Changes between the initial draft and the final draft are highlighted in gray.

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| **U.S. Radiocommunications Sector**  **Fact Sheet** | |
| **Working Party:** ITU-R WP 5B | **Document No:** USWP5B29-19-Final Draft |
| **Ref:** Annex 3 to 5B/531-E | **Date:** 12 May 2022 |
| **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.  This contribution is being developed as a possible multi-country proposal and expedited approval is being sought to allow this document to be posted as a WP-5B Contribution as early as possible. | |
| **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 3 to 5B/531  Subject: WRC-23 agenda item 1.8 draft CPM text | **Document 5B/XXX-E** |
| **July 2022** |
| **English only** |
| United States of America | |
| Working document towards a draft  CPM Report – Chapter 2 – WRC-23 agenda item 1.8 | |
|  | |

**Introduction**

During the last WP 5B meeting, multiple contributions towards Draft CPM Report text were reviewed and compiled into a single text that was carried forward to this WP-5B meeting as an annex to the Chairman’s report. A summary of the status of various section was included along with indications of what additional items are need to complete this document.

**Proposal**

The United States provides additions and edits to this Draft CPM Text to provide missing text and edit text to improve the Agenda Item 1.8 Draft CPM Text.

**Attachment**

ATTACHMENT

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

[The attached document originates from a merger of the working document towards CPM text (Annex 4 to Document [5B/481](http://www.itu.int/md/R19-WP5B-C-0481/en)) and proposed changes to this as contained in contributions [5B/489](http://www.itu.int/md/R19-WP5B-C-0489/en) (revision marks “USA”) and [5B/520](http://www.itu.int/md/R19-WP5B-C-0520/en) (revision marks “multi 5B/520”). Following discussions at the March/April meeting of WP 5B, the attached is the result.

In respect of section 2/1.8/1, the Executive Summary, it was agreed to halt development of text for this section until the other sections are further developed.

In respect of section 2/1.8/2 and its subsections, the text was agreed as shown as clean text in the attached document.

In respect of section /1.8/3, it was decided to halt development of subsection 2/1.8/3.1 until the other subsections of section 3 were further developed.

The text for subsection 2/1.8/3.2 was agreed and is shown as clean text. It was however noted that it was not known if the new Report ITU-R M.[UA\_PFD] would be finished before WRC-23 and for this reason, awaiting what will be the outcome, the reference to this Report is placed in square brackets.

The text for subsection 2/1.8/3.3 as contained in the annex to the WP 5B Chairman’s Report (Annex 4 to Document [5B/481](http://www.itu.int/md/R19-WP5B-C-0481/en)) was discussed and agreed. This is shown as the clean text in this subsection. Following this, proposed elements from contributions [5B/518](http://www.itu.int/md/R19-WP5B-C-0518/en) and [5B/521](http://www.itu.int/md/R19-WP5B-C-0521/en) were extracted and included into this subsection together with elements from subsection 2/1.8/3.3.1 from Annex 4 to Document [5B/481](http://www.itu.int/md/R19-WP5B-C-0481/en) and subsection 1/1.8/3.3.1 subsequently suggested deleted. Following this, suggestions to improve and clarify the language of Nos. 3 and 4 in subsection 2/1.8/3.3, with no change to the content, were made. It was also noted that after amendments of the title to subsection 2/1.8/3.3, this now is identical to that of section 2/1.8/3. A new title to subsection 2/1.8/3.3 therefore may be considered. Due to lack of time, it was not possible to return to and discuss these proposed new elements which therefore remain shown with track changes, indicating their origin.

The text for subsection 2/1.8/3.4 and its subsections was discussed and agreed as shown in clean text. Noting that contribution [5B/486 rev 1](https://www.itu.int/md/R19-WP5B-C-0486/en) which is discussing the status of secondary allocations in respect of WRC agenda items would only be introduced and discussed at the last Plenary of WP 5B at the Marc/April 2022 meeting, a placeholder was inserted in subsections 2/1.8/3.4 and 2/1.8/3.4.2 to consider if and how the outcome of that discussion would have an impact on agenda item 1.8. For the same reason, two sentences of subsection 2/1.8/3.4.2 were placed in square brackets. In subsection 2/1.8/3.4.2, there is also an editor’s note to remind that there is a need to add text addressing limits and provisions in respect of controlling interference from transmitting UA CNPC Earth stations into receiving terrestrial stations.

