ATTACHMENT A
to FCC Public Notice DA 18-1017

Draft Proposals presented at October 1, 2018 Meeting of the World Radiocommunication Conference Advisory Committee

Terrestrial Services

Document WAC/063 (01.10.18)

WRC-19 Agenda Item 1.13
(47.2 – 50.2 GHz)

IWG-2 members were not able to reach consensus on a proposal for WRC-19 Agenda Item 1.13 regarding the identification of frequency bands for the future development of International Mobile Telecommunications (IMT), in accordance with Resolution 238 (WRC-15) for the frequency range 47.2-50.2 GHz. The views on the appropriate regulatory changes the FCC should support are provided.

View A is supported by: Boeing, Echostar, Inmarsat, Viasat, Lockheed Martin, SES.

View B is supported by: AT&T, Cisco, CTIA, Ericsson, Global Mobile Suppliers Association (GSA), GSMA, Intel Corporation, Samsung, Sprint Corporation, T-Mobile, and Verizon.

VIEW A

View A:
View A proposes no change to the Radio Regulations in the 48.2-50.2 GHz band, taking into account the identification of this band in ITU-R Region 2 for high density applications in the fixed-satellite service (HDSSS), the United States *Spectrum Frontiers* decision to provide core uplink spectrum in the fixed-satellite service (FSS) in this band, and the critical requirement for core spectrum for regional and international GSO and NGSO satellite operations..
Finding that broadband services delivered over satellite networks could play a useful role in bringing the benefits of broadband to more Americans, the United States has reserved the HDFSS identifications at 48.2-50.2 GHz and 40-42 GHz for exclusive FSS use. Economies of scale in both earth station and spacecraft design require that satellite operators be able to rely on the availability of HDFSS identifications throughout the ITU Regions to which they apply.
Given the current state of satellite technology and the ubiquitous nature of HDFSS user terminals, these systems need access to spectrum where satellite end user devices can operate and be freely deployed without risk of interference to or from other services. An identification for IMT in the 48.2-50.2 GHz frequency band (and the corresponding 40-42 GHz downlink band) for IMT is incompatible with this objective because IMT and HDFSS applications will be ubiquitous, at locations unknowable in advance, making the interference case for both services uncertain.
View A suggests that an IMT identification may be made at 47.2-48.2 GHz (with the exception of the 47.5-47.9 GHz segment in ITU Region 1) under certain conditions. The United States did provide for terrestrial use of the 47.2-48.2 GHz band in the *Spectrum Frontiers* order, while making provisions for the co-primary fixed-satellite service to continue to use the band. The supporters of View A view continued use of this the 47.2-48.2 GHz band as vital to the FSS, and notes that View B contains no provisions to facilitate that continued use. Any IMT identification in the 47.2-48.2 GHz frequency band should be conditioned upon:

1) A total radiated power (TRP) limit and antenna electrical and mechanical downtilt standards for IMT base stations, which is necessary to avoid interference into FSS space stations at 47.2-48.2 GHz,
2) Mechanisms to permit continued access to the 47.2-48.2 GHz band by FSS Earth stations, and
3) Avoidance of IMT use of the space-to-Earth HDFSS identification at 47.5-47.9 GHz in ITU Region 1.

ATTACHMENT TO VIEW A:
UNITED STATES OF AMERICA

DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

Agenda Item 1.13

Agenda Item 1.13: *to consider identification of frequency bands for the future development of International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution* **238 (WRC-15)**

Background Information:
Both terrestrial and satellite broadband services play a crucial role in providing access to businesses and consumers worldwide and will be critical components of 5G networks. For continuity, resiliency and broad connectivity solutions, satellite broadband is an indispensable part of the broadband environment. Because of increased demand for satellite broadband services, there is a need for additional spectrum being made available to support its growing user base.

Broadband satellite systems require access to unencumbered uplink spectrum to operate widely deployed transmitting user terminals. To satisfy this minimum requirement, ITU Radio Regulation No. 5.516B identifies 2 GHz of uplink spectrum for high-density fixed-satellite service (HDFSS) operations in ITU Region 2 in the 48.2-50.2 GHz fixed-satellite service (FSS) band (Earth-to-space), paired with the 40-42 GHz FSS band (space-to-Earth) (see Resolution **143 (Rev. WRC-07)**). Ubiquitously-deployed IMT operations may not be compatible with ubiquitously-deployed co-frequency/co-coverage HDFSS or other FSS operations. As FSS operations are conducted on a regional and worldwide basis by both geostationary-satellite orbit (GSO) and non-GSO networks and systems, and access to core spectrum facilitates such operations, the 48.2-50.2 GHz band should remain unencumbered for FSS use worldwide.

HDFSS operations provide access to a wide range of broadband telecommunication applications, including broadband services and machine-to-machine (M2M) communications, both independently and in complement with other telecommunication systems. Growth in the satellite M2M market is expected to reach US$2.9 billion by 2026, driven by 6.8 million in-service terminals.[1] These terminals will be deployed over urban, suburban and rural areas of large geographical extent, and the practicability of techniques to successfully manage co-frequency sharing with ubiquitous terrestrial services, such as IMT, has not been demonstrated.

HDFSS systems require flexible, rapid and ubiquitous deployment of large numbers of cost-optimized earth stations employing small antennas and having common technical characteristics. The identification of bands for HDFSS facilitates its implementation and maximizes global/regional access and economies of scale noting the different bands identified for HDFSS in different regions as per No. 5.516B.

Given the current state of satellite technology, these systems would need access to spectrum where satellite end user devices can operate and be freely deployed uplink user terminals across in a given

[1] Alan Weissberger, IEEE Communication Society Blog, *NSR: Satellite IoT market forecast at $2.9B by 2026* (Oct. 1, 2017) (*available at* http://techblog.comsoc.org/2017/10/01/nsr-satellite-iot-market-forecast-at-2-9b-by-2026/).

country. To this end, the band 48.2-50.2 GHz worldwide should not be identified for ubiquitously-deployed IMT use.

Additionally, there is a recognition that IMT will require access to the 47.2-48.2 GHz portion of the 47.2-50.2 GHz band for ubiquitously-deployed terminals. Such use would be under the condition that use of the mobile service allocation by IMT does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. FSS earth stations are planning to use the 47.2-48.2 GHz band, along with other co-primary services, so it is necessary to provide technical and operational conditions on the IMT designation in the mobile service, in the form of an associated Resolution, to assure that FSS use is not effectively or otherwise precluded. Further, no change is proposed to the 47.5-47.9 GHz segment in ITU Region 1, due to the regional HDFSS allocation in the space-to-Earth direction.

Proposals:

ARTICLE 5

Frequency allocations

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

MOD USA/1.13/1

40-47.5 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
47.2-47.5	FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE ADD 5.H113 5.552A	

47.5-51.4 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
47.5-47.9 FIXED FIXED-SATELLITE (Earth-to-space) 5.552 (space-to-Earth) 5.516B 5.554A MOBILE	**47.5-47.9** FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE ADD 5.H113	

47.9-48.2	FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE ADD 5.H113 5.552A
* * *	

Reasons: Adds an identification for IMT to the mobile service allocation in 47.2-48.2 GHz in ITU Regions 2 and 3, and 47.2-47.5 and 47.9-48.2 GHz in ITU Region 1, with conditions to permit continued deployment of fixed-satellite service earth stations and protection of fixed-satellite service space stations.

ADD USA/1.13/2

5.H113 In ITU Regions 2 and 3, the frequency band 47.2-48.2 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). In ITU Region 1, the frequency bands 47.2-47.5 GHz and 47.9-48.2 GHz are identified for use by administrations wishing to implement the terrestrial component of IMT. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolutions **[B113-IMT 47 GHZ] (WRC-19)** and **750 (Rev.WRC-19)** shall apply. (WRC-19)

Reasons: Establishes conditions to permit continued deployment of fixed-satellite service earth stations and protection for fixed-satellite service space stations**.**

ADD USA/1.13/3

DRAFT NEW RESOLUTION [B113-IMT 47 GHZ] (WRC-19)

International Mobile Telecommunications in the frequency band 47.2-48.2 GHz

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

considering

a) that International Mobile Telecommunications (IMT) is intended to provide telecommunication services on a worldwide scale, regardless of location and type of network or terminal;

b) that IMT encompasses IMT-2000, IMT-Advanced, and IMT-2020 collectively, as described in Resolution ITU-R 56;

c) that International Mobile Telecommunications (IMT), including IMT-2000, IMT-Advanced and IMT-2020, is the ITU vision of global mobile access;

d) that IMT systems are now being evolved to provide diverse usage scenarios and applications such as enhanced mobile broadband, machine-type communications and ultra-reliable and low-latency communications;

e) that there is a need to take advantage of technological developments in order to increase the efficient use of spectrum and facilitate spectrum access;

f) that the properties of higher frequency bands, such as millimeter wavelength bands in the 47 GHz range, would better enable the use of advanced antenna systems including MIMO and beam-forming techniques in supporting enhanced broadband;

g) that the frequency bands 450-470 MHz, 694-960 MHz, 1 427-1 518 MHz, 1 710-1 885 MHz, 1 885-2 025 MHz, 2 110-2 200 MHz, 2 300-2 400 MHz, 2 500-2 690 MHz, 3 400-3 600 MHz, or parts thereof, are identified for use by administrations wishing to implement IMT;

h) that timely availability of spectrum is important to support future applications

i) that harmonized worldwide bands for IMT are desirable in order to achieve global roaming and the benefits of economies of scale;

j) that harmonized worldwide bands and harmonized frequency arrangements for IMT are highly desirable in order to achieve global roaming and the benefits of economies of scale;

k) that ITU-R has studied, in preparation for WRC-19, sharing and compatibility with services allocated in the frequency band 47.2-48.2 GHz;

l) that the results of ITU-R compatibility studies of IMT-2020 systems are probabilistic, and therefore the deployment parameters of IMT-2020 systems that affect compatibility with satellite receivers may vary during practical implementation and deployment of IMT-2020 networks;

m) that WRC-19 identified the frequency band 47.2-48.2 GHz for IMT in ITU Regions 2 and 3, and the frequency bands 47.2-47.5 GHz and 47.9-48.2 GHz for IMT in ITU Region 1, with certain regulatory conditions to address protection of services to which the band is allocated on a primary basis in No. 5.H113;

considering further

a) that the identification of the frequency band 47.2-48.2 GHz for IMT takes into account the use of the bands by other services and the evolving needs of these services;

b) that the identification of frequency bands for IMT-2020 requires technical and regulatory measures to ensure compatibility with and future development of incumbent services having an allocation in identified frequency bands,

noting

a) Resolutions **223 (Rev.WRC-15)**, **224 (Rev.WRC-15)** and **225 (Rev.WRC-12)**, which also relate to IMT;

b) that Resolution ITU-R 65 addresses the principles for the process of development of IMT for 2020 and beyond, and that Question ITU-R 77-7/5 considers the needs of developing countries in the development and implementation of IMT;

c) that Question ITU-R 229/5 seeks to address the further development of IMT;

d) that IMT encompasses IMT-2000, IMT-Advanced, and IMT-2020 collectively, as described in Resolution ITU-R 56-2;

e) Recommendation ITU-R M.2083, on the framework and objectives of the future development of IMT for 2020 and beyond;

f) that Recommendation ITU-R M.2083 provides IMT Vision – "Framework and overall objectives of the future development of IMT for 2020 and beyond," and that adequate and timely availability of spectrum and supporting regulatory provisions is essential to realize the objectives in Recommendation ITU-R M.2083;

g) that Report ITU-R M.2320 addresses future technology trends of terrestrial IMT systems;

h) Report ITU-R M.2376, on technical feasibility of IMT in the frequency bands above 6 GHz;

i) that Report ITU-R M.2370 analyses trends impacting future IMT traffic growth beyond the year 2020 and estimates global traffic demands for the period 2020 to 2030;

j) that there are ongoing studies within ITU-R on the propagation characteristics for mobile systems in higher frequency bands;

k) that the identification of a frequency band for IMT does not establish priority in the Radio Regulations and does not preclude the use of the frequency band by any application of the services to which it is allocated,

recognizing

a) that there should be no additional regulatory or technical constraints imposed on services to which the band is currently allocated on a primary basis;

b) that, due to the effect of aggregation of interference from IMT-2020 systems, the protection of satellite receivers is possible only if all administrations will follow the agreed technical characteristics and parameters of the deployment of IMT-2020 systems;

c) that the identification of high-density applications in the fixed-satellite service in the space-to-Earth direction in the bands 39.5-40 GHz in Region 1, 40-40.5 GHz in all Regions and 40.5-42 GHz in Region 2 and in the Earth-to-space direction in the bands 47.5-47.9 GHz in Region 1, 48.2-48.54 GHz in Region 1, 49.44-50.2 GHz in Region 1 and 48.2-50.2 GHz in Region 2 (see No. **5.516B**) does not preclude the use of the same or other FSS bands in other regions for high-density applications,

resolves

1 in order to ensure that IMT in the mobile service frequency band 47.2-48.2 GHz does not cause unacceptable interference to other services to which the frequency band is allocated, the following conditions on IMT use shall apply:

1a that the antenna pattern shall comply with Recommendation ITU-R M.2101 and IMT base stations shall comply with the Total Radiated Power (TRP) limits given in Table 2:

TABLE 2

TRP limits for IMT base stations

Frequency bands	**dB(W/200 MHz)**
47.2-48.2 GHz	[14/TBD][2]

[2] Note: The definition of Total Radiated Power is still under consideration in Working Party 1A. The value of 14

1b that, when deploying outdoor IMT base stations in the frequency band 47.2-48.2 GHz, administrations shall ensure that each antenna transmits only with the main beam pointing below the horizon and that the transmitting antenna shall have mechanical and electrical pointing below the horizon;

2 to ensure that, when considering, nationally or regionally, the spectrum to be used for IMT, due attention is paid to the need for spectrum for earth stations that could be deployed in a ubiquitous manner (i.e. small user earth stations) and for earth stations that could be coordinated (i.e. gateways) in both downlink and uplink directions in the 47.2-48.2 GHz band, taking into account spectrum identified for the HDFSS as per No. **5.516B**,

invites ITU-R

to develop an ITU-R Recommendation to assist administrations in ensuring the protection of existing and future FSS earth stations in the frequency band 47.2-48.2 GHz from IMT deployments in neighbouring countries.

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dBW/200 MHz is proposed with a definition of TRP as “the sum of all power radiated by an antenna connected to a transmitter.” This level applies for all foreseen modes of operation (i.e. maximum in-band power, electrical pointing, carrier configurations). A different definition may necessitate a different value.

NOC **USA/1.13/4**

ARTICLE 5

Frequency allocations

47.5-51.4 GHz

<table>
<tr><th colspan="3">Allocation to services</th></tr>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td>48.2-48.54
FIXED
FIXED-SATELLITE
(Earth-to-space) 5.552
(space-to-Earth) 5.516B
5.554A 5.555B
MOBILE</td><td colspan="2" rowspan="3">48.2-50.2
FIXED
FIXED-SATELLITE (Earth-to-space) 5.516B 5.338A 5.552
MOBILE

5.149 5.340 5.555</td></tr>
<tr><td>48.54-49.44
FIXED
FIXED-SATELLITE
(Earth-to-space) 5.552
MOBILE
5.149 5.340 5.555</td></tr>
<tr><td>49.44-50.2
FIXED
FIXED-SATELLITE
(Earth-to-space) 5.338A
5.552
(space-to-Earth) 5.516B
5.554A 5.555B
MOBILE</td></tr>
</table>

Reason: An IMT identification at 48.2-50.2 GHz is incompatible with the HDFSS identifications in the same band, which provides dedicated spectrum for ubiquitously deployed user terminals for broadband and M2M services. The current state of satellite technology requires access to spectrum where satellite end user devices can operate and be freely deployed without constraints caused by ubiquitous terrestrial services in the same band.

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VIEW B

VIEW B:
Introduction

View B proposes an identification to the terrestrial component of IMT for the 47.2-50.2 GHz frequency bands in all three Regions. View B is supported by AT&T, Cisco, CTIA, Ericsson, Global Mobile Suppliers Association (GSA), GSMA, Intel Corporation, Samsung, Sprint Corporation, T-Mobile, and Verizon.

Incredible technological innovation has enabled the use of higher frequency bands (e.g. millimeter wave) to help meet the ever-increasing demand for mobile broadband. As a global spectrum policy leader, the FCC led the US to be the first country in the world to make high band spectrum available for 5G with other leading countries also making spectrum available for 5G. Similarly, the FCC decision to make 47.2-48.2 GHz available for Upper Microwave Flexible Use Service (UMFUS) is anticipated to stimulate demand in nearby spectrum, with other countries and regions beginning to explore the possibility of 5G use in adjacent spectrum.

The 47.2-50.2 GHz frequency bands are allocated to the Fixed, Fixed Satellite, and Mobile Services on a co-primary basis in all three Regions. With respect to high density applications in the Fixed Satellite Service under No. **5516B**, it is important to note that Regions 1 and 2 utilize different portions of the 47.2-50.2 GHz bands for these applications and that the spectrum for high density applications in Region 3 is in frequency bands other than 47.2-50.2 GHz. Furthermore, No. **5516B** explicitly states that "This identification does not preclude the use of these bands by other fixed-satellite service applications or by other services to which these bands are allocated on a co-primary basis and does not establish priority in these Radio Regulations among users of the bands."

As part of WRC-19 agenda item 1.13 preparations, ITU-R Task Group 5/1 carried out extensive sharing and compatibility studies between the Fixed Satellite Service and IMT: these studies show that sharing in the 47.2-50.2 GHz frequency bands is feasible with a large interference margin. For example, the results for aggregate emissions from IMT into a GSO FSS space stations found the calculated I/N ranged from -37 to -30 dB: even worst case values for each IMT transmitter and no clutter loss found an I/N of -19 dB. For the non-GSO case, results ranged from *I/N* of -21.7 dB to -37 dB. With regards to protection of passive services in the adjacent band 50.2-50.4 GHz included in RR 5.340, no conditions are necessary in Resolution 750 since RR 5.340.1 clearly states that "The allocation to the Earth exploration-satellite service (passive) and the space research service (passive) in the band 50.2-50.4 GHz should not impose undue constraints on the use of the adjacent bands by the primary allocated services in those bands"

Given the potential for increased economies of scale, the co-primary allocation to the Mobile Service, the regulatory status of this spectrum in the Radio Regulations (including the fact that the frequency band is not identified for high density applications in the 3 Regions), and the favourable results of sharing studies, the above-signed support View B with an identification to the terrestrial component of IMT in 47.2-50.2 GHz.

ATTACHMENT TO VIEW B:
UNITED STATES OF AMERICA

DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

Agenda Item 1.13

Agenda Item 1.13: *to consider identification of frequency bands for the future development of International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution* **238 (WRC-15)**

Background Information:

Mobile broadband plays an increasingly crucial role in providing access to businesses and consumers worldwide. According to International Telecommunications Union (ITU) statistics, "Mobile-broadband subscriptions have grown more than 20% annually in the last five years and are expected to reach 4.3 billion globally by end 2017." while "Mobile-broadband prices as a percentage of GNI per capita halved between 2013 and 2016 worldwide.[3] Incredible technological innovation has enabled the use of higher frequency bands (e.g. mmWave) to help meet the ever-increasing demand for mobile broadband.

The 47.2-50.2 GHz frequency range is shared on a co-primary basis between the Fixed, Fixed Satellite and Mobile Services in all three Regions. The Fixed Service allocation includes a global identification for high-altitude platform stations ("HAPS") at 47.2-47.5 GHz paired with 47.9-48.2 GHz (No. **5.552A**). As part of the preparations for WRC-19 agenda item 1.13, ITU-R carried out extensive sharing and compatibility studies between IMT and the Fixed Satellite Service: these studies show that sharing between the terrestrial component of IMT and the Fixed Satellite Service is feasible with a large interference margin in the 47.2-50.2 GHz frequency range. The ITU-R Working Party 5C is studying sharing and compatibility of broadband HAPS with IMT for deployment of HAPS in this band with greater rain fade mitigation.

The harmonization of spectrum for mobile broadband provide benefits to consumers and businesses through economies of scale and global roaming. However, Administrations may be unable to make spectrum available in the exact same frequency bands due to different existing uses and priorities. Therefore, in order to achieve the benefits of harmonization while allowing regulators the flexibility to assign spectrum within this range for domestic use as appropriate, an identification for IMT is proposed in the 47.2-50.2 GHz frequency range. A global identification for IMT in 47.2-50.2 GHz would allow each country/region to assign spectrum for IMT consistent with their domestic use and priorities, while still facilitating the benefits of economies of scale for businesses and consumers.

Finally, there is no need for a WRC Resolution specifying technical and operational constraints on IMT to be associated with this proposed identification for IMT. Operational characteristics that are used by cellular providers, such as base station downtilt, that change on time scales needed to minimize intra- and inter-cell interference and also guarantee quality of service should not be encoded in the Radio Regulations. Similarly, with regards to the use of the band by high density applications in the FSS (No. **5.561B**), no condition is required to achieve a balance of spectrum

[3] ICT Facts and Figures 2017, p 4 and 5. See: https://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2017.pdf

between FSS and IMT since this is a national matter and hence should not be included in any WRC Resolution. With regards to protection of passive services in the adjacent band 50.2-50.4 GHz included in No. **5.340**, no changes to Resolution 750 are necessary since No. **5.340.1** clearly states that "The allocation to the Earth exploration-satellite service (passive) and the space research service (passive) in the band 50.2-50.4 GHz should not impose undue constraints on the use of the adjacent bands by the primary allocated services in those bands."

Proposals:

ARTICLE 5

Frequency allocations

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

MOD USA/1.13/1

40-47.5 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
47.2-47.5	FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE ADD 5.H113 5.552A	

47.5-51.4 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
47.5-47.9 FIXED FIXED-SATELLITE (Earth-to-space) 5.552 (space-to-Earth) 5.516B 5.554A MOBILE ADD 5.H113	**47.5-47.9** FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE ADD 5.H113	

<table>
<tr><td>47.9-48.2</td><td>FIXED
FIXED-SATELLITE (Earth-to-space) 5.552
MOBILE ADD 5.H113
5.552A</td></tr>
<tr><td>48.2-48.54
FIXED
FIXED-SATELLITE
(Earth-to-space) 5.552
(space-to-Earth) 5.516B
5.554A 5.555B
MOBILE ADD 5.H113</td><td rowspan="3">48.2-50.2
FIXED
FIXED-SATELLITE (Earth-to-space) 5.516B 5.338A 5.552
MOBILE ADD 5.H113

5.149 5.340 5.555</td></tr>
<tr><td>48.54-49.44
FIXED
FIXED-SATELLITE
(Earth-to-space) 5.552
MOBILE ADD 5.H113
5.149 5.340 5.555</td></tr>
<tr><td>49.44-50.2
FIXED
FIXED-SATELLITE
(Earth-to-space) 5.338A 5.552
(space-to-Earth) 5.516B
5.554A 5.555B
MOBILE ADD 5.H113</td></tr>
</table>

Reasons: As studies show sharing with other services operating in 47.2-50.2 GHz is feasible, these modifications provide an identification for IMT in the frequency range 47.2 to 50.2 GHz. This facilitates harmonized worldwide bands for IMT, which are highly desirable in order to achieve global roaming and the benefits of economies of scale.

ADD USA/1.13/2

5.H113 The frequency band 47.2-50.2 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations.

Reasons: Harmonized worldwide bands for IMT enable global roaming and the benefits of economies of scale as the same user equipment can be used to serve the global market**.**

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Document WAC/064 (01.10.18)

UNITED STATES OF AMERICA

DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

Agenda Item 1.13: *to consider identification of frequency bands for the future development of International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution 238* ***(WRC-15)***

Background Information:
The frequency band 66-71 GHz is allocated on the primary basis to inter-satellite, mobile-satellite radionavigation-satellite, mobile and radionavigation services. To date, very few, studies have been carried out to confirm IMT compatibility with some of the existing or planned networks operating under these allocations as part of the preparations for World Radiocommunication Conference 2019 (WRC-19) agenda item 1.13.

License-exempt access to spectrum plays a critical role in providing connectivity for users worldwide. In recognition of this fact, many countries have designated this frequency band for licence-exempt 5G (e.g. WiGig) technologies. In the United States, while issuing rules to facilitate 5G, the FCC decided to maintain the unlicensed use of the 64-71 GHz band. Similarly, the European Union's Radio Spectrum Policy Group stated, "*general authorised frequency use can be an important breeding ground for innovation and contributes towards a dynamic market environment. The application of a general authorisation regime is foreseen in the 66-71 GHz band which could be an important band for 5G.*"[4]

In many administration, the use of the 66-71 GHz band by applications in the Mobile service is regulated on a license-exempt, technology neutral basis, similar to the 2.4 GHz and 5 GHz bands. Under this approach regulators adopted rules for unlicensed devices that are designed to prevent harmful interference to authorized radio services through limits on transmitter power and spurious emissions, while industry has developed standards within the framework of these rules, generally with the intention of ensuring cooperative sharing of the spectrum by unlicensed devices. Such approach resulted in numerous benefits and innovative products for consumers. There is significant risk that identification of the 66-71 GHz band for IMT at WRC-19 would disrupt this dynamic by implying a different regulatory regime for one Mobile service application (i.e., IMT) over all others.

It is also important to recognize the nascent state of 5G ecosystem in the 60-70 GHz frequency range. Multi-gigabit devices are just beginning to be introduced into the market. Growing demand has been driving technological developments towards much higher throughputs (20 Gbps and higher), which can be attained only with corresponding spectrum capacity. In ITU-R significant efforts are underway to advance implementation of Multiple Gigabit Wireless Systems (MGWS) systems in 66-71 GHz frequency band.[5]

It is difficult to predict how technologies, spectrum needs, market demands and other factors will evolve in this frequency range. In the absence of this understanding, an international treaty-level regulatory action on the 66-71 GHz band at WRC-19 under agenda item 1.13 would be premature and counterproductive. Identifying 66-71 GHz for IMT would do little to achieve international harmonization. Instead, such action

[4] *See* RSPG Second Opinion on 5G Networks
[5] *See* ITU-R Doc. 5-1/32, Recommendation ITU-R M.2003-2 and Report ITU-R M.2227

would be highly disruptive to existing operations and discourage ongoing research and development of other types of 5G, multi-gigabit technologies.

PROPOSALS:

NOC USA/1.13/66-71GHZ/1

ARTICLE 5

Frequency allocations

66-81 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
66-71	INTER-SATELLITE MOBILE 5.553 5.558 MOBILE-SATELLITE RADIONAVIGATION RADIONAVIGATION-SATELLITE 5.554	

Reason: Studies have not been carried out in preparation for WRC-19 to show IMT compatibility with existing and planned space services networks, and radionavigation systems in the 66-71 GHz band. IMT identification in the 66-71 GHz band would be counterproductive to achieving international harmonization as many administrations confirmed plans for implementation of licence-exempt, non-IMT, 5G technologies such as Multiple Gigabit Wireless Systems (MGWS) systems.

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Document WAC/065 (01.10.18)

WRC-19 Agenda Item 1.14

IWG-2 members were not able to reach consensus on a proposal for WRC-19 Agenda Item 1.14 regarding the consideration, on the basis of ITU-R studies in accordance with Resolution 160 (WRC-15), appropriate regulatory actions for high-altitude platform stations (HAPS), within existing fixed-service allocations. The views on the appropriate regulatory changes the FCC should support are provided.

View A is supported by: Facebook, Loon, LLC

View B is supported by: AT&T, CTIA, Ericsson, Global Mobile Suppliers Association (GSA), GSMA, Intel Corporation, Sprint Corporation, T-Mobile, and Verizon.

View C is supported by: Lockheed Martin

View D is supported by: Echostar, Inmarsat, Viasat, SES

VIEW A

VIEW A:

WAC Members Facebook and Loon support View A (IWG-2 78rev4 1-14) and recommend it to the WAC and the FCC as the basis for reconciling a U.S. Proposal on HAPS (AI 1.14) for CITEL PCC.II. View A incorporates many requests from members of both the Mobile and Fixed Satellite sector, reflecting the last version considered by IWG-2, after many weeks of meetings and calls where edits were proposed and accepted.

Background: The U.S. has long been a leader in innovation. Advances in avionics, solar energy components and lightweight composite aircraft parts have fueled global interest in high-altitude unmanned vehicles for a range of applications, including delivery of broadband. Proponents of High Altitude Platform Stations ("HAPS"), signatories of View A, support the identification of sufficient spectrum for broadband HAPS, to extend broadband Internet access to underserved and unserved communities.

The U.S. has also long recognized the importance of broadband for economic growth. To be a leader in our Region and globally, the U.S. must also recognize the importance of broadband for our neighbors. At the last CITEL PCC.II meeting, a Draft Inter-American Proposal ("DIAP") was adopted by Brazil, the Bahamas and Ecuador that recognized the role HAPS can play in extending broadband networks at a more affordable cost point. HAPS is a station, akin to a tower in the sky, and not a service, so any operator licensed by its spectrum regulator can use this tool to extend their network, whether they are a Mobile or Satellite operator. This is a tool that should be embraced by all sectors. The HAPS DIAP, which proposes HAPS identifications in the 24.25-27.5 GHz and 38-39.5 GHz bands, was adopted on the basis of studies that Brazil's spectrum regulator, ANATEL, undertook on HAPS and IMT 2020 co-existence. Brazil also led the formation of a DIAP for identifying IMT 2020 under agenda item 1.13 in the same bands - 24.25-27.5 GHz and 38.0-39.5 GHz bands. Their studies determined that Mobile and HAPS fixed links can co-exist. The U.S. should propose identifications that cover these bands, to maintain leadership on this promising new technology. Moreover, at the last CITEL PCC.II, Mexico also proposed a HAPS identification in the 21.4-22 GHz band. To lead on HAPS for our Region, the U.S. should propose identifications that build upon these two proposals, and identify 21.4-22 GHz, 24.25-27.5 GHz, and 38-39.5 GHz for HAPS.

Discussion: The U.S. was the lead sponsor of HAPS at WRC-15, identifying that as a priority at the last Conference. The agenda item passed due to developing country support that the US encouraged, both in our Region and in Africa. The Resolution adopting agenda item 1.14 (Res. 160) noted that the existing HAPS identifications were not adopted in reference to today's broadband capabilities. Res. 160 identified two new bands to be studied in Region 2 (21.4-22 GHz and 24.25-27.5 GHz) for broadband HAPS, one band to be studied on a global basis (38-39.5 GHz), and the possible modification of the existing HAPS identifications to facilitate broadband. HAPS proponents have sought identifications in bands where mobile operators plan to deploy IMT 2020 (5G) precisely in order to benefit consumers with economies of scale in broadband equipment that can be used both in 5G and HAPS, such as chips, antenna components, etc., to make HAPS backhaul affordable in costly areas where 3G and 4G has not yet been deployed. It is expected that HAPS can further accelerate the growth of 5G by providing backhaul in underserved and unserved communities.

In the last two and a half years since studies began under AI 1.14, global interest in HAPS has increased dramatically. Major national operators are considering HAPS projects, as have many

aerospace companies. To enable co-existence with existing services, HAPS proponents propose ubiquitous pfd levels to protect Fixed and Mobile services from HAPS downlink emissions. To protect Fixed Satellite operations, proponents propose that HAPS links operate in the opposite direction to space stations where possible. For the protection of science services, EIRP limits and coordination among administrations can ensure protection. Finally, to protect passive science services in the bands adjacent to proposed HAPS identifications, OOBE limits for both HAPS platforms and ground stations are proposed in View A (#78rev4).

View A proposes that HAPS be identified in the 21 GHz, 24.25-27.5 GHz, and 38-39.5 GHz bands to both reflect U.S. industry views and align with our CITEL neighbors. View A also proposes that the single global existing HAPS identification in 47/48 GHz be modified for gateway use and better rain mitigation, recognizing that other bands would be available for user equipment uplinks downlinks. Lastly, View A proposes that the existing HAPS identification in 28/31 GHz band be modified for worldwide use, both with protections added for other co-primary services. Together, these identifications amount to what the ITU expert working party found was needed for broadband HAPS, about 4 GHz in most markets.

ATTACHMENT TO VIEW A:

UNITED STATES OF AMERICA

DRAFT PROPOSAL FOR THE WORK OF THE CONFERENCE

Agenda Item 1.14: *to consider, on the basis of ITU-R studies in accordance with Resolution 160 (WRC-15), appropriate regulatory actions for high-altitude platform stations (HAPS), within existing fixed-service allocations.*

BACKGROUND

No. 1.66A of the ITU Radio Regulations define a high-altitude platform station (HAPS) as "a station on an object at an altitude of 20 to 50 km and at a specified, nominal, fixed point relative to the Earth". Agenda Item 1.14 was adopted by WRC-15 to consider, in accordance with Resolution 160 (WRC-15), regulatory actions that can facilitate deployment of HAPS for broadband applications. Resolution 160 resolves to invite ITU-R to study additional spectrum needs of HAPS, examining the suitability of existing HAPS designations and conducting sharing and compatibility studies for additional designations in existing fixed allocations in the 38-39.5 GHz band on a global basis and in 21.4-22 GHz and 24.25-27.5 GHz bands in Region 2 exclusively.

Currently there are 3 spectrum bands identified for HAPS in the fixed services. These are:
- 47.2–47.5 GHz and 47.9 48.2 GHz,
- 27.9-28.2 GHz (HAPS-ground) and 31.0-31.3 GHz (ground-HAPS)
- 6 440–6 520 MHz (HAPS-ground) and 6 560-6 640 MHz (ground-HAPS).

However, spectrum needs of next-generation HAPS cannot be accommodated within these designations due to either geographical restrictions or technical limitations which impairs their operation. The global designations for HAPS links (which is in the 47.2-47.5 GHz band fixed-service allocation paired with the 47.9-48.2 GHz band fixed-service allocation) suffers from the effects of rain fade attenuation that severely limit service provision over high-precipitation geographies. The remaining 2 available bands (27.9-28.2 GHz paired with the frequency band 31.0-31.3 GHz, and 6440-6 520 MHz paired with 6 560-6 640 MHz) have been identified by a limited number of countries, none of which is within ITU Region 2. The ITU-R developed a Preliminary New Draft Recommendation (PDNR) assessing spectrum needs for broadband HAPS at an approximate 4 GHz aggregate capacity. The following proposals encourage the designation of HAPS in the fixed service allocations on a co-primary basis to facilitate investment in and deployment of HAPS, while ensuring protection to systems of other services allocated in the band as well as not providing priority to HAPS over other uses within the services allocated on a primary basis.

