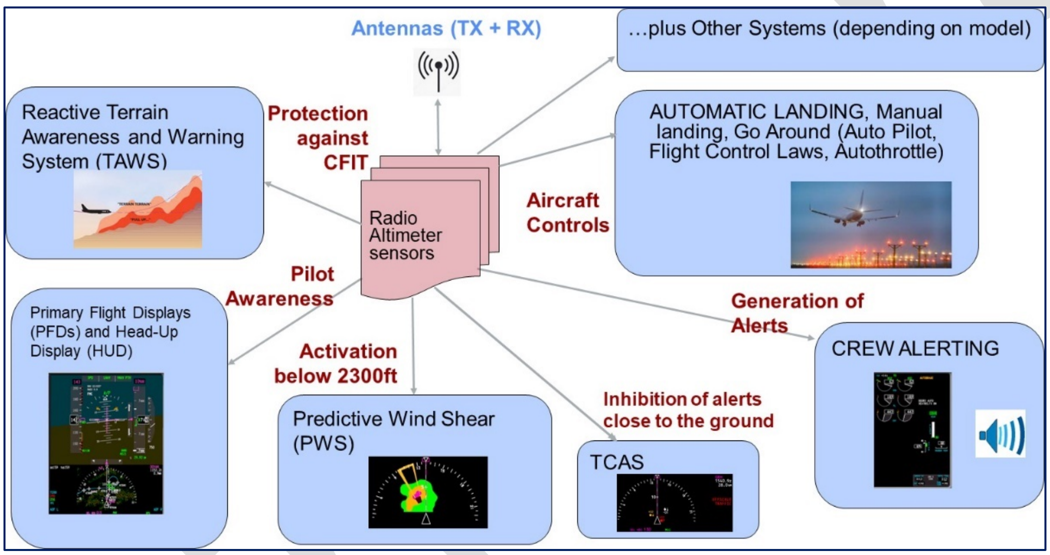
Chapter 2 - Potential impacts of 5G on Radio Altimeters during aircraft operations

2.1. Introduction

2.1.1. The band 4200 - 4400 MHz is allocated to the aeronautical radionavigation service (ARNS) and is reserved for radio altimeters installed onboard aircraft by ITU Radio Regulations Art. 5 – Frequency Allocations, footnote No. 5.438.

2.1.2. Radio altimeters are critical sensors used to enable and enhance several different safety and navigation functions throughout all phases of flight on all commercial aircraft and a wide range of other aircraft.

2.1.3. The radio altimeter is the only sensor onboard the aircraft capable of providing a direct measurement of the clearance height above the terrain and any obstacles, it plays a crucial role in providing situational awareness to the flight crew and is an essential component of aeronautical safety-of-life during aircraft operations. The main radio altimeters functions are illustrated in the following figure.



2.1.4. Radio altimeter systems are designed to operate for the entire life of the aircraft in which they are installed. The installed life can exceed 30 years, resulting in a wide range of equipment age, performance, and tolerance.

2.2. Radio altimeters characteristics (based on ITU-R M.2059)

2.2.1. General Characteristics

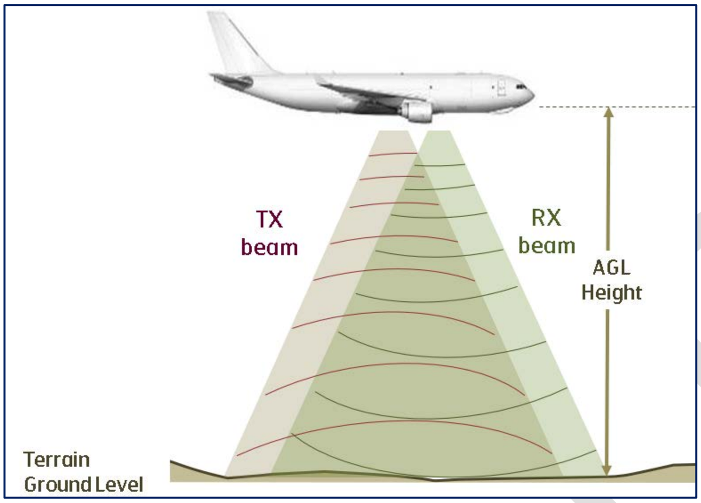
2.2.1.1. Technical characteristics for several types of radio altimeters operating within the frequency band 4200-4400 MHz can be found in Recommendation ITU-R M.2059[3]. In particular, Table 1 & and Table 2 give technical parameters of several radio altimeters.

2.2.1.2. Because of the importance of radio altimeters to safely operate an aircraft, they are included in the minimum equipment list on aircraft certified for passenger service. Furthermore, they must be certified

[3] https://www.itu.int/dms_pubrec/itu-r/rec/m/R-REC-M.2059-0-201402-I!!PDF-E.pdf

at a safety criticality rating or Design Assurance Level (DAL) of “A”, “Where a software/hardware failure would cause and/or contribute to a catastrophic failure of the aircraft flight control systems” for all transport aircraft and a DAL of “B”, “Where a software/hardware failure would cause and/or contribute to a hazardous/severe failure condition in the flight control systems” for business and regional aircraft. Design assurance level is a safety criticality rating from level A to E, with level A/B being the most critical and requiring the most stringent certification process.

2.2.1.3. Radio altimeter systems on a single aircraft consist of up to three identical radio altimeter transceiver (Tx/Rx) units with their associated equipment. All Tx/Rx units operate simultaneously and independently from one another. The radio altitude is computed from the time interval a signal, originating from the aircraft is reflected from the ground. Radio altimeters designed for use in automated landing systems are required to achieve an accuracy of 0.9 meters (3 feet). The following figure is an illustration of the TX/RX beams of radio altimeter signals. .



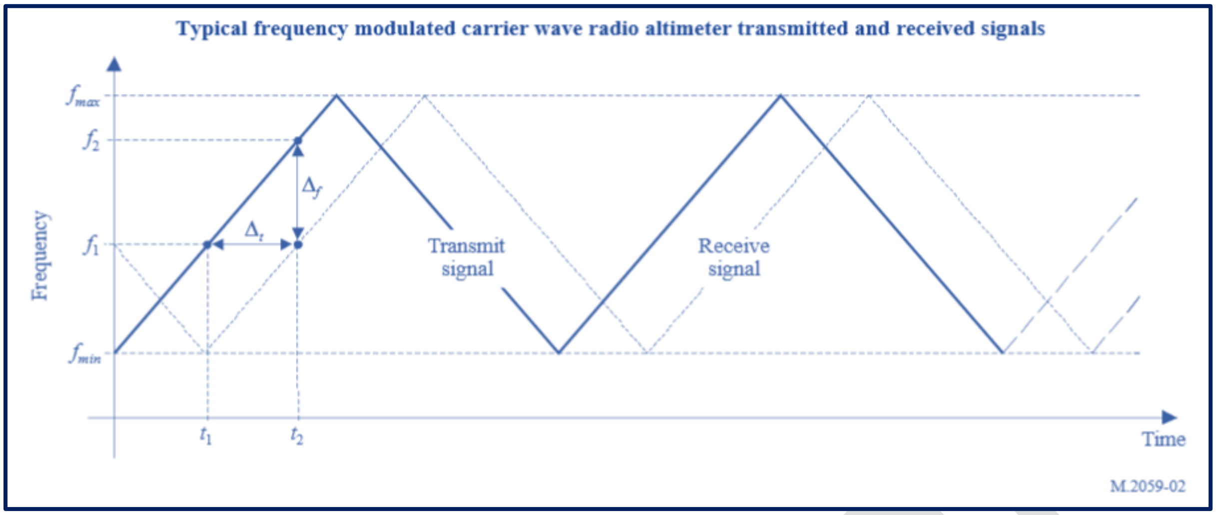
2.2.1.4. There are two types of radar waveform modulation methods for Radio altimeters:

- Continuous-wave of LFMCW (Linear Frequency Modulation Continuous Wave) or FMCW Radio altimeters (Frequency Modulated Carrier Wave); and
- Pulsed modulation.

2.2.2. FMCW radio altimeters

2.2.2.1. FMCW radio altimeters operate by a Tx/Rx working in conjunction with separate transmit/receive antennas. Operation requires a signal from the transmit antenna to be directed to the ground. When the signal hits the ground, it is reflected back to the receive antenna. The system then performs a time calculation to determine the distance between the aircraft and the ground, as the altitude of the aircraft is proportional to the time required for the transmitted signal to make the round trip.

2.2.2.2. It is important to note that FMCW radio altimeters do not have a fixed frequency. One can find the chirp bandwidth of each FMCW radio altimeter type in Table 1 of Recommendation ITU-R M.2059.



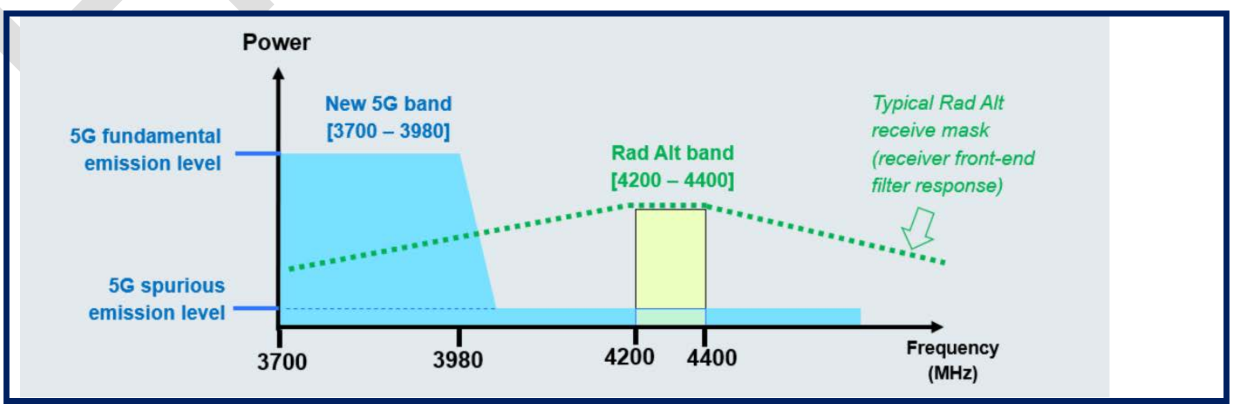
2.2.3. Pulsed radio altimeters

2.2.3.1. The pulsed-type radio altimeter uses a series of pulses of radio frequency energy transmitted towards the Earth to measure the absolute height above the terrain immediately underneath the aircraft. The time difference between the transmitted pulse and the received pulse is measured, and that time is proportional to the height of the aircraft. Pulsed radio altimeters are emitting at a fixed frequency (generally 4300 MHz). However, the emission bandwidth could vary (see for example D4 within the Table 1 from ITU-R M.2059).

2.2.4. Technical concerns

2.2.4.1. Standardized in 1980s, the radio altimeters, even though developed and deployed fully in compliance with national regulations and industry standards, have not been designed to fully withstand the high level of terrestrial interferences in its adjacent and near bands that may cause a blocking and/or spurious phenomenon. The fundamental terrestrial 5G energy is not filtered by all radio altimeters models.

2.2.4.2. In the United States, following an auction by the Federal Communications Commission (FCC) of the 3.7–3.98 GHz frequency band, RTCA formed a task force to assess the interference impact of wireless broadband operations in the 3.7–3.98 GHz band on radio altimeters. Based on the work of the task force, RTCA published a report entitled, “Assessment of C-Band Mobile Telecommunications Interference Impact on Low Range Radar Altimeter Operations” where it identified potential risk of interference that can be caused by 5G base stations operating within the band 3.7–3.98 GHz.



Source: *RTCA Paper No. 274-20/PMC-2073 – (Figure 3-1: Spectrum Illustration Showing 5G Fundamental and Spurious Emissions, page 20).*

2.3. Potential operational impacts of 5G on Flight Crew and Aircraft [4]

2.3.1. Loss of Situational Awareness

2.3.1.1. On all types of aircraft, situational awareness of the flight crew is paramount to ensuring safe flight operations, especially flying in busy airspace, close to the ground, or in low-visibility scenarios such as Instrument Meteorological Conditions (IMC). The radio altimeter plays a critical role in providing situational awareness in these operating conditions, in particular. Not only do radio altimeters provide a displayed indication of height above terrain to the flight crew, but they also form the basis of auditory altitude callouts during terminal landing procedures, as well as Traffic Alert and Collision Avoidance System/Airborne Collision Avoidance System (TCAS/ACAS) and Terrain Awareness Warning System (TAWS) advisories and warnings.

2.3.1.2. Erroneous or unexpected behavior of the radio altimeter directly leads to a loss of situational awareness for the flight crew. Not only does this loss of situational awareness present an immediate impact to the ability of the flight crew to maintain safe operation of the aircraft in its own right, it also requires the flight crew to attempt to compensate for the lack of reliable height above ground information using other sensors and visual cues, if available. This further leads to a risk of task saturation for the flight crew, particularly during operations or phases of flight which require continuous crew engagement, such as final approach and landing procedures.

2.3.2. Controlled Flight into Terrain

2.3.2.1. In the most extreme cases, loss of situational awareness may lead to an occurrence of Controlled Flight into Terrain (CFIT), which is when the pilot flies the aircraft into the ground. This situation is nearly always a devastating event resulting in aircraft hull loss and a high likelihood of loss of life or severe injuries to the flight crew and passengers. The frequency of CFIT accidents in earlier generations of aircraft operations was unacceptably high, providing the key motivating factor for the introduction of radio altimeters in civil and commercial aviation in the 1970s, as well as the subsequent development of TAWS. This implementation has greatly reduced the risk of CFIT, as long as the radio altimeter and associated systems are functioning properly.

2.3.2.2. However, CFIT may still occur in modern aircraft operations due to undetected erroneous output from the radio altimeter(s), which may be considered Hazardously Misleading Information (HMI) during certain phases of flight or operational conditions (such as IMC). If HMI is presented to the flight crew, TAWS, or the AFGCS, it may lead to incorrect and dangerous flight operations, and there may not be sufficient time to correct the error before a catastrophic result such as CFIT occurs.

2.3.3. Specific Operational Impacts on Aircraft

2.3.3.1. On commercial air transport and regional aircraft, high-end business aviation aircraft, and some general aviation aircraft and helicopters, the radio altimeter serves far more purposes than providing situational awareness of the terrain clearance height to the flight crew. In these cases, in addition to providing a displayed indication of the aircraft height above terrain, the radio altimeter will be used as a safety-

[4] *Descriptions from RTCA report,* https://www.rtca.org/wp-content/uploads/2020/10/SC-239-5G-Interference-Assessment-Report_274-20-PMC-2073_accepted_changes.pdf

critical navigation sensor by the Automatic Flight Guidance and Control Systems (AFGSC) and will also feed into systems such as TCAS/ACAS, Predictive Wind Shear (PWS), and TAWS. This usage by a wide variety of systems onboard the aircraft leads to the possibility of specific operational impacts that go beyond a general loss of situational awareness or risk of CFIT.

2.3.3.2. The table below illustrates typical radio altimeter failures with specific operational impacts that may be encountered due to undetected erroneous readings or unanticipated loss of output (indicated as a No Computed Data, or NCD, condition) from the radio altimeter on commercial or civil aircraft which utilize the radio altimeter for functions such as those mentioned in the preceding paragraph. For each impact, the severity is assessed in accordance with FAA system safety analysis guidelines[5]. The severity of each condition may be determined to be Minor, Major, Hazardous/Severe Major, or Catastrophic, with each severity classification having its own allowable occurrence rate. The allowable occurrence rate 1×10^{-3} per flight hour or less for Minor failure conditions, 1×10^{-5} per flight hour or less for Major failure conditions, 1×10^{-7} per flight hour or less for Hazardous/Severe Major failure conditions, and 1×10^{-9} per flight hour or less for Catastrophic failure conditions.

Radio Altimeter Failure	Operational Impact	Flight Phase	Severity
Undetected Erroneous Altitude	Just prior to touchdown, the aircraft performs a flare maneuver to avoid a hard landing. The flare may be performed manually by the flight crew, using auditory callouts of radio altimeter readings, if sufficient visibility is available. In low-visibility conditions, the flare may be controlled by an auto-land function. Erroneous radio altimeter readings in either case can result in the potential for CFIT with little or no time for the flight crew to react.	Landing – Flare	Catastrophic
Undetected Erroneous Altitude	Erroneous input to the AFGCS affects aircraft attitude commands and altitude, as well as flight control protection mechanisms	All Phases of Flight	Catastrophic
Unanticipated NCD	Undetected loss of PWS display to flight crew, preventing awareness of wind shear impact to vertical profile in front of the aircraft	Landing	Hazardous/Severe Major
Unanticipated NCD	Undetected loss of TCAS/ACAS inhibition near the ground, leading to potential erroneous descent advisory alert and associated possibility of CFIT in low-visibility conditions	Approach, Landing, Takeoff	Hazardous/Severe Major

[5] *See references in RTCA report paragraph 5.3, https://www.rtca.org/wp-content/uploads/2020/10/SC-239-5G-Interference-Assessment-Report_274-20-PMC-2073_accepted_changes.pdfhttps://www.rtca.org/wp-content/uploads/2020/10/SC-239-5G-Interference-Assessment-Report_274-20-PMC-2073_accepted_changes.pdf*

Radio Altimeter Failure	Operational Impact	Flight Phase	Severity
Undetected Erroneous Altitude	Erroneous triggering of TAWS reactive terrain avoidance maneuver, forcing mandatory response from flight crew and leading to potential traffic conflicts in surrounding airspace	Approach, Landing, Takeoff	Major
Unanticipated NCD	Aircraft landing guidance flight control laws violated leading to unnecessary missed approach and go-around, jeopardizing safety of surrounding airspace	Approach, Landing	Major
Unanticipated NCD	Loss of capability to perform approach and landing in low-visibility conditions (Category II/III approach), leading to unnecessary diversion and jeopardizing safety of surrounding airspace	Approach, Landing	Hazardous/Severe Major
Unanticipated NCD	Loss of capability to warn flight crew in case of excessive aircraft descent rate or excessive terrain closure rate (TAWS Mode 1 and 2 alert protection not active)	All Phases of Flight	Major
Unanticipated NCD	Loss of capability to warn flight crew of potentially dangerous loss of height after takeoff (TAWS Mode 3 alert protection not active)	Takeoff, Go-around	Major
Unanticipated NCD	Loss of capability to warn flight crew of potentially dangerous aircraft configuration—e.g., landing gear, slats, flaps—based on height above terrain (TAWS Mode 4 alert protection not active)	Landing	Major
Unanticipated NCD	Loss of capability to warn flight crew that aircraft is dangerously below glide path during precision instrument approach (TAWS Mode 5 alert protection not active)	Landing	Major

2.3.3.3. The operational impacts listed in the table above are not exhaustive, and other operational impacts which can compromise aviation safety may be encountered. The examples provided are intended to give a general idea of the types of specific impacts that may be experienced and their severity.

Chapter 3 – Short Term Safeguarding measures adopted at regional and global levels /Long Term Planning

3.1. Introduction

3.1.1. The aviation community has raised concerns about potential interference to radio altimeters operating in the frequency band 4.2 – 4.4 GHz from 5G networks deployed in adjacent and nearby bands. To this end, a detailed technical analysis was performed by RTCA, and a report was published in October 2020. The RTCA report studies the impact of 5G operations in the 3.7 – 3.98 GHz band based on US Federal Communication Commission (FCC)'s decision to allow the deployment of mobile networks in this band. Two main interference mechanisms are considered:

- spurious emissions from 5G transmitters falling into the main altimeter operating band and causing the altimeter receiver desensitization; and
- emissions from the main 5G operating band falling into altimeter sidebands and causing the altimeter receiver blocking.

3.1.2. The RTCA report considers the protection criteria established in ITU-R Recommendation M.2059 for altimeters. It describes the measurement tests conducted to determine interference tolerance thresholds for different aviation commercial altimeter models. The test results were presented for three user categories: Category 1 representing commercial air transport airplanes; Category 2 representing regional, business and general aviation airplanes; and Category 3 covering helicopters. For each user category, 5G interference levels are then calculated for different 5G deployment scenarios (urban, suburban, and rural) and compared against measured threshold levels. The report concludes that there is a risk of exceeding altimeter interference threshold levels by interference caused by 5G networks operating in 3.7 – 3.98 GHz band. The values are potentially based on worst-case noting that no information is available on the specific altimeters considered.

3.1.3. Within ICAO, the Frequency Spectrum Management Panel (FMSP) has considered the issue and reviewed submissions from several States. In addition, a group has been established to collect information related to 5G/Radio Altimeter compatibility and a State Letter has been produced advising ICAO member States of the issue.

3.1.4. Several States have already implemented temporary technical, regulatory, and operational mitigations on new 5G systems in order to protect the RA while more permanent solutions are being explored.

3.2. Measures adopted by States, Regional Organizations & SDOs

3.2.1. Australia

3.2.1.1. The Australian spectrum regulator (the ACMA) held a public consultation in May 2022 on replanning parts of the frequency band 3 400-4 000 MHz for 5G and wireless broadband expansion. Currently, 5G operates in Australia in the frequency range 3 565-3 700 MHz. The Australian Civil Aviation Safety Authority (CASA) published an Airworthiness Bulletin[6] asking operators to report any Radio-Altimeter interference that occurs below 2500 feet.

[6] *https://www.casa.gov.au/files/awb-34-020-issue-3-potential-interference-radio-altimeter-systems*

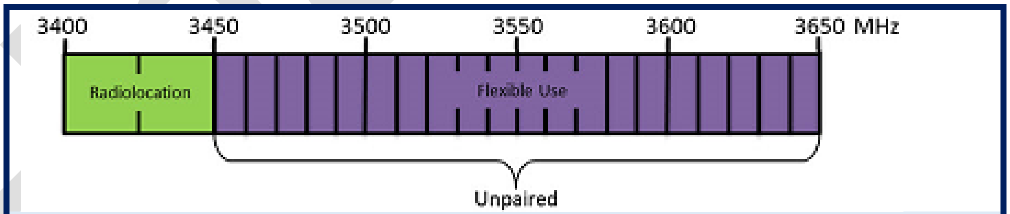
3.2.1.2. In late December 2021, CASA issued an [exclusion from the Operation of Airworthiness Directives FAA AD 2021-23-12 and FAA AD 2021-23-13][7]. This Exclusion applies to any Australian registered aircraft when it as operated outside the airspace of the United States of America.

3.2.2. Canada

3.2.2.1. Transport Canada Civil Aviation (TCCA) has published a [Civil Aviation Safety Alert (CASA) (2021-08)][8] Potential Risk of Interference of 5G Signals on Radio Altimeters (June 2021 and Dec 2021) to raise awareness of the potential risk of 5G interference worldwide and to recommend precautionary operational measures before confirmation of the impact of 5G to Radio Altimeters. It also recommends switching off all 5G passenger/flight crew devices and in case of interference, to report the event to the Air Traffic Service as soon as possible and to file a Radio Altimeter disturbance/interference report on a provided form.

3.2.2.2. In August 2021, Innovation, Science and Economic Development Canada (ISED) consulted the telecom and aviation industry on the interim technical mitigations to protect Radio Altimeters from 5G interference in the 3450-3650 MHz band. On Nov 18th, 2021, ISED established temporary restrictions to 5G based on available information and mitigations taken in France and Japan. ISED protection measures include:

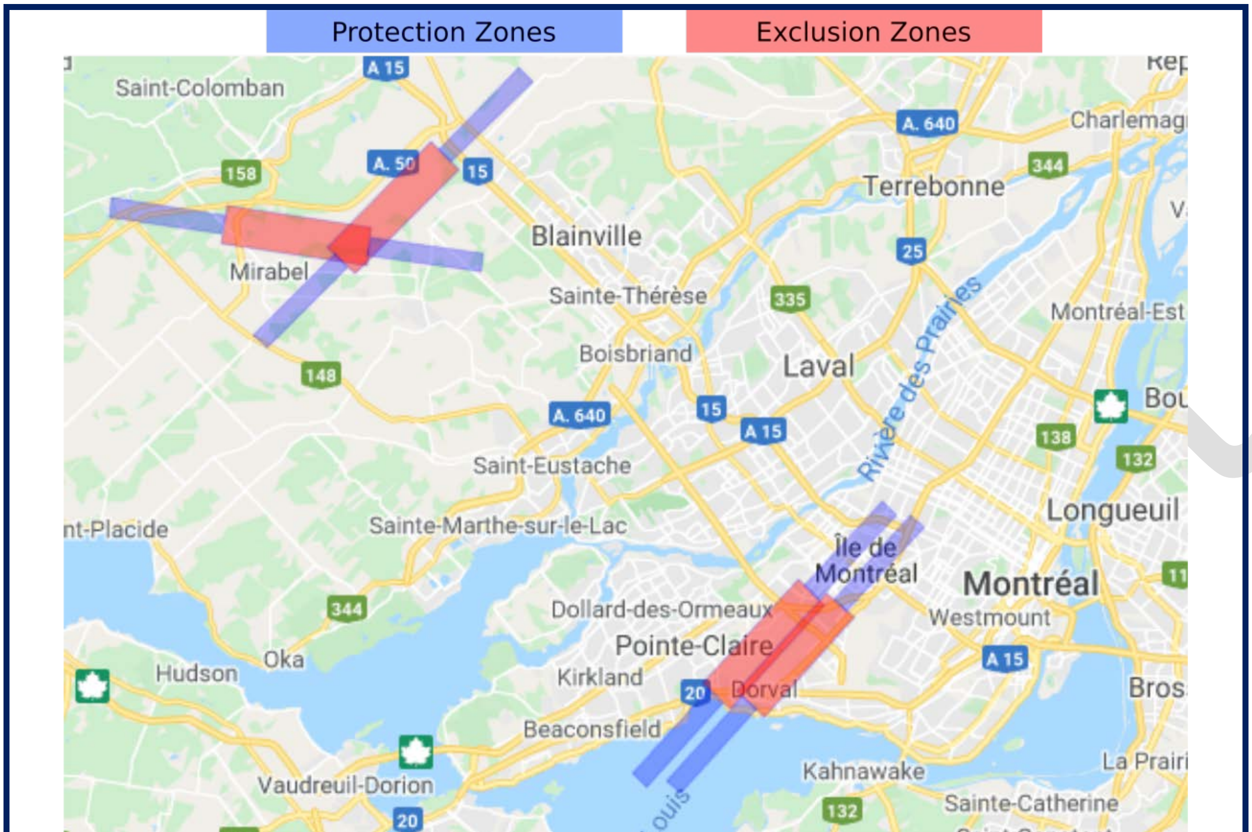
- exclusion and protection zones to mitigate interference to aircraft around certain airport runways where automated landing is authorized
- a national antenna down-tilt requirement to protect aircraft used in low altitude military operations, search and rescue operations and medical evacuations all over the country.
- Outdoor non-Active antenna system (AAS) and AAS fixed point-to-point and multipoint stations with a positive angle with reference to the horizon with limiting power.
- Airborne operations (e.g., drones) are not permitted in the 3450-3650 MHz band.
- Active antenna system (AAS), Non time division duplexing (TDD) systems, fixed point-point stations restriction.
- Frequency divided into 20 unpaired blocks of 10 MHz each as shown in the following figure.