There was no time to discuss sections 2/1.8/4 and 2/1.8/5 and no agreement should thus be assumed on the text in these sections. It is also noted that these sections would need to be significantly further developed to be completed at the July 2022 meeting of WP 5B.]

[USA Note: The US notes that the above text is informational in nature and was intended to guide for further development of this document.]

**Attachment:** 1

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

**[**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

UA are aircraft that are piloted remotely through the established communication link.

Report ITU-R M.2171 identified the spectrum requirements for unmanned aircraft (UA) command and non-payload communication (CNPC) that would be needed to support flight through non-segregated airspace.

WRC-15, under its agenda item 1.5 considered the possibility to use fixed-satellite service (FSS) networks to provide UAS CNPC links and established Resolution **155 (WRC-15)** in order to benefit of the opportunity of using existing satellite transponders. 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.

WRC-23 agenda item 1.8 was therefore established by WRC-19 to, 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 FSS networks by control and non-payload communications of unmanned aircraft systems.

## 3/1.8/2.1 Unmannned aircraft system architecture

FSS based unmanned aircraft systems (UAS) comprise:

**Unmanned aircraft (UA):** UA designates all types of remotely piloted 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.

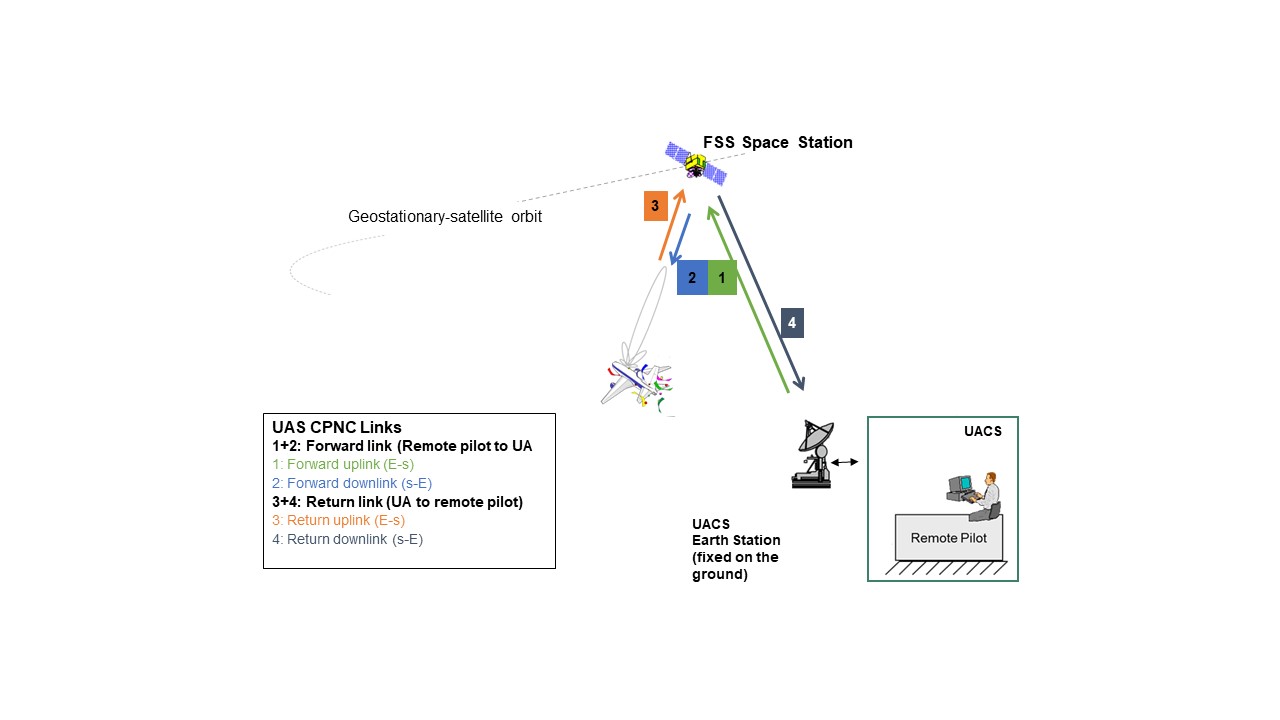
**UA control station (UACS[[4]](#footnote-4)):** Facility from which a UA is controlled remotely. The studies so far performed consider UACS earth stations using satellite communication located at a fixed point.