BROADBAND HAPS APPLICATIONS

Advances in aeronautics and transmission technologies have significantly improved the capabilities of HAPS to provide effective connectivity solutions and meet the growing demand for high capacity broadband networks, particularly in currently underserved areas. Recently conducted full-scale test flights have shown that solar-powered platforms in the upper-atmosphere can now be used

to carry payloads that offer connectivity over large areas in a reliable and cost-effective way, and a growing number of applications for the new generation of HAPS are being developed. The technology appears particularly well suited to complementing terrestrial networks by providing backhaul. A number of advantages of the new generation of HAPS are foreseen:

- **Wide-area coverage:** A single platform will be able to serve footprints larger than 100 km in diameter, and recent technological advances in the development of optical inter-HAPS links now allow the deployment of multiple linked HAPS, in fleets that can cover whole nations.
- **Low cost:** The cost of operating stratospheric platforms is projected to be significantly lower than other connectivity solutions in many areas, while mass production of the aircraft will significantly lower upfront capital expenditure for deployment.
- **Reach:** HAPS platforms will operate at around 20 km above ground, which reduces their vulnerability to weather conditions that may affect service, provides large coverage areas and avoids interference caused by physical obstacles.
- **Rapid deployment and flexibility:** It will be possible to deploy HAPS services without long lead times and it is relatively simple to return solar platforms to the ground for maintenance or payload reconfiguration.
- **Geographical reach:** HAPS that use the architecture of solar platforms can also provide connectivity where it is impossible to deploy terrestrial infrastructure: remote sites on land or sea.
- **Environmentally friendly:** HAPS can run exclusively on solar power for long periods, connecting people with almost no environmental impact.

Spectrum harmonization and utilization is facilitated by common worldwide designations. International regulatory flexibility can enable improvements in global connectivity by encouraging national regulators to permit operation of higher-speed Internet access services over new, complementary platforms, while ensuring protection of existing services. Additionally, harmonization of spectrum promotes economies of scale and commonality of equipment.

Broadband HAPS can also be used for:

- Response to natural disasters.
- Fire detection, monitoring, and firefighting.
- Law enforcement with communication needs across local actors and regional headquarters.
- Resource exploration missions for communication between exploration teams and regional home base.

SHARING STUDIES

A number of administrations and technology proponents have conducted compatibility studies to assess coexistence between HAPS and incumbent and proposed systems and services (including WRC-19 Agenda Items 1.6 and 1.13).

A power-flux density (PFD) threshold would be used to ensure the protection of the fixed and mobile services from downlink emissions by HAPS platforms (HAPS-to-ground), which if exceeded would require coordination with neighboring administrations and their explicit agreement. This PFD ensures that the signal level produced by HAPS systems at the location of fixed and mobile service stations will not cause interference. Protection from uplink emissions by HAPS

ground stations with other stations of the fixed service or mobile service could be ensured through coordination at the national level, based on the relatively short separation distances (and other mitigation techniques) provided by the studies.

The protection of FSS satellite networks on a co-channel basis appears to be feasible if the frequency bands used by a HAPS network is transmitting in an opposite direction from that of the FSS satellite network (i.e., satellite Earth-to-space with HAPS-to-ground, and satellite space-to-Earth with ground-to-HAPS). In these cases, some studies suggest that satellite stations can be protected from HAPS-to-ground emissions, while relatively short separation distances can be used to protect Earth stations from ground-to-HAPS emissions through station coordination amongst administrations or usual link planning procedures used at a national level. In the case of national level coordination, the use of mitigation techniques and/or geographical separation could be used to enable deployments by either service.

For the protection of science services (EESS, SRS, RAS), radiated power limits and coordination amongst administrations could be used to ensure the protection of these services. The receiving earth station for EESS and SRS can be protected through coordination. In the case of science services operating in adjacent bands to HAPS, specific limits on out-of-band emissions for both HAPS platforms and ground stations can be used to ensure their protection.

1. PROPOSALS FOR THE 6 GHZ BANDS

For the 6 440 – 6 520 MHz Band:

NOC **USA/1.14/1**

ARTICLE 5

Frequency allocations

Reasons: To maintain the existing designation for HAPS without modifications.

NOC **USA/1.14/2**

RESOLUTION 150 (WRC-12)

Use of the bands 6 440-6 520 MHz and 6 560-6 640 MHz by gateway links for high-altitude platform stations in the fixed service

Reasons: To maintain the existing designation for HAPS without modifications.

For the band 6 560–6 640 MHz Band:

NOC **USA/1.14/4**

ARTICLE 5

Frequency allocations

Reasons: To maintain the existing designation for HAPS without modifications.

NOC **USA/1.14/5**

RESOLUTION 150 (WRC-12)

Use of the bands 6 440-6 520 MHz and 6 560-6 640 MHz by gateway links for high-altitude platform stations in the fixed service

Reasons: To maintain the existing designation for HAPS without modifications.

2. PROPOSALS FOR THE 21.4 – 22 GHZ BAND

MOD USA/1.14/6

ARTICLE 5

Frequency allocations

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

18.4-22 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
21.4-22 FIXED MOBILE BROADCASTING- SATELLITE 5.208B 5.530A 5.530B 5.530D	**21.4-22** FIXED ADD 5.B114 MOBILE 5.530A	**21.4-22** FIXED MOBILE BROADCASTING- SATELLITE 5.208B 5.530A 5.530B 5.530D 5.531

Reasons: To add a footnote to the fixed service allocation in support of a HAPS designation in the 21.4 -22 GHz band.

ADD USA/1.14/7

5.B114 The allocation to the fixed service in the band 21.4-22 GHz is designated for use in Region 2 by high-altitude platform stations (HAPS). This designation does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Such use of the fixed-service allocation by HAPS is limited to the HAPS-to-ground direction in the 21.4 -22 GHz band. Such use is subject to the provisions of Resolution **[B114] (WRC-19)**. (WRC-19)

Reasons: To add the text of the footnote allowing HAPS to operate in the fixed service allocation in the 21.4-22 GHz band.

Draft new Resolution for the 21.4-22 GHz band

ADD **USA/1.14/8**

DRAFT NEW RESOLUTION [B114] (WRC-19)

Use of the band 21.4-22 GHz by high altitude platform stations in the fixed service for Region 2

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

considering

a) that WRC-15 considered that there is a need for greater broadband connectivity in underserved communities and in rural and remote areas, that current technologies can be used to deliver broadband applications by high-altitude platform stations (HAPS), which can provide broadband connectivity and disaster recovery communications with minimal ground network infrastructure;

b) that WRC-15 decided to study additional spectrum needs for fixed HAPS links to provide broadband connectivity, including within the band 21.4-22 GHz, recognizing that the existing HAPS designations were established without reference to today's broadband capabilities;

c) that HAPS can provide broadband connectivity with minimal ground network infrastructure;

d) that compatibility with existing services allocated on a primary basis in the frequency range 21.2-22.5 GHz must be ensured when introducing any new HAPS designations,

e) that Recommendation ITU-R P.618, "Propagation data and prediction methods required for the design of Earth-space telecommunication systems", should be used to determine rain attenuation from HAPS platforms.

recognizing

a) that RR No. **5.532** requires that the use of the band 22.21-22.5 GHz by the Earth Exploration-Satellite (passive) and space research (passive) services shall not impose constraints upon the fixed and mobile, except aeronautical mobile, services;

b) that HAPS is defined in No. **1.66A** of the Radio Regulations as a station located on an object at an altitude of 20-50 km and at a specified, nominal, fixed point relative to the Earth, and is subject to No. **4.23**,

c) that the band 21.4-22 GHz is also allocated to mobile service on a co-primary basis;

resolves

1 that for the purpose of protecting fixed service systems in neighboring administrations in the band 21.4-22 GHz, the power flux density level per HAPS platform station produced at the surface of the Earth in neighboring administrations shall not exceed the following pfd mask in dBW/m^2/MHz, under clear sky condition, without the explicit agreement from the affected administration:

$$pfd_{max}(El) = 0.7 \times El - 135 \text{ for } 0 \leq El < 10°$$

$$pfd_{max}(El) = 2.4 \times El - 152 \text{ for } 10° \leq El < 20°$$

$$pfd_{max}(El) = 0.45 \times El - 113 \text{ for } 20° \leq El < 60°$$

$$pfd_{max}(El) = -86 \text{ for } 60° \leq El \leq 90°$$

where El is the elevation angle in degrees (angles of arrival above the horizontal plane). To verify the compliance with the pfd mask the following equation shall be used:

$$pfd(El) = EIRP_{\frac{dBW}{MHz}}(El) + 10 * \log_{10}\left(\frac{1}{4\pi d^2_{(El)}}\right) - \text{rain fade}$$

where:

d distance in meters between the HAPS and the ground (elevation angle dependent);

EIRP HAPS platform nominal EIRP spectral density in dBW/MHz at a specific elevation angle;

pfd(El) is the power flux density at the Earth's surface per HAPS platform station in dBW/m^2/MHz.

rain fade rain attenuation in dB (ITU-R P.618)

2 that in order to ensure the protection of EESS (passive), the EIRP per HAPS platform, in the bands 21.2-21.4 GHz and 22.21-22.5 GHz, shall not exceed:

$$EIRP = (-0.76El - 9.5) \text{ dBW/100MHz} \quad \text{for} \quad -4.53° \leq El < 35.5°$$
$$EIRP = -36.5 \text{ dBW/100 MHz} \quad \text{for} \quad 35.5° \leq El < 90°$$

where *El* is the elevation angle in degrees (angles of arrival above the horizontal plane);

3 that in order to ensure the protection of the radio astronomy service, the unwanted emission pfd produced by HAPS platform downlink transmissions shall not exceed -176 dBW/m²/290 MHz for continuum observations, and -192 dBW/m²/250 kHz for spectral line observations in the band 22.21-22.5 GHz at an RAS station location at a height of 50m. These pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model;

4 that *resolves 3* above applies at any radio astronomy station that was in operation prior to 22 November 2019; and that has been notified to the Bureau in the band 22.21-22.5 GHz before 22 May 2020. Radio astronomy stations notified after this date may seek an agreement with administrations that have notified HAPS,

invites ITU-R

to develop ITU-R Reports that will assist administrations in facilitating coexistence with other co-primary services; and

instructs the Director of the Radiocommunication Bureau

to take all necessary measures to implement this Resolution.

Reasons: To add the text of a resolution specifying the operating requirements for HAPS to protect other services.

3. PROPOSALS FOR THE 24.25-27.5 GHZ BAND

For the 24.25-25.25 GHz Band

MOD USA/1.14/9

ARTICLE 5

Frequency allocations

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

24.25-25.25 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
24.25-24.45 FIXED	**24.25-24.45** FIXED ADD 5.C114 RADIONAVIGATION	**24.25-24.45** RADIONAVIGATION FIXED MOBILE
24.45-24.65 FIXED INTER-SATELLITE	**24.45-24.65** FIXED ADD 5.C114 INTER-SATELLITE RADIONAVIGATION 5.533	**24.45-24.65** FIXED INTER-SATELLITE MOBILE RADIONAVIGATION 5.533
24.65-24.75 FIXED FIXED-SATELLITE (Earth-to-space) 5.532B INTER-SATELLITE	**24.65-24.75** FIXED ADD 5.C114 INTER-SATELLITE RADIOLOCATION-SATELLITE (Earth-to-space)	**24.65-24.75** FIXED FIXED-SATELLITE (Earth-to-space) 5.532B INTER-SATELLITE MOBILE 5.533
24.75-25.25 FIXED FIXED-SATELLITE (Earth-to-space) 5.532B	**24.75-25.25** FIXED ADD 5.C114 FIXED-SATELLITE (Earth-to-space) 5.535	**24.75-25.25** FIXED FIXED-SATELLITE (Earth-to-space) 5.535 MOBILE

Reasons: To add a primary fixed service allocation to the 24.25-25.25 GHz band, in order to support a HAPS designation in that band.

ADD **USA/1.14/10**

5.C114 The allocation to the fixed service in the band 24.25-25.25 GHz is designated for and limited to use in Region 2 by high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS is limited to operation in the HAPS-to-ground direction and is subject to the provisions of Resolution **[C114] (WRC-19)**.

Reasons: To add the text of the footnote allowing HAPS to operate in the fixed service allocation in the 24.25-25.25 GHz band. The limitation of the use of HAPS in the HAPS-to-ground direction in the 24.25-25.25 GHz band is to ensure the protection of the:

- FSS operating in the 24.75-25.25 GHz band;
- ISS operating in the 24.45-24.75 GHz band;
- EESS passive operating in the 23.6-24 GHz band.

For the 25.25-27.5 GHz Band

MOD **USA/1.14/11**

ARTICLE 5

Frequency allocations

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

25.25-27.5 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
25.25-25.5	FIXED ADD 5.D114 INTER-SATELLITE 5.536 MOBILE Standard frequency and time signal-satellite (Earth-to-space)	
25.5-27	EARTH EXPLORATION-SATELLITE (space-to Earth) 5.536B FIXED ADD 5.D114 INTER-SATELLITE 5.536 MOBILE SPACE RESEARCH (space-to-Earth) 5.536C Standard frequency and time signal-satellite (Earth-to-space) 5.536A	

27-27.5 FIXED INTER-SATELLITE 5.536 MOBILE	**27-27.5** FIXED ADD 5.D114 FIXED-SATELLITE (Earth-to-space) INTER-SATELLITE 5.536 5.537 MOBILE

Reasons: To add a footnote to the 25.25-27.5 GHz band in Region 2 allowing HAPS to operate in the fixed service allocation.

ADD USA/1.14/12

5.D114 The allocation to the fixed service in the bands 25.25-25.5 GHz, 25.5-27.0 GHz and 27.0-27.5 GHz is designated for use in Region 2 by high-altitude platform stations (HAPS). This designation does not preclude the use of these frequency bands by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Such use of the fixed-service allocation by HAPS is limited to operation in the ground-to-HAPS in the frequency range 25.25-27 GHz, and HAPS-to-ground in the band 27.0-27.5 GHz. Such use of the fixed-service allocation by HAPS is subject to the provisions of Resolution **[C114] (WRC-19)**.

Reasons: To add the text of the footnote allowing HAPS to operate in the fixed service allocation in the 25.25-27.5 GHz band. The limitation of the use of HAPS in the ground-to-HAPS direction in the 25.25-27 GHz band is to ensure the protection of EESS/SRS services operating in the 25.5-27 GHz band. The limitation of the use of HAPS in the HAPS-to-ground direction in the 27-27.5 GHz band is to ensure the protection of the FSS operating in the same band.

Draft new Resolution for the 24.25-27.5 GHz band

ADD USA/1.14/13

DRAFT NEW RESOLUTION [C114]

Use of the frequency range 24.25-27.5 GHz by fixed links for high altitude platform stations in the fixed service in Region 2

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

considering

a) that WRC-15 considered that there is a need for greater broadband connectivity in underserved communities and in rural and remote areas, that current technologies can be used to deliver broadband applications by high-altitude platform stations (HAPS), which can provide broadband connectivity and disaster recovery communications with minimal ground network infrastructure;

b) that WRC-15 decided to study additional spectrum needs for fixed HAPS links to provide broadband connectivity, including within the band 24.25-27.5 GHz in Region 2, recognizing that

the existing HAPS designations were established without reference to today's broadband capabilities;

c) that HAPS can provide broadband connectivity with minimal ground network infrastructure;

d) that Recommendation ITU-R P.618, "Propagation data and prediction methods required for the design of Earth-space telecommunication systems", should be used to determine rain fade attenuation from HAPS platforms;

e) that Recommendation ITU-R P.452, "Prediction procedure for the evaluation of interference between stations on the surface of the Earth at frequencies above about 0.1 GHz", should be used to determine the propagation loss in the ground path from HAPS ground stations;

f) that Recommendation ITU-R SF.1395, "Minimum propagation attenuation due to atmospheric gases for use in frequency sharing studies between the fixed-satellite service and the fixed service", should be used to determine the gaseous attenuation;

g) that Recommendation ITU-R P.2108, "Prediction of Clutter Loss", should be used to determine the clutter loss,

recognizing

a) that HAPS is defined in No. **1.66A** of the Radio Regulations as a station located on an object at an altitude of 20-50 km and at a specified, nominal, fixed point relative to the Earth, and is subject to No. **4.23**;

b) that in the band 27.0-27.5 GHz with respect to earth stations in the Fixed-Satellite Service (Earth-to-space) and HAPS ground station receivers which operate in the Fixed Service, Nos. **9.17** and **9.18** applies;

resolves

1 that for the purpose of protecting the fixed service systems in neighboring administrations in the frequency range 24.25-27.5 GHz, the power flux density level per HAPS platform station at the surface of the Earth in neighboring administrations shall not exceed the following pfd mask in dBW/m^2/MHz, under clear sky condition, without the explicit agreement from the affected administration:

$$pfd_{max}(El) = 0.39 \times El - 132.12 \text{ for } 0 \leq El < 13°$$

$$pfd_{max}(El) = 2.715 \times El - 162.3 \text{ for } 13° \leq El < 20°$$

$$pfd_{max}(El) = 0.45 \times El - 117 \text{ for } 20° \leq El < 60°$$

$$pfd_{max}(El) = -90 \text{ for } 60° \leq El \leq 90°$$

where El is the elevation angle in degrees (angles of arrival above the horizontal plane).

To verify the compliance with the pfd mask the following equation shall be used:

$$pfd(El) = EIRP(El) - 10.\log_{10}(4\pi d^2) - \text{rain fade}$$

where:

EIRP is the nominal HAPS EIRP density level in dBW/MHz (dependent to the elevation angle);

d is the distance in meters between the HAPS and the ground (elevation angle dependent);

*pfd(*El*)* power flux density at the Earth surface per HAPS platform station in dBW/m²/MHz;

rain fade rain attenuation in dB (ITU-R P.618)

2 that for the purpose of protecting the terrestrial mobile service systems in neighboring administrations in the band 24.25-27.5 GHz, the power flux density level per HAPS platform station at the surface of the Earth in neighboring administrations shall not exceed the following pfd masks in dBW/m²/MHz for more than 0.1% of deployment, without the explicit agreement from the affected administration:

$$pfd_{max}(El) = -114 \quad \text{for } 0 \le El < 4°$$

$$pfd_{max}(El) = -114 + 1.24 \times (El - 4) \quad \text{for } 4 \le El < 9°$$

$$pfd_{max}(El) = -107.8 \quad \text{for } 9° \le El \le 90°$$

where El is the elevation angle in degrees (angle of arrival above the horizontal plane).

To verify the compliance with the pfd mask the following equation shall be used:

$$pfd(El) = EIRP(El) - 10.\log_{10}(4\pi d^2) - L_{Pol} - B_{loss} - GasAtt(El) - \text{rain fade}$$

where:

d distance in meters between the HAPS and the ground (elevation angle dependent);

EIRP HAPS platform nominal EIRP spectral density in dBW/MHz at a specific elevation angle;

*pfd(*El*)* power flux density at the Earth surface per HAPS platform station in dBW/m²/MHz;

Lpol polarization loss of 3 dB;

Bloss body loss of 4 dB;

GasAtt(El) gaseous attenuation;

rain fade rain attenuation in dB (ITU-R P.618)

3 that for the purpose of protecting the Inter Satellite service, the EIRP density per HAPS platform in the band 24.45-24.75 GHz, shall not exceed -19.9 dBW/MHz above 85 degree off-nadir; the EIRP density per HAPS platform in the bands 27-27.5 GHz, shall not exceed -70.7 dBW/Hz for off-nadir angle higher than 85°; and the EIRP density per HAPS ground station in the band 25.25-27 GHz, shall not exceed 13.5 dBW/MHz towards the ISS GSO receiver under clear sky conditions;

4 that for the purpose of protecting the Fixed Satellite service, the EIRP density per HAPS platform, in the bands 24.75-25.25 and 27-27.5 GHz, shall not exceed -9.1 dBW/MHz for off-nadir angle higher than 85°;

5 that in the band 24.75-25.25 GHz, Nos. **9.17** and **9.18** do not apply with respect to the Fixed Service allocation and in the band 27.0-27.5 GHz, Nos. **9.17** and **9.18** do not apply to the HAPS designation of the Fixed Service Allocation; HAPS ground stations shall not claim protection from Fixed-Satellite Service earth stations transmitting in the bands 24.75-25.25 GHz and 27.0-27.5 GHz in neighbouring administrations, and No. 5.43A shall not apply;

6 that for the purpose of protecting the Earth Exploration Satellite passive services the EIRP in the band 23.6-24 GHz per HAPS platform, operating in the band 24.25-25.25GHz, shall not exceed:

$$EIRP = (- 0.7714.El - 16.5)\ dBW/100MHz \quad for \quad - 4.53° \leq El < 35°$$

$$EIRP = - 43.5\ dBW/100\ MHz \quad for \quad 35° \leq El < 90°$$

where El is the elevation angle in° (angles of arrival above the horizontal plane);

7 that with respect to HAPS, the provisions of No. **5.536A** shall not apply;

8 that in order to ensure the protection of in-band SRS/EESS satellite services from a HAPS ground station in the band 25.5-27.0 GHz, the PFD shall not exceed the threshold values below at the SRS/EESS earth stations. The EESS PFD threshold values shall be applied at earth stations which only support EESS operations. If the PFD threshold values below are exceeded, then HAPS shall coordinate in accordance with No. 9.18, taking into account the parameters of the relevant systems.

SRS

$$PFD,\ dB\left(\frac{W}{m^2 * MHz}\right) = - 121.33$$

EESS NGSO

$$PFD,\ dB\left(\frac{W}{m^2 * MHz}\right) = - 96.87$$

EESS GSO

$$PFD,\ dB\left(\frac{W}{m^2 * MHz}\right) = - 128.57$$

For the HAPS ground station towards an SRS/EESS Earth station, attenuation using the relevant ITU-R propagation Recommendations shall be applied using the following

percentages: 1) SRS: .001%; 2) EESS NGSO: .005%; 3) EESS GSO: 20%, and the HAPS and SRS/EESS antenna heights shall be used in this calculation.

9 in order to ensure the protection of the radio astronomy service, the pfd produced by unwanted emissions from HAPS platform downlink transmissions operating in the band 24.25-25.25 GHz shall not exceed -177 dB W/m²/400 MHz for continuum observations and -191 dB W/m²/250 kHz for spectral line observations in the band 23.6-24 GHz at an RAS station location at the height of 50 m. These pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model.

To verify the compliance the following formula shall be used:

$$pfd = EIRP_{max\ clear\ sky}(Az,El) + Att_{618_{P=2\%}} - 10 * \log10(4\pi d^2)$$

where

$EIRP_{max\ clear\ sky}$ is the maximum EIRP towards the RAS station at which the HAPS platform station operates under clear sky condition in dBW/290 MHz for continuum observations and in dBW/250 kHz for spectral line observations in the band 23.6-24 GHz;

Az is the azimuth in degrees from the HAPS platform toward the RAS station;

El is the elevation angle in degrees at the HAPS platform towards the RAS station;

$Att_{618p=2\%}$ is the attenuation in dB from recommendation 618 corresponding to p=2% of the time at the radio astronomy location;

d is the separation distance in meters between the HAPS platform;

pfd is the power flux density at the Earth surface per HAPS platform station in dBW/m²/290 MHz for continuum observations and in dBW/m²/250 kHz for spectral line observations in the band 23.6-24 GHz;

10 that *resolves 9* shall apply at any radio astronomy station that was in operation prior to 22 November 2019 and has been notified to the Bureau in the band 23.6-24 GHz before 22 May 2020. Radio astronomy stations notified after this date may seek an agreement with administrations that have authorized HAPS,

invites ITU-R

to develop ITU-R Reports that will assist administrations in facilitating coexistence with other services

instructs the Director of the Radiocommunication Bureau

to take all necessary measures to implement this Resolution.

Reasons: To add the text of a resolution specifying the operating requirements for HAPS to protect other services to protect other services for the directions indicated in the Article 5 footnotes.

4. PROPOSALS FOR THE 28 / 31 GHZ BANDS

For the 27.9-28.32 GHz Band

MOD USA/1.14/14

ARTICLE 5

Frequency allocations

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

24.75-29.9 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
27.5-28.5	FIXED ADD 5.E114 FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 MOBILE 5.538 5.540	

Reasons: To add a footnote to the fixed service allocation in support of a HAPS designation in the 27.9-28.2 GHz band and to suppress the existing HAPS related footnote.

ADD USA/1.14/15

5.E114 The allocation to the fixed service in the band 27.9-28.2 GHz is designated for worldwide use by high-altitude platform stations (HAPS). This designation does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Such use of the fixed-service allocation by HAPS is limited to operation in the HAPS-to-ground direction and is subject to the provisions of Resolution **[E114] (WRC-19)**. (WRC-19)

Reasons: To add the text of the footnote allowing HAPS to operate in the fixed service allocation in the 27.9-28.2 GHz band on a worldwide basis.

SUP USA/1.14/16
5.537A

For the 31.0-31.3 GHz Band

MOD **USA/1.14/17**

ARTICLE 5

Frequency allocations

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

29.9-34.2 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
31-31.3	FIXED 5.338A ADD 5.F114 MOBILE Standard frequency and time signal-satellite (space-to-Earth) Space research 5.544 5.545 5.149	

Reasons: To add a footnote to the fixed service allocation in support of a HAPS designation in the 31-31.3 GHz band and to suppress the existing HAPS related footnote.

ADD **USA/1.14/18**

5.F114 The allocation to the fixed service in the band 31-31.3 GHz is designated for worldwide use by high-altitude platform stations (HAPS) in the HAPS-to-ground direction. This designation does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Such use of the fixed-service allocation by HAPS is subject to the provisions of Resolution **[E114] (WRC-19)**. (WRC-19)

Reasons: To add the text of the footnote allowing HAPS to operate in the fixed service allocation in the 31-31.3 GHz band on a worldwide basis.

SUP **USA/1.14/19**
5.543A

Draft new Resolution for the 27.9-28.2 and 31-31.3 GHz bands

ADD **USA/1.14/20**

DRAFT NEW RESOLUTION [E114] (WRC-19)

Use of the bands 27.9-28.2 GHz and 31-31.3 GHz by high altitude platform stations in the fixed service

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

considering

a) that WRC-15 considered that there is a need for greater broadband connectivity in underserved communities and in rural and remote areas, that current technologies can be used to deliver broadband applications by high-altitude platform stations (HAPS), which can provide broadband connectivity and disaster recovery communications with minimal ground network infrastructure;

b) that WRC-15 decided to study additional spectrum needs for fixed HAPS links to provide broadband connectivity, including the existing designations in the 27.9-28.2 GHz and the 31-31.3 GHz bands, recognizing that the existing HAPS designations were established without reference to today's broadband capabilities;

c) that HAPS can provide broadband connectivity with minimal ground network infrastructure;

d) that Recommendation ITU-R P.618, "Propagation data and prediction methods required for the design of Earth-space telecommunication systems", should be used to determine rain fade attenuation from HAPS platforms;

e) that Recommendation ITU-R P.452, "Prediction procedure for the evaluation of interference between stations on the surface of the Earth at frequencies above about 0.1 GHz", should be used to determine the propagation loss in the ground path from HAPS ground stations;

f) that Recommendation ITU-R SF.1395, "Minimum propagation attenuation due to atmospheric gases for use in frequency sharing studies between the fixed-satellite service and the fixed service", should be used to determine the gaseous attenuation;

g) that Recommendation ITU-R P.2108, "Prediction of Clutter Loss", should be used to determine the clutter loss,

recognizing

a) that HAPS is defined in No. **1.66A** of the Radio Regulations as a station located on an object at an altitude of 20-50 km and at a specified, nominal, fixed point relative to the Earth, and is subject to No. **4.23**,

resolves

1 that for the purpose of protecting the fixed wireless systems in neighboring administrations in the band 27.9-28.2 GHz, the power flux density level per HAPS platform station at the surface of the Earth in neighboring administrations shall not exceed the following pfd mask in dBW/m^2/MHz, under clear sky condition, without the explicit agreement from the affected administration:

$$pfd_{max}(El) = (3 \times El - 140) \text{ for } El \leq 10°$$
$$pfd_{max}(El) = (0.57 \times El - 115.7) \text{ for } 10° < El \leq 45°$$
$$pfd_{max}(El) = -90 \text{ for } 45° < El \leq 90°$$

where *El* is the elevation angle in degrees (angles of arrival above the horizontal plane).
To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pfd(El) = EIRP(El) - 10.\log_{10}(4\pi d^2) - \text{rain fade}$$

where:

d is the distance in meters between the HAPS and the ground;

e.i.r.p HAPS platform nominal EIRP spectral density in dBW/MHz at a specific elevation angle

pfd(El) power flux density at the Earth surface per HAPS platform station in dBW/m²/MHz;

rain fade rain attenuation in dB (ITU-R P.618)

2 that for the purpose of protecting the terrestrial mobile service systems in neighboring administrations in the band 27.9-28.2 GHz band, the power flux density level per HAPS platform station at the surface of the Earth in neighboring administrations shall not exceed the following pfd masks in dBW/m^2/MHz for more than 0.1% of deployment, without the explicit agreement from the affected administration:

$$pfd_{max}(El) = -122.6 \text{ for } El \leq 2°$$
$$pfd_{max}(El) = -122.6 + 1.5 \times (El - 2) \text{ for } 2° < El \leq 13.6°$$
$$pfd_{max}(El) = -105.2 \text{ for } 13.6° < El \leq 90°$$

To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pfd(El) = EIRP(El) - 10.\log_{10}(4\pi d^2) - L_{Pol} - B_{loss} - GasAtt(El) - \text{rain fade}$$

where:

d distance in meters between the HAPS and the ground (elevation angle dependent);

e.i.r.p. HAPS platform nominal EIRP spectral density in dBW/MHz at a specific elevation angle;

pfd(El) power flux density at the Earth surface per HAPS platform station in dB(W/m²/MHz);

Lpol polarization loss of 3 dB;

Bloss polarization loss of 4 dB;

GasAtt(El) gaseous attenuation (ITU-R SF.1395);

rainfade rain attenuation in dB (ITU-R P.618).

3 that for the purpose of protecting the fixed satellite service (Earth-to-space) in the 27.9-28.2 GHz, the maximum EIRP density per HAPS platform shall be less than -8 dBW/MHz for off-nadir angle higher than 85°;

4 that HAPS ground stations shall not claim protection from fixed-satellite service earth stations transmitting in the 27.9-28.2 GHz band, and No. 5.43A shall not apply;

5 that for the purpose of protecting the fixed service systems in neighboring administrations in the band 31-31.3 GHz, the power flux density level per HAPS platform station at the surface of the Earth in neighboring administrations shall not exceed the following pfd mask in dBW/m2/MHz, under clear sky condition, without the explicit agreement from the affected administration:

$$pfd_{max}(El) = (0.875 \times El - 143) \text{ for } El \leq 8°$$

$$pfd_{max}(El) = (2.58 \times El - 156.6) \text{ for } 8° < El \leq 20°$$

$$pfd_{max}(El) = (0.375 \times El - 112.5) \text{ for } 20° < El \leq 60°$$

$$pfd_{max}(El) = -90 \text{ for } 60° < El \leq 90°$$

where El is elevation angle in degrees (angle of arrival above the horizontal plane).
To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pfd(El) = EIRP(El) - 10.\log_{10}(4\pi d^2) - \text{rain fade}$$

where:

d distance in meters between the HAPS and the ground (elevation angle dependent);

e.i.r.p. HAPS platform nominal EIRP spectral density in dBW/MHz at a specific elevation angle;

pfd(El) power flux density at the Earth surface per HAPS platform station in dB(W/m²/MHz);

rainfade rain attenuation in dB (ITU-R P.618).

6 that in order to ensure the protection of EESS (passive) per RR.5.543A, the level of unwanted power density into the HAPS ground station antenna in the band 31.3-31.8 GHz shall be limited to −83 dB(W/200 MHz) under clear-sky conditions and may be increased under rainy conditions to mitigate fading due to rain, provided that the effective impact on the passive satellite does not exceed the impact under clear-sky conditions;

7 that in order to ensure the protection of EESS (passive) services the EIRP per HAPS platform, in the band 31.3-31.8 GHz, shall not exceed:

$$EIRP = (- El - 13.1)\ dBW/200MHz \quad for \quad - 4.53° \leq El < 22°$$

$$EIRP = - 35.1\ dBW/200\ MHz \quad for \quad 22° \leq El < 90°$$

8 that in order to ensure the protection of the radio astronomy service, the pfd level produced by any HAPS ground station at the RAS stations listed, shall not exceed -141 dBW/m^2/500MHz in the band 31.3-31.8 GHz, unless a higher pfd is otherwise agreed between the corresponding administrations;
To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pfd(El) = EIRP(El) + Att_{Rec\ P.452\ -\ 16}(d) - 10\log10\left(\frac{\lambda^2}{4\pi}\right)$$

where:

$Att_{Rec\ P.452\text{-}16}$ attenuation in dB based on Recommendation ITU-R P.452-16 propagation model with p = 2%;

e.i.r.p. maximum HAPS EIRP density level in dBW/MHz/500MHz (dependent to the elevation angle);

d distance in meters between the HAPS and the ground (Elevation angle dependent);

pfd(El) power flux density at the Earth surface per HAPS platform station in dB(W/m²/500MHz);

9 that in order to ensure the protection of the radio astronomy service the pfd produced by unwanted emissions from HAPS platform downlink transmissions shall not exceed -171 dB W/m²/500 MHz for continuum observations in the band 31.3-31.8 GHz at an RAS station location at a height of 50m, where this pfd value shall be verified considering a percentage of time of 2% in the relevant propagation model;

To verify the compliance the following formula shall be used:

$$pfd(El) = EIRP_{max\ \ clear\ sky}(Az, El) + Att_{618\ p\ =\ 2\%} - 10\log10(4\pi d^2)$$

where:

$EIRP_{max\ clear\ sky.}$ maximum EIRP towards the RAS station at which the HAPS platform station operates under clear sky condition in dB(W/500 MHz);

Az azimuth from the HAPS platform toward the RAS station;

El: is the elevation angle at the HAPS platform towards the RAS station;

$Att_{618p=2\%:}$ attenuation from recommendation 618 corresponding to p=2% of the time at the radio astronomy location;

d separation distance in m between the HAPS platform and the RAS station;

pfd(El) power flux density at the Earth surface per HAPS platform station in dB(W/m²/500MHz);

10 that *resolves 8* and *9* applies at any radio astronomy station that was in operation prior to 22 November 2019 and has been notified to the Bureau in the band 31.3-31.8 GHz before 22 May 2020; and that radio astronomy stations notified after this date may seek an agreement with administrations that have authorized HAPS,

instructs the Director of the Radiocommunication Bureau

to take all necessary measures to implement this Resolution.