This figure shows the 3500 MHz band deployment in Canada as of Dec 2021, which includes the frequency range of 3400 to 3650 MHz. The frequency range of 3400 to 3450 MHz is allocated for radiolocation. The frequency range of 3450 to 3650 MHz is divided into 20 unpaired blocks of 10 MHz each and allocated for fixed and mobile (flexible use).

- Maximum power is 68 dBm/5 MHz up to 305 metres and 61 dBm/MHz for channel bandwidth less than 5 MHz Antenna above 305 m need to calculate the maximum power emission

[7] https://www.legislation.gov.au/Details/F2021L01909
[8] https://tc.canada.ca/en/aviation/reference-centre/civil-aviation-safety-alerts/potential-risk-interference-5g-signals-radio-altimeter-civil-aviation-safety-alert-casa-no-2021-08



Sample of exclusion and protection zones in aerodrome located in Montreal (Canada)

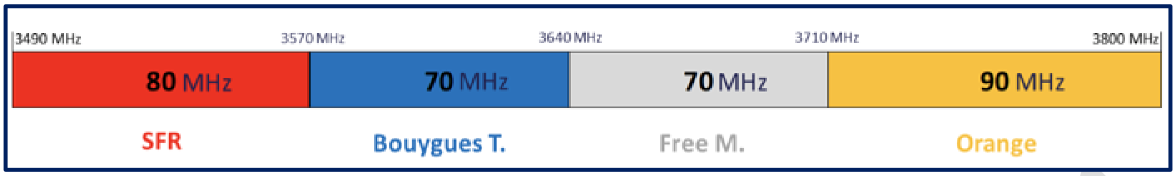
3.2.2.3. ISED has completed the Over-The-Air (OTA) testing and it is currently analyzing the enormous amount of data from the OTA testing to determine the in-flight susceptibility of interference of various radio altimeters to 5G operating in the 3500 MHz, 3800 MHz and 3900 MHz bands under specific test conditions. In addition, ISED is currently testing and analyzing a few additional radio altimeters in the laboratory setting and the analysis is on-going.

3.2.3. Europe

3.2.3.1. In Europe, Electronic Communications Committee (ECC) has adopted a work item that covers the analysis of unwanted emissions from Mobile/Fixed Communications Networks (MFCN) i.e., 5G operating in 3400 – 3800 MHz into 4200 – 4400 MHz radio altimeters band as well as the impact of blocking of radio altimeters from 3400 – 3800 MHz MFCN in-band emissions. The meeting further agreed to work on long-term Mobile Fixed Communication Network (MFCN) operational parameters for the update of the Minimal Operational Performance Standards (MOPS) to be provided to RTCA/EUROCAE. The target date for the ECC report as the deliverable for the analyses is set for July 2023.

3.2.4. France

3.2.4.1. The National Frequency Agency (ANFR), the spectrum regulator in France allows flexible use of networks and technology (including 5G) in the frequency band 3400-3800 MHz. The allocation of the band to the operators is illustrated in the following figure and the power spectral density (PSD) of the base stations varies according to the operators between 62.44dBm/5MHz to 67.34 dBm/5MHz. However, these limits are not binding and can evolve upwards.



3.2.4.2. Based on RTCA report, French Civil Aviation Authority (DGAC) in coordination with ANFR have defined provisional precautionary measures relating to the geographical location of some 5G antennas in the vicinity of airports with IFR procedures in mainland France to mitigate the risk interference from 5G systems into Radio altimeter system. These measures can be summarized as follows:

1) Operators must implement only downward tilt[9];
2) Operators have to take measures to avoid grating lobes as far as practicable;
3) Special protection zones are applied to all IFR aerodromes equipped with ILS CAT III facilities[10] and to some helicopter platforms. The methodology used for the calculation of the dimensions of special protection zones is provided in Appendix A to this document.

3.2.4.3. Measure 3) are verified by Civil aviation authority (DGAC) on the basis of the information provided by mobile operators and in close cooperation with National Frequency Agency (ANFR). Moreover, French DGAC has also published a Safety info leaflet[11] in addition to the mitigation measures implemented around all IFR aerodromes.

3.2.4.4. The Special protection zones around all IFR aerodromes, as illustrated hereafter, are defined as follows:

- **Safety Zone:** where 5G base stations are not authorized to transmit and defined to protect the Radio altimeters in the phase where the aircraft is at or below 200 ft (61 m). Safety zone based on the following assumption:
    a) 3° slope with a tolerance of 0.375° (i.e. 2.625°). Therefore, the aircraft may be below 200 ft (61 m) on the approach path to the runway threshold extended by 1130 m each side of a Base Station with a maximum Effective Isotropic Radiated Power (EIRP).
    b) 6 dB ICAO Safety margin
    c) 0 dBi maximum Radio altimeters antenna gain below 3.8 GHz based on RTCA Report
    d) -19 dBm interference threshold based on RTCA report (Cat.1 below 200 ft)

  The rectangular safety zone has a width on each side of the runway (protection distance) calculated with pervious assumptions and a length extended from each runway threshold by (1130 m + the protection distance). The protection distance value depends on the max EIRP of the BASE Station (e.g., for a Base Station with the Maximum EIRP of +78dBm, the protection distance value is 910m[12])

- **Precaution zone:** where 5G base stations implementation are coordinated and defined on each side of the Safety Zone to protect the landing approach below 1000 ft (305 m)

3.2.4.5. The protection zones dimensions are based on Minimum Coupling Loss (MCL) calculations and take into account the free space model (ITU-R P.525) at the frequency of 3750 MHz.

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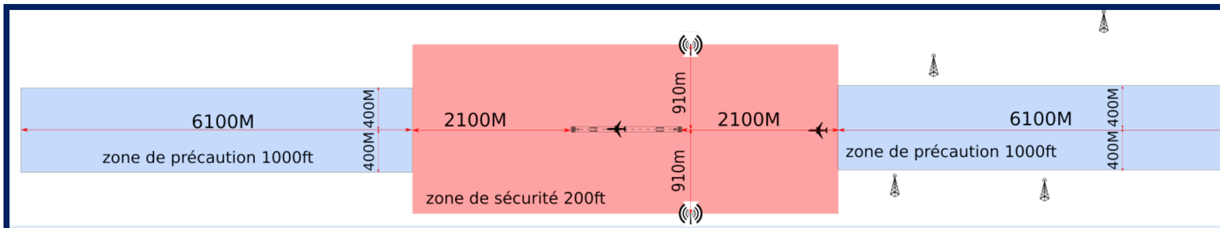
[9] *Following a complaint and legal threats from an operator, this constraint has been lifted during 2021 following a high-level political decision but his constraint remains valid in the "zone de précaution".)*

[10] *During the same decision as for the antenna tilt (Previous footnote refers), it was decided to limit these restrictions to airfields equipped with ILS CAT III. These decisions were made out of concern for the loss of all means of mitigation*

[11] https://www.ecologie.gouv.fr/sites/default/files/Safety_Info_Leaflet_2021_01_5G_interferences.pdf

[12] *Protection distance =(λ/ (4π)) x 10^((Max EIRP- interference threshold + ICAO Safety margin)/20)*

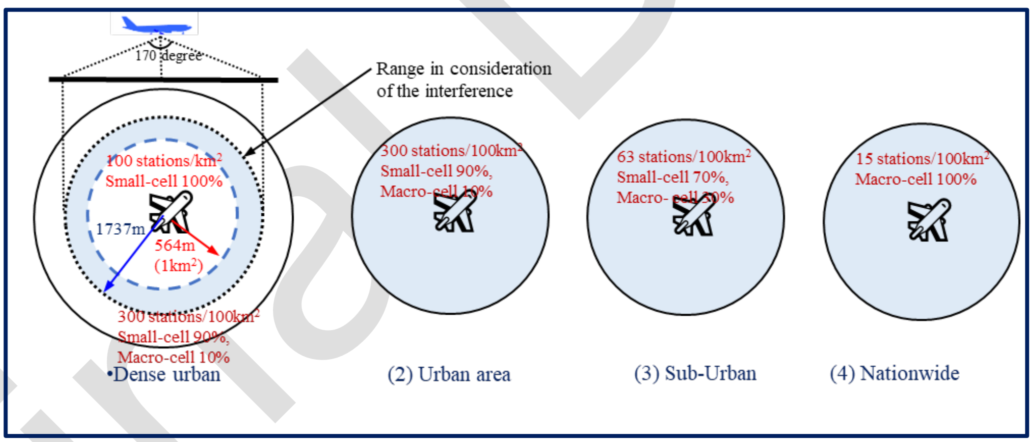


Special protection zones around all IFR aerodromes in mainland France

3.2.5. Japan

3.2.5.1. In Japan, 5G allocations are in the bands 3.6 – 4.1 GHz and 4.5 – 4.6 GHz which imply a 100 MHz guard band relevant to the radio altimeters band. The Ministry of Internal Affairs and Communications, the spectrum regulator in Japan, in coordination with specialized Institutes conducted a compatibility study using the parameters described in Recommendation ITU-R M.2059. The study has considered the following main factors:

- The BS deployment model is divided into 4 types of areas that have different densities and ratios of the 5G BSs as shown in the following figure. The angle of the range for aggregation is 170 degrees downward, and the area on the surface is calculated by the flight altitude. The maximum radius of the dense urban area model is 564m (1km2). The urban area model is placed surrounding the dense urban area model if the radius of the range of considerations is exceeding the maximum radius of the dense urban area model according to the flight altitude



BS Deployment model considered in the compatibility study between 5G base stations and radio altimeters in Japan

- Two types of 5G BS were considered as typical models for study. One is the macro-cell BS (with the higher power radiation and higher antenna height) and another is the small-cell (with the lower power radiation and lower antenna height). The specifications of the 5G BS are described in the following Table.

	Small-cell BS	**Macro-cell BS**
Maximum EIRP (dBm/MHz)	25	48
Maximum Antenna Gain (dBi)	23	23
Ohmic loss of Active Antenna System (AAS) (dB)	3	3
Mechanical tilt (degrees)	10	6

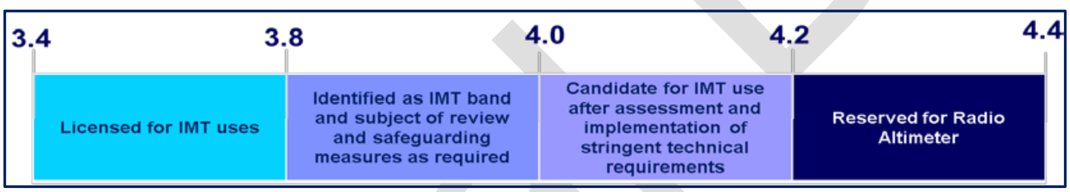
Antenna Height (m)	10	40
Spurious Level	-16 dBm/MHz	-4 dBm/MHz

3.2.5.2. Considering the results of the compatibility study between the RAs and 5G Base Station (BS), the Ministry of Internal Affairs and Communications set the following regulation for 5G BS:

- To avoid harmful interference to the RAs, a 100 MHz guard band is mandated.
- Additional requirement for the compatibility to the RAs near the aerodromes are applicable:
  - a) To avoid unwanted emission interference, unwanted emission of the 5G BS into the RA band should be reduced.
  - b) To avoid the blocking of radio altimeters, the location of the bands 4.0 – 4.1 GHz and 4.5 – 4.6 GHz used for 5G base station should be avoided within 200 m from the approaching path of aircraft.
  - c) For the heliports, the bands 4.0 – 4.1 GHz and 4.5 – 4.6 GHz used for 5G BS should be kept the physical separation more than 50 m for macro-cell and 20m for small-cell.

3.2.6. Saudi Arabia

3.2.6.1. The Communications and Information Technology Commission (CITC) is responsible for managing radio spectrum for all users in the Kingdom of Saudi Arabia. CITC has planned allocation of 5G IMT in the band 3.4 – 4.0 GHz as shown hereafter.



3.2.6.2. CITC conducted consultation with aircraft manufactures and operators in February 2021to take views and comments on the impact of 5G deployment in 3.8 – 4.0 GHz band on the RADALT. The main recommendations can be summarized as follows:

- The allocation in the band 3.8-4.0 GHz must be subject to protection criteria, technical and operational requirements considering the performance of RADALT to avoid any harmful interferences, which may include but not limited to (separation distance, antenna height, tilt, and power).
- Consideration should be given to the protection of altimeters operating on-board helicopters using helipads in built-up areas where 5G deployment is likely to be high-density.
- These arrangements need to be reviewed once the aviation industry has developed new radio altimeter standards taking account of 5G deployments and developed a transition plan. Once new standards are deployed for RADALT, the allocation for 5G IMT may be extended in the band 4.0-4.2 GHz.

3.2.6.3. CITC and General Authority of Civil Aviation (GACA) are collaborating with “Spectrum Advisory Group” to develop protection criteria for the altimeter systems to avoid harmful interference from the 5G networks. Interim measures using the French approach where exclusion and protection zones are established around major airports, are under consideration.

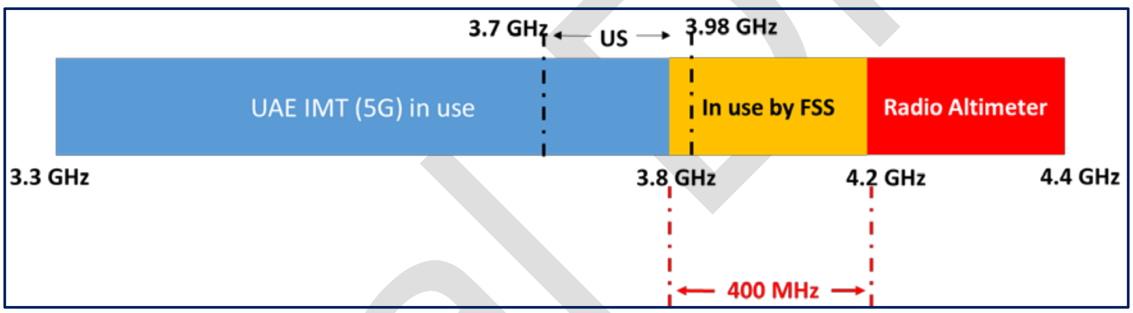
3.2.6.4. GACA published an Advisory Circular[13] to all operators of aircraft equipped with radio altimeters and air traffic service providers within the Kingdom of Saudi Arabia, informing them about the likelihood of 5G interferences on aircraft system. This Circular provides operational recommendations and invite aircraft operators, pilots, and Air Traffic Service Units to report to GACA any 5G interference events.

3.2.7. Oman

3.2.7.1. The Civil Aviation Authority (CAA - Sultanate of Oman) published an Aeronautical Information Circular (AIC)[14]. The purpose of this Civil Aviation Safety Alert is to raise awareness of the potential risk of 5G interference and to recommend precautionary operational measures before confirmation of impact of 5G radio waves on radio altimeters.

3.2.8. United Arab Emirates

3.2.8.1. Telecommunications and Digital Government Regulatory Authority is responsible for managing radio spectrum in UAE. 5G allocations in UAE are in the band 3.3 – 3.8 GHz as illustrated in the following figure.



3.2.8.2. The UAE gives high priority to RADALT protection in 4.2- 4.4 GHz. The UAE plans to use the band 3.8 – 4.0 GHz for IMT only after completion of technical studies to protect RADALT in 4.2- 4.4 GHz and in the future may extend this use up to 4.2 GHz.

3.2.8.3. The General Civil Aviation Authority (GCAA – UAE) published a Safety Alert[15] at the attention of United Arab Emirates Aircraft Operator, informing them about the likelihood of 5G interferences on aircraft systems. This safety alert also recommends monitoring and reporting any 5G interference events.

3.2.9. United Kingdom

3.2.9.1. In the UK, Ofcom are responsible for managing the radio spectrum for all users in UK. In consultation with the Civil Aviation Authority and the Ministry of Defence, Ofcom decided to release the frequency band 3.6-4.2 GHz for mobile applications.. The frequency band was split in two with the 3.6-3.8 GHz being auctioned off for 5G mobile services and 3.8-4.2 GHz was made available through coordinated local licenses to meet local wireless connectivity needs and innovation in rural areas with a lower radiated power.

3.2.9.2. Prior to the release of the consultation document for both frequency bands, UK conducted a number of theoretical study with respect to the potential impact on radio altimeters. Various scenarios based

[13] *GACA Advisory Circular*
[14] *https://www.caa.gov.om/upload/files/AIC 04-21.pdf*
[15] *https://www.gcaa.gov.ae/en/epublication/admin/Library Pdf/Safety Alerts/SAFETY ALERT 2021-03 - REQUIREMENTS TO MITIGATE 5G INTERFERENCE OPERATIONAL RISKS - ISSUE 01.pdf*

on International Telecommunication Union, European Commission & UK regulations and taking into account that signals will continue to roll-off in the spurious emission domain as well as other perceived reasonable assumptions. The initial study did not consider the impact of active antenna system due to modelling difficulties and user equipment was ignored as the power levels are significantly lower and therefore presumed not to be a threat. Subsequent studies have taken into account active antenna.

3.2.9.3. Whilst Ofcom, the Civil Aviation Authority and the Ministry of Defence were confident that the deployment of 5G services, especially around airports, would not pose a threat to radio altimeters. However, given the results of the RTCA studies the UK has monitored the situation carefully but there has been no evidence of interference caused by the introduction of high power 5G services in the frequency band 3.6-3.8 GHz or rural wireless services.

3.2.10. USA

3.2.10.1. The USA allocated 3.7-3.98 GHz to services including 5G in Feb 2020 in 20 MHz license blocks that can be aggregated by the same operator up to 100 MHz. The FCC limited the fundamental power to 65 dBm/MHz maximum EIRP for rural areas, and 62 dBm/MHz in urban areas, though no limits were placed on antenna positioning or vertical direction of the signal. Additionally, the FCC limited out of band spurious emissions levels to -13 dBm/MHz though 3rd Generation Partnership Project (3GPP) standards recommend -30 dBm/MHz. In some cases, based on testing, the aviation community has recognized the need for emission levels to be as low as -48 dBm/MHz to ensure adequate performance of the radio altimeter system.

3.2.10.2. The United States Federal Aviation Administration (FAA) on 18 October 2022 issued a Special Airworthiness Information Bulletin (SAIB) on the Risk of Potential Adverse Effects on Radio Altimeters[16], as well as, a Safety Alert for Operators (SAFO) on the Risk of Potential Adverse Effects on Radio Altimeters when Operating in the Presence of 5G C-Band Interference[17]. Concurrently, two Airworthiness Directives (ADs), FAA ADs 2021-23-12 and 2021-23-13,were issued: An Airworthiness Directive on altimeter interference for fixed wing aircraft [18], and an Airworthiness Directive on altimeter interference for rotary wing aircraft[19] Subsequently, seven additional ADs have been issued. These ADs revise the landing requirements, and in certain cases, prohibit landing at certain airports due to the reliance aircraft systems have on radio altimeters. The FAA issued Notices to Air Missions NOTAMs prohibiting certain operations. Therefore, FAA ADs must be followed when operating in the USA where a NOTAM is in place.

3.2.10.3. The FAA has defined protection areas around active runways as follows:

- **Runway Safety Zone (RSZ)** – The RSZ is defined as the volume where aircraft are highly likely to be operating during low altitude operations near the runway with 5G C-band emissions meeting maximum power requirements. The RSZ is based on instrument approach procedure (IAP) obstacle clearance surfaces (OCS) applicable to these low altitude operations (e.g., below 500 feet AGL) near the runway, specifically, the approach, missed approach, and CAT II/III OCS. Therefore, the RSZ is a 3D volume that begins at the surface on and near the runway, extends

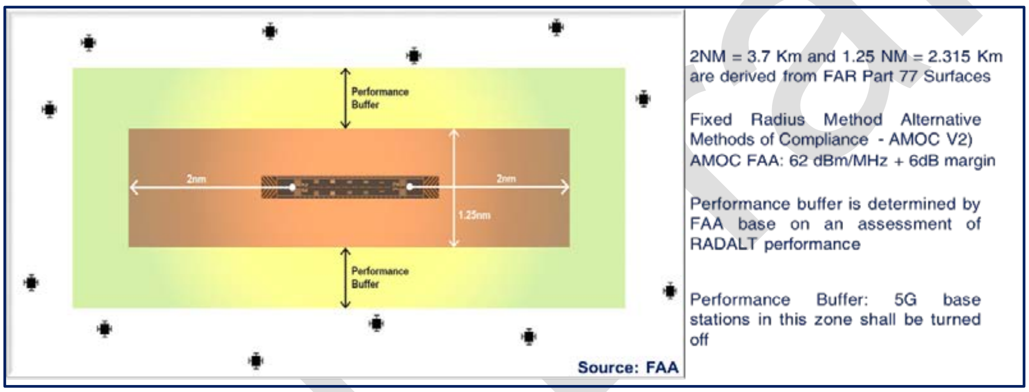
[16] *https://drs.faa.gov/browse/excelExternalWindow/DRSDOCID199898867620221018133547.0001*

[17] *https://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/safo/all_safos/media/2021/SAFO21007.pdf*

[18] *https://www.faa.gov/sites/faa.gov/files/2021-12/FRC_Document_AD-2021-01169-T-D.pdf*
[19] *https://www.faa.gov/sites/faa.gov/files/2021-12/FRC_Document_AD-2021-01170-R-D.pdf*

approximately 2 nm into the approach area along the extended runway center line, and slopes up based on the OCS as defined by the IAP glide path angle. The width of the RSZ is based on the OCS width at a specific distance from the landing threshold, and varies between 1300 and 3000 feet each side of the runway center line. In this area unreliable Radio Altimeter function can lead to a catastrophic outcome. Acceptance criteria: The Radio Altimeter must function accurately and reliably in the RSZ.

- **Performance Buffer (PB)** – Initially, the FAA defined PB as the zone in which 5G base stations were turned off based on an assessment of radio altimeter performance. Through collaboration with the aviation and wireless industry, this evolved into the current approach, where the 5G signal in space must meet specific power spectral density (PSD) requirements in the RSZ volume. Specific PSD requirements vary based on altitude above ground level, and are based on minimum required RA performance. These PSD requirements will continue to evolve as more minimum required RA performance increases (e.g., as more RAs are retrofitted or replaced), to support increased wireless base station power..



3.2.10.4. Since January 2022, the FAA has issued monthly Alternative Means of Compliance (AMOC) based on the performance capabilities of the Radio Altimeter while also considering antennas, cabling, and any other system integration issues. The method aims to determine the minimum distance away from a 5G antenna the aircraft needs to be to meet the acceptance criteria of the RSZ.

3.2.10.5. More information on historical FAA assessment, documentation, and actions can be found at www.faa.gov/5g.

3.2.11. Arab Civil Aviation Organization (ACAO)

3.2.11.1. Air Navigation Committee endorsed the following recommendation:

- Urge ACAO member states to take appropriate measures to reduce the impact of the installation of 5G cellular networks on the air traffic movement in coordination with the concerned national authorities of each country (national telecommunications regulatory bodies) including determining the levels of use of 5G cellular networks near airports and their future plans.....
- Task the General Administration of ACAO in coordination with the recently established 5 G Working Group of ICAO Middle East Regional Office to work on the development of a mechanism at the national and regional levels to report and analyze interference reports resulting from the use of 5G networks
- Urge ACAO member states to support ICAO's position during the 2023 World Telecommunications Conference WRC-23 meeting to be held on 2023 through coordination with the national telecommunications regulatory bodies of each member State.

3.2.12. EASA

3.2.12.1. European Aviation Safety Authority issued a Safety Bulletin: SIB No. 2021-16 on the subject of Operations to aerodromes located in United States with potential risk of interference from 5G ground stations.

3.2.13. IATA

3.2.13.1. IATA continues engaging with governments to mitigate threats to the civil aviation spectrum, including encouraging responsible deployments of 5G. IATA activities focus under four strategic pillars including:

1) Safe and uninterrupted airline operations - civil aviation should not be negatively impacted by any spectrum deployments.
2) Cooperative coordination - government agencies should plan spectrum deployments collaboratively together with industry stakeholders.
3) Protection of civil aviation spectrum resources and establishment of predictable global spectrum environment
4) Robust aircraft and avionics design with clear and cost-effective migration path

3.2.13.2. IATA and its member airlines understand the economic importance of 5G deployments. However, in line with Article 4.10 of the International Telecommunications Union Radio Regulations (pdf) and ICAO Standards and Recommended Practices, IATA insists that maintaining current levels of safety for civil aviation must continue to be one of the governments' highest priorities.