**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 2/1.8/2-1 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 2/1.8/2-1

Elements of UAS architecture using the FSS



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

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

TBD

## 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 the latest versions of:

– ITU-R [F.758](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](https://www.itu.int/rec/R-REC-S.465-6-201001-I/en), ITU-R [S.484](https://www.itu.int/rec/R-REC-S.484-3-199203-I/en), ITU-R [S.524](http://www.itu.int/rec/R-REC-S.524/en), ITU-R [S.579](https://www.itu.int/rec/R-REC-S.579-6-200504-I/en), ITU-R [S.728](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](https://www.itu.int/rec/R-REC-S.1062-4-200701-I/en), ITU-R [S.1064](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](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 the latest versions of:

– 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]**]**

[Editor’s Note: The above Report is placed in square brackets to await what will be the status of this Report at the end of this Study Cycle.]

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

In carrying out the technical and operational studies under 1.8 several key points were identified. Some of these key points are included in this section. Moreover, these key points are also included/reflected in Section 5 of Draft CPM text where applicable.

As can be seen in Figure 2/1.8/2-1, there are four different types of links between unmanned aircraft Earth stations and the fixed-satellite service (FSS) space stations:

**Link 1** UACS Earth station to FSS space station.

**Link 2** FSS space station to UA Earth station

**Link 3** UA Earth station to FSS space station

**Link 4** FSS space station to UACS Earth station

Earth stations for Links 1 and 4 are at a fixed specified location and are thus consistent with regular FSS operation. Links 2 and 3 involve mobile Earth stations and require additional consideration.

Key principles for UAS CNPC operation include:

1 The FSS space stations and the UACS Earth stations would fall in the category of regular FSS and be coordinated and notified following the regular Article 9 and 11 procedures for FSS networks and associated Typical/Specific FSS Earth stations.

2 UAS CNPC operation considered under WRC-23 agenda item 1.8 is seen as an operation under the FSS which has a primary status in the frequency bands under consideration and continues to have primary status.

3 UAS CNPC links and associated space and earth stations need to operate within the envelope of the technical characteristics and operational parameters of assignments of an associated FSS network(s) which is successfully coordinated and recorded in the MIFR.

4 [Note: Appears to duplicate item 3 above]5 In order to assess whether the safety-of-life requirements for a CNPC link could be fulfilled for a given flight, while the notifying administration has a certain amount of information related the coordination of its satellite networks, only the operator of the satellite on which the CNPC link will operate will have the full information related to the technical performance which is needed by the entity assessing the compliance to the safety-of-life requirement for a CNPC link.

6 FSS satellite networks with which UAS CNPC communicate do not have safety status.

7 In ITU, the notifying administration of the associated FSS network has no responsibility in respect of the safe operation of the UAS CNPC. However, UAS CNPC operation under an FSS network may lead to requirements or obligations for the notifying administration of the FSS network.

8 [Note: Appears to duplicate item 7 above]9 No additional status is to be granted 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.

10 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.

11 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.

12

13 The operation of UA earth stations on-board the unmanned aircraft should neither restrict nor limit/impact current operation and future development of terrestrial services/stations.

14 Receiving UA earth stations should not claim more protection from transmitting stations of terrestrial services than any Typical/Specific Earth station in that GSO FSS network. .

15 Transmitting UA earth stations should not cause unacceptable interference into receiving stations of terrestrial services.

16 In ITU, notifying administrations of terrestrial systems have no responsibility in respect of the safe operation of UAS CNPC.

17 Safety-of-life related to CNPC links cannot be assured on a generic basis for CNPC FSS, but rather will be assessed against ICAO requirements on a flight-by-flight basis based on the actual CNPC FSS radiofrequency environment at the time of flight.

18 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.

19 In revising Resolution 155 (Rev.WRC-19), ITU should not include provisions or assign responsibilities to countries in respect of topics that are already covered by ICAO.

20 In revising Resolution 155 (Rev.WRC-19), care should be taken not to include provisions wherein ITU would check that countries have followed the ICAO rules, but rather leave it to ICAO to check this.

21 If ICAO and the aviation community deems that the above key points for UAS CNPC operation in the FSS bands are not agreeable, then CNPC FSS links could not be used for the operation of UAS.

22 Responsibility under the Radio Regulations for the licensing and resolving the case of interference from the CNPC links, including the actions to be taken to address cases of harmful interference, will have to stay in line with the current ITU principles and procedures, notably as established for the operation of other aeronautical satellite earth stations (ESIMs).