Reasons: To add the text of a resolution specifying the operating requirements for HAPS to protect other services.

5. PROPOSALS FOR THE 38 - 39.5 GHZ BAND

MOD USA/1.14/21

ARTICLE 5

Frequency allocations

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

38-39.5 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
38-39.5	FIXED ADD 5.G114 FIXED-SATELLITE (space-to-Earth) MOBILE Earth exploration-satellite (space-to-Earth) 5.547	

Reasons: To add a footnote to the fixed service allocation in support of a worldwide HAPS designation in the 38-39.5 GHz band.

ADD USA/1.14/22

5.G114 The allocation to the fixed service in the band 38-39.5 GHz is designated for worldwide use by high-altitude platform stations (HAPS). This designation does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Such use of the fixed-service allocation by HAPS is limited to the ground-to-HAPS direction.

Reasons: To add the text of the footnote allowing HAPS to operate in the fixed service allocation in the 38-39.5 GHz band on a worldwide basis.

Draft new Resolution for the 38-39.5 GHz band

ADD **USA/1.14/23**

DRAFT NEW RESOLUTION [G114]

Use of the frequency range 38-39.5 GHz by fixed links for high altitude platform stations in the fixed service worldwide

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

considering

a) that WRC-15 considered that there is a need for greater broadband connectivity in underserved communities and in rural and remote areas, that current technologies can be used to deliver broadband applications by high-altitude platform stations (HAPS), which can provide broadband connectivity and disaster recovery communications with minimal ground network infrastructure;

b) that WRC-15 decided to study additional spectrum needs for fixed HAPS links to provide broadband connectivity, including within the band 38 – 39.5 GHz, recognizing that the existing HAPS designations were established without reference to today's broadband capabilities;

c) that HAPS can provide broadband connectivity with minimal ground network infrastructure;

d) that Recommendation ITU-R P.618, "Propagation data and prediction methods required for the design of Earth-space telecommunication systems", should be used to determine rain fade attenuation from HAPS platforms;

e) that Recommendation ITU-R P.452, "Prediction procedure for the evaluation of interference between stations on the surface of the Earth at frequencies above about 0.1 GHz", should be used to determine the propagation loss in the ground path from HAPS ground stations;

f) that Recommendation ITU-R SF.1395, "Minimum propagation attenuation due to atmospheric gases for use in frequency sharing studies between the fixed-satellite service and the fixed service", should be used to determine the gaseous attenuation;

g) that Recommendation ITU-R P.2108, "Prediction of Clutter Loss", should be used to determine the clutter loss,

Recognizing

a) that the use of HAPS in this band is intended for the ground to HAPS direction;

b) that with respect to coordination procedures between neighboring administration for terrestrial services Article 9.18 of the Radio Regulations applies;

Resolves

1 that for the purpose of protecting terrestrial mobile service systems in neighboring administrations in the frequency range 38-39.5 GHz, the power flux density limit per HAPS ground station at the surface of the Earth in neighboring administrations shall not exceed the following pfd masks in dBW/m^2/MHz under clear sky conditions without the explicit agreement from the affected administration:

$$pfd_{max} = -109 \text{ dBW/m}^2\text{/MHz}$$

where El is the elevation angle in degrees (angle of arrival above the horizontal plane).
To verify the that pfd produced by HAPS ground station does not exceed the proposed pfd mask, the following equation was used:

$$pfd(El) = EIRP_{\frac{dBW}{MHz}}(El) + 10 * \log_{10}\left(\frac{\lambda^2}{4\pi}\right) - P.452(d) - L_{Pol} - C_{loss}$$

Where:

e.i.r.p. nominal HAPS ground station EIRP density level in dBW/MHz (dependent to the elevation angle);

d distance between the HAPS ground station and the border of the neighboring administration (elevation angle dependent);

L_{pol} polarization discrimination of 3dB;

C_{loss} clutter loss (ITU-R P.2108);

P.452(d) propagation loss (ITU-R P.452);

2 that for the purpose of protecting FSS GSO and NGSO earth station systems in the fixed satellite service (space to-Earth) in neighboring administrations, coordination of a transmitting HAPS ground station is required when the power-flux density in dB(W/m²/MHz) at the border of an neighboring administration exceeds pfd limit of -111.3 dB(W/m²/MHz) for NGSO operations and -108.9 dB(W/m²/MHz) for GSO operations and the pfd values shall be verified considering a percentage of time of 20% in the relevant propagation model.

To verify the that pfd produced by HAPS ground station does not exceed the proposed pfd limits, the following equation was used:

$$pfd = EIRP_{\frac{dBW}{MHz}} + 10 * \log_{10}\left(\frac{\lambda^2}{4\pi}\right) - P.452(d)$$

Where:

$EIRP_{\frac{dBW}{MHz}}$ nominal HAPS ground station EIRP density level in dBW/MHz towards the horizon;

d distance between the HAPS ground station and the FSS earth station;

P.452(d) propagation loss (ITU-R P.452);

instructs the Director of the Radiocommunication Bureau

to take all necessary measures to implement this Resolution.

6. PROPOSALS FOR THE 47 GHZ BANDS

For the 47.2-47.5 GHz Band

MOD **USA/1.14/23**

ARTICLE 5

Frequency allocations

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

40-47.5 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
47.2-47.5	FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE MOD 5.552A	

Reasons: To modify footnote 5.552A to reference an updated Resolution 122 which addresses the current worldwide HAPS designation in the 47.2-47.5 GHz band.

For the 47.9-48.2 GHz Band

MOD **USA/1.14/24**

47.5-51.4 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
47.9-48.2	FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE MOD 5.552A	

Reasons: To modify footnote 5.552A to reference an updated Resolution 122 which addresses the current worldwide HAPS designation in the 47.9-48.2 GHz band.

MOD **USA/1.14/25**

5.552A The allocation to the fixed service in the bands 47.2-47.5 GHz and 47.9-48.2 GHz is designated for use by high altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS is limited to the ground-to-HAPS direction. The use of the bands 47.2-47.5 GHz and 47.9-48.2 GHz is subject to the provisions of Resolution **122 (Rev.WRC-19)**.

Reasons: To modify footnote 5.552A to reflect an updated Resolution 122 with allowances for increases in EIRP density levels during periods of rain and to limit operation to the ground-to-HAPS direction

Modification of Resolution 122 for the 47.2-47.5 GHz and 47.9-48.2 GHz bands

MOD USA/1.14/26

RESOLUTION 122 (REV.WRC-19)

Use of the bands 47.2-47.5 GHz and 47.9-48.2 GHz by high altitude platform stations in the fixed service and by other services

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

considering

a) that the band 47.2-50.2 GHz is allocated to the fixed, mobile and fixed-satellite services on a co-primary basis;

b) that WRC-97 made provision for operation of high altitude platform stations (HAPS), also known as stratospheric repeaters, within the fixed service in the bands 47.2-47.5 GHz and 47.9-48.2 GHz;

c) that establishing a stable technical and regulatory environment will promote the use of all co-primary services in the band 47.2-47.5 GHz and 47.9-48.2 GHz;

d) that systems using HAPS are in an advanced stage of development and some countries have notified such systems to ITU in the bands 47.2-47.5 GHz and 47.9-48.2 GHz;

e) that Recommendation ITU-R F.1500 contains the characteristics of systems in the fixed service using HAPS in the bands 47.2-47.5 GHz and 47.9-48.2 GHz;

f) that while the decision to deploy HAPS can be taken on a national basis, such deployment may affect neighboring administrations and operators of co-primary services;

g) that ITU-R has completed studies dealing with sharing between systems using HAPS in the fixed service and other types of systems in the fixed service in the bands 47.2-47.5 GHz and 47.9-48.2 GHz;

h) that ITU-R has completed studies on compatibility between HAPS systems in the 47.2-47.5 GHz and 47.9-48.2 GHz bands and the radio astronomy service in the 48.94-49.04 GHz band;

i) that No. **5.552** urges administrations to take all practicable steps to reserve fixed-satellite service (FSS) use of the band 47.2-49.2 GHz for feeder links for the broadcasting-satellite service (BSS) operating in the band 40.5-42.5 GHz, and that ITU-R studies indicate that HAPS in the fixed service may share with such feeder links;

j) that the technical characteristics of expected BSS feeder links and FSS gateway-type stations are similar;

k) that ITU-R has completed studies dealing with sharing between systems using HAPS in the fixed service and the fixed-satellite service,

recognizing

) that, in the long term, the bands 47.2-47.5 GHz and 47.9-48.2 GHz are expected to be required for HAPS operations for gateway applications;

b) that Recommendation ITU-R SF.1843 provides information on the feasibility of HAPS systems in the fixed service sharing with the FSS;

c) that ITU-R studies on HAPS operation in the bands 47.2-47.5 GHz and 47.9-48.2 GHz allocated to the fixed service have concluded that, in order to share with FSS (Earth-to-space), the maximum uplink transmit e.i.r.p. density of HAPS ground terminals in the bands should, in clear-sky conditions, be 6.4 dB(W/MHz) for Urban Area Coverage (UAC), 22.57 dB(W/MHz) for Suburban Area Coverage (SAC) and 28 dB(W/MHz) for Rural Area Coverage (RAC), and that these values can be increased by up to 20 dB during periods of rain;

e) that ITU-R studies have established specific power flux-density values to be met at international borders to facilitate bilateral agreement on sharing conditions for HAPS with other types of fixed service systems in a neighboring country;

f) that FSS satellite networks and systems with earth station antenna diameters of 2.5 meters or larger operating as a gateway-type station are capable of sharing with ubiquitous HAPS terminals,

resolves

1 that to facilitate sharing with the FSS (Earth-to-space), the maximum transmit e.i.r.p. density of a ubiquitous HAPS ground terminal shall not exceed the following levels under clear-sky conditions:

6.4	dB(W/MHz)	for UAC	(30□ < □ □ 90□)
22.57	dB(W/MHz)	for SAC	(15□ < □ □ 30□)
28	dB(W/MHz)	for RAC	(5□ < □ □ 15□)

where □ is the ground terminal elevation angle in degrees;

2 that the values in *resolves 1* can be increased, up to 20 dB, to compensate for rain fade provided that the pfd at the space station does not exceed the value that would result when transmitting with the levels in *resolves 1* in clear sky condition;

3 that the ground terminal antenna patterns of HAPS operating in the bands 47.2-47.5 GHz and 47.9-48.2 GHz shall meet the following antenna beam patterns:

$$G(j) = G_{max} - 2.5 \times 10^{-3} \left(\frac{D}{\lambda} j\right)^2 \quad \text{for} \quad 0 < j < j_m$$

$$G(j) = 39 - 5 \log (D/\lambda) - 25 \log j \quad \text{for} \quad j_m \leq j < 48$$

$$G(j) = -3 - 5 \log (D/\lambda) \quad \text{for} \quad 48 \leq j \leq 180$$

where:

G_{max} : maximum antenna gain (dBi)

$G(j)$: gain (dBi) relative to an isotropic antenna

j : off-axis angle (degrees)

D: antenna diameter

λ: wavelength

expressed in the same units

$$j_m \approx \frac{20 \lambda}{D} \sqrt{G_{max} - G_1} \quad \text{degrees}$$

G_1 : gain of the first side lobe

$-2 - 15 \log (D/\lambda)$ (dBi);

4 that for the purpose of protecting fixed wireless systems in neighboring administrations from co-channel interference, a HAPS system operating in the frequency bands 47.2-47.5 GHz and 47.9-48.2 GHz shall not exceed the following power flux-density values at the Earth's surface at an administration's border, unless explicit agreement of the affected administration is provided at the time of the notification of HAPS:

−141	dB(W/(m² · MHz))	for 0° £ δ < 3°
−141 + 2(δ − 3)	dB(W/(m² · MHz))	for 3° £ δ £ 13°
−121	dB(W/(m² · MHz))	for 13° < δ £ 90°

where δ is the angle of the arrival above the horizontal plane in degrees;

6 that administrations planning to implement a HAPS system in the 47.2-47.5 GHz and 47.9-48.2 GHz bands shall notify the frequency assignments by submitting all mandatory elements of Appendix **4** to the Bureau for the examination of compliance with respect to *resolves* 1, 2, 3, 4 and 5 above with a view to their registration in the Master International Frequency Register;

7 that administrations shall notify the new data elements for the notices referred to in *instructs the Director of the Radiocommunication Bureau* 1 in order to enable the Bureau to perform the examinations,

invites administrations

that intend to deploy HAPS systems in the fixed service in the bands 47.2-47.5GHz and 47.9-48.2 GHz to consider specifying the use of the bands 47.2-47.35 GHz and 47.9-48.05 GHz for ubiquitous HAPS terminals,

instructs the Director of the Radiocommunication Bureau

to examine all assignments to HAPS in the fixed service notified prior to 1 January 2020 and apply the provisions of *resolves* 1, 2, 3, 4 and 5 and the respective calculation methodologies included in Recommendation ITU-R F.1820 and Recommendation ITU-R SF.1843.

Reasons: To modify the existing Resolution 122 which supports a worldwide designation to HAPS to allow for increases in EIRP density levels during periods of rain.

VIEW B

View B:

View B addresses the protection of the fixed and mobile services under WRC-19 agenda item 1.14. View B is supported by AT&T, CTIA, Ericsson, Global Mobile Suppliers Association (GSA), GSMA, Intel Corporation, Sprint Corporation, T-Mobile, and Verizon.

View B provides a partial proposal, focused on the protection of the mobile and fixed services. This proposal includes updates of portions of various Resolutions associated with increased access to spectrum for HAPS. However, this should not be taken as an endorsement by the undersigned of an equal tatus for HAPS with mobile and conventional fixed systems (non-HAPS) as we have significant concerns about proposals to designate spectrum for HAPS without adequate protection of the fixed or mobile systems. Rather this proposal is to provide regulatory options in the event that the US decides to submit a proposal for HAPS use in the band(s) under study. Specifically, View B is narrowly focused on two main aspects:

1) Consistency with Resolution 160 (specifically Resolves 3, Further Resolves 1 and Recognizing a)

2) Ensuring appropriate protection of the fixed and mobile services and their future development is not constrained if there is a proposal is a proposal for HAPS

Specifically:

resolves 3 is "to study appropriate modifications to the existing footnotes and associated resolutions in the identifications in *recognizing c)* in order to facilitate the use of HAPS links on a global or regional level, limited to the currently identified frequency bands and, where the use of an identification is not technically feasible for HAPS use, the possible removal of the unsuitable identification". The proposals in View B with regards to 28 GHz and 31 GHz are treated consistent with Res. 160 as View B makes modifications to the existing footnotes and resolution to broaden the geographic area to the global or regionals level.

further resolves of Resolution 160

1 that the studies referred to in *resolves to invite ITU-R* 3 and 4 include sharing and compatibility studies to ensure protection of existing services allocated in the frequency ranges identified and, as appropriate, adjacent band studies, taking into account studies already performed in ITU-R;

recognizing

a) that existing services and their applications shall be protected from HAPS applications, and no undue constraints shall be imposed on the future development of existing services by HAPS;

The proposals in View B are consistent with these aspects of Resolution 160

With respect to the appropriate protection of the fixed and mobile services in band(s) in which there is a proposal,

- The Power Flux Density (pfd) for protection of a victim receiver from interference coming from any given angle as a function of its protection criteria is generally derived from the formula below:

$$pfd \; \square I / N \; 10\log(4\square / \square^2 \tilde{}) \; G_{RX} \; k \; 10\log(T_{RX} \bullet B_{REF})$$

where

pfd = power flux density, dB(W/m^2) in a reference bandwidth, B_{REF}

I/N = Protection criteria (expressed as interference-to-noise ratio), dB

λ = wavelength, m

G_{RX} = receive gain in the direction of the interferer, dBi

k = Boltzmann constant, dB(J/K)

T_{RX} = receive system total noise temperature (including Noise Figure), K

B_{REF} = reference bandwidth, Hz

- The technical conditions for the operation of HAPS provided by the expert groups for the services involved in sharing the bands with HAPS should be used. Specifically the pfd values derived using the formula above and system characteristics including antenna pattern from the experts groups (WP5A and WP5D) are provided in View B for the protection of mobile broadband services.
- For the fixed service pfd mask, there is disagreement in WP5C over the characteristics of the fixed service to use in sharing studies. For example, see section 3.2 of the sharing studies for 47 GHz in which there are editor's notes about which Recommendations (and version) should be used for technical characteristics as well as one regarding the antenna pattern to use. Since both technical characteristics and antenna pattern are key inputs to the derivation of an appropriate pfd mask, we are unable to provide the exact mask for use without additional guidance on which Recommendations should be used. With this information, we could provide the appropriate pfd mask for fixed services.
- Compliance with the pfd values for the protection of mobile and fixed services can be done at the national and bilateral level and there is no need to address any specific details for calculating the compliance values in the current regulations. Any reference for compliance procedure in the WRC Resolution will be an inappropriate precedence setting noting that there are many instances in the Radio Regulations where pfd values for the terrestrial services are specified without mention of any specific parameters related to compliance e.g. in RR 5.430A "This limit may be exceeded on the territory of any country whose administration has so agreed. In order to ensure that the pfd limit at the border of the territory of any other administration is met, the calculations and verification shall be made, taking into account all relevant information, with the mutual agreement of both administrations (the administration responsible for the terrestrial station and the administration responsible for the earth station) and with the assistance of the Bureau if so requested."

Finally we would like to note that the proposed technical characteristics for the six different HAPS systems have been a moving target throughout the process. For example, in the characteristics proposed at the 18th WP5C Meeting in January 2017, only one system proposed deployment in urban areas, and that system proposed only 1 CPE per beam, only 16 CPE beams, and 2 gateway beams. At the next WP5C Meeting in November 2017, 4 systems proposed deployments in urban areas, with one system proposing 1600 CPEs per beam and 100 CPE beams in all deployment environments. The characteristics changed yet again for the most recent WP5C Meeting in May 2018, with one system proposing 189 CPEs per beam and 67 CPE beams in all deployment scenarios. Even with this significant downward adjustment from 160,000 CPEs to 12,663 CPEs, there is still no information on what sharing with this system would be like.

Furthermore, the bands under this Agenda Item overlap with the bands under consideration under other Agenda Items including Agenda Item 1.13 for IMT identification. While the ITU-R expert group carried out studies regarding compatibility of HAPS in bands under this Agenda Item, these studies are still continuing. To date, the studies have focused on the two systems which have 16 and 32 CPEs, rather than the system with 12,663 CPEs. With regard to the amount of spectrum, we note that the existing allocations provide nearly double the minimum amount of spectrum needed according to ITU-R studies on the matter: the minimum amount is 720 MHz and the existing footnotes for HAPs total 1360 MHz.

It should be noted that given the length and number of Views in the WAC on WRC-19 agenda item 1.14, the proposals in View B are provided as a subset of the document with revisions shown relative to View A, with the exception of the 28 GHz and 31 GHz (in which they are shown relative to the Radio Regulations). For the 21 GHz, the supporters of View B believe the fixed service pfd mask would need to be provided and the compliance mask removed. Also in there is no consideration for the protection of any systems under mobile service allocated in the 21 GHz on co-primary basis

The supporters of View B respectfully request that these factors be taken into account as the US determines its proposal for WRC-19 agenda item 1.14.

ATTACHMENT TO VIEW B:

UNITED STATES OF AMERICA
DRAFT PROPOSAL FOR THE WORK OF THE CONFERENCE

Agenda Item 1.14: *to consider, on the basis of ITU-R studies in accordance with Resolution 160 (WRC-15), appropriate regulatory actions for high-altitude platform stations (HAPS), within existing fixed-service allocations.*

I. BACKGROUND

No. 1.66A of the ITU Radio Regulations define a high-altitude platform station (HAPS) as "a station on an object at an altitude of 20 to 50 km and at a specified, nominal, fixed point relative to the Earth". Agenda Item 1.14 was adopted by WRC-15 to consider, in accordance with Resolution 160 (WRC-15), regulatory actions that can facilitate deployment of HAPS for broadband applications. Resolution 160 resolves to invite ITU-R to study additional spectrum needs of HAPS, examining the suitability of existing HAPS designations and conducting sharing and compatibility studies for additional designations in existing fixed allocations in the 38-39.5 GHz band on a global basis and in 21.4-22 GHz and 24.25-27.5 GHz bands only in Region 2. Resolution 160 also states that existing services and their applications shall be protected from HAPS applications, and no undue constraints shall be imposed on the future development of existing services by HAPS.

The ITU-R developed a Preliminary New Draft Recommendation (PDNR) assessing spectrum needs for broadband HAPS which concludes “These assumed system characteristics show that the spectrum needs for HAPS are in the range from 396 MHz to 2 969 MHz for the uplink and 324 MHz to 1 505 MHz for downlink, for both GW and CPE links, which would need to be considered within existing and/or new HAPS designations. These ranges include the spectrum needs to cover those of specific applications (e.g., disaster relief missions) plus that for connectivity applications (e.g., commercial broadband).”

Currently there are 3 spectrum bands identified for HAPS in the fixed services. These are:

- 47.2–47.5 GHz and 47.9 48.2 GHz,
- 27.9-28.2 GHz (HAPS-ground) and 31.0-31.3 GHz (ground-HAPS),
- 6 440–6 520 MHz (HAPS-ground) and 6 560-6 640 MHz (ground-HAPS).

The amount of spectrum in the 3 spectrum bands identified for HAPS is 1360 MHz which exceeds the minimum spectrum needs of HAPS of 720 MHz by nearly 200%. However, the global designations for HAPS links (which is in the 47.2-47.5 GHz band fixed-service allocation paired with the 47.9-48.2 GHz band fixed-service allocation) suffers from the effects of rain fade attenuation that severely limit service provision over high-precipitation geographies. The remaining 2 available bands (27.9-28.2 GHz paired with the frequency band 31.0-31.3 GHz, and 6440-6 520 MHz paired with 6 560-6 640 MHz) have been identified by a limited number of countries, none of which is within ITU Region 2.

Spectrum harmonization and utilization is facilitated by common worldwide designations. International regulatory flexibility can enable improvements in global connectivity by encouraging national regulators to permit operation of higher-speed Internet access services over new, complementary platforms, while ensuring protection of existing services. Additionally, harmonization of spectrum promotes economies of scale and commonality of equipment.

BROADBAND HAPS APPLICATIONS

Advances in aeronautics and transmission technologies have significantly improved the capabilities of HAPS to provide effective connectivity solutions and meet the growing demand for high capacity broadband networks, particularly in currently underserved areas. Recently conducted full-scale test flights have shown that solar-powered platforms in the upper-atmosphere can now be used to carry payloads that offer connectivity over large areas in a reliable and cost-effective way, and a growing number of applications for the new generation of HAPS are being developed. The technology appears particularly well suited to complementing terrestrial networks by providing backhaul. A number of advantages of the new generation of HAPS are foreseen:

- **Wide-area coverage:** It is anticipated that a single platform would be able to serve footprints larger than 100 km in diameter, and recent technological advances in the development of optical inter-HAPS links now allow the deployment of multiple linked HAPS, in fleets that can cover whole nations.
- **Low cost:** The cost of operating stratospheric platforms is projected to be significantly lower than other connectivity solutions in many areas, while mass production of the aircraft will significantly lower upfront capital expenditure for deployment.
- **Reach:** HAPS platforms operate at around 20 km above ground, which reduces their vulnerability to weather conditions that may affect service, provides large coverage areas and avoids interference caused by physical obstacles.
- **Rapid deployment and flexibility:** HAPS services could be deployed without long lead times and it is relatively simple to return solar platforms to the ground for maintenance or payload reconfiguration.
- **Geographical reach:** HAPS that use the architecture of solar platforms can also provide connectivity in remote sites on land or sea.
- **Environmentally friendly:** HAPS can run exclusively on solar power for long periods, connecting people with almost no environmental impact.

Broadband HAPS can also be used for response to natural disasters, fire detection, monitoring, and fire fighting, law enforcement, and resource exploration missions.

SHARING STUDIES

A number of administrations and technology proponents have conducted compatibility studies to assess coexistence between HAPS and incumbent and proposed systems and services (including WRC-19 Agenda Items 1.6 and 1.13).

Power-flux density (PFD) masks are proposed to ensure the protection of the fixed and mobile services from downlink emissions by HAPS platforms (HAPS-to-ground), which if exceeded would require explicit agreement from affected administrations. However, these studies have not yet concluded. For example, in 25.25-27.5 GHz, sharing studies with the Mobile Service to date have only been conducted for two of the six proposed HAPS systems: it should be noted that the systems studied have a CPE density of 16 and 32 CPEs, while other systems which have not been studied include one system that has a CPE density of 12,663 CPEs. In the 47.2-47.5 GHz and 47.9-48.2

GHz bands, there is not even agreement on which Recommendations to use for characteristics of the Fixed Service. Furthermore, two HAPS proponents have assessed the prospects for sharing with mobile operations in the 26 GHz band in the United States, and concluded that "IMT cannot share the spectrum without causing unacceptable interference or imposing unreasonable constraints" on their proposed operations.[6]

…

These proposals provide appropriate modifications to the existing footnotes and associated resolutions in the existing HAPS identifications in order to facilitate the use of HAPS links on a global or regional level, limited to the currently identified frequency bands, consistent with Resolution 160 (WRC-15). Furthermore, it should be noted that these proposals do not include a compliance mask, which can be addressed at the national level.

Proposals:

ADD USA/1.14/12

5.D114 The allocation to the fixed service in the bands 25.25-25.5 GHz, 25.5-27.0 GHz and 27.0-27.5 GHz may also be used in Region 2 by high-altitude platform stations (HAPS): this does not preclude the use of these frequency bands by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Such use of the fixed-service allocation by HAPS is limited to operation in the HAPS-to-ground and ground-to-HAPS in the frequency range 25.25-27 GHz, and HAPS-to-ground only in the band 27.0-27.5 GHz. Such use of the fixed-service allocation by HAPS shall be in accordance with Resolution **[C114] (WRC-19)**. Furthermore, the future development of these other services shall not be constrained by HAPS.

Reasons: To add the text of the footnote allowing HAPS to operate in the fixed service allocation in the 25.25-27.55 GHz band. The limitation of the use of HAPS in the HAPS-to-ground direction in the 27-27.5 GHz band is to ensure the protection of the FSS operating in the same band.

ADD USA/1.14/13

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[6] Petition for Rulemaking of Elefante Group, Inc., *Petition for Rulemaking to Enable Fixed Stratospheric-Based Communications Services in the 21.5-23.6, 25.25-27.5, 71-76, and 81-86 GHz Bands*, RM-11809, at 75 n.98 (filed May 31, 2018), https://ecfsapi.fcc.gov/file/10531779304408/Elefante%20Group%20Petition%20for%20Rulemaking%205-31-2018.pdf; *see also* Comments of Elefante Group, Inc., *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, GN Docket NO. 14-177, at 63-68 (filed Sept. 10, 2018), https://ecfsapi.fcc.gov/file/1091164700443/Elefante%20Group%20Comments%20on%20Spectrum%20Frontiers%203rd%20FNPRM%20(FINAL%209-10-18).pdf.

DRAFT NEW RESOLUTION [C114]

Use of the frequency range 24.25-27.5 GHz by fixed links for high altitude platform stations in the fixed service in Region 2

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

considering

a) that WRC-15 considered that there is a need for greater broadband connectivity in underserved communities and in rural and remote areas, that current technologies can be used to deliver broadband applications by high-altitude platform stations (HAPS), which is one possible means to provide broadband connectivity and disaster recovery communications;

b) that WRC-15 decided to study additional spectrum needs for fixed HAPS links to provide broadband connectivity, including within the band 24.25-27.5 GHz in Region 2, recognizing that the existing HAPS designations were established without reference to today's broadband capabilities;

c) that HAPS can provide broadband connectivity with minimal ground network infrastructure;

recognizing

d) that HAPS is defined in No. **1.66A** of the Radio Regulations as a station located on an object at an altitude of 20-50 km and at a specified, nominal, fixed point relative to the Earth, and is subject to No. **4.23**;

e) that in the band 27.0-27.5 GHz with respect to earth stations in the Fixed-Satellite Service (Earth-to-space) and HAPS ground station receivers which operate in the Fixed Service, Nos. **9.17** and **9.18** applies;

resolves

1 that for the purpose of protecting the fixed service systems in neighboring administrations in the frequency range 24.25-27.5 GHz, the power flux density level per HAPS platform station at the surface of the Earth in neighboring administrations shall not exceed the following pfd mask in dBW/m^2/MHzwithout the explicit agreement from the affected administration:

$pfd_{max}(El) = 0.39 \times El - 132.12$ for $0 \leq El < 13°$

$$pfd_{max}(El) = 2.715 \times El - 162.3 \text{ for } 13° \leq El < 20°$$

$$pfd_{max}(El) = 0.45 \times El - 117 \text{ for } 20° \leq El < 60°$$

$$pfd_{max}(El) =- 90 \text{ for } 60° \leq El \leq$$

where El is the elevation angle in degrees (angles of arrival above the horizontal plane).

[NOTE TO FCC: The mask above should be confirmed or revised, using the correct formula and relevant ITU-R Recommendations, once the correct Recommendation to use is identified.]

2 that for the purpose of protecting the terrestrial mobile service systems in neighboring administrations in the band 24.25-27.5 GHz, the power flux density level per HAPS platform station or individual HAPS ground station at the surface of the Earth in neighboring administrations shall not exceed the following pfd masks in dBW/m^2/MHz without the explicit agreement from the affected administration:

PFD(δ) = -113.3	(dBW/m^2/1 MHz)	for $0° \leq \delta \leq 4°$
PFD(δ) = -113.3 + 1.2 * (δ - 4)	(dBW/m^2/1 MHz)	for $4° < \delta \leq 9°$
PFD(δ) = -107.3	(dBW/m^2/1 MHz)	for $9° < \delta \leq 90°$

where δ is the elevation angle in degrees (angle of arrival above the horizontal plane for the HAPS platform station and below the horizon for the HAPS ground station).

3 that HAPS stations shall not claim protection from Fixed or Mobile Service stations transmitting in the bands 25.25-27.5 GHz and No. 5.43A shall not apply;

4 …

Reasons: To add the text of a resolution specifying the operating requirements for HAPS to protect other services for the directions indicated in the Article 5 footnotes.

MOD USA/1.14/15

5.537A The allocation to the fixed service in the band 27.9-28.2 GHz may also be used by high altitude platform stations (HAPS): this does not preclude the use of these frequency bands by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Such use of 300 MHz of the fixed-service allocation by HAPS is further limited to operation in the HAPS-to-ground direction and shall not cause unacceptable interference to, nor claim protection from, other types of fixed-service systems or systems operating under other co-primary services. Furthermore, the development of these other services shall not be constrained by HAPS. See Resolution **145 (Rev.WRC-19)**.

MOD USA/1.14/20

RESOLUTION 145 (REV.WRC-19)

Use of the bands 27.9-28.2 GHz and 31-31.3 GHz by high altitude platform stations in the fixed service

The World Radiocommunication Conference (Geneva, 2012),

considering

a) that WRC-97 made provision for the operation of high altitude platform stations (HAPS), also known as stratospheric repeaters, within a 2 x 300 MHz portion of the fixed-service allocation in the bands 47.2-47.5 GHz and 47.9-48.2 GHz;

b) that No. **4.23** specifies that transmissions to or from HAPS shall be limited to the bands specifically identified in Article **5**;

c) that at WRC-2000, several countries in Region 3 and one country in Region 1 expressed a need for a lower frequency band for HAPS due to the excessive rain attenuation that occurs at 47 GHz in these countries;

d) that some countries in Region 2 have also expressed an interest in using a frequency range lower than those referred to in *considering a)*;

e) that, in order to accommodate the need expressed by the countries referred to in *considering c)*, WRC-2000 adopted Nos. **5.537A** and **5.543A**, which were modified at WRC-03 and then again at WRC-07 to permit the use of HAPS in the fixed service in the band 27.9-28.2 GHz and in the band 31-31.3 GHz in certain Region 1 and 3 countries on a non-harmful interference, non-protection basis;

f) that the bands 27.9-28.2 GHz and 31-31.3 GHz are already heavily used or planned to be used by a number of different services and a number of other types of applications in the fixed service;

g) that while the decision to deploy HAPS can be taken on a national basis, such deployment may affect neighbouring administrations, particularly in small countries;

h) that the 31.3-31.8 GHz band is allocated to the radio astronomy, Earth exploration-satellite (passive) and space research (passive) services, and that WRC-03 amended No. **5.543A** to specify signal levels that would protect satellite passive services and radio astronomy stations;

i) that ITU-R has conducted studies dealing with sharing between systems using HAPS in the fixed service and other types of systems in the fixed service in the bands 27.9-28.2 GHz and 31-31.3 GHz leading to Recommendation ITU-R F.1609;

j) that results of some ITU-R studies indicate that, in the bands 27.9-28.2 GHz and 31-31.3 GHz, sharing between fixed-service systems using HAPS and other conventional fixed-service systems in the same area will require appropriate interference mitigation techniques to be developed and implemented;

k) that ITU-R has conducted studies dealing with compatibility between systems using HAPS and the passive services in the 31.3-31.8 GHz band leading to Recommendations ITU-R F.1570 and ITU-R F.1612;

l) that ITU-R has produced Recommendation ITU-R SF.1601 containing methodologies for evaluating interference from fixed-service systems using HAPS into GSO FSS systems in the band 27.9-28.2 GHz;

m) that HAPS technical issues could continue to be studied in order to determine appropriate measures for protecting the fixed service and other co-primary services in the band 27.9-28.2 GHz,

resolves

1 that, notwithstanding No. **4.23**, the use of HAPS within the fixed-service allocations within the 27.9-28.2 GHz and 31-31.3 GHz bands shall not cause harmful interference to, nor claim protection from, other stations of services operating in accordance with the Table of Frequency Allocations of Article **5**, and, further, that the development of these other services shall proceed without constraints by HAPS operating pursuant to this Resolution;

2 that any use by HAPS of the fixed-service allocation at 27.9-28.2 GHz pursuant to *resolves* 1 above shall be limited to operation in the HAPS-to-ground direction, and that any use by HAPS of the fixed-service allocation at 31-31.3 GHz shall be limited to operation in the ground-to-HAPS direction;

2 bis that systems using HAPS in the band 27.9-28.2 GHz, in accordance with resolves 1 above, shall not cause unacceptable interference to the fixed service having a primary allocation in the band 27.5-29.5 GHz, the power flux density limit per HAPS platform station at the surface of the Earth in neighboring administrations shall not exceed the following pfd mask in dBW/m2/MHz without the explicit agreement from the affected administration:

[NOTE TO FCC: This mask should be provided, using the correct formula and relevant ITU-R Recommendations, once the correct Recommendation to use is identified.]