3.2.13.3. IATA has developed a website that includes the Global 5G C-Band status Dashboard and be accessed at: https://www.iata.org/en/programs/ops-infra/air-traffic-management/5g/

3.2.14. ICAO – FSMP

3.2.14.1. Within ICAO, the Frequency Spectrum Management Panel (FMSP) has considered the issue and reviewed submissions from several States and International Organizations. In addition, a Working Group (WG) has been established to collect information on 5G/Radio Altimeter compatibility. Based on a proposal from FSMP-WG, the ICAO Secretary General issued a State Letter expressing potential safety concerns regarding interference to radio altimeters (ICAO SL 21/22 "Potential safety concerns regarding interference to radio altimeters", published on 25 March 2021[20]). This letter encourages administrations to consider as a priority, public and aviation safety when deciding how to enable cellular broadband/5G services in radio frequency bands near that used by radio altimeters. The FSMP-WG continues to work on the subject and expects additional contributions from States, and specialized international organizations. The material produced by FMSP is publicly available through this link: https://www.icao.int/safety/FSMP/Pages/default.aspx[21].

3.2.14.2. Based on WP30[22] presented jointly by Air Transport Association (IATA), the International Business Aviation Council (IBAC), the International Coordinating Council of Aerospace Industries Associations (ICCAIA), the International Federation of Air Line Pilots' Associations (IFALPA) and RTCA on "Safety concerns regarding interference to aircraft radio altimeters", ICAO High Level Conference On COVID-19 (HLCC 2021) adopted the following Recommendation:

[20] https://www.icao.int/safety/FSMP/Documents/5G and Radio Altimeters/StateLetter_2021_022e.pdf
[21] https://www.icao.int/safety/FSMP/Pages/default.aspx
[22] https://www.icao.int/Meetings/HLCC2021/Documents/WP/EN/SAF/wp_030_en.pdf

Recommendation 5/5 — Mitigating the risk of 5G implementation to safety-critical radio altimeter functions That States:

a) consider, as a priority, public and aviation safety when deciding how to enable cellular broadband/5G services;
b) consult with aviation safety regulators, subject matter experts and airspace users, to provide all necessary considerations and regulatory measures to ensure that incumbent aviation systems and services are free from harmful interference;

and That ICAO:

c) continue coordinated aviation efforts, particularly at the International Telecommunication Union (ITU), to protect radio frequency spectrum used by aeronautical safety systems.

3.2.14.3. The Technical commission of the ICAO Assembly 41st session held from 29 September to 5 October 2022 reviewed several working papers on potential interference from 5G deployment to the radio altimeter and has encouraged States and regions to actively participate in spectrum protection activities and to endorse the ICAO position for the twenty-third meeting of the International Telecommunication Union World Radiocommunication Conferences (ITU WRC-23) (ICAO State letter E 3/5-21/37).

3.2.14.4. Based on a proposal of the technical commission, the Assembly adopted a resolution which supersedes Assembly Resolution A38-6: *Support of the ICAO policy on radio frequency spectrum matters*. This resolution urges Member States to consider, as a priority, public and aviation safety when deciding how to enable new or additional services, and to consult with aviation safety regulators, subject matter experts and airspace users, to provide all necessary considerations and to establish regulatory measures to ensure that incumbent aviation systems and services are free from harmful interference[23].

3.2.14.5. In addition, ICAO adopted the following additional actions:

- Updating its positions on Frequency spectrum use to highlight concerns on 5G band allocations and potential interference with RADALT. The position will be submitted for ITU World Radiocommunication Conference (WRC) 2023 highlighting the concerns.
- Amending ICAO-MID Frequency Management Ad-hoc working group ToRs to add a task to Collect and share information on the best practices implemented by States and Regional Organizations to mitigate potential radio altimeters (RADALT) interference caused by 5G operation
- Updating ICAO Spectrum Policy and Handbook to strengthen the need to protect the radio altimeter.
- Raising awareness and emphasizing the importance of the issue with State regulators, both aviation and spectrum, through its regional offices and meetings.
- Issuing of several ICAO liaison statements to the European spectrum regulator (CEPT) highlighting the need to protect the radio altimeter and to encourage conditions on 5G deployment that can ensure the functionality of current radio altimeters and thus can be accepted by aviation stakeholders.

3.2.15. RTCA-EUROCAE

3.2.15.1. Following the US national Communication Regulator i.e., Federal Communication Commission (FCC)'s decision to allow 5G services in the 3.7-3.98 GHz, an additional study was encouraged given the

[23] *https://www.icao.int/Meetings/a41/Documents/WP/wp_623_en.pdf - from page 10 to 12.*

questions raised by the aviation community. With this respect, RTCA established a public multi-stakeholder group under its Special Committee 239 (SC-239) that conducted an extensive theoretical study of the simulated 5G interference, assessing it against radio altimeter performance data from the major manufacturers in common and real-world scenarios. With the regulatory limits defined by the US FCC for base stations and handsets, combined with data from the 5G interests, the RTCA SC-239 Report[24] found that all aircraft types and multiple operations received interference from both simulated fundamental and spurious 5G emissions. The RTCA Report concluded that "5G base stations present a risk of harmful interference to radio altimeters across all aircraft types, with far-reaching consequences and impacts to aviation operations". RTCA published YouTube presentation of the Radio Altimeter issue[25].

3.2.15.2. RTCA and EUROCAE (SC-239/WG-119) have jointly initiated the drafting of new minimum operational performance standards (MOPS) for the Radio Altimeter, the completion of the work is scheduled for December 2023 as described in the following section.

3.3. Long Term Plan for Radio Altimeter

3.3.1. While the aviation industry has recognized that changes to the RF environment in which radio altimeters operate are inevitable and performance standards must be updated accordingly, this process necessarily takes a significant amount of time given the extreme rigor and caution with which aviation systems manufacturers, aircraft manufacturers, aircraft operators, and Civil Aviation Authorities (CAAs) work to develop and implement such changes. Even a technical solution which may be viable for retrofit installations, would take several years to properly validate, and deploy across all affected civil aircraft operating in the world. Therefore, it is critical that the performance of radio altimeters which are currently in service across tens of thousands of civil aircraft (The number of commercial aircraft in MENA is 2126 of which 1919 in MID Region) be understood and the risks and operational impacts due to interference be acknowledged.

3.3.2. New Radio Altimeter Standards are being developed to sustain planned 5G environment The effort for updating equipment standards for future radio altimeters has already started with the development of new Minimum Operational Performance Standards (MOPS) by the RTCA Special Committee SC-239 and EUROCAE working Group WG-119. The plan calls for completely re-write the MOPS document including the addition of new RF interference and test procedures and to release a new doc. DO-XXX/ED-XXX "Technical Standard on RF Interference Environment for Radio Altimeter "in December 2022 followed by document DO-155A/ED-30A MOPS revision in December 2023. While this new radar altimeter standard will define significantly more interference immunity to external RF sources, the limits of current technology will still have boundaries to the protection against all possible interference. Aircraft operating in close proximity to high power cellular towers with frequencies near the edges of the radar altimeter's 4 200 – 4 400 MHz band will still require national regulator action to protect certain aircraft operations.

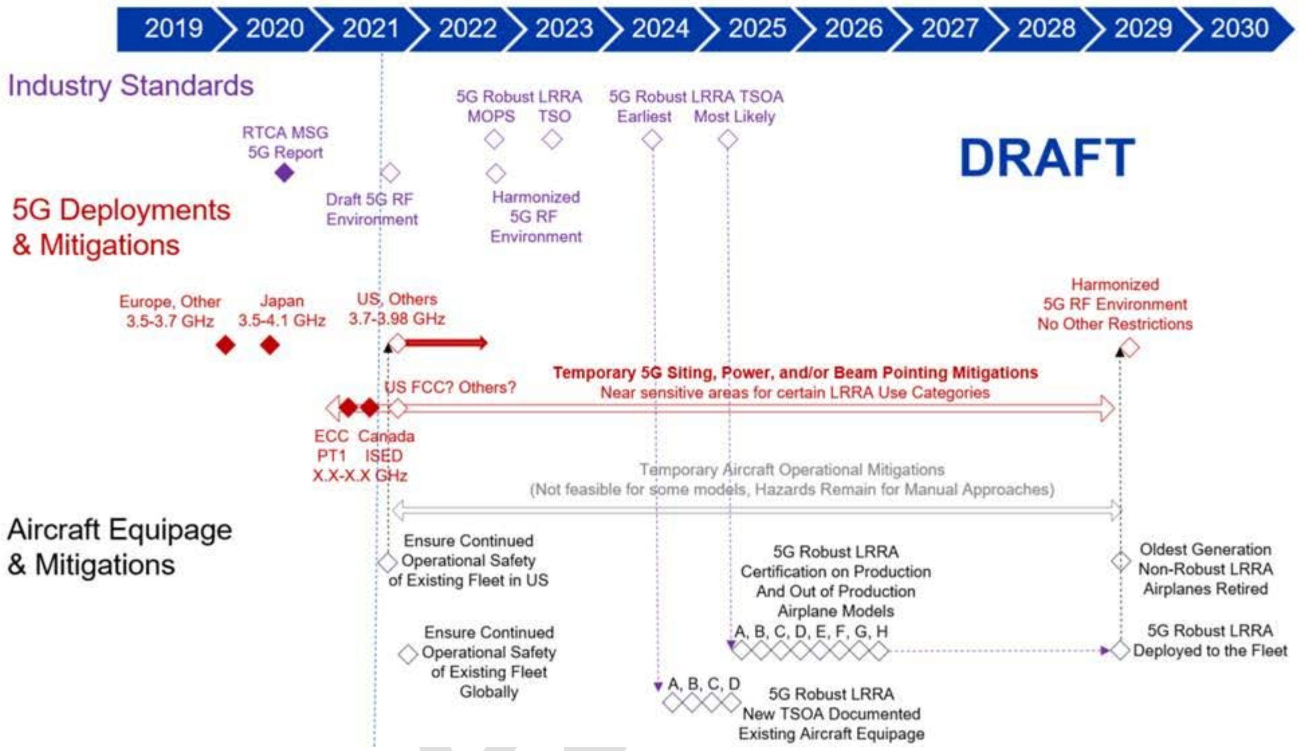
3.3.3. Once the MOPS is completed, ICAO in coordination with IATA and ICCAIA has agreed to include the new equipment standards into the ICAO Annexes. Moreover, ICAO has also agreed to assist with future coordination with ITU for the inclusion of important regulatory provisions into ITU global telecommunication treaty – the ITU Radio Regulations - aiming to provide appropriate legal protections for future radio altimeters.

[24] https://www.rtca.org/wp-content/uploads/2020/10/SC-239-5G-Interference-Assessment-Report_274-20-PMC-2073_accepted_changes.pdf

[25] https://www.youtube.com/watch?v=OpYhjK2MDqM

3.3.4. After the MOPS are updated, it is anticipated that they will be referenced by CAAs, to define new performance standards that must be met for equipment-level design approvals of radio altimeters. However, the new MOPS will only result in improved radio altimeter designs in the future—currently installed radio altimeters on commercial and civil aircraft will still be exposed to 5G and would operate for many years.

3.3.5. Below figure shows the plan and schedule for the development of new RTCA/EUROCAE Radio Altimeter standards:



Chapter 4 - Methodologies for defining safeguarding measures for aerodromes & heliports

4.1. Introduction

4.1.1. Recommendation ITU-R M.2059 explains three primary electromagnetic interference coupling mechanisms between radio altimeters and interfering signals from other transmitters: receiver overload, desensitization, and false altitude generation.

4.1.2. Any compatibility analysis between radio altimeters and other systems must utilize those protection criteria for the maximum acceptable degradation for a radio altimeter. These criteria are defined as followed:

- Receiver front-end overload where the value depends on each radio altimeters type
- Receiver desensitization which is the common I/N protection criteria of -6dB, and
- the False altitude reports which are defined by -143 dBm/100 Hz (–143 dBm considering 100 Hz detector bandwidth following the instantaneous altimeter local oscillator (LO) frequency).

4.1.3. It should be understood that any interference that is unpredictable and that can mix with the linear FM waveform, thereby causing the radio altimeter to mistake the mixed signal as terrain has the potential to cause a radio altimeter to report a false altitude. The fact that all radio altimeter antennas are necessary pointing at the Earth's surface makes the system vulnerable to all possible interference sources illuminated during the approach.

4.1.4. The radio altimeter antennas, due to their location on aircraft, do not have the benefit of being shielded or screened from many of the possible interference sources on the Earth's surface. Instead, it can virtually "see all possible radiation sources "as they escape buildings and via direct transmission from devices operating outside of any structure.

4.1.5. For studies focusing on emissions into the frequency band 4200-4400 MHz, only the false altitude reports and the receiver desensitization are applicable. A false altitude report is a serious radio altimeter error that may cause critical aircraft systems such as ground proximity warning, weather radar, traffic collision avoidance system (TCAS), flight controls and other critical systems to respond inappropriately. In the case of FMCW-based radio altimeters, false altitude reports occur when interference signals are detected as frequency components during spectral frequency analysis of the overall IF bandwidth.

4.1.6. As described in Chapter 3 of this document, the safeguarding measures and mitigations adopted by competent spectrum regulators and aviation authorities around the world, to protect RADALT from 5G BS deployment are mainly focusing on setting protection zones considering aircraft height/altitude above the BS[26]. These measures are aimed to reduce the probability of interference occurring by imposing limitations on the deployment of 5G base stations at aerodromes and in areas surrounding aerodromes. Chapter 3 provides an overview of protection zones measures applied in France, Canada, Japan, and USA.

4.1.7. The main practical measures that have been codified in national telecommunication regulations and successfully deployed include:

[26] *Note: The analysis of 5G BS is assuming that the proposed height is meeting the requirements of obstacle limitations surfaces defined under ICAO Annex 14, Chap. 4 Vol. I (aerodromes) and Vol. II for heliports*

1) Ensure through testing sufficient spectrum separation between 5G C-band deployments and 4.2-4.4 GHz frequency band used by existing radio altimeters
2) Clearly codify and enforce the maximum power limit for 5G C-band transmission and downward tilting (electronically or mechanically) of 5G C-band antenna.
3) Establishment of sufficient 5G C-band prohibition and pre-cautionary zones around airports.

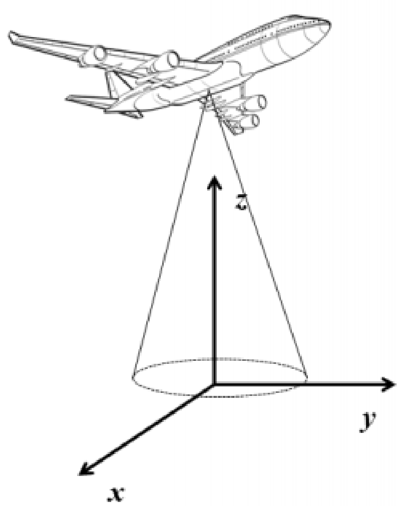
4.2. Methodology for the protection of Radio altimeters

4.2.1. General approach and Main considerations

4.2.1.1. To identify the protection areas around airports and heliports for proper mitigations, ICAO recommends to consider the following parameters when performing the analysis:

- The aircraft can have a maximum roll of up to +/-30 degrees from the horizontal in all directions,
- The air-to-ground propagation model (Recommendation ITU-R P.528-4[27]) with a minimum time percentage should be used. It should be noted that Rule of Procedure on RR 5.441B was adopted by the ITU Radio Regulatory Board and proposes to use this Recommendation with a time percentage of 1% for the calculation of IMT interference into non-safety aircraft applications. As a result, for safety applications such as radio altimeters a percentage value less than 1% should be considered. If the Recommendation is not capable of calculating path losses with time percentage less than 1%, then 1% should be used and appropriate margins added.

4.2.1.2. The characteristics of 5G BS are key information to check whether the protection criteria are met for an airplane flying at different heights (50, 200, 1000 ft and 2000 ft (15, 61, 310 and 610 meters)) above the base station. The figure below shows the geometry of the scenario.



4.2.1.3. With reference to the coordinate systems in this figure:

- The base station is located at (0,0,0);
- The aircraft is flying along a horizontal path defined by the coordinates (0, ya, ha). The altitude ha of the aircraft is fixed, so that its position varies along the axis y only;

[27] https://www.itu.int/rec/R-REC-P.528/en

- The radio-altimeter antenna beam is modeled based on the antenna pattern formula available in Report ITU-R M.2319[28] (§A-3.1.1).

4.2.1.4. The analysis should be based on a single base station to verify whether it can pose a threat to the aeronautical systems in the band (for simplicity the aircraft can have zero roll and pitch). If a single base station is predicted to not cause interference, the analysis can be expanded to consider the aggregation of multiple interferers and the roll and pitch of the aircraft.

4.2.1.5. As the main concern with aircraft being provided with erroneous radio altimeter data or loss of radio altimeter data during approach is infringement of minimum safe altitude/height above terrain/obstacles and incorrect execution of the flare. The flare is the pitch up movement of the aircraft just before touchdown that reduces the vertical speed and ensures a 'soft' touch down. The data provided by the radio altimeter is essential to determine the height above the terrain/obstacles and runway at which the flare is initiated.

4.2.1.6. As radio altimeter data is more critical during the approach phase for landing, the analysis of the impact of 5G BS should focus on the approach path considering the location of the Base station (BS). This would identify the minimum possible distance between the aircraft path and base station ensuring proper protection of the altimeter while providing height information to the autopilot during landing.

4.2.1.7. The assessment of the impact (Risk of interference) of deployment of a 5G network on radio altimeters is a complex activity (identification of protection areas) and depends on many parameters and factors such as:

- **Power of the 5G base station** (xxx dBm) call TRP (True Radiated Power)
- **Antenna gain** (yy dBi) depending on the type of antenna: Two different technologies are available for 5G antennas with different antenna gain:
  1) AAS antenna (Active Antenna System) is the general term used to describe antenna using adaptive beamforming. Depending on the information available, the gain can exceed 25dBi[29].
  2) Non AAS antennas are antennas with a fixed beam, usually 120° where the gain where the gain is constant around 15dBi.
- **Maximum Effective Isotropic Radiated Power** (E.I.R.P = power of the 5G base station (xxx) + antenna gain (yy))
- **The location of the Base station antenna**
- **The antenna tilt** should be below the horizon[30], and therefore the maximum gain towards the aircraft is lower (about 5dB) than the maximum gain of the antenna.
- **The vertical scan (Scan angle)**: There are no restrictions on the vertical scan angle in the Telecommunication regulations. The level of the grating lobes depends directly on the amplitude of the vertical scan angle.
- **The rate of use of a base station:** The power radiated by a base station depends on the data traffic passing through it. By the end of 2021, in France, data transmitted in 5G represents less than 1.5% of mobile data but since the number of 5G subscriptions doubles every 3 months.
- **The ground scattering and altitude:** The susceptibility of radio altimeters also depends on the ratio of the 5G signal to the radio altimeter return signal. The higher the ground scattering is,

[28] https://www.itu.int/dms_pub/itu-r/opb/rep/R-REP-M.2319-2014-PDF-E.pdf

[29] *Although this is often dependent on the choice of the mobile operator and confidential, the knowledge of the elevation of the Radiation pattern, of the 5G antenna, is an important element to accurately assess the interference risks.*

[30] *Until now, there is no restriction in Europe.*

the more resistant the radio altimeter is. The altitude of the aircraft increases the path loss of the Radio altimeter signal, and therefore makes its receiver more sensitive, but at the same time the altitude of the aircraft moves it away from the 5G base stations and increases 5G the path loss. Studies and simulations have shown that the most unfavorable altitude is around 200ft.

- **The frequency band used.**
- **Aggregated unwanted emission level**
- **Filtering characteristics of each radio altimeters and associated installation**

4.2.2. Main activities to define protection criteria

4.2.2.1. To identify the protection criteria for RADALT systems from the 5G networks, the regulators should perform the following approach is proposed for joint activities by relevant national spectrum and aviation regulatory authorities:

a) Development of detailed report summarizing the main findings of the international working groups and the corresponding administrations. The results and recommendations will be used as temporary and interim measures to protect the radio altimeters until the review of technical standards for RADALTs has been completed;

b) Conduct a detailed scientific technical study including simulations, and lab experiments. The study should accurately determine the level of coexistence between the RADALT systems and the 5G networks based on national 5G deployment plans in relation to the aviation environment. The study shall include at least the procedures, used tools and software, path loss model, references and findings. The findings shall include the following but not limited to:
   - The level of potential harmful radio interference;
   - The effect on the RADALT systems in case of potential interference;
   - A clear technical parameters or separation distance in case of a potential harmful interference.

c) The spectrum and aviation regulators should share the detailed report summarizing the main findings of scientific studies and lab experiments with all stakeholders;

d) The protection criteria will be updated according to the reported findings of scientific studies and lab experiments.

e) The research project team, in coordination with national spectrum and aviation regulators should perform a field trial, if feasible, to validate the scientific studies, simulations, and lab experiments findings and to ensure the coexistence between the RADLAT and 5G networks based on the applied protection criteria. The research project team should prepare a detailed report summarizing the main findings of field trials.

f) Finally, the protection criteria should be updated based on the reported findings of field trials.

4.2.2.2. In States with limited resources, consideration of work conducted in other States is acceptable, but care must be taken to ensure it is relevant to the national plan and scenario for the deployment of 5G networks.

4.2.3. Recommended methodology for the technical study

4.2.3.1. The UK presented a study at FSMP-Working Group (WG)/11 WP/27[31] outlining a methodology which could be used to assess the impact of 5G on RADALT. It investigates the potential interference from 5G base stations operating in the frequency range 3.6-4.2 GHz into radio altimeters under various scenarios as defined by the information contained in International Telecommunication Union,

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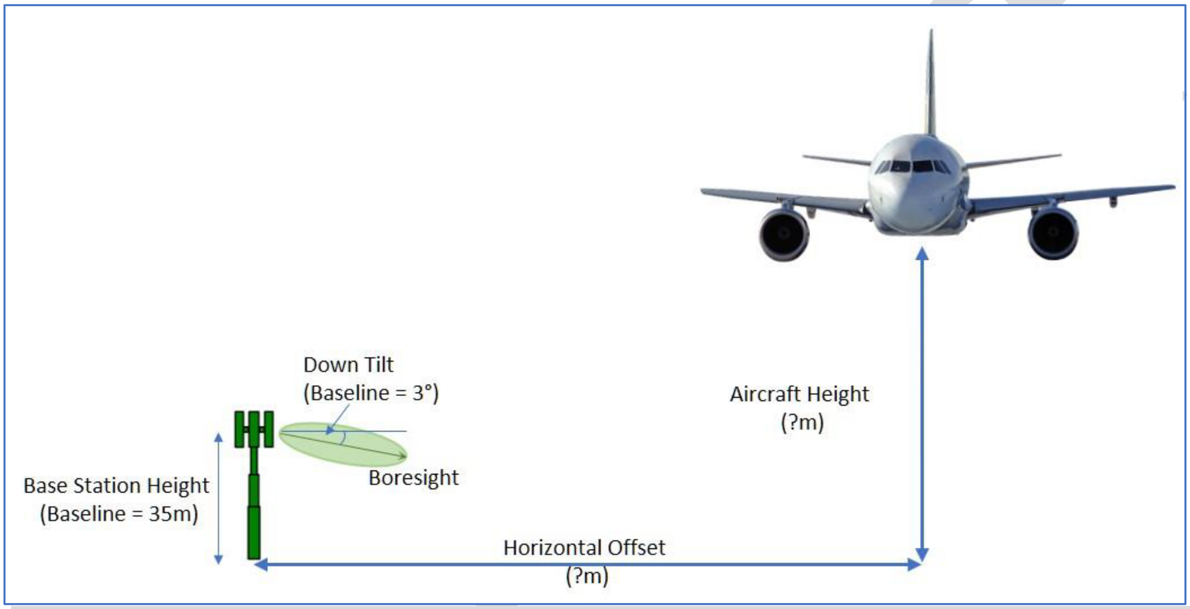
[31] *https://www.icao.int/safety/FSMP/MeetingDocs/FSMP%20WG11/WP/FSMP-WG11-WP27_Mobile%20vs%20Radalt%20REv.1.docx*

European Commission and UK regulations/documents. The methodology used in the study is based on the receiver overload threshold and it can be summarized as the following:

- The study considers the separation distance relative to the mobile base station's antenna required between a rural mobile base station and an aircraft in flight level flight, as illustrated in the next Figure.
- The study does not consider the impact of active antenna systems due to modelling difficulties and user equipment as the power levels are significantly lower and therefore presumed not to be a threat.



Scenario considered

(*Source: WG/27 Rev.1 presented by John Mettrop, FSMP Eleventh Working Group meeting)*

- For each angle during the approach of an aircraft, the required separation distance is calculated using the following ITU formula assuming free space path loss:

$$PRx = PTx + GTx + AFTx - FSPL + GRx + RxRej - FLRx + SM$$

Where:
PRx = Power received (assumed to be the receiver overload threshold)
PTx = Mobile base station power supplied to the antenna port
GTx = Gain of the mobile base station antenna in the direction of the aircraft
AFTx = Transmitter activity factor
FSPL = Free space path loss (=32.4+20log(FMHz)+20Log(Dkm)
FMHz = Frequency
Dkm = Separation distance
GRx = Gain of the radio altimeter antenna in the direction of the mobile base station
RxRej = Adjacent channel rejection of the radio altimeter receiver
FLRx = Feeder loss in the radio altimeter
SM = Safety margin (assumed to be 6dB)

Note:The above parameters might be changed according to the considered environment, i.e. based on the aerodromes, heliports. The radio altimeter information were taken from the ITU reports and studies.

After re-arranging the above equation, it can be re-written as follow:

$$DKM = 10^{(\frac{PTx+GTx+AFTx+GRx+RxRej-FLRx-32.4\ 20\ Log\ (FMHz)+SM}{20})}$$

- Having established the above baseline scenario, the following variations in the baseline scenario should be investigated for radio altimeters A1 and A3 taken from Recommendation ITU-R M.2059.
- The following parameters ware considered in the study:
  - **Pitch/Roll**: The impact of the aircraft pitching/rolling by 15°, 30°, 45° towards the mobile base station antenna.
  - **Mobile Antenna Heigh & Tilt:** Variations in the height and down tilt angle of the mobile base station for urban (25m & 6°) and suburban masts (20m & 10°) and this is based on
  - **Aggregate Effects:** The level of aggregate interference that should be applied assuming a standard rural macro deployment scenario taken from Recommendation ITU-R M.2101 &Report ITU-R M.2292
  - **Radio Altimeter Receiver Frequency Dependent Rejection:** Use the frequency dependent rejection at 3.75 GHz based on ITU-R M.2059 assuming the octave is based on the size of the frequency band & band edge frequency, radio regulatory guidance, RTCA worst case measured results.

