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North American, Central American and Caribbean Office

WORKING PAPER

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**Thirty first MEVA Technical Management Group Meeting (MEVA/TMG/31)**  
Kingston, Jamaica, 24 to 26 May 2016

**Agenda Item 5: Results of the International Telecommunication Union World Radiocommunication Conference 2015 (ITU WRC-15)**

**RESULTS OF THE ITU WORLD RADIOCOMMUNICATION CONFERENCE 2015 (WRC-15)**

(Presented by the Secretariat)

**EXECUTIVE SUMMARY**

This working paper recalls the results from the WRC-2015 regarding ICAO Position and addresses the positive precursors and future actions by the NAM/CAR States to continue the protection of the Radiofrequency spectrum, and the conclusion adopted in the ANI/WG/3 Meeting for the VSAT registration.

<b>Action:</b>	The suggested actions are detailed in Section 3.
<i>Strategic Objectives:</i>	<ul style="list-style-type: none"><li>• Safety</li><li>• Air Navigation Capacity and Efficiency</li><li>• Economic Development of Air Transport</li><li>• Environmental Protection</li></ul>
<i>References:</i>	<ul style="list-style-type: none"><li>• ICAO AN WP/9017</li><li>• Third NAM/CAR Air Navigation Implementation Working Group Meeting (ANI/WG/3), Mexico City, Mexico, 4 to 6 April 2016</li></ul>

**1. Introduction**

1.1 The radio frequency spectrum is a scarce natural resource with finite capacity limits and for which demand is constantly increasing. The availability of the necessary radio frequency spectrum is a critical aspect for safety of civil aviation and the effective implementation of existing and future Communications, Navigation and Surveillance (CNS) and Air Traffic Management (ATM) systems.

1.2 Radio frequency spectrum congestion imposes on all users the duty of spectrum-efficient operation. The adequate allotment/assignment of frequencies for aeronautical national/international use, based on regional agreements and coordinated between States and ICAO, is an indispensable task for the optimum use of radio frequency spectrum and safety of aviation operations.

1.3 Due to the importance of this matter, States and Territories adopted:

- the ICAO Twelfth Air Navigation Conference Assembly Recommendation 1/12 (*Development of the aeronautical frequency spectrum resource*)
- Assembly Resolution A38-6 (*Support of the ICAO policy on radio frequency spectrum matters*), urging Member States, international organizations and other civil aviation stakeholders to firmly support the ICAO frequency spectrum strategy and the ICAO position at WRCs and in regional and other international activities conducted in preparation for WRCs
- the NACC/WG/4 meeting formulated related conclusion 4/5 - *Active Support from States for ICAO ITU WRC-2015 Position*
- the ANI/WG/2 meeting carried out several actions and conclusions in support to these conclusions
- the MEVA TMG adopted several conclusions for the C Band protection.

1.4 ICAO submitted the ICAO position as approved by the ICAO Council through electronic bulletin, Ref: E 3/5. 15-13/57, dated 2 July 2013.

1.5 The ITU World Radiocommunication Conference (2015) (WRC-15) was held from 2 to 27 November 2015 in Geneva, Switzerland.

## **2. Discussion**

2.1 In general, the conference results fully conformed to the ICAO Position. In order to follow up on this very positive result, ICAO will need to ensure consistency between ICAO provisions and the new radio regulatory provisions through active participation in the relevant ITU studies and the development of SARPs as appropriate.

2.2 A significant element in the ICAO preparatory activities for this conference was the early awareness and involvement of Member States in the development of the ICAO Position. Major factors contributing to this achievement included:

- a) the early development and dissemination of the draft ICAO Position by the Secretariat (Regional Offices) and the Commission;
- b) the active participation by ICAO experts in the preparatory work of the ITU, including the relevant meetings of the ITU-R (e.g. Study Groups 4 and 5, including the relevant Working Parties, and the Conference Preparatory Meeting (CPM));
- c) the active participation by ICAO experts in meetings of the regional telecommunication organizations (like CITEL). The involvement and assistance of the regional offices proved important in supporting the development of proposals by the regional telecommunication organizations to the conference which were in line with the ICAO Position;
- d) the organization of ACP and FSMP working group meetings and ICAO radio frequency workshops in the ICAO regions;
- e) the implementation of Assembly Resolution A38-6; and
- f) the active participation of the ICAO delegation at the conference itself, during which the ICAO Position was often challenged, allowed ICAO to counter and refute numerous proposals that would adversely impact aeronautical spectrum.

2.3 The results of the WRC 2015 were presented to the ANI/WG/3 Meeting, where total support was expressed by the States. A summary of the results of this conference is shown in the **Appendix**.

2.4 From this experience an expeditious start of the ICAO preparatory activities for the next conference in 2019 is now essential. The FSMP will develop an initial draft of the ICAO Position by end of 2016. A final review of the ICAO Position by the Commission, and a subsequent approval by the Council, is foreseen in 2017.

2.5 In support to the positive results of the conference for ICAO position, the ANI/WG Meeting agreed and supported the following:

- keeping the State Points of Contact (PoCs) list in support of the ICAO WRC Position for coordination and mutual support
- keeping the Regional Frequency Assignment List available for States and general public: ICAO Website: <http://www.icao.int/NACC/Pages/frequency.aspx>.

2.6 Regarding the C band VSAT Air Navigation Networks, like MEVA and CAMSAT (COCESNA), the ANI/WG recalled that the MEVA and COCESNA had been informed in previously meeting about the studies for C-band protection; and report all aeronautical VSAT interference cases to the MEVA TMG, including recording and documenting each case (refer to MEVA TMG Conclusion 26/21).

2.7 Similarly, the States in the ANI/WG emphasized to ensure the proper register of their corresponding nodes in the ITU Master International Frequency Register (MIFR), as to identify and recognise the nodes and magnitude of the networks in use for safety reasons in air navigation. Finally, considered this matter as urgent to ensure the international recognition of the Air Navigation C Band networks; agreeing in the following draft conclusion:

#### **DRAFT CONCLUSION**

##### **ANI/WG/3/XX**

##### **PROTECTION AND RECOGNITION OF C BAND SPECTRUM USAGE**

That, in order to take the technical and regulatory actions to support existing and future operation of the 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 States, NAM/CAR States take the appropriate measures in order to ensure the protection of the satellite C-band operated by the National and Regional VSAT networks:

- a) Registration of the aeronautical VSAT frequencies in the States held by the national authorities of regulation of telecommunication; and
- b) Follow-up with the concerned authorities in the States to further register the frequencies in the ITU Master International Frequency Register (MIFR) by December 2016.

**3. Suggested Action**

3.1 The Meeting is invited to:

- a) Note of the positive results of the WRC-2015 for aviation and in accordance to ICAO position (Appendix);
- b) note the list of frequency assignment kept and coordinated by the ICAO NACC Regional Office (ICAO Website): <http://www.icao.int/NACC/Pages/frequency.aspx>);
- c) act on the conclusion agreed by the ANI/WG as shown in paragraph 2.7; and
- e) take any other action as deemed necessary.

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International Civil Aviation Organization

AN-WP/9017  
21/12/15

**WORKING PAPER**

**AIR NAVIGATION COMMISSION**

**REPORT ON THE RESULTS OF THE INTERNATIONAL TELECOMMUNICATION UNION  
(ITU) WORLD RADIOCOMMUNICATION CONFERENCE (2015) (WRC-15) AND APPROVAL  
OF DRAFT REPORT TO COUNCIL  
(Item No. 20118)**

(Presented by the Director of the Air Navigation Bureau)

**SUMMARY**

This working paper presents the results of the International Telecommunication Union (ITU) World Radiocommunication Conference (2015) (WRC-15) (2 to 27 November 2015, Geneva, Switzerland).

The Secretariat, assisted by the Frequency Spectrum Management Panel (FSMP), will place a high priority on the development of the ICAO Position for the WRC-19, in full coordination with other relevant bodies, taking due account of spectrum management activities in the regions.

Action by the Air Navigation Commission is in paragraph 5.

**COORDINATION**

AMO, OPS, RPAS

**REFERENCES**

- |                           |  |
|---------------------------|--|
| AN-WP/8742                | *Doc 9718, <i>Handbook on Radio Frequency Spectrum Requirements for Civil Aviation, Volume I - ICAO spectrum strategy, policy statements and related information</i> |
| AN-Min.193-6              | Doc 10007, <i>Report of the Twelfth Air Navigation Conference (2012)</i>   |
| AN-WP/8936                | Doc 10022, <i>Assembly Resolutions in Force (as of 4 October 2013)</i>   |
| AN Min.199-3              | *Doc 10046, <i>Second High Level Safety Conference Report</i>  |
| *C-WP/14279               |  |
| *C-Min.205/5              |  |
| State letter E 3/5-13/57  |  |
| *State letter E 3/5-15/52 |  |

This working paper relates to the Strategic Objectives for Safety and Air Navigation Capacity and Efficiency.

\*Principal references

## 1. INTRODUCTION

1.1 The ITU World Radiocommunication Conference (2015) (WRC-15) was held from 2 to 27 November 2015 in Geneva, Switzerland. The ICAO delegation to the conference included D/ANB (first day), an RO/CNS, ICAO WACAF Office (first two weeks), an RO/CNS, ICAO ESAF Office (third week) and two TOs/AOI (CNS) from Headquarters (full-time).

1.2 In total, about 3 800 delegates from 162 ITU Member States and 130 other entities, including international organizations and industry, participated in the work of the conference.

1.3 Two aviation coordination meetings were organized by the ICAO delegation during the conference. Coordination and promotion of the ICAO policy during the conference was also performed on a bilateral basis, including with individuals, various industry groups and groups representing spectrum administrations.

## 2. BACKGROUND

2.1 Frequency spectrum is a finite and limited resource managed by the ITU through its WRCs held approximately every four years. Availability of the necessary radio frequency spectrum is a critical prerequisite for the safety of civil aviation and the effective implementation of the communications, navigation, and surveillance/air traffic management (CNS/ATM) systems. However, as demand for radio spectrum from non-aviation users keeps growing, aviation faces ever-increasing competition for the limited available spectrum, in particular from mobile and broadband wireless access services. It is essential that aviation requirements for radio frequency spectrum be strongly supported by all ICAO Member States in all international fora where spectrum allocations are addressed so as to ensure that aviation requirements for safety of life services are duly presented and understood.

2.2 ICAO policies and practices related to radio frequency spectrum matters are outlined in Assembly Resolution A38-6, which urges ICAO Contracting States, international organizations and other civil aviation stakeholders to support aviation requirements for spectrum and instructs ICAO to make sufficient resources available to enable increased participation in spectrum management activities.

### 2.3 **Summary of the main significant efforts made during the lead up to WRC-15**

2.3.1 Development and distribution of the ICAO Position:

- a) initially developed in 2012 by Working Group F (frequency) of the Aeronautical Communications Panel (ACP WG-F), reviewed by the Air Navigation Commission (191-7 and 193-6), approved by Council (199/4) on 27 May 2013 and sent to States (State letter E 3/5-13/57);
- b) subsequent update by the Frequency Spectrum Management Panel (FSMP) (successor to ACP WG-F) to reflect the progress of studies within ITU and the FSMP, reviewed by the Commission (199-3), approved by Council (205/5) on 17 June 2015 and sent to States (State letter E 3/5-15/52); and
- c) ICAO Position submitted to the ITU WRC-12 on 16 July 2015.

2.3.2 ICAO Secretariat preparatory activities (missions) to promote the ICAO Position and spectrum policy to secure adequate support in the preparatory work leading up to WRC-15:

- a) support of ITU-Radiocommunication Sector (ITU-R) work activities, including ITU-R Study Groups 4 and 5, Working Parties 4A, 4C, 5B, JTG-4-5-6-7, CPM-15/2, RA-15; on average eleven man-weeks per year;
- b) support of the WRC-15 preparatory activities of regional telecommunication organizations<sup>1</sup>; on average four man-weeks per year; and
- c) meetings of FSMP (previously ACP WG-F) in conjunction with frequency spectrum workshops for aviation professionals in the ICAO regional offices; on average four man weeks per year.

### 3. RESULTS OF THE CONFERENCE ON THE AGENDA ITEMS RELATED TO INTERNATIONAL CIVIL AVIATION

3.1 Details of the results of the conference on all agenda items relevant to aviation are contained in Appendix A. Appendix B contains a copy of the Radioregulatory text developed to solve agenda items 1.5, 9.1.5 and Global Flight Tracking, including the Resolution describing an aeronautical agenda item for WRC-19 on the Global Aeronautical Distress and Safety System (GADSS). In summary, the main results for civil aviation are as outlined below.

#### 3.2 WRC-15 Agenda Item 1.1 *(detailed discussion in Appendix A, paragraph 1)*

3.2.1 The demand for spectrum for mobile and broadband applications is growing at a fast pace. Under this agenda item, the telecommunications industry was seeking up to 1 200 MHz of additional spectrum in the 300 MHz to 6 GHz range for international mobile telecommunications (IMT). This frequency range includes a number of aeronautical frequency bands and several of these were examined by the conference for a potential allocation to IMT, including 2 700 – 2 900 MHz used by aeronautical primary surveillance radar (PSR) and 4.4 – 4.5 GHz which is adjacent to the aeronautical radio altimeter band at 4.2 – 4.4 GHz. The aeronautical radio altimeters constitute a critical component of the aircraft ground proximity warning system (GPWS) and are used during CAT I/II/III landings.

3.2.2 While studies in the ITU prior to the conference had indicated that sharing is not possible between PSR and IMT, ITU had performed no studies to analyse adjacent band compatibility between IMT and the radio altimeters. ICAO studies (by FSMP) prior to the conference indicated a strong potential for harmful interference to the radio altimeters by IMT. Relatively early during the conference an agreement was reached to take PSR bands out of consideration. However, 4.4 – 4.5 GHz, adjacent to the radio altimeter band was not off the table until the final days of the conference. Prompt action by ICAO, IATA and other aeronautical stakeholders during the conference and direct coordination with aviation authorities through the ICAO APAC Office was instrumental in averting this threat.