2 ter that systems using HAPS in the band 27.9-28.2 GHz, in accordance with resolves 1 above, shall not cause unacceptable interference to the mobile service having a primary allocation in the band 27.5-29.5 GHz. The power flux density per HAPS platform station at the surface of the Earth in neighboring administrations shall not exceed the following pfd masks in dBW/m2/MHz without the explicit agreement from the affected administration

$$PFD(\delta) = -122.7 \quad (dBW/m2/1\ MHz) \quad \text{for } 0° \leq \delta \leq 2°$$

$$PFD(\delta) = -122.7 + 2 * (\delta - 2) \quad (dBW/m2/1\ MHz) \quad \text{for } 2° < \delta \leq 2.3°$$

$$PFD(\delta) = -122.6 + 1.5 * (\delta - 2) \quad (dBW/m2/1\ MHz) \quad \text{for } 2.3° < \delta \leq 7.9°$$

$$PFD(\delta) = -113.9 \quad (dBW/m2/1\ MHz) \quad \text{for } 7.9° < \delta \leq 90°$$

where δ is the elevation angle in degrees (angle of arrival above the horizontal plane for HAPS space station and below the horizon for the HAPS ground station);

3 that systems using HAPS in the band 31-31.3 GHz, in accordance with *resolves* 1 above, shall not cause harmful interference to the radio astronomy service having a primary allocation in the band 31.3-31.8 GHz, taking into account the protection criterion given in the relevant ITU-R Recommendation in the RA series. In order to ensure the protection of satellite passive services, the level of unwanted power density into the HAPS ground station antenna in the band 31.3-31.8 GHz shall be limited to −106 dB(W/MHz) under clear-sky conditions and may be increased up to −100 dB(W/MHz) under rainy conditions to mitigate fading due to rain, provided that the effective impact on the passive satellite does not exceed the impact under clear-sky conditions

3 bis that for the purpose of protecting the fixed service systems in neighbouring administrations in the band 31-31.3 GHz, the power flux density limit per HAPS platform station at the surface of the Earth in neighbouring administrations shall not exceed the following pfd mask in dBW/m^2/MHz, without the explicit agreement from the affected administration:

[NOTE TO FCC: This mask should be ,provided, using the correct formula and relevant ITU-R Recommendations, once the correct Recommendation to use is identified.]

4 that the administrations which intend to implement systems using HAPS in the fixed service in the bands 27.9-28.2 GHz and 31-31.3 GHz shall seek explicit agreement of concerned administrations with regard to their stations of primary services to ensure that the conditions in this Resolution are met, and those administrations which intend to implement systems using HAPS in the fixed service in these bands shall seek explicit agreement of concerned administrations with regard to their stations of services operating in accordance with the Table of Frequency Allocations of Article **5** to ensure that the conditions in *resolves* 1 and *resolves* 3 are met;

5 that administrations planning to implement a HAPS system pursuant to resolves 1 above shall notify the frequency assignment(s) by submitting all mandatory elements of Appendix 4 to the Radiocommunication Bureau for the examination of compliance with resolves 3 and 4 above,

invites ITU-R

1 to continue to carry out studies on the appropriate interference mitigation techniques for the situations referred to in *considering j)*;

2 to develop protection criteria for the mobile service having primary allocations in the frequency bands 31-31.3 GHz from HAPS in the fixed service.

ADD USA/1.14/22

5.G114 The allocation to the fixed service in the band 38-39.5 GHz may also be used by high-altitude platform stations (HAPS): this does not preclude the use of these frequency bands by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Such use of the fixed-service allocation by HAPS shall be in accordance with Resolution **[G114] (WRC-19)**. Such use of the fixed-service allocation by HAPS is limited to the ground-to-HAPS direction. Furthermore, the development of these other services shall not be constrained by HAPS.

Reasons: To add the text of the footnote allowing HAPS to operate in the fixed service allocation in the 38-39.5 GHz band on a worldwide basis.

ADD USA/1.14/23

DRAFT NEW RESOLUTION [G114]

Use of the frequency range 38-39.5 GHz by fixed links for high altitude platform stations in the fixed service worldwide

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

considering

a) that WRC-15 considered that there is a need for greater broadband connectivity in underserved communities and in rural and remote areas, that current technologies can be used to deliver broadband applications by high-altitude platform stations (HAPS), which is one possible means to provide broadband connectivity and disaster recovery communications

b) that WRC-15 decided to study additional spectrum needs for fixed HAPS links to provide broadband connectivity, including within the band 38 – 39.5 GHz, recognizing that the existing HAPS designations were established without reference to today's broadband capabilities;

c) that HAPS can provide broadband connectivity with minimal ground network infrastructure;

Recognizing

a) that the use of HAPS in this band is intended for the ground to HAPS direction;

;

Resolves

1 that for the purpose of protecting the fixed service systems in neighbouring administrations in the band 38-39.5 GHz, the power flux density limit per HAPS platform station at the surface of the Earth in neighbouring administrations shall not exceed the following pfd mask in in dBW/m^2/MHz, under clear sky condition, without the explicit agreement from the affected administration:

[NOTE TO FCC: This mask should be ,provided, using the correct formula and relevant ITU-R Recommendations, once the correct Recommendation to use is identified.]

1bis that for the purpose of protecting terrestrial mobile service systems in neighboring administrations in the frequency range 38-39.5 GHz, the power flux density limit per HAPS ground station at the surface of the Earth in neighboring administrations shall not exceed the following pfd masks in dBW/m^2/MHz without the explicit agreement from the affected administration:

PFD(δ) = -110.8	(dBW/m^2/1 MHz)	for $0° \leq \delta \leq 4°$
PFD(δ) = -110.8 + 1.5 * (δ - 4)	(dBW/m^2/1 MHz)	for $4° < \delta \leq 11.5°$
PFD(δ) = -101.8	(dBW/m^2/1 MHz)	for $11.5° < \delta \leq 90°$

where δ is the elevation angle in degrees (angle of arrival above the horizontal plane for HAPS space station and below the horizon for the HAPS ground station)).

…

2 that HAPS platforms shall not claim protection from FSS satellite stations, fixed service stations, or mobile service stations transmitting in the 38-39.5 GHz band, and No. 5.43A shall not apply;

instructs the Director of the Radiocommunication Bureau

to take all necessary measures to implement this Resolution.

MOD USA/1.14/25

5.552A The allocation to the fixed service in the bands 47.2-47.5 GHz and 47.9-48.2 GHz may be used by gateways for high altitude platform stations (HAPS): this does not preclude the use of these frequency bands by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Such use of the fixed-service allocation by HAPS is limited to the ground-to-HAPS direction. The use of the bands 47.2-47.5 GHz and 47.9-48.2 GHz shall be in accordance with Resolution **122 (Rev.WRC-19)**.

Reasons: To modify footnote 5.552A to provide clarity about the use of the band by applications of the fixed and other service and reflect an updated Resolution 122 with allowances for increases in EIRP density levels during periods of rain and to limit operation to the ground-to-HAPS direction

MOD USA/1.14/26

RESOLUTION 122 (REV.WRC-19)

Use of the bands 47.2-47.5 GHz and 47.9-48.2 GHz in the ground to HAPS direction in by high altitude platform stations in the fixed service and by other services

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

considering

a) that the band 47.2-50.2 GHz is allocated to the fixed, mobile and fixed-satellite services on a co-primary basis;

b) that WRC-97 made provision for operation of high altitude platform stations (HAPS), also known as stratospheric repeaters, within the fixed service in the bands 47.2-47.5 GHz and 47.9-48.2 GHz;

c) that establishing a stable technical and regulatory environment will promote the use of all co-primary services in the band 47.2-47.5 GHz and 47.9-48.2 GHz;

d) that some countries have notified such systems to ITU in the bands 47.2-47.5 GHz and 47.9-48.2 GHz;

e) that Recommendation ITU-R F.1500 contains the characteristics of systems in the fixed service using HAPS in the bands 47.2-47.5 GHz and 47.9-48.2 GHz;

f) that while the decision to deploy HAPS can be taken on a national basis, such deployment may affect neighbouring administrations and operators of co-primary services;

g) that ITU-R has completed studies dealing with sharing between systems using HAPS in the fixed service and other types of systems in the fixed service in the bands 47.2-47.5 GHz and 47.9-48.2 GHz;

h) that ITU-R has completed studies on compatibility between HAPS systems in the 47.2-47.5 GHz and 47.9-48.2 GHz bands and the radio astronomy service in the 48.94-49.04 GHz band;

i) that No. 5.552 urges administrations to take all practicable steps to reserve fixed-satellite service (FSS) use of the band 47.2-49.2 GHz for feeder links for the broadcasting-satellite service (BSS) operating in the band 40.5-42.5 GHz, and that ITU-R studies indicate that HAPS in the fixed service may share with such feeder links;

j) that the technical characteristics of expected BSS feeder links and FSS gateway-type stations are similar;

k) that ITU-R has completed studies dealing with sharing between systems using HAPS in the fixed service and the fixed-satellite service*,*

recognizing

a) that, in the long term, the bands 47.2-47.5 GHz and 47.9-48.2 GHz are expected to be required for HAPS operations for gateway;

b) that Recommendation ITU-R SF.1843 provides information on the feasibility of HAPS systems in the fixed service sharing with the FSS;

d) that ITU-R studies on HAPS operation in the bands 47.2-47.5 GHz and 47.9-48.2 GHz allocated to the fixed service have concluded that, in order to share with FSS (Earth-to-space), the maximum uplink transmit e.i.r.p. density of HAPS ground terminals in the bands should, in clear-sky conditions, be 6.4 dB(W/MHz) for Urban Area Coverage (UAC), 22.57 dB(W/MHz) for Suburban Area Coverage (SAC) and 28 dB(W/MHz) for Rural Area Coverage (RAC), and that these values can be increased by up to 20 dB during periods of rain;

e) that ITU-R studies have established specific power flux-density values to be met within the territory of a neighbouring country to facilitate bilateral agreement on sharing conditions for HAPS with other types of fixed service systems in a neighboring country;

f) that FSS satellite networks and systems with earth station antenna diameters of 2.5 meters or larger operating as a gateway-type station are capable of sharing with ubiquitous HAPS terminals,

resolves

1 that to facilitate sharing with the FSS (Earth-to-space), the maximum transmit e.i.r.p. density of a ubiquitous HAPS ground terminal shall not exceed the following levels under clear-sky conditions:

6.4	dB(W/MHz)	for UAC	(30□ < □ □ 90□)
22.57	dB(W/MHz)	for SAC	(15□ < □ □ 30□)
28	dB(W/MHz)	for RAC	(5□ < □ □ 15□)

where □ is the ground terminal elevation angle in degrees;

2 that the values in *resolves 1* can be increased, up to 20 dB, to compensate for rain fade provided that the pfd at the space station does not exceed the value that would result when transmitting with the levels in *resolves 1* in clear sky condition;

3 that the ground terminal antenna patterns of HAPS operating in the bands 47.2-47.5 GHz and 47.9-48.2 GHz shall meet the following antenna beam patterns:

$$G(j) = G_{max} - 2.5 \times 10^{-3} \left(\frac{D}{\lambda}\right)^2 \quad \text{for} \quad 0 < j < j_m$$

$$G(j) = 39 - 5 \log (D/\lambda) - 25 \log j \quad \text{for} \quad j_m \leq j < 48$$

$$G(j) = -3 - 5 \log (D/\lambda) \quad \text{for} \quad 48 \leq j \leq 180$$

where:

G_{max} : maximum antenna gain (dBi)

$G(j)$: gain (dBi) relative to an isotropic antenna

j : off-axis angle (degrees)

D: antenna diameter
□: wavelength
expressed in the same units

$$\square_m \quad \frac{20 \lambda}{D} \sqrt{G_{max} - G_1} \quad \text{degrees}$$

G_1 : gain of the first side lobe
□2 15 log (D/□) (dBi);

4 that for the purpose of protecting fixed wireless systems in neighbouring administrations from co-channel interference, a HAPS system operating in the frequency bands 47.2-47.5 GHz and 47.9-48.2 GHz shall not exceed the following power flux-density values at the Earth's surface in a neighbouring territoryunless explicit agreement of the affected administration is provided at the time of the notification of HAPS:

−141	dB(W/(m^2 · MHz))	for	0°	£	δ	<	3°
−141 + 2(δ − 3)	dB(W/(m^2 · MHz))	for	3°	£	δ	£	13°
−121	dB(W/(m^2 · MHz))	for	13°	<	δ	£	90°

where δ is the angle of the arrival above the horizontal plane in degrees;

[NOTE TO FCC: THIS MASK SHOULD BE CONFIRMED BASED UPON CORRECT FORMULA AND RELEVANT ITU-R RECOMMENDATIONS.]

5that for the purpose of protecting systems in the mobile service in neighbouring administrations, a HAPS system operating in the frequency bands 47.2-47.5 GHz and 47.9-48.2 GHz shall not exceed the following power flux density values at the Earth's surface in a neightouring territory without the explicit agreement of the affected administrations:−109 dB(W/(m^2 · MHz)) for 0° □ □ □ 4°

−109 + 1.2 (□ 4) dB(W/(m^2 · MHz)) for 4° < □ □ 11.5°

−100 dB(W/(m^2 · MHz)) for 11.5° < □ □ 90°

where δ is the elevation angle in degrees (angle of arrival above the horizontal plane for HAPS space station and below the horizon for the HAPS ground station).

6 that administrations planning to implement a HAPS system in the 47.2-47.5 GHz and 47.9-48.2 GHz bands shall notify the frequency assignments by submitting all mandatory elements of Appendix **4** to the Bureau for the examination of compliance with respect to *resolves* 1, 2, 3, 4 and 5 above with a view to their registration in the Master International Frequency Register;

7 that administrations shall notify the new data elements for the notices referred to in *instructs the Director of the Radiocommunication Bureau* 1 in order to enable the Bureau to perform the examinations,

invites administrations

that intend to deploy HAPS systems in the fixed service in the bands 47.2-47.5 GHz and 47.9-48.2 GHz to consider specifying the use of the bands 47.2-47.35 GHz and 47.9-48.05 GHz for ubiquitous HAPS terminals,

instructs the Director of the Radiocommunication Bureau

2 to examine all assignments to HAPS in the fixed service notified prior to 20 October 2007 and apply the provisions of *resolves* 1, 2, 3, 4 and 5 and the respective calculation methodologies included in Recommendation ITU-R F.1820 and Recommendation ITU-R SF.1843.

Reasons: To modify the existing Resolution 122 which supports a worldwide designation to HAPS to allow for increases in EIRP density levels during periods of rain.

SUP USA/1.14/27

RESOLUTION 160 (WRC-15)

Facilitating access to broadband applications delivered by high-altitude platform stations

Reasons: The work associated with Resolution 160 is completed.

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VIEW C

View C: ***Supported by Lockheed Martin Corporation.***

Lockheed Martin, supporting Elefante Group on the technologies for its proposed stratospheric-based communications systems, presents views on the changes necessary to allow operation of HAPS in the ground-to-platform direction in the 21.5-22 GHz range and in the platform-to-ground direction in the 25.25-27.5 GHz range. This proposal may potentially be merged with other proposals that address the other directions in these two ranges, or HAPS operation in other prospective bands.

II. WITH THE REGULATORY PROVISIONS PROPOSED IN VIEW C, THE OBJECTIVES OF THE PROPOSALS IN VIEWS A, B, AND D COULD BE ACCOMMODATED WITHOUT PRECLUDING OR UNNECESSARILY CONSTRAINING OPERATION OF HAPS IN THE 21.5-22 GHZ AND 25.25-27.5 GHZ FREQUENCY RANGES.

The proponents of View C seek the following objectives:
(1) To allow for HAPS in the ground-to-platform direction in the 21.5-22 GHz range and in the platform-to-ground direction in the 25.25-27.5 GHz frequency range.
(2) To include provisions ensuring compatibility of HAPS systems with fixed and mobile services, as well as other incumbent services, without unduly constraining deployment of the variety of HAPS systems that will undoubtedly emerge.
(3) To ensure that any power flux density levels that apply to HAPS systems take into account all transmission path characteristics before the potential victim receiver of terrestrial services.

Regarding item (1), Footnotes Nos. 5.B114 and 5.D114 ensure that HAPS can operate in the ground-to-platform direction in the 21.5-22 GHz range and in the platform-to-ground direction in the 25.25-27.5 GHz range, respectively. Compatible operation with other allocated services in neighboring administrations can be ensured through appropriate regulatory language. Accordingly, the footnotes should expressly provide designations for HAPS in these frequencies in these directions so as to facilitate the deployment of HAPS systems and the realization of their potential benefits.

Concerning item (2), the power flux density masks in 25.25-27.5 GHz set out in *resolves 1* and *2* of attached Draft New Resolution [C114] are described as threshold levels for compatibility but are not expressed as "limits" so as to allow HAPS operators the ability to demonstrate that their systems' adherence to other power flux density levels will also ensure compatibility apart from this safe harbor. The power flux density masks contained in *resolves 1* and *2* are based on the system characteristics of System 6, such as a platform coverage radius of 50 km. Other HAPS systems are being planned, including those with larger coverage areas, larger payloads, and greater capacity and capabilities, and there may be further evolution of HAPS technology. The proponents of View C note that the Article 21 power flux density limits which provide compatibility of satellite systems with terrestrial fixed and mobile services would equally ensure compatibility of HAPS with fixed and mobile service systems, as the high-altitude geometry of HAPS systems is the same as satellite systems from the perspective of terrestrial system receivers. (Note that the proposed levels in *resolves 1* and *2* based on the recent studies are higher than Article 21 levels by up to 15 dB for elevation angles greater than 27 degrees and lower by up to 17 dB for elevation angles less than 20 degrees.) The Article 21 limits have stood the test of time to accommodate compatible operations by a variety of satellite systems and characteristics at a full range of elevation angles.

The proponents of View C do not advocate adoption of Article 21 limits here, although it would be appropriate to do so, but put forth the levels provided in *resolves 1* and *2*. Although these were derived as the result of ITU Studies based on a very specific set of HAPS system and victim ground station characteristics, they can be adequate to the task of ensuring compatibility with the fixed and mobile terrestrial services, *provided* the conditions discussed in item (3) are included, *and provided further* that they operate as a safe harbor, such that HAPS operators will have the opportunity to demonstrate that another mask also ensures compatibility and to comply with it. To that end, reference to Article 21 is made here as proof that other masks are possible which can ensure compatibility with terrestrial services from high altitudes. Treating the power flux density levels in *resolves 1* and *2* as limits would artificially constrain future design and configurations of HAPS systems. Therefore, the proponents recommend that the proposed power flux density levels be used as a safe harbor with HAPS operators having the latitude to demonstrate compatibility in other ways.

Finally, regarding item (3), power flux density compliance should take into account all transmission characteristics *before* the potential victim mobile user equipment ("UE") receiver. Body loss is clearly a path loss characteristic which effects the amount of interference power received from the potential interferer by the potential victim receiver. In this way, it is indistinguishable from other path loss parameters such as polarization loss and atmospheric loss contained in the compliance formula for *pfd(El)* in *resolves 2* of the attached Draft New Resolution [C114]. View C proponents believe consistency requires inclusion of body loss as part of overall path loss from HAPS transmissions, *not* as part of the UE receiver characteristics.

Further, if body loss is applied as part of the path loss then the same body loss figure would be applied to all UEs, regardless of their configuration. By contrast, were body loss treated as part of the UE receiver characteristics, the HAPS transmissions could be unreasonably limited by the smallest level of body loss that is claimed by any single UE within the HAPS coverage area. This would generate uncertainty and artificially constrain the ability of HAPS systems designers and operators to plan and deploy consistent service quality.

View C proponents note that, by analogy, it is common where there is an established I/N protection criterion to show compatibility by demonstrating that total received interference in a victim receiver satisfies that criterion. In such a case, it is the responsibility of the potentially interfering service operator to account for all path loss parameters so that the total received interference may be compared to the receive system noise. Under this well-established approach, body loss would be included in the path loss calculation rather than in the receive system noise calculation.

* * *

For all of these reasons, the United States at WRC-19 should propose the modifications to the Table of Frequency Allocations to add Footnote Nos. 5.B114 and 5.D114 and adopt new Resolutions [B114] and [C114], as reflected in the Attachment hereto.

ATTACHMENT TO VIEW C:

UNITED STATES OF AMERICA

DRAFT PROPOSAL FOR THE WORK OF THE CONFERENCE

Agenda Item 1.14: *to consider, on the basis of ITU-R studies in accordance with Resolution **160 (WRC-15)**, appropriate regulatory actions for high-altitude platform stations (HAPS), within existing fixed-service allocations;*

Background: No. **1.66A** of the ITU Radio Regulations define a high-altitude platform station (HAPS) as "a station on an object at an altitude of 20 to 50 km and at a specified, nominal, fixed point relative to the Earth". Agenda Item 1.14 was adopted by WRC-15 to consider, in accordance with Resolution **160 (WRC-15)**, regulatory actions that can facilitate deployment of HAPS for broadband applications. Resolution **160** resolves to invite ITU-R to study additional spectrum needs of HAPS, examining the suitability of existing HAPS designations and conducting sharing and compatibility studies for additional designations in existing fixed allocations in the 38-39.5 GHz band on a global basis and in 21.4-22 GHz and 24.25-27.5 GHz bands in Region 2 exclusively.

Currently there are 3 spectrum bands identified for HAPS in the fixed services. These are:
- 47.2–47.5 GHz and 47.9 48.2 GHz,
- 27.9-28.2 GHz (HAPS-ground) and 31.0-31.3 GHz (ground-HAPS),
- 6 440–6 520 MHz (HAPS-ground) and 6 560-6 640 MHz (ground-HAPS).

However, spectrum needs of next-generation HAPS cannot be accommodated within these designations due to either geographical restrictions or technical limitations which impairs their operation. The global designation for HAPS links (which is in the 47.2-47.5 GHz band fixed-service allocation paired with the 47.9-48.2 GHz band fixed-service allocation) suffers from the effects of rain fade attenuation that severely limit service provision over high-precipitation geographies. The remaining 2 available bands (27.9-28.2 GHz paired with the frequency band 31.0-31.3 GHz, and 6440-6 520 MHz paired with 6 560-6 640 MHz) have been identified by a limited number of countries, none of which is within ITU Region 2. The ITU-R developed a Preliminary New Draft Recommendation (PDNR) assessing spectrum needs for broadband HAPS at an approximate 4 GHz aggregate capacity. The following proposals encourage the designation for HAPS in the fixed service allocations on a co-primary basis to facilitate investment in and the adoption and deployment of HAPS while ensuring compatibility with systems of other services allocated in the band as well as not providing priority to HAPS over other uses within the services allocated on primary basis.

BROADBAND HAPS APPLICATIONS

Advances in aeronautics and transmission technologies have significantly improved the capabilities of HAPS to provide effective connectivity solutions and meet the growing demand for high capacity broadband networks. Recently conducted full-scale test flights have shown that solar-powered platforms in the upper-atmosphere can now be used to carry payloads that offer connectivity over large areas in a reliable and cost-effective way, and a growing number of applications for the new generation of HAPS are being developed. The technology appears

particularly well suited to complementing terrestrial networks by providing backhaul. A number of advantages of the new generation of HAPS are foreseen:

- **Wide-area coverage and high capacity:** A single platform will be able to serve footprints larger than 100 km in diameter with high capacity (e.g. 1 Tbps) and recent technological advances now allow the deployment of multiple HAPS, in fleets that can cover whole nations.
- **Low cost:** The cost of providing communications from a large stratospheric platform is projected to be significantly lower than other connectivity solutions in urban and rural areas, while mass production of the aircraft will significantly lower upfront capital expenditure for deployment.
- **Reach:** HAPS platforms will operate at around 20 km above ground, which reduces their vulnerability to weather conditions that may affect service, provides large coverage areas and avoids interference caused by physical obstacles.
- **Rapid deployment and flexibility:** It will be possible to deploy HAPS services without long lead times and it is relatively straightforward to return unmanned-powered platforms to the ground for maintenance or payload reconfiguration for new or upgraded services.
- **Geographical reach:** HAPS can also provide near instantaneous connectivity where it is impossible or difficult to deploy terrestrial infrastructure.
- **Environmentally friendly:** HAPS can run exclusively on solar and hydrogen power for long periods, connecting people with almost no environmental impact.

Spectrum harmonization and utilization is facilitated by common worldwide and regional designations. International regulatory flexibility can enable improvements in global connectivity by encouraging national regulators to permit operation of higher-speed Internet access services over new, complementary platforms, while ensuring compatibility with existing services. Additionally, harmonization of spectrum promotes economies of scale and commonality of equipment.

A number of administrations and technology proponents have conducted compatibility studies to assess coexistence between HAPS and incumbent and proposed systems and services (including WRC-19 Agenda Items 1.6 and 1.13).

Using a power-flux density threshold as a basis for coordination with neighboring administrations can ensure compatibility with the fixed and mobile services from downlink emissions by HAPS platforms (HAPS-to-ground). As HAPS systems may vary, including an approach that demonstrates compatibility with services of another administration is appropriate. An appropriate power flux density level ensures that the signal level produced by HAPS systems at the location of fixed and mobile service stations will not cause harmful interference. Compatibility between uplink emissions of HAPS ground stations and other stations of the fixed service or mobile service could be ensured through coordination at the national level. Therefore, no regulatory provisions are needed between HAPS uplinks and fixed and mobile services in the Radio Regulations.

Compatibility with FSS satellite networks on a co-channel basis appears to be feasible if the frequency bands used by a HAPS network is transmitting in an opposite direction from that of the FSS satellite network (i.e., satellite Earth-to-space with HAPS-to-ground, and satellite space-to-Earth with ground-to-HAPS). In these cases, some studies suggest that relatively short separation distances can be used to ensure compatibility with earth stations from ground-to-HAPS emissions through station coordination amongst administrations or usual link planning procedures used at a national level. In the case of national level coordination, the use of mitigation techniques and/or geographical separation could be used to enable deployments by either service.

For compatibility with science services (EESS, SRS, RAS), radiated power limits and coordination amongst administrations could be used. EESS/SRS earth stations can be accommodated through station coordination amongst administrations or at a national level. In this latter case of national level coordination, the use of mitigation techniques and/or geographical separation could be used to enable deployments by either service. In the case of science services operating in adjacent bands to HAPS, specific limits on out-of-band emissions for both HAPS platforms and ground stations can be used to ensure compatibility.

PROPOSALS:

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations

(See No. **2.1**)

MOD USA/1.14/1

18.4-22 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
21.4-22 FIXED MOBILE BROADCASTING-SATELLITE 5.208B 5.530A 5.530B 5.530D	**21.4-22** FIXED ADD 5.B114 MOBILE 5.530A	**21.4-22** FIXED MOBILE BROADCASTING-SATELLITE 5.208B 5.530A 5.530B 5.530D 5.531

Reasons: To add a footnote to the fixed service allocation in support of a HAPS designation in the band 21.5-22 GHz.

ADD USA/1.14/2

5.B114 The allocation to the fixed service in the band 21.5-22 GHz is designated for use in Region 2 by high-altitude platform stations (HAPS) in the ground-to-platform direction. This designation does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Such use is subject to the provisions of Resolution **[B114] (WRC-19)**. (WRC-19)

Reasons: To add text of the footnote allowing HAPS to operate in the fixed service allocation in the uplink direction in the 21.5-22 GHz portion only of the band 21.4-22 GHz to ensure compatibility with AMS and other services in the subjacent band.

MOD **USA/1.14/3**

25.25-27.5 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
25.25-25.5	FIXED ADD 5.D114 INTER-SATELLITE 5.536 MOBILE Standard frequency and time signal-satellite (Earth-to-space)	
25.5-27	EARTH EXPLORATION-SATELLITE (space-to Earth) 5.536B FIXED ADD 5.D114 INTER-SATELLITE 5.536 MOBILE SPACE RESEARCH (space-to-Earth) 5.536C Standard frequency and time signal-satellite (Earth-to-space) 5.536A	
27-27.5 FIXED INTER-SATELLITE 5.536 MOBILE	**27-27.5** FIXED ADD 5.D114 FIXED-SATELLITE (Earth-to-space) INTER-SATELLITE 5.536 5.537 MOBILE	

Reasons: To add a footnote to the 25.5-27.5 GHz band in Region 2 allowing HAPS to operate in the fixed service allocation.

ADD **USA/1.14/4**

5.D114 The allocation to the fixed service in the bands 25.25-25.5 GHz, 25.5-27.0 GHz, and 27.0-27.5 GHz is designated for use in Region 2 by high-altitude platform stations (HAPS) in the platform-to-ground direction. This designation does not preclude the use of these frequency bands by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Such use of the fixed-service allocation by HAPS is subject to the provisions of Resolution **[C114] (WRC-19)**.

Reasons: To add text of a footnote allowing HAPS to operate in the fixed service allocation in the downlink direction in the frequency range 25.25-27.5 GHz.

ADD USA/1.14/5

DRAFT NEW RESOLUTION [B114] (WRC-19)

Use of the band 21.5-22 GHz by high altitude platform stations in the fixed service for Region 2

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

considering

a) that WRC-15 considered that there is a need for greater broadband connectivity in underserved communities and in rural and remote areas, that current technologies can be used to deliver broadband applications by high-altitude platform stations (HAPS), which can provide broadband connectivity in rural as well as urban areas and disaster recovery communications with minimal ground network infrastructure;

b) that WRC-15 decided to study additional spectrum needs for fixed HAPS links to provide broadband connectivity, including within the band 21.4-22 GHz, recognizing that the existing HAPS designations were established without reference to today's broadband capabilities;

c) that HAPS can provide broadband connectivity in both rural and urban areas with minimal ground network infrastructure;

d) that spectrum sharing among services allocated on a primary basis in the frequency range 21.2-22.5 GHz must not be altered when introducing any new HAPS designations;

e) that Recommendation ITU-R P.618, "Propagation data and prediction methods required for the design of Earth-space telecommunication systems," should be used to determine rain fade attenuation from HAPS platforms,

recognizing

a) that RR No. **5.532** requires that the use of the band 22.21-22.5 GHz by the Earth Exploration-Satellite (passive) and space research (passive) services shall not impose constraints upon the fixed and mobile, except aeronautical mobile, services;

b) that HAPS is defined in No. **1.66A** of the Radio Regulations as a station located on an object at an altitude of 20-50 km and at a specified, nominal, fixed point relative to the Earth, and is subject to No. **4.23**,

c) that the band 21.5-22 GHz is also allocated to the mobile service on a co-primary basis;

resolves

1 that in order to ensure compatibility with EESS (passive) services, the ground-to-HAPS level of unwanted EIRP in the frequency band:

22.21-22.5 GHz shall be limited to -32.6 dB(W/100 MHz) in the direction of the satellite,
21.2-21.4 GHz shall not exceed:

$EIRP = (- 0.76El - 9.5)$ dBW/100MHz for $0° \leq El < 35.25°$

EIRP =- 36.5 dBW/100 MHz for $35.25° \leq El < 90°$

where *El* is the elevation angle in degrees (angles of arrival above the horizontal plane);

2 that in order to ensure compatibility with the radio astronomy service, the unwanted emission pfd produced by HAPS uplink transmissions shall not exceed -146 dBW/m²/290 MHz for continuum observations, and -162 dBW/m²/250 kHz for spectral line observations in the band 22.21-22.5 GHz at an RAS station location at a height of 50m, and that these pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model;

3 that *resolves* 2 above applies at any radio astronomy station that was in operation prior to 22 November 2019; and that has been notified to the Bureau in the band 22.21-22.5 GHz before 22 May 2020. Radio astronomy stations notified after this date may seek an agreement with administrations that have notified HAPS,

invites ITU-R

to develop ITU-R Reports that will assist administrations in facilitating coexistence with other co-primary services

instructs the Director of the Radiocommunication Bureau

to take all necessary measures to implement this Resolution.

Reasons: To add the text of a resolution specifying the operating requirements for HAPS to ensure compatibility with other services.