4.2.4. Recommended Safeguarding and Interference Mitigation Measures

4.2.4.1. As a minimum, the list of regulatory actions and measures that need to be taken to protect Radio Altimeters may include the following:

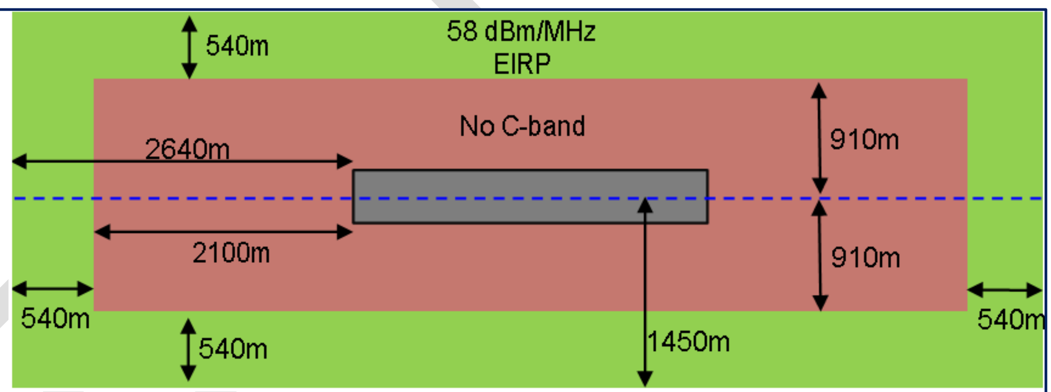
- Regulators to consider safety notices or circulars to aircraft operators highlighting the potential interference of 5G network emissions with aircraft RADALTs which may include:

1) PEDs be turned off (or in airplane mode) during flight.
2) Passengers must be advised to ensure that all electronic devices in checked baggage are turned off.
3) Operators must advise the air traffic service provider of any disturbance to the radio altimeter and report the occurrence to the CAA using normal company safety reporting procedures. Flight crew should include as much as possible, details regarding the type of malfunction, including duration and location (particularly if during an approach or departure phase), the runway in use and the height above the ground that the malfunction was observed
4) Air Traffic Service Providers are encouraged to inform their controllers of the possibility of such reports by crews.
5) Operators should ensure their flight crew are aware of the possible implications of radio altimeter malfunctions for the types of aircraft operated; this may be particularly relevant when conducting Precision Instrument Approaches during Low Visibility Operations
6) Where a State, based on the safety analysis of its own 5G roll out, has issued a NOTAM or similar directive, OT operators are required to adhere to any state operational restrictions. The absence of a NOTAM does not necessarily imply that interference will not be encountered.

7) Flight crew experiencing radio altimeter or auto flight malfunctions should not assume that this has been caused by 5G interference and should follow normal operating procedures for any malfunctions or failures. Although flight crew should be aware of the possibility of 5G interference, any malfunctions observed may well be caused by other factors such as radio altimeter and associated antenna technical failures.

4.2.4.2. State spectrum management authorities in coordination with Civil aviation authorities should consider adopting the following measures when approving the installation of 5G Ground stations around aerodromes:

- through testing by aviation subject matter experts and validation by aviation safety authorities, ensuring sufficient spectrum separation between 5G C-band deployments and 4.2-4.4 GHz frequency band used by existing radio altimeters
- clearly codifying and enforcing the maximum power limit for 5G band transmission which has been proven to the satisfaction of the State aviation safety regulators to not harmfully interfere with all existing aircraft radio altimeters
- prescribing a downward-looking radiation pattern for 5G C-band transmitting stations (Antenna downward tilting)
- establishing two protection zones, namely Safety and Precautionary zones, around aerodromes with sufficient technical conditions (such as restricting 5G transmission power) for each zone. Example of these protection zones as published by a State spectrum regulator are provided below:
  a) ‘Safety zone’ around the airport for the protection of the RA where the aircraft is below 200 ft (61m)
  b) Precaution zone on each side of the ‘safety zone’ to protect the landing approach below 1000ft (305m)
- 5G service providers have to take measures to avoid grating lobes as far as practicable.



Note: This illustration is for guidance on the protection zones at an aerodrome. The green area is defined as buffer zone that depends on the location of BS and several other factors.

4.2.4.3. For such efforts to be effective, timely transparency and cooperation from 5G network service providers in coordination with State spectrum regulators with regards to the provision of location information for their stations as well as details of the transmission characteristics (e.g., antenna radiation patterns, power levels) is required.

4.2.5. 5G devices used on board aircraft

4.2.5.1. A number of 5G user equipment and devices are expected to be transmitting on board an aircraft while the radio altimeter is operational. Many safety advisories and leaflets published by civil aviation authorities address this issue. An example is the Advisory Circular (AC) issued by General Authority of Civil Aviation (GACA – KSA)[32] defines operational recommendations for aircraft operators and pilots related to this subject. The following rules are the first three statements of the AC:

Operators and pilots of aircraft equipped with radio altimeters:

1) *Remind passengers that all portable electronic devices allowed for transport in checked baggage (including smartphones and other devices) should be turned off and protected from accidental activation.*
2) *Remind passengers to set all portable electronic devices in the cabin and any carried on the aircraft to a non-transmitting mode or turn them off.*
3) *Instruct crew to use 3G or 4G communication devices only when essential communication is required, such as during emergency medical service operations.*

4.2.5.2. Similar rules may be adopted as interim measures to protect radio altimeter from any interference that may be caused by 5G user equipment and devices used onboard an aircraft.

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[32] *The Advisory Circular issued by General Authority of Civil Aviation (GACA – KSA)*

Appendix A – French Methodology to set the dimensions of Special Protection Zones around airports

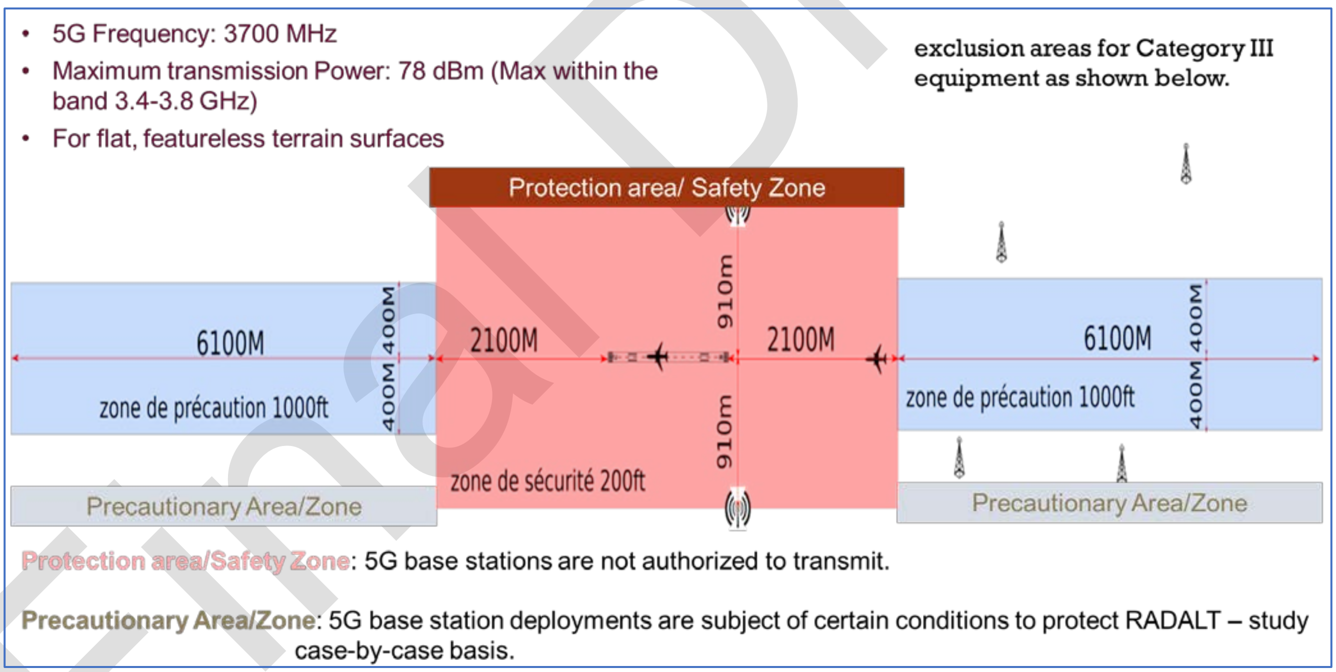
A.1 The French frequency management authority (ANFR) in coordination with the Civil Aviation Authority (CAA) adopted interim arrangements to protect aircraft RADALT from any interference of the 5G network deployed around the aerodromes. The main technical considerations and the dimensions of the protection areas are described in the following sections.

A.2 Protection areas

The protection areas identified around the French aerodrome used for IFR operations are divided into two types:

- Safety area/zone where no 5G network infrastructure deployment is allowed.
- Precautionary zone/area where 5G BS may be allowed only after case-by-case assessment..

The main criteria and the dimensions of the protection areas are illustrated in the following figure.



The width of the safety zone is calculated based on the attenuation of maximum effective radiated power (e.g. 78 dBm) increase by the fundamental tolerance threshold defined under the RTCA report and ICAO safety margin (6 dB) that should be considered for compatibility study. The length of the safety area/zone is based on the calculation of the distance required for an aircraft in the final approach phase at 200 ft until the touchdown zone with 3° slope with a tolerance of 0.375° (i.e. 2.625°)Glide Slope. The following illustrations provide details on the calculation of the dimensions of the safety zone.

Table 7-2: Comparison of VSG Spurious Output to Spurious Tolerance Thresholds

Usage Category	Altitude	Maximum VSG Output for 5G Fundamental Tolerance Threshold[32]	Predicted Worst-Case VSG Spurious in 4.2–4.4 GHz Band	Measured 5G Spurious Tolerance Threshold
1	200 ft	+7 dBm	-112 dBm/MHz	-80 dBm/MHz
	1,000 ft	-1 dBm	-120 dBm/MHz	-85 dBm/MHz
	5,000 ft	-7 dBm	-126 dBm/MHz	-107 dBm/MHz
2	200 ft	-19 dBm	-138 dBm/MHz	-112 dBm/MHz
	1,000 ft	-26 dBm	-145 dBm/MHz	-103 dBm/MHz
	2,000 ft	-35 dBm	-154 dBm/MHz	-119 dBm/MHz
3	200 ft	-14 dBm	-133 dBm/MHz	-96 dBm/MHz
	1,000 ft	-26 dBm	-145 dBm/MHz	-103 dBm/MHz
	2,000 ft	-35 dBm	-154 dBm/MHz	-119 dBm/MHz

As shown in Table 7-2, the expected spurious output from the VSG which reaches the radar altimeter receiver input during the 5G fundamental emissions tolerance threshold tests is far lower (by at least 19 dB) than the measured tolerance thresholds for spurious interference in the 4.2–4.4 GHz band for all altimeters and test conditions.

Interference Safety Margin

The ICAO *Handbook on Radio Frequency Spectrum Requirements for Civil Aviation* [17] states in paragraph 9.2.23 that an additional safety margin should be considered for interference analysis concerning aeronautical safety systems. This paragraph, in its

The attenuation of the maximum transmission power in space is: 78 dBm + 19 dBm + 6 dB

103 dB

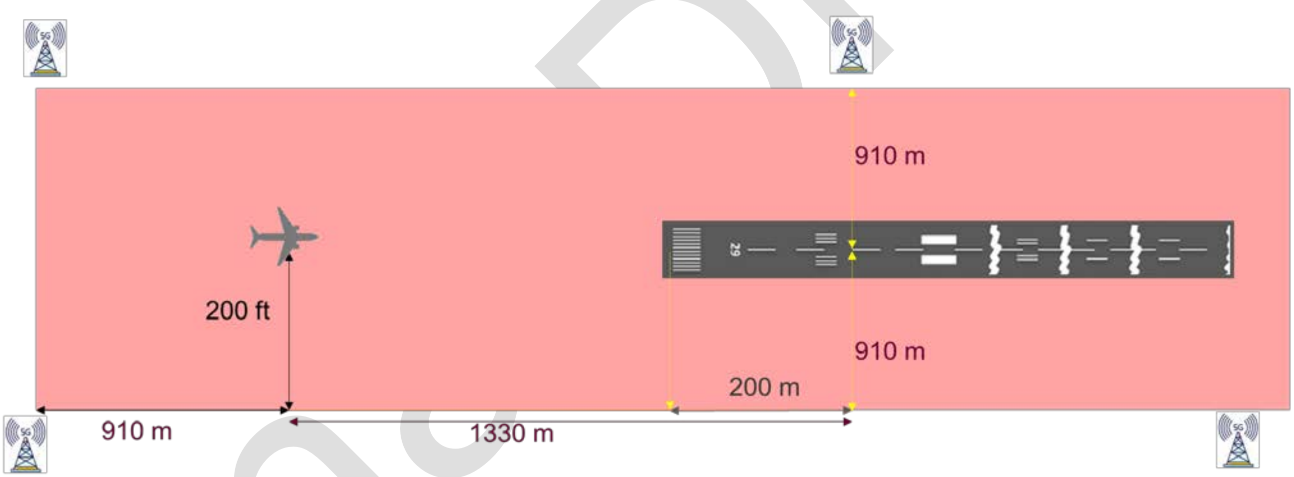
This requires a minimum distance between an aircraft and any 5G Ground Station of at least:

910 m.

19 dBm attenuation at the level of RADALT

ICAO Safety margin to be included in the interference study: 6 dB.

Protection area & Safety zone

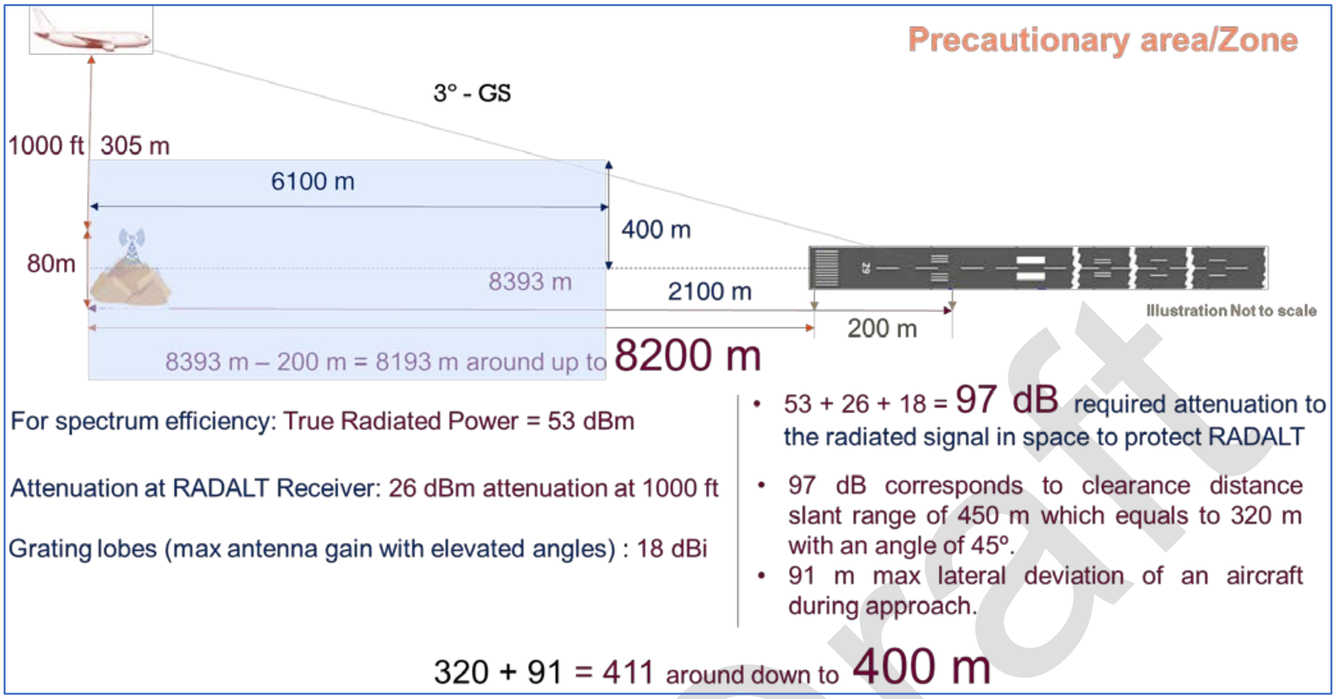


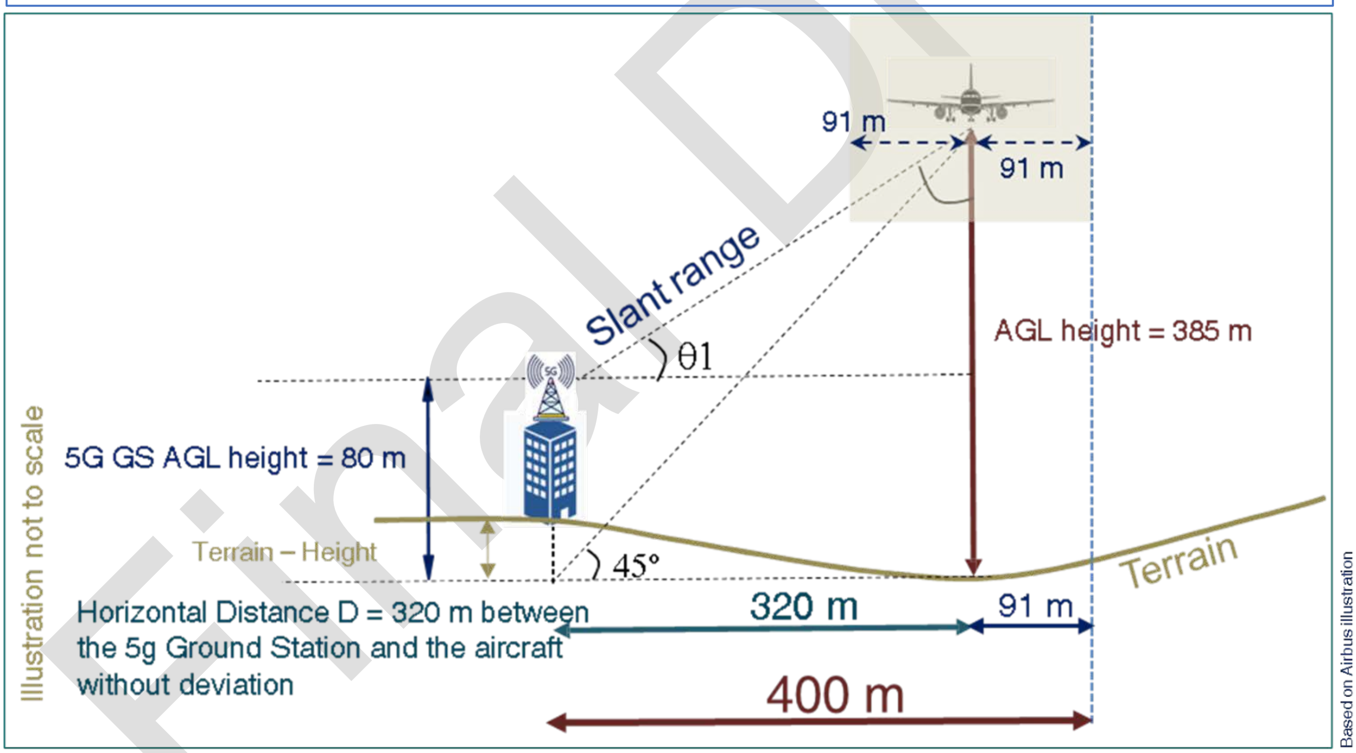
910 m: is the required Distance to protect RADLAT from 5G Base Station / Ground Station and ensure an attenuation of maximum transmission power by 103 dB.

The dimensions of the protection area/safety zone is: (910 + 1330 -200) = 2040 m around up to

2100m

The dimensions of the precautionary area/zone are calculated based on the attenuation of true radiated power (53 dBm) increase by the fundamental tolerance threshold defined under RTCA report and the antenna gain as defined by ITU. The length of the precautionary area/zone is based on the calculation of the distance required for an aircraft in the final approach path at 1000 ft above terrain until the touchdown zone with a 3ºGlide Slope. The following illustrations provide details on the calculation of the dimensions of the precaution area/zone.


Precautionary area/Zone
3° - GS
1000 ft
305 m
6100 m
400 m
80m
8393 m
2100 m
200 m
Illustration Not to scale
8393 m – 200 m = 8193 m around up to 8200 m
For spectrum efficiency: True Radiated Power = 53 dBm
Attenuation at RADALT Receiver: 26 dBm attenuation at 1000 ft
Grating lobes (max antenna gain with elevated angles) : 18 dBi
• 53 + 26 + 18 = 97 dB required attenuation to the radiated signal in space to protect RADALT
• 97 dB corresponds to clearance distance slant range of 450 m which equals to 320 m with an angle of 45º.
• 91 m max lateral deviation of an aircraft during approach.
320 + 91 = 411 around down to 400 m


91 m
91 m
Slant range
θ1
AGL height = 385 m
5G GS AGL height = 80 m
Terrain – Height
45°
Terrain
Illustration not to scale
Horizontal Distance D = 320 m between the 5g Ground Station and the aircraft without deviation
320 m
91 m
400 m
Based on Airbus illustration

MID Doc 006

INTERNATIONAL CIVIL AVIATION ORGANIZATION

MIDDLE EAST AIR NAVIGATION PLANNING
AND IMPLEMENTATION REGIONAL GROUP
(MIDANPIRG)

MID REGION GUIDANCE FOR THE IMPLEMENTATION OF AIDC/OLDI

EDITION ~~2~~1.2
~~APRIL~~ MAY, 20~~23~~19

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TABLE OF CONTENTS

RECORD OF AMENDMENTS

The following table records the history of the successive editions of the present document:

Edition Number	Edition Date	Description	Pages Affected
0.1	03 February 2014	Initial version	All
0.2	09 September 2014	CNS SG/6 update	All
1.0	26 November 2014	MSG/4 endorsement	All
1.1	June 2015	Deletion of the planning parts and change of title of the Document. MIDANPIRG/15 endorsement.	All
1.2	April 2019	Update the table - Details of the ATM systems to support Implementation Table	13-15
2.0	May 2023	Added Performance requirements and benefits, Training requirements, main Systems affected by OLDI implementation and mapping AIDC/OLDI messages sets Deleted Details of the ATM systems to support implementation table and Assembly WP	

1. INTRODUCTION

1.1 Seeking to ensure continuous Safety improvement and Air Navigation modernization, the International Civil Aviation Organization (ICAO) has developed the strategic systems approach termed Aviation System Block Upgrade (ASBU). The latter, defines programmatic and flexible global systems, allows all States to advance their Air Navigation capacities based on their specific operational requirements.

1.2 The ASBU approach has four Blocks, namely Block 0, Block 1, Block 2 and Block 3. Each block is further divided into ~~Modules~~Elements~~. Block 0 is composed of Modules containing technologies and capabilities that are implemented currently.~~

1.3 ~~Module~~ Element AIDC is in FICE ~~in~~Thread Block 0 (FICE-B0/1). AIDC is introduced to improve coordination between air traffic service units (ATSUs) by using ATS inter-facility data communication (AIDC). The transfer of communication in a data link environment improves the efficiency of this process. The data link environment enhances capacity, efficiency, interoperability, safety and reduces cost.

1.4 The AIDC and the OLDI are tools to coordinate flight data between Air Traffic Service Units (ATSU) and both satisfies the requirements of basic coordination of flight notification, coordination and transfer of control.

1.5 Various items concerning MID Region Implementation of AIDC/OLDI have been detailed in this document.

2. BACKGROUND ~~AND~~on ASBU ~~B0~~ FICE B0/1 (AIDC)

Module B0-FICE: Increased Interoperability, Efficiency and Capacity through Ground-Ground Integration:

Summary	To improve coordination between air traffic service units (ATSUs) by using ATS interfacility data communication (AIDC) defined by the ICAO *Manual of Air Traffic Services Data Link Applications* (Doc 9694). The transfer of communication in a data link environment improves the efficiency of this process particularly for oceanic ATSUs.	
~~**Main performance impact as per Doc 9883**~~	~~KPA-02 – Capacity, KPA-04 – Efficiency, KPA-07 – Global Interoperability, KPA-10 – Safety.~~	
Operating environment/ Phases of flight	All flight phases and all type of ATS units.	
Applicability considerations	Applicable to at least two area control centres (ACCs) dealing with en-route and/or terminal control area (TMA) airspace. A greater number of consecutive participating ACCs will increase the benefits.	
~~**Global concept component(s) as per Doc 9854**~~	~~CM – conflict management~~	
~~**Global plan initiatives (GPI)**~~	~~GPI-16: Decision support systems~~	
~~**Main dependencies**~~	~~Linkage with B0-*TBO*~~	
~~**Global readiness checklist**~~		~~Status (ready now or estimated date)~~
	~~Standards readiness~~	~~√~~
	~~Avionics availability~~	~~No requirement~~
	~~Ground systems availability~~	~~√~~
	~~Procedures available~~	~~√~~
	~~Operations approvals~~	~~√~~

2.1 General

2.1.1 Flights which are being provided with air traffic services are transferred from one air traffic services (ATS) unit to the next in a manner designed to ensure safety. In order to accomplish this objective, it is a standard procedure that the passage of each flight across the boundary of the areas of responsibility of the two units is co-ordinated between them beforehand and that the control of the flight is transferred when it is at, or adjacent to, the said boundary.

