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Session 3 –Aeronautical issues

WRC-23 AIs 1.6, 1.7 & 1.8

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Rapporteur – Chapter 2

AERONAUTICAL ISSUES

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

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

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

Agenda Item 1.6

AGENDA ITEM 1.6

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

RESOLUTION 772 (WRC-19)

Consideration of regulatory provisions to facilitate the introduction of sub-orbital vehicles

resolves to invite the ITU Radiocommunication Sector

1 to study spectrum needs for communications between stations on board sub- orbital vehicles and terrestrial/space stations providing functions such as, *inter alia*, voice/data communications, navigation, surveillance and TT&C;

AGENDA ITEM 1.6

resolves to invite the ITU Radiocommunication Sector (continued)

2 to study appropriate modification, if any, to the Radio Regulations, excluding any new allocations or changes to the existing allocations in Article **5**, to accommodate stations on board sub-orbital vehicles, whilst avoiding any impact on conventional space launch systems with the following objectives:

– to determine the status of stations on sub-orbital vehicles, and study corresponding regulatory provisions to determine which existing radiocommunication services can be used by stations on sub-orbital vehicles, if necessary;

– to determine the technical and regulatory conditions to allow some stations on board sub-orbital vehicles to operate under the aeronautical regulation and to be considered as earth stations or terrestrial stations even if a part of the flight occurs in space;

– to facilitate radiocommunications that support aviation to safely integrate sub-orbital vehicles into the airspace and be interoperable with international civil aviation;

– to define the relevant technical characteristics and protection criteria relevant for the studies to be undertaken in accordance with the bullet point below;

– to conduct sharing and compatibility studies with incumbent services that are allocated on a primary basis in the same and adjacent frequency bands in order to avoid harmful interference to other radiocommunication services and to existing applications of the same service in which stations on board sub-orbital vehicles operate, having regard to the sub-orbital flight application scenarios;

AGENDA ITEM 1.6

resolves to invite the ITU Radiocommunication Sector (continued)

3 to identify, as a result of the studies above, whether there is a need for access to additional spectrum that should be addressed after WRC-23 by a future competent conference,

Invites the International Civil Aviation Organization ICAO

to participate in the studies and provide to ITU the relevant technical characteristics required for the studies called for in *resolves to invite ITU-R*,

invites the 2023 World Radiocommunication Conference

to consider the results of the studies above and take the appropriate action,

instructs the Director of the Radiocommunication Bureau

to bring this Resolution to the attention of the relevant ITU-R study groups,

invites administrations

to participate actively in the studies by submitting contributions to ITU-R,

SUMMARY OF STUDIES

- There is no intention to define a new category of station in the RR.
- As the sub-orbital vehicle may be physically located within the major portion of the Earth's atmosphere and/or in space for a brief period of time, the definitions could lead to an inconsistency in the application of the regulations for the stations on the sub-orbital vehicle which intend to operate as terrestrial and/or earth stations.
- One view from the study is to consider that RR No. **1.64** is the baseline for the classification of a station on board sub-orbital vehicle.
- This view considers that in accordance with the definition of RR. No. **1.64**, the classification of the stations on board a sub-orbital vehicle has to be "*space stations"* when the operation "*is beyond, is intended to go beyond, or has been beyond, the major portion of the Earth's atmosphere*". These stations need to use the appropriate space service allocation.
- Earth station or a terrestrial station on board sub-orbital vehicle operating in space could only be notified under RR No. **4.4**. The radiocommunications requiring to apply RR No. **4.10** for aeronautical application would then have to remain beyond the major portion of the atmosphere.
- If the application of RR No. **4.4** is not sufficient for earth stations or terrestrial stations intending to reach space, then additional studies would be required under a possible new agenda item for WRC-27.

SUMMARY OF STUDIES *(CONTINUED)*

- Another view is to consider that the sub-orbital vehicle terrestrial and earth stations retain the status of the terrestrial station or earth station during the whole flight.

- This view considers that A *terrestrial station* is defined as "a station effecting *terrestrial radiocommunication*", and *terrestrial radiocommunication* (RR No. **1.7**) is defined as "any radiocommunication other than *space radiocommunication* or *radio astronomy*". As per RR No. **1.61**, each station shall be classified by the service in which it operates permanently or temporarily.

- While the sub-orbital vehicle is physically located beyond the Earth's atmosphere for a brief period of time, the physical location of the sub-orbital vehicle on which the stations are located does not change the need for, or purpose of the use of, specific radiocommunication applications.

