

2015 WORLD RADIOCOMMUNICATION CONFERENCE

DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

Agenda Item 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 airspace in accordance with Resolution 153 (WRC-12)*

Background Information: 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. While the LOS requirements were addressed at the last World Radiocommunication Conference (WRC) held in 2012 the BLOS requirements were only partially addressed. As a result a new agenda item for the 2015 WRC (Agenda Item 1.5) was established to investigate whether fixed satellite networks, not subject to Appendix 30, 30A and 30B could be used to provide additional capacity for UAS CNPC links. This agenda item ~~is to~~ supports the addition of technical and regulatory provisions to enable use of portions of bands allocated to the fixed satellite service (FSS) for ~~unmanned aircraft system (UAS) control and non-payload communications (CNPC)~~ links in non-segregated airspace, if provided studies demonstrate compatibility with incumbent services and that the requirements of aviation authorities are satisfied ~~without supporting the addition of an aeronautical mobile satellite (route) service (AMS(R)S) allocation to the FSS bands used for this purpose.~~

In the context of this agenda item, a UAS consists of an ~~unmanned aircraft (UA)~~ with an Earth station on-board to interconnect the UA and the associated Earth station of the unmannered aircraft control station (UACS) ~~with its own Earth station~~ through a satellite operating in the FSS. UA are aircraft that do not carry a human pilot but that are piloted remotely, i.e. through a reliable communication link ~~(CNPC) from outside the aircraft.~~ UAS operations up to now have been limited to segregated airspace. However, it is planned to expand UAS deployment outside of segregated airspace.

The development of UAS is based on recent technological advances in aviation, electronics and structural materials, making the economics of UAS operations more favorable, particularly for more repetitive, routine and long-~~haul~~ 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 in the fields of economy, public safety and science. Further details on UAS applications in non-segregated airspace can be found in Report ITU-R M.2171. 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.

A huge number of More than 100 geostationary satellite communication networks operate ~~on in~~ frequency bands allocated to the FSS in the bands 10.7-12.75, 13.75-14.5, 17.3-20.2, and 27.5-30.0 GHz. Report ITU-R M.2171 identifies a large variety of prospects for UAS remotely piloted (Unmanned) aircraft that would need to fly long-distances (worldwide) through airspaces controlled by civil air traffic control (ATC). Immediate access to this globally existing capacity would provide great advantages for UAS fleet operators fostering new applications, enabling faster developments of new markets, while providing

planning stability for significant investments. Studies under this agenda item investigated the link feasibilities and sharing conditions for using UAS CNPC links over typical frequency spectrum allocated in several FSS allocations ~~under which such applications could be authorized.~~

Report ITU-R M.2233 contains examples of technical characteristics for UA CNPC including FSS systems operating in portions of the frequency ranges 10.95-14.5 GHz and 17.3-30.0 GHz. These examples indicated that it may be possible to operate UAS CNPC links in these bands while meeting the desired link performance. It is recognized that a further Report may be available by the time of WRC-15.

The proposal found below sets forth the basis for accomplishing ~~the this~~ objective of using frequency bands allocated to the FSS for safe operation of UAS CNPC links. It includes text for a footnote to the appropriate FSS bands which points to a Resolution that spells out the conditions of use for supporting safe and efficient operation of UAS.

Proposal:

ADD USA/1.5/1

ARTICLE 5

Frequency allocations

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

10-11.7 GHz

Allocation to services		
Region 1	Region 2	Region 3
10.7-11.7 FIXED FIXED-SATELLITE (space-to-Earth) 5.441 5.484A 5.XXX (Earth-to-space) 5.484 MOBILE except aeronautical mobile	10.7-11.7 FIXED FIXED-SATELLITE (space-to-Earth) 5.441 5.484A 5.XXX MOBILE except aeronautical mobile	

