[Note: The proposed 1st Draft US Edits are highlighted in Light Gray.]

[Note: The proposed Final Draft US Edits are highlighted in Gray.]

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| **U.S. Radiocommunications Sector****Fact Sheet** |
| **Working Party:** ITU-R WP 5B | **Document No:** USWP5B28-05-Final Draft |
| **Ref:** Annex 4 to 5B/481-E | **Date:** 17 February 20221 |
| **Document Title:** WORKING DOCUMENT TOWARDS DRAFT CPM REPORT Chapter 2 AGENDA ITEM 1.8 (WRC-23) - Use of fixed-satellite service (FSS) networks by control and non-payload communications of unmanned aircraft systems |
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| **Purpose/Objective:** The purpose of this contribution is to update the draft CPM Text for Agenda Item 1.8 (WRC-23) in Annex 4 to 5B/481-E and to propose consolidation of the text proposed by multiple contributions. |
| **Abstract:** This contribution will propose updates to the draft CPM Text for Agenda Item 1.8 (WRC-23). The updates will propose to consolidate the inputs from multiple contributions to create a unified and concise text for CPM. |

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| **Radiocommunication Study Groups** |  |
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| Source: Document Annex 4 to 5B/481-ESubject: WRC-23 agenda item 1.8Resolution **171 (WRC-19)** | **Document 5B/XXX-E** |
| **17 February 2022** |
| **English only** |
| United States of America |
| Working document towards a draft CPM Report – Chapter 2 – WRC-23 agenda item 1.8 |
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**Introduction**

During the last WP 5B meeting, contributions towards Draft CPM Report text were received from the United States, Germany, and AsiaSat. These contributions were merged into a single document and attached to the Chairman’s Report of the twenty seventh meeting of Working Party 5B. In the merged document the elements submitted by the three contributions are presented as follows:

* Document [5B/444 (USA)](http://www.itu.int/md/R19-WP5B-C-0444/en) (no highlight)
* Document [5B/467 (Germany)](http://www.itu.int/md/R19-WP5B-C-0467/en) (sand colour)
* Document [5B/470 (AsiaSat)](http://www.itu.int/md/R19-WP5B-C-0470/en) (light green)

The merged document was not discussed in the WP-5B meeting and no agreement has been reached on any part of the text of the merged document.

**Proposal**

The United States proposes to Accept some of the changes proposed by Germany and AsiaSat and to provide some additional text to further the development of Draft Agenda Item 1.8 CPM text.

**Attachment**

ATTACHMENT

Working document towards a draft CPM Report –
Chapter 2 – WRC-23 agenda item 1.8

CHAPTER 2

Aeronautical and maritime issues

(Agenda items 1.6, 1.7, 1.8, 1.9, 1.10, 1.11)

Agenda item 1.8

(**WP 5B[[1]](#footnote-1)\* / WP 4A, WP 4B**)

*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*

# 2/1.8/1 Executive summary

*[Text of the executive summary, not more than half a page of text to describe briefly the purpose of the agenda item, summarize the results of the studies carried out and, most importantly, provide a brief description of the method(s) identified that may satisfy the agenda item. See also § A2.1 of Annex 2 to* [*Resolution ITU-R 2-8*](http://www.itu.int/pub/R-RES-R.2-8-2019)*]*

Agenda item 1.8 was established to revise Resolution **155** **(Rev.WRC-19)** which was initially established by WRC-15 on the use of geostationary-satellite networks in the fixed-satellite service in certain frequency bands for the control and non-payload communications (CNPC) of unmanned aircraft systems (UAS).

Studies upon technical and regulatory conditions carried out in the frame of the WRC-15 showed that the use of FSS network for UA CNPC purposes is feasible under certain conditions. These conditions include flight scenarios which were provided by ICAO and the existing FSS framework. Furthermore, ICAO studies showed that – based on given FSS characteristic envelops – the FSS based UAS CNPC can be a working solution compliant to the SARPs for the RPAS C2 Link[[2]](#footnote-2).

It is proposed to set the regulatory conditions for such an operation through RR No. **5.484B** together with the associated Resolution **155 (Rev.WRC-19)**.

[Editor’s Note: a summary of the results of the studies and a brief description of the method(s) is still needed in the Executive Summary.]

