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| Summary:  |
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| Proposal: |
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DRAFT CEPT BRIEF ON 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);

# ISSUE

1. to conduct, in time for WRC‑15, the necessary studies leading to technical, regulatory and operational recommendations to the Conference, enabling that Conference to decide on the usage of FSS for the CNPC links for the operation of UAS;
2. to include, in the studies referred to in invites ITU‑R 1, sharing and compatibility studies with services already having allocations in those bands;
3. to take into account information from operations referred to in considering e

((considering e) that UAS already operate in fixed-satellite service (FSS) frequency bands for the UA to satellite CNPC links under No. 4.4 of the Radio Regulations)

 (note: this operation takes place outside of non-segregated airspace);

Resolution 153 (WRC-12) invites ITU-R to conduct, in time for WRC-15, the necessary studies enabling the Conference to decide on the usage of fixed-satellite service (FSS) for the CNPC links for the safe operation of UAS in non-segregated airspace. These studies will include compatibility studies with services already having allocations in those bands.

# Preliminary CEPT position

CEPT supports conducting, the necessary studies leading to technical, regulatory and operational recommendations to the WRC-15, enabling that Conference to decide on the usage of FSS for the CNPC links for the safe operation of UAS in non-segregated airspace.

# Background

## introduction

Unmanned aircraft systems (UAS) consist of an unmanned aircraft (UA) and associated unmanned aircraft control station (UACS).

UA are aircraft that are piloted remotely for all or part of the flight and may or may not carry a human pilot. Currently, UA operations have been restricted to segregated airspaces where separation from other air traffic can be assured. However, it is intended to expand the UA deployment outside 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 favourable, particularly for dull, dangerous, and difficult long-haul applications. The current state of the art in UAS design and operation, would already allow for a rapid development of UAS to serve many commercial, scientific, and public applications. For safe flight operations of unmanned aircraft (UA) reliable communication links are essential especially for the link between the remote pilot and the UA to command and control the UA and to relay air traffic communications. In ITU-R, links carrying all this information are addressed as 'Control and non-Payload Communication' (CNPC) links. WRC 12 AI 1.3 considered the spectrum requirements to support the safe operation of unmanned aircraft systems in non-segregated airspace.

WRC-15 Agenda Item 1.5 is to be considered in the continuation of WRC-12 Agenda Item 1.3. Regarding the satellite component of UAS CNPC links, WRC-12 agreed:

* That the spectrum requirements can be accommodated in existing satellite allocations.
* That use of FSS allocations should be studied in addition.

Some proposals submitted to WRC-12 intended to introduce provisions to the Radio Regulations that would have allowed using UA systems operating CNPCs under allocations to the fixed satellite service. But due to a lack of supporting studies, WRC-12 resolved to study this topic further and agreed on Agenda Item 1.5 of WRC-15 to consider, if and under which provisions the use of certain frequency bands allocated to the fixed satellite service, except those allocated under Appendices 30, 30A, and 30B, is appropriate for UA CNPC.

Protection criteria were not possible to be agreed within the ITU-R yet. This prevents the ITU-R to establish whether UAS CNPC links can operate safely in bands allocated to the FSS.

## Regulatory considerations

In the absence of results from technical studies, it is premature to work on the development of detailed regulatory provisions. However, the three following principles can already be proposed.

### Identification of bands for UAS

It is important that WRC-15 Agenda Item 1.5 should not be used to specifically point towards certain FSS allocations for UAS use. This would otherwise be detrimental to solutions in other allocations to services which definition directly encompasses UAS CNPC links.

The Resolution mechanism should therefore be used to translate in regulatory terms the possible outcomes from WRC-15 Agenda Item 1.5 studies, as this mechanism offers the possibility to provide details on the background in the considering and noting sections.