11.7-14 GHz

Allocation to services			
Region 1	Region 2	Region 3	
11.7-12.5 FIXED MOBILE except aeronautical mobile BROADCASTING BROADCASTING-SATELLITE 5.492	11.7-12.1 FIXED 5.486 FIXED-SATELLITE (space-to-Earth) 5.484A 5.488 5.XXX Mobile except aeronautical mobile 5.485	11.7-12.2 FIXED MOBILE except aeronautical mobile BROADCASTING BROADCASTING-SATELLITE 5.492	
	12.1-12.2 FIXED-SATELLITE (space-to-Earth) 5.484A 5.488 5.XXX 5.485 5.489		5.487 5.487A
	5.487 5.487A	12.2-12.7 FIXED MOBILE except aeronautical mobile BROADCASTING BROADCASTING-SATELLITE 5.492	12.2-12.5 FIXED FIXED-SATELLITE (space-to-Earth) 5.XXX MOBILE except aeronautical mobile BROADCASTING 5.484A 5.487
	12.5-12.75 FIXED-SATELLITE (space-to-Earth) 5.484A 5.XXX (Earth-to-space)	5.487A 5.488 5.490	12.5-12.75 FIXED FIXED-SATELLITE (space-to-Earth) 5.484A 5.XXX MOBILE except aeronautical mobile BROADCASTING-SATELLITE 5.493
5.494 5.495 5.496	12.7-12.75 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE except aeronautical mobile		
13.75-14	FIXED-SATELLITE (Earth-to-space) 5.484A 5.XXX RADIOLOCATION Earth exploration-satellite Standard frequency and time signal-satellite (Earth-to-space) Space research 5.499 5.500 5.501 5.502 5.503		

14-14.5 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 5.XXX RADIONAVIGATION 5.504 Mobile-satellite (Earth-to-space) 5.504B 5.504C 5.506A Space research 5.504A 5.505	
14.25-14.3	FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B 5.484A 5.506 5.506B 5.XXX RADIONAVIGATION 5.504 Mobile-satellite (Earth-to-space) 5.504B 5.506A 5.508A Space research 5.504A 5.505 5.508	
14.3-14.4 FIXED FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B 5.484A 5.506 5.506B 5.XXX MOBILE except aeronautical mobile Mobile-satellite (Earth-to-space) 5.504B 5.506A 5.509A Radionavigation-satellite 5.504A	14.3-14.4 FIXED-SATELLITE (Earth-to-space) 5.457A 5.484A 5.506 5.506B 5.XXX Mobile-satellite (Earth-to-space) 5.506A Radionavigation-satellite 5.504A	14.3-14.4 FIXED FIXED-SATELLITE (Earth-to-space) 5.457A 5.484A 5.506 5.506B 5.XXX MOBILE except aeronautical mobile Mobile-satellite (Earth-to-space) 5.504B 5.506A 5.509A Radionavigation-satellite 5.504A
14.4-14.47	FIXED FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B 5.484A 5.506 5.506B 5.XXX MOBILE except aeronautical mobile Mobile-satellite (Earth-to-space) 5.504B 5.506A 5.509A Space research (space-to-Earth) 5.504A	
14.47-14.5	FIXED FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B 5.484A 5.506 5.506B 5.XXX MOBILE except aeronautical mobile Mobile-satellite (Earth-to-space) 5.504B 5.506A 5.509A Radio astronomy 5.149 5.504A	

17.3-18.4 GHz

Allocation to services		
Region 1	Region 2	Region 3
17.3-17.7 FIXED-SATELLITE (Earth-to-space) 5.516 (space-to-Earth) 5.516A 5.516B 5.XXX Radiolocation 5.514	17.3-17.7 FIXED-SATELLITE (Earth-to-space) 5.516 BROADCASTING-SATELLITE Radiolocation 5.514 5.515	17.3-17.7 FIXED-SATELLITE (Earth-to-space) 5.516 Radiolocation 5.514
17.7-18.1 FIXED FIXED-SATELLITE (space-to-Earth) 5.484A (Earth-to-space) 5.516 MOBILE	17.7-17.8 FIXED FIXED-SATELLITE (space-to-Earth) 5.517 (Earth-to-space) 5.516 BROADCASTING-SATELLITE Mobile 5.515	17.7-18.1 FIXED FIXED-SATELLITE (space-to-Earth) 5.484A (Earth-to-space) 5.516 MOBILE
	17.8-18.1 FIXED FIXED-SATELLITE (space-to-Earth) 5.484A (Earth-to-space) 5.516 MOBILE 5.519	
18.1-18.4	FIXED FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B 5.XXX (Earth-to-space) 5.520 MOBILE 5.519 5.521	