ADD **USA/1.14/6**

DRAFT NEW RESOLUTION [C114]

Use of the frequency range 25.25-27.5 GHz by fixed links for high altitude platform stations in the fixed service in Region 2

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

considering

a) that WRC-15 considered that there is a need for greater broadband connectivity in underserved communities and in rural and remote areas, that current technologies can be used to deliver broadband applications by high-altitude platform stations (HAPS), which can provide broadband connectivity and disaster recovery communications with minimal ground network infrastructure;

b) that WRC-15 decided to study additional spectrum needs for fixed HAPS links to provide broadband connectivity, including within the frequency range 24.25-27.5 GHz in Region 2, recognizing that the existing HAPS designations were established without reference to today's broadband capabilities;

c) that HAPS can provide broadband connectivity in both rural and urban areas with minimal ground network infrastructure;

d) that Recommendation ITU-R P.618, "Propagation data and prediction methods required for the design of Earth-space telecommunication systems," should be used to determine rain fade attenuation from HAPS platforms;
e) that Recommendation ITU-R P.452, "Prediction procedure for the evaluation of interference between stations on the surface of the Earth at frequencies above about 0.1 GHz," should be used to determine the propagation loss in the ground path from HAPS ground stations;
f) that Recommendation ITU-R SF.1395, "Minimum propagation attenuation due to atmospheric gases for use in frequency sharing studies between the fixed-satellite service and the fixed service," should be used to determine the gaseous attenuation;
g) that Recommendation ITU-R P.2108, "Prediction of Clutter Loss," should be used to determine the clutter loss,

recognizing

a) that HAPS is defined in No. **1.66A** of the Radio Regulations as a station located on an object at an altitude of 20-50 km and at a specified, nominal, fixed point relative to the Earth, and is subject to No. **4.23**;
b) that in the band 27.0-27.5 GHz with respect to earth stations in the Fixed-Satellite Service (Earth-to-space) and the fixed service, Nos. **9.17** and **9.18** applies,

resolves

1 that, unless otherwise demonstrated, for the purpose of compatible operation with fixed service systems in neighbouring administrations in the frequency range 25.25-27.5 GHz, the power flux density level per HAPS platform station at the surface of the Earth in neighbouring administrations shall not exceed the following pfd mask in dBW/m^2/MHz, under clear sky condition:

$$pfd_{max}(El) = 0.39 \times El - 132.12 \text{ for } 0 \leq El < 13°$$

$$pfd_{max}(El) = 2.715 \times El - 162.3 \text{ for } 13° \leq El < 20°$$

$$pfd_{max}(El) = 0.45 \times El - 117 \text{ for } 20° \leq El < 60°$$

$$pfd_{max}(El) = -90 \text{ for } 60° \leq El \leq 90°$$

where *El* is the elevation angle in degrees (angles of arrival above the horizontal plane).

To verify the compliance with the pfd mask the following equation shall be used:

$$pfd(El) = EIRP(El) - 10.\log_{10}(4\pi d^2) - \text{rain fade}$$

where:

EIRP is the nominal HAPS EIRP density level in dBW/MHz (dependent to the elevation angle);

d is the distance in meters between the HAPS and the ground (elevation angle dependent);

*pfd(*El*)* power flux density at the Earth surface per HAPS platform station in dBW/m²/MHz;

rain fade rain attenuation in dB.

2 that, unless otherwise demonstrated, for the purpose of compatible operation with mobile service systems in neighbouring administrations in the frequency range 25.25-27.5 GHz, the power flux density level per HAPS platform station at the surface of the Earth in neighbouring administrations shall not exceed the following pfd mask in dBW/m^2/MHz, under clear sky condition

$$pfd_{max}(El) = -114 \quad \text{for } 0 \leq El < 4°$$

$$pfd_{max}(El) = -114 + 1.24 \times (El - 4) \quad \text{for } 4 \leq El < 9°$$

$$pfd_{max}(El) = -107.8 \quad \text{for } 9° \leq El \leq 90°$$

To verify the compliance with the pfd mask the following equation shall be used:

$$pfd(El) = EIRP(El) - 10.\log_{10}(4\pi d^2) - L_{Pol} - B_{loss} - GasAtt(El) - \text{rain fade}$$

where:

d distance in meters between the HAPS and the ground (elevation angle dependent);

EIRP HAPS platform nominal EIRP spectral density in dBW/MHz at a specific elevation angle;

*pfd(*El*)* power flux density at the Earth surface per HAPS platform station in dBW/m²/MHz;

Lpol polarisation loss of 3 dB;

Bloss body loss of 4 dB;

GasAtt(El) gaseous attenuation;

rain fade rain attenuation in dB.

3 that for the purpose ensuring compatibility with the Inter-Satellite Service, the EIRP density per HAPS platform in the frequency range 25.25-27.5 GHz shall not exceed -70.7 dBW/Hz for off-nadir angles greater than 85° under clear sky conditions;

4 that for the purpose of ensuring compatibility with the Fixed-Satellite Service, the EIRP density per HAPS platform, in the band 27-27.5 GHz shall not exceed -10.8 dBW/MHz for off-nadir angles greater than 85°;

5 that in the band 27.0-27.5 GHz, Nos. **9.17** and **9.18** do not apply to the HAPS designation of the Fixed Service allocation; HAPS ground stations shall not claim protection from Fixed-Satellite Service earth stations transmitting in the band 27.0-27.5 GHz in neighbouring administrations, and No. **5.43A** shall not apply;

6 that with respect to HAPS, the provisions of No. **5.536A** shall not apply, and that, in order to ensure compatibility with in-band SRS/EESS satellite services from the HAPS platform in the band 25.5-27.0 GHz, the power flux density of a HAPS platform shall not exceed the threshold values below at SRS/EESS earth stations. The EESS power flux density threshold values shall be applied at earth stations which only support EESS operations. If the power flux density threshold values below are exceeded, then HAPS shall coordinate in accordance with No. **9.18**, taking into account the parameters of the relevant systems.

SRS

$$\text{pfd, dB}\left(\frac{\text{W}}{\text{m}^2 * \text{MHz}}\right) = \begin{cases} -138.8 + 25 * \log(5 - \varphi) & 0 \le \varphi < 4.925 \\ -166.9 & 4.925 \le \varphi < 5 \\ -183.9 & 5 \le \varphi \le 90 \end{cases}$$

Where (φ) is the angle of arrival (φ) of the interfering signal above the local horizontal plane at the SRS antenna.

EESS NGSO

$$\text{pfd, dB}\left(\frac{\text{W}}{\text{m}^2 * \text{MHz}}\right) = \begin{cases} -108.8 + (25 * \log(3 - \varphi) & 0 \le \varphi < 2.808 \\ -126.7 & 2.808 \le \varphi < 3 \\ -143.4 & 3 \le \varphi \le 90 \end{cases}$$

Where (φ) is the angle of arrival (φ) of the interfering signal above the local horizontal plane at the EESS antenna.

EESS GSO

$$\text{pfd, dB}\left(\frac{\text{W}}{\text{m}^2 * \text{MHz}}\right) = \begin{cases} -140.5 + 25 * \log(3 - \varphi) & 0 \le \varphi < 2.808 \\ -158.4 & 2.808 \le \varphi < 3 \\ -178.5 & 3 \le \varphi \le 90 \end{cases}$$

Where (φ) is the angle of arrival (φ) of the interfering signal above the local horizontal plane at the EESS antenna.

The power flux density values above shall be met under clear sky conditions 100% of the time.

invites ITU-R

to develop ITU-R Reports that will assist administrations in facilitating coexistence with other co-primary services

instructs the Director of the Radiocommunication Bureau

to take all necessary measures to implement this Resolution.

Reasons: To add text of a resolution specifying the operating requirements for HAPS in the 25.25-27.5 GHz frequency range to ensure compatibility with other services for the platform to ground direction.

SUP USA/1.14/7

RESOLUTION 160 (WRC-15)

Facilitating access to broadband applications delivered by high-altitude platform stations

Reasons: Consequential. There is no need to retain Resolution **160 (WRC-15)**.

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VIEW D

View D:

View D is provided by the above-indicated WAC members from the fixed-satellite service (FSS) community in response to the proposals in Document IWG-2/078r3.

The protection of GSO FSS satellite networks/non-GSO FSS satellite systems on a co-frequency/co-coverage basis may be feasible if the frequency bands used by a HAPS network is transmitting in an opposite direction from that of the FSS satellite network (i.e., satellite Earth-to-space with HAPS-to-ground, and satellite space-to-Earth with ground-to-HAPS). In these cases, some studies conducted for FSS bands other than those identified today for HAPS in the fixed service in the 6 GHz range suggest that satellite stations can be protected from HAPS-to-ground emissions, while relatively short separation distances can be used to protect Earth stations from ground-to-HAPS emissions. Unfortunately, the specific conditions of co-frequency/co-coverage operations between HAPS networks in the fixed service and FSS satellite networks and systems remain under development within the ITU-R in the 24.75-25.25 GHz, 27-27.5 GHz, 27.9-28.2 GHz, 38-39.5 GHz and 47.2-47.5/47.9-48.2 GHz bands.

Until protection of FSS networks and systems by HAPS networks in the fixed service is able to be confirmed, there is no opportunity for changes to existing HAPS designations in the currently-identified fixed service bands. Accordingly, and at this time, there can be no change to HAPS designations in the fixed service bands used by the fixed-satellite service, and no new HAPS designations.

In addition, there is an issue with the proposed pfd mask in Doc. IWG-2/078r3 for protection of the mobile service from HAPS in the 27.9-28.2 GHz band. The pfd levels in the mask in *resolves 2* of Draft New Resolution [E114] in Proposal No. USA/1.14/20 from View A are clearly intended to protect the mobile service from HAPS-to-ground emissions in the 27.9-28.2 GHz band. There is no agreement from the proponents of View D, however, that the levels in this pfd mask are necessary to protect the co-frequency mobile service, or on whether higher pfd levels could be produced at some elevation angles without causing unacceptable interference to mobile stations and links. Indeed, a different pfd mask from protection of mobile service stations and links across the entire 27.5-29.5 GHz band from aeronautical earth stations in motion (aeronautical ESIM) is proposed for in View A to the proposal for WRC-19 Agenda item 1.5 (*see* Document IWG-3/051r3). Thus, the authors of View D are of the opinion that the mask in *resolves 2* of Draft New Resolution [E114] in Proposal No. USA/1.14/20 from View A overprotects the mobile service, and that higher pfd levels than those in the View A mask may be able to be produced by aeronautical ESIM and still protect the mobile service from unacceptable interference.

The proposals below reflect the present view that no change is presently justified under Agenda Item 1.14 to the FSS bands at 24.75-25.25 GHz, 27-27.5 GHz, 27.9-28.2 GHz, 38-39.5 GHz and 47.2-47.5/47.9-48.2 GHz. The proponents of View D will continue to participate in ITU-R studies responsive to Agenda item 1.14, and anticipate that they may be able at a future point, and in time for consideration by WRC-19, to agree with the proponents of View A on appropriate protection provisions that will allow for new or improved designations for HAPS in fixed service bands on a co-frequency/co-coverage basis with the FSS in some or all of these bands.

ATTACHMENT TO VIEW D:

UNITED STATES OF AMERICA

DRAFT PROPOSAL FOR THE WORK OF THE CONFERENCE

Agenda Item 1.14: *to consider, on the basis of ITU-R studies in accordance with Resolution 160 (WRC-15), appropriate regulatory actions for high-altitude platform stations (HAPS), within existing fixed-service allocations.*

BACKGROUND

No. 1.66A of the ITU Radio Regulations define a high-altitude platform station (HAPS) as "a station on an object at an altitude of 20 to 50 km and at a specified, nominal, fixed point relative to the Earth". Agenda Item 1.14 was adopted by WRC-15 to consider, in accordance with Resolution 160 (WRC-15), regulatory actions that can facilitate deployment of HAPS for broadband applications. Resolution 160 resolves to invite ITU-R to study additional spectrum needs of HAPS, examining the suitability of existing HAPS designations and conducting sharing and compatibility studies for additional designations in existing fixed allocations in the 38-39.5 GHz band on a global basis and in 21.4-22 GHz and 24.25-27.5 GHz bands in Region 2 exclusively.

Currently there are 3 spectrum bands identified for HAPS in the fixed services. These are:
- 47.2–47.5 GHz and 47.9 48.2 GHz,
- 27.9-28.2 GHz (HAPS-ground) and 31.0-31.3 GHz (ground-HAPS)
- 6 440–6 520 MHz (HAPS-ground) and 6 560-6 640 MHz (ground-HAPS).

However, spectrum needs of next-generation HAPS cannot be accommodated within these designations due to either geographical restrictions or technical limitations which impairs their operation. The global designations for HAPS links (which is in the 47.2-47.5 GHz band fixed-service allocation paired with the 47.9-48.2 GHz band fixed-service allocation) suffers from the effects of rain fade attenuation that severely limit service provision over high-precipitation geographies. The remaining 2 available bands (27.9-28.2 GHz paired with the frequency band 31.0-31.3 GHz, and 6440-6 520 MHz paired with 6 560-6 640 MHz) have been identified by a limited number of countries, none of which is within ITU Region 2. The ITU-R developed a Preliminary New Draft Recommendation (PDNR) assessing spectrum needs for broadband HAPS at an approximate 4 GHz aggregate capacity. The following proposals encourage the designation of HAPS in the fixed service allocations on a co-primary basis to facilitate investment in and deployment of HAPS, while ensuring protection to systems of other services allocated in the band as well as not providing priority to HAPS over other uses within the services allocated on a primary basis.

BROADBAND HAPS APPLICATIONS

Advances in aeronautics and transmission technologies have significantly improved the capabilities of HAPS to provide effective connectivity solutions and meet the growing demand for high capacity broadband networks, particularly in currently underserved areas. Recently conducted full-scale test flights have shown that solar-powered platforms in the upper-atmosphere can now be used to carry payloads that offer connectivity over large areas in a reliable and cost-effective way, and a

growing number of applications for the new generation of HAPS are being developed. The technology appears particularly well suited to complementing terrestrial networks by providing backhaul. A number of advantages of the new generation of HAPS are foreseen:

- **Wide-area coverage:** A single platform will be able to serve footprints larger than 100 km in diameter, and recent technological advances in the development of optical inter-HAPS links now allow the deployment of multiple linked HAPS, in fleets that can cover whole nations.
- **Low cost:** The cost of operating stratospheric platforms is projected to be significantly lower than other connectivity solutions in many areas, while mass production of the aircraft will significantly lower upfront capital expenditure for deployment.
- **Reach:** HAPS platforms will operate at around 20 km above ground, which reduces their vulnerability to weather conditions that may affect service, provides large coverage areas and avoids interference caused by physical obstacles.
- **Rapid deployment and flexibility:** It will be possible to deploy HAPS services without long lead times and it is relatively simple to return solar platforms to the ground for maintenance or payload reconfiguration.
- **Geographical reach:** HAPS that use the architecture of solar platforms can also provide connectivity where it is impossible to deploy terrestrial infrastructure: remote sites on land or sea.
- **Environmentally friendly:** HAPS can run exclusively on solar power for long periods, connecting people with almost no environmental impact.

Spectrum harmonization and utilization is facilitated by common worldwide designations. International regulatory flexibility can enable improvements in global connectivity by encouraging national regulators to permit operation of higher-speed Internet access services over new, complementary platforms, while ensuring protection of existing services. Additionally, harmonization of spectrum promotes economies of scale and commonality of equipment.

Broadband HAPS can also be used for:

- Response to natural disasters.
- Fire detection, monitoring, and firefighting.
- Law enforcement with communication needs across local actors and regional headquarters.
- Resource exploration missions for communication between exploration teams and regional home base.

SHARING STUDIES

A number of administrations and technology proponents have conducted compatibility studies to assess coexistence between HAPS and incumbent and proposed systems and services (including WRC-19 Agenda Items 1.6 and 1.13).

A power-flux density (PFD) threshold would be used to ensure the protection of the fixed and mobile services from downlink emissions by HAPS platforms (HAPS-to-ground), which if exceeded would require coordination with neighboring administrations and their explicit agreement. This PFD ensures that the signal level produced by HAPS systems at the location of fixed and mobile service stations will not cause interference. Protection from uplink emissions by HAPS ground stations with other stations of the fixed service or mobile service could be ensured through

coordination at the national level, based on the relatively short separation distances (and other mitigation techniques) provided by the studies.

The protection of GSO FSS satellite networks/non-GSO FSS satellite systems on a co-frequency/co-coverage basis may be feasible if the frequency bands used by a HAPS network is transmitting in an opposite direction from that of the FSS satellite network (i.e., satellite Earth-to-space with HAPS-to-ground, and satellite space-to-Earth with ground-to-HAPS). In these cases, some studies conducted for FSS bands other than those identified today for HAPS in the fixed service in the 6 GHz range suggest that satellite stations can be protected from HAPS-to-ground emissions, while relatively short separation distances can be used to protect Earth stations from ground-to-HAPS emissions. Unfortunately, the specific conditions of co-frequency/co-coverage operations between HAPS networks in the fixed service and FSS satellite networks and systems remain under development within the ITU-R in the 24.75-25.25 GHz, 27-27.5 GHz, 27.9-28.2 GHz, 38-39.5 GHz and 47.2-47.5/47.9-48.2 GHz bands. Until protection of FSS networks and systems by HAPS networks in the fixed service is able to be confirmed, there is no opportunity for changes to existing HAPS designations in the currently-identified fixed service bands. Accordingly, and at this time, there can be no change to HAPS designations in the fixed service bands used by the fixed-satellite service, and no new HAPS designations.

For the protection of science services (EESS, SRS, RAS), radiated power limits and coordination amongst administrations could be used to ensure the protection of these services. The receiving earth station for EESS and SRS can be protected through coordination. In the case of science services operating in adjacent bands to HAPS, specific limits on out-of-band emissions for both HAPS platforms and ground stations can be used to ensure their protection.

1. PROPOSALS FOR THE 6 GHZ BANDS

For the 6 440 – 6 520 MHz Band:

NOC **USA/1.14/1**

ARTICLE 5

Frequency allocations

Reasons: To maintain the existing designation for HAPS without modifications.

NOC **USA/1.14/2**

RESOLUTION 150 (WRC-12)

Use of the bands 6 440-6 520 MHz and 6 560-6 640 MHz by gateway links for high-altitude platform stations in the fixed service

Reasons: To maintain the existing designation for HAPS without modifications.

Note: Identical to Doc. IWG-2/078r3

For the band 6 560–6 640 MHz Band:

NOC **USA/1.14/4**

ARTICLE 5

Frequency allocations

Reasons: To maintain the existing designation for HAPS without modifications.

NOC **USA/1.14/5**

RESOLUTION 150 (WRC-12)

Use of the bands 6 440-6 520 MHz and 6 560-6 640 MHz by gateway links for high-altitude platform stations in the fixed service

Reasons: To maintain the existing designation for HAPS without modifications.

Note: Identical to Doc. IWG-2/078r3

2. PROPOSALS FOR THE 21.4 – 22 GHZ BAND

MOD USA/1.14/6

ARTICLE 5

Frequency allocations

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

18.4-22 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
21.4-22 FIXED MOBILE BROADCASTING- SATELLITE 5.208B 5.530A 5.530B 5.530D	**21.4-22** FIXED ADD 5.B114 MOBILE 5.530A	**21.4-22** FIXED MOBILE BROADCASTING- SATELLITE 5.208B 5.530A 5.530B 5.530D 5.531

Reasons: To add a footnote to the fixed service allocation in support of a HAPS designation in the 21.4 -22 GHz band.

ADD USA/1.14/7

5.B114 The allocation to the fixed service in the band 21.4-22 GHz is designated for use in Region 2 by high-altitude platform stations (HAPS). This designation does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Such use of the fixed-service allocation by HAPS is limited to the HAPS-to-ground direction in the 21.4 -22 GHz band and the ground-to-HAPS direction in the 21.5-22 GHz band. Such use is subject to the provisions of Resolution **[B114] (WRC-19)**. (WRC-19)

Reasons: To add the text of the footnote allowing HAPS to operate in the fixed service allocation in the 21.4-22 GHz band.

ADD **USA/1.14/8**

DRAFT NEW RESOLUTION [B114] (WRC-19)

Use of the band 21.4-22 GHz by high altitude platform stations in the fixed service for Region 2

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

considering

a) that WRC-15 considered that there is a need for greater broadband connectivity in underserved communities and in rural and remote areas, that current technologies can be used to deliver broadband applications by high-altitude platform stations (HAPS), which can provide broadband connectivity and disaster recovery communications with minimal ground network infrastructure;

b) that WRC-15 decided to study additional spectrum needs for fixed HAPS links to provide broadband connectivity, including within the band 21.4-22 GHz, recognizing that the existing HAPS designations were established without reference to today's broadband capabilities;

c) that HAPS can provide broadband connectivity with minimal ground network infrastructure;

d) that compatibility with existing services allocated on a primary basis in the frequency range 21.2-22.5 GHz must be ensured when introducing any new HAPS designations,

e) that Recommendation ITU-R P.618, "Propagation data and prediction methods required for the design of Earth-space telecommunication systems", should be used to determine rain attenuation from HAPS platforms.

recognizing

a) that RR No. **5.532** requires that the use of the band 22.21-22.5 GHz by the Earth Exploration-Satellite (passive) and space research (passive) services shall not impose constraints upon the fixed and mobile, except aeronautical mobile, services;

b) that HAPS is defined in No. **1.66A** of the Radio Regulations as a station located on an object at an altitude of 20-50 km and at a specified, nominal, fixed point relative to the Earth, and is subject to No. **4.23**,

c) that the band 21.4-22 GHz is also allocated to mobile service on a co-primary basis;

resolves

3 that for the purpose of protecting fixed service systems in neighboring administrations in the band 21.4-22 GHz, the power flux density level per HAPS platform station produced at the surface of the Earth in neighboring administrations shall not exceed the following pfd mask in

dBW/m^2/MHz, under clear sky condition, without the explicit agreement from the affected administration:

$$pfd_{max}(El) = 0.7 \times El - 135 \quad \text{for } 0 \leq El < 10°$$

$$pfd_{max}(El) = 2.4 \times El - 152 \quad \text{for } 10° \leq El < 20°$$

$$pfd_{max}(El) = 0.45 \times El - 113 \quad \text{for } 20° \leq El < 60°$$

$$pfd_{max}(El) = -86 \quad \text{for } 60° \leq El \leq 90°$$

where El is the elevation angle in degrees (angles of arrival above the horizontal plane).
To verify the compliance with the pfd mask the following equation shall be used:

$$pfd(El) = EIRP_{\frac{dBW}{MHz}}(El) + 10 * \log_{10}\left(\frac{1}{4\pi d^2_{(El)}}\right) - \text{rain fade}$$

where:

d distance in meters between the HAPS and the ground (elevation angle dependent);

EIRP HAPS platform nominal EIRP spectral density in dBW/MHz at a specific elevation angle;

pfd(El) is the power flux density at the Earth's surface per HAPS platform station in dBW/m^2/MHz.

rain fade rain attenuation in dB (ITU-R P.618)

2 that in order to ensure the protection of EESS (passive), the EIRP per HAPS platform, in the bands 21.2-21.4 GHz and 22.21-22.5 GHz, shall not exceed:

$$EIRP = (-0.76El - 9.5) \text{ dBW/100MHz} \quad \text{for} \quad -4.53° \leq El < 35.5°$$
$$EIRP = -36.5 \text{ dBW/100 MHz} \quad \text{for} \quad 35.5° \leq El < 90°$$

where *El* is the elevation angle in degrees (angles of arrival above the horizontal plane);

3 that in order to ensure compatibility with EESS (passive) services, the ground-to-HAPS level of unwanted EIRP:

- in the frequency band 22.21-22.5 GHz shall be limited to -32.6 dB(W/100 MHz) in the direction of the satellite,
- in the frequency band 21.2-21.4 GHz shall not exceed:

$$EIRP = (-0.76El - 9.5) \text{ dBW/100MHz} \quad \text{for} \quad 0° \leq El < 35.5°$$
$$EIRP = -36.5 \text{ dBW/100 MHz} \quad \text{for} \quad 35.5° \leq El < 90°$$

where El is the elevation angle in° (angles of arrival above the horizontal plane);

4 that in order to ensure the protection of the radio astronomy service, the unwanted emission pfd produced by HAPS platform downlink transmissions shall not exceed -176 dBW/m²/290 MHz for continuum observations, and -192 dBW/m²/250 kHz for spectral line observations

in the band 22.21-22.5 GHz at an RAS station location at a height of 50m. These pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model;

5 that in order to ensure the protection of the radio astronomy service, the unwanted emission pfd produced by HAPS uplink transmissions shall not exceed -146 dBW/m²/290 MHz for continuum observations, and -162 dBW/m²/250 kHz for spectral line observations in the band 22.21-22.5 GHz at an RAS station location at a height of 50m, and that these pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model;

6 that *resolves 4* and *5* above applies at any radio astronomy station that was in operation prior to 22 November 2019; and that has been notified to the Bureau in the band 22.21-22.5 GHz before 22 May 2020. Radio astronomy stations notified after this date may seek an agreement with administrations that have notified HAPS,

invites ITU-R

to develop ITU-R Reports that will assist administrations in facilitating coexistence with other co-primary services; and

instructs the Director of the Radiocommunication Bureau

to take all necessary measures to implement this Resolution.

Reasons: To add the text of a resolution specifying the operating requirements for HAPS to protect other services.

Note: Identical to Doc. IWG-2/078r3

3. PROPOSALS FOR THE 24.25-27.5 GHZ BAND

For the 24.25-24.75 GHz Band

MOD USA/1.14/9

ARTICLE 5

Frequency allocations

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

24.25-25.25 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
24.25-24.45 FIXED	**24.25-24.45** FIXED ADD 5.C114 RADIONAVIGATION	**24.25-24.45** RADIONAVIGATION FIXED MOBILE
24.45-24.65 FIXED INTER-SATELLITE	**24.45-24.65** FIXED ADD 5.C114 INTER-SATELLITE RADIONAVIGATION 5.533	**24.45-24.65** FIXED INTER-SATELLITE MOBILE RADIONAVIGATION 5.533
24.65-24.75 FIXED FIXED-SATELLITE (Earth-to-space) 5.532B INTER-SATELLITE	**24.65-24.75** FIXED ADD 5.C114 INTER-SATELLITE RADIOLOCATION- SATELLITE (Earth-to-space)	**24.65-24.75** FIXED FIXED-SATELLITE (Earth-to-space) 5.532B INTER-SATELLITE MOBILE 5.533
* * *		

Reasons: To add a primary fixed service allocation to the 24.25-24.75 GHz band, in order to support a HAPS designation in that band.

ADD **USA/1.14/10**

5.C114 The allocation to the fixed service in the band 24.25-24.75 GHz is designated for and limited to use in Region 2 by high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS is subject to the provisions of Resolution **[C114] (WRC-19)**.

Reasons: To add the text of the footnote allowing HAPS to operate in the fixed service allocation in the 24.25-24.75 GHz band.

For the 24.75-25.25 GHz Band

NOC **USA/1.14/10*bis***

ARTICLE 5

Frequency allocations

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

24.25-25.25 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
* * *		
24.75-25.25 FIXED FIXED-SATELLITE (Earth-to-space) 5.532B	**24.75-25.25** FIXED FIXED-SATELLITE (Earth-to-space) 5.535	**24.75-25.25** FIXED FIXED-SATELLITE (Earth-to-space) 5.535 MOBILE

Reasons: Studies have not yet demonstrated that the addition of a primary fixed service allocation designated for HAPS can be made compatibly with the FSS (Earth-to-space) use of the 24.75-25.25 GHz band.

For the 25.25-27 GHz Band

MOD USA/1.14/11

ARTICLE 5

Frequency allocations

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

25.25-27.5 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
25.25-25.5	FIXED ADD 5.D114 INTER-SATELLITE 5.536 MOBILE Standard frequency and time signal-satellite (Earth-to-space)	
25.5-27	EARTH EXPLORATION-SATELLITE (space-to Earth) 5.536B FIXED ADD 5.D114 INTER-SATELLITE 5.536 MOBILE SPACE RESEARCH (space-to-Earth) 5.536C Standard frequency and time signal-satellite (Earth-to-space) 5.536A	
27-27.5 FIXED INTER-SATELLITE 5.536 MOBILE	**27-27.5** FIXED ADD 5.D114 FIXED-SATELLITE (Earth-to-space) INTER-SATELLITE 5.536 5.537 MOBILE	

Reasons: To add a footnote to the 25.25-27.5 GHz band in Region 2 allowing HAPS to operate in the fixed service allocation.

ADD USA/1.14/12

5.D114 The allocation to the fixed service in the bands 25.25-25.5 GHz and 25.5-27.0 GHz is designated for use in Region 2 by high-altitude platform stations (HAPS). This designation does not preclude the use of these frequency bands by any application of the services to which they are

allocated and does not establish priority in the Radio Regulations. Such use of the fixed-service allocation by HAPS is subject to the provisions of Resolution **[C114] (WRC-19)**.

Reasons: To add the text of the footnote allowing HAPS to operate in the fixed service allocation in the 25.25-27 GHz band.

ADD USA/1.14/13

DRAFT NEW RESOLUTION [C114]

Use of the frequency range 24.25-27 GHz by fixed links for high altitude platform stations in the fixed service in Region 2

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

considering

a) that WRC-15 considered that there is a need for greater broadband connectivity in underserved communities and in rural and remote areas, that current technologies can be used to deliver broadband applications by high-altitude platform stations (HAPS), which can provide broadband connectivity and disaster recovery communications with minimal ground network infrastructure;

b) that WRC-15 decided to study additional spectrum needs for fixed HAPS links to provide broadband connectivity, including within the band 24.25-27.5 GHz in Region 2, recognizing that the existing HAPS designations were established without reference to today's broadband capabilities;

c) that HAPS can provide broadband connectivity with minimal ground network infrastructure;

d) that Recommendation ITU-R P.618, "Propagation data and prediction methods required for the design of Earth-space telecommunication systems", should be used to determine rain fade attenuation from HAPS platforms;

e) that Recommendation ITU-R P.452, "Prediction procedure for the evaluation of interference between stations on the surface of the Earth at frequencies above about 0.1 GHz", should be used to determine the propagation loss in the ground path from HAPS ground stations;

f) that Recommendation ITU-R SF.1395, "Minimum propagation attenuation due to atmospheric gases for use in frequency sharing studies between the fixed-satellite service and the fixed service", should be used to determine the gaseous attenuation;

g) that Recommendation ITU-R P.2108, "Prediction of Clutter Loss", should be used to determine the clutter loss,

recognizing

that HAPS is defined in No. **1.66A** of the Radio Regulations as a station located on an object at an altitude of 20-50 km and at a specified, nominal, fixed point relative to the Earth, and is subject to No. **4.23**;

resolves

1 that for the purpose of protecting the fixed service systems in neighboring administrations in the frequency ranges 24.25-24.75 GHz and 25.25-27 GHz, the power flux density level per HAPS platform station at the surface of the Earth in neighboring administrations shall not exceed the following pfd mask in dBW/m^2/MHz, under clear sky condition, without the explicit agreement from the affected administration:

$$pfd_{max}(El) = 0.39 \times El - 132.12 \text{ for } 0 \leq El < 13°$$

$$pfd_{max}(El) = 2.715 \times El - 162.3 \text{ for } 13° \leq El < 20°$$

$$pfd_{max}(El) = 0.45 \times El - 117 \text{ for } 20° \leq El < 60°$$

$$pfd_{max}(El) = -90 \text{ for } 60° \leq El \leq 90°$$

where El is the elevation angle in degrees (angles of arrival above the horizontal plane).

To verify the compliance with the pfd mask the following equation shall be used:

$$pfd(El) = EIRP(El) - 10.\log_{10}(4\pi d^2) - \text{rain fade}$$

where:

EIRP is the nominal HAPS EIRP density level in dBW/MHz (dependent to the elevation angle);

d is the distance in meters between the HAPS and the ground (elevation angle dependent);

*pfd(*El*)* power flux density at the Earth surface per HAPS platform station in dBW/m²/MHz;

rain fade rain attenuation in dB (ITU-R P.618)

2 that for the purpose of protecting the terrestrial mobile service systems in neighboring administrations in the bands 24.25-24.75 GHz and 25.25-27 GHz, the power flux density level per HAPS platform station at the surface of the Earth in neighboring administrations shall not exceed the following pfd masks in dBW/m^2/MHz for more than 0.1% of deployment, without the explicit agreement from the affected administration:

$$pfd_{max}(El) = -114 \text{ for } 0 \leq El < 4°$$

$$pfd_{max}(El) = -114 + 1.24 \times (El - 4) \text{ for } 4 \leq El < 9°$$

$$pfd_{max}(El) = -107.8 \text{ for } 9° \leq El \leq 90°$$

where El is the elevation angle in degrees (angle of arrival above the horizontal plane).

To verify the compliance with the pfd mask the following equation shall be used:

$$pfd(El) = EIRP(El) - 10.\log_{10}(4\pi d^2) - L_{Pol} - B_{loss} - GasAtt(El) - \text{rain fade}$$

where:

d distance in meters between the HAPS and the ground (elevation angle dependent);

EIRP HAPS platform nominal EIRP spectral density in dBW/MHz at a specific elevation angle;

*pfd(*El*)* power flux density at the Earth surface per HAPS platform station in dBW/m²/MHz;

Lpol polarization loss of 3 dB;

Bloss body loss of 4 dB;

GasAtt(El) gaseous attenuation;

rain fade rain attenuation in dB (ITU-R P.618)

3 that for the purpose of protecting the terrestrial mobile service systems in neighboring administrations in the band 24.25-24.75 GHz and 25.25-27 GHz, the power flux density limit per HAPS ground station at the surface of the Earth in neighboring administrations shall not exceed the following pfd in dBW/m^2/MHz, under clear sky condition, without the explicit agreement of the affected administration:

$$pfd_{max}(El) = -111 \text{ dBW/m}^2\text{/MHz}$$

where *El* is the elevation angle in degrees (angle of arrival above the horizontal plane).

To verify the that pfd produced by HAPS ground station does not exceed the pfd mask, the following equation was used:

$$pfd(El) = EIRP_{\frac{dBW}{MHz}}(El) - 10 * \log_{10}\left(\frac{\lambda^2}{4\pi}\right) - P.452(d) - L_{Pol} - B_{loss} - C_{loss}$$

Where:

EIRP nominal HAPS ground station EIRP density level in dBW/MHz (dependent to the elevation angle);

d distance between the HAPS ground station and the border of the neighboring administration (elevation angle dependent);

L_{pol} polarization discrimination in dB;

$C_{loss}C_{loss}$ clutter loss (ITU-R P.2108);

P.452(d) propagation loss (ITU-R P.452);

B_{loss} body loss of 4 (dB)

4 that for the purpose of protecting the Inter Satellite service, the EIRP density per HAPS platform in the band 24.45-24.75 GHz, shall not exceed -19.9 dBW/MHz above 85 degree off-nadir; and the EIRP density per HAPS ground station in the band 25.25-27 GHz, shall not exceed 13.5 dBW/MHz towards the ISS GSO receiver under clear sky conditions;

5 that for the purpose of protecting the Earth Exploration Satellite passive services the EIRP in the band 23.6-24 GHz per HAPS platform, operating in the band 24.25-24.75GHz, shall not exceed:

$$EIRP = (- 0.7714.El - 16.5)\ dBW/100MHz \quad for \quad - 4.53° \leq El < 35°$$

$$EIRP = - 43.5\ dBW/100\ MHz \quad for \quad 35° \leq El < 90°$$

where El is the elevation angle in° (angles of arrival above the horizontal plane);

6 that for the purpose of protecting the Earth Exploration Satellite passive services the EIRP in the band 23.6-24 GHz per HAPS ground station operating in the band 24.25-24.75 GHz shall not exceed -36 dBW/200 MHz;

7 that with respect to HAPS, the provisions of No. **5.536A** shall not apply;

8 that in order to ensure the protection of in-band SRS/EESS satellite services from the HAPS platform or from the HAPS ground station in the band 25.5-27.0 GHz, the PFD of a HAPS shall not exceed the threshold values below at the SRS/EESS earth stations. The EESS PFD threshold values shall be applied at earth stations which only support EESS operations. If the PFD threshold values below are exceeded, then HAPS shall coordinate in accordance with No. 9.18, taking into account the parameters of the relevant systems.