Proposals introducing new provisions for authorising UA CNPC applications are based on sharing conditions which sometimes differ for the various FSS allocations under consideration. Resolution 153 (WRC-12) already excludes certain bands and additional criteria as studied in Report ITU-R M.[UAS-FSS]. Clear guidance on the conditions of use by UA CNPC applications for each eligible FSS allocation is also given in this report.

### No ambiguity in the Radio Regulations

Certain frequency bands allocated to FSS and considered under WRC-15 Agenda Item 1.5 are also allocated to the mobile-satellite service or to the aeronautical mobile satellite service. And certain provisions of the Radio Regulations related to these services in certain frequency bands might be interpreted as making the consideration of these allocations for UAS CNPC links in non-segregated airspace difficult, although this application directly falls within the definition of these services.

Though this is not directly within the scope of WRC-15 Agenda Item 1.5, it will be necessary to revise these provisions, in case of positive outcomes of studies on the use of FSS for UAS CNPC links. Otherwise, this would create a difficult situation where “FSS earth stations on aircraft” for UAS CNPC links would be in accordance with the Radio Regulations, while aircraft earth stations (i.e. operated in the mobile-satellite or aeronautical mobile satellite services) would not.

This is for instance the case of No. 5.527 which states that “in the bands 19.7-20.2 GHz and 29.5-30 GHz, the provisions of No. 4.10 do not apply with respect to the mobile-satellite service”, and therefore might forbid the use of this band by aircraft earth stations for safety applications. No. 5.527 should therefore be revisited if the bands 19.7-20.2 GHz/29.5-30 GHz are considered positively under WRC-15 Agenda Item 1.5, otherwise resulting ambiguity may prevent ICAO from eventually considering the development of SARPS in these bands.

### Coordination requirement and notification of FSS Systems

The following question should be addressed in term of coordination status:

- what would be the impact on the coordination of existing/planned FSS application of the possible introduction of a safety application such as UAS CNPC links in non-segregated airspace.- the regulatory provisions to be included in the ITU Radio Regulations that would allow CNPC messages to be provided through FSS links, ensuring adequate protection for this safety service;

### Consideration of ICAO position

Careful consideration of the conditions contained in the ICAO position is being given to ensure consistency with ICAO technical and regulatory requirements for a safety service. This is required to provide the necessary assurance that there are no undue implications to other aeronautical systems. The ICAO position is contained under section 6.3.

## Technical considerations

Resolution 153 addresses FSS in general without pointing towards specific system architectures or specific frequency ranges. Technical characteristics of FSS systems are taken from WD PDNR Recommendation ITU-R S.[UAS-FSS].

It is recognized that UAS already operate in fixed-satellite service (FSS) frequency bands for the UA-to-satellite CNPC links under No. 4.4 of the Radio Regulations in segregated airspace. Additionally, it is recognized that FSS systems have the bandwidth capacity to meet the CNPC requirements.

### System architecture

It is proposed in particular to limit studies to geostationary (GSO) FSS systems, as this is the type of FSS system that is addressed in Resolution 153, implicitly under considering e) and explicitly under recognizing b).

At this stage, there is no reason to consider any other a priori limitation in the type of FSS system architecture considered. Studies such as that initiated by Germany under document 5B/111 to the November 2012 WP5B meeting will determine specific features (for instance spot beam coverage) required on FSS systems to adequately support CNPC links. And compatibility studies with incumbent services may then lead to certain technical constraints.

### Frequency bands

Regarding frequency bands to be investigated, the only exclusion in Resolution 153 is for FSS frequency bands subject to Appendices 30, 30A and 30B.

However, it is proposed to concentrate first on FSS ranges already discussed in WP5B, ie in the 10/14 GHz and the 20/30 GHz frequency ranges.

Further investigation on the interference to and from Earth stations on -board an UA with respect to services other than FSS is identified as required, since such scenarios have not been adequately addressed to date and covered by the ITU Radio Regulations.