18.4-20.2 GHz

Allocation to services		
Region 1	Region 2	Region 3
18.4-18.6	FIXED FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B 5.XXX MOBILE	
18.6-18.8 EARTH EXPLORATION-SATELLITE (passive) FIXED FIXED-SATELLITE (space-to-Earth) 5.522B 5.XXX MOBILE except aeronautical mobile Space research (passive) 5.522A 5.522C	18.6-18.8 EARTH EXPLORATION-SATELLITE (passive) FIXED FIXED-SATELLITE (space-to-Earth) 5.516B 5.522B 5.XXX MOBILE except aeronautical mobile SPACE RESEARCH (passive) 5.522A	18.6-18.8 EARTH EXPLORATION-SATELLITE (passive) FIXED FIXED-SATELLITE (space-to-Earth) 5.522B 5.XXX MOBILE except aeronautical mobile Space research (passive) 5.522A
...		
19.7-20.1 FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B 5.XXX Mobile-satellite (space-to-Earth) 5.524	19.7-20.1 FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B 5.XXX MOBILE-SATELLITE (space-to-Earth) 5.524 5.525 5.526 5.527 5.528 5.529	19.7-20.1 FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B 5.XXX Mobile-satellite (space-to-Earth) 5.524
20.1-20.2	FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B 5.XXX MOBILE-SATELLITE (space-to-Earth) 5.524 5.525 5.526 5.527 5.528	

27.5-29.9 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 5.XXX MOBILE 5.538 5.540	
28.5-28.629.1	FIXED FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.523A 5.539 5.XXX MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540	
28.6-29.1	FIXED FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.523A 5.539 MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540	
...		
29.5-29.9 FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 5.XXX Earth exploration-satellite (Earth-to-space) 5.541 Mobile-satellite (Earth-to-space) 5.540 5.542	29.5-29.9 FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 5.XXX MOBILE-SATELLITE (Earth-to-space) Earth exploration-satellite (Earth-to-space) 5.541 5.525 5.526 5.527 5.529 5.540 5.542	29.5-29.9 FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 5.XXX Earth exploration-satellite (Earth-to-space) 5.541 Mobile-satellite (Earth-to-space) 5.540 5.542

29.9-30 GHz

Allocation to services		
Region 1	Region 2	Region 3
29.9-30	FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 5.XXX 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	

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 USA/1.5/2

5.XXX ~~This~~ The FSS in this frequency band may also be used for the control and non-payload communication ~~(CNPC)~~ of unmanned aircraft systems. ~~s.~~ s Such use shall be in accordance with Resolution [FSS-UA-CNPC] (WRC-15).

ADD USA/1.5/3

~~DRAFT~~ RESOLUTION [FSS-UA-CNPC] (WRC-15)

Provision related to Earth stations on board unmanned aircraft which operate with geostationary satellites in the fixed-satellite service for the control and non-payload communications (~~CNPC~~) of unmanned aircraft systems in non-segregated airspaces

The World Radiocommunication Conference (Geneva, 2015),

considering

- a) that worldwide use of unmanned aircraft systems (UAS) ,which includes the unmanned aircraft (UA) and the unmanned aircraft control station (UACS), is expected to increase significantly in the near future;
- b) that ~~unmanned aircraft (UA)~~ need to operate seamlessly with piloted aircraft in non-segregated airspace;
- c) that the operation of UAS in non-segregated airspace requires reliable control and non-payload communication (CNPC) links, in particular to relay ~~the~~ air traffic control communications and for the remote pilot to control the flight;
- d) that there is a demand for ~~the control of unmanned aircraft systems (UAS) CNPC links~~ via satellite communication networks ~~to relay control and non-payload for~~ communications (~~CNPC~~) beyond the radio horizon while operating in non-segregated airspace as shown in Annex 12;
- e) that there is a need to provide ~~regulation for the internationally harmonized~~ use of spectrum for UAS CNPC links application;
- f) that ~~appropriate the use of fixed satellite service (FSS) frequency assignments by UAS CNPC links should take into account their Article 11 notification status of a FSS network is a pre-requisite for the use of FSS space system (channel) for UA CNPC links;~~

considering further

- a) that there is a need to limit the ~~number-amount~~ of communication equipments onboard a UA;
- b) that, as a dedicated satellite system for UAS CNPC links is not likely to be implemented in the short or medium term, it is necessary to take into account the existing and future satellite systems to accommodate the growth in of the use of UAS operations;