## 2/1.8/3.4 Sharing considerations

Under this agenda item, assignments pertaining to 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. 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 2/1.8/3.4.4, is a discussion on measures in respect of the radio astronomy service.

With respect to other secondary services in the abovementioned frequency bands the following course of action is to be taken:

TBD

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.

### 2/1.8/3.4.1 Relationship between UAS CNPC links and other satellite networks

UAS CNPC links need to operate within the notified and recorded technical parameters of the associated FSS satellite network as well as within the coordinated limits of that satellite network. The use of FSS networks for CNPC links should in no way give rise to adversely affect other satellite networks. 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 radiocommunication service, is subject to unpredictable unintentional interference which needs to be taken into account and duly mitigated in considering UAS CNPC operation in the above mentioned 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 those assignments pertaining to other satellite networks recorded in MIFR under RR No. **11.41.** Moreover, operation of UAS CNPC links should 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 need to be addressed under the current regulatory procedures/provisions and therefore would not require any further sharing and interference analysis with satellite networks and systems. The above conditions are necessary in order not to put any constrains/not adversely affect the operations of other FSS networks.

It is worth to mention that safety aspects of UAS CNPC operation is addressed in section 2/1.8/3.3.

### 2/1.8/3.4.2 Relationship with terrestrial services

With respect to the relationship between UAS CNPC and terrestrial services, the following three cases need to be taken into account:

1) Space station used for UAS CNPC

2) UACS Earth station at fixed, known location

3) UA CNPC Earth stations on board unmanned aircraft

The relationship between the stations referred in 1) and 2) above and terrestrial services are covered under the current procedures of the Radio Regulations. The relationship between UA CNPC Earth station and terrestrial services is described below.

UA CNPC 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 CNPN Earth stations with terrestrial services is based on two principles (see also section 2/1.8/3.3):

- Receiving UA earth stations need to not seek protection from terrestrial services and shall pose no limitation on the current terrestrial services nor the future development of these.

- Transmitting UA earth stations need to 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 CNPN Earth stations from terrestrial services nor are any provisions in the Radio Regulations 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 primary allocations to terrestrial services in the 29.5-30 GHz band which is subject to this agenda item. **[**However there are secondary services (see below). 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.

[Editor’s Note: Add text on technical studies for 14-14.47 GHz, limits and provisions in respect of transmitting UA earth stations]

With respect to terrestrial services under a secondary allocation in the abovementioned frequency bands, the following course of action is to be taken:

### 2/1.8/3.4.3 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 CNPC 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 the space station or the UACS Earth station is required under this agenda item.

In respect of protection of RNS from transmitting UA CNPC Earth stations, it is to be emphasised that should these UA CNPC Earth stations operate within the envelope of technical characteristics and operational parameters as well as the envelope of coordinated limits of specific and/or typical earth stations of the associated FSS network recorded in MIRF with favourable findings there would be no additional requirements to protect RNS from transmitting UA CNPC Earth stations.

### 2/1.8/3.4.4 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 FSS (Earth-to-space) in 14-14.47 GHz band subject to this agenda item. This band will see operation of transmitting UA CNPC 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:

**• *RR.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;”*

– Recommendation ITU-R RA.769-2 provides the interference threshold pfd density for radio astronomy receivers (−221 dB(W/(m2 • Hz))). Recommendation ITU-R RA.1513-2 explains that the protection threshold in Recommendation ITU-R RA.769-2 may be exceeded for 2% of the time by systems operating in one network, as long as the threshold is not violated for more than 5% of the time by all networks.

– RR Article **29** describes 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.

Noting that there are a limited number of radio astronomy stations at known locations, it may be appropriate to 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. However, no compatibility or sharing studies have yet been conducted.

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

[X] methods to satisfy WRC-23 agenda item 1.8 have been identified. The below subsections give a description of each of these methods.

## 2/1.8/4.1 Method 1

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.

## 2/1.8/4.2 Method 2

TBD

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## 2/1.8/4.X Method X

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. As opposed to most WRC agenda items, NOC is not a viable option under WRC-23 agenda item 1.8. 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)**.

[Editor’s Note: 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

The following subsections provide example regulatory text in response to the methods to satisfy WRC-23 agenda item 1.8 as identified in section 2/1.8/4.

2/1.8/5.1 Method 1

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.