3.2.3 A favourable outcome was secured for the C-band (3.4 – 4.2 GHz), used for satellite links in the fixed satellite service (FSS) supporting aeronautical ground-ground communications, using very

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<sup>1</sup> African Telecommunication Union (ATU), Asia-Pacific Telecommunity (APT), European Conference of Postal and Telecommunications Administrations (CEPT), Inter-American Telecommunication Commission (CITEL).

small aperture terminal (VSAT) equipment, especially in Africa (Agenda Item 9.1.5 also refers) and South/Central America. The conference made no new allocations or identifications for IMT between 3.7 and 4.2 GHz. In the remainder of the C-band (less critical for aviation VSATs), the conference specified necessary conditions to protect the FSS.

### 3.3 **WRC-15 Agenda Item 1.5**

*(detailed discussion in Appendix A, paragraph 3)*

3.3.1 Existing satellite networks operating in the FSS in the frequency bands at 14/12 GHz (Ku-band) and 30/20 GHz (Ka-band) have potential spectrum capacity to meet the requirements for beyond line-of-sight communication links and could be used for the command and control (C2) of remotely piloted aircraft systems (RPAS), provided that certain principles (conditions) as indicated in the ICAO Position are fulfilled. However, the FSS is normally not recognized in the ITU as a *safety service*. State operated RPAS have been using C2 links over FSS in segregated airspaces for a number of years. Previously WRC-12 had attempted but failed to develop a solution supporting the use of FSS spectrum for RPAS in a manner satisfying the *safety and regularity of flight* requirements of civil aviation.

3.3.2 The conference agreed to new allocations in the FSS Ku and Ka frequency bands, identifying over 2.2 GHz of spectrum against a Resolution. The Resolution specifies that these frequency bands can be used for the RPAS C2 links in non-segregated airspace and any other airspace under the control of civil aviation authorities. This use is contingent on the successful development of ICAO SARPs. The Resolution goes into considerable detail to protect the current FSS environment against being disrupted by the introduction of a *safety service*. While not providing a traditional aeronautical mobile satellite (route) service, the Resolution introduces an application with *safety of life* implications into the FSS and contains language consistent with a *safety service* and appropriately referencing article **4.10** of the Radio Regulations. While ensuring the highest degree of certainty against harmful interference, to the extent possible under the conditions governing the coordination process for FSS, this approach also takes care of the moral obligation by States and spectrum users for safeguarding life in the use of the relevant frequencies. However, a part of the burden to ensure operation without harmful interference, such as real time interference monitoring and predicting interference risks, will have to be addressed in SARPs and is thus placed on the shoulders of the aeronautical regulators. Further, the Resolution requires ICAO to report on its progress in the development of SARPs for the RPAS C2 link to WRC-19 and WRC-23. This reporting should include identification of any problems in the application of the Resolution and potential means by the WRC to address those. The Resolution comes fully into force by WRC-23.

3.3.3 The delicate compromise achieved by the conference is fully in line with the ICAO Position. It provides the Remotely Piloted Aircraft Systems Panel (RPASP) with a set of conditions to develop SARPs against – or to identify showstoppers, if any. However, the implicit obligation of the ICAO work programme to fully support the required ITU studies, to enable WRC-19 and WRC-23 to fine tune the Resolution before it enters into full force in 2023, should be noted. It is expected that this work will take place within the FSMP, RPASP and other supporting panels of the Air Navigation Commission.

### 3.4 **WRC-15 Agenda Item 9.1.5**

*(detailed discussion in Appendix A, paragraph 14.2)*

3.4.1 The efficient and safe provision of air navigation services requires the implementation and operation of ground communications infrastructure with high availability, reliability and integrity. In the Africa and Indian Ocean Region, the difficulty of fulfilling these requirements, given the extent of the airspace and weakness in terrestrial communication infrastructure, led, in 1997, the ICAO AFI Planning



and Implementation Regional Group to approve the use of satellite terminals (VSAT) operating under the FSS to support terrestrial aeronautical communications services in the frequency range 3.4 – 4.2 GHz, a frequency range which remains the only viable option for satellite links with high availability in tropical regions due to the pronounced rain attenuation at higher frequency bands.

3.4.2 While the frequency band 3.4 – 3.6 GHz is allocated to the FSS, it is also allocated to the mobile service, identified for international mobile telecommunications (IMT). Aeronautical VSAT operations have experienced a number of cases of harmful interference due to lack of sufficient measures to protect them by administrations when licensing IMT or other services to co-share the band. To address this issue, the conference modified Resolution **154** to underscore the protection needs of existing and planned aeronautical and meteorological VSAT stations. The modified Resolution also highlights the need to license the VSAT stations and register them in the Master International Frequency Register (MIFR) to ensure that they are visible to all administrations concerned.

3.4.3 The modification to Resolution **154** developed by the conference is fully in line with the ICAO Position. As a follow up measure, aviation service providers operating VSAT stations should be encouraged to have their stations licensed and registered in the MIFR. It is expected that the same measures will help ameliorate similar issues currently experienced with the operation of aeronautical VSAT networks in South and Central America

### **3.5 WRC-15 Agenda Item on Global Flight Tracking for Civil Aviation and a Future Agenda Item on the Global Aeronautical Distress and Safety System**

*(detailed discussion in Appendix A, paragraphs 15 and 16)*

3.5.1 While the year 2014 represented one of aviation's safest years in terms of the number of accidents, the tragedy of Malaysia Airlines flight 370 in March 2014 highlighted vulnerabilities in the global air navigation system requiring urgent mitigation. To address these vulnerabilities, the aviation community embarked on a global effort to develop and implement a Global Aeronautical Distress and Safety System (GADSS), and forged consensus among its Member States and the international air transport industry sector on the near-term priority to track airline flights, no matter their global location or destination. The ICAO Second High-level Safety Conference 2015 (HLSC 2015) supported that ICAO should encourage States and the ITU to discuss allocation requirements at WRC-15 to provide the necessary frequency spectrum allocations to enable global air traffic services (ATS) surveillance. The HLSC 2015 also endorsed a concept of operations to support future development of the GADSS. It is envisaged that GADSS will address issues such as: aircraft tracking under normal and abnormal conditions; autonomous distress tracking; automatic deployable flight recorder; and procedures and information management.

3.5.2 The collective urgency of the situation was further highlighted by the decision of the ITU Plenipotentiary Conference (October 2014), instructing WRC-15 to include in its agenda, as a matter of urgency, the consideration of global flight tracking for civil aviation.

3.5.3 Addressing the issue of global flight tracking, WRC-15 agreed to an allocation to aeronautical mobile satellite (route) service (Earth-to-space) at 1 090 MHz, limited to the space station reception of ADS-B emissions from aircraft transmitters operating in accordance with ICAO SARPs. The new allocation has to protect the aeronautical radionavigation service under which the aircraft secondary surveillance radar transponders and distance measuring equipment operate. The ITU Radiocommunication Sector (ITU-R) has been tasked to complete studies related to the space station

reception of ADS-B, including consideration of potential interference from non-ICAO standardized systems, and to report their outcome to ICAO. This result fully accommodates the ICAO Position.

3.5.4 The conference decided on an agenda item for WRC-2019 to consider spectrum needs and regulatory provisions for the introduction and use of GADSS. ICAO is invited to participate actively in the studies by providing requirements and information that should be taken into account in the studies of ITU-R, in particular the quantification and characterization of radiocommunication requirements related to the GADSS. This outcome is fully in line with the ICAO Position.

#### 4. CONCLUSIONS

4.1 In general, the conference results fully conformed to the ICAO Position. In order to follow up on this very positive result, ICAO will need to ensure consistency between ICAO provisions and the new radioregulatory provisions through active participation in the relevant ITU studies and the development of SARPs as appropriate. In this regard, sections 3.3 and 3.5 are highlighted.

4.2 A significant element in the ICAO preparatory activities for this conference was the early awareness and involvement of Member States in the development of the ICAO Position. Major factors contributing to this achievement included:

- a) the early development and dissemination of the draft ICAO Position by the Secretariat and the Commission, assisted by the ACP and the FSMP;
- b) the active participation by ICAO experts in the preparatory work of the ITU, including the relevant meetings of the ITU-R (e.g. Study Groups 4 and 5, including the relevant Working Parties, and the Conference Preparatory Meeting (CPM));
- c) the active participation by ICAO experts in meetings of the regional telecommunication organizations (APT, CEPT, CITELE, ATU). The involvement and assistance of the regional offices proved important in supporting the development of proposals by the regional telecommunication organizations to the conference which were in line with the ICAO Position;
- d) the organization of ACP and FSMP working group meetings and ICAO radio frequency workshops in the ICAO regions;
- e) the implementation of Assembly Resolution A38-6; and
- f) the active participation of the ICAO delegation at the conference itself, during which the ICAO Position was often challenged, allowed ICAO to counter and refute numerous proposals that would adversely impact aeronautical spectrum.

4.3 An expeditious start of the ICAO preparatory activities for the next conference in 2019 is now essential. The FSMP will develop an initial draft of the ICAO Position by end of 2016. A final review of the ICAO Position by the Commission, and a subsequent approval by the Council, is foreseen in 2017.

5. **ACTION BY THE AIR NAVIGATION COMMISSION**

5.1 The Air Navigation Commission is invited to:

- a) note the conclusions in paragraph 4.1;
- b) note the information provided in paragraph 4.2;
- c) place a high priority on the development of the ICAO Position for the WRC-19, in full coordination with other relevant bodies, taking due account of spectrum management activities in the regions; and
- d) approve the attached draft information paper to Council.

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## APPENDIX A

### WRC-15 RESULTS OF RELEVANCE TO INTERNATIONAL CIVIL AVIATION

**1. Agenda Item 1.1: To consider additional spectrum allocations to the mobile service on a primary basis and identification of additional frequency bands for International Mobile Telecommunications (IMT) and related regulatory provisions, to facilitate the development of terrestrial mobile broadband applications, in accordance with Resolution 233 (WRC-12).**

1.1 The demand for spectrum for mobile and broadband applications is growing at a fast pace. Under this agenda item, the telecommunications industry was seeking up to 1 200 MHz of additional spectrum in the 300 MHz to 6 GHz range for mobile and broadband applications.

1.2 The ICAO Position was to oppose any new allocation to the mobile service for IMT in or adjacent to frequency bands used for aeronautical safety applications unless it had been demonstrated through agreed studies that there would be no impact on those applications. The ICAO Position emphasized the importance of the frequency bands 1 215 – 1 350 MHz and 2 700 – 2 900 MHz for primary surveillance radar and the frequency band 4.2 – 4.4 GHz, used by radio altimeters which are a critical component of the aircraft ground proximity warning system (GPWS) and used during CAT I/II/III landings.

1.3 Relatively early during the conference an agreement was reached to take the bands immediately above 1 350 MHz and the band 2 700 – 2 900 MHz out of consideration, thus satisfying the aeronautical concerns to protect primary surveillance radar (PSR).

1.4 Similarly, a favourable outcome was secured for the C-band (3.4 – 4.2 GHz). This band is used for satellite links in the Fixed Satellite Service (FSS) supporting aeronautical ground-ground communications, using very small aperture terminal (VSAT) equipment, especially in Africa (WRC-15 Agenda Item 9.1.5 refers) and South/Central America. The conference made no new allocations or identifications for IMT between 3.7 and 4.2 GHz. In the remainder of the frequency range (less critical for aviation VSATs), the conference identified 3.4 to 3.6 GHz to IMT for ITU Region 1, which comprises Europe, Africa, the Middle East and Russia; Region 2, which comprises the Americas; and a number of countries in Region 3, the Asia Pacific, while specifying necessary conditions to protect the FSS, through coordination. Additionally, in Region 2 a few countries identified 3.6 – 3.7 GHz for IMT, similarly while specifying necessary conditions to protect the FSS. Discussions on WRC-15 agenda items 8 and 9.1.5 also refer to this issue.

1.5 Overall, the conference was only successful in identifying less than 400 MHz for IMT on a global or regional scale. One unexpected threat to aviation emerged towards the end of the conference and involved the protection of aeronautical radio altimeters, operating in the band, 4.2 – 4.4 GHz. Several countries made a strong push to identify the adjacent frequency band 4.4 – 4.5 GHz to IMT, despite the fact that no studies had been performed within the ITU Radiocommunication sector (ITU-R) analysing adjacent band compatibility and despite the fact that preliminary studies within ICAO (FSMP) had indicated that IMT in the adjacent band would interfere with the radio altimeters. Prompt action by ICAO, IATA and other aeronautical stakeholders during the conference and direct coordination to aviation authorities through the ICAO APAC Office, was instrumental in averting the threat in the final days of the conference.

2. **Agenda Item 1.4: To consider possible new allocation to the amateur service on a secondary basis within the band 5 250 - 5 450 kHz in accordance with Resolution 649 (WRC-12).**

2.1 The ICAO Position on this agenda item was to ensure that any allocation made to the amateur service would not cause harmful interference to aeronautical systems operating under the allocation to the aeronautical mobile (R) service in the adjacent frequency band 5 450 – 5 480 kHz in Region 2. The conference allocated 5 351.5 – 5 366.5 kHz to the amateur radio service, limited to a maximum radiated power of below 25W. The new allocation provides a guard band of 83.5 kHz thus fully protecting the aeronautical mobile (R) service.

3. **Agenda Item 1.5: To consider the use of frequency bands allocated to the fixed-satellite service not subject to Appendices 30, 30A and 30B for the control and non-payload communications of unmanned aircraft systems (UAS) in non-segregated airspaces, in accordance with Resolution 153 (WRC-12).**

3.1 Existing satellite networks operating in the FSS in the unplanned frequency bands at 14/12 GHz (Ku band) and 30/20 GHz (Ka band) have potential spectrum capacity available to meet the requirements for beyond line-of-sight links communications and could be used for unmanned aircraft systems (UAS)<sup>2</sup> control and non-payload communications links (CNPC)<sup>3</sup> provided that certain principles (conditions) indicated in the ICAO Position are fulfilled. However, the FSS is normally not recognized in the ITU as a *safety service* and it should be noted that any consideration of operation of UAS CNPC under an allocation to the FSS must address an inconsistency with Article 1 definitions of the FSS (No. **1.21**) and aircraft earth station (No. **1.84**). State operated UAS have been using CNPC links over FSS in segregated airspaces for a number of years. Previously WRC-12 had attempted but failed to develop a solution supporting the use of FSS spectrum for UAS in a manner satisfying the *safety and regularity of flight* requirements of civil aviation.