2.1.2 Where it is carried out by telephone, the passing of data on individual flights as part of the coordination process is a major support task at ATS units, particularly at area control centres (ACCs). The operational use of connections between flight data processing systems (FDPSs) at ACCs replacing phone coordination (on-line data interchange (OLDI)) is already proven in ~~Europe~~several MID States.

2.1.3 This is now fully integrated into the ATS interfacility data communications (AIDC) messages in the *Procedures for Air Navigation Services — Air Traffic Management,* (PANS-ATM, Doc 4444) which describes the types of messages and their contents to be used for operational communications between ATS unit computer systems. This type of data transfer (AIDC) will be the basis for migration of data communications to the aeronautical telecommunication network (ATN).

2.1.4 The AIDC module is aimed at improving the flow of traffic by allowing neighboring air traffic services units to exchange flight data automatically in the form of coordination and transfer messages.

2.1.5 With the greater accuracy of messages based on the updated trajectory information contained in the system and where possible updated by surveillance data, controllers have more reliable information on the conditions at which aircraft will enter in their airspace of jurisdiction with a reduction of the workload associated to flight coordination and transfer. The increased accuracy and data integrity permits the safe application of reduced separations.

2.1.6 Combined with air-ground data link applications, AIDC also allows the transfer of aircraft logon information and the timely initiation of establishing controller-pilot data link communications (CPDLC) by the next air traffic control (ATC) unit with the aircraft.

2.1.7 These improvements outlined above translate directly into a combination of performance improvements.

2.1.8 Information exchanges between flight data processing systems are established between air traffic services units for the purpose of notification, coordination and transfer of flights and for the purpose of civil/military coordination. These information exchanges rely upon appropriate and harmonized communication protocols to secure their interoperability.

2.1.9 Information exchanges apply to:

a) communication systems supporting the coordination procedures between air traffic services units using a peer-to-peer communication mechanism and providing services to general air traffic; and

b) communication systems supporting the coordination procedures between air traffic services units and controlling military units, using a peer-to-peer communication mechanism.

Baseline

2.1.10 The baseline for this module is the traditional coordination by phone, and procedural and/or radar distance/time separations.

~~Change brought by the module~~

~~2.1.11 The module makes available a set of messages to describe consistent transfer conditions via electronic means across ATS units' boundaries. It consists of the implementation of the set of AIDC messages in the flight data processing systems (FDPS) of the different ATS units involved and the establishment of a Letter of Agreement (LoA) between these units to set the appropriate parameters.~~

~~2.1.12 Prerequisites for the module, generally available before its implementation, are an ATC system with flight data processing functionality and a surveillance data processing system connected to each other.~~

~~**Other remarks**~~

~~2.1.13 This module is a first step towards the more sophisticated 4D trajectory exchanges between both ground/ground and air/ground according to the ICAO *Global Air Traffic Management Operational Concept* (Doc 9854).~~

2.2 Intended Performance Operational Improvement

2.2.1 Metrics to determine the success of the ~~module~~ Element are proposed in the *Manual on Global Performance of the Air Navigation System* (Doc 9883).

Capacity	Reduced controller workload and increased data integrity supporting reduced separations translating directly to cross sector or boundary capacity flow increases.
Efficiency	The reduced separation can also be used to more frequently offer aircraft flight levels closer to the flight optimum; in certain cases, this also translates into reduced en-route holding.
Global interoperability	Seamlessness: the use of standardized interfaces reduces the cost of development, allows air traffic controllers to apply the same procedures at the boundaries of all participating centres and border crossing becomes more transparent to flights.
Safety	Better knowledge of more accurate flight plan information.
Cost Benefit Analysis	Increase of throughput at ATS unit boundary and reduced ATCO workload will outweigh the cost of FDPS software changes. The business case is dependent on the environment.

2.3 Necessary Procedures (Air and Ground)

2.3.1 Required procedures exist. They need local analysis of the specific flows and should be spelled out in a Letter of Agreement between ATS units; the experience from other Regions can be a useful reference.

2.4 Necessary System Capability

Avionics

2.4.1 No specific airborne requirements.

Ground systems

2.4.2 Upgrade the ground system to support the composition, exchange and processing of messages set either AIDC or/and OLDI~~Technology is available. It consists in implementing the relevant set of AIDC messages in flight data processing and could use the ground network standard AFTN-AMHS or ATN. Europe is presently implementing it in ADEXP format over IP wide area networks~~. Connectivity between ATSU systems through IP, AMHS, etc

2.4.3 The technology also includes for oceanic ATSUs a function supporting transfer of communication via data link.

2.5 Human Performance

Human Factors Considerations

2.5.1 Ground interoperability reduces voice exchange between ATCOs and decreases workload. A system supporting appropriate human-machine interface (HMI) for ATCOs is required.

2.5.2 Human factors have been taken into consideration during the development of the processes and procedures associated with this module. Where automation is to be used, the HMI has been considered from both a functional and ergonomic perspective (see Section 6 for examples). The possibility of latent failures, however, continues to exist and vigilance is required during all implementation activity. In addition it is important that human factor issues, identified during implementation, be reported to the international community through ICAO as part of any safety reporting initiative.

Training and Qualification Requirements

2.5.3 To make the most of the automation support, training in the operational standards and procedures will be required and can be found in the links to the documents in Section 8 to this module. Likewise, the qualifications requirements are identified in the regulatory requirements in Section 6 which are integral to the implementation of this module.

2.6 Regulatory/Standardization Needs and Approval Plan (Air and Ground)

- Regulatory/standardization: use current published criteria that include:

  a) ICAO Doc 4444, *Procedures for Air Navigation Services — Air Traffic Management*;
  b) EU Regulation, EC No 552/2004.

- CAA may need to amend the national regulatory provisions on the use of AIDC. References: PANS-ATM (ICAO Doc 4444) and Regional Interface Control (ICD) documents.~~Approval plans: to be determined based on regional consideration of ATS interfacility data communications (AIDC).~~

  - Apply Safety Management System in accordance with the national requirements and guidance.

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2.7 Implementation and Demonstration Activities (As known at time of writing)

2.7.1 ~~Although already implemented in several areas, there is a need to complete the existing SARPs to improve harmonization and interoperabiltiy. For Oceanic data link application, North Atlantic (NAT) and Asia and Pacific (APAC) (cf ISPACG PT/8 WP.02 - GOLD) have defined some common coordination procedures and messages between oceanic centres for data link application (ADS-C CPDLC).~~

2.7.2 Current use

- **MID Region**: MIDANPIRG classified the implementation of AIDC connections in the MID Region into two priorities based on traffic volume and operational needs. Priority-one connections are mandated to be implemented as per the ATM-Specific requirements in the MID Air Navigation Plan, Volume II.

- **Europe:** It is mandatory for exchange between ATS units. http://europa.eu/legislation_summaries/transport/air_transport/l24070en.htm

  The European Commission has issued a mandate on the interoperability of the European air traffic management network, concerning the coordination and transfer (COTR) between ATS units through REG EC 1032/2006 and the exchange of flight data between ATS units in support of air-ground data link through REG EC 30/2009. This is based on the standard OLDI-Ed 4.2 and ADEXP-Ed 3.1.

- **EUROCONTROL:** Specification of interoperability and performance requirements for the flight message transfer protocol (FMTP). The available set of messages to describe and negotiate consistent transfer conditions via electronic means across centres' boundaries have been used for trials in Europe in 2010 within the scope of EUROCONTROL's FASTI initiative.

- **India:** AIDC implementation is in progress in Indian airspace for improved coordination between ATC centres. Major Indian airports and ATC centres have integrated ATS automation systems having AIDC capability. AIDC functionality is operational between Mumbai and Chennai ACCs. AIDC will be implemented within India by 2012. AIDC trials are underway between Mumbai and Karachi (Pakistan) and are planned between India and Muscat in coordination with Oman.

- **AIDC:** is in use in the Asia-Pacific Region, Australia, New-Zealand, Indonesia and others.

2.7.3 ~~Planned or Ongoing Activities~~

~~To be determined.~~

~~2.7.4 Currently in Operation~~

~~To be determined.~~

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2.8 Reference Documents

2.8.1 Standards

- ICAO Doc 4444, *Procedures for Air Navigation Services - Air Traffic Management*, Appendix 6 - *ATS Interfacility Data Communications (AIDC) Messages.*

- ICAO Doc 9880, *Manual on Detailed Technical Specifications for the Aeronautical Telecommunication Network (ATN) using ISO/OSI Standards and Protocols*, Part II — *Ground-Ground Applications — Air Traffic Services Message Handling Services (ATSMHS).*

~~2.8.2 Procedures~~

~~To be determined.~~

2.8.3 Guidance material

 ICAO Doc 9694, Manual of Air Traffic Services Data Link Applications; Part 6;

 GOLD Global Operational Data Link Document (APANPIRG, NAT SPG), June 2010;

 Pan Regional Interface Control Document for Oceanic ATS Interfacility Data.

Communications (PAN ICD) Coordination Draft Version 0.3. 31 August 2010;

 Asia/Pacific Regional Interface Control Document (ICD) for ATS Interfacility Data Communications (AIDC) available at http://www.bangkok.icao.int/edocs/icd_aidc_ver3.pdf, ICAO Asia/Pacific Regional Office.

 EUROCONTROL Standard for On-Line Data Interchange (OLDI); and EUROCONTROL Standard for ATS Data Exchange Presentation (ADEXP).

~~ASSEMBLY — 38TH SESSION A38-WP/266.~~

2.9 Performance benefits

- The OLDI exchanges mean the provision / reception of ATC coordination and transfer data in an automated way replacing the verbal coordination and transfer.
- The benefits of these automated exchanges can be several folds as:
  - Substantial increase in **Capacity**, because of ATCO workload reduction compared with the conventional process without an automated support. If the phone coordination is replaced by an automated one, the ATCO workload is reduced providing a means to increase the sector entry rates and accept more traffic within the sector, increasing the ATCO productivity.
  - The implementation of OLDI basic and advance features led in many cases to 7-10 % increase of sector capacity figures, therefore OLDI is considered as one of main booster for capacity increase.
  - The automation of coordination and transfer exchanges will slightly improve **Safety** due to the automation and reduction of human errors induced by verbal coordination and transfer.
  - The **Operational Efficiency** will increase by enabling more efficient planning and operational decision making.
  - The traffic **Predictability** will be slight improved as adjacent ATS units will share the same information about the flight, therefore it is less needed to add buffers. Knowing in advance where aircraft will be and at what time will allow capacity to match demand, reducing penalties.
  - The benefits of OLDI come from having a method to share the operational flight data information between adjacent ATS units each time there is an update. The impacted ANSPs can use this up-to-date information to calculate their trajectory predictions. As

these predictions will be more accurate, i.e. with a narrower range of uncertainty, there might be some improvements in the performance of conflict detection tools (MTCD).

- OLDI provides more dialogue functionalities and more flexibility in the way flights are exchanged across centres (e.g., SKIP functionality).

2.10 OLDI Performance requirements

2.10.1 Availability

- In principle, the OLDI facility needs be available 24 hours every day, but especially during the hours of normal and peak traffic flows between the two units concerned. Any scheduled down-time periods (and thus the planned availability time) needs be bilaterally agreed between the two units concerned.

2.10.2 Reliability

- Reliability on every OLDI link shall be at least 99.86 % (equivalent to a down-time of not more than 12 hours per year based on 24-hour availability).

- Where operationally justified, a reliability of at least 99.99% (equivalent to a down-time of not more than 52 minutes per year, based on 24 Hour availability) should be provided.

2.10.3 Data security / integrity

- Data security methods (e.g., access rights, source verification) and, where applicable, network management should be applied to OLDI facilities. The failure rate at application level shall be less than or equal to one transmission error per 2000 messages.

2.10.4 Operational evaluation

- Each new OLDI facility, including a new facility on an existing link, shall be subject to an evaluation period to verify the data integrity, accuracy, performance, compatibility with ATC procedures and overall safety prior to its operational implementation.

- 2.10.5 The OLDI transaction times specified include transmission, initial processing at the receiving / accepting unit, creation of the acknowledgement message, its transmission and reception at the transferring unit. The maximum transaction times for the OLDI messages in 90% of cases need to be below 4 seconds, while for 99,8% of cases should not below 10 seconds.

- If no acknowledgement has been received within the specified time after transmission, a message shall be considered to have been unsuccessfully transmitted or processed and a warning output. The OLDI message response time in the generation and reception phases shall not exceed 2 seconds.

- A time-out value addresses the case of no reception of LAM. If no acknowledgement has been received within the specified time after transmission:

    - a message needs to be considered to have been **unsuccessfully transmitted or processed** and

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- a **warning output** as specified in the specification for each process.

- Usual time-out values are between 15-30 seconds, depending on bilateral agreements for the exchanges of OLDI messages.

2.11 Main systems affected by OLDI deployment

- OLDI exchanges might be used to support the coordination and transfer process with adjacent ACC / APP / TWR units within the same FIR or with cross-border enroute, approach and TWR ATS unit.

- The main affected system is the Flight Data Processing System (FDPS). The FDPS needs to be capable of performing OLDI communication with up to predefined number of external / internal co-ordination partners. The FDPS shall be capable of sending and receiving defined set of OLDI messages in ICAO/ADEXP format, including RVSM and 8.33khz fields.

- As an integral part of each system flight plan (SFPL), the FDPS needs to maintain a copy of all OLDI messages which have been correlated to the SFPL.

- The FDPS needs to be sufficiently flexible in the selection of items to be used in the sending of OLDI messages with an external ATS unit, per COP and next ATS Unit. The FDPS shall permit the configuration of messages and parameters as defined in the EUROCONTROL OLDI specification for coordination with each external partner and optionally per COP.

The system also needs to check the syntax and semantics of received OLDI messages and return LAM if the are OK. The received OLDI messages will be used to update the trajectory or trajectory elements of the concerned flight.

The exchanged OLDI messages need to be presented on the Controller Working Position (CWP) with an adequate interface (HMI). The OLDI messages need to be presented in the track label or different flight lists to support the inter-sector co-ordination and full OLDI / OLDI dialogue co-ordination. The OLDI data needs to be presented in the track label, extended track label and corresponding FP lists and co-ordination windows.

The CWP functionalities need to support the co-ordination with adjacent ATS units with OLDI links as well as co-ordination between ARS unit without OLDI. The CWP needs to indicate that the transmission of the OLDI message is in progress or has been successfully transmitted as appropriate. The HMI at ATC positions using OLDI needs to provide a warning if the OLDI facility is not available.

The CWP needs remind the operator to use the telephone in order to perform the co-ordination data exchange with adjacent ATS units when the following events happen:

- the LAM message does not arrive within the parameter time (time out), indicating that the other sector might not have received the OLDI message

- there is a general fault in the OLDI communication / application;

- OLDI message (REV) is not supported;

- Exceeding time parameters for OLDI messages exchanges (REV/RRV).

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The FDPS / CWP needs to provide a mechanism by which an estimate can be rapidly entered for a flight for which automatic notification is not available (e.g., no OLDI link with upstream ATSU);

The ATC supervisor needs to monitor the availability of OLDI links;

- The Flight Data Assistant (FDA) positions need to be equipped with capability for reception and handling of incorrect OLDI messages, as well as handling of incoming and outgoing verbal coordination with adjacent ATS units not equipped with OLDI facilities (or failed OLDI link) and inserting verbal co-ordination data in the system

The reminder (part of ATC toolkit) for manual co-ordination is derived from the relevant Letters of Agreement (LoA) or Standard Operating Procedures (SOP). This reminder is used in case the OLDI functionality is not available. Additional reminders as change of frequency and potential co-ordination failure are also needed.

The OLDI links and functionality need to be monitored and controlled by Technical Monitoring and Control System (TMCS). LOF / NAN OLDI messages are used for air-ground data link applications. OLDI also affects the Recording and Reply System (RRS) as all OLDI messages entering / leaving the system need to be recorded.

2.11 Training requirements

The automated exchanges of transfer and co-ordination data have substantial impact on ATC procedures and ATCO working methods. Therefore, an adequate familiarisation training for ATCO needs to be ensured. This training could be part with the overall training for the introduction of a new system or could be handled as special refreshment training on OLDI topics.

The ATC Coordination and Transfer is part of the ATCO Common Core Content (CCC). Therefore, OLDI as a means to achieve the automation of this process needs to be carefully addressed.The Flight Data Assistant needs to be trained as well on the OLDI topics and how to handle the correction of wrong OLDI messages.

ATSEPs also need to be trained on how to maintain the equipment: OLDI communication facilities, flight data processing, OLDI front-end and any other equipment involved in reception / provision and handling of OLDI messages. Usually all these training session are organised by the System Manufacturers who got a contract for the provision of a new or the upgrade of a existing ATC system.

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~~3. ICAO GENERAL ASSEMBLY 38 WP 266~~

~~International Civil Aviation Organization~~

~~A38-WP/266~~

~~TE/120~~

~~12/09/13~~

~~WORKING PAPER~~

~~ASSEMBLY — 38TH SESSION~~

~~TECHNICAL COMMISSION~~

~~**Agenda Item** **Air Navigation Standardization**~~

~~OLDI as AIDC realisation in the MID Region~~

~~(Presented by the United Arab Emirates)~~

~~EXECUTIVE SUMMARY~~

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The Aviation System Block Upgrade (ASBU) B0-25 recommends "Increased interoperability, efficiency and capacity through ground-ground integration". To this end ATS inter-facility data communication (AIDC) is presumed by many States. The EUROCONTROL uses a different tool called On Line Data Interchange (OLDI) satisfying all AIDC requirements.

The AIDC and the OLDI are tools to coordinate flight data between Air Traffic Service Units (ATSU) and both satisfies the basic coordination of flight notification, coordination and transfer of control.

Additional options like pre-departure coordination, Civil Military coordination and air-ground data link for forwarding log-on parameters are available in the OLDI.

The majority of States in the MID Region has either implemented or is planning to implement OLDI and have no intention of using only AIDC.

Action: The Assembly is invited to:

a) Recommend that OLDI implementation be accepted as MID regional variation of AIDC implementation.

b) Urge States to capitalise opportunities provided by OLDI and wherever both AIDC and OLDI are implemented, choose the suitable option satisfying the requirements of the partnering States.

Strategic Objectives:	This working paper relates to Strategic Objective B
Financial implications:	Not applicable
References:	1. Manual of Air Traffic Services Data Link Applications (Doc 9694) 2. MID Region ATN-IPS WG5 meeting report, 3. MID Region ATN-IPS WG5 WP4 Appendix A

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1. INTRODUCTION

1.1 Seeking to ensure continuous Safety improvement and Air Navigation modernization, the International Civil Aviation Organization (ICAO) has developed the strategic systems approach termed Aviation System Block Upgrade (ASBU). The latter, which defines programmatic and flexible global systems, allows all States to advance their Air Navigation capacities based on their specific operational requirements.

1.2 The ASBU approach has four Blocks, namely Block 0, Block 1, Block 2 and Block 3. Each block is further divided into Modules. Block 0 is composed of Modules containing technologies and capabilities that are implemented to date.

1.3 Module 25 in Block 0 is introduced to improve coordination between air traffic service units (ATSUs) by using ATS inter-facility data communication (AIDC). The transfer of communication in a data link environment improves the efficiency of this process. The data link environment enhances capacity, efficiency, interoperability, safety and reduces cost.

2. DISCUSSION

2.1 EUROCONTROL uses a different tool called On Line Data Interchange (OLDI) satisfying all AIDC requirements. The AIDC and the OLDI are tools to coordinate flight data between Air Traffic Service Units (ATSU) and both satisfies the basic coordination of flight notification, coordination and transfer of control. Additional options like pre-departure coordination, Civil-Military coordination and air-ground data link for forwarding log-on parameters are available in the OLDI.

2.2 The OLDI is a proven technology and is in operational use for more than twenty years in the European Region and for more than four years in the United Arab Emirates. This technology meets all the AIDC requirements and is kept up to date to cope with the new developments in the industry. An example is the release of OLDI version 4.2 to accommodate INFPL requirements.

2.3 Based on the analysis carried out during the MID Region ATN IPS WG5 meeting it was noted that the majority of States in the MID Region have either implemented OLDI or are planning to implement OLDI and have no intention of using only AIDC. Therefore, the meeting agreed that OLDI implementation should be considered and accepted as Regional variation of AIDC implementation as was the case in the European Region.

2.4 The MID Region ATN IPS WG5 meeting further agreed that if both AIDC and OLDI are implemented, then it will be a bilateral issue and some States that are interfacing with adjacent Regions may require to support and implement dual capabilities (AIDC and OLDI).

2.5 The MID Region is monitoring the work of the joint taskforce harmonization of AIDC and OLDI in NAT and ASIA PAC as it is important to harmonize AIDC and OLDI in order that States in the interface areas have smooth operations.

3. CONCLUSION

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4. 3.1 The implementation of OLDI in the MID Region should be accepted as variation AIDC implementation. Wherever both AIDC and OLDI are implemented then States should choose the suitable one satisfying the requirements of the partnering State.

3. AIDC & OLDI Messages Mapping

- The initial mapping is contained in ICAO Manual 9694. The mapping in below table is more focused on OLDI and their AIDC equivalents.

OLDI Message	**AIDC equivalent**
ABI	Notify
ACT	CoordinateInitial
PAC	CoordinateInitial
RAP	CoordinateNegotiate
ACP	CoordinateAccept
RJC	CoordinateReject
REV	CoordinateUpdate
RRV	CoordinateUpdate
CDN	CoordinateUpdate also reply to CoordinateNegotiate
MAC	CoordinateCancel
SBY	CoordinateStandby
LAM	AppAccept
TIM	TransferInitiate

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HOP	TransferConditionsProposal
MAS	TransferCommAssume
ROF	TransferRequest and TransferConditionsAccept
COF	TransferComm
SDM	GeneralExecData
TIP	No
RTI	No
SKC	No
SKO	No
RRQ	No
RLS	No
CRQ	**No**
CRP	No
INF	No
PNT	GeneralPoint
COD	No
AMA	No

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LOF	No
NAN	**No**
BFD	No
CFD	No
TFD	No
XIN	No
XRQ	No
XAP	No
XCM	**No**
Not specifically addressed, but it is a part of processes supported by ACT / RAP. The reception of ACT / RAP or REV/RRV cause the update of flight trajectory	CoordinateReady
Not specifically addressed, but it is a part of processes supported by ACT / RAP. The reception of ACT / RAP or REV/RRV cause the update of flight trajectory	CoordinateCommit
Not specifically addressed, but it is a part of processes supported by RAP, RRV and RJC. If the coordination is rejected	CoordinateRollback

the previous agreed coordination remains in place	
Not supported, all OLDI fields are structured	FreetextEmergency
Not supported, all OLDI fields are structured	FreetextGeneral
Not specifically addressed, but it is a part of processes supported by COF, as transfer of control coincide with change of frequency	TransferControl
Not specifically addressed, but it is a part of processes supported by MAS, the assumption coincide with MAS	TransferControlAssume
No, very specific for AIDC	AppStatus
No, very specific for AIDC	AppError

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5. DETAILS OF THE ATM SYSTEMS TO SUPPORT IMPLEMENTATION

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					DC	DI	DC	DI	DC	DI		
hrain	ales pSky-C	DI 2.3 TP 2.0		OLDI								DI implemented with UAE DI with Doha is in progress
ypt	PSKY IALES) pport X25 tocol only	DI V 4.2 DC .0		OLDI								-OLDI is implemented with EUR -OLDI with Nicosia is in progress DC over AFTN is planned with Je artoum
n	ales	DI		ne								DI messages are sent to Ankara
q	ales TopSky	DI		ne								DI planned with Kuwait and Ank
dan	con 2100 ra	DI 4.1 DC 2.0		ne								nned with Jeddah and Egypt
wait	con 2100 DRA	DI v4.2 DC v3.0		ne								DI to connect to rain and Riyadh

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~~banon~~				~~LDI with~~ ~~prus~~								~~DI with Cyprus is in progress~~ ~~nned OLDI with Syria~~
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~~tar~~	~~ex~~	~~DI V4.2~~ ~~TP 2.0~~ ~~OC 2.0~~										~~DI in use with UAE and planned~~ ~~h Bahrain~~
~~di Arabia~~	~~ORA~~	~~DI V4.2~~ ~~OC V3.0~~ ~~TP V4 &~~		~~one~~ ~~(Eurocat-X)~~ ~~OC Connected~~ ~~ween Riyadh~~ ~~l Jeddah~~								~~DI planned for 2020/2021~~
~~lan~~	~~oSky~~	~~DI 4.3~~ ~~OC 2.0~~										~~h AIDC and OLDI to cater to nei~~ ~~ts requests~~
~~Syria~~				~~ne~~								
~~AE~~	~~ISMA from~~ ~~OMSOFT~~	~~DI V4.2~~ ~~TP 2.0~~		~~two-way~~ ~~egrated OLDI~~ ~~nections~~								~~DI already in use with 7 partn~~ ~~ghbouring ATSUs are OLDI c~~

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~~6.~~4. MESSAGE TYPES – PHASE 1

These are the messages that were agreed to be used in ICAO MID Region:

I. Basic Procedure Messages

1.	Advance Boundary Information	ABI
2.	Activate	ACT
3.	Revision	REV
4.	Preliminary Activation	PAC
5.	Abrogation of Co-ordination	MAC
6.	SSR Code Assignment	COD
7.	Arrival Management	AMA
8.	Logical Acknowledgement Message	LAM
9.	Information Message	INF

II. Advance Boundary Information ABI

1. Purpose of the ABI Message

   The ABI message satisfies the following operational requirements:
   - Provide for acquisition of missing flight plan data;
   - Provide advance boundary information and revisions thereto for the next ATC unit;
   - Update the basic flight plan data;
   - Facilitate early correlation of radar tracks;
   - Facilitate accurate short-term sector load assessment;
   - Request the assignment of an SSR code from the unit to which the above notification is sent, if required.

   The ABI is a notification message.

2. Message Contents

   The ABI message shall contain the following items of data:
   - Message Type;
   - Message Number;
   - Aircraft Identification;
   - SSR Mode and Code (if available);
   - Departure Aerodrome;
   - Estimate Data;
   - Destination Aerodrome;
   - Number and Type of Aircraft;
   - Type of Flight;
   - Equipment Capability and Status.