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations  
(See No. 2.1)

MOD

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

MOD

RESOLUTION 155 (REV.WRC‑23)

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[[5]](#footnote-7)\*

The World Radiocommunication Conference (XXX, 2023),

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 to this Resolution;

*c)* that CNPC links between space stations and stations on board unmanned aircraft (UA) are permitted 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

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 WRC‑15 adopted Resolution **156 (WRC‑15)** 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 (SARPs) 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 SARPs to ensure safe operation of UAS under these conditions;

*c)* that Section VI of Article **22** contains limits on equivalent isotropically radiated power at off-axis angles of 3 degrees or more for earth stations of a geostationary satellite network in the fixed-satellite service in the frequency bands 14-14.47 GHz and 29.5-30 GHz;

*d)* that terrestrial services operate in the frequency bands 10.95-11.2 GHz, 11.45-11.7 GHz, 11.7-12.1 GHz (Region 2), 12.1-12.2 GHz (on the territory of the country listed in No. **5.489**), 12.2-12.5 GHz (Region 3), 12.5-12.75 GHz (on the territory of the countries listed in No. **5.494** and in Region 3);

*e)* that terrestrial services also operate in the frequency bands 14.0-14.3 GHz (on the territory of countries listed in No. **5.505**), 14.25-14.3 GHz (on the territory of countries listed in No. **5.508**), 14.3-14.4 GHz (Regions 1 and 3), and 14.4-14.47 GHz;

*f)* that CNPC links using earth stations onboard unmanned aircraft are not subject to the regulatory provisions that apply to earth stations in motion (ESIM),

resolves

1 that, for CNPC links using Earth stations onboard Unmanned Aircraft (“CNPC UA ES”) communicating with a GSO FSS space station 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), or parts thereof, are an application of the primary FSS (Fixed-Satellite Service) and the following conditions shall apply:

1.1 with respect to space services in the frequency bands referred to in *resolves* 1, the notifying administration of the GSO FSS network shall ensure that its CNPC UA ES complies with the following conditions:

1.1.1 with respect to satellite networks or systems of other notifying administrations, the CNPC UA ES characteristics shall remain within the envelope of characteristics of the typical earth stations associated with the satellite network with which the CNPC UA ES communicates;

1.1.2 that CNPC UA ES shall be designed and operated so as to be able to meet their required performance with interference caused by other satellite networks resulting from application of Articles **9** and **11** andthe use of CNPC UA ES shall not cause more interference and shall not claim more protection than any Typical Earth station in that GSO FSS network;

1.1.3 the operation of CNPC UA ES shall comply with the coordination agreements for the frequency assignments of the Typical Earth station of the GSO FSS networks obtained under the relevant provisions of the Radio Regulations, taking into account *resolves* 3.4;

1.1*.*4 for the implementation of *resolves*1.1.1, the notifying administration for the GSO FSS networks with which the CNPC UA ES communicate shall, in accordance with this Resolution, send to the Radiocommunication Bureau (BR) information on assignments for which the UG station class shall be applied or, alternatively, the relevant Appendix **4** notification information related to the characteristics of the CNPC UA ES intended to communicate with those GSO FSS networks, together with the commitment that the CNPC UA ES operation shall be in conformity with the Radio Regulations, including this Resolution;

1.2 with respect to terrestrial services in the frequency bands referred to in *resolves* 1, the notifying administration of the GSO FSS network shall ensure that its CNPC UA ES complies with the following conditions:

1.2.1 receiving CNPC UA ES in the frequency bands referred to in *recognizing d)* shall be designed and operated so as to be able to accept the interference from stations of terrestrial services to which the frequency band is allocated when those stations of terrestrial services operate in accordance with the Radio Regulations;

1.2.2 transmitting CNPC UA ES in the frequency bands referred to in *recognizing e)* shall be designed and operated so as to not cause harmful interference to stations of terrestrial services to which the frequency band is allocated when those terrestrial stations operate in accordance with the Radio Regulations, and Annex 2 (see *instructs the Director of the Radiocommunication Bureau* 1) to this Resolution shall apply so as to set the conditions for protecting terrestrial services from harmful interference in neighbouring countries in these frequency bands;

1.2.3 higher pfd levels than those provided in Annex 2 produced by CNPC UA ES on the surface of the Earth within any administration shall be subject to the prior agreement of that administration;