# 2/1.8/2 Background

*[Text of the background, not more than half a page of text to provide general information in a concise manner, in order to describe the rationale of the agenda items (or issue(s)). See also §A2.2 of Annex 2 to* [*Resolution ITU-R 2-8*](http://www.itu.int/pub/R-RES-R.2-8-2019)*]*

**[**In the context of this agenda item, an unmanned aircraft system (UAS) consists of a geostationary satellite operating under a fixed-satellite service (FSS) allocation, an unmanned aircraft (UA) with an earth station on-board to interconnect the communication link between this UA and associated remote earth station, called "unmanned aircraft control station” (UACS). UA are aircraft that do not carry a human pilot but that are piloted remotely, i.e. through a reliable communication link from outside the aircraft.**]**

**[**In the context of this agenda item, an unmanned aircraft system consists of a geostationary satellite operated in FSS frequency bands, an UA with an Earth stations on-board to interconnect the communication link between this UA and associated remote Earth station, called "unmanned aircraft control station” (UACS). UA are aircrafts that do not carry a human pilot but that are piloted remotely, i.e. through a reliable communication link from outside the aircraft.**]**

**[**There are a variety of existing and envisioned applications of UAS in the fields of economy, public safety and science. Further details on UAS applications in can be found in Report ITU-R M.2171. The operation of UA requires addressing the same issues as manned aircraft, namely safe and efficient integration into the air traffic control system.**]**

 (WRC-12) (WRC-15)

WRC-15, under its agenda item 1.5 considered use of fixed-satellite service (FSS) networks to provide UAS CNPC links and established Resolution **155 (WRC-15)** in response to this. Recognizing the need for further studies on regulatory provisions and technical criteria both within ICAO and ITU, WRC-15 decided that consideration of the outcome of these studies, also taking into account the progress obtained by ICAO in the completion of its Standards And Recommended Practices (SARPs) on the use of FSS for the UAS CNPC links would again be considered by WRC‑23.

by WRC-19 , in accordance with Resolution **171** **(WRC‑19)**, consider 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

# 3/1.8/2.1 UAS architecture

FSS based unmanned aircraft systems (UAS) comprise:

**Unmanned aircraft (UA):** UA designates all types of remotely controlled aircraft[[3]](#footnote-3).

Definition of an earth station on a UA: A fixed-satellite service earth station on an unmanned aircraft shall be defined as an earth station operating in the fixed-satellite service.

**Control and non-payload communications (CNPC)** is understood as the radio data links used to exchange information between the UA and UACS ensuring safe, reliable, and effective UA flight operation. A CNPC communication link comprises data for:

– Telecommand (forward) control messages and telemetry (return) data relevant to enable full remote control all UA functions.

– ATC relay communication (to ensure at the remote pilot site the same situational awareness of VHF voice communication representative for the radio vicinity at the current location of the UA.

– Sense and avoid (S&A) data: comprising target track data, airborne weather radar data corresponding to the piloting principle of “see and avoid” which is used in all airspace volumes where the pilot is responsible for ensuring separation from nearby aircraft, terrain and obstacles.

– UA control station (UACS[[4]](#footnote-4)): Facility from which a UA is controlled remotely. The studies performed in this Report consider UACS earth stations using satellite communication located at a fixed point.

– Geostationary satellite: A geosynchronous satellite whose circular and direct orbit lies in the plane of the Earth’s equator and which thus remains fixed relative to the Earth; by extension, a geosynchronous satellite which remains approximately fixed relative to the Earth (RR No. **1.189**).

Figure 3/1.8/4-1

Typical beyond line-of-sight command and non-payload communication links
in an unmanned aircraft system



Links 1 and 4, are locate at fixed locations and are thus consistent with existing FSS Earth station operations. Links 2 and 3 are mobile and require additional consideration. This additional consideration involves ensuring that:

1 the operations of the mobile Earth stations on-board the unmanned aircraft are consistent with expected FSS performance (Links 2 and 3);

2 the mobile Earth stations on-board the unmanned aircraft are designed to ensure acceptable operations in the presence of expected emissions from the terrestrial services (Link 2), and

3 the terrestrial services that operate in the same bands are protected from harmful interference from the mobile Earth station on-board the unmanned aircraft (Link 3).