SRS

$$PFD,\ dB\left(\frac{W}{m^2 * MHz}\right) = \begin{cases} - 138.8 + 25\ *\ \log(5 - \varphi) & 0 \leq \varphi < 4.925 \\ - 166.9 & 4.925 \leq \varphi < 5 \\ - 183.9 & 5 \leq \varphi \leq 90 \end{cases}$$

Where (φ) is the angle of arrival (φ) of the interfering signal above the local horizontal plane at the SRS antenna.

EESS NGSO

$$PFD,\ dB\left(\frac{W}{m^2 * MHz}\right) = \begin{cases} - 108.8 + (25\ *\ \log(3 - \varphi) & 0 \leq \varphi < 2.808 \\ - 126.7 & 2.808 \leq \varphi < 3 \\ - 143.4 & 3 \leq \varphi \leq 90 \end{cases}$$

Where (φ) is the angle of arrival (φ) of the interfering signal above the local horizontal plane at the EESS antenna.

EESS GSO

$$PFD,\ dB\left(\frac{W}{m^2 * MHz}\right) = \begin{cases} - 140.5 + 25\ *\ \log(3 - \varphi) & 0 \leq \varphi < 2.808 \\ - 158.4 & 2.808 \leq \varphi < 3 \\ - 178.5 & 3 \leq \varphi \leq 90 \end{cases}$$

Where (φ) is the angle of arrival (φ) of the interfering signal above the local horizontal plane at the EESS antenna.

For the case of HAPS platforms to earth stations, the PFD values above applied to HAPS shall be met under clear sky conditions 100% of the time. For the case of the HAPS ground station towards an SRS/EESS Earth station path case, attenuation using the relevant ITU-R propagation Recommendations shall be applied using the following percentages: 1) SRS: .001%; 2) EESS NGSO: .005%; 3) EESS GSO: 20%, and the HAPS and SRS/EESS antenna heights shall be used in this calculation.

9 that in order to ensure the protection of radio astronomy service in the band 23.6-24 GHz from unwanted emission of HAPS ground stations operating in the band 24.25-24.75 GHz, the pfd of a HAPS ground station shall not exceed -147 dB(W/m^2/400 MHz) for continuum observations and -161 dB(W/m^2/250 kHz) for spectral line observations at RAS station location at a height of 50 m. These pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model;

10 in order to ensure the protection of the radio astronomy service, the pfd produced by unwanted emissions from HAPS platform downlink transmissions operating in the band 24.25-24.75 GHz shall not exceed -177 dB W/m²/400 MHz for continuum observations and -191 dB W/m²/250 kHz for spectral line observations in the band 23.6-24 GHz at an RAS station location at the height of 50 m. These pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model.

To verify the compliance the following formula shall be used:

$$pfd = EIRP_{max\ clear\ sky}(Az,El) + Att_{618_{P=2\%}} - 10 * \log10(4\pi d^2)$$

where

$EIRP_{max\ clear\ sky}$ is the maximum EIRP towards the RAS station at which the HAPS platform station operates under clear sky condition in dBW/290 MHz for continuum observations and in dBW/250 kHz for spectral line observations in the band 23.6-24 GHz;

Az is the azimuth in degrees from the HAPS platform toward the RAS station;

El is the elevation angle in degrees at the HAPS platform towards the RAS station;

$Att_{618p=2\%}$ is the attenuation in dB from recommendation 618 corresponding to p=2% of the time at the radio astronomy location;

d is the separation distance in meters between the HAPS platform;

pfd is the power flux density at the Earth surface per HAPS platform station in dBW/m²/290 MHz for continuum observations and in dBW/m²/250 kHz for spectral line observations in the band 23.6-24 GHz;

11 that *resolves 9* and *10* shall apply at any radio astronomy station that was in operation prior to 22 November 2019 and has been notified to the Bureau in the band 23.6-24 GHz before 22 May 2020. Radio astronomy stations notified after this date may seek an agreement with administrations that have authorized HAPS,

invites ITU-R

to develop ITU-R Reports that will assist administrations in facilitating coexistence with other services

instructs the Director of the Radiocommunication Bureau

to take all necessary measures to implement this Resolution.

Reasons: To add the text of a resolution specifying the operating requirements for HAPS to protect other services to protect other services for the directions indicated in the Article 5 footnotes.

For the 27-27.5 GHz Band

NOC **USA/1.14/13*bis***

ARTICLE 5

Frequency allocations

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

25.25-27.5 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
* * *		
27-27.5 FIXED INTER-SATELLITE 5.536 MOBILE	**27-27.5** FIXED FIXED-SATELLITE (Earth-to-space) INTER-SATELLITE 5.536 5.537 MOBILE	

Reasons: Studies have not yet demonstrated that the addition of a designation to HAPS in the primary fixed service allocation at 27-27.5 GHz can be made compatibly with the FSS (Earth-to-space) use of the 27-27.5 GHz band.

4. PROPOSALS FOR THE 28 / 31 GHZ BANDS

For the 27.9-28.32 GHz Band

NOC **USA/1.14/14**

ARTICLE 5

Frequency allocations

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

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 MOBILE 5.538 5.540	

Reasons: Studies have not yet demonstrated that any change to the designation to HAPS in the primary fixed service allocation at 27.9-28.2 GHz can be made compatibly with the FSS (Earth-to-space) use of the 27-27.5 GHz band. The designation to HAPS should remain limited as per No. **5.537A**.

NOC **USA/1.14/15**

5.537A

Reasons: Consequential.

NOC **USA/1.14/16**

RESOLUTION 145 (REV.WRC-12)

Use of the bands 27.9-28.2 GHz and 31-31.3 GHz by high altitude platform stations in the fixed service

For the 31.0-31.3 GHz Band

MOD **USA/1.14/17**

ARTICLE 5

Frequency allocations

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

29.9-34.2 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
31-31.3	FIXED 5.338A ADD 5.F114 MOBILE Standard frequency and time signal-satellite (space-to-Earth) Space research 5.544 5.545 5.149	

Reasons: To add a footnote to the fixed service allocation in support of a HAPS designation in the 31-31.3 GHz band and to suppress the existing HAPS related footnote.

ADD **USA/1.14/18**

5.F114 The allocation to the fixed service in the band 31-31.3 GHz is designated for worldwide use by high-altitude platform stations (HAPS) in the HAPS-to-ground direction. This designation does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Such use of the fixed-service allocation by HAPS is subject to the provisions of Resolution **[E114] (WRC-19)**. (WRC-19)

Reasons: To add the text of the footnote allowing HAPS to operate in the fixed service allocation in the 31-31.3 GHz band on a worldwide basis.

SUP **USA/1.14/19**
5.543A

ADD **USA/1.14/20**

DRAFT NEW RESOLUTION [E114] (WRC-19)

Use of the band 31-31.3 GHz by high altitude platform stations in the fixed service

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

considering

a) that WRC-15 considered that there is a need for greater broadband connectivity in underserved communities and in rural and remote areas, that current technologies can be used to deliver broadband applications by high-altitude platform stations (HAPS), which can provide broadband connectivity and disaster recovery communications with minimal ground network infrastructure;

b) that WRC-15 decided to study additional spectrum needs for fixed HAPS links to provide broadband connectivity, including the existing designations in the 27.9-28.2 GHz and the 31-31.3 GHz bands, recognizing that the existing HAPS designations were established without reference to today's broadband capabilities;

f) that HAPS can provide broadband connectivity with minimal ground network infrastructure;

d) that Recommendation ITU-R P.618, "Propagation data and prediction methods required for the design of Earth-space telecommunication systems", should be used to determine rain fade attenuation from HAPS platforms;

e) that Recommendation ITU-R P.452, "Prediction procedure for the evaluation of interference between stations on the surface of the Earth at frequencies above about 0.1 GHz", should be used to determine the propagation loss in the ground path from HAPS ground stations;

f) that Recommendation ITU-R SF.1395, "Minimum propagation attenuation due to atmospheric gases for use in frequency sharing studies between the fixed-satellite service and the fixed service", should be used to determine the gaseous attenuation;

g) that Recommendation ITU-R P.2108, "Prediction of Clutter Loss", should be used to determine the clutter loss,

recognizing

a) that HAPS is defined in No. **1.66A** of the Radio Regulations as a station located on an object at an altitude of 20-50 km and at a specified, nominal, fixed point relative to the Earth, and is subject to No. **4.23**,

resolves

1 that for the purpose of protecting the fixed service systems in neighboring administrations in the band 31-31.3 GHz, the power flux density level per HAPS platform station at the surface of the Earth in neighboring administrations shall not exceed the following pfd mask in dBW/m2/MHz, under clear sky condition, without the explicit agreement from the affected administration:

$$pfd_{max}(El) = (0.875 \times El - 143) \text{ for } El \leq 8°$$

$$pfd_{max}(El) = (2.58 \times El - 156.6) \text{ for } 8° < El \leq 20°$$

$$pfd_{max}(El) = (0.375 \times El - 112.5) \text{ for } 20° < El \leq 60°$$

$$pfd_{max}(El) = -90 \text{ for } 60° < El \leq 90°$$

where El is elevation angle in degrees (angle of arrival above the horizontal plane).
To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pfd(El) = EIRP(El) - 10.\log_{10}(4\pi d^2) - \text{rain fade}$$

where:

d distance in meters between the HAPS and the ground (elevation angle dependent);

e.i.r.p. HAPS platform nominal EIRP spectral density in dBW/MHz at a specific elevation angle;

pfd(El) power flux density at the Earth surface per HAPS platform station in dB(W/m²/MHz);

rainfade rain attenuation in dB (ITU-R P.618).

2 that in order to ensure the protection of EESS (passive) per RR.5.543A, the level of unwanted power density into the HAPS ground station antenna in the band 31.3-31.8 GHz shall be limited to −83 dB(W/200 MHz) under clear-sky conditions and may be increased under rainy conditions to mitigate fading due to rain, provided that the effective impact on the passive satellite does not exceed the impact under clear-sky conditions;

3 that in order to ensure the protection of EESS (passive) services the EIRP per HAPS platform, in the band 31.3-31.8 GHz, shall not exceed:

$$EIRP = (-El - 13.1) \text{ dBW/200MHz} \quad \text{for} \quad -4.53° \leq El < 22°$$

$$EIRP = -35.1 \text{ dBW/200 MHz} \quad \text{for} \quad 22° \leq El < 90°$$

4 that in order to ensure the protection of the radio astronomy service, the pfd level produced by any HAPS ground station at the RAS stations listed, shall not exceed -141 dBW/m²/500MHz in the band 31.3-31.8 GHz, unless a higher pfd is otherwise agreed between the corresponding administrations;
To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pfd(El) = EIRP(El) + Att_{Rec\ P.452\ -\ 16}(d) - 10\log10\left(\frac{\lambda^2}{4\pi}\right)$$

where:

$Att_{Rec\ P.452-16}$ attenuation in dB based on Recommendation ITU-R P.452-16 propagation model with p = 2%;

e.i.r.p. maximum HAPS EIRP density level in dBW/MHz/500MHz (dependent to the elevation angle);

d distance in meters between the HAPS and the ground (Elevation angle dependent);

pfd(El) power flux density at the Earth surface per HAPS platform station in dB(W/m²/500MHz);

5 that in order to ensure the protection of the radio astronomy service the pfd produced by unwanted emissions from HAPS platform downlink transmissions shall not exceed -171 dB W/m²/500 MHz for continuum observations in the band 31.3-31.8 GHz at an RAS station location at a height of 50m, where this pfd value shall be verified considering a percentage of time of 2% in the relevant propagation model;

To verify the compliance the following formula shall be used:

$$pfd(El) = EIRP_{max\ \ clear\ sky}(Az, El) + Att_{618\ p\ =\ 2\%} - 10\log10(4\pi d^2)$$

where:

$EIRP_{max\ clear\ sky.}$ maximum EIRP towards the RAS station at which the HAPS platform station operates under clear sky condition in dB(W/500 MHz);

Az azimuth from the HAPS platform toward the RAS station;

El: is the elevation angle at the HAPS platform towards the RAS station;

$Att_{618p=2\%:}$ attenuation from recommendation 618 corresponding to p=2% of the time at the radio astronomy location;

d separation distance in m between the HAPS platform and the RAS station;

pfd(El) power flux density at the Earth surface per HAPS platform station in dB(W/m²/500MHz);

6 that *resolves 4* and *5* apply at any radio astronomy station that was in operation prior to 22 November 2019 and has been notified to the Bureau in the band 31.3-31.8 GHz before 22 May 2020; and that radio astronomy stations notified after this date may seek an agreement with administrations that have authorized HAPS,

instructs the Director of the Radiocommunication Bureau
to take all necessary measures to implement this Resolution.

Reasons: To add the text of a resolution specifying the operating requirements for HAPS in the 31-31.3 GHz band to protect other services.

5. PROPOSALS FOR THE 38 - 39.5 GHZ BAND

NOC **USA/1.14/21**

ARTICLE 5

Frequency allocations

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

Reasons: Studies have not yet demonstrated that the addition of a designation to HAPS in the primary fixed service allocation at 38-39.5 GHz can be made compatibly with the FSS (space-to-Earth) use of the 38-39.5 GHz band.

6. PROPOSALS FOR THE 47.2-47.5 GHZ AND 47.9-48.2 GHz BANDS

NOC **USA/1.14/22**

ARTICLE 5

Frequency allocations

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

Reasons: Studies have not yet demonstrated that any change to the designations to HAPS in the primary fixed service allocation at 47.2-47.5 GHz and 47.9-48.2 GHz can be made compatibly with the FSS (Earth-to-space) use of the same bands. The designation to HAPS should remain limited as per No. **5.552A**.

NOC **USA/1.14/23**

5.552A

Reasons: Consequential

NOC **USA/1.14/24**

RESOLUTION 122 (REV.WRC-07)

Use of the bands 47.2-47.5 GHz and 47.9-48.2 GHz by high altitude platform stations in the fixed service and by other services

Reasons: Consequential

SUP USA/1.14/25

RESOLUTION 160 (WRC-15)

Facilitating access to broadband applications delivered by high-altitude platform stations

Reasons: The studies called for by WRC-15 are complete or underway.

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Document WAC/066 (01.10.18)

WRC-19 Agenda Item 1.16
(5 150 - 5 250 MHz)

IWG-2 members were not able to reach consensus on a proposal for WRC-19 Agenda Item 1.16, considering issues related to wireless access systems, including radio local area networks (WAS/RLAN), in the frequency band 5150-5250 MHz, in accordance with Resolution 239 (WRC-15). The views on the appropriate regulatory changes the FCC should support are provided.
View A is supported by: Apple, Inc., Cisco Systems, Inc., Comcast, Inc., Facebook Inc., Global Mobile Suppliers Association, Intel Corporation, Microsoft Corporation, NCTA - The Internet & Television Association, and Wi-Fi Alliance

View B is supported by: Globalstar and Omnispace.

VIEW A

View A:

2019 World Radiocommunication Conference Advisory Committee
Agenda Item 1.16 (5 150 - 5 250 MHz)

Reference: IWG-2/076r1

Supported by Apple, Inc., Cisco Systems, Inc., Comcast, Inc., Facebook Inc., Global Mobile Suppliers Association, Intel Corporation, Microsoft Corporation, NCTA - The Internet & Television Association, and Wi-Fi Alliance

In 2014, after years of consideration following the Spectrum Act of 2012, the FCC decided to revise the rules governing U-NII (i.e., RLAN) operations in the band 5 150-5 250 MHz. In that decision, proceeded by public notice and numerous comments, the Commission recognized that demand for Wi-Fi connectivity could not be accommodated by the spectrum that was then available for unlicensed operations, under the then-applicable rules,[7/] and that future (and now current) applications will rely on wider bandwidth channels and outdoor deployments that can be best supported by greater harmonization of the technical parameters permitted across the 5 GHz sub-bands.[8/] Based on an extensive record and thorough technical analyses, the Commission adopted reasonable changes to its rules allowing outdoor RLAN deployments in the band 5 150- 5 250 MHz, and limiting e.i.r.p. above 30 degrees elevation to protect Globalstar's (i.e., Mobile Satellite Service (MSS) feeder uplink) operations.[9/] U-NII operation in the 5 150 – 5 250 MHz band has enabled U-NII devices to pair that spectrum with operation in the 5 725 – 5 850 MHz band to allow for Gigabit Wi-Fi under IEEE 802.11ac and IEEE 802.11ax, which permits pairing of 80 MHz channels for a total of 160 MHz. Following the adoption of the 5 GHz R&O, other countries have recognized the importance of increased and outdoor RLAN spectrum access and moved to revise their national regulations, similar to the FCC.[10/]

Consistent with the FCC rules and market deployment data, the U.S. presented contributions to the ITU-R Working Party 5A ("WP 5A") preparatory efforts on WRC-19 Agenda Item 1.16, confirming that RLAN outdoor or indoor operations will cause "**no harmful interference to the single MSS system using the 5 150–5 250 MHz band for FSS feeder links"**.[11/] In fact, the U.S. studies contributed to WP 5A show a negligible long term impact on the MSS system capacity far below the acceptable 1% threshold under ITU-R Recommendation S.1427.

The attached proposal's only objective is to align the ITU Radio Regulations with the FCC rules governing RLAN operations in the band 5 150-5 250 MHz. A U.S. proposal to WRC-19 other than the attached View A would be inconsistent and contradictory. The organizations and companies listed above urge FCC to adopt the attached recommendation for WRC-19 Agenda Item 1.16 proposal (View A).

7/ *2014 5 GHz Order,* ¶ 9.

8/ *2014 5 GHz Order*, ¶¶ 1, 9.

9/ *2014 5 GHz Order,* ¶¶ 25-37.

10/ *See* Canada, Indonesia, Japan , South Korea.

11/ Radiocommunication Study Groups, Preliminary Draft CPM Text for WRC-19 Agenda Item 1.16, at 5 (May 8, 2018); Sharing and Compatibility Study Between WAS/RLAN Applications and NGSO Systems in the Mobile Satellite Service with FSS Feeder Links Operating in the 5091-5250 MHz Band, Document 5A/727-E, at 35 (May 9, 2018).

ATTACHMENT TO VIEW A:
UNITED STATES OF AMERICA

DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

Agenda Item 1.16: *to consider issues related to wireless access systems, including radio local area networks (WAS/RLAN), in the frequency bands between 5 150 MHz and 5 925 MHz, and take the appropriate regulatory actions, including additional spectrum allocations to the mobile service, in accordance with Resolution* ***239 (WRC-15)***

Background Information:

Radio Local Area Networks (RLANs) have proven to be a tremendous success in providing affordable and ubiquitous broadband connectivity. Introduced by some administrations in limited spectrum in the 2.4 GHz band and subsequently expanded into the 5 GHz band, RLANs, specifically Wi-Fi devices, now are an integral component of the world's connectivity infrastructure. According to the latest statistics, more than 50% of all global IP traffic will be delivered over Wi-Fi[12], and forecasts suggest that with the introduction of 5G and gigabit wireless technologies, the demand will continue to grow rapidly in the coming years. In spite of the growing demand, however, the spectrum available globally for RLAN access has remained unchanged since World Radiocommunication Conference 2003 (WRC-03). This lack of adequate spectrum threatens to degrade RLAN performace and limit conectivity for billions of consumers worldwide. This problem is particularly acute for RLAN outdoor deployments. Since WRC-03, requirements for RLAN outdoor deployments have evolved, for example:

- Smart cities and communities;[13]
- Mobile Data – volume of mobile data traffic offloaded to Wi-Fi significantly exceeds traffic carried (remaining) on cellular networks;[14]
- Locations which are increasingly expected to offer ubiquitous Wi-Fi access including outdoor areas such as sports arenas, municipal/private networks, parks, and other high traffic areas as well as indoor areas such as shopping malls, airports, hotels, restaurants office buildings and schools;
- Sensors and connectivity for public transport, automotive, utilities, etc. rely on Wi-Fi connectivity;
- Internet of Things (IoT) technologies entail both indoor and outdoor deployments;
- Connected wearables and other consumer applications rely on Wi-Fi to support various use cases.

The problem of inadequate spectrum access for RLANs is exacerbated further by the fact that except for the band 5 150-5 250 MHz, other spectrum in the 5 GHz range harmonized for RLANs on a world-wide basis is subject to the dynamic frequency selection (DFS) constraint. The DFS constraint, albeit necessary, reduces spectrum access and raises equipment cost and complexity for RLAN implementation. Thus, the 5 150 – 5 250 MHz band offers unique advantages in addressing the growing need for RLAN outdoor access. Recognizing this fact, in 2014, the United States adopted regulations that protect other operations while allowing limited RLAN operations outdoors

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[12] https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/vni-hyperconnectivity-wp.html

[13] https://www.itu.int/en/ITU-T/ssc/Pages/default.aspx

[14] https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/vni-hyperconnectivity-wp.html

in the 5 150 – 5 250 MHz band. In particular, the United States regulations have promoted RLAN use of this band in co-existence with mobile-satellite-service (MSS) operations through E.I.R.P. limitations at higher antenna elevation angles. The United States rules generally permit indoor and outdoor RLAN operations in the 5 150 – 5 250 MHz band at up to 1 Watt conducted or 4 Watt E.I.R.P., except that operations with antenna elevation angles in excess of 30 degrees from the horizon must not exceed 125 mW E.I.R.P.[15] These rules are intended to prevent harmful interference to MSS Earth-to-space communications by limiting the aggregate noise received by the satellite. U.S. RLAN interests and MSS operators agreed to this approach to sharing.[16]

Since the United States adoption of these more permissive regulations for 5 150 – 5 250 MHz, other countries authorized similar outdoor RLAN deployments. The proposal below establishes an international regulatory framework that will enable much-needed RLAN outdoor deployments while ensuring protection of other operations in the 5 150-5 250 MHz band.

Proposal:

MOD USA/1.16/1

RESOLUTION 229 (REV.WRC-19)

Use of the bands 5 150-5 250 MHz, 5 250-5 350 MHz and 5 470-5 725 MHz by the mobile service for the implementation of wireless access systems including radio local area networks

The World Radiocommunication Conference (Sharm El Sheikh, 2019)

Considering

a) that WRC-03 allocated the bands 5 150-5 350 MHz and 5 470-5 725 MHz on a primary basis to the mobile service for the implementation of wireless access systems (WAS), including radio local area networks (RLANs);

b) that WRC-03 decided to make an additional primary allocation for the Earth exploration-satellite service (EESS) (active) in the band 5 460-5 570 MHz and space research service (SRS) (active) in the band 5 350-5 570 MHz;

c) that WRC-03 decided to upgrade the radiolocation service to a primary status in the 5 350-5 650 MHz band;

d) that the band 5 150-5 250 MHz is allocated worldwide on a primary basis to the fixed-satellite service (FSS) (Earth-to-space), this allocation being limited to feeder links of non-geostationary-satellite systems in the mobile-satellite service (No. **5.447A**);

e) that the band 5 150-5 250 MHz is also allocated to the mobile service, on a primary basis, in some countries (No. **5.447**) subject to agreement obtained under No. **9.21**;

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15 47 C.F.R. § 15.407(a)(1)(i).

16 *Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, First Report and Order, FCC 14-30, 29 FCC Rcd. 4127 ¶ 37 (rel. Apr. 1, 2014).

f) that the band 5 250-5 460 MHz is allocated to the EESS (active) and the band 5 250-5 350 MHz to the SRS (active) on a primary basis;

g) that the band 5 250-5 725 MHz is allocated on a primary basis to the radiodetermination service;

h) that there is a need to protect the existing primary services in the 5 150-5 350 MHz and 5 470-5 725 MHz bands;

i) that results of studies in ITU-R indicate that sharing in the band 5 150-5 250 MHz between WAS, including RLANs, and the FSS is feasible under specified conditions;

j) that studies have shown that sharing between the radiodetermination and mobile services in the bands 5 250-5 350 MHz and 5 470-5 725 MHz is only possible with the application of mitigation techniques such as dynamic frequency selection;

k) that there is a need to specify an appropriate e.i.r.p. limit and, where necessary, operational restrictions for WAS, including RLANs, in the mobile service in the bands 5 250-5 350 MHz and 5 470-5 570 MHz in order to protect systems in the EESS (active) and SRS (active);

l) that the deployment density of WAS, including RLANs, will depend on a number of factors including intrasystem interference and the availability of other competing technologies and services;

m) that the means to measure or calculate the aggregate pfd level at FSS satellite receivers specified in Recommendation ITU-R S.1426 are currently under study;

n) that certain parameters contained in Recommendation ITU-R M.1454 related to the calculation of the number of RLANs tolerable by FSS satellite receivers operating in the band 5 150-5 250 MHz require further study;

p) that an aggregate pfd level has been developed in Recommendation ITU-R S.1426 for the protection of FSS satellite receivers in the 5 150-5 250 MHz band,

further considering

a) that the interference from a single WAS, including RLANs, complying with the operational restrictions under *resolves* 2 will not on its own cause any unacceptable interference to FSS receivers on board satellites in the band 5 150-5 250 MHz;

b) that such FSS satellite receivers may experience an unacceptable effect due to the aggregate interference from these WAS, including RLANs, especially in the case of a prolific growth in the number of these systems;

c) that the aggregate effect on FSS satellite receivers will be due to the global deployment of WAS, including RLANs, and it may not be possible for administrations to determine the location of the source of the interference and the number of WAS, including RLANs, in operation simultaneously,

noting

a) that, prior to WRC-03, a number of administrations have developed regulations to permit indoor and outdoor WAS, including RLANs, to operate in the various bands under consideration in this Resolution;

b) that, in response to Resolution **229 (WRC-03)**, ITU-R developed Report ITU-R M.2115, which provides testing procedures for implementation of dynamic frequency selection,

recognizing

a) that in the band 5 600-5 650 MHz, ground-based meteorological radars are extensively deployed and support critical national weather services, according to footnote No. **5.452**;

b) that the performance and interference criteria of spaceborne active sensors in the EESS (active) are given in Recommendation ITU-R RS.1166;

c) that a mitigation technique to protect radiodetermination systems is given in Recommendation ITU-R M.1652;
f

d) that Recommendation ITU-R RS.1632 identifies a suitable set of constraints for WAS, including RLANs, in order to protect the EESS (active) in the 5 250-5 350 MHz band;

e) that Recommendation ITU-R M.1653 identifies the conditions for sharing between WAS, including RLANs, and the EESS (active) in the 5 470-5 570 MHz band;

f) that the stations in the mobile service should also be designed to provide, on average, a near-uniform spread of the loading of the spectrum used by stations across the band or bands in use to improve sharing with satellite services;

g) that WAS, including RLANs, provide effective broadband solutions, and that the demand has increased since the frequency range was first identified for this application;

h) that there is a need for administrations to ensure that WAS, including RLANs, meet the required mitigation techniques, for example, through equipment or standards compliance procedures,

resolves

1 that the use of these bands by the mobile service is for the implementation of WAS, including RLANs, as described in the most recent version of Recommendation ITU-R M.1450;

2 that in the band 5 150-5 250 MHz, stations in the mobile service shall be restricted to maximum conducted output of 1 W provided the maximum antenna gain does not exceed 6 dBi (i.e., a total maximum mean e.i.r.p. of 36 dBm)[1], and, in addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band, and, for the outdoor operation of stations in the mobile service the maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon shall not exceed 125 mW (21 dBm), and finally, for WAS/RLAN transmitters operating in the 5 150-5 250 MHz band, all unwanted emissions outside of the 5 150-5 350 MHz band shall not exceed an e.i.r.p. of -27 dBm/MHz;

43 that in the band 5 250-5 350 MHz, stations in the mobile service shall be limited to a maximum mean e.i.r.p. of 200 mW and a maximum mean e.i.r.p. density of 10 mW/MHz in any 1 MHz band. Administrations are requested to take appropriate measures that will result in the predominant number of stations in the mobile service being operated in an indoor environment. Furthermore, stations in the mobile service that are permitted to be used either indoors or outdoors may operate up to a maximum mean e.i.r.p. of 1 W and a maximum mean e.i.r.p. density of 50 mW/MHz in any 1 MHz band, and, when operating above a mean e.i.r.p. of 200 mW, these stations shall comply with the following e.i.r.p. elevation angle mask where □ is the angle above the local horizontal plane (of the Earth):

−13 dB(W/MHz) for 0° ≤ □ < 8□

[1] In the context of this Resolution, “mean e.i.r.p.” refers to the e.i.r.p. during the transmission burst which

□−13 − 0.716(□ − 8) dB(W/MHz) for 8° ≤ □ < 40□
−35.9 − 1.22(□ − 40) dB(W/MHz) for 40° ≤ □ ≤ 45□
□−42 dB(W/MHz) for 45° < □;

54 that administrations may exercise some flexibility in adopting other mitigation techniques, provided that they develop national regulations to meet their obligations to achieve an equivalent level of protection to the EESS (active) and the SRS (active) based on their system characteristics and interference criteria as stated in Recommendation ITU-R RS.1632;

65 that in the band 5 470-5 725 MHz, stations in the mobile service shall be restricted to a maximum transmitter power of 250 mW[2] with a maximum mean e.i.r.p. of 1 W and a maximum mean e.i.r.p. density of 50 mW/MHz in any 1 MHz band;

76 that in the bands 5 250-5 350 MHz and 5 470-5 725 MHz, systems in the mobile service shall either employ transmitter power control to provide, on average, a mitigation factor of at least 3 dB on the maximum average output power of the systems, or, if transmitter power control is not in use, then the maximum mean e.i.r.p. shall be reduced by 3 dB;

87 that, in the bands 5 250-5 350 MHz and 5 470-5 725 MHz, the mitigation measures found in Annex 1 to Recommendation ITU-R M.1652-1 shall be implemented by systems in the mobile service to ensure compatible operation with radiodetermination systems,

invites administrations

to consider appropriate measures when allowing the operation of stations in the mobile service using the e.i.r.p. elevation angle mask referred to in *resolves* 3 above, to ensure the equipment is operated in compliance with this mask,

invites ITU-R

2 to continue studies on mitigation techniques to provide protection of EESS from stations in the mobile service;

32 to continue studies on suitable test methods and procedures for the implementation of dynamic frequency selection, taking into account practical experience.

Reason: The band 5 150-5 250 MHz is the only worldwide harmonized spectrum for RLANs in the 5 GHz range that is not subject to the dynamic frequency selection constraint. Studies confirm that RLAN operations outdoors in the band 5 150-5 250 MHz will not cause harmful interference to other operations in the band. The results of these studies are further confirmed by the real-world operational experience with some countries allowing RLAN operations outdoors in the 5 150-5 250 MHz with appropriate constraints. Allowing RLAN access to outdoor use in the band 5 150-5 250 MHz would address the growing demand for continuous and ubiquitous connectivity.

MOD **USA/1.16/2**

5.446A The use of the bands 5 150-5 350 MHz and 5 470-5 725 MHz by the stations in the mobile, except aeronautical mobile, service shall be in accordance with Resolution **229 (Rev.WRC-19~~12~~)**

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corresponds to the highest power, if power control is implemented.

[2] Administrations with existing regulations prior to WRC-03 may exercise some flexibility in determining transmitter power limits.

Reasons: Consequential change to update reference to the revised Resolution **229 (Rev.WRC-19)**.

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VIEW B

VIEW B:
WAC members Globalstar and Omnispace support the objective of WRC-19 agenda item 1.16, in accordance with Resolution **239 (WRC-15)** which, *invites the ITU-R:* to conduct and complete in time for WRC-19: "… studies with a view to identify potential WAS/RLAN mitigation techniques to facilitate sharing with incumbent systems in the frequency bands 5 150-5 350 MHz, 5 350-5 470 MHz, 5 725-5 850 MHz and 5 850-5 925 MHz, while ensuring the protection of incumbent services including their current and planned use;" This agenda item calls for the protection of the current and planned uses of incumbent services in bands between 5150- 5925 MHz. The proposal contained in this view deals with only the 5150-5250 MHz portion of that frequency range. Globalstar and Omnispace operate global satellite systems in non-geostationary orbit that use the 5150-5250 MHz band for feeder links from gateways in a number of countries, including the United States, and interference from outdoor RLANs could impact Globalstar and Omnispace operations. Globalstar feeder links extend down to 5091 MHz and telecommand operations are transmitted in the range between 5091 - 5096 MHz. Omnispace has telecommand operations in the 5150-5250 MHz band. Globalstar and Omnispace support View B.

Background
The band 5150-5250 MHz is allocated on a primary basis to the fixed-satellite service (Earth-to-space), which is limited to feeder links of non-geostationary-satellite systems in the mobile-satellite service (MSS). Globalstar, Omnispace, and other MSS operators use this band for feeder links from gateways in a number of countries, including the United States. Omnispace also uses this band for telecommand, the essential function of sending instructions to control a satellite.
The Globalstar MSS system has provided reliable connections to under-developed and underserved areas since 1998. In 2007, Globalstar introduced the SPOT line of products which provide personal location and emergency services. Since its inception, SPOT terminals, as well as Globalstar's other duplex products, have been responsible for initiating thousands of rescues of persons in distress around the world. Just within the 30 days preceding 21 September, Globalstar's customers have initiated approximately twenty rescues requiring helicopter evacuations in various regions of the world. Further, the newly released SPOT-X terminal now provides two-way communications for areas that are beyond the range of more conventional terrestrial networks.
In 1997, the FCC authorized unlicensed Radio Local Area Networks (RLANs) known as "Unlicensed National Information Infrastructure" (U-NII). The FCC established the "U-NII-1" band at 5150-5250 MHz. In order to protect other radio services, a maximum equivalent isotropic radiated power (E.I.R.P.) of 200 milliwatts (mW) was adopted and operations in the U-NII-1 band were restricted to indoor use. These 1997 Rules were consistent with Resolution **229 (WRC-12)** of the Radio Regulations. In 2014 the FCC adopted revised rules in the U-NII-1 band permitting outdoor RLAN operations at up to 1 Watt conducted or 4 Watt E.I.R.P., except that operations with antenna elevation angles in excess of 30 degrees from the horizon must not exceed 125 mW E.I.R.P. U.S. RLAN interests and Globalstar, participating in the FCC's regulatory proceeding, agreed to this approach to sharing, with Globalstar's agreement conditioned on the existence of a remedial mechanism to limit any interference to MSS to an acceptable level. In the Report and Order[17], the FCC stated that licensed MSS operations are protected from harmful interference from unlicensed terrestrial wireless operations. The FCC also recognized the ability of Globalstar to measure interference in the feeder uplink band and stated that remedial action would be taken to reduce or eliminate any harmful interference to licensed MSS operations.