1.3 that, in order to protect the radio astronomy service in the frequency band 14.47‑14.5 GHz, the notifying administration of the GSO FSS network operating CNPC UA ES 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 CNPC UA ES in the frequency band 14.47-14.5 GHz do not exceed the level and percentage of data loss given in the most recent versions of Recommendations ITU-R RA.769 and ITU-R RA.1513;

2 that CNPC UA ES

2.1 using station class UG are permitted to communicate with a space station of a geostationary FSS satellite network operating in the frequency bands listed in *resolves* 1 and limited to the frequency bands listed in *resolves* 1 when communicating with a space station of a geostationary FSS satellite network under this resolution;

2.2 assignments of an FSS satellite network shall not constrain other FSS satellite networks beyond those already imposed by Typical Earth stations associated with the network during the application of the provisions of Articles **9** and **11** norresult in additional coordination constraints on terrestrial services under Articles**9** and **11**;

2.3 in application of this Resolution does not provide a regulatory status that is different from that derived from the GSO FSS networks with which they communicate, taking into account the provisions referred to in this Resolution (see *resolves* 3.4);

3 that, in order to ensure freedom from harmful interference, that may affect operation of UAS, the notifying administration of the GSO FSS network shall cooperate with the administration of the country in which the UA is registered to:

3.1 ensure that the use of CNPC UA ES is in accordance with international standards and recommended practices (SARPs) consistent with Article 37 of the Convention on International Civil Aviation;

3.2 take the required measures, consistent with No. **4.10**,to ensure freedom from harmful interference to CNPC UA ES and operated in accordance with this Resolution;

3.3 act immediately when their attention is drawn to any such harmful interference, as freedom from harmful interference to CNPC UA ES is imperative to ensure their safe operation, taking into account *resolves* 1.2.1;

3.4 use assignments associated with the FSS networks for CNPC UA ES (see Figure 1 in Annex 1), including assignments to space stations, Specific or Typical Earth stations and CNPC UA ES (see *resolves* 2.2), that have been successfully coordinated under Article **9** (including provisions identified in *resolves* 1.1.4) 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 (see *instructs the Director of the Radiocommunication Bureau* 2);

3.5 use techniques to maintain antenna pointing accuracy for the operation of CNPC UA ES with the associated GSO FSS satellites, without inadvertently tracking adjacent GSO satellites;

3.6 take all necessary measures so that CNPC UA ES are subject to permanent monitoring and control by a network control and monitoring centre (NCMC) or equivalent facility in order to comply with the provisions in this Resolution;

3.7 provide NCMC or equivalent facility permanent points of contact for the purpose of tracing any suspected cases of harmful interference from CNPC UA ES and to immediately respond to requests from the points of contact of authorizing administrations;

4 that the procedures in Section VI of Article **15** apply when:

4.1 CNPC UA ES causes harmful interference to stations of primary allocated services that are operating in accordance with the Radio Regulations;

4.2 CNPC UA ES receives harmful interference from stations of a primary allocated service that are not operating in accordance with the Radio Regulations;

4.3 CNPC UA ES receives harmful interference from stations of other than a primary allocated service.

5 that the notifying administration of the GSO FSS network shall ensure that the operation of CNPC UA ES within the territories, including territorial waters and territorial airspaces, of an administration shall be carried out only if authorized by that administration,

instructs the Director of the Radiocommunication Bureau

1 upon receipt of the notification information referred to in *resolves*1.1.4, the BR shall examine it with respect to the provisions referred to in *resolves*1.1.1, the commitments received with respect to the provisions referred to in *resolves* 1.1.4, conformity with *resolves* 3.4, and with respect to the conformity with the power flux-density (pfd) limits on the Earth’s surface specified in Annex 2 along with any agreements obtained as referred to in *resolves* 1.2.3;

2 if the finding from the examination in *instructs* 1 is favourable, the BR shall publish the modified or additional assignment along with the results of such examinations in the International Frequency Information Circular (BR IFIC) and the modified or additional assignment shall retain the priority date of protection with that of the existing assignment,

