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| **World Radiocommunication Conference (WRC-15)Geneva, 2–27 November 2015** |  |
| **INTERNATIONAL TELECOMMUNICATION UNION** |  |
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| PLENARY MEETING | **Document 115-E** |
|  | **16 October 2015** |
|  | **Original: English** |
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| Germany (Federal Republic of), Austria, Belgium, Croatia (Republic of), Estonia (Republic of), Finland, France, Hungary, Latvia (Republic of), Lithuania (Republic of), Luxembourg, Poland (Republic of), Portugal, Slovak Republic, Romania, Slovenia (Republic of), Turkey |
| Proposals for the work of the conference |
|  |
| Agenda item 1.5 |

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

Introduction

UA are aircraft that do not carry any human pilot but that are piloted remotely, i.e. through a reliable communication link. The development of Unmanned Aircraft Systems (UAS) is based on recent technological advances in aviation, electronics and structural materials, making the economics of UAS operations more favourable, particularly for more repetitive, routine and long duration applications. The current state of the art in UAS design and operation, is leading to the rapid development of UAS applications to fill many diverse requirements. There are a large variety of existing and envisioned applications of UAS such as cargo transportation, fire-fighting, flood monitoring, search and rescue, disaster operations management, oceanographic and atmospheric observations, weather forecasting, geological survey, monitoring of gas pipelines and electricity distribution systems, city and highway traffic, border patrol, law enforcement, counter drug operations, crop and harvest monitoring, broadcast and airborne relay-type services, as well as, of course, national security purposes. Further details on UAS applications in non-segregated airspace can be found in Report ITU-R M.2171.

UAS operations up to now have been limited to segregated airspace. However, it is planned to expand UAS deployment outside segregated airspace. The operation of UAS outside segregated airspace requires addressing the same issues as manned aircraft, namely safe and efficient integration into the air traffic control system. In the context of this agenda item, a UAS consists of an UA with an Earth station on-board to interconnect the UA and the associated Earth station of the unmanned aircraft control station (UACS) through a satellite operating in the FSS.

Report ITU-R M.2171 identified the spectrum requirements for unmanned aircraft system (UAS) command and non-payload communication (CNPC) links that would be needed to support flight through non-segregated airspace. Those requirements identified the need for both line of sight (LOS) and beyond line of sight (BLOS) spectrum. UAS CNPC links are under consideration at ITU since 2007. WRC-12 Agenda Item 1.3 dealt with terrestrial and satellite spectrum requirements to support the safe operation of unmanned aircraft systems in non-segregated airspace. In addition, as UA in segregated airspace already operate for several years in FSS frequency bands under No. 4.4 of the Radio Regulations for the UA-to-satellite CNPC links (see considering e) of Resolution 153 (WRC-12)), Agenda item 1.5 studied if this situation can be extended to UA in non-segregated airspace. This agenda item supports the addition of technical and regulatory provisions to enable use of some of the bands allocated to the fixed satellite service (FSS) for UAS CNPC links, provided compatibility with incumbent services can be ensured.

Sharing studies have addressed the conditions to ensure the protection of systems operating in the fixed services and have provided an estimation of the level of interferences seen by a receiver fitted on UA under various UAS operating conditions. ICAO UAS CNPC SARPS are in the early stage of development.

This proposal provides a regulatory framework for the operation of UAS CNPC links in FSS bands under the ITU Radio Regulations; thus obtaining international recognition. It includes text for a footnote to the appropriate FSS bands which points to a Resolution that spells out the conditions of use for operation of UAS.

This proposal to WRC-15 is based on two conditions:

– Other fixed satellite service applications as well as terrestrial services allocated in the frequency bands subject to this proposed Resolution should not be affected by the possibility offered for CNPC for UAS to use commercial FSS transponder;

– ICAO will be supportive of considering whether these provisions are acceptable for the development of SARPS which will ensure the safety of CNPC for UAS.