c) that there are various technical methods that may be used to increase the reliability of digital communication links, e.g. modulation, coding, redundancy, etc. that can be used to ensure safe operations of UAS in ~~all non-segregated~~ air space;

d) that ~~for UAS CNPC communications used for the control of UA, relay of air traffic control (ATC) voice communications, and sense and avoid~~, relate to the safe operation of UAS and have certain technical, operational, and regulatory requirements;

e) that the requirements in *considering further d)* can be specified for UAS use of FSS networks,

noting recognizing

a) that Report ITU-R M.2171 provides information on the vast number of applications for UAS Unmanned Aircraft needing access to non-segregated airspaces;

b) that Recommendation **724 (WRC-07)** notes that FSS is not, intrinsically, a safety service;

recognizing

a) that appropriate technical and operational provisions can be implemented in the ITU-R to enhance the robustness of the UAS CNPC links;

b) that ~~the UAS CNPC links shall be operated~~, in accordance with international standards and recommended practices and procedures established the Convention in accordance with the Convention on International Civil Aviation, ~~the operation of UAS in non-segregated airspace has to meet standards and recommended practices;~~

c) that the International Telecommunications Union (ITU) and the International Civil Aviation Organization (ICAO) will carry out their mutual responsibilities in a cooperative manner.

d) that the respective roles of ICAO and the ITU must be fully understood to ensure appropriate separation of provisions to be addressed in the Radio Regulations and regulatory and operational matters that need to be addressed by ICAO.

e) that in this context, ITU will develop the typical conditions for operation of CNPC links, and then, ICAO will develop further operational conditions to ensure safe UAS operation,

resolves

1 that earth stations on-board UA can communicate with a space station operating in the fixed satellite service, including while the UA is in motion that UA control and non-payload communication shall operate under the regulatory and operational provisions contained in Annex 1;

2 that the use of such links and their associated performance requirements shall be ~~operated~~ in accordance with the international standards and recommended practices (SARPS) and procedures established by the International Civil Aviation Organization (ICAO) in accordance consistent with Article 37 of the Convention on International Civil Aviation;

3. that a fixed satellite service earth station on an unmanned aircraft shall be considered defined as an earth station operating in the fixed satellite service;

4. that the FSS stations operating in frequency bands supporting these CNPC links shall conform to the applicable technical provisions of the radio regulations;

5. that the use of UAS CNPC links is for safe operation and regularity of flight and requires absolute international protection;

6. that the freedom from harmful interference to UAS CNPC links is imperative to ensure safe operation and administrations shall act immediately when their attention is drawn to any such harmful interference;

7. that the FSS operator will ensure that the assignments associated with the FSS networks to be used for UAS CNPC links (see figure 1 in Annex 1) have obtained the necessary protected status under the provisions of No. 11.32, 11.32A, 11.42, or 11.42A including the examinations made by the BR and have been successfully registered in the MIFR;

8. that, real time interference monitoring and predicting interference risks, and planning solutions for potential interference scenarios, shall be addressed in the specific agreements between FSS operators and UAS operators with guidance from Aviation Authorities,

encourages concerned administrations

1. to cooperate with administrations which license UAS CNPC while seeking agreement under the above mentioned provisions,

instructs the Secretary-General

to bring this Resolution to the attention of the Secretary-General of the International Civil Aviation Organization (ICAO).

~~ANNEX 1 TO RESOLUTION [FSS-UA-CNPC] (WRC-15)~~

~~**Regulatory and operational provisions for UA-CNPC links operating through satellite systems operated in the FSS frequency bands**~~