This section concerns the analyses of the FSS links 1, 2, 3, and 4 as shown in Figure 3/1.8/4-1 that support the control of unmanned aircraft systems operating in non-segregated airspace. As these are links associated with GSO FSS satellite networks the technical filings that support the networks have been examined by the BR and therefore have been confirmed to be in accordance with the technical regulations contained in the RR.

GSO FSS satellite systems can share the same frequency bands in the same geographical area thanks to the directivity of the antennas used by user terminals (UTs) and to the fact that GSO FSS satellites are separated sufficiently by an appropriate geocentric angle on the GSO arc. In order to maximize the efficiency of the use of the GSO arc, a certain amount of inter-system interference to FSS networks is accommodated by GSO FSS systems being required to be designed to take this interference into account.

The FSS inter-system interference levels are known to FSS operators, after coordination of satellite frequency assignments. The associated coordination and notification processes are carried out in accordance with Articles **9** and **11** of the Radio Regulations.

# 2/1.8/3 Summary and analysis of the results of ITU-R studies

*[This section should contain a summary of the technical and operational studies performed within ITU-R, including a list of relevant ITU-R Recommendations. Depending on the agenda item, this section could be divided in two parts, one part dealing with the summary and the other part dealing with the analysis. The results of the ITU-R studies should also be analysed with respect to the possible methods of satisfying the agenda item, and presented in a concise manner.]*

## 2/1.8/3.1 Summary of technical and operational studies

Based on Report [ITU-R M.2171](http://www.itu.int/pub/R-REP-M.2171), the maximum amount of spectrum required for UAS CNPC links is 56 MHz for the satellite component assuming regional beams with suitable antenna discrimination. However, this estimation could rise to 169 MHz when using small aperture antenna with limited discrimination in lower frequency bands. However, it is important to note, that due to the uncertainties of the market demand for this entirely new way of operating aircraft fleets, the possibility to access a huge capacity of FSS satellite systems would provide the needed flexibility worldwide when needed reducing significantly the commercial risk.

## 2/1.8/3.2 Relevant ITU-R recommendations and reports

ITU-R Recommendations, relevant for studies under WRC-23 agenda item 1.8, as appropriate, are:

– ITU-R [F.758-5](http://www.itu.int/rec/R-REC-F.758/en), ITU-R [F.1494](http://www.itu.int/rec/R-REC-F.1494/en), ITU-R [F.1495](http://www.itu.int/rec/R-REC-F.1495/en), ITU-R [F.1565](http://www.itu.int/rec/R-REC-F.1565/en);

– ITU-R [M.1180](http://www.itu.int/rec/R-REC-M.1180/en), ITU-R [M.1233](http://www.itu.int/rec/R-REC-M.1233/en), ITU-R [M.1372](http://www.itu.int/rec/R-REC-M.1372/en), ITU-[R M.1643](http://www.itu.int/rec/R-REC-M.1643/en), ITU-R [M.1644](http://www.itu.int/rec/R-REC-M.1644/en), ITU‑R [M.1730](http://www.itu.int/rec/R-REC-M.1730/en), ITU-R [M.2008](http://www.itu.int/rec/R-REC-M.2008/en);

– ITU-R [P.528-5,](https://www.itu.int/rec/R-REC-P.528-5-202109-I/en) ITU-R [P.2108-1](https://www.itu.int/rec/R-REC-P.2108-1-202109-I/en);

– ITU-R [SF.1006](http://www.itu.int/rec/R-REC-SF.1006/en), ITU-R [SF.1650](http://www.itu.int/rec/R-REC-SF.1650/en), ;