- A further view was expressed that, upon review of the RR provisions, it could be considered that there are no difficulties with the existing RR Article **5** allocations when a *space station* on board a sub-orbital vehicle goes beyond or is intended to go beyond-a major portion of the Earth's atmosphere, based on the space radiocommunication service in which the station operates.

- **There is currently no consensus on the best approach.**

METHODS PROPOSED TO SOLVE THE AGENDA ITEM

Method A:
No change to the Radio Regulations

Method B:
A new World Radiocommunication Conference (WRC) Resolution containing the provisions to operate radiocommunications for sub-orbital vehicles, including definition or description of sub-orbital vehicle without any change to RR Article **5**.

There are three alternative approaches to this method based on the elements to be contained in the Resolution.

METHODS PROPOSED TO SOLVE THE AGENDA ITEM

Method B Approaches:

Method B, Approach A

- Providing definitions of sub-orbital flight and of sub-orbital vehicles;
- Listing minimum required frequency bands to safely operate sub-orbital vehicles operated for aeronautical purposes;
- Providing provisions to avoid adversely affecting other systems and other services;
- Describing operations in space under RR No. **4.4** for terrestrial stations and earth stations.

Method B, Approach B

- Referring to Report ITU-R M.2477 for description of sub-orbital flight and of sub-orbital vehicle;
- Requiring frequencies to be used by sub-orbital vehicles in accordance with their present regulatory status and not changing the stations from either terrestrial or earth station to a space station.

Method B, Approach C

- A definition of stations on a sub-orbital vehicle which includes operation when in space and includes space launch vehicles.
- The identification of the specific services in which sub-orbital vehicles may operate (AM(R)S, MSS, RNSS, and potentially others) and to clarify that stations on sub-orbital vehicles may operate as aircraft stations or earth stations in those services, for all parts of a flight.
- The requirement that the operation of stations on sub-orbital vehicles in the above services is under the same conditions as those for conventional stations.
- The exclusion of systems in the space operation service from the scope of the Resolution.

Agenda Item 1.7

AGENDA ITEM 1.7

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

Resolution 428 (WRC-19)

Studies on a possible new allocation to the aeronautical mobile satellite (R) service within the frequency band 117.975-137 MHz in order to support aeronautical VHF communications in the Earth-to-space and space-to-Earth directions

AGENDA ITEM 1.7

resolves to invite the ITU Radiocommunication Sector

1. to define the relevant technical characteristics and to study, taking into account considering c) and taking into account No. **5.200**, compatibility between potential new AMS(R)S systems that operate within the frequency band 117.975-137 MHz in the Earth-to-space and spaceto-Earth directions and existing primary services in that frequency band and in adjacent frequency bands, while ensuring the protection of systems using existing primary services in those frequency bands and not constraining planned usage of those systems;

2. to take into account the results of the studies to provide technical and regulatory recommendations relative to a possible new AMS(R)S allocation within the frequency band 117.975-137 MHz, taking into consideration the responsibility of ICAO referred to in noting b),

AGENDA ITEM 1.7

invites the 2023 World Radiocommunication Conference

to consider the results of the studies and take appropriate actions, including possible primary allocation to AMS(R)S within the frequency band 117.975-137 MHz,

invites Member States and Sector Members

to participate actively in the studies and to submit characteristics of any current and planned systems to be studied, as appropriate,

invites the International Civil Aviation Organization

to participate in the studies by providing aeronautical operational requirements and relevant available technical characteristics to be taken into account in ITU-R studies and to take into account the sharing and compatibility conclusions at ITU-R in the SARPs to be developed for AMS(R)S,

instructs the Secretary-General

to bring this Resolution to the attention of ICAO.

SUMMARY OF STUDIES

- In liaison with the ICAO, ITU-R has studied the architecture, parameters, and baseline link budgets of a reference AMS(R)S system for the provision of standardized communications for air traffic management, without modification to aircraft equipment.

- In order to support compatibility studies, example of link budgets for satellite-to-aircraft (downlink) and aircraft-to-satellite (uplink) VHF links have been developed, based on propagation considerations discussed with the relevant ITU-R group.

- Studies with existing systems operating under an in-band/adjacent band allocation to a primary service has been assessed in close liaison with ICAO and the relevant ITU-R Working Parties to ensure the protection of existing systems from possible interference resulting from the introduction of a new AMS(R)S system in this frequency band.