3.2 The ICAO Position on this agenda item referenced recommendations of the 12th ICAO Air Navigation Conference<sup>4</sup> and the 38th ICAO Assembly<sup>5</sup> and recognized that *Unmanned aircraft systems have great potential for innovative civil applications, provided that their operation does not introduce risks to the safety of life*. Further, the ICAO Position listed three conditions that would need to be satisfied: 1) that the technical and regulatory actions be limited to the case of UAS using satellites, as studied, and not set a precedent that puts other aeronautical safety services at risk; 2) that all frequency bands which carry aeronautical safety communications be clearly identified in the ITU Radio Regulations; and 3) that the assignments and use of the relevant frequency bands be consistent with article **4.10** of the ITU Radio Regulations which recognizes that safety services require special measures to ensure their freedom from harmful interference. The ICAO Position specified that further provisions for UAS CNPC links to meet the technical and operational requirements for any specific airspace would be addressed within ICAO and provided background on four such further conditions that would need to be addressed in ICAO SARPs.

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<sup>2</sup> UAS is referred to in ICAO as Remotely Piloted Aircraft Systems (RPAS).

<sup>3</sup> CNPC is referred to in ICAO as Command and Control (C2) or Command, Control and ATC Communications (C3).

<sup>4</sup> “That ICAO ... develop and implement a comprehensive aviation frequency spectrum strategy ... which includes the following objectives: ... clearly state in the strategy the need for aeronautical systems to operate in spectrum allocated to an appropriate aeronautical safety service.”

<sup>5</sup> “That ICAO should support studies in the International Telecommunication Union Radio Communication Sector (ITU-R) to ensure that the safety of life concerns could be sufficiently addressed. The outcome of these studies would have to provide the necessary assurance that there were no undue implications for other aeronautical systems. Provided this was the case, then it could be determined what ITU regulatory actions would be required to enable use of frequency bands allocated to the fixed-satellite service (FSS) for RPAS command and control links to ensure consistency with ICAO technical and regulatory requirements for a safety service.”

3.3 The issue of using the FSS for a *safety and regularity of flight* related application poses a dilemma, as FSS is normally not considered a *safety service*. Hence the task for the conference was to find a solution which would satisfy the requirements of a *safety service* without developing additional constraints on the existing services within the frequency bands of the FSS. Needless to say, even before the conference this approach proved to be very divisive amongst aeronautical colleagues (example ref: AN Min. 193-6).

### 3.4 The FSS as a resource of spectrum and infrastructure

3.4.1 There are hundreds of satellites operating in the FSS, utilizing about 6 GHz in total in the Ku and Ka frequency bands. While under oversight by the Radio Regulators, coordination of frequency assignments in the FSS takes place to a large extent directly between the satellite operators, through the development of agreements with regard to the interference environment of their links. Amending the Radio Regulations to accommodate a traditionally allocated *safety service* within this environment, including additional safety margins, would create leverage for those satellite operators providing service for UAS on a permanent or temporary basis, thus being able to gradually taking over the frequency assignments of neighbouring satellites in orbit. Such a solution would be highly controversial and is neither supported by National Radio Regulators nor operators of satellites in the FSS.

### 3.5 FSS spectrum vis-à-vis a safety service

3.5.1 Radiocommunication services, such as the FSS are protected through the application of the rules laid out in the Radio Regulations. The application of these rules ensures freedom from harmful interference under normal conditions.

3.5.2 The Radio Regulations provide aviation with spectrum allocations suitable to accommodate *safety of life* critical applications through the provision of services such as the *aeronautical mobile satellite (route) service* (AMS(R)S). Such services are termed *safety services*. *Safety service* is a term introduced in the ITU Constitution and Convention, describing a radiocommunication service suitable for the *safeguarding of human life and property*. Safety concerns are of paramount importance when providing a CNPC link for UAS.

3.5.2.1 Safety services receive additional protection through the provision of Article **4.10** of the Radio Regulations, which states:

- No. **4.10** 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.

Application of **4.10** is traditionally provided through two means: **1)** the requirement for careful frequency assignment co-ordination to avoid *harmful interference* from taking place; **2)** swift action to clear any *harmful interference* when it happens.

3.5.2.2 The traditional means to provide **1)** above is the application of an *aviation safety margin*, an additional margin, usually of 6 dB, when determining acceptable interference margins between frequency assignments. When sharing a frequency band with a non-safety service, a de-facto consequence of the application of this requirement could be to push a traditional radiocommunication service out in case it interferes with the *safety service*. In other words, the *safety service* becomes super-primary.

3.5.3 When accessing an abundant frequency spectrum resource such as the FSS, an alternate/equivalent means to the traditional aviation safety margin is possible, to provide the additional assurance of a robust and safe link. This alternate means to provide **1)** as referred above, is the application of increased frequency bandwidth rather than increased margin for signal over interference. One application of this is to mandate the use of dual (or multiple) redundant links.

3.5.4 The application of **2)** above refers to the action by a national radioregulatory authority in case of interference, not the potential action by the provider of the link. Hence such action, even if swift, is measured in hours or days – not in seconds. While **2)** is very important to ensure swift resolution of any interference to assignments used by aeronautical communications, navigation and surveillance systems, it is clear that critical aeronautical applications operating in a satellite environment, such as the UAS CNPC link, will have to rely on dual or multiple redundant frequency assignments.

3.5.5 One additional issue that a clear and unambiguous allocation to a *safety service* ensures is the one of moral responsibility by the National Administration and the frequency user to not cause harm to human life or property by a wilful or grossly negligent act. While this aspect is not directly addressed through assignment of frequencies through the technical application of the provisions contained in the Radio Regulations, it is nevertheless a very important factor.

### 3.6 Solution agreed by WRC-15

3.6.1 The conference agreed to an allocation by footnote to a number of FSS frequency bands identifying over 2.2 GHz in the Ku and Ka bands against an associated Resolution (**COM4/5**). These allocations can be used for the UAS CNPC link in non-segregated airspaces and any other airspaces under the control of civil aviation authorities, in accordance with ICAO SARPs. The allocations are contingent on the successful development of ICAO SARPs under the conditions specified in the Resolution.

3.6.2 Resolution (**COM4/5**) presents a carefully formulated and delicate balance to introduce an application with safety of life implications into the FSS. Although not providing a traditional AMS(R)S service, the Resolution contains language consistent with a *safety service* and references No. **4.10** of the Radio Regulations, while also carefully protecting the current FSS environment. In addition, the Resolution specifies more stringent coordination procedures than those normally required for FSS assignments. While this approach ensures the highest level of care in the coordination of relevant FSS assignments and takes care of the moral obligation by National Administrations and frequency users to safeguard human life and property in the use of the relevant frequencies, this solution places part of the burden of ensuring interference free operation, such as real time interference monitoring and predicting interference risks, on the shoulders of the aeronautical regulators. To address inconsistencies with Article 1 definitions, a new class of station will be defined.

3.6.3 Further, the Resolution requires ICAO to report on its progress in the development of SARPs for the UAS CNPC link to WRC-19 and WRC-23. This reporting should include identification of any problems in the application of the Resolution and potential means by the WRC to address those. The Resolution comes fully into force by WRC-23.

3.6.4 The delicate compromise achieved by the conference is in line with the three conditions of the ICAO Position as well as the four additional conditions provided in the background to the ICAO Position. It provides the Remotely Piloted Aircraft Systems Panel (RPASP) with a set of conditions to develop SARPs against – or to identify showstoppers, if any. The implicit obligation of the ICAO work programme to fully support the required ITU studies, to enable WRC-19 and WRC-23 to fine tune the Resolution before it enters into full force in 2023, should be noted. It is expected that this work will take

place within the Frequency Spectrum Management Panel (FSMP), the Remotely Piloted Aircraft Systems Panel (RPASP) and other supporting panels of the Air Navigation Commission.

4. **Agenda Item 1.6: To consider possible additional primary allocations:**

- to the fixed-satellite service (Earth-to-space and space-to-Earth) of 250 MHz in the range between 10 GHz and 17 GHz in Region 1;
- to the fixed-satellite service (Earth-to-space) of 250 MHz in Region 2 and 300 MHz in Region 3 within the range 13 – 17 GHz;

and review the regulatory provisions on the current allocations to the fixed-satellite service within each range, taking into account the results of ITU-R studies, in accordance with Resolutions 151 (WRC-12) and 152 (WRC-12), respectively.

4.1 The ICAO Position on this agenda item was to oppose any new FSS allocation within the frequency bands 13.25 – 13.4 and 15.4 – 15.7 GHz, which contain allocations for the aeronautical radionavigation service. In support of this agenda item, the conference agreed on allocations outside of those highlighted to be of concern in the ICAO Position.

5. **Agenda Item 1.7: To review the use of the band 5 091 – 5 150 MHz by the fixed-satellite service (Earth-to-space) (limited to feeder links of the non-geostationary mobile-satellite systems in the mobile-satellite service) in accordance with Resolution 114 (Rev.WRC-12).**

5.1 Under this agenda item the conference considered the removal of a date limit to an allocation of the FSS within the frequency band 5 091 – 5 150 MHz, shared with the aeronautical radionavigation service (microwave landing systems) and the aeronautical mobile (route) service (AeroMACS, a WiMAX system for aeronautical safety communications at the airport surface).

5.2 The ICAO position was to support the removal of the date limit, while also asking for improved flexibility in the access to the frequency band by the aeronautical services (improvement in the flexibility to manage the allowed FSS satellite noise temperature increase by the aeronautical radionavigation and the aeronautical mobile (route) services operating in this frequency band). The outcome of the conference is fully in line with the ICAO position.

6. **Agenda Item 1.10: To consider spectrum requirements and possible additional spectrum allocations for the mobile-satellite service in the Earth-to-space and space-to-Earth directions, including the satellite component for broadband applications, including International Mobile Telecommunications (IMT), within the frequency range from 22 GHz to 26 GHz, in accordance with Resolution 234 (WRC-12).**

6.1 The ICAO Position on this agenda item was to oppose any new mobile-satellite service allocation unless it had been demonstrated through agreed studies that there would be no impact on aviation use in the 24.25 – 24.65 GHz bands in Regions 2 and 3. No new allocation was made by the conference in support of this agenda item.

7. **Agenda Item 1.11: To consider a primary allocation for the Earth exploration-satellite service (Earth-to-space) in the 7 - 8 GHz range, in accordance with Resolution 650 (WRC-12).**

7.1 The ICAO Position on this agenda item was to oppose any new allocation to the earth exploration service in the frequency band 8 750 – 8 850 MHz, unless agreed studies showed no impact to



aviation use. The conference allocated 7 190 – 7 250 MHz under this agenda item, hence no impact on aviation.

**8. Agenda Item 1.12: To consider an extension of the current worldwide allocation to the Earth exploration-satellite (active) service in the frequency band 9 300 – 9 900 MHz by up to 600 MHz within the frequency bands 8 700 – 9 300 MHz and/or 9 900 – 10 500 MHz, in accordance with Resolution 651 (WRC-12).**

8.1 The ICAO Position on this agenda item was to oppose any new allocation to the earth exploration-satellite service (EESS) in the frequency band 9 000 – 9 200 MHz, as it has been demonstrated through agreed studies that EESS would impact aviation use and place constraints on the use of the frequency band by the aeronautical systems. WRC-15 agreed to a solution which included allocations to the EESS in the bands 9 200 – 9 300 and 9 900 – 10 400 MHz. These new allocations will not affect aeronautical services.

**9. Agenda Item 1.16: To consider regulatory provisions and spectrum allocations to enable possible new Automatic Identification System (AIS) technology applications and possible new applications to improve maritime radiocommunication in accordance with Resolution 360 (WRC-12).**

9.1 The maritime automatic identification systems are fitted in search and rescue (SAR) aircraft to allow co-ordination of SAR activities in which both ships and aircraft are involved. Hence, the ICAO Position was to ensure that any change to the regulatory provisions and spectrum allocations resulting from this agenda item would not adversely impact the capability of SAR aircraft to effectively communicate with ships during disaster relief operations.

9.2 The conference developed a solution which facilitates the implementation of a VHF data exchange system (VDES) for ships and identified certain VHF channels in the maritime mobile service for VDES and other application specific messages. The solution protects existing AIS and is fully in line with the ICAO Position.

**10. Agenda Item 1.17: To consider possible spectrum requirements and regulatory actions, including appropriate aeronautical allocations, to support wireless avionics intracommunications (WAIC), in accordance with Resolution 423 (WRC-12).**

10.1 The aerospace industry continues to develop new commercial aircraft to provide airlines and the flying public with more cost-efficient and environmentally friendly air transportation while maintaining required levels of safety and reliability. One important means of accomplishing these aims is to reduce overall aircraft weight, e.g. by reducing wiring, while providing multiple and redundant methods to transmit safety-related information within and on an aircraft. The utilization of wireless technologies is one potential method of accomplishing these goals thus providing environmental benefits such as reduction of carbon footprints as well as cost savings to manufacturers and operators.

10.2 In line with results of ICAO and ITU-R studies prior to the conference, the ICAO Position on this agenda item was to support a global aeronautical mobile (route) service allocation in the radio altimeter frequency band (4 200 - 4 400 MHz), exclusively reserved for WAIC systems operating in accordance with recognized international aeronautical standards.

10.3 Fully in line with the ICAO Position, the conference allocated the frequency band 4 200 - 4 400 MHz to the aeronautical mobile (route) service, exclusively reserved for WAIC, operating

in accordance with international aeronautical standards. The associated Resolution (**COM4/1**) requires that the WAIC systems protect the operation of the radio altimeters and operate in accordance with SARPs as contained in Annex 10 to the ICAO Convention. It is expected that standardization work will be initiated within RTCA and/or EUROCAE before development of SARPs commences within ICAO.

**11. Agenda Item 1.18: Allocation of the band 77.5 – 78 GHz to the radiolocation service to support automotive short-range high-resolution radar operations.**

11.1 This agenda item was devised by WRC-12 to facilitate high resolution radar applications for the automotive industry.