ARTICLE 5

Frequency allocations

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

MOD D/AUT/BEL/HRV/EST/FIN/F/HNG/LVA/LTU/LUX/POL/POR/SVK/ROU/
 SVN/TUR/115/1

10-11.7 GHz

|  |
| --- |
| Allocation to services |
| Region 1 | Region 2 | Region 3 |
| 10.7-10.95FIXEDFIXED-SATELLITE(space-to-Earth) 5.441(Earth-to-space) 5.484MOBILE except aeronauticalmobile | 10.7-10.95 FIXED FIXED-SATELLITE (space-to-Earth) 5.441 MOBILE except aeronautical mobile |
| 10.95-11.2FIXEDFIXED-SATELLITE(space-to-Earth) 5.484AADD 5.A15(Earth-to-space) 5.484MOBILE except aeronauticalmobile | 10.95-11.2 FIXED FIXED-SATELLITE (space-to-Earth) 5.484A ADD 5.A15 MOBILE except aeronautical mobile |
| 11.2-11.45FIXEDFIXED-SATELLITE(space-to-Earth) 5.441(Earth-to-space) 5.484MOBILE except aeronauticalmobile | 11.2-11.45 FIXED FIXED-SATELLITE (space-to-Earth) 5.441 MOBILE except aeronautical mobile |
| 11.45-11.7FIXEDFIXED-SATELLITE(space-to-Earth) 5.484A(Earth-to-space) 5.484 ADD 5.A15MOBILE except aeronauticalmobile | 11.45-11.7 FIXED FIXED-SATELLITE (space-to-Earth) 5.484A ADD 5.A15 MOBILE except aeronautical mobile |

**Reasons:** To add a footnote allowing the use of UAS CNPC links in the fixed-satellite service not subject to Appendices 30, 30A and 30B.

MOD D/AUT/BEL/HRV/EST/FIN/F/HNG/LVA/LTU/LUX/POL/POR/SVK/ROU/
 SVN/TUR/115/2

11.7-14 GHz

|  |
| --- |
| Allocation to services |
| Region 1 | Region 2 | Region 3 |
| 11.7-12.5FIXEDMOBILE except aeronautical mobileBROADCASTINGBROADCASTING-SATELLITE   5.492 | 11.7-12.1FIXED 5.486FIXED-SATELLITE(space-to-Earth) 5.484A 5.488ADD 5.A15Mobile except aeronautical mobile5.485 | 11.7-12.2FIXEDMOBILE except aeronautical mobileBROADCASTINGBROADCASTING-SATELLITE   5.492 |
| 12.1-12.2FIXED-SATELLITE (space-to-Earth) 5.484A 5.488ADD 5.A15 |
|  | 5.485 5.489 | 5.487 5.487A |
|  | 12.2-12.7FIXEDMOBILE except aeronauticalmobileBROADCASTINGBROADCASTING-SATELLITE   5.492 | 12.2-12.5FIXEDFIXED-SATELLITE(space-to-Earth)ADD 5.A15MOBILE except aeronauticalmobileBROADCASTING |
| 5.487 5.487A |  | 5.A84A 5.487 |
| 12.5-12.75 | 5.487A 5.488 5.490  | 12.5-12.75 |
| FIXED-SATELLITE(space-to-Earth) 5.484AADD 5.A15(Earth-to-space)5.494 5.495 5.496 | 12.7-12.75FIXEDFIXED-SATELLITE(Earth-to-space)MOBILE except aeronauticalmobile | FIXEDFIXED-SATELLITE(space-to-Earth) 5.484AADD 5.A15MOBILE except aeronauticalmobileBROADCASTING-SATELLITE 5.493 |

**Reasons:** To add a footnote allowing the use of UAS CNPC links in the fixed-satellite service not subject to Appendices 30, 30A and 30B.

MOD D/AUT/BEL/HRV/EST/FIN/F/HNG/LVA/LTU/LUX/POL/POR/SVK/ROU/
 SVN/TUR/115/3

14-15.4 GHz

|  |
| --- |
| Allocation to services |
| Region 1 | Region 2 | Region 3 |
| 14-14.25 FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B 5.484A    5.506 5.506B ADD 5.A15 RADIONAVIGATION 5.504 Mobile-satellite (Earth-to-space) 5.504B 5.504C 5.506A Space research 5.504A 5.505 |
| 14.25-14.3FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B 5.484A   5.506 5.506B ADD 5.A15 RADIONAVIGATION 5.504 Mobile-satellite (Earth-to-space) 5.504B 5.506A 5.508A Space research 5.504A 5.505 5.508 |
| 14.3-14.4FIXEDFIXED-SATELLITE(Earth-to-space) 5.457A5.457B 5.484A 5.506 5.506BADD 5.A15MOBILE except aeronauticalmobileMobile-satellite (Earth-to-space) 5.504B 5.506A 5.509ARadionavigation-satellite5.504A | 14.3-14.4FIXED-SATELLITE(Earth-to-space) 5.457A5.484A 5.506 5.506BADD 5.A15Mobile-satellite (Earth-to-space) 5.506ARadionavigation-satellite5.504A | 14.3-14.4FIXEDFIXED-SATELLITE(Earth-to-space) 5.457A5.484A 5.506 5.506BADD 5.A15MOBILE except aeronauticalmobileMobile-satellite (Earth-to-space) 5.504B 5.506A 5.509ARadionavigation-satellite5.504A |
| 14.4-14.47 FIXED FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B 5.484A 5.506 5.506B ADD 5.A15 MOBILE except aeronautical mobile Mobile-satellite (Earth-to-space) 5.504B 5.506A 5.509A Space research (space-to-Earth) 5.504A |