- ITU-R [S.465-6](https://www.itu.int/rec/R-REC-S.465-6-201001-I/en), ITU-R [S.484-3](https://www.itu.int/rec/R-REC-S.484-3-199203-I/en), ITU-R [S.524-9](http://www.itu.int/rec/R-REC-S.524/en), ITU-R [S.579-6](https://www.itu.int/rec/R-REC-S.579-6-200504-I/en), ITU-R [S.728-1](https://www.itu.int/rec/R-REC-S.728-1-199510-I/en), ITU‑R [S.734](https://www.itu.int/rec/R-REC-S.734-0-199203-I/en), ITU-R [S.738](https://www.itu.int/rec/R-REC-S.738-0-199203-I/en), ITU-R [S.740](https://www.itu.int/rec/R-REC-S.740-0-199203-I/en), ITU-R [S.1062-4](https://www.itu.int/rec/R-REC-S.1062-4-200701-I/en), ITU-R [S.1064-1](https://www.itu.int/rec/R-REC-S.1064-1-199510-I/en), ITU‑R [S.1254](https://www.itu.int/rec/R-REC-S.1254-0-199705-I/en), ITU-R [S.1424](https://www.itu.int/rec/R-REC-S.1424-0-200001-I/en), ITU-R [S.1432-1](https://www.itu.int/rec/R-REC-S.1432-1-200604-I/en), ITU-R [S.1716](https://www.itu.int/rec/R-REC-S.1716-0-200502-I/en), ITU-R [S.1806](https://www.itu.int/rec/R-REC-S.1806-0-200808-I/en), ITU‑R [S.1856](https://www.itu.int/rec/R-REC-S.1856-0-201001-I/en), ITU-R [S.2099](https://www.itu.int/rec/R-REC-S.2099-0-201612-I/en), ITU-R [S.2131](https://www.itu.int/rec/R-REC-S.2131-0-201909-I/en).

ITU-R Reports, relevant for the studies under WRC-23 agenda item 1.8 are:

– ITU-R [M.2171](http://www.itu.int/pub/R-REP-M.2171), [ITU-R M.2233](http://www.itu.int/pub/R-REP-M.2233).

New ITU-R Reports developed for this topic are:

– Preliminary draft new Report ITU-R [UA\_PFD]

## 2/1.8/3.3 Analysis of the results of studies

**[**

Figure 1

Elements of UAS architecture using the FSS



Links 1 and 4, are locate at fixed locations and are thus consistent with existing FSS Earth station operations. Links 2 and 3 are mobile and require additional consideration. This additional consideration involves ensuring that:

1 the operations of the mobile Earth stations on-board the unmanned aircraft are consistent with expected FSS performance (Links 2 and 3);

2 the mobile Earth stations on-board the unmanned aircraft are designed to ensure acceptable operations in the presence of expected emissions from the terrestrial services (Link 2), and

3 the terrestrial services that operate in the same bands are protected from harmful interference from the mobile Earth station on-board the unmanned aircraft (Link 3).**]**

**[**Figure 2/1.8/3.3-1 shows the UAS CNPC structure with its links, earth stations and space station. The UACS earth station allows the remote pilot to communicate with the UA earth station on-board the unmanned aircraft through transponders of a regular geostationary FSS space station. Links 1 and 2 signify the links for signals from the transmitting UACS earth station to the receiving UA earth station and Links 3 and 4 are the links for the signals from the transmitting UA earth station to the receiving UACS earth station.

Figure 2/1.8/3.3-1

Unmanned aircraft system for control and non-payload communication (UAS CNPC)



Links 1 and 4, are locate at fixed locations and are thus consistent with existing FSS Earth station operations. Links 2 and 3 are mobile and require additional consideration. This additional consideration involves ensuring that:

1 the operations of the mobile Earth stations on-board the unmanned aircraft are consistent with expected FSS performance (Links 2 and 3);

2 the mobile Earth stations on-board the unmanned aircraft are designed to ensure acceptable operations in the presence of expected emissions from the terrestrial services (Link 2), and

3 the terrestrial services that operate in the same bands are protected from harmful interference from the mobile Earth station on-board the unmanned aircraft (Link 3).**]**

Key principles for UAS CNPC operation include:

* UAS CNPC operation considered under WRC-23 agenda item 1.8 is seen as an application of the FSS which has a primary status in the frequency bands under consideration.
* UAS CNPC links and associated space and earth stations operate within the envelope of the technical parameters and emission levels of an associated FSS network(s) as submitted to ITU and successfully coordinated.
* UAS CNPC links in the frequency bands considered under WRC-23 agenda item 1.8 operate under FSS networks without safety status, together with other non-safety FSS networks under conditions laid out by their respective ITU submissions and associated coordination agreements.
* No additional status is to be granted to to UAS CNPC links and its associated space and earth stations than that already obtained through the associated FSS network and its specific and typical earth stations.
* No change of existing bilateral coordination agreements or additional agreements between the notifying administration of the FSS network under which the UAS CNPC links are provided and the notifying administrations of other FSS networks shall be needed.
* UAS CNPC operation under the associated FSS network shall not have an adverse effect during the regular satellite coordination processes of future FSS networks nor impose any additional coordination requirements due to the UAS CNPC operation. Safety of life or other special requirements for UAS CNPC operation shall not be used as an argument to request more protection than what is normally considered during the regular bilateral coordination process between FSS networks.
* Operation of UA earth stations on-board the unmanned aircraft shall not limit stations of terrestrial services, current operation or their future development.
* Receiving UA earth stations shall not claim protection from transmitting stations of terrestrial services.
* Transmitting UA earth stations shall not cause unacceptable interference into receiving stations of terrestrial services.

### 2/1.8/3.3.1 Aspects in respect of the need for safe operation

UAS CNPC operation need to ensure the safe operation of the unmanned aircraft. UAS CNPC in the frequency bands subject to WRC-23 agenda item 1.8 is seen as an application of the FSS which has a primary status in the frequency bands under consideration. However, in establishing provisions for UAS CNPC operation in these frequency bands, there is a need to not grant any additional status to links, earth stations or space stations of UAS CNPC than that already obtained in regard with the associated FSS network and specific and typical earth stations communicating with the space stations. Furthermore, the UA CNCP earth stations on-board the unmanned aircraft need to be operated in such a manner that they do not limit stations of terrestrial services, their current operation and their future development. For this purpose, UA CNPC earth stations shall seek no protection from terrestrial services and shall not cause unacceptable interference to terrestrial services.

Defining how to ensure the safe operation of UAS CNPC under regular FSS without any upgrade of the status from non-safety service to safety service is under the responsibility of ICAO and will be specified in their Standards And Recommended Practices (SARPs). Necessary mitigation measures including its associated techniques and interference management functions in order to meet the safety requirements need to be implemented without having negative effect on incumbent services, their existing operation and future development.

### 2/1.8/3.3.2 Sharing consideration

Under this agenda item, assignments geostationary FSS 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. RR Article **5** of the Radio Regulations provides a complete overview of frequency allocations for various services and special conditions for their operation. Table 2/1.8/3.3.2-1 provides an overview of primary allocations for services in the subject frequency bands from Article **5** of the Radio Regulations.

In considering UAS CNPC operation under this agenda item, issues related to compatibility with the services having primary allocations in the subject frequency bands is discussed in the following sub-sections.

In addition to consideration of compatibility with services having primary allocations in the subject frequency bands, the radio astronomy service is allocated on a secondary basis in the adjacent 14.47-14.5 GHz band and is subject to RR No. **5.149** in which “*administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference. Emissions from spaceborne or airborne stations can be particularly serious sources of interference to the radio astronomy service (see RR Nos. 4.5 and 4.6 and Article 29)*”. Consequently, in sub-section 2/1.8/3.3.2.4, is a discussion on measures in respect of the radio astronomy service.

Table 2/1.8/3.3.2-1

Overview of primary allocations in the frequency bands subject to WRC-23 agenda item 1.8

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | space-to-Earth | Earth-to-space | space-to-Earth | Earth-to-space |
| 10.95-11.2 GHz | 11.45-11.7 GHz | 11.7-12.2 GHz | 12.2-12.5 GHz | 12.5-12.75 GHz | 14-14.3 GHz | 14.3-14.47 GHz | 19.7-20.1 GHz | 20.1-20.2 GHz | 29.5-29.9 GHz | 29.9-30 GHz |
| Globally | Globally | Region 2 | Region 3 | Regions 1 & 3 | Globally | Globally | Globally | Globally | Globally | Globally |
| FSS | V | V | V | V | V | V | V | V | V | V | V |
| MSS | - | - | - | - | - | - | - | V*ii* | V*iii* | V*ii* | V*iii* |
| BSS | - | - | - | - | V*iv* | - | - | - | - | - | - |
| FS | V | V | V*v* | V | V*vi* | -*vii* | V*viii* | -*x* | -*x* | - | - |
| MS*i* | V | V | - | V | V*vi* | - | V*viii* | -*x* | -*x* | - | - |
| RNS | - | - | - | - | - | V*ix* | - | - | - | - | - |

*i*Except aeronautical mobile.