11.2 As aircraft have become larger, the ability of the pilot to accurately taxi an aircraft around a busy airport has become more difficult and incidents of aircraft colliding with other objects on the airport have become more common. A potential solution to this issue would be to use off-the-shelf automotive radar located in the wing tips of aircraft to detect other ground objects that may be in the path of the taxiing aircraft. Hence the ICAO Position was to support the allocation of the frequency band 77.5 – 78 GHz to the radiolocation service in such a way as not to preclude its use on an advisory basis by taxiing aircraft.

11.3 Concerns by other users of this frequency band, namely the amateur, amateur satellite and the radio astronomy service were addressed by limiting a new allocation to “automotive and other ground based applications”. While the new allocation is not conditional, the ITU Radiocommunication Sector has been tasked with further studies to assist administrations in ensuring compatibility between the incumbent services.

11.4 The new allocation enables use of this frequency band for wing tip radars on aircraft, operational only while the aircraft is not airborne. This solution is fully in line with the ICAO Position.

**12. Agenda Item 4: In accordance with Resolution 95 (Rev. WRC-07), to review the Resolutions and Recommendations of previous conferences with a view of possible revision, replacement or abrogation.**

12.1 The following Resolutions were addressed in a manner different from the ICAO Position:

12.1.1 Resolution **18** relates to the procedure for identifying and announcing the position of ships and aircraft of States which are not party to an armed conflict. A minor update was made to this Resolution, removing a reference to Radiotelegraphy. This does not affect aviation.

12.1.2 Resolution **28** addresses revision of references to the text of ITU-R recommendations incorporated by reference in the Radio Regulations. A minor update was made to a *considering*, reflecting the most recent version of Resolution **27** (WRC-12). This does not affect aviation.

12.1.3 Resolution **114** addresses the compatibility between the ARNS and the FSS, 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. An update was made to this resolution reflecting the solution made by the conference under agenda item 1.7. This is fully in line with the ICAO Position.

12.1.4 Resolution **154** considers the technical and regulatory actions in order to support existing and future operation of the 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. An update was made to this Resolution as referred in the section on WRC-15 agenda item 9.1.5, contained in this appendix. This update solves agenda item 9.1.5, in line with the ICAO Position.

12.1.5 Resolution **205** addresses the protection of systems operating in the mobile-satellite service in the band 406 – 406.1 MHz, limited to the use of low-power satellite emergency position-indicating radiobeacons (EPIRBs). Modifications to this Resolution request Administrations not to make new frequency assignments in a guard band of 100 kHz around the allocation of 406 – 406.1 MHz, used for COSPAS-SARSAT. This fully satisfies the concerns expressed in the ICAO Position. Agenda item 9.1.1 refers.

12.1.6 Resolution **207** discusses measures to address unauthorized use of and interference to frequencies in the frequency bands allocated to the maritime mobile service and to the aeronautical mobile (route) service. Minor modifications were made to this resolution, reflecting the abrogation of No. **5.129** by WRC-07. This update has no consequence for aviation.

12.1.7 Resolution **360** considers regulatory provisions and spectrum allocations to the maritime mobile-satellite service to enable the satellite component of the VHF Data Exchange System and enhanced maritime radiocommunication. This resolution was updated in line with agenda item 1.16 of the conference. The updates have no negative consequences for aviation.

12.1.8 Resolution **417** addresses the use of the frequency band 960 – 1 164 MHz by the aeronautical mobile (route) service. reference to Recommendation ITU-R M.2013, describing the characteristics of non-ICAO standardized ARNS systems operated in certain States was updated to reflect the latest version of this Recommendation. No implications have been identified as a result of this update.

12.1.9 Resolution **418** addresses the use of the frequency band 5 091 – 5 250 MHz by the aeronautical mobile service for telemetry applications. A reference to Resolution **748** was updated to reflect the latest version of this Resolution. No implications have been identified as a result of this update.

12.1.10 Resolution **608** addresses use of the frequency band 1 215 – 1 300 MHz by systems of the radionavigation satellite service (space-to-Earth). Additions were made to the *noting* part of the Resolution, to include references to relevant Recommendations of the ITU Radiocommunication Sector. These updates help to further protect the radionavigation satellite service and are fully compatible with the ICAO Position.

12.1.11 Resolution **705** considers mutual protection of radio services operating in the frequency band 70 – 130 kHz. The previous version of this Resolution, as developed in 1987, contained a request to States, ITU Council and international organizations, including ICAO, for further studies and provision of information. This request has been suppressed. No implications are identified as a result of this update.

12.1.12 Resolution **748** addresses compatibility between the aeronautical mobile (route) service and the fixed satellite service (Earth-to-space) in the frequency band 5 091 – 5 150 MHz. In line with the solution achieved under agenda item 1.7, updates were made to the Resolution, removing a reference to max aggregate interference limit by the aeronautical mobile service and the aeronautical mobile (route) service and updating references to relevant Recommendations of the ITU Radiocommunication Sector, as incorporated by reference. This is fully in line with the ICAO Position.

12.2 Recommendation **75** calls for a study of the boundary between the out-of-band and spurious domains of primary radars using magnetrons. Minor updates, no implications identified.

13. **Agenda Item 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-07).**

13.1 Footnotes **5.181**, **5.197** and **5.259** were introduced in about twenty countries in 1987 in view of the foreseen global transition from ILS to MLS and were intended to enable the introduction of the mobile service in the ILS bands as and when these would no longer be required for ILS. However, it has been apparent for a while that a global transition to MLS is not taking place as originally foreseen and that ILS will continue to be used by aviation for the foreseeable future. Therefore the existence of these footnotes is no longer justified. Most administrations have already removed their name from these footnotes at previous conferences, however, a few countries still remain. No names were removed during the conference.

13.2 Footnotes **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, those allocations should be deleted. Some country names were removed from these footnotes during the conference, but about 20 country names still remain.

13.3 The band 1 215 – 1 300 MHz is used by civil aviation in a large number of countries for the provision of radionavigation services (primary radar) through footnote No. **5.331**. Footnote No. **5.330** also allocates the band in a number of countries to the fixed and mobile service. Given the receiver sensitivity of aeronautical uses of the band, ICAO does not support the continued inclusion of an additional service through country footnotes. Over 30 countries remain in this footnote.

13.4 The ICAO Position supported the deletion of footnotes **5.362B** and **5.362C** which allocated the GNSS band 1 559 – 1 610 MHz on a secondary basis to the (terrestrial) fixed service in certain countries until 1 January 2015. Continued use by the fixed service would constitute a severe constraint on the safe and effective use of GNSS in some areas of the world, as coordination distances of up to 400 km between the stations of the fixed service and the aircraft would be required. These footnotes were deleted by the conference, thus providing better worldwide protection of GNSS.

13.5 In the frequency band 3 400 – 4 200 MHz, the existing allocation to the FSS (space-to-Earth) is used to provide aeronautical VSAT service (see discussion under agenda items 1.1 and 9.1.5). Prior to WRC-15, Footnote No. **5.430A** allocated this band also to the mobile service in a number of States in Region 1, including Africa, subject to coordination to protect the FSS. The ICAO Position for WRC-15, was to recommend African States to withdraw their names from this footnote as there have been instances of the FSS not being protected sufficiently in spite of the conditions specified in the footnote. The conference amended this footnote making it into a generic one, applicable to all of Region 1. This result is not strictly in line with the ICAO Position. This is not considered a major issue however, as the footnote calls for coordination under No. **9.21** and provides protection values for the FSS, and should be seen in context with modifications to Resolution **154**, discussed under agenda item 9.1.5 which support stricter adherence to the conditions of No. **5.430A**.

13.6 The band 4 200 – 4 400 MHz is reserved for use by airborne radio altimeters. Footnote No. **5.439** allows the operation of the fixed service in this band on a secondary basis. Radio altimeters are a critical element in aircraft automatic landing systems and serve as a sensor in ground proximity warning

systems. The ICAO Position recommends deletion of this footnote. Iran (Islamic Republic of) is the one single country remaining in this footnote.

**14. Agenda Item 9.1: To consider and approve the Report of the Director of the Radiocommunication Bureau, in accordance with Article 7 of the Convention: On the activities of the Radiocommunication Sector since WRC-12.**

**14.1 Sub-item 1 (9.1.1): Resolution 205 – Protection of the systems operating in the mobile-satellite service in the band 406 –406.1 MHz.**

14.1.1 Emergency locating transmitters (ELT) are an element of the COSPAS-SARSAT system. Mandatory carriage of ELTs for aircraft is specified in Annex 6 to the ICAO Convention and SARPs for ELTs are contained in Annex 10. The ICAO Position on this agenda item was to support increased protection of the COSPAS-SARSAT system in the frequency band 406 – 406.1 MHz.

14.1.2 The conference modified Resolution **205**, addressing the protection of COSPAS-SARSAT. The modified provisions request Administrations not to make new frequency assignments in a guard band of 100 kHz around the allocation of 406 – 406.1 MHz, used for COSPAS-SARSAT. This fully satisfies the concerns expressed in the ICAO Position.

**14.2 Sub-item 5 (9.1.5): 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 (Resolution 154 (WRC-12)).**

14.2.1 The efficient provision of air navigation services requires the implementation and operation of ground communications infrastructure with high availability, reliability and integrity in order to fulfil aviation performance requirements. In the Africa and Indian Ocean Region, the difficulty of fulfilling these requirements, given the extent of the airspace and weakness in terrestrial communication infrastructure, led, in 1997, the ICAO AFI Planning and Implementation Regional Group to approve the use of fixed satellite technology (VSAT) operating under the Fixed Satellite Service (FSS) to support terrestrial aeronautical communications services in the frequency range 3.4 – 4.2 GHz. In tropical regions, due to more pronounced rain attenuation at higher frequency bands, this frequency range remains the only viable option for satellite links with high availability.

14.2.2 The ICAO Position under this agenda item was to support possible technical and regulatory protection of VSATs used for the transmission of aeronautical and meteorological information in the frequency range 3.4 – 4.2 GHz from other services operating in frequency bands within the same or adjacent frequency range.

14.2.3 While the frequency band 3.4 – 3.6 GHz is allocated to the FSS on a Primary basis, it is also allocated to the Mobile service, identified for International Mobile Telecommunications (IMT), through Footnote No. **5.430A**. This footnote requires that use by the IMT is coordinated under No. **9.21** and that the power flux-density received by the satellite terminals does not exceed a harmful value at the border of States which are not party to such coordination. Prior to this conference, No. **5.430A** was limited to certain countries in Region 1, including a large number of countries in Africa, now it has been changed into a generic footnote applicable to all of Region 1.

14.2.4 The main difficulty that aeronautical VSAT operations have been facing is the lack of sufficient measures to protect them by National Administrations when licensing IMT or other services to

co-share the band. This has resulted in a number of cases where harmful interference to aeronautical VSATs has occurred. To address this issue, the conference modified Resolution **154**.

14.2.5 Resolution **154** (WRC-15) highlights the requirement that Administrations in certain countries of Region 1 where the frequency band 3.4 – 3.6 GHz is allocated on a primary basis for use by the IMT, ensure compliance of those IMT stations with the relevant provisions of No. **5.430A** addressing the protection needs of existing and planned aeronautical and meteorological VSAT stations in this frequency band, used as an aid to the safe operation of aircraft and reliable distribution of meteorological information. The Resolution highlights the need to license the VSAT stations and register them in the ITU Master International Frequency Register (MIFR), to ensure that they are visible to all Administrations concerned.

14.2.6 The modification to Resolution **154** developed by the conference is fully in line with the ICAO Position. As a follow-up measure, aviation service providers operating VSAT stations for the transmission of aeronautical and meteorological information should be encouraged to have their stations licensed and registered in the MIFR. It is expected that the same measures will help ameliorate similar issues, currently experienced with the operation of aeronautical VSAT networks in South and Central America

14.3 **Sub-item 6 (9.1.6): Resolution 957 – Studies towards review of the definitions of *fixed service, fixed station and mobile station*.**

14.3.1 The definitions in the Radio Regulations for *fixed service, fixed station and mobile station* are indirectly related to aeronautical services and hence any change of these definitions could have an impact on the interpretation of the definition of aeronautical mobile services. Hence the ICAO Position was to ensure that any change to the definitions would not adversely impact aviation. The conference did not make any modification to these definitions, an outcome fully in line with the ICAO Position.

15. **Global Flight Tracking, Resolution 185 (Busan, 2014): To instruct WRC-15, pursuant to No. 119 of the ITU Convention, to include in its agenda, as a matter of urgency, the consideration of global flight tracking, including, if appropriate, and consistent with ITU practices, various aspects of the matter, taking into account ITU-R studies.**

15.1 One of the reasons why aviation has consistently improved upon its levels of safety and efficiency over the decades has been its willingness to invest significant effort and resources to learn important lessons – even from rare events. While the year 2014 represented one of aviation’s safest years in terms of the number of accidents, the tragedy of Malaysia Airlines flight 370 in March 2014 highlighted vulnerabilities in the global air navigation system requiring urgent mitigation. In order to address these vulnerabilities, the aviation community embarked in a global effort to develop and implement a Global Aeronautical Distress and Safety System (GADSS) encompassing all phases of flight under all circumstances, including distress.

15.2 Upon the completion of a Special Meeting on Global Flight Tracking of Aircraft in Montréal, May 2014, ICAO forged consensus among its Member States and the international air transport industry sector on the near-term priority to track airline flights, no matter their global location or destination. The ICAO Second High-level Safety Conference 2015 (HLSC 2015) held from 2 to 5 February 2015 noted existing technologies such as automatic dependent surveillance – contract (ADS-C) and future technologies that could support flight tracking in oceanic and remote airspace such as satellite-based ADS – broadcast (ADS-B). In this regard, the HLSC 2015 supported that ICAO should

encourage States and the ITU to discuss allocation requirements at WRC-15 to provide the necessary frequency spectrum allocations to enable global air traffic services (ATS) surveillance.

15.3 The issue of Global Flight Tracking was not on the initial agenda for WRC-15, however, the 2014 Plenipotentiary Conference of the ITU (PP-14, October 2014) adopted Resolution **185** (Busan, 2014), instructing WRC-15, pursuant to No. **119** of the ITU Convention, “to include in its agenda, as a matter of urgency, the consideration of global flight tracking, including, if appropriate, and consistent with ITU practices, various aspects of the matter, taking into account ITU-R studies”.