Discussion

[17] *Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, First Report and Order, FCC 14-30, 29 FCC Rcd. 4127 (2014).

Globalstar's measurement of the noise level over the United States in the 5091-5250 MHz band began in 2014 and is continuing. These measurements have shown a significant increase in interference to its feeder uplinks since early 2017, resulting in reduced MSS capacity, a reduction of the MSS coverage area, and an increased burden on the spacecraft bus power of Globalstar's satellites. These negative effects are expected to become greater over time as outdoor RLAN operations expand and the noise level in the 5091-5250 MHz band over the United States. continues to rise. In addition, Globalstar has conducted similar measurements of the noise level at 5091-5250 MHz over Europe, Central and South America, and Australia, and these measurements have shown no similar increase in interference.

Studies are currently being conducted in the ITU-R to determine whether it is feasible to permit co-channel operation of outdoor RLAN transmitters and MSS feeder uplink operations at 5150-5250 MHz without causing unacceptable interference to MSS satellite receivers. Five out of six of these studies predict harmful interference to MSS feeder links from outdoor RLANs. Globalstar presented its interference measurement results to the ITU-R, providing empirical evidence substantiating the predicted interference. Further, Globalstar has petitioned the FCC to open an inquiry seeking comment on the feasibility of continued sharing of the 5150-5250 MHz band between the MSS and outdoor RLAN transmitters.

Prior to the 2014 Rule change in the USA that allowed outdoor deployment and increased transmitter power, RLANs and MSS feeder links successfully shared the 5150-5250 MHz band for nearly 16 years.

Recommendation

Based on the studies in the ITU-R predicting interference from RLAN transmitters deployed outdoors at increased power levels coupled with the interference measurements performed by Globalstar, the supporters of View B recommend that the United States propose no change (NOC) to the Radio Regulations for the 5150-5250 MHz band and the 5150-5250 MHz portions of Resolution **229 (WRC-12)** as reflected in the View B proposal below.

ATTACHMENT TO VIEW B:
UNITED STATES OF AMERICA

DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

Agenda Item 1.16: *to consider issues related to wireless access systems, including radio local area networks (WAS/RLAN), in the frequency bands between 5 150 MHz and 5 925 MHz, and take the appropriate regulatory actions, including additional spectrum allocations to the mobile service, in accordance with Resolution* ***239 (WRC-15)***

Background Information:

In the early-to-mid 1990s, the ITU authorized non-geostationary satellite systems in the Mobile-Satellite Service (MSS) under revisions to the ITU-R Radio Regulations. Specifically, in 1992 the ITU adopted allocations for user links in the L and S bands, and in 1995 it adopted allocations for the feeder links between gateway earth stations and the NGSO satellites. The international feeder uplink allocations were made in the 5.1 and 29.2 GHz ranges, while the feeder downlink allocations were made in the 7 and 19 .5 GHz ranges. MSS operators have been licensed by different Administrations to use the 5150-5250 MHz range for feeder uplinks from earth stations to MSS satellites. These feeder uplinks at 5150-5250 MHz have been in continuous use globally since 1998. Two MSS operator currently use the 5150-5250 MHz band for this purpose. These MSS systems provide vital communication links to underserved areas and are often the only communication link available in these remote areas.

In Report and Order FCC 97-5 in 1997, the FCC authorized unlicensed Radio Local Area Networks (RLANs) known as "Unlicensed National Information Infrastructure" (U-NII).[18] In this Report and Order, the FCC established the "U-NII-1" band at 5150-5250 MHz. In order to protect other radio services at 5150-5250 MHz, including fixed-satellite service (FSS) transmissions used to provide feeder uplinks for non-geostationary MSS systems, the FCC adopted a maximum equivalent isotropic radiated power (EIRP) of 200 milliwatts (mW) and restricted RLAN operations in the U-NII-1 band to indoor use.

Following a year-long rulemaking proceeding, the FCC in 2014 adopted revised rules in the U-NII-1 band that permit outdoor RLAN operations at increased power levels. The rules adopted in FCC Report and Order FCC 14-30[19] generally permit indoor and outdoor RLAN operations in the 5150 – 5250 MHz band at up to 1 Watt conducted or 4 Watt E.I.R.P., except that operations with antenna elevation angles in excess of 30 degrees from the horizon must not exceed 125 mW E.I.R.P.[20] These rules were intended to prevent harmful interference to MSS Earth-to-space communications by limiting the aggregate noise received by the satellite. U.S. RLAN interests and the MSS operator participating in the FCC's regulatory proceeding agreed to this approach to sharing, with the MSS operator's agreement conditioned on the existence of a remedial mechanism to limit any

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[18] *Amendment of the Commission's Rules to Provide for Operation of Unlicensed NII Devices in the 5 GHz Frequency Range*, Report and Order, 12 FCC Rcd 1576, FCC 97-5 (1997) ("*1997 U-NII Order*").

[19] *Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, First Report and Order, FCC 14-30, 29 FCC Rcd. 4127 (2014).

[20] 47 C.F.R. § 15.407(a)(1)(i).

interference to MSS to an acceptable level.[21] In this Report and Order, the FCC stated that licensed MSS operations are protected from harmful interference from unlicensed terrestrial wireless operations. The U.S. Administration also recognized the ability of the participating MSS operator to measure interference in the feeder uplink band, and stated that remedial action would be taken to reduce or eliminate any harmful interference to licensed MSS operations.

The MSS operator's measurement of the noise level over the USA in the 5091-5250 MHz band began in 2014 and is currently ongoing. This MSS operator's measurements have shown a significant increase in interference to its feeder uplinks and MSS system since early 2017. This interference to the MSS operator's satellite service has resulted in reduced MSS capacity, reduction of MSS coverage area, and an increased burden on the spacecraft bus power of the MSS satellites. These negative effects are expected to become greater over time as outdoor RLAN operations expand and the noise level in the 5091-5250 MHz band over the U.S. continues to rise. Although the MSS operator's measurements cover spectrum outside the 5150-5250 MHz frequency range (at 5091-5150 MHz), exhaustive research has not revealed any material interference sources at 5091-5150 MHz. In addition, the MSS operator has conducted similar measurements of the noise level at 5091-5250 MHz over Europe, Central and South America, and Australia, and these measurements have shown no similar increase in interference. The MSS operator has provided the results of its interference measurements to the FCC.

Since the FCC's adoption of these more permissive regulations for outdoor RLAN operations at 5150–5250 MHz, other countries have authorized similar outdoor RLAN deployments, but only with regulatory constraints such as temporary, provisional licenses and registration of RLAN transmitter locations.

Studies are currently ongoing in the ITU-R to determine whether it is feasible to permit co-channel operation of outdoor RLAN transmitters and MSS feeder uplink operations at 5150-5250 MHz without causing unacceptable interference to MSS satellite receivers. The MSS operator conducting interference measurements has presented its measurement results to the ITU-R. Further, it has petitioned the FCC to open an inquiry seeking comment on the feasibility of continued sharing of the 5150-5250 MHz band between the MSS and outdoor RLAN transmitters. Prior to the 2014 Rule change, in the USA, that allowed outdoor deployment and increased transmitter power, RLANs and MSS feeder links successfully shared the 5150-5250 MHz band for nearly 16 years.

In light of these facts, incorporation of the revisions to the Radio Regulations that permit outdoor deployment and increased transmitter power is not consistent with the protection of incumbent services from unacceptable interference.

Proposal:

<u>NOC</u> **USA/1.16/1**

[21] MSS interests feared that such a drastic change in operating conditions - outdoor deployment and an 80 times increase in power level - would result in disruptive interference to feeder uplink operations. This EIRP coupled with the loss due to indoor deployment of the U-NII devices, standardized at 50 times, would result in an overall EIRP increase of 4000 times or 36 dB.

RESOLUTION 229 (REV.WRC-19)

Use of the bands 5 150-5 250 MHz, 5 250-5 350 MHz and 5 470-5 725 MHz by the mobile service for the implementation of wireless access systems including radio local area networks

NOC **USA/1.16/2**

5.446A The use of the bands 5 150-5 350 MHz and 5 470-5 725 MHz by the stations in the mobile, except aeronautical mobile, service shall be in accordance with Resolution **229 (Rev.WRC-12)**

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Document WAC/067 (01.10.18)

UNITED STATES OF AMERICA

PROPOSALS FOR THE WORK OF THE CONFERENCE

(NOTE: Presented as a revision to the RCS Proposal.)

Agenda Item 1.16: To consider issues related to wireless access systems, including radio local area networks (WAS/RLAN), in the frequency bands between 5 150 MHz and 5 925 MHz, and take the appropriate regulatory actions, including additional spectrum allocations to the mobile service, in accordance with Resolution **239 (WRC-15)**.

Background Information: Resolution **239 (WRC-15)** calls for ITU-R to study WAS/RLAN technical characteristics and operational requirements in the 5 GHz frequency range. The resolution also calls for ITU-R to
to conduct studies with a view to identify potential WAS/RLAN mitigation techniques to facilitate sharing with incumbent systems in the frequency bands 5 150-5 350 MHz, 5 350-5 470 MHz, 5 725-5 850 MHz and 5 850-5 925 MHz, while ensuring the protection of incumbent services including their current and planned use.

Recognizing results of the ITU-R studies and existing uses in the frequency bands between 5 250 MHz and 5 925 MHz, this proposal is for NOC for the 5 250-5 350 MHz, 5 350-5 470 MHz, and 5 850-5 925 MHz bands. The proposal is also for NOC in the frequency band 5 725-5 850 MHz in Region 2 and 3. No proposal is made with regard to WAS/RLANs in the frequency band 5 725-5 850 MHz in Region 1. Region 2 and 3 countries wishing to implement WAS/RLANs in the frequency band 5 725-5 850 MHz can do so on non-interference basis or by adding their name to No. **5.453**.

Proposal:

Article 5

Frequency Allocations

Section IV – Table of Frequency Allocations

(See No. **2.1**)

NOC **USA/1.16/1**

5 250-5 570 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
5 250-5 255	EARTH EXPLORATION-SATELLITE (active) MOBILE except aeronautical mobile 5.446A 5.447F RADIOLOCATION SPACE RESEARCH 5.447D 5.447E 5.448 5.448A	

5 255-5 350	EARTH EXPLORATION-SATELLITE (active) MOBILE except aeronautical mobile 5.446A 5.447F RADIOLOCATION SPACE RESEARCH (active) 5.447E 5.448 5.448A
…	

Reasons: Since the adoption of Resolution **229 (Rev. WRC-12)** at WRC-03, millions of WAS/RLAN (such as Wi-Fi) devices have been deployed in the band 5 250-5 350 MHz. Studies in response to *invite c* of Resolution **229** have shown that changing the WAS/RLAN operating conditions in the band 5 250-5 350 MHz would not ensure protection of incumbent radiodetermination services and EESS (active) sensors.

NOC **USA/1.16/2**

5 250-5 570 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
…		
5 350-5 460	EARTH EXPLORATION-SATELLITE (active) 5.448B RADIOLOCATION 5.448D AERONAUTICAL RADIONAVIGATION 5.449 SPACE RESEARCH (active) 5.448C	
5 460-5 470	EARTH EXPLORATION-SATELLITE (active) RADIOLOCATION 5.448D RADIONAVIGATION 5.449 SPACE RESEARCH (active) 5.448B	
…		

Reasons: Previous ITU-R studies show that sharing between WAS/RLAN operating in the band 5 350-5 470 MHz and the EESS (active) systems or between WAS/RLAN and different radar systems would not be feasible unless WAS/RLAN implement additional mitigation measures. After further review of currently available mitigation measures, study results show that there are no feasible mitigation techniques to facilitate sharing between WAS/RLAN and EESS (active) or between WAS/RLAN and radar systems in the 5 350-5 470 MHz band.

NOC **USA/1.16/3**

5 570-6 700 MHz

Allocation to services		
	Region 2	**Region 3**
…		
	5 725-5 830 RADIOLOCATION Amateur 5.150 5.453 5.455	
	5 830-5 850 RADIOLOCATION Amateur Amateur-satellite (space-to-Earth) 5.150 5.453 5.455	
…		

Reasons: No change is proposed to the allocations in Region 2 and 3 in the 5 725-5 850 MHz frequency range because billions of WAS/RLANs have been deployed and are operational in many Region 2 and 3 countries. To date, no cases of interference from WAS/RLAN operations in the 5 725-5 850 MHz frequency range have been reported to the ITU. It is also important to note that No. **5.150** designates the 5 725-5 875 MHz frequency band for Industrial, Scientific, and Medical (ISM) applications and under No. **5.453** over 40 countries have allocated the 5 650-5 850 MHz frequency range to the fixed and mobile services on a primary basis. Region 2 and 3 countries wishing to implement WAS/RLANs in the frequency band 5 725-5 850 MHz can do so on non-interference basis or by adding their name to No. **5.453**. No further changes under WRC-19 agenda item 1.16 in Region 2 and 3 in the 5 725-5 850 MHz frequency range are required because such changes would be highly disruptive and are unnecessary.

NOC **USA/1.16/4**

5 570-6 700 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
…		
5 850-5 925 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE 5.150	**5 850-5 925** FIXED FIXED-SATELLITE (Earth-to-space) MOBILE Amateur Radiolocation 5.150	**5 850-5 925** FIXED FIXED-SATELLITE (Earth-to-space) MOBILE Radiolocation 5.150
…		

Reasons: The mobile service is co-primary in the 5 850-5 925 MHz band. Various countries have already implemented RLAN applications under the mobile allocation in this band. Therefore, this agenda item should not prejudice usages of the mobile service and should not consider imposing any additional constraints on other allocated services in the band.

Space Services Issues

Document WAC/068 (01.10.18)

WRC-19 Agenda Item 1.5

IWG-3 members were not able to reach consensus on a proposal for WRC-19 Agenda Item 1.5 regarding the use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion communicating with geostationary space stations in the fixed-satellite service, in accordance with Resolution **158 (WRC-15).** The views on the appropriate regulatory changes the FCC should support are provided.

View A is supported by: Inmarsat, Viasat, SES, Boeing, Thales

View B is supported by AT&T, CTIA, Ericsson, Global Mobile Suppliers Association (GSA), GSMA, Intel Corporation, Sprint Corporation, T-Mobile, and Verizon.
View C is supported by: Iridium

VIEW A

View A:
View A proposes to adopt regulatory and technical considerations for the use of earth stations in motion (ESIM) communicating with geostationary-satellite orbit (GSO) fixed-satellite service (FSS) space stations in the 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) frequency bands.
Although FSS traditionally involves communications between satellites in orbit and earth stations in fixed locations, the growing demand for broadband communications to vessels, land vehicles, and aircraft has resulted in increased use of FSS for mobility applications. ESIM in the 17.7-19.7 GHz and 27.5-29.5 GHz bands enable the provision of very high data rate broadband communications, navigation, situational awareness, and other services to mobile platforms that often cannot be served using other communications technologies. ESIM are used to deliver broadband to ships, vehicles, trains, and aircraft using the same frequency bands, hardware, satellites, transponder beams, and control stations used to serve earth stations at fixed locations.

At WRC-15, the ITU adopted regulatory and technical provisions for ESIM in the 29.5-30 GHz and 19.7-20.2 GHz frequency bands. Use of these bands by services other than the FSS is limited. Resolution 158 (WRC-15) established a list of sharing and protection cases to be addressed under Agenda item 1.5. All of the required studies have been undertaken in the ITU-R during the 2015-2019 study cycle. Where provisions were shown to be required for the protection of existing services and applications – such as the mobile service, the fixed service, and non-GSO FSS systems in portions of the band subject to No. **22.2** – studies leading to the conditions necessary for such protection have been identified and are nearing conclusion. The ITU-R determined that a WRC Resolution containing the regulatory, technical, and operational conditions for ESIM operation on aircraft, maritime vessels, and land vehicles could be developed and effectively implemented to address this agenda item.
View A contains a series of proposals for establishment of ESIMs in the 17.7-19.7 GHz and 27.5-29.5 GHz bands:
The first element is a proposed footnote for Article 5 that authorizes ESIM and makes them subject to a new WRC resolution. This footnote tracks exactly the consensus version in the draft CPM Report for CPM19-2.
The second element is the draft WRC Resolution mentioned in the new footnote. This Resolution provides the regulatory mechanism for ESIM – which must operate within the envelope of existing or proposed fixed earth stations associated with the GSO FSS network with which the ESIM communicate – and sets up the examination required by the BR. The Resolution also provides specific provisions for protection of neighboring GSO FSS satellite networks, and for non-GSO FSS systems in the segments of the 27.5-29.5 GHz band where there is no coordination under RR No. 9.11A. No separate provisions for protection of non-GSO MSS feeder links in the 29.1-29.5 GHz band, or for non-GSO FSS systems in the 28.6-29.1 GHz band are included because these bands are subject to coordination under No. 9.11A; operation within the envelope (*resolves* 1.1.1 of the Resolution) assures compatible operation and no unacceptable interference. Protection of terrestrial services (fixed and mobile) from unacceptable interference is provided in *resolves* 1.2 through 1.2.5 of the draft Resolution. These provisions include specific provisions for protection of fixed and mobile services in Annex 2. A pfd mask –for protection of fixed and mobile systems from aeronautical ESIM in 27.5-29.5 GHz, and included as an option in the draft CPM Report – is proposed for Annex 2.
The final element of the proposal is a new entry in Appendix 4 of the Radio Regulations. This provides a commitment by administrations adding ESIM to their satellite networks that the ESIM operation would be in conformity with the Radio Regulations and the new draft Resolution (including the annexes).

The proponents of View A maintain that the proposals above – all of which are the result of intense ITU-R study and are reflected in the draft CPM Report, and are consistent with how the FCC has treated ESIM in the past – provide the complete and appropriate measures for successful governance of the operation of ESIM communicating with GSO FSS networks in the 17.7-19.7 GHz and 27.5-29.5 GHz bands. Existing services are protected from unacceptable interference, important guidance is provided to administrations seeking to implement ESIM, and the stage is set for a new and important tool for provision of broadband services to be established.

ATTACHMENT TO VIEW A:
UNITED STATES OF AMERICA

DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

Agenda Item 1.5: *to consider the use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion communicating with geostationary space stations in the fixed-satellite service and take appropriate action, in accordance with Resolution* ***158 (WRC-15)***

BACKGROUND INFORMATION:

The global demand for broadband communications continues unabated and is not location specific. Such demand includes requirements of connectivity for users on vessels, aircraft and vehicles that operate at both fixed locations and while in motion, often in very remote parts of the globe. ITU for many years has and continues to address ways of meeting this important need. State of the art 30/20 GHz GSO FSS satellite networks and earth stations that employ advanced technology available today are capable of meeting the connectivity requirements of broadband users on vehicles and vessels, including high-throughput applications.

Advances in satellite manufacturing and directional earth station technology, particularly the development of multi-axis stabilized earth station antennas capable of maintaining a high degree of pointing accuracy while stationary or on rapidly moving platforms, have made earth stations with very stable pointing characteristics both available and practical. These earth stations can operate in the same interference environment, and comply with same regulatory and technical constraints as typical GSO FSS earth stations. Satellite network operators are designing, coordinating, and bringing into use GSO FSS networks that can offer both stationary and moving broadband services using a single stabilized directional antenna within existing GSO FSS technical parameters.

The ITU-R has been studying deployment of earth stations in motion (ESIM) communicating with GSO FSS space stations for many years. WRC-15 adopted regulatory provisions for the operation of ESIM communicating with GSO FSS space stations in the 29.5-30 GHz and 19.7-20.2 GHz bands under No. **5.527A** and Resolution **156 (WRC-15)**, and prior Conferences adopted provisions for operation of ESIM on maritime vessels communicating with GSO FSS space stations in lower FSS bands.

The latest bands to be considered for ESIM communication with GSO FSS space stations are the 27.5-29.5 GHz and 17.7-19.7 GHz bands. These bands were considered separately from the "upper 500 MHz" of the 30/20 GHz band due to the fact that the upper bands are allocated predominantly to satellite services while the lower portions of the 30/20 GHz bands are shared on a global basis with the fixed and mobile services as well as other users.

The sharing cases requiring study in the 27.5-29.5 GHz and 17.7-19.7 GHz bands were set out in Resolution **158 (WRC-15)**. Where provisions were shown to be required for the protection of existing services and applications – such as the mobile service, the fixed service, and non-GSO FSS systems in portions of the band subject to No. **22.2** – studies leading to the conditions necessary for such protection have been identified or are nearing conclusion. The ITU-R determined that a

resolution containing the regulatory, technical, and operational conditions for ESIM operation on aircraft, maritime vessels, and land vehicles could be developed and effectively implemented.

Adoption of the proposals below will provide up to 2000 megahertz, in each the uplink and downlink directions, to support these important and growing global broadband requirements, on an equal basis in all three Regions and result in rational and efficient use of the radio spectrum resource. Adoption of this proposal will also assure the protection of existing services.

Proposals

ARTICLE 5

Frequency allocations

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

MOD USA/1.5/1

15.4-18.4 GHz

<table>
<tr><th colspan="3">Allocation to services</th></tr>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td rowspan="2">17.7-18.1
FIXED
FIXED-SATELLITE
(space-to-Earth) 5.484A
ADD5.A15
(Earth-to-space) 5.516
MOBILE</td><td>17.7-17.8
FIXED
FIXED-SATELLITE
(space-to-Earth) 5.517
ADD5.A15
(Earth-to-space) 5.516
BROADCASTING-SATELLITE
Mobile
5.515</td><td rowspan="2">17.7-18.1
FIXED
FIXED-SATELLITE
(space-to-Earth) 5.484A
ADD5.A15
(Earth-to-space) 5.516
MOBILE</td></tr>
<tr><td>17.8-18.1
FIXED
FIXED-SATELLITE
(space-to-Earth) 5.484A
ADD5.A15
(Earth-to-space) 5.516
MOBILE
5.519</td></tr>
<tr><td>18.1-18.4</td><td colspan="2">FIXED
FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B ADD5.A15
(Earth-to-space) 5.520
MOBILE
5.519 5.521</td></tr>
</table>

MOD USA/1.5/2

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	
18.6-18.8 EARTH EXPLORATION-SATELLITE (passive) FIXED FIXED-SATELLITE (space-to-Earth) 5.522B ADD5.A15 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 ADD5.A15 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 ADD5.A15 MOBILE except aeronautical mobile Space research (passive) 5.522A
18.8-19.3	FIXED FIXED-SATELLITE (space-to-Earth) 5.516B 5.523A ADD5.A15 MOBILE	
19.3-19.7	FIXED FIXED-SATELLITE (space-to-Earth) (Earth-to-space) 5.523B 5.523C 5.523D 5.523E ADD5.A15 MOBILE	

MOD USA/1.5/3

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 ADD5.A15 MOBILE 5.538 5.540	
28.5-29.1	FIXED FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.523A 5.539 ADD5.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 5.535A 5.539 5.541A ADD5.A15 MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540	

ADD USA/1.5/4

5.A15 The operation of earth stations in motion communicating with geostationary FSS space stations in the bands 17.7-19.7 GHz and 27.5-29.5 GHz shall be subject to Resolution **[A15] (WRC-19)**.

Reasons: Adoption of these proposals would provide the availability of 2 GHz of additional spectrum in each the FSS uplink and downlink directions at 30/20 GHz to support important and growing global broadband communication requirements for users on ships, airplanes, and land vehicles, on an equal basis in all three Regions and result in rational and efficient use of the radio spectrum resource.

ADD USA/1.5/5

DRAFT NEW RESOLUTION [A15] (WRC-19)

Use of the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz by earth stations in motion (ESIM) communicating with geostationary space stations in the fixed-satellite service[1]

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

considering

a) that there is a need for global broadband mobile-satellite communications, and that some of this need could be met by allowing ESIM to communicate with space stations of geostationary-satellite orbit (GSO) fixed-satellite service (FSS) operating in the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space);

b) that appropriate regulatory and interference management mechanisms are necessary for the operation of ESIM;

c) that the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) are also allocated to terrestrial and space services used by a variety of different systems and these existing services and their future development need to be protected from the operation of ESIM,

d) that ITU-R studies have shown that aeronautical ESIM are capable of operating without causing harmful interference interfering with non-GSO mobile-satellite service feeder link satellite receivers in the 29.1-29.5 GHz band,

recognizing

a) that the administration authorising ESIM on territory under its jurisdiction has the right to require that ESIM referred to above only use those assignments associated with GSO FSS networks which have been successfully coordinated, notified, brought into use and recorded in the MIFR with a favourable finding under Article **11**, including Nos. **11.31**, **11.32** or **11.32A**, where applicable;

b) that for cases of incomplete coordination under No. **9.7** of the GSO FSS network with assignments to be used by ESIM, the operation of ESIM on those assignments needs to be in accordance with the provisions of No. **11.42** with respect to any recorded frequency assignment which was the basis of the unfavourable finding under No. **11.38;**

c) that any course of action taken under this Resolution has no impact on the original date of receipt of the frequency assignments of the GSO FSS satellite network with which ESIM communicate or on the coordination requirements of that satellite network,

resolves

1 that for any ESIM communicating with a GSO FSS space station in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz, or portions thereof, the following conditions shall apply:

1.1 with respect to space services in the 17.7-19.7 GHz and 27.5-29.5 GHz bands, ESIM shall comply with the following conditions:

1.1.1 with respect to satellite networks or systems of other administrations, ESIM shall remain within the envelope of the satellite network with which these ESIM communicate;

1.1.2 for the implementation of *resolves* 1.1.1 above, the notifying administration of the GSO FSS network with which ESIM communicate shall send to the Bureau under this Resolution the relevant Appendix **4** information related to the characteristics of the ESIM intended to communicate with the space station of that GSO FSS network, including a commitment that the ESIM operation would be in conformity with the Radio Regulations and this Resolution (including its annexes, as applicable);

1.1.3 upon receipt of the information provided in accordance with *resolves* 1.1.2 above, the Bureau shall examine it in relation to the requirements referred to in *resolves* 1.1.1 based on the complete information submitted to the Bureau under No. **11.2,** and complying with No. **11.28,** for the satellite network of the GSO FSS space station with which the ESIM is intended to communicate;

1.1.4 if, following the examination referred to in *resolves* 1.1.3 above, the Bureau concludes that the ESIM characteristics are within the envelope of the satellite network, it shall publish the results in a Special Section annexed to the BR IFIC, and retain the original date of protection for the assignment being modified where the information is presented as a modification of an existing notice;

1.1.5 if, following the examination referred to in *resolves* 1.1.3 above, the Bureau concludes that the ESIM characteristics are not within the envelope of the satellite network, the information shall be returned to the notifying administration;

1.1.6 for the protection of non-GSO FSS systems operating in the band 27.5-28.6 GHz, ESIM communicating with GSO FSS networks shall comply with the provisions contained in Annex 1 to this Resolution;

1.1.7 ESIM shall not claim protection from non-GSO FSS systems operating in the frequency band 17.8-18.6 GHz in accordance with the Radio Regulations, including No. **22.5C**;

1.1.8 ESIM shall not claim protection from BSS feeder link earth stations operating in the frequency band 17.7-18.4 GHz in accordance with the Radio Regulations and shall not constrain their future development;

1.2 with respect to terrestrial services in the 17.7-19.7 GHz and 27.5-29.5 GHz frequency bands ESIM shall comply with the following conditions:

1.2.1 the receiving ESIM in the 17.7-19.7 GHz frequency band shall not claim protection from any stations in the terrestrial services in this band operating in accordance with the Radio Regulations and shall not affect the future development of these services;

1.2.2 the transmitting aeronautical and maritime ESIM in the 27.5-29.5 GHz frequency band shall not cause unacceptable interference to any stations in the terrestrial services in this band operating

in accordance with the Radio Regulations and shall not affect the future development of these services, and Annex 2 applies;

1.2.3 the transmitting land ESIM in the 27.5-29.5 GHz frequency band shall not cause interference to any stations in the terrestrial services in this band operating in accordance with the Radio Regulations and shall not affect the future development of these services, and Annex 3 applies;

1.2.4 for the implementation of *resolves* 1.2.2 and 1.2.3 above, the notifying administration responsible for the GSO FSS satellite network with which ESIM communicate shall, in making the commitment referred to in *resolves* 1.1.2 above, be deemed to have committed that it shall, upon receipt of a report of unacceptable interference (in the case of aeronautical or maritime ESIM) or interference (in the case of land ESIM), take necessary action to immediately cease or reduce interference to an acceptable level;

1.2.5 any transmitting aeronautical or maritime ESIM that conforms to the requirements in Annex 2 to this Resolution shall be deemed to have met its obligation to terrestrial stations under *resolves* 1.2.2 above;

2 that ESIM shall not be used or relied upon for safety-of-life applications;

3 that for the implementation of this Resolution, administrations may consider relevant parts of Annex 3 when considering to authorise ESIM as well as in their bi-lateral or multi-lateral negotiations;

4 that, in addition to *resolves* 3, administrations authorizing land ESIM shall ensure that land ESIM operating in their territory do not cause unacceptable interference to terrestrial services of other countries operating in accordance with the Radio Regulations

5 that the administration responsible for the GSO FSS satellite network with which the ESIM communicate shall ensure that:

5.1 ESIM employ techniques to track the associated GSO FSS satellite without inadvertently tracking adjacent GSO satellites;

5.2 the ESIM network operator puts in place all necessary measures so that its ESIM are subject to permanent monitoring and control by a Network Control and Monitoring Centre (NCMC) or equivalent facility and are capable of receiving and acting upon at least “enable transmission” and “disable transmission” commands from the NCMC or equivalent facility (see also Annex 3);

6 that the application of this Resolution does not provide regulatory status to ESIM different from that derived from the GSO FSS network with which they communicate taking into account the provisions referred to in this Resolution,

instructs the Director of the Radiocommunication Bureau

1 to take any necessary actions for the implementation of this Resolution;

2 to take any necessary actions to facilitate the implementation of this Resolution by administrations, including assisting in resolving any potential interference issues;

3 to report to WRC-23 any difficulties or inconsistencies encountered in the implementation of this Resolution;

invites administrations

to collaborate, to the maximum extent practicable, for the implementation of this Resolution, in particular for resolving any potential interference.

ANNEX 1 TO DRAFT NEW RESOLUTION [A15] (WRC-19)

Provisions for ESIM to protect non-GSO FSS systems in the frequency band 27.5-28.6 GHz

1 In order to protect those non-GSO FSS referred to in *resolves* 1.1.6 of this Resolution, ESIM shall comply with the following provisions:

a. The level of equivalent isotropically radiated power (e.i.r.p.) density emitted by an ESIM in a geostationary-satellite network in the 27.5-28.6 GHz frequency band shall not exceed the following values for any off-axis angle □ which is 3° or more off the main-lobe axis of an ESIM antenna and outside 3° of the GSO:

Off-axis angle	*Maximum e.i.r.p. density*
3□ □ □ □ 7□	28 – 25 log □dB(W/40 kHz)
7□ □ □ □ 9.2□	7 dB(W/40 kHz)
9.2□ □ □ □ 48□	31 – 25 log □dB(W/40 kHz)
48□ □ □ □ 180□	1 dB(W/40 kHz)

b. For any ESIM that does not meet Condition 1.a above, outside of 3 deg of the GSO, the maximum ESIM on-axis e.i.r.p. shall not exceed 55 dBW for emission bandwidths up to and including 100 MHz. For emission bandwidths larger than 100 MHz, the maximum ESIM on-axis e.i.r.p. may be increased proportionately.

ANNEX 2 TO DRAFT NEW RESOLUTION [A15] (WRC-19)

Provisions for maritime and aeronautical ESIM to protect terrestrial services operating in the frequency band 27.5-29.5 GHz for the implementation of resolves 1.2.2

Part 1: Maritime ESIM

1 Maritime ESIM shall comply with items 1.1 and 1.2 below:

1.1 The minimum distance from the low-water mark as officially recognized by the coastal State beyond which maritime ESIM can operate without the prior agreement of any administration is 60 km in the 27.5-29.5 GHz frequency band. Any transmissions from maritime ESIM within the minimum distance shall be subject to the prior agreement of the concerned coastal State.

1.2 The maximum maritime ESIM e.i.r.p. spectral density towards the territory of any coastal State will be limited to 24.44 dBW in reference bandwidth of 14 MHz. Transmissions from

maritime ESIM with higher e.i.r.p. spectral density levels towards the territory of any coastal state shall be subject to the prior agreement of the concerned coastal State.

Part 2: Aeronautical ESIM

1 Aeronautical ESIM communicating with GSO FSS networks shall comply with the provisions of items 1.1 and 1.2 below:

1.1 When within line-of-sight of the territory of an administration, the maximum pfd produced (in a reference bandwidth of 14 MHz) at the surface of the Earth within the territory of that administration by emissions from a single aeronautical ESIM shall not exceed:

$PFD(\delta)=-124.7$	(dBW/m^2/14 MHz)	for	$0°\leq\delta\leq0.01°$
$PFD(\delta)=-120.9+1.9\cdot\log10(\delta)$	(dBW/m^2/14 MHz)	for	$0.01°\leq\delta\leq0.3°$
$PFD(\delta)=-124.7$	(dBW/m^2/14 MHz)	for	$0°\leq\delta\leq0.01°$
$PFD(\delta)=-120.9+1.9\cdot\log10(\delta)$	(dBW/m^2/14 MHz)	for	$0.01°\leq\delta\leq0.3°$
$PFD(\delta)=-116.2+11\cdot\log10(\delta)$	(dBW/m^2/14 MHz)	for	$0.3°<\delta\leq1°$
$PFD(\delta)=-116.2+18\cdot\log10(\delta)$	(dBW/m^2/14 MHz)	for	$1°<\delta\leq2°$
$PFD(\delta)=-117.9+23.7\cdot\log10(\delta)$	(dBW/m^2/14 MHz)	for	$2°<\delta\leq8°$
$PFD(\delta)=-96.5$	(dBW/m^2/14 MHz)	for	$8°<\delta\leq90.0°$

where δ is the angle of arrival of the radio-frequency wave (degrees above the horizon).