*ii* Only Region 2, with special conditions outlined in RR No. **5.525**, **5.526**, **5.527**, **5.528** and **5.529**.

*iii* Special conditions outlined in RR No. **5.525**, **5.526**, **5.527** and **5.528**.

*iv* Only for Region 3.

*v* Only 11.7-12.1 GHz (secondary in USA in accordance with RR No. **5.486**). 12.1-12.2 GHz primary in Peru (RR No. **5.489**).

*vi* Country footnotes RR No. **5.494** and No. **5.496** with primary allocations for FS and MS for named Region 1 countries.

*vii* Country footnote RR No. **5.505** with primary allocation for FS in 14-14.3 GHz for named Region 1 and 3 countries. Country footnote RR No. **5.508** with primary allocation for FS in 14.25-14.3 GHz for named Region 1 countries.

*viii* For 14.3-14.4 GHz, only Regions 1 & 3.

*ix* In accordance with RR No. **5.504**, The use of the band 14-14.3 GHz by the radionavigation service shall be such as to provide sufficient protection to space stations of the fixed-satellite service.

*x* Country footnote RR No. **5.524** with primary allocation for FS and MS in 19.7-21.2 GHz for named Region 1, 2 and 3 countries. This additional use shall not impose any limitation on the power flux density of space stations in the fixed-satellite service.

#### 2/1.8/3.3.2.1 Relationship with satellite services

UAS CNPC links, including the associated space and earth stations need to operate within the notified and recorded technical parameters of the associated FSS satellite network as well as within the coordinated limits of this. The requirements for safe operation of UAS CNPC links shall not cause more interference to nor require more protection from other satellite networks and systems. Therefore, the use of FSS networks for CNPC links should not in any way give rise to further constraints to satellite networks operating applications other than UAS CNPC links. In this respect it is to be noted that FSS in the frequency bands in question is heavily used for commercial applications, and as any such radio service, is subject to unpredictable unintentional interference which needs to be taken into account in considering UAS CNPC operation in these frequency bands.

UA CNPC earth stations need to be designed and operated with the interference caused by other satellite networks in their application of RR Articles **9** and **11**, and notably RR No. **11.41**, and shall not have any impact on the existing and future satellite networks coordination agreements or the regular satellite coordination process.

Consequently, interference to/from other satellite networks will be addressed under the current regulatory process and therefore would not require any further sharing and interference analysis with satellite networks and systems. The above is so as not to constrain other FSS operations due to requirements for safe operation of UAS CNPC and relies on the principle that UAS CNPC operation should not offer any special rights or status compared to regular FSS.

#### 2/1.8/3.3.2.2 Relationship with terrestrial services

As shown in Figure 2/1.8/3.3-1, the UAS CNPC consist of the space station, the UACS earth station and the UA earth stations. Each of these types of stations will have their specific relationship with respect to terrestrial services as discussed below.

Space station

The space station used for UAS CNPC is a regular FSS satellite, successfully coordinated and entered into MIFR. Where terrestrial and space services share frequency bands above 1 GHz (see Table 2/1.8/3.3.2-1 in respect of frequency bands subject to this agenda item), RR Article **21** provides limits to ensure compatibility between the two, commonly through power flux density or emission limits. Since compatibility between the space station and terrestrial services is ensured through the current RR, there is no need for any special provisions in respect of space stations used for UAS CNPC. Consequently, also no technical studies in this respect have been conducted.

UACS earth station

The UACS earth stations are located at fixed, known locations and with known characteristics. Such earth stations can be notified as specific FSS earth stations (see RR No. **9.17**) under the current RR No. **11.2** and coordinated under the current RR No. **9.17** if required. The process under the current RR Nos. **11.2** and **9.17** also includes provisions and criteria to ensure compatibility between the specific earth station and terrestrial services and therefore, there is no need for additional provisions in respect of UACS earth stations. Consequently, also no technical studies in this respect have been conducted.