- ~~1—It is anticipated that ICAO will develop associated standards and recommended practices (SARPs), taking into account the above.~~
- ~~2—Conformity with the Radio Regulations is ensured by application of Articles 9 and 11. In the course of this action, the BR always checks the consistency of any frequency assignment with the relevant technical and regulatory provisions contained in the RR, thus meeting the requirement in the ICAO conditions. Any UAS-CNPC link will operate under the protection provided by the registered FSS frequency assignments.~~
- ~~3—FSS frequencies used for UAS will use frequency assignments that are “successfully coordinated”. Satellite operators and administrations are required to carry out coordination of their FSS frequency assignments in accordance with the provisions contained in Article 9 of the Radio Regulations. The application of such provisions ensures that FSS frequency assignments can operate free from harmful interference caused by and to other systems. The efficiency of those rules is proven by the fact that FSS frequency assignments have been successfully operated for many years.~~
- ~~4—When the coordination process is completed, the BR will be notified (according to the provisions of RR Article 11) by the administration proposing the new system and the frequency assignments will be recorded in the MIFR. If a frequency assignment is recorded in the MIFR under RR 11.41, such an assignment is still entitled to protect and be protected against frequency assignments of other networks with which coordination has been successfully completed. The FSS operator then has to make sure that the outstanding coordination issues are examined to determine if UAS-CNPC operations can take place within the ICAO requirements. This would be done for example by determining whether the affected network with which coordination has not been achieved is actually in operation and if so what the operational parameters are (e.g. orbital location and filed power levels) to ensure that any resultant impact would be acceptable.~~
- ~~5—Predicting interference risks, planning solutions for potential interference scenarios, adopting measures to solve the interference issues and reporting on the interference cases, are elements which are well known to FSS operators and which should be included in the specific agreements between FSS operators and UAS operators with guidance from Aviation Authorities (some of which could be included in SARPs).~~
- ~~6—Innovative ways to detect and prosecute the interference cases are being developed nowadays at international level, in order to gain further experience and contribute to harmonized and transparent reporting mechanisms of interference cases.~~
- ~~7—The ITU and ICAO will carry out their mutual responsibilities in a cooperative manner. It is important that the respective roles of ICAO and the ITU be fully understood to ensure appropriate separation of regulatory needs to be addressed in the RR and operational issues to be addressed by ICAO processes. In this context, ITU will develop the typical conditions for operation of CNPC links, and then, ICAO will develop further operational conditions to ensure safe operation.~~

ANNEX 12 TO RESOLUTION [FSS-UA-CNPC] (WRC-15)

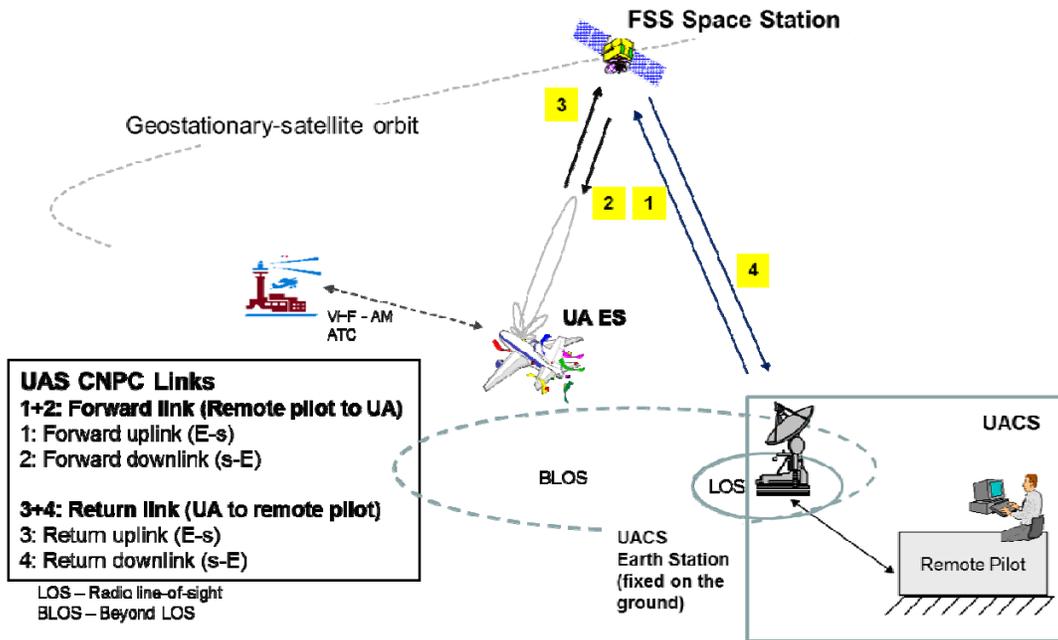
UA CNPC links-architecture

1 — **UA CNPC FSS Links**

FIGURE 1

Elements of UAS architecture using the FSS

Typical BLOS-CNPC links in an unmanned aircraft system



The forward and return (UAS) links via an FSS network