15.4 Global Flight Tracking is a fundamental component of the GADSS. One technology enabler for Global Flight Tracking builds on ADS-B, an existing technology already in use, whereby aircraft broadcast position reports at 1 090 MHz. In principle ADS-B provides all the information required for GFT. The only component missing is satellite reception, to provide the ability to receive those transmissions in remote, oceanic and polar regions, where flight tracking needs are most acute.

15.5 An important advantage of the satellite reception of ADS-B is that it leverages existing aircraft system capabilities without requiring additional transmitters or transmissions. Another important advantage of this technology is that due to already published mandates, commercial aircraft will be required to carry ADS-B before 2020.

15.6 1 090 MHz is a highly loaded frequency. It used by the Secondary Surveillance Radar (SSR) transponder on-board commercial aircraft. An additional function of the SSR transponder is to transmit the aircraft position twice every second (ADS-B). Another function of the transponder involves the Aircraft Collision Avoidance System. In addition, in certain parts of the world, due to congestion in the Distance Measuring Equipment (DME) band (960 – 1 215 MHz), DMEs have been assigned to adjacent frequencies, potentially close enough to cause interference at 1 090 MHz. The frequency 1 090 MHz is also used by certain aeronautical military systems.

15.7 The issue of Global Flight Tracking proved to be quite controversial during deliberations in the ITU Radiocommunication Sector prior to the conference (ITU-R WP5B, CPM15-2). The reasons for this can be said to be mainly threefold: 1) the unusual addition of the issue to the agenda of WRC-15 by an ITU Plenipotentiary Conference (Assembly) and the potential precedence this may cause for future WRCs; 2) concerns by spectrum users, incumbent services and otherwise, that the addition of this service, without complete studies might have unforeseen consequences; and 3) the very short study period before the conference.

15.7.1 Studies within ICAO (FSMP and Surveillance Panel) and other studies submitted to ITU prior to and during the conference helped alleviate concerns about consequences to other users around 1 090 MHz, the potential usefulness of the system and difficulties in its operation in the presence of interference from other users around 1 090 MHz. One relevant factor is that the aircraft transmits its position report through ADS-B twice per second, however, for successful tracking of the aircraft only a very low number of those transmissions are required to be received by the satellite. Submitted studies indicated that the system may provide useful performance in high density traffic areas, (better than one ADS-B position message received per minute) while performance in remote areas with lower traffic densities would be much better.

## 15.8 ICAO Position and solution agreed by WRC-15

15.8.1 As a follow-up action to the outcome of the HLSC 2015, the ICAO Position on this agenda item was developed by FSMP and the Air Navigation Commission and approved by Council in

June 2015. The position was to support consideration of all possible options for support of ICAO global flight tracking as supported by studies, including a new provision in the Earth-to-space direction only for an aeronautical mobile satellite (route) service allocation at 1 090 MHz for the satellite reception of existing aircraft ADS-B signals operating in accordance with ICAO SARPs and under the condition that it not constrain existing aeronautical safety systems.

15.8.2 The conference agreed to an allocation by footnote to the aeronautical mobile satellite (route) service (Earth-to-space) at 1 090 MHz and an associated new Resolution (**COM4/2**), limiting the allocation to the space station reception of ADS-B emissions from aircraft transmitters operating in accordance with ICAO SARPs. The new allocation has to protect the existing allocation to the aeronautical radionavigation service under which the aircraft SSR transponders and the DME operate. In addition, the associated Resolution contains language to protect existing military applications at 1 090 MHz. The ITU Radiocommunication Sector has been tasked to complete studies related to the space station reception of ADS-B, including consideration of non-ICAO standardized systems, and to report their outcome to ICAO. This result fully accommodates the ICAO Position.

16. **Agenda Item 10: To recommend to the Council items for inclusion in the agenda for the next WRC, and to give its views on the preliminary agenda for the subsequent conference and on possible agenda items for future conferences, in accordance with Article 7 of the Convention.**

16.1 Upon the completion of a Special Meeting on Global Flight Tracking of Aircraft in Montréal, May 2014, ICAO forged consensus among its Member States and the international air transport industry sector on the near-term priority to track airline flights, no matter their global location or destination. While concluding that global flight tracking should be pursued as a matter of urgency the development of a concept of operations to support future development of a Global Aeronautical Distress and Safety System (GADSS) was also initiated. While this work is still ongoing, it is envisaged that the GADSS will address issues such as:

- Aircraft tracking under normal and abnormal conditions
- Autonomous distress tracking
- Automatic deployable flight recorder
- Procedures and information management

16.2 The collective urgency of the situation was highlighted by the decision of the ITU Plenipotentiary Conference (October 2014), through Resolution **185**, to instruct WRC-15 to include in its agenda, as a matter of urgency, the consideration of global flight tracking. With respect to the GADSS however, while the systems needed have yet to be fully defined, it is anticipated that there will be a need to change the Radio Regulations in order to facilitate their introduction. Therefore the ICAO Position proposed an agenda item be established for WRC-2019, flexible enough to address any required changes to the Radio Regulations necessary to allow the implementation of the GADSS.

16.3 The conference decided on an agenda item for WRC-2019, “to consider spectrum needs and regulatory provisions for the introduction and use of the Global Aeronautical Distress and Safety System (GADSS)...” and an associated new Resolution (**COM6/11**). ICAO is invited to participate actively in the studies by providing requirements and information that should be taken into account in the studies of the ITU Radiocommunication Sector, in particular the quantification and characterization of radiocommunication requirements related to GADSS. This outcome is fully in line with the ICAO Position.



## 17. Agenda for WRC-19

17.1 A preliminary review of the draft agenda for WRC-19 has identified the items below as potentially being of interest to aviation:

**1.8** to consider possible regulatory actions to support Global Maritime Distress Safety Systems (GMDSS) modernization and to support the introduction of additional satellite systems into the GMDSS, in accordance with Resolution **359 (Rev.WRC-15)**;

**1.9** to consider, based on the results of ITU-R studies:

**1.9.1** regulatory actions within the frequency band 156-162.05 MHz for autonomous maritime radio devices to protect the GMDSS and automatic identifications system (AIS), in accordance with Resolution **COM6/10 (WRC-15)**;

**1.9.2** modifications of the Radio Regulations, including new spectrum allocations to the maritime mobile-satellite service (Earth-to-space and space-to-Earth), preferably within the frequency bands 156.0125-157.4375 MHz and 160.6125-162.0375 MHz of Appendix **18**, to enable a new VHF data exchange system (VDES) satellite component, while ensuring that this component will not degrade the current terrestrial VDES components, applications specific messages (ASM) and AIS operations and not impose any additional constraints on existing services in these and adjacent frequency bands as stated in *recognizing d) and e)* of Resolution **360 (Rev.WRC-15)**;

**1.10** to consider spectrum needs and regulatory provisions for the introduction and use of the Global Aeronautical Distress and Safety System (GADSS), in accordance with Resolution **COM6/11 (WRC-15)**;

**1.12** to consider possible global or regional harmonized frequency bands, to the maximum extent possible, for the implementation of evolving Intelligent Transport Systems (ITS) under existing mobile-service allocations, in accordance with Resolution **COM6/13 (WRC-15)**;

**1.13** to consider identification of frequency bands for the future development of International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution **COM6/20 (WRC-15)**;

**1.14** to consider, on the basis of ITU-R studies in accordance with Resolution **COM6/21 (WRC-15)**, appropriate regulatory actions for high-altitude platform stations (HAPS), within existing fixed-service allocations;

**1.16** to consider issues related to wireless access systems, including radio local area networks (WAS/RLAN), in the frequency bands between 5 150 MHz and 5 925 MHz, and take the appropriate regulatory actions, including additional spectrum allocations to the mobile service, in accordance with Resolution **COM6/22 (WRC-15)**;

**4** in accordance with Resolution **95 (Rev.WRC-07)**, to review the resolutions and recommendations of previous conferences with a view to their possible revision, replacement or abrogation;

**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-07)**;

**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-15;

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**APPENDIX B**

**Radioregulatory amendments and additions by WRC-15**

relevant to

**WRC-15 Agenda Items 1.5, 9.1.5, Global Flight Tracking for Civil Aviation**

and

**WRC-19 Agenda Item 1.10 on GADSS**

**WRC-15 Agenda Item 1.5: To consider the use of frequency bands allocated to the fixed-satellite service not subject to Appendices 30, 30A and 30B for the control and non-payload communications of unmanned aircraft systems (UAS) in non-segregated airspaces, in accordance with Resolution 153 (WRC-12)**

**MOD**<sup>#35333</sup>

**10-11.7 GHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>10.7-10.95</b> FIXED FIXED-SATELLITE (space-to-Earth) 5.441 (Earth-to-space) 5.484 MOBILE except aeronautical mobile	<b>10.7-10.95</b> FIXED FIXED-SATELLITE (space-to-Earth) 5.441 MOBILE except aeronautical mobile	
<b>10.95-11.2</b> FIXED FIXED-SATELLITE (space-to-Earth) 5.484A ADD 5.A15 (Earth-to-space) 5.484 MOBILE except aeronautical mobile	<b>10.95-11.2</b> FIXED FIXED-SATELLITE (space-to-Earth) 5.484A ADD 5.A15 MOBILE except aeronautical mobile	
<b>11.2-11.45</b> FIXED FIXED-SATELLITE (space-to-Earth) 5.441 (Earth-to-space) 5.484 MOBILE except aeronautical mobile	<b>11.2-11.45</b> FIXED FIXED-SATELLITE (space-to-Earth) 5.441 MOBILE except aeronautical mobile	

<p><b>11.45-11.7</b> FIXED FIXED-SATELLITE (space-to-Earth) 5.484A (Earth-to-space) 5.484 <b>ADD 5.A15</b> MOBILE except aeronautical mobile</p>	<p><b>11.45-11.7</b> FIXED FIXED-SATELLITE (space-to-Earth) 5.484A <b>ADD 5.A15</b> MOBILE except aeronautical mobile</p>
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**MOD**#35334

11.7-14 GHz

Allocation to services		
Region 1	Region 2	Region 3
<p><b>11.7-12.5</b> FIXED MOBILE except aeronautical mobile BROADCASTING BROADCASTING-SATELLITE 5.492</p>	<p><b>11.7-12.1</b> FIXED 5.486 FIXED-SATELLITE (space-to-Earth) 5.484A 5.488 <b>ADD 5.A15</b> Mobile except aeronautical mobile 5.485</p>	<p><b>11.7-12.2</b> FIXED MOBILE except aeronautical mobile BROADCASTING BROADCASTING-SATELLITE 5.492</p>
	<p><b>12.1-12.2</b> FIXED-SATELLITE (space-to-Earth) 5.484A 5.488 <b>ADD 5.A15</b> 5.485 5.489</p>	
	<p><b>12.2-12.7</b> FIXED MOBILE except aeronautical mobile BROADCASTING BROADCASTING-SATELLITE 5.492</p>	
<p><b>12.5-12.75</b> FIXED-SATELLITE (space-to-Earth) 5.484A <b>ADD 5.A15</b> (Earth-to-space)</p>	<p>5.487A 5.488 5.490</p> <p><b>12.7-12.75</b> FIXED FIXED-SATELLITE (Earth-to-space) MOBILE except aeronautical mobile</p>	<p><b>12.2-12.5</b> FIXED FIXED-SATELLITE (space-to-Earth) <b>ADD 5.A15</b> MOBILE except aeronautical mobile BROADCASTING 5.487 5.484A</p> <p><b>12.5-12.75</b> FIXED FIXED-SATELLITE (space-to-Earth) 5.484A <b>ADD 5.A15</b> MOBILE except aeronautical mobile BROADCASTING-SATELLITE 5.493</p>

MOD#35335

## 14-15.4 GHz

Allocation to services		
Region 1	Region 2	Region 3
<b>14-14.25</b>	FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B 5.484A 5.506 5.506B <b>ADD 5.A15</b> RADIONAVIGATION 5.504 Mobile-satellite (Earth-to-space) 5.504B 5.504C 5.506A Space research 5.504A 5.505	
<b>14.25-14.3</b>	FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B 5.484A 5.506 5.506B <b>ADD 5.A15</b> RADIONAVIGATION 5.504 Mobile-satellite (Earth-to-space) 5.504B 5.506A 5.508A Space research 5.504A 5.505 5.508	
<b>14.3-14.4</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B 5.484A 5.506 5.506B <b>ADD 5.A15</b> MOBILE except aeronautical mobile Mobile-satellite (Earth-to-space) 5.504B 5.506A 5.509A Radionavigation-satellite 5.504A	<b>14.3-14.4</b> FIXED-SATELLITE (Earth-to-space) 5.457A 5.484A 5.506 5.506B <b>ADD 5.A15</b> Mobile-satellite (Earth-to-space) 5.506A Radionavigation-satellite  5.504A	<b>14.3-14.4</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.457A 5.484A 5.506 5.506B <b>ADD 5.A15</b> MOBILE except aeronautical mobile Mobile-satellite (Earth-to-space) 5.504B 5.506A 5.509A Radionavigation-satellite 5.504A
<b>14.4-14.47</b>	FIXED FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B 5.484A 5.506 5.506B <b>ADD 5.A15</b> MOBILE except aeronautical mobile Mobile-satellite (Earth-to-space) 5.504B 5.506A 5.509A Space research (space-to-Earth) 5.504A	

MOD<sup>#33320</sup>

18.4-22 GHz

Allocation to services		
Region 1	Region 2	Region 3
<p><b>19.7-20.1</b> FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B ADD 5.5X ADD 5.A15 Mobile-satellite (space-to-Earth)  5.524</p>	<p><b>19.7-20.1</b> FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B ADD 5.5X ADD 5.A15 MOBILE-SATELLITE (space-to-Earth) 5.524 5.525 5.526 5.527 5.528 5.529</p>	<p><b>19.7-20.1</b> FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B ADD 5.5X ADD 5.A15 Mobile-satellite (space-to-Earth)  5.524</p>
<p><b>20.1-20.2</b> FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B ADD 5.5X ADD 5.A15 MOBILE-SATELLITE (space-to-Earth) 5.524 5.525 5.526 5.527 5.528</p>		