UA earth station

UA earth stations will operate within a specified geographic area, but not at one specific and defined location. As such, they are understood as typical earth stations (see RR No. **11.17**).The relationship of UA earth stations with terrestrial services is based on two principles:

* Receiving UA earth stations shall seek no protection from terrestrial services and shall pose no limitation on the current terrestrial services nor the future development of these.
* Transmitting UA earth stations shall not cause unacceptable interference to current or future receiving stations of terrestrial services.

Taking note of this, no technical studies have been conducted in respect of protection of receiving UA earth stations from terrestrial services nor are any provisions in RR required in this respect.

In respect of transmitting UA earth stations, it can be seen from Table 2/1.8/3.3.2-1 that there are no allocations to terrestrial services in the 29.5-30 GHz band which is subject to this agenda item. Consequently, there is no need for provisions to protect terrestrial services in this band or studies in this respect. For the 14-14.47 GHz band which is the other transmitting band for UA earth stations under this agenda item, it can however be seen that this band is shared with terrestrial services. Consequently, there is a need for provisions to ensure that no unacceptable interference is inflicted on current or future receiving stations of terrestrial services.

[*Add text on technical studies for 14-14.47 GHz, limits and provisions in respect of transmitting UA earth stations*]

#### 2/1.8/3.3.2.3 Relationship with radio navigation service

The Radionavigation Service (RNS) is allocated on a primary basis in 14.0-14.3 GHz band. Under this agenda item, this band is used by transmitting UA and UACS earth stations and receiving space stations. As discussed earlier, the space station and the UACS earth station are filed with ITU and coordinated as regular FSS under the normal procedures of the current Radio Regulations. It is also noted that in respect of protection of the receiving space station, RR No. **5.504** stipulates that “*The use of the band 14-14.3 GHz by the radionavigation service shall be such as to provide sufficient protection to space stations of the fixed-satellite service.*”. For these reasons, no particular consideration of these stations is required under this agenda item.

In respect of protection of RNS from transmitting UA earth stations, it is noted that these earth stations operate within the envelope of the typical earth stations of the associated FSS network in respect of emission levels, technical characteristics and service area and therefore, the interference into RNS will be defined by that of the associated FSS network. Consequently, no special provisions to protect RNS from transmitting UA earth stations or studies in this respect is required under this agenda item.

#### 2/1.8/3.3.2.4 Relationship with radio astronomy service

The radio astronomy service (RAS) is allocated on a secondary basis in the 14.47-14.5 GHz band which is immediate adjacent to the 14-14.47 GHz Earth-to-space band subject to this agenda item. This band will see operation of transmitting UA and UACS earth stations. UACS earth stations are filed and coordinated as required as regular specific FSS earth stations under the normal procedures of the current Radio Regulations. Consequently, consideration under this agenda item has only been given to transmitting UA earth stations.

RR No. **5.149** stipulates that “*administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference. Emissions from spaceborne or airborne stations can be particularly serious sources of interference to the radio astronomy service (see RR Nos. 4.5 and 4.6 and Article 29)*”.

RR Nos. **4.5** and **4.6** further stipulates:

“***4.5*** *The frequency assigned to a station of a given service shall be separated from the limits of the band allocated to this service in such a way that, taking account of the frequency band assigned to a station, no harmful interference is caused to services to which frequency bands immediately adjoining are allocated.*

***4.6*** *For the purpose of resolving cases of harmful interference, the radio astronomy service shall be treated as a radiocommunication service. However, with regard to emissions from services operating in other bands, it shall be afforded the same degree of protection as such services are afforded vis-à-vis each other.*”

*Resolves* 17 of Resolution **155 (Rev WRC-19)** also specifically addresses protection of the Radioastronomy Service:

“*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;*”

The most recent versions of Recommendations ITU-R RA.769 and ITU-R RA.1513 for protection of RAS provide protection objectives for RAS.

RR Article **29** is describing how, due to the very high sensitivity to interference of the radio astronomy service, mitigation techniques to avoid interference needs to be implemented both by the radio astronomy side and those services potentially interfering with the radio astronomy service. Such mitigation techniques include choice of sites for radio astronomy stations, use of site shielding, time sharing and consideration of actual characteristics for each case. Such measures can only be applied on a case-by-case basis.