For information: the frequency band 14.47-14.5 GHz is not considered for use of UAS CNPC under the FSS due to co-channel allocation to the radioastronomy service.

**Reasons:** To add a footnote allowing the use of UAS CNPC links in the fixed-satellite service not subject to Appendices 30, 30A and 30B. To protect RAS in the frequency band 14.47-14.5 GHz, this band is not proposed for use by UA CNPC links.

MOD D/AUT/BEL/HRV/EST/FIN/F/HNG/LVA/LTU/LUX/POL/POR/SVK/ROU/
 SVN/TUR/115/4

18.4-22 GHz

|  |
| --- |
| Allocation to services |
| Region 1 | Region 2 | Region 3 |
| 18.4-18.6 FIXED FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B ADD5.A15 MOBILE |
| 18.6-18.8EARTH EXPLORATION-SATELLITE (passive)FIXEDFIXED-SATELLITE(space-to-Earth) 5.522BADD 5.A15MOBILE except aeronauticalmobileSpace research (passive) | 18.6-18.8EARTH EXPLORATION-SATELLITE (passive)FIXEDFIXED-SATELLITE(space-to-Earth) 5.516B 5.522BADD 5.A15MOBILE except aeronautical mobileSPACE RESEARCH (passive) | 18.6-18.8EARTH EXPLORATION-SATELLITE (passive)FIXEDFIXED-SATELLITE(space-to-Earth) 5.522BADD 5.A15MOBILE except aeronauticalmobileSpace research (passive) |
| 5.522A 5.522C | 5.522A | 5.522A |
| 18.8-19.3 FIXED FIXED-SATELLITE (space-to-Earth) 5.516.B 5.523A ADD 5.A15 MOBILE |
| 19.3-19.7 FIXED FIXED-SATELLITE (space-to-Earth) (Earth-to-space) 5.523B5.523C 5.523D 5.523E ADD 5.A15 MOBILE |
| 19.7-20.1FIXED-SATELLITE(space-to-Earth) 5.484A 5.516BADD 5.A15Mobile-satellite (space-to-Earth) | 19.7-20.1FIXED-SATELLITE(space-to-Earth) 5.484A 5.516BADD 5.A15MOBILE-SATELLITE(space-to-Earth) | 19.7-20.1FIXED-SATELLITE(space-to-Earth) 5.484A 5.516BADD 5.A15Mobile-satellite (space-to-Earth) |
| 5.524 | 5.524 5.525 5.526 5.527 5.528 5.529 | 5.524 |
| 20.1-20.2FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B ADD 5.A15 MOBILE-SATELLITE (space-to-Earth) 5.524 5.525 5.526 5.527 5.528 |

**Reasons:** To add a footnote allowing the use of UAS CNPC links in the fixed-satellite service not subject to Appendices 30, 30A and 30B.

MOD D/AUT/BEL/HRV/EST/FIN/F/HNG/LVA/LTU/LUX/POL/POR/SVK/ROU/
 SVN/TUR/115/5

24.75-29.9 GHz

|  |
| --- |
| Allocation to services |
| Region 1 | Region 2 | Region 3 |
| 27.5-28.5 FIXED 5.537A FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 ADD 5.A15 MOBILE 5.538 5.540 |
| 28.5-29.1 FIXED FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.523A 5.539 ADD 5.A15 MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540 |
| 29.1-29.5 FIXED FIXED-SATELLITE (Earth-to-space) 5.516B 5.523C 5.523E 5.535A5.539 5.541A ADD 5.A15 MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540 |
| 29.5-29.9FIXED-SATELLITE(Earth-to-space) 5.484A 5.516B 5.539 ADD 5.A15Earth exploration-satellite(Earth-to-space) 5.541Mobile-satellite (Earth-to-space) | 29.5-29.9FIXED-SATELLITE(Earth-to-space) 5.484A 5.516B 5.539 ADD 5.A15MOBILE-SATELLITE(Earth-to-space)Earth exploration-satellite(Earth-to-space) 5.541 | 29.5-29.9FIXED-SATELLITE(Earth-to-space) 5.484A 5.516B 5.539 ADD 5.A15Earth exploration-satellite(Earth-to-space) 5.541Mobile-satellite (Earth-to-space)  |
| 5.540 5.542 | 5.525 5.526 5.527 5.529 5.540  | 5.540 5.542 |