MOD<sup>#33321</sup>

24.75-29.9 GHz

Allocation to services		
Region 1	Region 2	Region 3
<p><b>29.5-29.9</b> FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 ADD 5.5X ADD 5.A15 Earth exploration-satellite (Earth-to-space) 5.541 Mobile-satellite (Earth-to-space)  5.540 5.542</p>	<p><b>29.5-29.9</b> FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 ADD 5.5X ADD 5.A15 MOBILE-SATELLITE (Earth-to-space) Earth exploration-satellite (Earth-to-space) 5.541  5.525 5.526 5.527 5.529 5.540</p>	<p><b>29.5-29.9</b> FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 ADD 5.5X ADD 5.A15 Earth exploration-satellite (Earth-to-space) 5.541 Mobile-satellite (Earth-to-space)  5.540 5.542</p>

MOD<sup>#33322</sup>

29.9-34.2 GHz

Allocation to services		
Region 1	Region 2	Region 3
<p><b>29.9-30</b> FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 ADD 5.5X ADD 5.A15 MOBILE-SATELLITE (Earth-to-space) Earth exploration-satellite (Earth-to-space) 5.541 5.543 5.525 5.526 5.527 5.538 5.540 5.542</p>		

**ADD**

**5.A15** Resolution [COM4/5] (WRC-15) shall apply. (WRC-15)

**ADD**<sup>#35455</sup>

**RESOLUTION COM4/5 (WRC-15)**

**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\***

The World Radiocommunication Conference (Geneva, 2015),

*considering*

- a) that the operation of unmanned aircraft systems (UAS) requires reliable control and non-payload communication (CNPC) links, in particular to relay air traffic control communications and for the remote pilot to control the flight;
- b) that satellite networks may be used to provide CNPC links of UAS beyond the line-of-sight, as shown in Annex 1;
- c) that CNPC links between space stations and stations on board unmanned aircraft (UA) are proposed to be operated under this resolution in the primary fixed-satellite service (FSS) in frequency bands shared with other primary services, including terrestrial services, however that would not preclude the use of other available allocations to accommodate this application,

*considering further*

- a) that UAS CNPC links relate to the safe operation of UAS and have to comply with certain technical, operational and regulatory requirements,

*noting*

- a) that this conference has adopted Resolution **COM5/2** on the use of earth stations in motion communicating with geostationary FSS space stations in the frequency bands 19.7-20.2 GHz and 29.5-30.0 GHz;
- b) that Report ITU-R M.2171 provides information on characteristics of UAS and spectrum requirements to support their safe operation in non-segregated airspace,

*recognizing*

- a) that the UAS CNPC links will operate in accordance with international standards and recommended practices and procedures established in accordance with the Convention on International Civil Aviation;
- b) that, in this resolution, conditions are provided for operations of CNPC links without prejudging whether the International Civil Aviation Organization (ICAO) would be able to develop standards and recommended practices to ensure safe operation of UAS under these conditions,

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\* May also be used consistent with international standards and practices approved by the responsible civil aviation authority.

*resolves*

- 1 that assignments to stations of geostationary FSS satellite networks operating in the frequency bands 10.95-11.2 GHz (space-to-Earth), 11.45-11.7 GHz (space-to-Earth), 11.7-12.2 GHz (space-to-Earth) in Region 2, 12.2-12.5 GHz (space-to-Earth) in Region 3, 12.5-12.75 GHz (space-to-Earth) in Regions 1 and 3 and 19.7-20.2 GHz (space-to-Earth), and in the frequency bands 14-14.47 GHz (Earth-to-space) and 29.5-30.0 GHz (Earth-to-space), may be used for UAS CNPC links in non-segregated airspace\*, provided that the conditions specified in *resolves* below are met;
- 2 that earth stations in motion on board UA may communicate with the space station of a geostationary FSS satellite network operating in the frequency bands listed in *resolves* 1 above, provided that the class of the earth station in motion on board UA is matched with the class of the space station and that other conditions of this resolution are met (see also *instructs the Director of the Radiocommunication Bureau* 3 below);
- 3 that the frequency bands specified in *resolves* 1 shall not be used for the UAS CNPC links before the adoption of the relevant international aeronautical standards and recommended practices (SARPs) consistent with Article 37 of the Convention on International Civil Aviation, taking into account *instructs the Director of the Radiocommunication Bureau* 4;
- 4 that administrations responsible for an FSS network providing UA CNPC links shall apply the relevant provisions of Articles 9 (necessary provisions need to be identified or developed) and 11 for the relevant assignments, including, as appropriate, assignments to the corresponding space station, specific and typical earth station and earth station in motion on board UA, including the request for publication in BR IFIC of items referred to in *resolves* 2 and the course of actions identified in that *resolves* in order to obtain international rights and recognition as specified in Article 8;
- 5 that earth stations of UAS CNPC links shall operate within the notified and recorded technical parameters of the associated satellite network, including specific or typical earth stations of the geostationary FSS satellite network(s) as published by the Radiocommunication Bureau;
- 6 that earth stations of UAS CNPC links shall not cause more interference to, or claim more protection from, other satellite networks and systems than specific or typical earth stations as indicated in *resolves* 5 as published by the Bureau;
- 7 that, in order to apply *resolves* 6 above, administrations responsible for the FSS network to be used for UAS CNPC links shall provide the level of interference for the reference assignments of the network used for CNPC links upon request by an administration authorizing the use of UAS CNPC links within its territory;
- 8 that earth stations of UAS CNPC links of a particular FSS network shall not cause more interference to, or claim more protection from, stations of terrestrial services than specific or typical earth stations of that FSS network as indicated in *resolves* 5 that have been previously coordinated and/or notified under relevant provisions of Articles 9 and 11;
- 9 that the use of assignments of a FSS satellite network for UAS CNPC links shall not constrain other FSS satellite networks during the application of the provisions of Articles 9 and 11;
- 10 that the introduction of UAS CNPC links shall not result in additional coordination constraints on terrestrial services under Articles 9 and 11;
- 11 that earth stations on board UA shall be designed and operated so as to be able to accept the interference caused by terrestrial services operating in conformity with the Radio Regulations in the frequency bands listed in *resolves* 1 without complaints under Article 15;

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\* May also be used consistent with international standards and practices approved by the responsible civil aviation authority.



12 that earth stations on board UA shall be designed and operated so as to be able to operate with interference caused by other satellite networks resulting from application of Articles 9 and 11;

13 that, in order to ensure safety-of-flight operation of UAS, administrations responsible for operating UAS CNPC links shall:

- ensure that the use of UAS CNPC links be in accordance with the international standards and recommended practices (SARPs) consistent with Article 37 of the Convention on International Civil Aviation;
- take the required measures, consistent with No. 4.10, to ensure freedom from harmful interference to earth stations on board UA operated in accordance with this resolution;
- act immediately when their attention is drawn to any such harmful interference, as freedom from harmful interference to UAS CNPC links is imperative to ensure their safe operation, taking into account *resolves* 11;
- use assignments associated with the FSS networks for UAS CNPC links (see Figure 1 in Annex 1), including assignments to space stations, specific or typical earth stations and earth stations on board UA (see *resolves* 2), that have been successfully coordinated under Article 9 (including provisions identified in *resolves* 4) and recorded in the Master International Frequency Register (MIFR) with a favourable finding under Article 11, including Nos. 11.31, 11.32 or 11.32A where applicable, and except those assignments that have not successfully completed coordination procedures under No. 11.32 by applying Appendix 5 § 6.d.i;
- ensure that real-time interference monitoring, estimation and prediction of interference risks and planning solutions for potential interference scenarios are addressed by FSS operators and UAS operators with guidance from aviation authorities;

14 that, unless otherwise agreed between the administrations concerned, UA CNPC earth stations shall not cause harmful interference to terrestrial services of other administrations (see also Annex 2);

15 that, in order to implement *resolves* 14 above, power flux-density hard limits need to be developed for UAS CNPC links; one possible example of such provisional limits to protect the fixed service is provided in Annex 2; subject to agreement between the administrations concerned, that annex may be used for the implementation of this resolution;

16 that the power flux-density hard limits provided in Annex 2 shall be reviewed and, if necessary, revised by the next conference;

17 that, in order to protect the radio astronomy service in the frequency band 14.47-14.5 GHz, administrations operating UAS in accordance with this resolution in the frequency band 14-14.47 GHz within line-of-sight of radio astronomy stations are urged to take all practicable steps to ensure that the emissions from the UA in the frequency band 14.47-14.5 GHz do not exceed the levels and percentage of data loss given in the most recent versions of Recommendations ITU-R RA.769 and ITU-R RA.1513;

18 to consider the progress obtained by ICAO in the process of preparation of SARPs for UAS CNPC links, to review this resolution at WRC-23, taking into account the results of the implementation of Resolution COM5/2 (WRC-15), and to take necessary actions as appropriate;

19 that ITU Radiocommunication Sector (ITU-R) studies on technical, operational and regulatory aspects in relation to the implementation of this resolution shall be completed, together with the adoption of relevant ITU-R Recommendations defining the technical characteristics of CNPC links and conditions of sharing with other services,

*resolves to encourage administrations*

1 to provide the relevant information where available in order to facilitate the application of *resolves 6*;

2 to participate actively in the studies referred to in *invites ITU-R* by submitting contributions to ITU-R,

*resolves further to invite the 2023 World Radiocommunication Conference*

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,

*invites ITU-R*

to conduct, as a matter of urgency, relevant studies of technical, operational and regulatory aspects in relation to the implementation of this resolution,

*instructs the Director of the Radiocommunication Bureau*

1 to examine the relevant part of this resolution requiring actions to be taken by administrations to implement this resolution, with a view to sending it to administrations and posting it on the ITU website;

2 to present to subsequent WRCs a progress report relating to the implementation of this resolution;

3 to define a new class of station in order to be able to process satellite network filings submitted by administrations for earth stations providing UA CNPC links, after the resolution is implemented, in accordance with this resolution, and publish the information as referred in *resolves 4*;

4 not to process satellite network filing submissions by administrations with a new class of a station for earth stations providing UA CNPC links before *resolves 1-12 and 14-19* of this resolution are implemented;

5 to report to subsequent WRCs on the progress made by ICAO on the development of SARPs for UAS CNPC links,

*instructs the Secretary-General*

to bring this resolution to the attention of the Secretary-General of ICAO,

*invites the International Civil Aviation Organization*

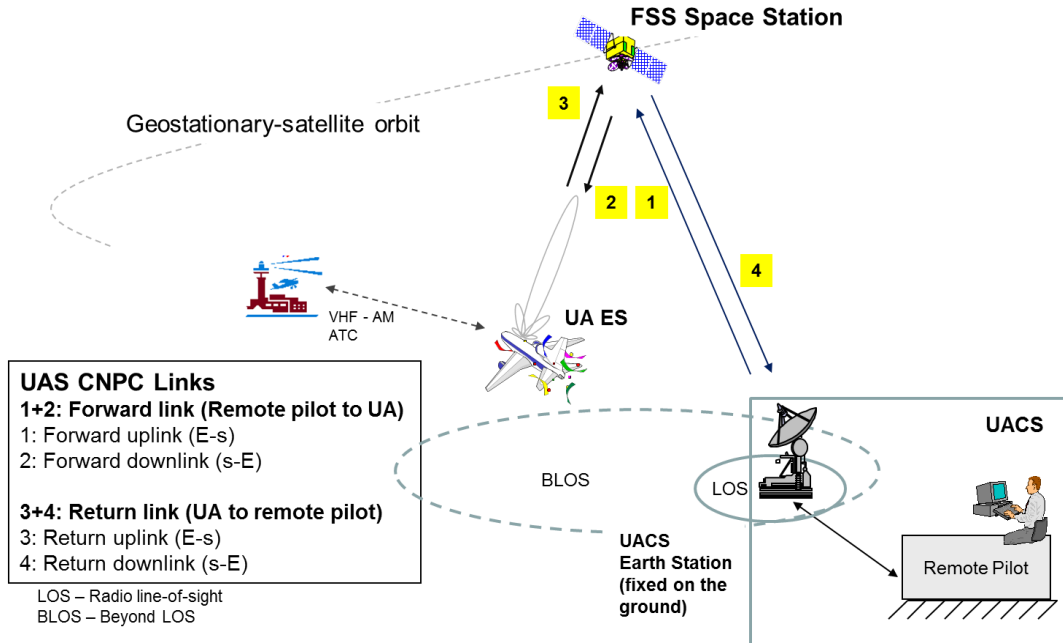
to provide to the Director of the Radiocommunication Bureau, in time for WRC-19 and WRC-23, information on ICAO efforts regarding implementation of UAS CNPC links, including the information related to the development of SARPs for UAS CNPC links.

ANNEX 1 TO RESOLUTION COM4/5 (WRC-15)

**UAS CNPC links**

FIGURE 1

Elements of UAS architecture using the FSS



ANNEX 2 TO RESOLUTION COM4/5 (WRC-15)

**Protection of the fixed service from UAS CNPC emissions**

The fixed service is allocated by table entries and footnotes in several countries with co-primary status with FSS. Conditions of UA using CNPC shall be such that the fixed service is protected from any harmful interference as follows:

An earth station on board UA in the frequency band 14.0-14.47 GHz shall comply with provisional power flux-density (pfd) limits described below:

$$\begin{array}{llll}
 -132 + 0.5 \cdot \theta & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} & \theta \leq 40^\circ \\
 -112 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} & 40 < \theta \leq 90^\circ
 \end{array}$$

where  $\theta$  is the angle of arrival of the radio-frequency wave (degrees above the horizontal).