Recommendation ITU-R RA.769 provides the interference threshold pfd density for radio astronomy receivers (-221 dB(W/(m2 • Hz))). However, both this Recommendation and Recommendation ITU-R RA.1513 notes that this level is in respect of the aggregation of all interfering sources which would include emissions from non-UAS earth stations to all satellites and emissions from transmitters of terrestrial services.

For these reasons, and also noting that there are a limited number of radio astronomy stations at known and well defined locations, it is deemed not appropriate to have general pfd limits for transmitting UA earth stations, but rather address compatibility with radio astronomy stations on a case-by-case basis taking into account the specific characteristics for each station and the out-of-band frequency discrimination towards the adjacent 14.47-14.5 GHz radio astronomy band. For this reason, also no compatibility or sharing studies have been conducted.**]**

# 2/1.8/4 Methods to satisfy the agenda item

*[This section should contain the brief description of the Method or Methods to satisfy the agenda item as per Section A2.4 of Annex 2 to* [*Resolution* *ITU-R 2-8*](http://www.itu.int/pub/R-RES-R.2-8-2019)*]*

**[**After considering the progress obtained by the International Civil Aviation Organization (ICAO) in the process of preparing Standards and Recommended Practices (SARPs) for unmanned aircraft systems, the studies to protect the terrestrial services from harmful interference, and the implementation of Resolution **156 (WRC-15)**, revisions to RR No. **5.484B** and 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, permitting the use of compliant FSS links to support UAS CNPC operations without adversely affecting existing and future FSS networks or terrestrial services.**]**

**[**Resolution **155** (**Rev.WRC-19**) need to be revised in order to clearly separate between the responsibilities if ICAO and ITU is needed. ICAO has already established SARPs for the safe operation of UAS CNPC and further detailed provisions are expected to be in place in time for WRC‑23.

RR No. **5.484B** needs to be updated to indicate the purpose of this footnote.**]**

*[In describing the method(s) the different administrations involved, their roles and responsibilities in respect of various elements of UAS CNPC and submissions to ITU in this respect should be made clear.]*

2/1.8/5 Regulatory and procedural considerations

*[Example(s) of regulatory text relating to the Method(s) to satisfy the agenda item]*

**[**In response to *resolves* 1 and *resolves* 2 of Resolution **171 (WRC-19)** and with input from Administrations and the International Civil Aviation Organization (ICAO), the following modifications are provided for consideration.**]**

**[**WRC-23 may finally decide to a selection or the total of frequency bands identified in Resolution **155 (WRC-23)** by referring to this Resolution through the footnote **5.484B** as shown in this example.**]**

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**[**5.484BThe operation of earth stations on board unmanned aircraft communicating with geostationary fixed-satellite service (FSS) space stations within 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) are an application of the FSS, are limited to internationally standardized aeronautical systems, and shall be subject to the application of Resolution **155 (Rev.WRC‑23)**.     (WRC-23)**]**

**[**5.484B This frequency band, may also be used for the control and non-payload communication of unmanned aircraft systems. Such use shall be in accordance with Resolution **155** **(Rev.WRC-23)**.     (WRC‑23)**]**

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Resolution 155 (WRC-19)

[Proposed revisions to Resolution **155 (Rev.WRC-19)** contained in Document 5B/467 suggested to be discussed separately together with other proposed revisions to this Resolutions contained in other contributions.]

[Editor’s note: The above mentioned modification of Resolution **155** is being considered separately and will be incorporated into this CPM Text once the text of the Resolution has been agreed upon.]

SUP

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**

1. \* Note: See relevant text in CPM23-1 meeting report (Annex 4 to BR Administrative Circular [CA/251](https://www.itu.int/md/R00-CA-CIR-0251/en)) on how to facilitate the work related to satellite. [↑](#footnote-ref-1)
2. In ICAO, an “unmanned aircraft system” (UAS) is referred to as a “Remotely piloted aircraft system” (RPAS), the CNPC link is referred to C2 Link (Command and Control). [↑](#footnote-ref-2)
3. In ICAO, the UA is referred to Remotely Piloted Aircraft (RPA). [↑](#footnote-ref-3)
4. In ICAO, UACS is referred to Remote Piloted Station (RPS) with the Ground Earth Station (GER). [↑](#footnote-ref-4)