**Reasons:** To add a footnote allowing the use of UAS CNPC links in the fixed-satellite service not subject to Appendices 30, 30A and 30B.

MOD D/AUT/BEL/HRV/EST/FIN/F/HNG/LVA/LTU/LUX/POL/POR/SVK/ROU/
 SVN/TUR/115/6

29.9-34.2 GHz

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

ADD D/AUT/BEL/HRV/EST/FIN/F/HNG/LVA/LTU/LUX/POL/POR/SVK/ROU/
 SVN/TUR/115/7

5.A15 Resolution [115-A15] (WRC-15) shall apply. (WRC-15)

**Reasons:** To provide a footnote allowing the use of UAS CNPC links in the fixed-satellite service not subject to Appendices 30, 30A and 30B.

ADD D/AUT/BEL/HRV/EST/FIN/F/HNG/LVA/LTU/LUX/POL/POR/SVK/ROU/
 SVN/TUR/115/8

DRAFT NEW RESOLUTION [115-A15]

Regulatory provisions related to earth stations on board unmanned aircraft operating in non-segregated airspaces with geostationary satellite networks in the fixed-satellite service in certain frequency bands not subject to a Plan for the control and non-payload communications of unmanned aircraft systems

The World Radiocommunication Conference (Geneva, 2015),

considering

*a)* that worldwide use of unmanned aircraft systems, which include unmanned aircraft and unmanned aircraft control stations, is expected to increase significantly in the near future;

*b)* that unmanned aircraft need to operate seamlessly with piloted aircraft in non-segregated airspaces;

*c)* that the operation of unmanned aircraft systems in non-segregated airspaces requires reliable control and non-payload communication links, in particular to relay air traffic control communications and for the remote pilot to control the flight;

*d)* that satellite networks may be used to provide control and non-payload communication links of unmanned aircraft systems beyond the radio horizon while the unmanned aircraft is operating in non-segregated airspaces, as shown in Annex 1;

*e)* that, although other allocations are available to accommodate these control and non-payload communication links between space stations and stations on-board unmanned aircraft, these links are also proposed to be operated under this Resolution in the primary fixed satellite service in bands shared with other primary services, including terrestrial services;

*f)* that there is interest in harmonising internationally the use of spectrum for UAS CNPC links;

*g)* that the use of fixed satellite service (FSS) frequency assignments by UAS CNPC links relies on the successful application of the provisions of Articles 9 and 11 to the FSS assignments used for control and non-payload communication CNPC links of unmanned aircraft systems,

considering further

*a)* that various technical methods may be used to increase the reliability of digital communication links (e.g. modulation, coding, etc.) that can be used to ensure safe operation of unmanned aircraft systems in all airspaces;

*b)* that control and non-payload communications of unmanned aircraft systems relate to the safe operation of these systems and have to comply with certain technical, operational, and regulatory requirements,

noting

that Report ITU‑R M.2171 provides information on the vast number of applications where unmanned aircraft systems need access to non-segregated airspaces,

recognizing

*a)* that the power flux-density limits in Section V of Article 21 apply to space-to-Earth transmissions in the fixed-satellite service (FSS) for communications with UAS;

*b)* that ITU-R has developed conditions for operations of control and non-payload communication links without prejudging whether ICAO would consider the development of standards and recommended practices to ensure safe operation of unmanned aircraft systems under these conditions,

resolves

1 that geostationary FSS satellite networks operating in the space-to-Earth direction in the frequency bands 10.95-11.2 GHz (all Regions), 11.45-11.7 GHz (all Regions), 11.7-12.2 GHz (Region 2), 12.2-12.5 GHz (Region 3), 12.5-12.75 GHz (Regions 1 and 3), 18.4-20.2 GHz (all Regions) and in the Earth-to-space direction in the frequency bands 14-14.47 GHz (all Regions), 27.5-30 GHz (all Regions) may be used for the control and non-payload communications of unmanned aircraft systems operated in non-segregated airspace;

