

MOD

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\***

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*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 proposed to be operated under this Resolution in the primary fixed-satellite service (FSS) in frequency bands shared with other primary services, including terrestrial services, however that would not preclude the use of other available allocations to accommodate this application,

*considering further*

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 (ESIMs) 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;

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

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,

*resolves*

1 that assignments to stations of GSO 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 in non-segregated airspace\*, provided that the conditions specified in *resolves* below are met;

2 that ESIMs on board UA may communicate with the space station of a GSO FSS network operating in the frequency bands listed in *resolves* 1 above, provided that the class of the ESIM on board UA is matched with the class of the space station and that other conditions of this Resolution are met (see also *instructs the Director of the Radiocommunication Bureau* 3 below);

3 that the frequency bands specified in *resolves* 1 shall not be used for the UAS CNPC links before the adoption of the relevant international aeronautical SARPs consistent with Article 37 of the Convention on International Civil Aviation, taking into account *instructs the Director of the Radiocommunication Bureau* 4;

4 that administrations responsible for an FSS network providing UA CNPC links shall apply the relevant provisions of Articles 9 (necessary provisions need to be identified or developed) and 11 for the relevant assignments, including, as appropriate, assignments to the corresponding space station, specific and typical earth station and ESIM on board UA, including the request for publication in the International Frequency Information Circular (BR IFIC) of items referred to in *resolves* 2 and the course of actions identified in that *resolves* in order to obtain international rights and recognition as specified in Article 8;

5 that earth stations of UAS CNPC links shall operate within the notified and recorded technical parameters of the associated satellite network, including specific or typical earth stations of the GSO FSS network(s) as published by the Radiocommunication Bureau (BR);

6 that earth stations of UAS CNPC links shall not cause more interference to, or claim more protection from, other satellite networks and systems than specific or typical earth stations as indicated in *resolves* 5 as published by BR;

7 that, in order to apply *resolves* 6 above, administrations responsible for the FSS network to be used for UAS CNPC links shall provide the level of interference for the reference assignments of the network used for CNPC links upon request by an administration authorizing the use of UAS CNPC links within its territory;

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

8 that earth stations of UAS CNPC links of a particular FSS network shall not cause more interference to, or claim more protection from, stations of terrestrial services than specific or typical earth stations of that FSS network as indicated in *resolves* 5 that have been previously coordinated and/or notified under relevant provisions of Articles 9 and 11;

9 that the use of assignments of an FSS satellite network for UAS CNPC links shall not constrain other FSS networks during the application of the provisions of Articles 9 and 11;

10 that the introduction of UAS CNPC links shall not result in additional coordination constraints on terrestrial services under Articles 9 and 11;

11 that earth stations on board UA shall be designed and operated so as to be able to accept the interference caused by terrestrial services operating in conformity with the Radio Regulations in the frequency bands listed in *resolves* 1 without complaints under Article 15;

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

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

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

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

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

16 that the pfd hard limits provided in Annex 2 shall be reviewed and, if necessary, revised by WRC-23<sup>1</sup>;

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

18 to consider the progress obtained by ICAO in the process of preparation of SARPs for UAS CNPC links, to review this Resolution at WRC-23, taking into account the results of the implementation of Resolution **156 (WRC-15)**, and to take necessary actions as appropriate;

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

*encourages administrations*

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

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

*invites the 2023 World Radiocommunication Conference*

to consider the results of the above studies referred to in this Resolution with a view to reviewing and, if necessary, revising this Resolution, and take necessary actions, as appropriate,

*invites the ITU Radiocommunication Sector*

to conduct, as a matter of urgency, relevant studies of technical, operational and regulatory aspects in relation to the implementation of this Resolution<sup>1</sup>,

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<sup>1</sup> WRC-19 received a proposal from one regional organization regarding protection of the fixed service using a revised pfd mask as contained in Annex 2 section b). ITU-R is invited, in continuing its study on the implementation of this Resolution, to consider this mask and take necessary action as appropriate.