instructs the Secretary-General

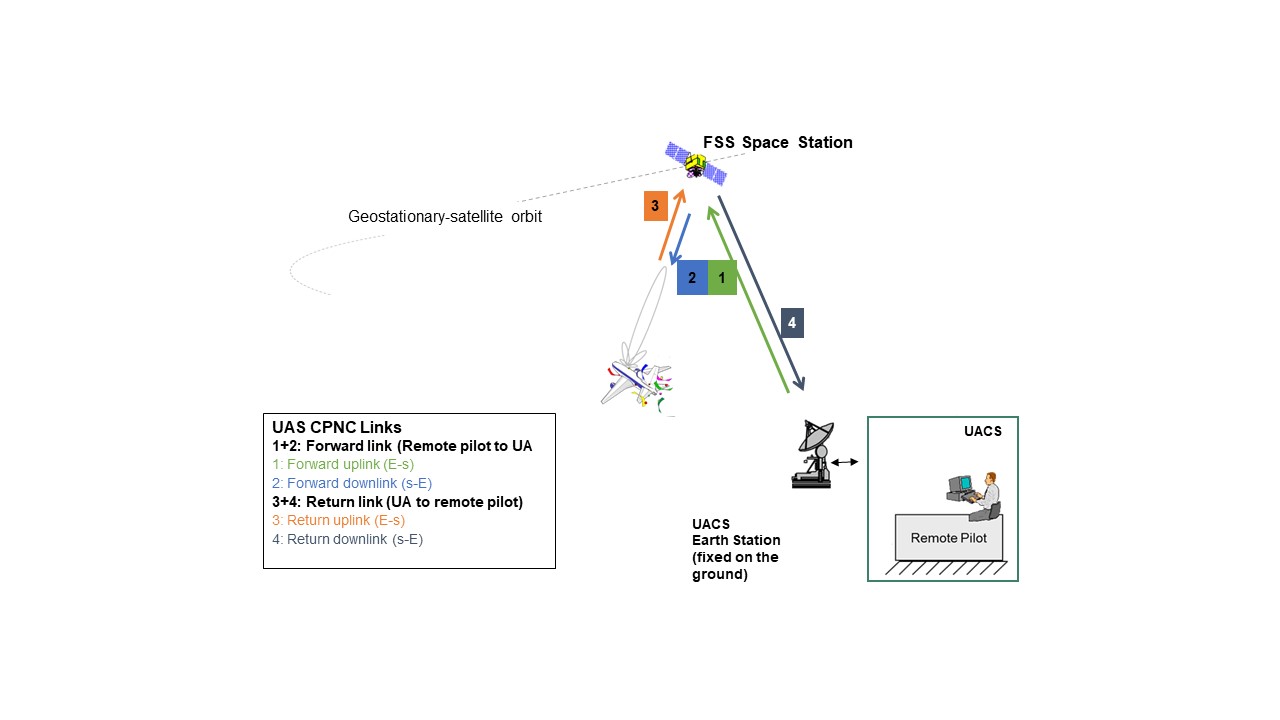
to bring this Resolution to the attention of the Secretary General of ICAO.

Annex 1 to Resolution 155 (rev.WRC‑19)

UAS CNPC links

Figure 1

Elements of UAS architecture using the FSS



Annex 2 to Resolution 155 (rev.WRC‑23)

Protection of terrestrial services from CNPC UA ES emissions

An earth station on board UA in the frequency band 14.0-14.3 GHz shall comply with the pfd limits described below, on the territory of countries listed in No.**5.505**:

     for 0° ≤ θ ≤ 90°

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

An earth station on board UA:

– in the frequency band 14.25-14.3 GHz on the territory of countries listed in No. **5.508**;

– in the frequency band 14.3-14.4 GHz in Regions 1 and 3;

– in the frequency band 14.4-14.47 GHz worldwide,

shall comply with the pfd limits described below:

     for 0° ≤ θ ≤ 90°

where θ 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.

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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

## 2/1.8/5.2 Method 2

TBD

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2/1.8/5.X Method X

SUP

5.484B

SUP

RESOLUTION 155 (REV.WRC‑19)

Regulatory provisions related to earth stations on board unmanned aircraft which operate with geostationary-satellite networks in the fixed-satellite   
service in certain frequency bands not subject to a Plan of Appendices 30,  
30A and 30B for the control and non-payload communications of   
unmanned aircraft systems in non-segregated airspaces[[6]](#footnote-10)\*

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

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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 as *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 as *Remote Pilot Station (RPS)* with the *Ground Earth Station* (GES)*.* [↑](#footnote-ref-4)
5. \* May also be used consistent with international standards and practices approved by the responsible civil aviation authority. [↑](#footnote-ref-7)
6. \* May also be used consistent with international standards and practices approved by the responsible civil aviation authority. [↑](#footnote-ref-10)