*Note. — The aforementioned limits relate to the pfd and angles of arrival that would be obtained under free-space propagation conditions.*

**WRC-15 Agenda Item 9.1, sub-item 5 (9.1.5): 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 (Resolution 154 (WRC-12))**

MOD<sup>#32608</sup>

## RESOLUTION 154 (REV.WRC-15)

### **Consideration of technical and regulatory actions in order to support existing and future operation of fixed-satellite service earth stations within the frequency 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**

The World Radiocommunication Conference (Geneva, 2015),

*considering*

- a) that the frequency band 3 400-4 200 MHz is allocated worldwide to the fixed-satellite service (FSS) in the space-to-Earth direction and to the fixed service on a primary basis;
- b) that the frequency band 3 400-3 600 MHz is allocated on a primary basis to the mobile, except aeronautical mobile, service and identified for International Mobile Telecommunications (IMT) in Region 1 countries as specified in Article 5 of the Radio Regulations;
- c) that in Region 1, the allocation to the mobile, except aeronautical mobile, service in the frequency band 3 400-3 600 MHz is subject to technical and regulatory conditions aimed at ensuring compatibility with co-primary services of neighbouring countries;
- d) that a number of developing countries rely, to a great extent, on FSS systems using very small aperture terminals (VSAT) in the frequency band 3 400-4 200 MHz for the provision of communications as an aid to safe operation of aircraft and reliable distribution of meteorological information;
- e) that, in some cases, where an adequate terrestrial communication infrastructure is not available, VSAT networks referred to in *considering d)* above are the only viable option to augment the communication infrastructure in order to satisfy the overall communications infrastructure requirements of the International Civil Aviation Organization (ICAO) and to ensure distribution of meteorological information under the auspices of the World Meteorological Organization (WMO);
- f) that the relevant ITU Radiocommunication Sector (ITU-R) studies showed a potential for interference from fixed wireless access and IMT stations into FSS receiving earth stations at distances from less than one kilometre up to hundreds of kilometres, depending on the parameters and deployment of stations of these services;
- g) that WRC-12, taking into account the studies mentioned in *considering f)* above, decided to study technical and regulatory measures to support the FSS earth stations referred to in *considering e)* above,

*noting*

- a) that, by the date of this conference, several cases of harmful interference to the FSS VSATs used for aeronautical safety communications from fixed wireless access or IMT stations were reported;

- b) that these reported cases of interference indicated difficulties that some administrations have encountered in the coordination of frequencies between the fixed wireless access or IMT systems and frequency assignments for VSATs used for aeronautical and meteorological purposes;
- c) that, in many countries, FSS VSAT earth stations are not subject to individual licensing and not registered as specific stations in their national frequency databases and in the ITU Master International Frequency Register (MIFR) due to the considerable administrative work involved;
- d) that knowledge of the location and operational frequencies of VSAT stations used for communications as an aid to the safe operation of aircraft and/or distribution of meteorological information is critically important for ensuring compatibility with applications of other services,

*recognizing*

- a) that ITU-R conducted comprehensive studies of compatibility between FSS on the one hand and fixed wireless access systems and IMT applications on the other hand in the frequency band 3 400-4 200 MHz, and summarized the results of the studies in Recommendation ITU-R SF.1486 as well as Reports ITU-R S.2199, ITU-R M.2109 and ITU-R S.2368;
- b) that the Recommendation and Reports identified in *recognizing a)* offer a set of mitigation techniques that could be employed for international coordination and at a national level and to facilitate coexistence of FSS, fixed service and mobile service systems;
- c) that Recommendation ITU-R S.1856 contains methodologies for verification of compliance with the relevant power flux-density (pfd) limit set forth in the Radio Regulations,

*resolves*

- 1 to recommend that administrations in countries where the frequency band 3 400-3 600 MHz is allocated on a primary basis to the mobile, except aeronautical mobile, service in Region 1 and identified for IMT in Region 1 ensure compliance of IMT stations with the relevant provisions set forth in the Radio Regulations and apply the relevant coordination procedures before bringing these applications into use;
- 2 to urge administrations in Region 1, when planning and/or licensing fixed point-to-point, fixed wireless access and IMT systems in frequency bands referred to in *considering b)* above, to take into account the protection needs of existing and planned FSS earth stations within the frequency 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;
- 3 to invite administrations in Region 1, taking into account the number of earth stations involved for this particular type of usage, to consider the possibility of licensing the FSS earth stations used for communications as an aid to the safe operation of aircraft and/or distribution of meteorological information on an individual basis and registering them in the MIFR as specific earth stations;
- 4 to encourage administrations in Region 1 to employ the appropriate mitigation techniques described in the ITU-R publications referred to in *recognizing a)* above;
- 5 to invite administrations to ensure that the application of these technical and regulatory measures to FSS and the mobile service does not limit the use of the frequency band 3 400-4 200 MHz by other existing and planned systems and services in other countries,

*instructs the Secretary-General*

to bring this resolution to the attention of ICAO and WMO.

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**WRC-15 Agenda Item on Global Flight Tracking, Resolution 185 (Busan, 2014): To instruct WRC-15, pursuant to No. 119 of the ITU Convention, to include in its agenda, as a matter of urgency, the consideration of global flight tracking, including, if appropriate, and consistent with ITU practices, various aspects of the matter, taking into account ITU-R studies**

**MOD**<sup>#31087</sup>

**890-1 300 MHz**

Allocation to services	
<b>960-1 164</b>	AERONAUTICAL MOBILE (R) 5.327A AERONAUTICAL RADIONAVIGATION 5.328 ADD 5.A25

**ADD**<sup>#31088</sup>

**5.A25** *The frequency band 1 087.7-1 092.3 MHz is also allocated to the aeronautical mobile-satellite (R) service (Earth-to-space) on a primary basis, limited to the space station reception of Automatic Dependent Surveillance-Broadcast (ADS-B) emissions from aircraft transmitters that operate in accordance with recognized international aeronautical standards. Stations operating in the aeronautical mobile-satellite (R) service shall not claim protection from stations operating in the aeronautical radionavigation service. Resolution COM4/2 (WRC-15) shall apply. (WRC-15)*

**ADD**<sup>#31089</sup>

### RESOLUTION COM4/2 (WRC-15)

#### **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**

The World Radiocommunication Conference (Geneva, 2015),

*considering*

- a)* that Resolution 185 (Busan, 2014) of the Plenipotentiary Conference instructed WRC-15, pursuant to No. 119 of the ITU Convention, to include in its agenda, as a matter of urgency, the consideration of global flight tracking, including, if appropriate, and consistent with ITU practices, various aspects of the matter, taking into account ITU-R studies;
- b)* that the frequency band 960 - 1 164 MHz is allocated to the aeronautical radionavigation service (ARNS) and the aeronautical mobile (R) service (AM(R)S);
- c)* that the frequency band 960 - 1 164 MHz is used by International Civil Aviation Organization (ICAO) standardized and non-ICAO systems, thus creating a complex interference environment;
- d)* that Automatic Dependent Surveillance-Broadcast (ADS-B) is defined by ICAO, and involves aircraft transmission of data such as identification and position;

- e) that the frequency band 1 087.7 - 1 092.3 MHz is currently utilized for terrestrial transmission and reception of ADS-B signals in accordance with ICAO standards, involving transmissions from aircraft to terrestrial stations on the ground within line-of-sight;
- f) that this conference allocated the frequency band 1 087.7-1 092.3 MHz to the aeronautical mobile-satellite (R) service (AMS(R)S) in the Earth-to-space direction, limited to the space station reception of ADS-B emissions from aircraft transmitters that operate in accordance with recognized international aeronautical standards;
- g) that the allocation of the frequency band 1 087.7-1 092.3 MHz to AMS(R)S is to extend reception of currently transmitted ADS-B signals beyond terrestrial line-of-sight, to facilitate reporting the position of ADS-B equipped aircraft located anywhere in the world;
- h) that, taking into account *considering c)*, use of the frequency band 1 087.7-1 092.3 MHz requires some administrations to control all users to ensure proper operation of all terrestrial systems,

*recognizing*

- a) that ICAO develops Standards and Recommended Practices (SARPs) for systems enabling position determination and tracking of aircraft;
- b) that Annex 10 to the Convention on International Civil Aviation contains SARPs for terrestrial ADS-B usage of the frequency band 1 087.7-1 092.3 MHz,

*noting*

that the development of performance criteria for space station reception of ADS-B operating under the provisions of No. **5.A25**, including whether such criteria would require modifications to ICAO standard ADS-B equipment, is the responsibility of ICAO,

*resolves*

- 1 that the use of the frequency band 1 087.7 - 1 092.3 MHz by AMS(R)S systems shall be in accordance with recognized international aeronautical standards;
- 2 that AMS(R)S systems (Earth-to-space) in the frequency band 1 087.7 - 1 092.3 MHz shall be designed so that they can operate in the interference environment as described in *considering c)*;
- 3 that, taking into account *resolves 2*, AMS(R)S use of the frequency band 1 087.7 - 1 092.3 MHz shall not constrain administrations which have responsibilities as referred to in *considering h)*,

*invites the ITU Radiocommunication Sector*

to complete, as a matter of urgency, the studies related to the space station reception of ADS-B in the frequency band 1 087.7 - 1 092.3 MHz,

*further invites the International Civil Aviation Organization*

to continue to participate in the studies,

*instructs the Secretary-General*

to bring this resolution to the attention of ICAO and communicate the results of the studies when available.

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**Agenda Item for WRC-19 supporting the Global Aeronautical Distress and Safety System:**

**1.10** to consider spectrum needs and regulatory provisions for the introduction and use of the Global Aeronautical Distress and Safety System (GADSS), in accordance with Resolution COM6/11 (WRC-15);

**ADD**<sup>#34293</sup>

**RESOLUTION COM6/11 (WRC-15)**

**Studies on spectrum requirements and regulatory provisions for the introduction and use of the Global Aeronautical Distress and Safety System**

The World Radiocommunication Conference (Geneva, 2015),

*considering*

- a) that the International Civil Aviation Organization (ICAO) has developed the initial version of the concept of operations for the Global Aeronautical Distress and Safety System (GADSS);
- b) that GADSS is intended to address the timely identification and location of an aircraft during all phases of flight as well as distress and emergency situations;
- c) that GADSS is intended to use existing and new applications to support search and rescue (SAR) and flight data retrieval;
- d) that GADSS is intended to include terrestrial and satellite components supporting different terrestrial and space applications;
- e) that not all requirements in the concept of operation for GADSS are currently fulfilled by existing technologies;
- f) that future systems based on new technologies are being developed to contribute to fully meeting the GADSS requirements;
- g) that, as stated by ICAO, “the full GADSS concept can be realized in an evolutionary manner”, and some applications may be developed after 2019;
- h) that the performance-based elements of the GADSS are still being defined by ICAO, and should be provided by ICAO in time to use them in ITU Radiocommunication Sector (ITU-R) studies;
- i) that the introduction of the GADSS needs to ensure the protection of, and impose no additional constraints on, all existing services,

*recognizing*

- a) that there are provisions in the Radio Regulations, including frequency band allocations, related to aeronautical services that support distress and safety systems;
- b) that Annex 10 to the Convention on International Civil Aviation is a part of International Standards and Recommended Practices (SARPs) for aeronautical telecommunication systems used by international civil aviation,



*noting*

that the concept of operations and requirements for GADSS is general, its components and applications currently provide only scenarios, and it is being developed in an evolutionary manner in ICAO,

*resolves to invite the 2019 World Radiocommunication Conference*

- 1 to take appropriate actions, taking into account the results of ITU-R studies;
- 2 to analyse the necessity for further studies, and consider whether this matter should be brought to the attention of a future competent conference,

*invites the ITU Radiocommunication Sector*

1 to conduct the relevant studies, taking into account information and requirements provided by ICAO for both the terrestrial and satellite components, including:

- a) quantification and characterization of radiocommunication requirements related to GADSS, such as:
    - data traffic requirements for different system components of GADSS (such as the aircraft tracking, autonomous distress and flight data recovery systems) and their terrestrial and satellite components at each phase of the operation;
    - information on the radiocommunication requirement related to safety-of-life applications;
    - performance criteria for terrestrial and satellite systems;
  - b) analysis of the existing allocations to the relevant aeronautical services and determining whether any additional spectrum is required;
  - c) studies on sharing and/or compatibility with the existing services;
- 2 to undertake studies of the existing regulatory provisions to determine whether it might be necessary to apply additional regulatory measures,

*invites the International Civil Aviation Organization*

to participate actively in the studies by providing requirements and information that should be taken into account in ITU-R studies, in particular those mentioned in *invites the ITU Radiocommunication Sector 1 a)*,

*instructs the Secretary-General*

to bring this resolution to the attention of the ICAO, the International Air Transport Association (IATA) and the International Maritime Organization (IMO).

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International Civil Aviation Organization

**WORKING PAPER**

C-WP/xxxxx  
xx/x/16  
(Information paper)

**COUNCIL — 207TH SESSION**

**Subject No. 14.3.9: Communications**

**REPORT ON THE RESULTS OF THE INTERNATIONAL TELECOMMUNICATION UNION  
(ITU) WORLD RADIOCOMMUNICATION CONFERENCE (2015) (WRC-15)**

(Presented by the President of the Air Navigation Commission)

**EXECUTIVE SUMMARY**

This paper presents the results of the International Telecommunication Union (ITU) World Radiocommunication Conference (2015) (WRC-15) (2 to 27 November 2015, Geneva, Switzerland).

In general the conference results conformed to the ICAO Position. An expeditious start of the ICAO preparatory activities for the next conference in 2019 is now essential.

The Air Navigation Commission recommends that Council note the conclusions in paragraph 4.

<i>Strategic Objectives:</i>	This information paper relates to the Strategic Objectives of Safety and Air Navigation Capacity and Efficiency.
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<i>Financial implications:</i>	There is a cost to the necessary engagement by States and industry on the issue.
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<i>References:</i>	C-WP/14279 C-Min.205/5 AN-WP/9017 AN Min. 201-x Doc 9718, <i>Handbook on Radio Frequency Spectrum Requirements for Civil Aviation, Volume I – ICAO spectrum strategy, policy statements and related information</i> Doc 10007, <i>Report of the Twelfth Air Navigation Conference (2012)</i> Doc 10022, <i>Assembly Resolutions in Force</i> (as of 4 October 2013) Doc 10046, <i>Second High Level Safety Conference 2015 Report</i> State letter E 3/5-13/57 State letter E 3/5-15/52
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**1. INTRODUCTION**

1.1 On [D] January 2016, the Air Navigation Commission (AN Min. 201-x) conducted its review of the results of the International Telecommunication Union (ITU) World Radiocommunication Conference (2015) (WRC-15).

1.2 The ITU WRC-15 was held from 2 to 27 November 2015 in Geneva, Switzerland. The ICAO delegation to the conference included D/ANB (first day), an RO/CNS, ICAO WACAF Office (first two weeks), an RO/CNS, ICAO ESAF Office (third week) and two TOs/AOI (CNS) from Headquarters (full-time).