   If bilaterally agreed, the ABI message shall contain any of the following items of data:
   - Route;
   - Other Flight Plan Data.

3. Example
   - (ABIOMAE/OMSJ578-ABY464/A5476-VIDP-MAXMO/0032F100-OMSJ-9/A320/M-15/N0457F360 OBDAG LUN G333 TIGER/N0454F380 G452 RK G214 PG G665 ASVIB M561 MOBET/N0409F260 A419 DARAX -80/S-81/W/EQ Y/EQ U/NO R/EQ/A1B1C1D1L1O1S1)

III. Activate ACT

1. Purpose of the ABI Message
   The ACT message satisfies the following operational requirements:
   - Replace the verbal boundary estimate by transmitting automatically details of a flight from one ATC unit to the next prior to the transfer of control;
   - Update the basic flight plan data in the receiving ATC unit with the most recent information;
   - Facilitate distribution and display of flight plan data within the receiving ATC unit to the working positions involved;
   - Enable display of correlation in the receiving ATC unit;
   - Provide transfer conditions to the receiving ATC unit.

2. Message Contents
   The ACT message shall contain the following items of data:
   - Message Type;
   - Message Number;
   - Aircraft Identification;
   - SSR Mode and Code;
   - Departure Aerodrome;
   - Estimate Data;
   - Destination Aerodrome;
   - Number and Type of Aircraft;
   - Type of Flight;
   - Equipment Capability and Status.

   If bilaterally agreed, the ACT message shall contain any of the following items of data:
   - Route;
   - Other Flight Plan Data;
   - Actual Take-Off Time.

   Note: The Actual Take-Off Time is normally used in the cases where the ACT follows a PAC message that included the Estimated Take-Off Time.

3. Example
   - (ACTOMAE/OMSJ727-ABY604/A7306-HEBA-ALRAR/0130F110-OMSJ-9/A320/M-15/N0428F250 DCT NOZ A727 CVO/N0461F350 UL677 MENLI UN697 NWB W733 METSA UB411 ASH G669 TOKLU UP559 ASPAK/N0438F290 UP559 NALPO P559 ITGIB/N0409F230 P559 -80/S-81/W/EQ Y/EQ U/NO R/EQ/A1B1C1D1L1O1S1)

IV. Revision Message REV

1. Purpose of the REV Message

   The REV message is used to transmit revisions to co-ordination data previously sent in an ACT message provided that the accepting unit does not change as a result of the modification.

2. Message Contents

   The REV message shall contain the following items of data:
   - Message Type;
   - Message Number;
   - Aircraft Identification;
   - Departure Aerodrome;
   - Estimate Data and/or Co-ordination point;
   - Destination Aerodrome;

   Note: The Estimate Data contained in the REV has to include complete data in the Estimate Data field in order to eliminate any ambiguity regarding the transfer elements. If the ACT message included the supplementary flight level, the following REV message will include the supplementary flight level if still applicable.

   The REV message shall contain the following items of data if they have changed:
   - SSR Mode and Code;
   - Equipment Capability and Status.

     If bilaterally agreed, the REV message shall contain any of the following items of data, if they have changed:
   - Route.

     If bilaterally agreed, the REV message shall contain any of the following items of data:
   - Message Reference.

3. Example
   - (REVBC/P873-UAE4486-OMDB-TUMAK/2201F360-LERT-81/Y/NO U/EQ)

V. Preliminary Activation PAC

1. Purpose of the PAC Message

   The PAC message satisfies the following operational requirements:

   - Notification and pre-departure co-ordination of a flight where the time of flight from departure to the COP is less than that which would be required to comply with the agreed time parameters for ACT message transmission;
   - Notification and pre-departure co-ordination of a flight by a local (aerodrome /approach control) unit to the next unit that will take control of the flight;
   - Provide for acquisition of missing flight plan data in case of discrepancies in the initial distribution of flight plan data;
   - Request the assignment of an SSR code from the unit to which the above notification/coordination is sent.

2. Message Contents

   The PAC message shall contain the following items of data:

   - Message Type;
   - Message Number;
   - Aircraft Identification;
   - SSR Mode and Code;
   - Departure Aerodrome;
   - Estimated Take-Off Time or Estimate Data;
   - Destination Aerodrome;
   - Number and Type of Aircraft;

   A PAC message sent from a TMA control unit or an ACC shall contain the following items of data:

   - Type of Flight;
   - Equipment Capability and Status.

     If bilaterally agreed, the PAC message shall contain any of the following items of data:
   - Route;
   - Other Flight Plan Data;
   - Message Reference.

3. Example

   - (PACOMSJ/OMAE292-SQC7365/A9999-OMSJ0020-WSSS-9/B744/H-15/N0505F310 DCT RIKET B525 LALDO B505 NADSO A777 VAXIM P307 PARAR N571 VIRAM/N0505F330 N571 LAGOG/M084F330 N571 IGOGU/M084F350 N571 GUNIP/N0500F350 R467 -80/S-81/W/EQ Y/EQ U/NO R/EQ/)

VI. Message for the Abrogation of Co-ordination MAC

1. Purpose of the MAC Message

   A MAC message is used to indicate to the receiving unit that the co-ordination or notification previously effected for a flight is being abrogated. The MAC is not a replacement for a Cancellation (CNL) message, as defined by ICAO, and therefore, shall not be used to erase the basic flight plan data.

2. Message Contents

   The MAC message shall contain the following items of data:

   - Message Type;
   - Message Number;
   - Aircraft Identification;
   - Departure Aerodrome;
   - Co-ordination point;
   - Destination Aerodrome;

     If bilaterally agreed, the MAC message shall contain any of the following items of data:
   - Message Reference;
   - Co-ordination Status and Reason

3. Example

   - (MACAM/BC112 AM/BC105-HOZ3188-EHAM-NIK-LFPG-18/STA/INITFL)

VII. SSR Code Assignment Message COD

1. Purpose of the COD Message

   The Originating Region Code Allocation Method (ORCAM) is provided to permit a flight to respond on the same code to successive units within a participating area. Unless code allocation is performed centrally, e.g. by an ACC, airports may need to be individually allocated a set of discrete SSR codes. Such allocations are very wasteful of codes.

   The COD message satisfies the operational requirement for the issue of a Mode A SSR code by one Air Traffic Service Unit to another for a specified flight when requested.

   The COD message also satisfies the operational requirement to inform the transferring Air Traffic Service Unit of the next Mode A SSR code when the code assigned cannot be retained by the accepting Air Traffic Service Unit.

2. Message Contents

   The COD message shall contain the following items of data:

   - Message Type;
   - Message Number;
   - Aircraft Identification;
   - SSR Mode and Code;
   - Departure Aerodrome;
   - Destination Aerodrome;

   If bilaterally agreed, the COD message shall contain any of the following items of data:

   - Message Reference.

3. Example
    - (CODOMAE/OMSJ720-ABY567/A3450-OMSJ-OAKB)

VIII. **<u>Arrival Management Message AMA</u>**

1. Purpose of the AMA Message

    Arrival management requires the capability for an accepting unit to pass to the transferring unit information on the time that a flight is required to delay (lose) or gain in order to optimise the approach sequence.

    The AMA message satisfies the following operational requirements in order to alleviate ATC workload in co-ordinating arriving flights:
    - Provide the transferring ATC unit with the time that the flight is to delay/gain at the arrival management metering fix;
    - Where procedures have been bilaterally agreed between the units concerned, provide the transferring ATC unit with a target time for the flight to be at the COP;
    - When bilaterally agreed, provide the transferring unit with a speed advisory. The speed advisory needs to be communicated to the flight, prior to transfer.

2. Message Contents

    The AMA message shall contain the following items of data:
    - Message Type;
    - Message Number;
    - Aircraft Identification;
    - Departure Aerodrome;
    - Destination Aerodrome;

      and based on bilateral agreement, contain one or more of the following items of data:
        - Metering Fix and Time over Metering Fix;
        - Total Time to Lose or Gain;
        - Time at COP;
        - Assigned speed;
        - Application point;
        - Route;
        - Arrival sequence number

    Note: The item Route contains the requested routing

3. Example
    - (AMAM/BN112-AZA354-LIRF-CLS/0956-LEMD-18/MFX/PRADO TOM/1022 TTL/12)

IX. Logical Acknowledgement Message LAM

1. Purpose of the LAM Message

   The LAM is the means by which the receipt and safeguarding of a transmitted message is indicated to the sending unit by the receiving unit.

   The LAM processing provides the ATC staff at the transferring unit with the following:

   - A warning when no acknowledgement has been received;
   - An indication that the message being acknowledged has been received, processed successfully, found free of errors, stored and, where relevant, is available for presentation to the appropriate working position(s).

2. Message Contents

   The LAM message shall contain the following items of data:

   - Message Type;
   - Message Number;
   - Message Reference.

3. Example

   - (LAMOMSJ/OMAE939OMAE/OMSJ718)

X. Logical Acknowledgement Message LAM

1. The INF message is used to provide information on specific flights to agencies not directly involved in the coordination process between two successive ATC units on the route of flight.

   The INF message may be used to provide copies of messages and to communicate agreed co-ordination conditions to such agencies following a dialogue between controllers. For this purpose INF messages may be generated by the systems at the transferring or accepting unit. The message may also be used to provide information in relation to any point on the route of flight to an agency. The format allows the communication of initial data, revisions and cancellations.

2. The INF message shall contain the following items of data:

   - Message type;
   - Message number;
   - All items of operational data as contained in the original message or resultant
   - co-ordination being copied;
   - Reference Message Type.

6.3. Example

(INFL/IT112-BAW011/A5437-EGLL-KOK/1905F290-OMDB-9/B747/H-15/N0490F410 DVR
KOK UG1 NTM UB6 KRH-18/MSG/ACT)

The Pan Regional (NAT and APAC) Interface Control Document for ATS Interfacility Data Communications (PAN AIDC ICD) Version1.0 has defined the specific AIDC messages to be used between ATSUs should be included in bilateral agreements as in the below table which is number as table 4-3

AIDC Messages

Core	Non-core	Message Class	Message
X		Notification	ABI (Advance Boundary Information)
X		Coordination	CPL (Current Flight Plan)
X		Coordination	EST (Coordination Estimate)
	X	Coordination	PAC (Preliminary Activate)
X		Coordination	MAC (Coordination Cancellation)
X		Coordination	CDN (Coordination Negotiation)
X		Coordination	ACP (Acceptance)
X		Coordination	REJ (Rejection)
	X	Coordination	PCM (Profile Confirmation Message)
	X	Coordination	PCA (Profile Confirmation Acceptance)
	X	Coordination	TRU (Track Update)
X		Transfer of Control	TOC (Transfer of Control)
X		Transfer of Control	AOC (Acceptance of Control)
X		General Information	EMG (Emergency)
X		General Information	MIS (Miscellaneous)
X		Application Management	LAM (Logical Acknowledgement Message)
X		Application Management	LRM (Logical Rejection Message)
	X	Application Management	ASM (Application Status Monitor)
	X	Application Management	FAN (FANS Application Message)
	X	Application Management	FCN (FANS Completion Notification)
	X	Surveillance Data Transfer	ADS (Surveillance ADS-C)

~~7.~~5. D – MESSAGE TYPES – PHASE 2

The messages during this phase will be the advance messages covering all phases of flight

Intentionally left blank

~~8.~~6. TEST OBJECTIVES

Test Objectives		
No	**Test step**	**Test Description**
01	Connectivity between FDPSs	Check connectivity between FDPSs.
02	FPL Processing	Check FPLs are correctly received and processed.
Preliminary Activation Message (PAC)		
03	PAC Message association	Check PAC messages are correctly sent, received, processed and associated with the correct FPL. If the system is unable to process a message that is syntactically and semantically correct, it should be referred for Manual intervention.
04	Coordination of Changes to previous PAC message	Check changes to previous PAC messages such as Change in SSR code, Aircraft type, Coordination point, Flight level and Destination aerodrome are correctly sent, received and associated with the correct FPL.
Advance Boundary Information (ABI)		
05	ABI Message association	Check ABI messages are correctly sent, received, processed and associated with the correct FPL. If the system is unable to process a message that is syntactically and semantically correct, it should be referred for Manual intervention.
06	Coordination of Changes to previous ABI message	Check changes to previous ABI messages such as Change in SSR code, Aircraft type, Coordination point, Flight level and Destination aerodrome are correctly sent, received and associated with the correct FPL.
Activate (ACT)		
07	ACT Message association	Check ACT messages are correctly sent, received, processed and associated with the correct FPL. If the system is unable to process a message that is syntactically and semantically correct, it should be referred for Manual intervention.
Logical Acknowledgement Messages (LAM)		
08	LAM Message generation	Check LAM messages are generated for messages that are syntactically and semantically correct.
SSR Code Request Messages (COD)		
09	COD Message association	Check COD messages are sent with correct SSR Code, received, processed and associated with the correct FPL. If the system is unable to process a message that is syntactically and semantically correct, it should be referred for Manual intervention.

~~9.~~7. SAMPLE TEST SCRIPTS

NOTE: All the samples are provided by UAE

1. Test 001 Connectivity:

Test 001 – Connectivity				
No	***Test description***	***UAE ACC FDPS***	***Doha FDPS***	***Remarks***
01	Ping Doha FDPS from RDS FDPS	OK / Not OK	OK / Not OK	
02	Ping RDS FDPS from Doha FDPS	OK / Not OK	OK / Not OK	
03	Check the link	Log in as root in rds fdps Type in netstat –tnap, should show the link "established" OK / Not OK	Check the link "established" OK / Not OK	

2. Test 002 Flight plan:

Test 002 – Flight Plan – *sent from UAE ACC*				
No	***Test description***	***UAE ACC FDPS***	***Doha FDPS***	***Remarks***
01	Send TST001 (OMAA-OTBD)	OK / Not OK	OK / Not OK	
02	Send TST002 (OMAM-OTBH)	OK / Not OK	OK / Not OK	

03	Send TST003 (OMAA-OEJN)	OK / Not OK	OK / Not OK	
04	Send TST004 (OOMS – OTBD)	OK / Not OK	OK / Not OK	
05	Send TST005 (OTBD – OMDB)	OK / Not OK	OK / Not OK	
06	Send TST006 (OTBH – OMDM)	OK / Not OK	OK / Not OK	
07	Send TST007 (OEJN-OMAD)	OK / Not OK	OK / Not OK	
08	Send TST008 (OTBD – OOMS)	OK / Not OK	OK / Not OK	

3. <u>Test 003 Preliminary Activation Message (PAC):</u>

Test 003 – Preliminary Activation Message (PAC) ***Doha FDPS to UAE ACC FDPS***				
No	***Test description***	***UAE ACC FDPS***	***Doha FDPS***	***Remarks***
01	Activate start up TST005 (OTBD – OMDB) SSR code:0001 RFL : FPL level	SFPL moves from Pending to Workqueue with SSR code, check CFL field OK / Not OK	OK / Not OK	
02	Change SSR of TST005 New SSR Code:0002	SFPL colour changes to Green in Workqueue OK / Not OK	OK / Not OK	
03	Change ATYP of TST005 New ATYP: A332	SFPL colour changes to Green in Workqueue OK / Not OK	OK / Not OK	
04	Change ADES of TST005 New ADES: VOMM	New FPL is created by OLDI with new ADES	OK / Not OK	

		OK / Not OK		
05	Change RFL of TST005 New RFL: 370	Manual coordination requires OK / Not OK	OK / Not OK	
06	Change COP of TST005 New COP : NADAM	SFPL colour changes to Green in Workqueue OK / Not OK	OK / Not OK	
07	Check LAM messages	OK / Not OK	OK / Not OK	

4. <u>Test 004 ABI & ACT messages:</u>

Test 004 – Advance Boundary Information Message (ABI), Activate Message (ACT) *Doha FDPS to UAE ACC FDPS*				
No	***Test description***	***UAE ACC FDPS***	***Doha FDPS***	***Remarks***
01	Enter estimate for TST007 (OEJN – OMAD) SSR code:0003 Exit level : 190 ETX : Current time	SFPL moves from Pending to Work queue with SSR code, check ETN and CFL field OK / Not OK	OK / Not OK	
02	Change SSR of TST007 New SSR code: 0004	SFPL colour changes to Green if in Workqueue OK / Not OK	OK / Not OK	
03	Change ATYP of TST007 New ATYP: C130	SFPL colour changes to Green if in Workqueue OK / Not OK	OK / Not OK	

04	Change ADES of TST007 New ADES: OMAL	New FPL is created by OLDI with new ADES OK / Not OK	OK / Not OK	
05	Change XFL of TST007 New XFL: 170	SFPL colour changes to Green if in Workqueue OK / Not OK	OK / Not OK	
06	Change COP of TST007 New COP: NAMLA	SFPL colour changes to Green if in Workqueue OK / Not OK	OK / Not OK	
07	when ETX is Current time + 5 minutes the ACT should be automatically generated	No change, SFPL already in active. OK / Not OK	OK / Not OK	
08	Change ATYP of TST007 New ATYP:C30J	No change, SFPL already in active Expect manual coordination. OK / Not OK	Flag to notify ATCA that ATYP change is not communicated OK / Not OK	
09	Check LAM messages	OK / Not OK	OK / Not OK	

5. <u>Test 005 ABI & ACT messages:</u>

Test 005 – Advance Boundary Information Message (ABI), Activate Message (ACT) *UAE ACC FDPS to Doha FDPS*				
No	***Test description***	***UAE ACC FDPS***	***Doha FDPS***	***Remarks***
01	Enter estimate for TST004 (OOMS – OTBD) SSR code:0005 Exit level : 180 ETN : Current time COPX: MEKMA	SFPL moves from Pending to Active with SSR code A new ABI wiil be generated OK / Not OK	SSR, ETN and Entry level and entry point should be automatically updated for the concerned flight and flagged for ATCA OK / Not OK	

02	Change SSR of TST004 New SSR code: 0006	A new ABI wiil be generated OK / Not OK	SSR should be automatically updated for the concerned flight and flagged for ATCA OK / Not OK	
03	Change ATYP of TST004 New ATYP: AT45	A new ABI wiil be generated OK / Not OK	ATYP should be automatically updated for the concerned flight and flagged for ATCA OK / Not OK	
04	Change ADES of TST004 New ADES: OTBH	A new ABI wiil be generated OK / Not OK	ADES should be automatically updated for the concerned flight and flagged for ATCA OK / Not OK	
05	Change XFL of TST004 New XFL: 160	A new ABI wiil be generated OK / Not OK	Entry level should be automatically updated for the concerned flight and flagged for ATCA OK / Not OK	
06	Change COP of TST004 New COP: BUNDU	A new ABI wiil be generated OK / Not OK	COP should be automatically updated for the concerned flight and flagged for ATCA OK / Not OK	
07	when ETX is Current time + 5 minutes the ACT should be automatically generated	ACT will be generated OK / Not OK	OK / Not OK	
08	Change ATYP of TST004 New ATYP: B738	An indication to ATCO to show that this change needs to be manually coordinated	Expect manual coordination OK / Not OK	
09	Check LAM messages	OK / Not OK	OK / Not OK	

6. <u>Test 006 PAC, ABI, ACT without FPL for UAE:</u>

Test 006 – PAC, ABI, ACT – No FPL for UAE ***Doha FDPS to UAE ACC FDPS***				
No	***Test description***	***UAE ACC FDPS***	***Doha FDPS***	***Remarks***
01	Activate start up TST009 (OTBD – OMAA) SSR code:0007 ATYP:A320 XFL: 210 COP: NAMLA	SFPL is created by PAC. OLDI window pops up. OK / Not OK	Automatically generates PAC message OK / Not OK	
02	Enter estimate for TST010, (OEJN – OOMS) SSR Code: 0010 ATYP: B738 XFL: 230 COP: BUNDU ETX: Current time	SFPL is created by ABI. OLDI window pops up. OK / Not OK	Automatically generates ABI message OK / Not OK	
03	Enter estimate for TST011, (OEJN – OOMS) SSR Code: 0011 ATYP: B738 XFL: 230 COP: BUNDU ETX: Current time + 3 mins	SFPL is created by ACT. OLDI window pops up. OK / Not OK	Automatically generates ACT message OK / Not OK	
04	Check LAM messages	OK / Not OK	OK / Not OK	

7. <u>Test 007 ABI, ACT without FPL for Doha:</u>

Test 007 – ABI, ACT – No FPL for Doha FDPS ***UAE ACC FDPS to Doha FDPS***				
No	***Test description***	***UAE ACC FDPS***	***Doha FDPS***	***Remarks***
01	Enter estimate for TST012, (TACT – OTBH) SSR Code: 0012 ATYP: K35R XFL: 220 COP: TOSNA ETN: Current time	Automatically generates ABI message OK / Not OK	FPL created by ABI and flags for ATCA attention. OK / Not OK	
02	Enter estimate for TST013, (OOMS – OTBD) SSR Code: 0013 ATYP: A321 XFL: 180 COP: MEKMA ETN: Current time -20 mins	Automatically generates ACT message OK / Not OK	FPL created by ACT and flags for ATCA attention. OK / Not OK	
03	Check LAM messages	OK / Not OK	OK / Not OK	

8. Test 008 Duplicate SSR:

Test 008 – Duplicate SSR				
No	***Test description***	***UAE ACC FDPS***	***Doha FDPS***	***Remarks***
01	Create a FPL TST020 at Doha with SSR 0014 to block SSR code Enter estimate data for TST002 at UAE RDS (OMAM – OTBH) SSR Code : 0014 ETN: Current time XFL: 180	OLDI message window pops up with a question mark on TST002 OK / Not OK	Duplicate SSR should be duly flagged to operator OK / Not OK	
02	Create a FPL TST030 at UAE RDS with SSR 0015 to block SSR code Enter estimate data for TST008 at Doha (OTBD – OOMS) SSR Code : 0015 ETN: Current time XFL: 230	OLDI message window pops up with a question mark on TST008 OK / Not OK	Duplicate SSR should be duly flagged to operator OK / Not OK	

9. Test 009 Communication failure:

Test 009 – Communication failure				
No	***Test description***	***UAE ACC FDPS***	***Doha FDPS***	***Remarks***
01	Simulated link failure	OLDI messages that are not coordinated will move from Active to Workqueue OK / Not OK	Failures should be duly flagged to operator OK / Not OK	

10. Test Flight plans:

a. TST001 (OMAA – OTBD)

(FPL-TST001-IS
-A320/M-SDFHIJLOPRVWY/SD
-OMAA0655
-N0415F220 TOXIG Z994 VEBAT P899 MEKMA DCT NAJMA DCT DOH
-OTBD0030 OEDF
-PBN/A1B1C1D1L1O1S1 NAV/GPSRNAV DOF/13???? REG/A6TST
EET/OMAE0008 OBBB0020 SEL/ARKQ OPR/TST RMK/TEST FPL)

b. TST002 (OMAM – OTBH)

(FPL-TST002-IM
-C17/H-SGHJPRWXYZ/SD
-OMAM0820
-N0454F280 DCT MA270020 DCT MA285032 DCT DASLA Z994 BUNDU B415
DOH
DCT
-OTBH0032 OMAM
-PBN/A1B1C1D1L1O1S1 NAV/GPSRNAV DOF/13???? REG/A6TST
EET/OBBB0019 SEL/CFPR NAV/RNP10 RNAV1 RNAV5 RNVD1E2A1
RMK/TEST FPL)

c. TST003 (OMAA – OEJN)

(FPL-TST003-IS
-A320/M-SDGHIJLPRWXY/S
-OMAA0800
-N0467F220 TOXIG Z994 BUNDU B415 DOH A415 KIA G782 RGB/N0461F360
UM309 RABTO G782 ASLAT DCT
-OEJN0201 OEMA
-PBN/A1B1C1D1L1O1S1 NAV/GPSRNAV DAT/SV DOF/13???? REG/A6TST
EET/OMAE0009 OBBB0021 OEJD0044 SEL/BMAR RMK/TCAS
EQUIPPED RMK/TEST FPL)

d. TST004 (OOMS – OTBD)

(FPL-TST004-IS
-A320/M-SDFHIJLOPRVWY/SD
-OOMS0655
-N0458F320 MCT L764 PAXIM P899 ITRAX ALN P899 DASLA/N0440F260
Z994
VEBAT/N0424F220 P899 MEKMA DCT NAJMA DCT DOH
-OTBD0057 OMAA
-PBN/A1B1C1D1L1O1S1 DAT/V NAV/TCAS DOF/13???? REG/A6TST
EET/OMAE0023 OBBB0047 SEL/GLEH RMK/TEST FPL)

e. TST005 (OTBD – OMDB)

(FPL-TST005-IS

-B738/M-SHPRWXYIGZ/S
-OTBD1230
-N0390F210 DOH L305 ITITA L308 DESDI DESDI4T
-OMDB0049 OMRK OMAL
-PBN/A1B1C1D1L1O1S1 NAV/RNAV1 RNAV5 RNP4 RNP10 RNP5
RNVD1E2A1 DOF/13???? REG/A6TST
EET/OMAE0015 SEL/HQER RMK/TEST FPL)

f. TST006 (OTBH – OMDM)

(FPL-TST006-IM
-C130/M-SHITUY/S
-OTBH1000
-N0311F150 UL305 ALSEM L305 ITITA L308 SHJ DCT
-OMDM0059 OBBI
-PBN/A1B1C1D1L1O1S1 NAV/RNAV1 RNAV5 RNP4 RNP10 RNP5
RNVD1E2A1 DOF/13???? REG/A6TST
EET/OMAE0020 RMK/TEST FPL)

g. TST007 (OEJN – OMAD)

(FPL-TST007-IN
-GLF4/M-SDGHIRVWXY/S
-OEJN0600
-N0458F210 JDW T532 KIA B418 ASPAN N318 XAKUM Q666 BOXAK DCT
-OMAD0212 OMAL
-PBN/A1B1C1D1L1O1S1 NAV/RNAV1 RNAV5 RNP4 RNP10 RNP5
RNVD1E2A1 DOF/13???? REG/A6TST EET/OBBB0113 OMAE0151
RMK/TEST FPL)

h. TST008 (OTBD – OOMS)

(FPL-TST008-IS
-A320/M-SDFHIJLOPRVWY/SD
-OTBD0630
-N0466F310 B415 AFNAN B415 ADV N685 LAKLU G216 MCT DCT
-OOMS0103 OMAL
-PBN/A1B1C1D1L1O1S1 NAV/RNAV1 RNAV5 RNP4 RNP10 RNP5
RNVD1E2A1 DOF/13???? REG/A6TST EET/OBBB0007 OMAE0012
OOMM0038 SEL/GLEH RMK/TEST FPL)

~~10.~~8. BILATERAL AGREEMENT TEMPLATE

Bilateral Agreement Template to be appended to the main Letter of Agreement (LoA) Template
Please choose the appropriate OLDI or AIDC.