2 that earth stations on-board unmanned aircraft are allowed to communicate with the space station of a geostationary FSS satellite network operating in the frequency bands listed in *resolves* 1 above, including while the unmanned aircraft is in motion;

3 that earth stations on-board unmanned aircraft shall operate within the technical parameters of the associated typical earth stations of the geostationary FSS satellite network which is referred to in *resolves* 2 and shall not cause more interference to, nor claim more protection from, other satellite networks and systems than the above-mentioned typical earth stations that are located on the surface of the Earth;

4 that unmanned aircraft systems operated within the FSS as described in *resolves* 1 and 2 shall be treated in the same way as other FSS applications during all the phases of the coordination and notification process under Articles 9 and 11;

5 that the administration operating an unmanned aircraft system shall take the required measures, based on the international standards and recommended practices and procedures established by ICAO, to ensure freedom from harmful interference to earth stations receivers on-board unmanned aircraft operated in accordance with this Resolution, including the successful application of the provisions of Articles 9 and 11 to the FSS assignments used for control and non-payload communication CNPC links of unmanned aircraft systems;

6 that administrations operating control and non-payload communication links of unmanned aircraft systems shall

– ensure that the use of UAS CNPC links and their associated performance requirements shall be in accordance with the international standards and recommended practices (SARPS) and procedures established by ICAO consistent with Article 37 of the Convention on International Civil Aviation;

– act immediately when their attention is drawn to any harmful interference, taking into account *resolves* 7;

– use assignments associated with the FSS networks for UAS CNPC links (see Figure 1 in Annex 1) that have been recorded in the MIFR with a favourable finding;

– ensure that real-time interference monitoring, predicting interference risks, and planning solutions for potential interference scenarios, shall be addressed by FSS operators and UAS operators with guidance from aviation authorities taking into account the international standards and recommended practices and procedures established by ICAO;

7 that earth stations on-board unmanned aircraft shall be designed so as to be able to operate in the interference environment created by terrestrial services operating in the frequency bands listed in *resolves* 1 above without claiming protection from licenced stations of terrestrial services;

8 that, in order to protect the fixed and mobile services, the unmanned aircraft systems shall be operated in accordance with the conditions given in Annex 2;

9 that, in order to protect the radioastronomy service in the band 14.47-14.5 GHz, all unmanned aircraft systems operated in accordance with this Resolution in the 14-14.47 GHz band within line-of-sight of radio astronomy stations during radio astronomy observations shall have emissions in the band 14.47-14.5 GHz not exceeding the levels and percentage of data loss given in Recommendations ITU-R RA.769 and ITU-R RA.1513;

10 that WRC-19 shall review, on the basis of the information contained in the Report from the Director of the BR, the actual progress of development by ICAO of the international standards and recommended practices and procedures for the operation of CNPC links for UAS in the frequency bands mentioned in *resolves* 1;

11 that WRC-19 shall decide, on the basis of the review mentioned in *resolves* 10, if the provisions of this Resolution shall be maintained or removed from the Radio Regulations,

encourages concerned administrations

to cooperate with administrations which license control and non-payload communications of unmanned aircraft systems while seeking agreement under the provisions of this Resolution,

instructs the Secretary-General

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

invites ICAO

to inform, in time for WRC-19, the Director of the Radiocommunication Bureau whether the conditions contained in this Resolution allows ICAO to develop standards and recommended practices for CNPC links,

invites ITU-R

to provide technical characteristics on the interference environment of UAS CNPC links operated in FSS allocations in order to assist ICAO in conducting studies on the possibility to develop standards and recommended practices for such links.

Annex 1 to draft new Resolution [115-A15] (WRC‑15)

UA CNPC links

Figure 1

Elements of UAS architecture using the FSS



Annex 2 to DRAFT NEW Resolution [115-A15] (WRC-15)

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

1) UA shall not operate at latitudes above [] degrees;

2) UA shall not operate on frequencies in the band 14.00 to 14.47 GHz in altitudes below [] ft;

3) UA shall not operate on frequencies in the band 27.5-29.5 GHz in altitudes below [] ft;

4) Earth station on UA shall comply with the two band-specific PFD masks described below [TBD].

Editor's Note 1: “This annex will be subject to further input to WRC-15 by CEPT administrations”

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