For each of the above mentioned frequency ranges, the characteristics of FSS systems are given by WD PDNR Recommendation S.[UAS-FSS]. Studies with incumbent services should then be generic to a particular range and include the following sections:

* Studies with incumbent services in the 10/14 GHz range :
* Protection of UAs reception in FSS (space-to-Earth) allocations from emissions of incumbent services
* Protection of incumbent services reception from UAS emissions in FSS (Earth-to-space) allocations
* Studies with incumbent services in the 20/30 GHz range :
* Protection of UAs reception in FSS (space-to-Earth) allocations from incumbent services emissions
* Protection of incumbent services reception from UAS emissions in FSS (Earth-to-space) allocations

The detailed sub-bands eventually considered in each range can be decided at a later stage, taking into account different considerations such as:

* ICAO clarification on its preference for worldwide allocations, to determine if regional space-to-Earth FSS allocations in 11.7-12.75 GHz are to be considered
* Existing regulatory constraint, such as No. 5.502 of the Radio Regulations, which imposes a minimum antenna diameter of 1.2m for earth stations operating in the band 13.75-14 GHz. This can certainly be acceptable for UA Control Stations (UACS) but will likely be a difficulty for UA terminals.
* The possibility or not to derive specific considerations in the 20/30 GHz regarding the compatibility between UAS CNPC links operations on GSO FSS networks and NGSO FSS systems operations, in parts of the FSS allocation where GSO networks are subject to coordination with NGSO systems (i.e. 18.8/19.7 GHz and 28.6/29.5 GHz).
* The result of the different compatibility studies.

### Availability of UAS CNPC link

Discussions in WP5B indicate that one parameter considered essential in WRC-15 Agenda Item 1.5 studies is the minimum required availability of forward and return CNPC satellite links between UACS and UA.

ICAO has been questioned on this issue, and answered that the first guidance material resulting from its on-going standardization work on UAS CNPC links is “provisionally scheduled for 2014”. It seems therefore very possible that no figure be provided by ICAO in time for the completion of studies under WRC-15 Agenda Item 1.5, and it is necessary to adapt these studies consequently.

The objective of WRC-15 Agenda Item 1.5 is to investigate if it is possible to adapt the Radio Regulations in order to enable the use of certain FSS allocations for UAS CNPC links in non-segregated airspace. This work on the regulatory framework should not be mixed with standardization activities conducted in ICAO.

Studies under WRC-15 Agenda Item 1.5 regarding availability should therefore focus on the following elements:

* 1. to determine what typical availability is practical through FSS links deployed in different frequency bands., taking into account the technical characteristics of UA/UACS earth stations and the typical characteristics of space stations in the bands under consideration. ;
	2. to determine the UAS elements that might affect the availability of the CNPC link through a satellite (e.g. UAV or UACS antenna mispointing, electronic or mechanical failures of the satellite);
	3. to determine other elements that should be taken into account when assessing the compliance with a given availability requirement (e.g. attenuation due to gaseous absorption, attenuation due to the rain if the UAV is flying below the altitude of the clouds);
	4. to investigate and identify those techniques that could be deployed to achieve larger than typical availabilities, by using the satellite networks in operation today (e.g. use of appropriate link margin, use of adaptive code modulation schemes, use of link redundancy);
	5. taking into account the results obtained in section d), to determine and quantify the measures to be adopted to achieve a given link availability, provided that a minimum availability requirements performance is provided by ICAO.

These studies could then be used as an element among others to prepare WRC-15 Agenda Item 1.5. It might also provide ICAO with technical information which could be useful for its own UAS standardization activities once availability requirements are known.

### FSS protection criterion

First compatibility studies between FSS used for CNPC links and incumbent services have been presented to the November 2012 meeting of WP5B.

One of the parameters discussed in that framework is the FSS protection criterion to be considered in order to assess the impact of FS emissions on UA earth stations.