NOTE:
This part of the LOA only to be used as guidance it is related to the Automatic data exchange either OLDI or AIDC which are attachments 1 and 2 respectively to Appendix C of the complete letter of agreement.

Appendix C (1)

Exchange of Flight Data

(With automatic data exchange)

Unit 1 **Unit 2**

Revision: xxxx

Effective: xx xxxx xxxx

Revised: xxx

C.1 General

C.1.1 **Basic Flight Plans**

Basic flight plan data should normally be available at both ATS Units.

C.1.2 **Current Flight Plan Data**

Messages, including current flight plan data, shall be forwarded by the transferring ATS unit to the accepting ATS unit either by automatic data exchange or by telephone to the appropriate sector/position.

C.1.2.1 Automatic Data Exchange.

The messages (List agreed message for OLD e.g. ABI/ACT/LAM/PAC/REV/MAC messages are exchanged between the two ATS units in accordance with Attachment 1 or Attachment 2 to Appendix C.

C.1.2.2 Verbal Estimates.

For conditions that are not supported by the automatic data exchange, verbal estimates will be exchanged.

A verbal estimate shall be passed to the appropriate sector at the accepting ATS unit at least value minutes prior, but not earlier than 30 minutes before the aircraft is estimated to pass the transfer of control point.

A verbal estimate shall contain:

a) Callsign.

Note: To indicate that the flight plan is available, the accepting ATS unit should state aircraft type and destination after having received the callsign.

b) SSR code:

Note: Normally, the notification of a SSR code indicates that the selection of that code by the aircraft was verified.

c) ETO for the appropriate COP as laid down in Appendix D to this LoA.

d) Cleared level, specifying climb or descent conditions if applicable, at the transfer of control point.

Requested level if different from cleared level.

e) Other information, if applicable.

Normally, verbal estimates will not be passed in parallel with ACT messages.

In all cases, verbally passed data shall take precedence over data exchanged automatically.

C.1.2.3 Failure of Automatic Data Exchange.

In the event of a failure which prevents the automatic transfer of data, the Supervisors shall immediately decide to revert to the verbal exchange of estimates.

After recovery from a system failure, the Supervisors shall agree as to when they will revert to automatic data exchange.

C.1.3 **Non-availability of Basic Flight Plan Data**

If the accepting ATS unit does not have basic flight plan data available, additional information may be requested from the transferring ATS unit to supplement the ACT message or a verbal estimate.

Within the context of RVSM, such additional information should include:

a. the RVSM approval status of the aircraft; and

b. whether or not a non-RVSM approved aircraft is a State aircraft.

C.1.4 **Revisions**

Any significant revisions to the flight data are to be transmitted to the accepting ATS unit. Time differences of value minutes or more are to be exchanged.

Any levels which different than describe in Appendix D of this LOA are subject to an Approval Request.

C.1.5 **Expedite Clearance and Approval Requests**

Whenever the minimum time of value minutes for a verbal estimate, or those prescribed in Attachment 1 to Appendix C for ACT messages, cannot be met, either an expedite clearance request, an approval request (*or a PAC)*, as appropriate, shall be initiated.

C.2 Means of Communications and their Use

C.2.1 **Equipment**

The following lines are available between Unit 1 and Unit 2:

Line Type	Amount	Additional Information
Data Line		
Telephone Lines		

"Additional Information" column should indicate if telephone lines meet the requirements for Direct Controller-Controller Voice Communication (DCCVC) or Instantaneous Direct Controller-Controller Voice Communication (ICCVC)

C.2.2 **Verbal Co-ordination**

All verbal communications between non-physically adjacent controllers should be terminated with the initials of both parties concerned.

Exchange of flight plan data, estimates and control messages by voice shall be carried out in accordance with the following tables:

C.2.2.1 Messages from Unit 1 to Unit 2.

Receiving Sector/COPs	Message	Position
Sector Name COPs	Flight Plan Data and Estimates	
	Control Messages, Expedite Clearances, Approval Requests and Revisions	
	Surveillance Co-ordination	

C.2.2.2 Messages from Unit 2 to Unit 1.

Receiving Sector/COPs	Message	Position
Sector Name COPs	Flight Plan Data and Estimates	
	Control Messages, Expedite Clearances, Approval Requests and Revisions	
	Surveillance Co-ordination	

C.3 Failure of Ground/Ground Voice Communications

C.3.1 **Fall-Back Procedures for Co-ordination**

To mitigate the effects of failures of direct speech circuits, both parties will establish and maintain dial-up facilities via PABX and ATC Voice Communications Systems (VCS) as follows:

Sector Name	Tel Number (For Both Units)

Stand-alone telephones with auto-dial facilities will be maintained as a second level of fall-back to cover the event of failure of PABX or VCS:

Sector Name	Tel Number (For Both Units)

C.3.2 **Alternate Fall-Back Procedures for Co-ordination**

In case of communications failure where the alternatives described in paragraph C.3.1 above are not available or practicable, pilots shall be instructed, at least 5 minutes prior to the transfer of control point, to pass flight data on the appropriate frequency of the accepting ATS unit for the purpose of obtaining an ATC entry clearance from the accepting ATS unit.

If the accepting ATS unit cannot issue an entry clearance to the pilot upon his initial contact, the pilot shall be instructed to inform the transferring ATS unit accordingly via RTF.

The transferring ATS unit shall hold the aircraft within its AoR and after a minimum of 10 minutes instruct the pilot to re-establish RTF contact with the accepting ATS unit.

This procedure shall be repeated until an onward clearance has been obtained from the accepting ATS unit.

C.4 Validity

This Appendix to the LoA takes effect on xxx xxxx xxxx and supersedes previous Appendix to Letter of arrangements between the Unit 1 and Unit 2.

Date:	Date:
___________________________	___________________________
Name	Name
Title	Title
Authority 1	Authority 2

Attachment 1 to Appendix C

Automatic Data Exchange related to OLDI

ABI/ACT/LAM messages are exchanged between the two ATS units in accordance with the table below:

Messages	COPs	**Time and/or Distance Parameters**	
		Messages from Unit 1 To Unit 2	Messages from Unit 1 To Unit 2
ABI			
ACT			
LAM			
REV			
PAC			
MAC			
LOF			
NAN			

Attachment 2 to Appendix C

Automatic Data Exchange related to AIDC

This is the Generic Template available in the PAN which also contain real sample agreement Auckland Oceanic – Brisbane ATS Centre and Auckland Oceanic – Nadi ATM Operations Centre

AIDC Procedures

1. The format of AIDC messages (*List messages used e.g. ABI, PAC, CDN, CPL, ACP, REJ, MAC, LAM and LRM)* are as defined by the Pan Regional (NAT and APAC) AIDC Interface Control Document (ICD) as amended from time to time, unless described otherwise in this LOA.
2. List messages not supported (*e.g. "EST, TOC, AOC* messages are not supported").
3. Acceptance of CPL or CDN message is approval of the flight's profile and requires no further voice communication (i.e. Non-Standard Altitudes, Block Altitudes, and Deviations).
4. (*Describe other procedures applicable to the use of AIDC for this LOA. Some examples are listed below)*
    a. *Example only. If there is any doubt with regard to the final coordination data, voice coordination should be used for confirmation.*
    b. *Example only. Receipt of a MAC message must not be interpreted as meaning that the flight plan has been cancelled. Voice coordination must be conducted by the transferring controller to confirm the status of the flight.*
    c. *Example only. Each facility should advise the other facility of any known equipment outage that affects AIDC. In the event of AIDC outage, voice communication procedures will apply.*
    d. *Example only. Truncation. Where route amendment outside the FIR is unavoidable.*
        i. *Terminate the route details at the farthest possible flight plan significant point of the flight and enter "T" immediately following this.*
        ii. *Without amending the originally received details, every effort is to be made to truncate the route at a minimum of one significant point beyond the adjacent FIR to provide an entry track in that FIR.*

AIDC Messages

(For each message used describe when it will be sent by each ATSU under the parameter column and use the Notes column to describe other applicable information for the message use by each ATSU. The data below provides an example of the type of information that could be incorporated.)

Messages	Parameter	Notes
ABI	***ATSU1*:** Sends ABI approx. 80 minutes prior to boundary (73 minutes prior to the 50 nm expanded sector boundary). ***ATSU2:*** Sends ABI approx. 87 minutes prior to boundary (80 minutes prior to the 50 nm expanded sector boundary). (*Note: An updated ABI will not be sent once a CPL has been sent.)*	***ATSU1 : ATSU2*** *Updated ABI's will be sent automatically if there is any change to profile. ABI is sent automatically and is transparent to the controller. ABI automatically updates the receiving unit's flight data record.*
CPL	***ATSU1 : ATSU2*** *Send CPL messages approx. 37 minutes prior to the boundary (30 minutes prior to the 50 nm expanded sector boundary).*	***ATSU1 : ATSU2*** *CPL messages should be sent by the transferring controller in sufficient time to allow the completion of coordination at least 30 minutes prior to the boundary or 30 minutes prior to the aircraft passing within 50nmof the FIR boundary for information transfers.*
CDN	***ATSU1 : ATSU2*** *CDN messages are sent by either the transferring or receiving facility to propose a change once the coordination process has been completed, i.e., CPL sent and ACP received. CDN's must contain all applicable profile restrictions (e.g. weather deviations, speed assignment, block altitude). If the use of a CDN does not support this requirement, then verbal coordination is required.*	***ATSU1 : ATSU2*** *The APS will display a flashing "DIA" until receipt of ACP. If ACPJ not received within ten (10) minutes, controller is alerted with a message to the queue. CDN messages are not normally used for coordination of reroutes; however, with the receiving facilities approval a CDN may be used to coordinate a reroute on a critical status aircraft such as in an emergency.*
PAC	***ATSU1 : ATSU2*** *PAC messages will normally be sent when the time criteria from the departure point to the boundary is less than that stipulated in the CPL.*	***ATSU1 : ATSU2*** *Will respond to a PAC message with an ACP. PAC messages should be verbally verified with receiving facility.*
ACP	***ATSU1 : ATSU2***	***ATSU1 : ATSU2*** *The APS will display a flashing "DIA" until receipt of ACP. If ACP not received within ten (10) minutes, controller is alerted with a message to the queue.*
TOC	***ATSU1 : ATSU2*** *Not supported. Implicit hand in/off.*	
AOC	***ATSU1 : ATSU2*** *Not supported. Implicit hand in/off.*	
MAC	***ATSU1 : ATSU2*** *MAC messages are sent when a change to the route makes the other facility no longer the "next" responsible unit.*	***ATSU1 : ATSU2*** *Receipt of a MAC message must not be interpreted as meaning that the flight plan has been cancelled. Voice coordination must be conducted by the transferring*

		controller to confirm the status of the flight.
REJ	***ATSU1 : ATSU2*** *REJ messages are sent in reply to a CDN message when the request change is unacceptable*	***ATSU1 : ATSU2*** *REJ messages are sent only as a response to a CDN message.*

AIDC Messages

(For each message used describe when it will be sent by each ATSU under the parameter column and use the Notes column to describe other applicable information for the message use by each ATSU. The data below provides an example of the type of information that could be incorporated.)

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AOC	***ATSU1 : ATSU2*** *Not supported. Implicit hand in/off.*	
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REJ	***ATSU1 : ATSU2*** *REJ messages are sent in reply to a CDN message when the request change is unacceptable*	***ATSU1 : ATSU2*** *REJ messages are sent only as a response to a CDN message.*

~~11.~~9. IMPLEMENTATION PHASES

In line with ASBU Block 0 time lines, the AIDC/OLDI implementation shall be completed as per the MID Air Navigation Plan. In order to support and assist, the implementation could be accomplished in phases listed below. The actual targets set for the MID Region are in the MID Air Navigation Strategy.

Phase 1	• OLDI/AIDC capable ATSUs should start implementation activities. The activity should cover the following: ➢ test activities ➢ operator training ➢ Revision of LoA ➢ transition activities ➢ implementation ➢ post-implementation reviews • The ATSUs not capable of OLDI/AIDC should avail the facility of Standalone terminals with a planned implementation asap, and budget for full Integration with a planned implementation date of the MID Air Navigation Strategy.
Phase 2	• The ATSUs using OLDI/AIDC in an Operational environment should assist other ATSUs to implement OLDI/AIDC • The OLDI/AIDC software is readily available therefore the ATSUs waiting for software upgrade should expect a software package asap. On receipt of it they should start implementation activities. The activity should cover the following: ➢ test activities ➢ operator training ➢ Revision of LoA ➢ transition activities ➢ implementation ➢ post-implementation reviews
Phase 3	• All ATSUs are connected by Integrated OLDI/AIDC or Standalone terminals

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APPENDIX 4G

NOTAM TEMPLATE FOR GNSS INTERFERENCE

Item Q – Qualifier: the following qualifiers shall be mentioned in item Q:

Qualifier FIR: This Item shall contain the ICAO location indicator of the FIR within which the flights may be impacted by the RFI. If more than one FIR of the same country is impacted, the ICAO nationality letters of that country (e.g. OE) should be followed by 'XX'.

Qualifier NOTAM CODE: the following NOTAM code qualifiers (second and third letter) shall be used as appropriate for GNSS RFI event notification in the case of:

GNSS airfield specific operations – QGA [GNSS AIRFIELD]

GNSS area wide operations – QGW [GNSS AREA]

Followed by the appropriate fourth and fifth letters from the below list:

LF – interference from [INTERFERENCE FM]

AU – Not available (specify reason if appropriate) [NOT AVBL]

For cancellation NOTAM the following 4TH and 5th letters shall be used:

AK – Resumed normal operations [OKAY]

AL – Operative (or re-operative) subject to previously published limitations/conditions [OPR SUBJ PREVIOUS COND]

Qualifier TRAFFIC: the « IV » should be used as a traffic qualifier, indicating that both IFR and VFR traffic may be impacted by the RFI

Qualifier PURPOSE: the code NBO should be used to notify RFI events:

Qualifier SCOPE: Depending on the impacted area, one of the following codes should be used:

- A = if the event only impacts aerodrome(s) operations (used QGA)
- E = if the event only impacts en-route traffic (used QWA)
- AE = if the event impacts both Aerodrome and En-route traffic (used QWA)

Qualifier LOWER/UPPER: Depending on the jamming range and the traffic in the impacted area.

Qualifier GEOGRAPHICAL REFERENCE – Coordinates: this qualifier indicates the interference source coordinates. For NOTAM with 'Scope' 'A' the Aerodrome Reference Point (ARP) coordinates should be inserted. For NOTAM with 'Scope' 'AE' or 'E' the centre of a circle whose radius encompasses the whole area of interference should be inserted.

Qualifier 'GEOGRAPHICAL REFERENCE' – Radius*: The radius of the impacted area should be inserted in this field.

Item A – Location

All FIR location indicators affected by the information should be entered in Item A), each separated by a space. In the case of a single FIR, the Item A) entry must be identical to the 'FIR' qualifier entered in Item Q). When an aerodrome indicator is given in Item A), it must be an aerodrome/heliport situated in the FIR entered in Item Q).

Item B – Start of Activity

A ten-digit date-time group giving the year, month, day, hour and minutes, at which the NOTAM comes into force, should be mentioned in Item B).

Item C – End of Validity

A ten-digit date-time group giving the year, month, day, hour and minute, at which the NOTAM ceases to be in force and becomes invalid, should be mentioned in Item C). This date and time should be later than that given in Item B).

Item E – NOTAM Text

The following standard text <u>should</u> be used according to Q-code:

QGAAU – GNSS NOT AVBL

QGWAU – GNSS NOT AVBL WITHIN: {specify route / geographical area (coordinates / waypoints)

or

QGALF – GNSS INTERFERANCE

QGWLF – GNSS INTERFERANCE WITHIN: specify route / geographical area (coordinates / waypoints)

When cancelling the NOTAM, the following standard text shall be used:

QGAAK or QGWAK – GNSS OKAY {when resuming normal operations}

QGAAL or QGWAK – GNSS OPR SUBJ PREVIOUS COND. {only to be used where conditions have been published}.

MID DOC 013

INTERNATIONAL CIVIL AVIATION ORGANIZATION

MIDDLE EAST AIR NAVIGATION PLANNING

AND IMPLEMENTATION REGIONAL GROUP

(MIDANPIRG)

MID REGION SURVEILLANCE PLAN

EDITION MAY 2023

Developed by:

MIDANPIRG COMMUNICATION, NAVIGATION AND SURVEILLANCE SUB-GROUP (CNS SG)

TABLE OF CONTENTS

1- BACKGROUND

Aeronautical surveillance systems are major elements of modern air navigation infrastructure required to safely manage increasing levels and complexity of air traffic. The sixteenth meeting of Air Navigation Planning and Implementation Regional Group in the Middle East (MIDANPIRG/16) tasked the CNS SG through Decision 16/24 to develop the MID Region Surveillance Plan based on the Regional operational requirements, Users' capabilities and specificities of the Region:

> *DECISION 16/ 23: MID REGION SURVEILLANCE PLAN*
>
> *That, the MID Region Surveillance Plan be developed by the CNS SG, based on the operational needs identified by the ATM SG.*

The Global Air Navigation Plan (GANP) through B0-ASUR, defined the possibility of using lower-cost ground surveillance supported by technologies such as ADS-B OUT and Wide Area Multilateration (MLAT) systems.

This document reviews the available surveillance technologies and highlight their strengths and weaknesses. The plan timelines are divided into three stages; short-term until 2020, mid-term from 2021 to 2025, and long-term beyond 2025.

2- INTRODUCTION

The surveillance service delivered to users may be based on a mix of three main types of surveillance:

a) independent non-cooperative surveillance: the aircraft position is derived from measurement not using the cooperation of the remote aircraft; like Primary Surveillance Radar (PSR);

b) independent cooperative surveillance: the position is derived from measurements performed by a local surveillance subsystem using aircraft transmissions. Aircraft derived information (e.g., pressure altitude, aircraft identity) can be provided from those transmissions, like Secondary Surveillance Radar (SSR) and Multilateration; and

c) dependent cooperative surveillance: the position is derived on board the aircraft and is provided to the local surveillance subsystem along with possible additional data (e.g., aircraft identity, pressure altitude), like Automatic Dependent Surveillance-Broadcast (ADS-B) and Automatic Dependent Surveillance-Contract (ADS-C).

The main applications of ATC Surveillance in civil aviation are:

1- Aerodrome Control Service;
2- Approach Control Service;
3- Area Control Service;and
4- Surface/ Ground Management

3- SURVEILLANCE IN GANP

The GANP addressed operating and emerging Surveillance technologies through the thread Alternative Surveillance (ASUR), the technologies laid down in that module are ADS-B, MLAT, and Mode S.

The lower costs of dependent surveillance infrastructure (ADS-B and MLAT) in comparison to conventional radars support business decisions to expand radar-equivalent service volumes and the use of radar-like separation procedures into remote or non-radar areas.

The eleventh Air Navigation Conference recommended ADS-B on 1090MHz for international use and this is happening. Equipage rate is growing for Mode S, airborne collision avoidance system (ACAS) and ADS-B OUT. ADS-B OUT, Version 2 also provides ACAS RA DOWNLINK information.

The GANP Surveillance roadmap is depicted in *figure (1).* Alternative Surveillance elements as mentioned in the GANP 7th edition, are listed in *figure (2)*

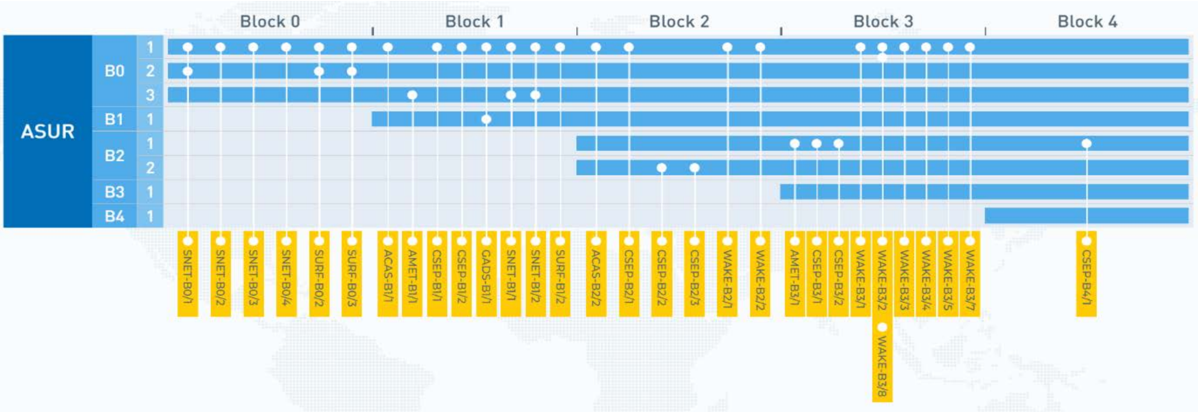


Figure (1)

Element ID	Title
ASUR-B0/1	Automatic Dependent Surveillance – Broadcast (ADS-B)
ASUR-B0/2	Multilateration cooperative surveillance systems (MLAT)
ASUR-B0/3	Cooperative Surveillance Radar Downlink of Aircraft Parameters (SSR-DAPS)
ASUR-B1/1	Reception of aircraft ADS-B signals from space (SB ADS-B)
ASUR-B2/1	Evolution of ADS-B and Mode S
ASUR-B2/2	New community based surveillance system for airborne aircraft (low and higher airspace)
ASUR-B3/1	New non-cooperative surveillance system for airborne aircraft (medium altitudes)
ASUR-B4/1	Further evolution of ADS-B and MLAT

Figure (2)

4- RFI

the potential increase of safety risks due to 1090 MHz congestion; it was highlighted that States should monitor and report the performance and the use of this RF band; detect and investigate the unexpected transmissions on these frequencies; and study the interoperability impact between existing and new systems on this RF band.

5- Surveillance Technologies

4-1 Primary Radar

Primary Surveillance Radar (PSR) derives aircraft position based on radar echo returns, PSR transmits a high-power signal, some of which is reflected by the aircraft back to the radar. The radar determines the aircraft's position in range from the elapsed time between transmission and reception of the reflection.

Surface Movement Radar (SMR) is the most widely used non-cooperative surveillance system for aerodrome surveillance. SMR may use a primary radar for providing surveillance cover for the manoeuvring area, which is defined as that used for the take-off, landing and taxiing of aircraft. In A-SMGCS, the non-cooperative surveillance service is typically provided by one or several SMRs.

Millimetre radar is an emerging technology used for aerodrome surveillance which provides higher resolution than traditional SMR. Millimetre Radar and SMR can be used for FOD Detection.

The strengths and weaknesses below are related to the PSR.

4-1-1 Strengths

- independent Radar, does not require any specific equipment of the aircraft (Transponder).

4-1-2 Weaknesses

- does not provide the identity or the altitude of the Aircraft
- cannot be easily sited in oceanic locations, or rough terrain such as in mountainous regions
- PSR has a heavy reliance on mechanical components with large maintenance requirements
- high CAPEX
- can report false target
- depends on the cross section of the target
- Silence Cone
- Requires high transmission power.

4-2 Secondary Surveillance Radar (SSR/MSSR)

A surveillance radar system which uses transmitters/receivers (interrogators) and Aircraft transponders.

4-2-1 Strengths

- receive aircraft data for barometric altitude and, identification code
- depends on Reply pulses, which are stronger than echo signals used in Primary Radar.
- Separate frequency spectrum for transmission and reception, Clutter reduction

4-2-2 Weaknesses

- high CAPEX
- cannot be easily sited in oceanic locations, or rough terrain such as in mountainous regions
- has a heavy reliance on mechanical components with large maintenance requirements
- Silence Cone

4-3 Mode S Radar

An enhanced mode of SSR that permits selective interrogation and reply capability.

4-3-1 Strengths

- improve shortage and constraints in Mode A codes (Aircraft ID)
- backward compatible with transponder mode A/C
- ability to download enhance surveillance information
- increase in data integrity by the use of a parity check mechanism.
- high parametric altitude accuracy (Coding of altitude data in 25-foot increments).

4-3-2 Weaknesses

- has a heavy reliance on mechanical components with large maintenance requirements
- cannot be easily sited in oceanic locations, or rough terrain such as in mountainous regions
- high CAPEX
- Silence Cone

4-4 ADS-B

Dependent surveillance is a surveillance technology that allows avionics to broadcast an aircraft's identification, position, altitude, velocity, and other information.

4-4-1 Strengths

- improve shortage and constraints in Mode A codes (Aircraft ID)
- Low ground infrastructure cost
- Easy to maintain
- The non-mechanical nature of the ADS-B ground infrastructure make it easy to relocate and maintain.
- it to be sited in locations that are difficult for radar installations, like hilly areas, filling the surveillance gap between radar coverage
- provide radar-like separation procedures into remote or non-radar areas
- Use of dependent surveillance also improves the search and rescue support provided by the surveillance network, ADS-B's positional accuracy and update rate allows for improved flown trajectory tracking allowing for early determination of loss of contact and enhances the ability for search and rescue teams to pinpoint the related location
- no Silence Cone

4-4-2 Weaknesses

- aircraft must be equipped with ADS-B OUT
- dependent on GNSS, outage of GNSS affect ADS-B

4-5 ADS-C

The aircraft uses on-board navigation systems to determine its position, velocity and other data. A ground ATM system establishes a "contract" with the aircraft to report this information at regular intervals or when defined events occur. This information is transmitted on point-to-point data links.