- Analysis of the results of studies divided into five subsections as follows:
  - In-band sharing between the systems operating in the AMS(R)S service and systems operating in the aeronautical mobile (route) service.
  - Adjacent band compatibility between systems operating in the AMS(R)S service above 117.975 MHz and systems operating in the aeronautical radionavigation service below 117.975 MHz.
  - Adjacent band compatibility with systems operating above 137 MHz.
  - In-band sharing with other services.
  - Compatibility between systems operating in the aeronautical mobile (route) service from different administrations.

METHODS PROPOSED TO SOLVE THE AGENDA ITEM

Method A

No change to the Radio Regulations

Method B

New allocation to the aeronautical mobile-satellite (route) service within the frequency band 117.975-137 MHz

Create a new co-primary allocation for the AMS(R)S in the Earth-to-space and space-to-Earth directions in the frequency band 117.975-137 MHz, or part thereof, under the following conditions:

– the use of frequency band 117.975-137 MHz is limited to non-geostationary satellite systems only;
– limiting the use of the new AMS(R)S allocation to internationally standardised aeronautical systems;

Method B is not an independent and standalone Method as such and thus should be considered together with Methods B1 or B2.

METHODS PROPOSED TO SOLVE THE AGENDA ITEM

Method B1

Ensuring protection of the AM(OR)S in the frequency band 132-137 MHz, noting that the characteristics of the AM(OR)S are not available. Nevertheless, AM(OR)S systems are understood to operate on channels within national assignments of the AM(R)S, and coexistence between the AM(R)S, AMS(R)S and AM(OR)S might therefore be envisioned through frequency planning and coordination;

Ensuring protection of services in adjacent bands and not constraining these services.

In-band coexistence between the AM(R)S and AMS(R)S and adjacent-band coexistence between the ARNS and AMS(R)S around 117.975 MHz needs to be ensured through frequency planning and coordination work.

The protection of adjacent band services operating above 137 MHz from AMS(R)S space stations unwanted emissions falling above 137 MHz is ensured:

- 1 MHz guard band in 136-137 MHz, as RR Appendix **3** provides appropriate limits for spurious emissions for AMS(R)S systems operating in 117.95-136 MHz;
- a limit of satellite pfd of −166.6 dB(W/(m² · 14 kHz)) on the level of unwanted emissions above 137 MHz for AMS(R)S emissions from systems operating in 136-137 MHz.

METHODS PROPOSED TO SOLVE THE AGENDA ITEM

Method B2

- Applying RR No. **9.11A** coordination procedures (including RR No. **9.14**) for AMS(R)S systems, e.g. extending scope of RR No. **5.208** to the AMS(R)S in 117.975-137 MHz;
- Applying coordination threshold (-140 dB(W/(m^2 at 4 kHz)) at the Earth's surface for AMS(R)S space stations during coordination under RR No. **9.14**, by including the AMS(R)S in the frequency band 117.975-137 MHz in Annex 1 to Appendix **5** of the RR;
- Ensuring protection of systems operating in adjacent bands and not constraining these systems by adopting restrictions on unwanted emissions from AMS(R)S space stations. Such limits should not be worse than those specified in ICAO SARPs for AM(R)S aircraft transmitting stations in adjacent channels (see Section 6.3.4, Annex 10 to the Convention on International Civil Aviation — Aeronautical Telecommunications, Volume III — Communication Systems, ICAO);
- AMS(R)S systems in the frequency band 117.975-137 MHz should not claim protection from interference from AM(R)S and AM(OR)S systems operating in the common frequency band, as well as from the ARNS, MSS (space- Earth), SOS (space-to-Earth), SRS (space-to-Earth) and MetSat (space-to-Earth) operating in adjacent frequency bands;
- Applying RR No. **5.208A** and RR No. **5.208B** for the application of the conditions for new AMS(R)S allocations in the frequency band 117.975-137 MHz.

Agenda Item 1.8

AGENDA ITEM 1.8

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

Resolution 171 (WRC-19)
Review and possible revision of Resolution 155 (Rev.WRC-19) and No. 5.484B in the frequency bands to which they apply

AGENDA ITEM 1.8

resolves to invite the ITU Radiocommunication Sector

1. to continue and complete in time for WRC 23 relevant studies of the technical, operational and regulatory aspects, based on the frequency bands mentioned in resolves 1 of Resolution **155 (Rev.WRC 19)**, in relation to the implementation of Resolution **155 (Rev.WRC 19)**, taking into account the progress obtained by ICAO in the completion of SARPs on the use of FSS for the UAS CNPC links;
2. to review No. **5.484B** and Resolution **155 (Rev.WRC 19**) taking into account the results of the above studies,

Resolves to invites the 2023 World Radiocommunication Conference

to revise, if necessary, No. **5.484B** and Resolution **155 (Rev.WRC 19)** and take other necessary actions, as appropriate, on the basis of the studies conducted under Resolution **155 (Rev.WRC 19**) and resolves to invite ITU R above,

instructs the Secretary-General

to bring this Resolution to the attention of the Secretary-General of ICAO.