An I/N long-term criterion of -12.2 dB, not to be exceeded for more than 20% of time, was proposed, based on Recommendation ITU-R S.1432. However, the following remarks and questions were raised:

* Recommendation ITU-R S.1432 deals with “time-invariant” interference on FSS, which is not the case in the study in question since the FSS earth station is on a mobile UA.
* Is it reasonable to have a criterion that can be exceeded during 20% of time for the protection of a safety application like UAS CNPC links in non-segregated airspace
* The -12.2 dB value results from a 6% apportionment and applies for 100% of time.
* If a long-term criterion is used, it seems necessary to also have an associated short term criterion.
* It was also proposed to consider a possibility of application of the same protection criterion I/N = -12.2 dB being used for AMS(R)S (Recommendation ITU-R M.1234-1). Nevertheless, clarification on the interpretation of this recommendation was asked to WP 4B.

# List of relevant documents

ITU-Recommendations:

ITU-Reports: ITU-R M.2171, M.2204, M.2205, M.2233

Other ITU documents:

Updated information/documentation on the ITU-R Preparatory Studies for WRC-15 are available at <http://www.itu.int/ITU-R/go/rcpm-wrc-15-studies>.

CEPT and/or ECC Documentation (Decisions, Recommendations, Reports):

EU Documentation (Directives, Decisions, Recommendations, other):

# Actions to be taken

* Study the technical feasibility CNPC link under the restrictions applicable for FSS systems
* Study effects on the operation of terrestrial systems in the bands under study resulting from the operation of mobile Earth stations
* Study to what extent would satellite systems need to complete frequency coordination, given the due process that needs to be followed to enable frequency assignments to be entered into the MIFR, before use of satellite systems could be considered as suitable in the provision of CNPC links for UAS;
* Study the impact on the coordination of existing/planned FSS application of the possible introduction of a safety application such as UAS CNPC links in non-segregated airspace.
* Study the regulatory provisions to be included in the ITU Radio Regulations that would allow CNPC messages to be provided through FSS links, ensuring adequate protection for this safety service
* Study the compatibility between new UAS FSS and incumbent FSS
* Study how the conditions set by ICAO can be met.

# Relevant information from outside CEPT (examples of these are below)

## European Union (date of proposal)

## Regional telecommunication organisations:

APT (APG15-2, 1 – 5 July 2013)

Support ITU-R studies on measures to allow 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).

Satellite command and control links should comply with accepted safety requirements, including ICAO Standards and Recommended Practices (SARPs) when developed.

Any regulation modifications relating to UAS operation in FSS bands should not impact existing and future satellite networks of the FSS and other services in the same band.

Clear identification of globally harmonized spectrum for UAS CNPC links is preferred so that the current practice of licensing of manned aircraft following the ICAO standards can be extended to unmanned aircraft.

ATU (January 2014)

To support continuation of ongoing studies, and the position to be taken after the outcome of studies.

Arab Spectrum Management Group (AMSG, 28 November 2013)

Follow up the current studies with focus on frequency bands allocated to the fixed-satellite service not subject to Appendices 30, 30A and 30B .

Focus on protection of the existing services via providing the necessary regulatory, technical and operational regulations for using FSS allocations for safe operating the non-payload communications of unmanned aircraft systems (UAS) in non-segregated airspaces within activities of WP 5B.

CITEL (8 November 2013)

Preliminary views:

CAN

Support use of FSS bands not subject to App 30, 30A, 30B for UAS control and non-payload communications in non-segregated airspaces only if ITU-R studies show it’s possible to provide safe and efficient integration into the ATC system.

USA

ADD footnote 5.XXX in most FSS bands from 10-30 GHz to allow for control and non-payload communication (CNPC) of unmanned aircraft systems

ADD Resolution specifying regulatory and operational procedures

RCC (22 December 2013)

The RCC Administrations consider that the use of unplanned FSS allocations by satellite component of UAS CNPC links shall not impose additional constraints on the use of these bands by existing and future FSS and other primary service systems and shall provide the existing level of protection for these systems.