4-5-1 Strengths

- can be easily sited in oceanic locations, or rough terrain such as in mountainous regions
- does not need ground infrastructure when supported via satellite systems
- low investment cost at ANSP
- use of dependent surveillance also improves the search and rescue support provided by the surveillance network

4-5-2 Weaknesses

- high cost per report, as the airline use third party network.
- long latency when satellite used.

The ADS-C used in Oceanic and remote areas (non-Radar area), therefore, it will be excluded in the next section as it's not applicable in the MID Region.

4-6 MLAT

MLAT is a system that uses existing aircraft transponder signals to calculate, usually as a minimum, a three-dimensional position. it requires a minimum of four receiving stations to calculate an aircraft's position. If the aircraft's pressure altitude is known, then the position may be resolved using three receiving stations.

MLAT can act in two modes; Passive mode where it uses the existing transmissions made by the aircraft, or active mode, one interrogator (at least) to trigger replies in the manner of Mode S SSR interrogations.

The technique can be used to provide surveillance over wide area (wide area MLAT system - WAM).

4-6-1 Strengths

- can make use of currently existing aircraft transmissions, does not requires specific avionic.
- improve shortage and constraints in Mode A codes (Aircraft ID)
- provides a transition to an environment where the majority of aircraft will be equipped with ADS-B.
- no Silence Cone.

4-6-2 Weaknesses

- requires multiple receiving sensors to calculate aircraft's positions
- high running cost; including maintenance; telecommunication; multiple secured sites
- needs a common time reference to determine the relative TOA of the signal at the receiving stations (time-stamped by a common clock or synchronism by a common reference such as GNSS)

4-7 Surveillance Cameras

Surveillance Camera can be used to send high-resolution images at the airport to a workstation in the control tower. Surveillance Camera is an enabler to run remotely aerodrome control as in ASBU module B1-RATS. The air traffic controller can monitor air traffic via screens which provide an image that corresponds to the view through the window in a traditional control tower.

4-8 Precision Approach Radar (PAR)

Primary radar equipment used to determine the position of an aircraft during final approach, in terms of lateral and vertical deviations relative to a nominal approach path, and in range relative to touchdown. PAR is still used by military organizations. with ILS being part of the standard aircraft equipment (together with VHF radio and VOR), airline users no longer derive benefit from this technology

5- Comparison between Surveillance Technologies

	PSR	MSSR	Mode S	ADS-B	MLAT
1)Required Avionics	No avionics required	Transponder is required Mode A/C	Transponder is required Mode S transponder	Transponder is required ADS-B or 1090 ES (Mode S + ADS-B)	Transponder is required Can process data from all ADS-B/ES, Mode S, Mode A/C
2)Information Provided	Range and Azimuth	Mode A codes, Pressure altitude	Mode A codes; Pressure altitude; 24-bit address of the aircraft; aircraft “on-the-ground” status; aircraft ID; aircraft pressure-altitude with 25-ft resolution; and other information	Position, flight level (barometric), position integrity, geometric altitude (GPS altitude), 24 bit unique code, Flight ID, velocity vector, vertical rate, emergency flags, aircraft type category	Position, flight level (barometric), calculated altitude, 4 digit octal identity, calculated velocity vector +mode s data
3)Accuracy & update rate	Accuracy depends on target cross-section and range	Dependent on range	Dependent on range	High accuracy ,inherent accuracy of the GPS determined position, and very high update rate	High accuracy at Local Area (LAM), less accurate for Wide Area (WAM) Some MLAT has its own of source

					of synchronization GNSS is critical for some MLAT for time synchronization.

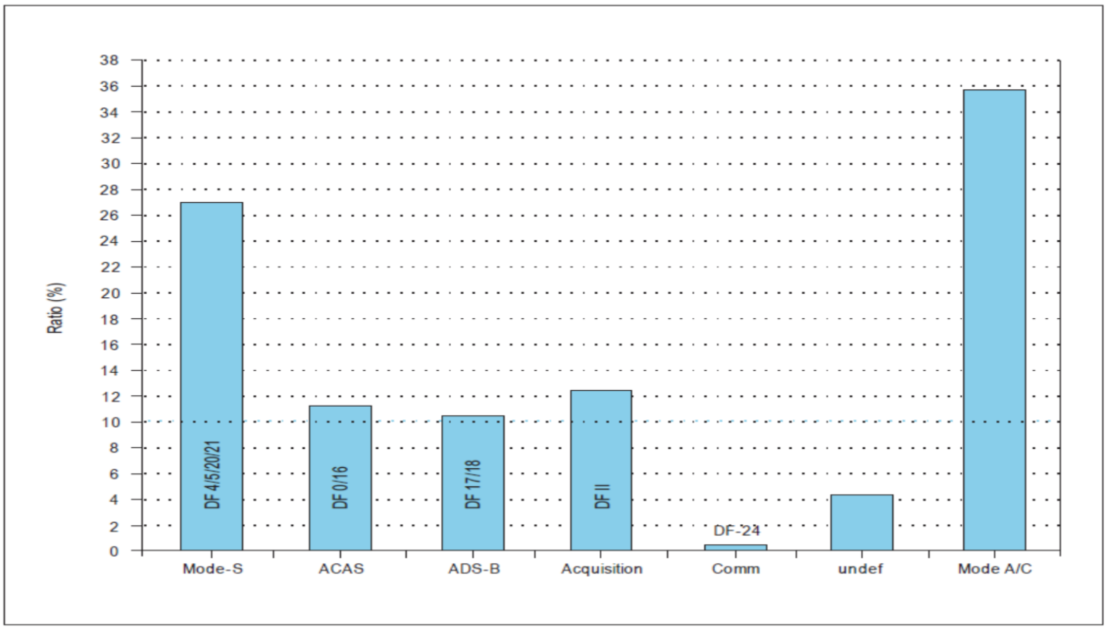
4)Coverage	Up to 250 NM	250 NM	250 NM	250 NM Traffic density can affect the coverage	**Depending on the geometry,number of sensors, hilly areas requires more sensors
5)Failure effect		Total loss of coverage	Total loss of coverage	Total loss of coverage	Partial or negligible, (N-1) principle
	6) Cost*				
	6.1 CAPEX				
Sensor Purchase	Very high	High	high	very low	Depending on geometry,
Site requirement (Civil work, renting/buying land(s), fence,…, etc.)	One site required High cost of the tower	One site required High cost of the tower	One site required High cost of the tower	One site required Cost less	Multiple sites required
	6.2 OPEX				
Maintenance cost (periodic, preventive, emergency)	Heavy maintenance (mechanical parts)	Heavy maintenance (mechanical parts)	Heavy maintenance (mechanical parts)	Low maintenance cost	High maintenance costs to multiple sites
Telecommunication media	Dual Telecom. connections Required from the sensor site. to the ATM centre	Dual Telecom. connections Required from the sensor site to the ATM centre	Dual Telecom. connections Required from the sensor site to the ATM centre	Dual Telecom. connections Required from the sensor site to the ATM centre	Multiple Dual Telecom. connections Required From the sensors sites to the ATM centre
Site physical Security	One secured site	One secured site	One secured site	One secured site	Multiple secured Sites

**The cost does not take into consideration fleet equipage cost*

6. 1090 SPECTRUM CONGESTION

1090 CONGESTION SOURCES:

- SSR/MLAT replies
- TCAS/ACAS replies
- Squitters
  – Acquisition Squitter (Mode S)
  – Extended Squitter (ADS-B OUT)



SOURCE CONTRIBUTION EXAMPLE (ICAO DOC 9924)

1090ES (ADS-B) utilization of 1090 MHz grows linearly with equipped aircraft in a given airspace volume but is typically not the biggest user. TCAS/ACAS utilization of 1090 MHz grows by more than the square of equipped aircraft in a given airspace volume, use of Extended Hybrid Surveillance, which is required in ACAS Xa may be the mitigation measure

The 1090 MHz activity results from both SSR Mode A/C and Mode S type interrogators, however SSR Mode A/C operation is less spectrum efficient than Mode S SSR. Therefore, Managing interrogations in heavily surveilled airspace is very important o SSRs sharing surveillance data via networking (aka, "clustering"), thereby eliminating redundant surveillance coverage in overlapping geographic regions o Use of Passive Acquisition by SSRs and Wide-Area Multilateration

Mode S Downlink of Aircraft Parameters (DAPs) adds to 1090 MHz utilization, it should be used with caution. States with high dense FIR are encouraged to monitor 1090 MHz RF utilization.

States should ensure that aircraft transponders are not subject to excessive interrogations and that the use of a ground based transmitter do not produce harmful interference on other surveillance systems. States should monitor and report the performance and the use of this RF band; detect and investigate the unexpected transmissions on these frequencies; and study the interoperability impact between existing and new systems on this RF band.

States are urged to develop their contingency plans/procedures and back-up systems, to ensure continuous surveillance services/safe operations in the event of RFI or any malfunction of the Surveillance Systems. Furthermore, States are encouraged to take measures to mitigate RFI on surveillance systems:
• Use of multi constellation/multi frequency GNSS
• Employing multiple surveillance sensors in critical areas

• Use of monitoring and prediction tools/applications

7. OPERATIONAL REQUIREMENTS

The need to increase the availability of Surveillance services and to cover the gap areas in the MID Region.
States to ensure that sufficient terrestrial CNS capabilities remain available to ensure safe operations and complement aircraft-level integration of position, velocity and time with independent surveillance information (Resolution A41-8, Appendix C)

7. BASELINE IN THE MID REGION (1/12/2020)

- All MID State uses SSR/MSSR, some States Uses PSR for Security and Safety purposes. Any user charges associated with existing PAR installations should be eliminated.
- Bahrain, Egypt, Oman and UAE implemented MLAT at International Aerodromes and Lebanon plan to do same.
- ADS-B has been implemented at some States as backup and complementary means to the MSSR in Egypt, Iraq, Jordan, Sudan and UAE.
- Bahrain has implemented ADS-B for Vehicle Tracking purpose.
- Bahrain, Egypt, Iraq, Jordan, Oman, Qatar, Saudi Arabia, Sudan and UAE have installed SSR Mode S.
- Saudi Arabia is using Combined PSR/MSSR and standalone MSSR Mode S in major TMAs to ensure adequate level of surveillance redundancy and identification of all flights;
- UAE issued ADS-B/Out carriage Mandate as of 01 January 2020, ADS-B IN capability shall not be carried unless approved by the GCAA.Saudi Arabia issued ADS-B/Out carriage Mandate as of 01 January 2023 for all airspace users flying in Class A, B, C, D and E.
- Other ICAO Regions/States mandated carriage of ADS-B; Australia, Europe and United States (FAA) in 2020.
- Several ADS-B mandates worldwide may accelerate the ADS-B equipage. However, Regional Airline, General flights and Military aircraft impeding the ADS-B implementation in the MID Region.
- Saudi Arabia is implementing A-SMGCS systems at all Intl. airports listed in ICAO MID ANP. Each A-SMGCS system is composed of: 1) an SMR system, 2) a network of MLAT and ADS-B ground Stations with required central processing and monitoring systems.

8- Surveillance Plan

8.1 Short Term (2020 – 2024)

- Make full use of SSR Mode ‘S’ capabilities, reduce reliance on 4-digit octal code.
- States to consider emerging dependent Surveillance technologies (ADS-B and MLAT) in their National Surveillance Plans.
- Non-cooperative Surveillance radars maybe retained for Airports and approach services based on States operational needs (detection drones with large Radar Cross Section (RCS), detection of non-equipped vehicle,…,etc).
- ADS-B/Out Implementation:

1- Prioritize ADS-B/Out implementation in areas where there is no radar coverage surveillance.
2- State shall conduct safety assessment for ADS-B/ MLAT implementation as per *Reference [6]*.
3- The proportions of equipped aircraft are critical for the ADS-B deployment. Therefore, States should involve early in their joint planning and decision-making process. Subsequently, States should effectively communicate the change, the rationale and the impact
4- States are encouraged to use INCENTIVE strategy with stakeholders to accelerate ADS-B equipage; incentive approach might be financial or operational incentive or combined (e.g. Most Capable Best Served principle, waive fees).

- MLAT/SMR/ADS-B to be implemented at Aerodrome to enable A-SMGCS.
- Where there is a lack of ADS-B avionics equipage, MLAT can be an alternative mean to meet specific surveillance requirements, such as being a gap-filler of SSR coverages or supporting airport ground movement operations.

- States to share SSR/ADS-B data to improve boundary coverage and enhance the surveillance availability services. These type of surveillance data have very limited military.

- Space based ADS-B can be used where installation of ground based surveillance sensor is not possible due to geography and other security reasons.

- Video Surveillance System can be used to operate Remote Control Tower (RATS B1/1).

- When operationally required, MLAT/SMR/Video Surveillance System may be implemented at Aerodrome for Ground/ Surface Management service.

8.2 Mid Term (2025 - 2030)

- ADS-B/Out Implementation (*High proportion of ADS-B equipage is anticipated):*
  1- ADS-B to be implemented for Area and approach Control Services, where implementation would bring capacity and operational efficiencies;
  2- Relocate, as appropriate, any existing MLAT Sensors to work as ADS-B receiver.

- Retain some SSR Mode S Radar as supplement/ backup to ADS-B. States should develop progressive rationalization plans base on consultations with aviation stakeholders.

- The Introduction of Multi-constellation GNSS (GPS, Galileo, GLONASS, …, etc.) may reduce the likelihood of ADS-B outage linked to GNSS interference events. However, necessary ICAO standards will need to be completed before any avionics deployment can be expected. Any use of multi-constellation capability should follow natural avionics life-cycle and should not be mandatory.

- Implementation of Airborne Collision Avoidance System (ACAS X) adapted to trajectory-based operations with improved surveillance function supported by ADS-B aimed at reducing nuisance alerts and deviations (ACAS B2/1)

- States to develop required certification requirements for RPAS equipped with ACAS X (detect and avoid system), the ACAS systems for RPAS use multiple surveillance sensor inputs to determine the position and velocity of nearby aircraft (ACAS B2/2)

- ICAO will be able to assign additional 24-bit addresses (adoption of Annex 10, VOL III amendment) to States who have a small number of addresses (such as 1024) and for allocating codes to surface vehicle.

8.3 Long Term (2031 Onward)

- ADS-B is foreseen to be main Surveillance technology. Globally harmonized avionics requirements and clear definition of roles, responsibilities, and liabilities of pilots and air traffic controllers should be developed in support of ADS-B IN applications. Subsequently, airlines and ATS providers should conduct a cost and benefit analysis for ADS-B IN to determine if a positive business case for airlines and ATS providers can be obtained.

REFERENCES

[1] ICAO Annex 10, Aeronautical Telecommunication.

[2] ICAO Doc 9924, Aeronautical Surveillance Manual

[3] ICAO Doc 9869, Performance-Based Communication and Surveillance (PBCS) Manual

[4] ICAO Doc 9994, Manual on Airborne Surveillance Applications

[5] The Global Air Navigation Plan (9750), 6th edition https://www4.icao.int/ganpportal/[6] ICAO Doc 9871, Technical Provisions for Mode S Services and Extended Squitter.

[6] ICAO circular 326, Assessment of ADS-B and Multilateration Surveillance to Support Air Traffic Services and Guidelines for Implementation

[7] EUROCONTROL Standard Document for RADAR Surveillance in EN-Route Airspace and Major Terminal Areas.

[8] Guidance Material on Comparison of Surveillance Technologies (GMST), APAC Region.

[9] ICAO Global Navigation Satellite System (GNSS) Manual (Doc 9849)

APPENDIX 4I

MID Region ANS Cyber Security Action Plan

2023-2024

Action Number	Specific Measures/Task	by	Start date of Implementation	Traceability to Cybersecurity Action Plan
MID-01	States to develop their own national/organizational Cyber Security policies using ICAO model Cybersecurity Policy at attachment A	MID States	2023	CyAP 0.1
MID-02	Plan, organize and support international and regional events to promote cybersecurity in civil aviation.	MID States ICAO MID	2023 - 2024	CyAP 1.8
MID-03	Establish a governance structure in the civil aviation for ANS cybersecurity field.	MID States	2023	CyAP 2.1
MID-04	Promote coordination mechanisms between civil aviation authorities and cybersecurity authorities.	MID States	2023	CyAP 2.4
MID-05	Establishment of a civil aviation ANS cybersecurity point of contact network.	MID States	2023	CyAP 5.5
MID-06	To share cybersecurity-related information using ADCS portal	MID States	2023 - 2024	CyAP 5.2
MID-07	develop and implement capabilities and plans for civil aviation cybersecurity incident detection, analysis and response at operational level.	MID States	2023 - 2024	CyAP 6.4
MID-08	Conduct periodically ANS Cyber Resilience table top and live exercises at Regional and national levels	MID States	2023 – 2024	CyAP6.6
MID-09	Organization of ANS Cyber Sec capacity building activities (ANS Cyber Security oversight, Managing Security risks in ATM)	ICAO MID	2023 – 2024	CyAP 7.5
MID-10	Identify potential threats and vulnerabilities for ANS systems	ACS WG MID States	2023 – 2024	-

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ATTACHMENT A

ICAO MID

CNS SG/12

(Amman, Jordan, 2-4 May 2023)

State/ Org	Contact	Title	Email	Remarks
MID STATES				
Bahrain	Mr. Yaseen Hassan AlSayed	Director Air Navigation Systems Ministry of Transportation & Telecommunications	y.alsayed@mtt.gov.bh	Tel: + 973 17321187 Mob.: +973 39520025
	Ms. Sara Ebrahim Husain	Sr. Telecommunication Engineer	Sara.husain@mtt.gov.bh	Tel.: +97317321034 Mob.: +97339339487
Egypt	Mr. Ahmed Mostafa Mohamed Arman	Senior ANS Safety Oversight Inspector	Engahmed.arman@yahoo.com	Tel.: +222677617 Mob.: +201144369596
Iraq	Mr. Ibrahim Sabah Naiem	MICA Focal Point	micagcans@gcans.gov.iq	Mob.: +9647812801524
	Mr. Hayder Akram Ibrahim	Radio Communication Manager	mobilecom@gcans.gov.iq	Mob.: +9647702523146
	Mr. Mustafa Z. Abdulameer	Network & Security Specialist	mostaphazedanameer@gmail.com	Mob.: +9647816870464
	Mr. Arkan Muslim Baqer	AFTN/AMHS Engineer	muslemarkan@gmail.com	Mob.: +9647801065757
Jordan	Mrs. Neveen Askar	Head of Communication & Navigation Aids Division /Administration	n.askar@carc.gov.jo	Tel : +962 6 4892282 Mob: +962 795973591
	Mr. Sameer M. R. Abu Khadra	Chief of ANSP Design	s.abukhadra@carc.gov.jo	Mob.: +9620795680013
	Mr. Nart Bzadagh	QSMS	n.omar@carc.gov.jo	Tel.: +0796245294
	Mr. Mohamad Ahmd Rashid Al Qirem	Radar ATC	alqiremmohamad@gmail.com	Tel.: +0799876948
	Mr. Mahmoud Allahem	Director ATM	Mahmoud.allahem@carc.gov.jo	Tel. : +962798545036
	Mr. Ibrahim Faraj	Director of Technical Support	Ibrahim.Faraj@carc.gov.jo	Tel. : +962-79-5057006
	Mr. Yaser Mustafa Issa Ziad	Chief of AFS Engineering Division	Yasser.Zayyad@carc.gov.jo	Tel. : +962795781882
	Mrs. Taghreed Al-assa'ad	Chief of Comm.\ Nav division KHIA	Taghreed.Al-assad@carc.gov.jo	Tel. : +9625185717
	Mrs. Wesam Jebreen	Chief of Radar Maint dvision	Wesam.Jebreen@carc.gov.jo	Tel. : +96279012346
	Mr. Mahmoud Alkhraisha	Head Of CNS Division /Amman Airport	m.alkhraisha@carc.gov.jo	Tel. : +962-78-8586491
	Mrs. Lina Ahmad Yousef Abuawad	AFTN/AMHS System Engineer	lina.abuawwad@carc.gov.jo	Tel. : +962798110860
	Mr. Areej Said Khaled Alajou	CNS inspector	Areej.Alajow@carc.gov.jo	Tel. : +962795455067

State/ Org	Contact	Title	Email	Remarks
	Mr. Ahmad Odeh	DANS Queen Alia Airport	ahmad.odeh@carc.gov.jo	Tel. : +962796993321
	Mr. Bassam Abdulrahman Refai abed	Acting director ANS/AMMAN Civil Airport	Bassam.Abid@carc.gov.jo	Tel. : +962791451294
	Mr. Ali taleb emrazeeq	Chief of Training / ATM	Ali.taleb@carc.gov.jo	Tel. : +962799766728
	Mr. Mahmoud Hatem Ibrahem	Chief of Comm.\ Nav division QAIA	m.hatem @carc.gov.jo	Tel. : +962795212938
	Mr. Saed Odeh Abdaljaleel Al Reyahi	Air Navigation Specialist - QAIA	Saed.Reyahi@carc.gov.jo	Tel. : +962788557890
	Mr. Awni NaeemAl-mousa	Supervisor of COM/NAV Aids Section /Amman	Awni76_naeem@hotmail.com	Tel. : +962-79-5985965
	Mr. Raed Rahahleh	CNS Specialist	Raed.Rahahleh@carc.gov.jo	Tel. : +962799599759
	Mrs. Aseel Shaker Omer Abdalqader	Radar Engineer	Aseelshaker123@gmail.com	Tel.: +96264892282 Mob.: +962799506443
	Mrs. Ghada Al-faoury	Supervisor of radar main division	Ghada.Al-faoury@carc.gov.jo	Tel. : +962795984449
	Mr. Eman Abdel Qader Alkalaldeh	Chief of AFTN/AMHS	Eman. AL_kalaldeh @carc.gov.jo	Tel. : +96264892282
	Mr. Amer Mohammad Theeb Yousef	AFTN/AMHS System Engineer	amerdeeb_81@hotmail.com	Tel. : +962795093039
	Mr. Abdelnasser Mohammad Yousif Batayneh	Air Navigation Systems Specialist	a.batayneh@carc.gov.jo	Tel. : +962787469388
	Mr. Yusef.Arafat	Air Navigation technician - QAIA	Yusef.Arafat@carc.gov.jo	Tel. : +962795776068
	Mrs. Suzan.Al-taweeL	AIR Communication technician - QAIA	suzan.Al-taweel @carc.gov.jo	Tel.: +962795164074
	Mr. Mohanad Sahail Hamada Al-Essa	Air Navigation Specialist - QAIA	Mohanad.Alessa @carc.gov.jo	Tel. : +962791925917
	Mr. Omar Mohamed Salameh Hourani	ATC Supervisor	Omarhorrani943@yahoo.com	Tel.: +0798808496
	Yousef Ibrahim Ahmad Al-Aaghanai	Air Traffic Controller	Joseph-fgi@yahoo.com	Tel.: +0796839754
	Mr. Mahmoud Mohammad K. Sabrah	Director ANS –K.H.I.A	m.sabra@carc.gov.jo	Mob.: +962799732522
Oman	Mr. Said HusseinAl Balushi	Chief of Air Com	said@caa.gov.om	Mob.: +96899386366
	Mr. Mohammed Ahmed Omar Ba Abood	ANS Engineer-Act ATM System Supervisor &CNS Chief	Mohammed.baabood@caa.gov.om	Mob.: +96899278822

State/ Org	Contact	Title	Email	Remarks
Qatar	Mr Khalid Al-Muftah	Senior Electronics Engineer	khalid@caa.gov.qa	Mob.: +97455551266
	Nayif Al-Jaber	Electronics Engineer	Nayif.aljaber@caa.gov.qa	Mob.: +97433666884
	Mr. Hamad Al Dosari	Electronics Engineer	Hamad.AlDosari@caa.gov.qa	Mob.: +97455222749
Saudi Arabia	Mr. Loay Beshawri	Automation/Surveillance Engineering Manager	lbeshawri@sans.com.sa	Mob.: +966562289944
	Mr. Faisal Al Zarhrani	Automation Engineering Supervisor	fzahrani@sans.com.sa	Mob.: +966-541341000
UAE	Mr. Yousif Al Awadhi	Director CNS	yawadi@szc.gcaa.ae	Tel.: +97125996860 Mob.: +972564188799
	Mr. Hamad Mohamed Al Marzooqi	Communication Supervisor	hmalmarzooqi@szc.gcaa.ae	Mob.: +971557725551
	Mr. Ahmed Al Obeidli	Senior Manager – Air Navigation	aobaidli@gcaa.gov.ae	Tel.: +97124054410 Mob.: +971556322226
	Ms. Eman Obaid Khamis Balhaj Almarashda	ANS Specialist Engineer	emarashda@szc.gcaa.ae	Mob.: +971502116442
ORGANIZATIONS/INDUSTRIES				
IATA	Mr . Yassine El Charkaoui	Manager Operations, ATM and Infrastructure – AME	charkaouiy@iata.org	Mob.: +962 795428351
	Mr. Jehad Faqir	Head of Regional Safety-Africa and Middle East	faqirj@iata.org	Mob.: +9625804200 Ext. 1216 Mob.: +962795111238
	Mrs. Zainab Khudhair	Manager Operations, ATM and Infrastructure-AME	Khudhairz@iata.org	Mob.: +962795222602
ICAO MID STAFF				
ICAO Headquarters	Miss Fabiola Chouha	Technical Associate, ANB/ANS/CNSS	FChouha@icao.int	
ICAO-MID	Mrs. Muna Alnadaf – ICAO MID	Regional Officer, Communication, Navigation and Surveillance (RO/CNS)	malnadaf@icao.int	Tel.: + 202 22674840
	Mrs. Hoda Gabriel	Technical Assistant	hgabriel@icao.int	Tel.: + 202 22674840

-END-