SUMMARY OF STUDIES

- In considering UAS CNPC operation under this agenda item, issues related to compatibility with the services having primary allocations in the subject frequency bands studied as following:
  - Relationship between UAS command and control communication links and other satellite networks
  - Relationship with terrestrial services
  - Relationship with radionavigation service
  - Relationship with radio astronomy service

METHODS PROPOSED TO SOLVE THE AGENDA ITEM

Method A:
Method A proposes to suppress RR No. **5.484B** together with Resolution **155 (Rev.WRC-19)** as well as Resolution **171 (WRC-19)**.

Method B:
Method B intends to revise Resolution **155 (Rev.WRC-19)** in accordance with Resolution **171 (WRC-19)** and consequently suppress Resolution **171 (WRC-19)**. In addition, this Method contains the revision of RR No. **5.484B** as an option.

- clearly separate between the responsibilities of ICAO and ITU;
- consider how to ensure the safety of flight while recognizing the issue of RR No. **4.10**;
- remove ambiguities contained in Resolution **155 (Rev.WRC-19)**;
- clarify that UAS CNPC is an operation under the primary FSS while avoiding adverse effects to terrestrial stations;
- maintain the existing procedure for the FSS network coordination as well as for bilateral coordination agreements;
- provide a process to treat cases of interference caused by UA earth station.

METHODS PROPOSED TO SOLVE THE AGENDA ITEM

Method A:

Method A proposes to suppress RR No. **5.484B** together with Resolution **155 (Rev.WRC-19)** as well as Resolution **171 (WRC-19)**.

Reasons:

- Resolution **171 (WRC-19)** is requiring a review and possible revision of Resolution **155 (Rev.WRC-19)** since this in its current state does not enable operation of UA earth stations.
- This agenda item stems from agenda item 1.3 of WRC-12 and agenda item 1.5 of WRC-15 and consideration of the matter of WRC-19 which resulted in Resolution **171 (WRC-19)**.
- After more than ten years of extensive studies, there are still key problems that have not been resolved, in particular the contradiction between the safety nature of the operation of UAS and the non-safety status of the fixed-satellite service.
- With no satisfactory solution identified for the operation of UA earth stations, it therefore would be necessary to suppress RR No. **5.484B** together with Resolution **155 (Rev.WRC-19)** as well as Resolution **171 (WRC-19)**.

METHODS PROPOSED TO SOLVE THE AGENDA ITEM

Method B:

Method B intends to revise Resolution **155 (Rev.WRC-19)** in accordance with Resolution **171 (WRC-19)** and consequently suppress Resolution **171 (WRC-19)**. In addition, this Method contains the revision of RR No. **5.484B** as an option.

Reasons:

- After considering the progress obtained by the International Civil Aviation Organization (ICAO) in the process of establishing and preparing Standards and Recommended Practices (SARPs) for the safe operation of unmanned aircraft systems, the studies to protect the terrestrial services from harmful interference, revisions to Resolution **155 (Rev.WRC-19)** are proposed to satisfy this agenda item.

- The intention being that compliance with the Resolution would ensure that all required ITU-R technical, operational, and regulatory conditions are met, and would not adversely affect existing and future FSS networks or terrestrial services.

TEXT PROVIDED BY WORKING PARTY 5B FOR THE DRAFT CPM REPORT ON AGENDA ITEM 1.8

- Due to the complexity of the agenda item and the difficulties caused to this work by COVID-19, it was not possible, despite all efforts being made during this study period, to complete the work on preparing draft Conference Preparatory Meeting (CPM) text in respect of this agenda item.

- Regulatory and procedural considerations section is completed in respect of Method A. However, in respect of Method B, due to the complexity of the matter and due to lack of time, it was not possible to finalize the review of proposed revisions of Resolution **155 (Rev.WRC 19)** which is an element of this method.

- In respect of the preamble to the Resolution, *considering*, *noting* and *recognizing*, proposals for revisions have not yet been reviewed or agreed.

- In respect of the *resolves* part, *resolves* 11.3 and onwards have not been reviewed or agreed.

- Among the issues in the revision to Resolution **155 (Rev.WRC-19)** which were not fully discussed and completed due to lack of time is the issue of safety of life, referred to in Radio Regulations (RR) No. **4.10**, which is one of the crucial and important elements of this agenda item.