1.3 In total, about 3 800 delegates from 162 ITU Member States and 130 other entities, including international organizations and industry, participated in the work of the conference.

1.4 Two aviation coordination meetings were organized by the ICAO delegation during the conference. Coordination and promotion of the ICAO policy during the conference was also performed on a bilateral basis, including individuals, various industry groups and groups representing spectrum administrations.

## 2. BACKGROUND

2.1 Frequency spectrum is a finite and limited resource managed by the ITU through its WRCs held approximately every four years. Availability of the necessary radio frequency spectrum is a critical prerequisite for the safety of civil aviation and the effective implementation of the communications, navigation, and surveillance/air traffic management (CNS/ATM) systems. However, as demand for radio spectrum from non-aviation users keeps growing, aviation faces ever-increasing competition for the limited available spectrum, in particular from mobile and broadband wireless access services. It is essential that aviation requirements for radio frequency spectrum be strongly supported by all ICAO Member States in all international fora where spectrum allocations are addressed so as to ensure that aviation requirements for safety of life services are duly presented and understood.

2.2 ICAO policies and practices related to radio frequency spectrum matters are outlined in Assembly Resolution A38-6, which urges ICAO Contracting States, international organizations and other civil aviation stakeholders to support aviation requirements for spectrum and instructs ICAO to make sufficient resources available to enable increased participation in spectrum management activities.

### 2.3 Summary of the main significant efforts made during the lead up to WRC-15

2.3.1 Development and distribution of the ICAO Position:

- a) initially developed in 2012 by Working Group F (frequency) of the Aeronautical Communications Panel (ACP WG-F), reviewed by the Air Navigation Commission (191-7 and 193-6), approved by Council (199/4) on 27 May 2013 and sent to States (State letter E 3/5-13/57);
- b) subsequent update by the Frequency Spectrum Management Panel (FSMP) (successor to ACP WG-F) to reflect the progress of studies within ITU and the FSMP, reviewed by the Commission (199-3), approved by Council (205/5) on 17 June 2015 and sent to States (State letter E 3/5-15/52); and
- c) ICAO Position submitted to the ITU WRC-12 on 16 July 2015.

2.3.2 ICAO Secretariat preparatory activities (missions) to promote the ICAO Position and spectrum policy to secure adequate support in the preparatory work leading up to WRC-15:

- a) support of ITU-Radiocommunication Sector (ITU-R) work activities, including ITU-R Study Groups 4 and 5, Working Parties 4A, 4C, 5B, JTG-4-5-6-7, CPM-15/2, RA-15; on average eleven man-weeks per year;

- b) support of the WRC-15 preparatory activities of regional telecommunication organizations<sup>6</sup>; on average four man-weeks per year; and
- c) meetings of FSMP (previously ACP WG-F) in conjunction with frequency spectrum workshops for aviation professionals in the ICAO regional offices; on average four man weeks per year.

### **3. RESULTS OF THE CONFERENCE ON THE AGENDA ITEMS RELATED TO INTERNATIONAL CIVIL AVIATION**

3.1 Details of the results of the conference on all agenda items relevant to aviation are contained in Appendix A. Appendix B contains a copy of the Radioregulatory text developed to solve agenda items 1.5, 9.1.5 and Global Flight Tracking, including the Resolution describing an aeronautical agenda item for WRC-19 on the Global Aeronautical Distress and Safety System (GADSS). In summary, the main results for civil aviation are as outlined below.

#### **3.2 WRC-15 Agenda Item 1.1**

3.2.1 The demand for spectrum for mobile and broadband applications is growing at a fast pace. Under this agenda item, the telecommunications industry was seeking up to 1 200 MHz of additional spectrum in the 300 MHz to 6 GHz range for international mobile telecommunications (IMT). This frequency range includes a number of aeronautical frequency bands and several of these were examined by the conference for a potential allocation to IMT, including 2 700 – 2 900 MHz used by aeronautical primary surveillance radar (PSR) and 4.4 – 4.5 GHz which is adjacent to the aeronautical radio altimeter band at 4.2 – 4.4 GHz. The aeronautical radio altimeters constitute a critical component of the aircraft ground proximity warning system (GPWS) and are used during CAT I/II/III landings.

3.2.2 While studies in the ITU prior to the conference had indicated that sharing is not possible between PSR and IMT, ITU had performed no studies to analyse adjacent band compatibility between IMT and the radio altimeters. ICAO studies (by the Frequency Spectrum Management Panel) prior to the conference indicated a strong potential for harmful interference to the radio altimeters by IMT. Relatively early during the conference an agreement was reached to take PSR bands out of consideration. However, 4.4 – 4.5 GHz, adjacent to the radio altimeter band was not off the table until the final days of the conference. Prompt action by ICAO, IATA and other aeronautical stakeholders during the conference and direct coordination with aviation authorities through the ICAO APAC Office was instrumental in averting this threat.

3.2.3 A favourable outcome was secured for the C-band (3.4 – 4.2 GHz), used for satellite links in the fixed satellite service (FSS) supporting aeronautical ground-ground communications, using very small aperture terminal (VSAT) equipment, especially in Africa (Agenda Item 9.1.5 also refers) and South/Central America. The conference made no new allocations or identifications for IMT between 3.7 and 4.2 GHz. In the remainder of the C-band (less critical for aviation VSATs) the conference specified necessary conditions to protect the FSS.

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<sup>6</sup> African Telecommunication Union (ATU), Asia-Pacific Telecommunity (APT), European Conference of Postal and Telecommunications Administrations (CEPT), Inter-American Telecommunication Commission (CITEL).

### 3.3 WRC-15 Agenda Item 1.5

3.3.1 Existing satellite networks operating in the FSS in the frequency bands at 14/12 GHz and 30/20 GHz have potential spectrum capacity to meet the requirements for beyond line-of-sight communication links and could be used for the command and control (C2) of remotely piloted aircraft systems (RPAS), provided that certain principles (conditions) as indicated in the ICAO Position are fulfilled. However, the FSS is normally not recognized in the ITU as a *safety service*. State operated RPAS have been using C2 links over FSS in segregated airspaces for a number of years. Previously WRC-12 had attempted but failed to develop a solution supporting the use of FSS spectrum for RPAS in a manner satisfying the *safety and regularity of flight* requirements of civil aviation.

3.3.2 The conference agreed to new allocations in the FSS Ku and Ka frequency bands, identifying over 2.2 GHz of spectrum against a Resolution. The Resolution specifies that these frequency bands can be used for the RPAS C2 links in non-segregated airspace and any other airspace under the control of civil aviation authorities. This use is contingent on the successful development of ICAO SARPs. The Resolution goes into considerable detail to protect the current FSS environment against being disrupted by the introduction of a *safety service*. While not providing a traditional aeronautical mobile satellite (route) service, the Resolution introduces an application with *safety of life* implications into the FSS and contains language consistent with a *safety service* and appropriately referencing article 4.10 of the Radio Regulations. While ensuring the highest degree of certainty against harmful interference, to the extent possible under the conditions governing the coordination process for FSS, this approach also takes care of the moral obligation by States and spectrum users for safeguarding life in the use of the relevant frequencies. However a part of the burden to ensure operation without harmful interference, such as real time interference monitoring and predicting interference risks, will have to be addressed in SARPs and is thus placed on the shoulders of the aeronautical regulators. Further, the Resolution requires ICAO to report on its progress in the development of SARPs for the RPAS C2 link to WRC-19 and WRC-23. This reporting should include identification of any problems in the application of the Resolution and potential means by the WRC to address those. The Resolution comes fully into force by WRC-23.

3.3.3 The delicate compromise achieved by the conference is fully in line with the ICAO Position. It provides the Remotely Piloted Aircraft Systems Panel (RPASP) with a set of conditions to develop SARPs against – or to identify showstoppers, if any. However, the implicit obligation of the ICAO work programme to fully support the required ITU studies, to enable WRC-19 and WRC-23 to fine tune the Resolution before it enters into full force in 2023, should be noted. It is expected that this work will take place within the FSMP, RPASP and other supporting panels of the Air Navigation Commission.

### 3.4 WRC-15 Agenda Item 9.1.5

3.4.1 The efficient and safe provision of air navigation services requires the implementation and operation of ground communications infrastructure with high availability, reliability and integrity. In the Africa and Indian Ocean Region, the difficulty of fulfilling these requirements, given the extent of the airspace and weakness in terrestrial communication infrastructure, led, in 1997, the ICAO AFI Planning and Implementation Regional Group to approve the use of satellite terminals (VSAT) operating under the Fixed Satellite Service (FSS) to support terrestrial aeronautical communications services in the frequency range 3.4 – 4.2 GHz, a frequency range which remains the only viable option for satellite links with high availability in tropical regions due to the pronounced rain attenuation at higher frequency bands.

3.4.2 While the frequency band 3.4 – 3.6 GHz is allocated to the FSS, it is also allocated to the mobile service, identified for international mobile telecommunications (IMT). Aeronautical VSAT operations have experienced a number of cases of harmful interference due to lack of sufficient measures

to protect them by administrations when licensing IMT or other services to co-share the band. To address this issue, the conference modified Resolution **154** to underscore the protection needs of existing and planned aeronautical and meteorological VSAT stations. The modified Resolution also highlights the need to license the VSAT stations and register them in the Master International Frequency Register (MIFR) to ensure that they are visible to all administrations concerned.

3.4.3 The modification to Resolution **154** developed by the conference is fully in line with the ICAO Position. As a follow up measure, aviation service providers operating VSAT stations should be encouraged to have their stations licensed and registered in the MIFR. It is expected that the same measures will help ameliorate similar issues currently experienced with the operation of aeronautical VSAT networks in South and Central America

### 3.5 **WRC-15 Agenda Item on Global Flight Tracking for Civil Aviation; and a Future Agenda Item on the Global Aeronautical Distress and Safety System**

3.5.1 While the year 2014 represented one of aviation's safest years in terms of the number of accidents, the tragedy of Malaysia Airlines flight 370 in March 2014 highlighted vulnerabilities in the global air navigation system requiring urgent mitigation. To address these vulnerabilities, the aviation community embarked on a global effort to develop and implement a Global Aeronautical Distress and Safety System (GADSS), and forged consensus among its Member States and the international air transport industry sector on the near-term priority to track airline flights, no matter their global location or destination. The ICAO Second High-level Safety Conference 2015 (HLSC 2015) supported that ICAO should encourage States and the ITU to discuss allocation requirements at WRC-15 to provide the necessary frequency spectrum allocations to enable global air traffic services (ATS) surveillance. The HLSC 2015 also endorsed a concept of operations to support future development of the GADSS. It is envisaged that GADSS will address issues such as: aircraft tracking under normal and abnormal conditions; autonomous distress tracking; automatic deployable flight recorder; and procedures and information management.

3.5.2 The collective urgency of the situation was further highlighted by the decision of the ITU Plenipotentiary Conference (October 2014), instructing WRC-15 to include in its agenda, as a matter of urgency, the consideration of global flight tracking for civil aviation.

3.5.3 Addressing the issue of global flight tracking, WRC-15 agreed to an allocation to aeronautical mobile satellite (route) service (Earth-to-space) at 1 090 MHz, limited to the space station reception of ADS-B emissions from aircraft transmitters operating in accordance with ICAO SARPs. The new allocation has to protect the aeronautical radionavigation service under which the aircraft secondary surveillance radar transponders and distance measuring equipment operate. The ITU Radiocommunication Sector (ITU-R) has been tasked to complete studies related to the space station reception of ADS-B, including consideration of potential interference from non-ICAO standardized systems, and to report their outcome to ICAO. This result fully accommodates the ICAO Position.

3.5.4 The conference decided on an agenda item for WRC-2019 to consider spectrum needs and regulatory provisions for the introduction and use of GADSS. ICAO is invited to participate actively in the studies by providing requirements and information that should be taken into account in the studies of ITU-R, in particular the quantification and characterization of radiocommunication requirements related to the GADSS. This outcome is fully in line with the ICAO Position.

#### 4. CONCLUSIONS

4.1 In general, the conference results fully conformed to the ICAO Position. In order to follow up on this very positive result, ICAO will need to ensure consistency between ICAO provisions and the new radioregulatory provisions through active participation in the relevant ITU studies and the development of SARPs as appropriate. In this regard, sections 3.3 and 3.5 are highlighted.

4.2 A significant element in the ICAO preparatory activities for this conference was the early awareness and involvement of Member States in the development of the ICAO Position. Major factors contributing to this achievement included:

- a) the early development and dissemination of the draft ICAO Position by the Secretariat and the Commission, assisted by the ACP and the FSMP;
- b) the active participation by ICAO experts in the preparatory work of the ITU, including the relevant meetings of the ITU-R (e.g. Study Groups 4 and 5, including the relevant Working Parties, and the Conference Preparatory Meeting (CPM));
- c) the active participation by ICAO experts in meetings of the regional telecommunication organizations (APT, CEPT, CITELE, ATU). The involvement and assistance of the regional offices proved important in supporting the development of proposals by the regional telecommunication organizations to the conference which were in line with the ICAO Position;
- d) the organization of ACP and FSMP working group meetings and ICAO radio frequency workshops in the ICAO regions;
- e) the implementation of Assembly Resolution A38-6; and
- f) the active participation of the ICAO delegation at the conference itself, during which the ICAO Position was often challenged, allowed ICAO to counter and refute numerous proposals that would adversely impact aeronautical spectrum.

4.3 In addition to follow up by the Air Navigation Commission and its panels on the items identified at sections 3.3 and 3.5, an expeditious start of the ICAO preparatory activities for the next conference in 2019 is now essential. An initial draft of the ICAO Position will be developed by end of 2016, to be subsequently reviewed by the Air Navigation Commission and sent to States for comments. A final review of the ICAO Position and its subsequent approval by the Council is foreseen by mid-2017. In light of the constantly growing demand for spectrum for non-aviation users (section 2.1 refers), it is expected that non-aviation interests will oppose some or all of the elements of the ICAO Position at WRC-19 by targeting existing aeronautical spectrum for allocation to other uses and by opposing aviation attempts to obtain new allocations. As a consequence, a substantial effort will be required on the part of the Organization and its Member States to ensure that the ICAO Position is supported by the conference.