The RCC Administrations consider that the use of unplanned FSS allocations for operation of satellite component of UAS CNPC links shall be harmonized in all three Regions.

## International organisations

IATA (date of proposal)

ICAO (27 May 2013)

The following position has been taken from input document “CPG PTC(13) INFO 09\_ICAO WRC 15 position”:

Unmanned aircraft systems (UAS) have great potential for innovative civil applications, provided that their operation does not introduce risks to the safety of life.

Taking into account Recommendations 1/12 and 1/13 of the Twelfth Air Navigation Conference (November 2012) “That ICAO … develop and implement a comprehensive aviation frequency spectrum strategy … which includes the following objectives: … clearly state in the strategy the need for aeronautical systems to operate in spectrum allocated to an appropriate aeronautical safety service”; and “That ICAO support studies in the International Telecommunication Union Radio Communication Sector (ITU-R) to determine what ITU regulatory actions are required to enable use of frequency bands allocated to the fixed satellite service for remotely piloted aircraft system command and control (C2) links to ensure consistency with ICAO technical and regulatory requirements for a safety service.”, in order to support the use of FSS systems for UAS CNPC links in non-segregated airspace, the technical and regulatory actions identified by studies under Resolution 153 (WRC-12) must be consistent with the above Recommendations, and satisfy the following conditions:

1. That the technical and regulatory actions should be limited to the case of UAS using satellites, as studied, and not set a precedent that puts other aeronautical safety services at risk.
2. That all frequency bands which carry aeronautical safety communications need to be clearly identified in the Radio Regulations.
3. That the assignments and use of the relevant frequency bands have to be consistent with article 4.10 of the Radio Regulations which recognizes that safety services require special measures to ensure their freedom from harmful interference.
4. Knowledge that any assignment operating in those frequency bands:

is in conformity with technical criteria of the Radio Regulations,

has been successfully co-ordinated, including cases where co-ordination was not completed but the ITU examination of probability of harmful interference resulted in a favourable finding, or any caveats placed on that assignment have been addressed and resolved such that the assignment is able to satisfy the requirements to provide BLOS communications for UAS; and

has been recorded in the International Master Frequency Register.

1. That interference to systems is reported in a transparent manner and addressed in the appropriate timescale.
2. That realistic worst case conditions, including an appropriate safety margin, can be applied during compatibility studies.
3. That any operational considerations for UAS will be handled in ICAO and not in the ITU.

IMO (date of proposal)

NATO (6 December 2013)

NATO supports all regulatory action which permits the usage of FSS bands for CNPC links for the operation of UAS, being aware that studies identified in Resolution 153 (WRC-12) will have to demonstrate that the requirements of aviation authorities are satisfied.

SFCG ( July 2013)

SFCG supports the protection of existing space science service allocations while recognizing the practical requirement of UAS CNPC links, in particular for beyond line of sight operations (BLOS), in FSS bands. There is a secondary SRS allocation in the band 13.75-14 GHz (primary status with respect to FSS systems for some GSO SRS networks for which API has been received prior to a certain date). No changes to the FSS allocation in the 13.75-14 GHz band should be made unless acceptable sharing criteria are developed with the SRS. Although it can be assumed that the focus will be more on FSS Ku and Ka bands, the SFCG also seeks to ensure that this item will not lead to authorising UAS in the FSS X-band allocations shared with EESS and METSAT. SFCG also supports the protection of secondary srs allocations in 14-14.3 GHz and 14.4-14.47 GHz bands. Finally, any use of FSS bands for UAS CNPC links in 18.6-18.8 GHz band must meet the provisions of RR Nos. 5.522A and 5.522B.

WMO and EUMETNET (date of proposal).

## Regional organisations

CRAF (April 2013)

CRAF supports the protection of existing RAS allocations. No changes should be made to the RR unless acceptable sharing criteria are developed with the RAS and SRS.

ESA (date of proposal)

Eurocontrol (date of proposal