*instructs the Director of the Radiocommunication Bureau*

- 1 to examine the relevant part of this Resolution requiring actions to be taken by administrations to implement this Resolution, with a view to sending it to administrations and posting it on the ITU website;
- 2 to present to subsequent WRCs a progress report relating to the implementation of this Resolution;
- 3 to define a new class of station in order to be able to process satellite network filings submitted by administrations for earth stations providing UA CNPC links, after the Resolution is implemented, in accordance with this Resolution, and publish the information as referred to in *resolves* 4;
- 4 not to process satellite network filing submissions by administrations with a new class of a station for earth stations providing UA CNPC links before *resolves* 1-12 and 14-19 of this Resolution are implemented;
- 5 to report to subsequent WRCs on the progress made by ICAO on the development of SARPs for UAS CNPC links,

*instructs the Secretary-General*

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

*invites the International Civil Aviation Organization*

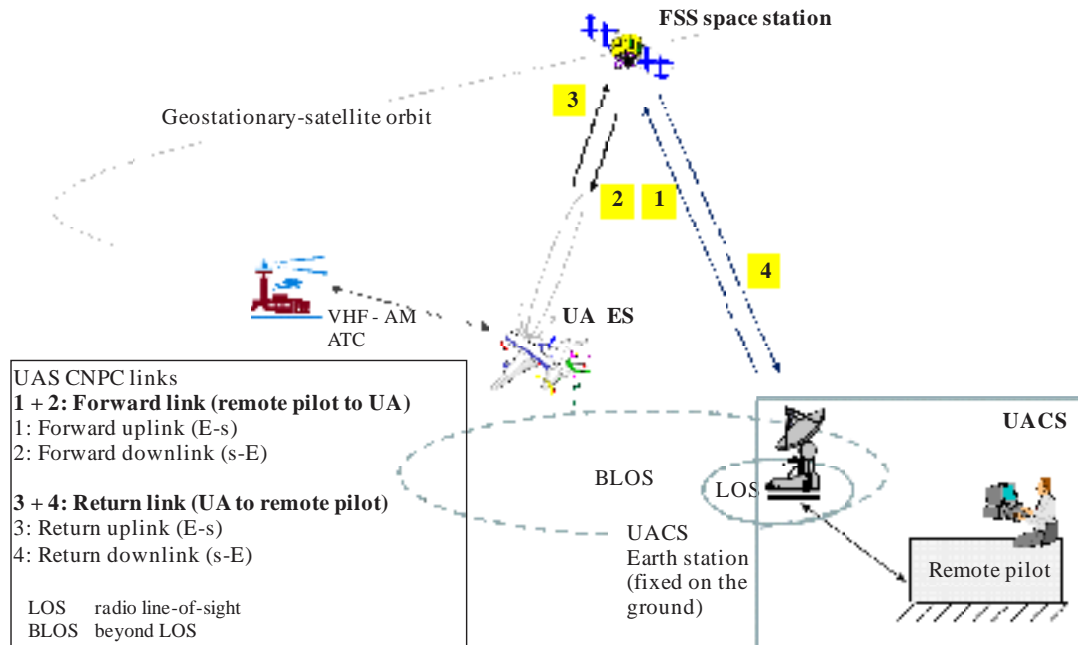
to provide to the Director of BR, in time for WRC-23, information on ICAO efforts regarding implementation of UAS CNPC links, including the information related to the development of SARPs for UAS CNPC links.

## ANNEX 1 TO RESOLUTION 155 (REV.WRC-19)

## UAS CNPC links

FIGURE 1

Elements of UAS architecture using the FSS



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## ANNEX 2 TO RESOLUTION 155 (REV.WRC-19)

## Protection of the fixed service from UAS CNPC emissions

## a) Example provided to WRC-15

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

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

$$\begin{array}{lll}
 -132 + 0.5 \cdot \theta & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for } 0^\circ \leq \theta \leq 40^\circ \\
 -112 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for } 40^\circ < \theta \leq 90^\circ
 \end{array}$$

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

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

**b) Example provided to WRC-19**

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**:

$$15\log(\theta+0.9) - 124 \text{ dB} \left( \text{W} / \left( \text{m}^2 \cdot \text{MHz} \right) \right) \quad \text{for } 0^\circ \leq \theta \leq 90^\circ$$

where  $\theta$  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:

$$15\log(\theta+0.9) - 133.5 \text{ dB} \left( \text{W} / \left( \text{m}^2 \cdot \text{MHz} \right) \right) \quad \text{for } 0^\circ \leq \theta \leq 90^\circ$$

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

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