1.2 Higher pfd levels than provided in 1.1 above produced by aeronautical ESIM on surface of the Earth within the territory of an administration that is within line-of-sight of the aeronautical ESIM shall be subject to the prior agreement of that administration.

NOTE 1 – When calculating whether an ESIM meets the pfd levels specified in provision 1.1 above, free-space propagation, atmospheric absorption, and any attenuation due to the aircraft fuselage should be considered.

ANNEX 3 TO DRAFT NEW RESOLUTION [A15] (WRC-19)

Guidelines to assist administrations to authorize ESIM in the frequency band 27.5-29.5 GHz

The following guidelines are provided for all administrations involved in the authorization and operation of ESIM in the 27.5-29.5 GHz and 17.7-19.7 GHz frequency bands:

1. With regard to Land ESIM (L-ESIM), the administration authorizing L-ESIM has the right to require:

1.1 that L-ESIM operate within the territory under the jurisdiction of an administration only if authorised by that administration;

1.2 the operator of any ESIM network within which the L-ESIM operate to confirm that such L-ESIM have the capability to limit operations to the territory of administrations having authorized those L-ESIM;

1.3 The operator of the ESIM network within which the L-ESIM operate must provide a point of contact for the purpose of tracing any suspected cases of interference from L-ESIM.

2. With regard to Maritime ESIM (M-ESIM), the administration authorizing M-ESIM has the right to require:

2.1 that M-ESIM operate within the territorial waters under the jurisdiction of an administration only if authorised by that administration.

2.2. the operator of any ESIM network within which the M-ESIM operate to confirm that such M-ESIM have the capability to limit operations to the territorial waters of administrations having authorized those M-ESIM.

2.3 The operator of the ESIM network within which the M-ESIM operate provide a point of contact for the purpose of tracing any suspected cases of interference from M-ESIM.

3. With regard to Aeronautical ESIM (A-ESIM), the administration authorizing A-ESIM has the right to require:

3.1 that A-ESIM operate within the territorial airspace under the jurisdiction of an administration only if authorized by that administration;

3.2 the operator of any ESIM network within which the A-ESIM operate to confirm that such A-ESIM have the capability to limit operations to the territorial airspace of administrations having authorized those A-ESIM.

3.3 The operator of the ESIM network within which the A-ESIM operate provide a point of contact for the purpose of tracing any suspected cases of interference from A-ESIM.

Reasons: Adoption of this proposal would provide the availability of 2 GHz of additional spectrum in each the FSS uplink and downlink directions at 30/20 GHz to support important and growing global broadband communication requirements for users on ships, airplanes, and land vehicles, on an equal basis in all three Regions and result in rational and efficient use of the radio spectrum resource.

MOD USA/1.5/6

APPENDIX 4 (REV.WRC-15)

Consolidated list and tables of characteristics for use in the application of the procedures of Chapter III

ANNEX 2

Characteristics of satellite networks, earth stations or radio astronomy stations[2] (Rev.WRC-12)

Items in Appendix	*A - GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK, EARTH STATION OR RADIO ASTRONOMY STATION*	*Advance publication of a geostationary-satellite network*	*Advance publication of a non-geostationary-satellite network subject to coordination under Section II*	*Advance publication of a non-geostationary-satellite network not subject to coordination under Section II*	*Notification or coordination of a geostationary-satellite network (including*	*Notification or coordination of a non-geostationary-satellite network*	*Notification or coordination of an earth station (including notification under Appendices 30A or 30B)*	*Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (Articles 4 and 5)*	*Notice for a satellite network (feeder-link) under Appendix 30A (Articles 4 and 5)*	*Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8)*	*Items in Appendix*	*Radio astronomy*
* * *	* * *										* * *	
A.18	**COMPLIANCE WITH NOTIFICATION OF AIRCRAFT EARTH STATION(S)**											
A.18.a	a commitment that the characteristics of the aircraft earth station (AES) in the aeronautical mobile-satellite service are within the characteristics of the specific and/or typical earth station published by the Bureau for the space station to which the AES is associated Required only for the band 14-14.5 GHz, when an aircraft earth station in the aeronautical mobile-satellite service communicates with a space station in the fixed-satellite service				+	+					A.18.a	
A.19	**COMPLIANCE WITH § 6.26 OF ARTICLE 6 OF APPENDIX 30B**										**A.19**	

Footnotes to Tables A, B, C and D

MOD

TABLE A

Table of characteristics to be submitted for space andradio astronomy services
(Rev.WRC -12)

A.19.a	a commitment that the use of the assignment shall not cause unacceptable interference to, nor claim protection from, those assignments for which agreement still needs to be obtained Required if the notice is submitted under § 6.25 of Article 6 of Appendix **30B**									+	A.19.a	
A.20	**COMPLIANCE WITH *Resolves* 1.1.2 of Resolution [AI 1.5/XXX] (WRC-19)**										**A.20**	
A.20.a	indicator (yes) if an assignment for the 27.5-29.5 GHz and/or 17.7-19.7 GHz band in the satellite network will be used by ESIM						**O**				A.20.a	
A.20.b	if yes under A.20.a, a commitment that the ESIM operation would be in conformity with the Radio Regulations and Resolution **[AI1.5/XXX] (WRC-19)** (including its annexes)						+				A.20.b	

Reasons: This Appendix **4** element is needed to implement *resolves* 1.1.2 of Draft New Resolution **[A1.5] (WRC-19).**

SUP USA/1.5/7

RESOLUTION 158 (WRC-15)

Use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion communicating with geostationary space stations in the fixed-satellite service

Reasons: Consequential.

_____

VIEW B

VIEW B:
View B addresses WRC-19 agenda item 1.5 with an emphasis on the appropriate protection of the mobile service in the 28 GHz band. View B is supported by AT&T, CTIA, Ericsson, Global Mobile Suppliers Association (GSA), GSMA, Intel Corporation, Sprint Corporation, T-Mobile, and Verizon.
View B is based upon several important principles.

3) The benefits of a tuning range approach. Similar to the position the above-signed took with WRC-19 agenda item 1.13 for IMT, this proposal recognizes the benefits of a tuning range approach for ESIMS (when 5G is the victim service). We continue to believe the United States should propose a tuning range approach and that both agenda items 1.13 and 1.5 should be treated in the same manner. If the US decides to not support a tuning range approach for agenda item 1.13 (e.g. 37-43.5 GHz), then we would request that a similar approach be taken with agenda item 1.5 (i.e. segment the band and only propose ESIM operation in the upper part of the 28 GHz band consistent with US rules).
4) Ensuring appropriate protection of the mobile services. ITU-R Working Party 5A (WP5A), the expert group on mobile broadband, liaised characteristics of mobile broadband systems to ITU-R Working Party 4A for sharing and compatibility studies under WRC-19 agenda item 1.5. In particular, the liaison covered two mobile broadband systems. Consistent with long-time ITU procedures, it is crucial to ensure the protection of both systems. Currently, under agenda item 1.5, protection is being considered for only one of the systems provided by the expert group: this would create a precedence in the ITU where a service disregard protection of specific systems of other services. Furthermore, even for the protection being considered in some cases for the first system, the pfd mask that is being proposed is not adequate and does not cover all pointing angles. The mask in View B is a composite mask which utilizes the formula provided by WP5A as well as the technical characteristics for both mobile broadband systems provided by WP5A.
5) Compliance with the pfd values for the protection of mobile and fixed services can be done at the national and bilateral level, and there is no need to address any specific details for calculating the pfd values in the current regulations. Any reference for compliance procedure in the WRC Resolution will be an inappropriate precedence setting, noting that there are many instances in the Radio Regulations where pfd values for the terrestrial services are specified without mention of any specific parameters related to compliance e.g. in RR 5.430A "This limit may be exceeded on the territory of any country whose administration has so agreed. In order to ensure that the pfd limit at the border of the territory of any other administration is met, the calculations and verification shall be made, taking into account all relevant information, with the mutual agreement of both administrations (the administration responsible for the terrestrial station and the administration responsible for the earth station) and with the assistance of the Bureau if so requested."

Based upon these principles, the above signed companies support View B with respect to WRC-19 agenda item 1.5.

ATTACHMENT TO VIEW B:
UNITED STATES OF AMERICA

DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

AGENDA ITEM 1.5: *to consider the use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion communicating with geostationary space stations in the fixed-satellite service and take appropriate action, in accordance with Resolution* ***158 (WRC-15)***

BACKGROUND INFORMATION:

There is a need for mobile communications, including global broadband satellite services. Some of this need can be met by allowing earth stations in motion to communicate with space stations of the FSS operating in the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space).

The ITU-R has been studying deployment of earth stations in motion (ESIM) communicating with GSO FSS space stations for many years. WRC-15 adopted regulatory provisions for the operation of ESIM communicating with GSO FSS space stations in the 29.5-30 GHz and 19.7-20.2 GHz bands under No. **5.527A** and Resolution **156 (WRC-15)**. Resolution 156 *resolves 1.3* states that "with respect to any terrestrial systems operating in the frequency band 29.5-29.9 GHz in Regions 1 and 3 in the countries listed in No. **5.542**, the notifying administrations operating maritime earth stations in motion operating in international waters and aeronautical earth stations in motion operating in international airspace shall ensure that such operations do not cause unacceptable interference."

WRC-19 agenda item 1.5 considers the use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion (ESIM) communicating with geostationary space stations in the fixed-satellite service (FSS). This agenda item has studied three types of ESIM: aeronautical, maritime and land, depending on which vehicle they are installed.

The ITU-R examined sharing conditions between ESIM and terrestrial services in the 27.5-29.5 GHz band and concluded that there would be potential interference to receiving stations of terrestrial services from ESIM transmitters. Therefore, aeronautical and maritime ESIM should operate under the specified technical, operational and regulatory conditions to avoid causing unacceptable interference to receiving stations of terrestrial services operating in accordance with the Radio Regulations.

This proposal provides a new footnote in Article 5 of the Radio Regulations for the operation of maritime and aeronautical earth stations in motion communicating with geostationary FSS space stations within the bands 17.7-19.7 GHz and 27.5-29.5 GHz, referencing a new WRC Resolution providing the conditions for the operation of ESIM and protection of the services to which the bands are allocated, and consequential suppression of Resolution **158 (WRC-15)**.
It should be noted that the conditions for the protection of the terrestrial services includes a composite pfd mask to protect both mobile systems provided by the ITU-R.

Proposals

ARTICLE 5

Frequency allocations

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

MOD USA/1.5/1

15.4-18.4 GHz

<table>
<tr><th colspan="3">Allocation to services</th></tr>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td rowspan="2">17.7-18.1
FIXED
FIXED-SATELLITE
(space-to-Earth) 5.484A
ADD5.A15
(Earth-to-space) 5.516
MOBILE</td><td>17.7-17.8
FIXED
FIXED-SATELLITE
(space-to-Earth) 5.517
ADD5.A15
(Earth-to-space) 5.516
BROADCASTING-SATELLITE
Mobile
5.515</td><td rowspan="2">17.7-18.1
FIXED
FIXED-SATELLITE
(space-to-Earth) 5.484A
ADD5.A15
(Earth-to-space) 5.516
MOBILE</td></tr>
<tr><td>17.8-18.1
FIXED
FIXED-SATELLITE
(space-to-Earth) 5.484A
ADD5.A15
(Earth-to-space) 5.516
MOBILE
5.519</td></tr>
<tr><td>18.1-18.4</td><td colspan="2">FIXED
FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B ADD5.A15
(Earth-to-space) 5.520
MOBILE
5.519 5.521</td></tr>
</table>

MOD USA/1.5/2

18.4-22 GHz

<table>
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<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td>18.4-18.6</td><td colspan="2">FIXED
FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B ADD5.A15
MOBILE</td></tr>
</table>

18.6-18.8 EARTH EXPLORATION-SATELLITE (passive) FIXED FIXED-SATELLITE (space-to-Earth) 5.522B ADD5.A15 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 ADD5.A15 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 ADD5.A15 MOBILE except aeronautical mobile Space research (passive) 5.522A
18.8-19.3	FIXED FIXED-SATELLITE (space-to-Earth) 5.516B 5.523A ADD5.A15 MOBILE	
19.3-19.7	FIXED FIXED-SATELLITE (space-to-Earth) (Earth-to-space) 5.523B 5.523C 5.523D 5.523E ADD5.A15 MOBILE	

MOD USA/1.5/3

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 ADD5.A15 MOBILE 5.538 5.540	
28.5-29.1	FIXED FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.523A 5.539 ADD5.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 5.535A 5.539 5.541A ADD5.A15 MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540	

ADD USA/1.5/4

5.A15 The operation of earth stations in motion communicating with geostationary FSS space stations in the bands 17.7-19.7 GHz and 27.5-29.5 GHz, or portions thereof, shall be subject to Resolution **[A15] (WRC-19)**.

Reasons: Permitting the operation of earth stations in motion within these frequency bands would provide the additional spectrum to support broadband communication for users globally.

ADD USA/1.5/5

DRAFT NEW RESOLUTION [A15] (WRC-19)

Use of the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz by earth stations in motion (ESIM) communicating with geostationary space stations in the fixed-satellite service[1]

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

considering

a) that there is a need for global broadband mobile-satellite communications, and that some of this need could be met by allowing ESIM to communicate with space stations of geostationary-satellite orbit (GSO) fixed-satellite service (FSS) operating within the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space);

b) that appropriate regulatory and interference management mechanisms are necessary for the operation of ESIM;

c) that the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz are also allocated to terrestrial and space services used by a variety of different systems and these existing services and their future development need to be protected from the operation of ESIM,

d) that ITU-R studies have shown that aeronautical ESIM are capable of operating without causing harmful interference interfering with non-GSO mobile-satellite service feeder link satellite receivers in the 29.1-29.5 GHz band,

recognizing

a) that the administration authorising ESIM on territory under its jurisdiction has the right to require that ESIM referred to above only use those assignments associated with GSO FSS networks which have been successfully coordinated, notified, brought into use and recorded in the MIFR with a favourable finding under Article **11**, including Nos. **11.31**, **11.32** or **11.32A**, where applicable;

b) that for cases of incomplete coordination under No. **9.7** of the GSO FSS network with assignments to be used by ESIM, the operation of ESIM on those assignments needs to be in accordance with the provisions of No. **11.42** with respect to any recorded frequency assignment which was the basis of the unfavourable finding under No. **11.38;**

c) that any course of action taken under this Resolution has no impact on the original date of receipt of the frequency assignments of the GSO FSS satellite network with which ESIM communicate or on the coordination requirements of that satellite network,

resolves

1 that for any ESIM communicating with a GSO FSS space station in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz, or portions thereof, the following conditions shall apply:

1.1 with respect to space services in the 17.7-19.7 GHz and 27.5-29.5 GHz bands, ESIM shall comply with the following conditions:

1.1.1 with respect to satellite networks or systems of other administrations, ESIM shall remain within the envelope of the satellite network with which these ESIM communicate;

1.1.2 for the implementation of *resolves* 1.1.1 above, the notifying administration of the GSO FSS network with which ESIM communicate shall send to the Bureau under this Resolution the relevant Appendix **4** information related to the characteristics of the ESIM intended to communicate with the space station of that GSO FSS network, including a commitment that the ESIM operation would be in conformity with the Radio Regulations and this Resolution (including its annexes, as applicable);

1.1.3 upon receipt of the information provided in accordance with *resolves* 1.1.2 above, the Bureau shall examine it in relation to the requirements referred to in *resolves* 1.1.1 based on the complete information submitted to the Bureau under No. **11.2,** and complying with No. **11.28,** for the satellite network of the GSO FSS space station with which the ESIM is intended to communicate;

1.1.4 If, following the examination referred to in *resolves* 1.1.3 above, the Bureau concludes that the ESIM characteristics are within the envelope of the satellite network, it shall publish the results in a Special Section annexed to the BR IFIC, and retain the original date of protection for the assignment being modified where the information is presented as a modification of an existing notice;

1.1.5 if, following the examination referred to in *resolves* 1.1.3 above, the Bureau concludes that the ESIM characteristics are not within the envelope of the satellite network, the information shall be returned to the notifying administration;

1.1.6 for the protection of non-GSO FSS systems operating in the band 27.5-28.6 GHz, ESIM communicating with GSO FSS networks shall comply with the provisions contained in Annex 1 to this Resolution;

1.1.7 ESIM shall not claim protection from non-GSO FSS systems operating in the frequency band 17.8-18.6 GHz in accordance with the Radio Regulations, including No. **22.5C**;

1.1.8 ESIM shall not claim protection from BSS feeder link earth stations operating in the frequency band 17.7-18.4 GHz in accordance with the Radio Regulations and shall not affect their future development;

1.2 with respect to terrestrial services in the 17.7-19.7 GHz and 27.5-29.5 GHz frequency bands ESIM shall comply with the following conditions:

1.2.1 the receiving ESIM in the 17.7-19.7 GHz frequency band shall not claim protection from any stations in the terrestrial services or any assignments to stations of terrestrial services in this band operating in accordance with the Radio Regulations and shall not affect the future development of these services;

1.2.2 the transmitting aeronautical and maritime ESIM in the 27.5-29.5 GHz frequency band shall not cause unacceptable interference to any stations in the terrestrial services in this band or any assignments to stations of terrestrial services operating in accordance with the Radio Regulations and shall not affect the future development of these services;

1.2.3 the transmitting land ESIM in the 27.5-29.5 GHz frequency band shall not cause unacceptable interference to nor claim protection from any stations in the terrestrial services or any assignments to stations of terrestrial services in this band operating in accordance with the Radio Regulations and shall not affect the future development of these services;

1.2.4 for the implementation of *resolves* 1.2.2 and 1.2.3 above, the notifying administration responsible for the GSO FSS satellite network with which ESIM communicate shall submit to the

Bureau together with the Appendix **4** data referred to in *resolves* 1.1.2 a commitment undertaking that in case of interference, upon receipt of a report of interference, take necessary action to immediately cease or reduce interference to an acceptable level;

2 that ESIM shall not be used or relied upon for safety-of-life applications;

3 that for the implementation of this Resolution, administrations may consider relevant parts of Annex 3 when considering to authorise ESIM as well as in their bi-lateral or multi-lateral negotiations;

4 that, in addition to *resolves* 3, administrations authorizing land ESIM shall ensure that land ESIM operating in their territory do not cause unacceptable interference to terrestrial services of other countries operating in accordance with the Radio Regulations

5 that the administration responsible for the GSO FSS satellite network with which the ESIM communicate shall ensure that:

5.1 ESIM employ techniques to track the associated GSO FSS satellite without inadvertently tracking adjacent GSO satellites;

5.2 the ESIM network operator puts in place all necessary measures so that its ESIM are subject to permanent monitoring and control by a Network Control and Monitoring Centre (NCMC) or equivalent facility and are capable of receiving and acting upon at least “enable transmission” and “disable transmission” commands from the NCMC or equivalent facility (see also Annex 3);

6 that the application of this Resolution does not provide regulatory status to ESIM different from that derived from the GSO FSS network with which they communicate taking into account the provisions referred to in this Resolution,

instructs the Secretary General

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

ANNEX 1 TO DRAFT NEW RESOLUTION [A15] (WRC-19)

Provisions for ESIM to protect non-GSO FSS systems in the frequency band 27.5-28.6 GHz

1 In order to protect those non-GSO FSS referred to in *resolves* 1.1.6 of this Resolution, ESIM shall comply with the following provisions:

a. The level of equivalent isotropically radiated power (e.i.r.p.) density emitted by an ESIM in a geostationary-satellite network in the 27.5-28.6 GHz frequency band shall not exceed the following values for any off-axis angle which is 3° or more off the main-lobe axis of an ESIM antenna and outside 3° of the GSO:

Off-axis angle	*Maximum e.i.r.p. density*

3□ □ □ □ 7□	28 – 25 log □dB(W/40 kHz)
7□ □ □ □ 9.2□	7 dB(W/40 kHz)
9.2□ □ □ □ 48□	31 – 25 log □dB(W/40 kHz)
48□ □ □ □ 180□	1 dB(W/40 kHz)

b. For any ESIM that does not meet Condition 1.a above, outside of 3 deg of the GSO, the maximum ESIM on-axis e.i.r.p. shall not exceed 55 dBW for emission bandwidths up to and including 100 MHz. For emission bandwidths larger than 100 MHz, the maximum ESIM on-axis e.i.r.p. may be increased proportionately.

ANNEX 2 TO DRAFT NEW RESOLUTION [A15] (WRC-19)

Part 1:

Provisions for maritime ESIM to protect terrestrial services operating in the frequency band 27.5-29.5 GHz

Part 2:

Provisions for aeronautical ESIM to protect terrestrial services operating in the frequency band 27.5-29.5 GHz

Part 1: Maritime ESIM

1 Maritime ESIM operating within the frequency band 27.5-29.5 Hz shall comply with items 1.1 and 1.2 below:

1.1 The minimum distance from the low-water mark as officially recognized by the coastal State beyond which maritime ESIM can operate without the prior agreement of any administration is 60 km within the 27.5-29.5 GHz frequency band. Any transmissions from maritime ESIM within the minimum distance shall be subject to the prior agreement of the concerned coastal State.

1.2 The maximum maritime ESIM e.i.r.p. spectral density towards the territory of any coastal State will be limited to 12.98 dBW in a reference bandwidth of 1 MHz. Transmissions from maritime ESIM with higher e.i.r.p. spectral density levels towards the territory of any coastal state shall be subject to the prior agreement of the concerned coastal State.

Part 2: Aeronautical ESIM

1 Aeronautical ESIM operating within the frequency band 27.5-29.5 GHz shall comply with the provisions of items 1.1 and 1.2 below:

1.1 When within line-of-sight of the territory of an administration, the maximum pfd produced (in a reference bandwidth of 1 MHz) at the surface of the Earth within the territory of that administration by emissions from aeronautical ESIM shall not exceed:

PFD(δ) = -122.6	(dBW/m^2/1 MHz)	for 0° ≤ δ ≤ 2°
PFD(δ) = -122.6 + 1.5 * (δ - 2)	(dBW/m^2/1 MHz)	for 2° < δ ≤ 13.6°
PFD(δ) = -105.2	(dBW/m^2/1 MHz)	for 13.6° < δ ≤ 90°

where δ is the angle of arrival of the radio-frequency wave (degrees above the horizon).

1.2 Higher pfd levels than provided in 1.1 above produced by aeronautical ESIM on surface of the Earth within the territory of an administration that is within line-of-sight of the aeronautical ESIM shall be subject to the prior agreement of that administration.

ANNEX 3 TO DRAFT NEW RESOLUTION [A15] (WRC-19)

Guidelines to assist administrations regarding the authorization and operation of ESIM in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz

The following guidelines are provided for all administrations involved in the authorization and operation of ESIM in the 27.5-29.5 GHz and 17.7-19.7 GHz frequency bands:

1. With regard to Land ESIM (L-ESIM), the administration authorizing L-ESIM has the right to require:

1.1 that L-ESIM operate within the territory under the jurisdiction of an administration only if authorised by that administration;

1.2 the operator of any ESIM network within which the L-ESIM operate to confirm that such L-ESIM have the capability to limit operations to the territory of administrations having authorized those L-ESIM;

1.3 The operator of the ESIM network within which the L-ESIM operate provide a point of contact for the purpose of tracing any suspected cases of interference from L-ESIM.

2. With regard to Maritime ESIM (M-ESIM), the administration authorizing M-ESIM has the right to require:

2.1 that M-ESIM operate within the territorial waters under the jurisdiction of an administration only if authorised by that administration.

2.2. the operator of any ESIM network within which the M-ESIM operate to confirm that such M-ESIM have the capability to limit operations to the territorial waters of administrations having authorized those M-ESIM.

2.3 The operator of the ESIM network within which the M-ESIM operate provide a point of contact for the purpose of tracing any suspected cases of interference from M-ESIM.

3. With regard to Aeronautical ESIM (A-ESIM), the administration authorizing A-ESIM has the right to require:

3.1 that A-ESIM operate within the territorial airspace under the jurisdiction of an administration only if authorized by that administration;

3.2 the operator of any ESIM network within which the A-ESIM operate to confirm that such A-ESIM have the capability to limit operations to the territorial airspace of administrations having authorized those A-ESIM.

3.3 The operator of the ESIM network within which the A-ESIM operate provide a point of contact for the purpose of tracing any suspected cases of interference from A-ESIM.

Reasons: This Resolution provides the conditions to protect services allocated on a primary basis while permitting the operation of earth stations in motion within these frequency bands.

SUP USA/1.5/6

RESOLUTION 158 (WRC-15)

Use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion communicating with geostationary space stations in the fixed-satellite service

Reasons: Consequential suppression as the work related to Resolution 158 is completed.

_____

VIEW C

View C:
Supporters of View C maintain it is premature for the WAC to approve Document IWG-3/051 ("Doc. 051") because ITU-R studies are incomplete and because the Doc. 051 proposes frequencies for ESIM use that is inconsistent with the United States and European frequency plans. Therefore, the WAC should not recommend Doc. 051 to the FCC to use as the basis for a draft United States proposal to the upcoming meeting of CITEL PCC.II (3-6 December 2018, Brasilia, Brazil).

However, if the FCC decides to move forward anyway, it should use Document IWG-3/057 ("Doc. 057") as the basis for reconciling a proposal on AI 1.5 with the National Telecommunications and Information Administration and the Department of State. Doc. 057 provides for sufficient additional spectrum for ESIM use while protecting frequencies used by the View C proponent.

Introduction

The View C proposal addresses two deficiencies in Doc. 051:

- Incomplete compatibility studies concerning ESIM compatibility with non-Geostationary Mobile-satellite service feeder links ("NGSO MSS feeder links); and
- Inconsistency with United States frequency allocations and Europe's European Economic Community ("ECC") Decision 13(01) that specifies frequencies available for ESIM use.[22]

Discussion

Incomplete Compatibility Studies. In proposed Draft New Resolution **[A15] WRC-19**, c*onsidering c)*, View A Doc. 051 states:

"*d)* that ITU-R studies have shown that aeronautical ESIM are capable of operating without causing harmful interference interfering with non-GSO mobile-satellite service feeder link satellite receivers in the 29.1-29.5 GHz band,"

The statement above is untrue.

Among other things, Resolution **158 (WRC-15)**[23] resolves to invite the ITU-R to:

> "to study the technical and operational characteristics and user requirements of different types of earth stations in motion that operate or plan to operate within geostationary FSS allocations in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz, including the use of spectrum to provide the envisioned services to various types of earth station in motion and the degree to which flexible access to spectrum can facilitate sharing with services identified in *recognizing further a) to n)*;"

Recognizing further "*g)*" and "*h)* call for studies to facilitate sharing with NGSO MSS feeder links in the bands 19.3-19.7 GHz and 29.1-29.5 GHz respectively.

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[22] ECC Decision (ECC/DEC/(13)01) on the harmonized use, free circulation and exemption from individual licensing of Earth Stations on Mobile Platforms (ESOMPs) within the frequency bands 17.3-20.2 GHz and 27.5-30.0 GHz (approved March 8, 2013).

[23] ITU-R Resolution 158 (WRC-15), Use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion communicating with geostationary space stations in the fixed-satellite service.

Resolution 158 also invites the 2019 World Radiocommunication Conference "to consider the results of the above studies and take necessary actions, as appropriate, provided that the results of the studies referred to in resolves to invite ITU-R *are complete and agreed by ITU-R study groups*." (*emphasis added*).

The studies regarding NGSO MSS feeder links are in process in ITU-R WP 4A ("WP 4A"), but are not complete. Currently, in WP 4A there exists Document 4A/826, Annex 15 ("Annex 15"),[24] with the following editor's note:

> "*[Editor's note: This document is a compilation of contributions received on this subject at the July 2018 meeting of WP 4A and its content is not agreed at this time]*."

The editor's note is there because Annex 15 consists of a simple compilation of input contributions, with no analysis by WP 4A.

As part of the Annex 15 compilation there are example NGSO MSS protection analyses that have not been analyzed formally within WP 4A, nor agreed. Indeed, within USWP4A, the Department of State's preparatory process for WP 4A, there remains an open debate (therefore, the U.S. position remains open and inconclusive on ESIM-NGSO MSS feeder link compatibility) on methodologies and parameters to use to determine whether ESIM are compatible with and can share spectrum use. Until studies are agreed among ESIM proponents and NGSO MSS feeder link users and agreed by ITU-R study groups as Resolution 158 dictates, the FCC should not advocate for a United States proposal on this matter.

Inconsistency with the United States and European Frequency Plans. The United States should not propose for others what it cannot use itself. That is, the United State should not support any Agenda Item 1.5 proposal that is contrary to the U.S. band plan embodied in the U.S. Table of Frequency Allocations (47 CFR 2.106). As described below, Doc. 051 fails in this respect by proposing for ESIM frequencies that are not available in the United States. It fails in Europe as well, by proposing frequencies Europe took off of the table back in 2013.

The View C proposal is consistent with the FCC's United States non-federal Ka-band plan ("U.S. band plan"). The frequency bands identified by Resolution 158 for compatibility studies include the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space). However, the U.S. band plan does not authorize GSO FSS satellite transmission in the 19.4-19.6 GHz band, nor does it authorize GSO FSS satellite reception in the 29.1-29.25 GHz band, as mandated by footnote NG166 in the U.S. Table of Frequency Allocations. Furthermore, the FCC's NPRM and Draft Order on ESIMs does not propose the use of the 19.4-19.6 GHz and 29.1-29.25 GHz bands for ESIMs. Consequently, ESIM communicating with GSO FSS satellite systems cannot operate in these bands.[25]

Europe's plan for ESIM frequency use is in ECC Decision (13)01, approved March 09, 2013. Decides 2 Of ECC Decision (13)01 provides that CEPT administrations shall:

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[24] *See* ITU-R WP4A, *Earth stations in motion (ESIM) compatibility with non-GSO MSS feeder links in the bands 19.3-19.7 GHz and 29.1-29.5 GHz*, Document 4A/486, Annex 15 (July 23, 2018).

[25] *See Amendment of Parts 2 and 25 of the Commission's Rules to Facilitate the Use of Earth Stations in Motion Communicating with Geostationary Orbit Space Stations in Frequency Bands Allocated to the Fixed Satellite Service*, Draft Report and Order and Further Notice of Proposed Rulemaking, FCC-CIRC1809-08, IB Docket No. 17-95 (circulated Sept. 5, 2018).

"b. Designate the frequency bands 17.3-19.7 GHz (space-to-Earth), 27.5-27.8285 GHz (Earth-to-space), 28.4445-28.8365 GHz (Earth-to-space), and 29.4525-29.5 GHz (Earth-to-space) for the operation of ESOMPs;"

Thus, for the bands considered under Agenda Item 1.5, in Europe in the Earth-to-space direction only the 29.4525 -29.5 GHz band is available. Consequently, taking account of the U.S. Table of Frequency Allocations restrictions, and the ESIM band availability specified in ECC Decision 13(01), the spectrum common to the U.S. and Europe that may be available for ESIM is as follows:

- 17.7-19.4 GHz and 19.6-19.7 GHz (space-to-Earth); and,
- 27.5-29.1 GHz and 29.4525-29.5 GHz (Earth-to-Space).

The View A proposal in Doc. 051 is inconsistent with the above restrictions and exclusions.

The View C Proposal Provides Sufficient Spectrum for ESIM Use. The 17.7-19.4 GHz and 19.6-19.7 GHz (space-to-Earth) and 27.5-29.1 GHz and 29.4525-29.5 GHz (Earth-to-Space) bands form the basis of the View C proposal as the spectrum that should be common in all three Regions. Though this proposal does not protect the entirety of the 19.3-19.7 GHz and 29.1-29.5 GHz bands, as the View C proponent desires to ensure continued favorable conditions for current use and future deployment of NGSO MSS feeder links, at least, in the absence of conclusive studies, protects spectrum the View C proponent uses today.

The View C proposal provides for spectrum which should be more than sufficient for ESIM use. Combined with WRC-15's identification of the 29.5-30 GHz and 19.7-20.2 GHz bands under No. 5.527A, the View C proposal, if adopted by WRC-19, results in 2.1475 GHz of spectrum in the Earth-to-space direction, and 2.7 GHz of spectrum in the space-to-Earth direction available for ESIM use.

Summary:

Doc. 051 fails to recognize that ITU-R studies concerning ESIM compatibility with NGSO MSS feeder links are incomplete. Thus Resolution 158 (WRC-15) is not satisfied. It also proposes to WRC-19 to identify frequency bands for ESIM use that is inconsistent with the Federal Communication Commission's United States Non-Federal Ka-band frequency allocations codified in 47 CFR 2.106, and inconsistent with the availability of frequencies for ESIM in Europe, captured in ECC Decision 13 (01). Consequently, with these issues outstanding, the View C proponent believes the proposal in Doc. 051 is premature.

For these reasons, at this time the FCC should not move forward with any Agenda Item 1.5 draft proposal. If the FCC decides otherwise, it should use Document IWG-3/057 – which considers the View C proponent's spectrum use, while providing sufficient additional spectrum for ESIM use – as the basis for reconciling a proposal on AI 1.5 with the National Telecommunications and Information Administration and the Department of State.

Attachment to View C:

UNITED STATES OF AMERICA

DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

Agenda Item 1.5: *to consider the use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion communicating with geostationary space stations in the fixed-satellite service and take appropriate action, in accordance with Resolution **158 (WRC-15)***

BACKGROUND INFORMATION:

Advances in satellite manufacturing and directional earth station technology, particularly the development of multi-axis stabilized earth station antennas capable of maintaining a high degree of pointing accuracy from stationary or on rapidly moving platforms to GSO FSS space stations. Satellite network operators are designing, coordinating, and bringing into use GSO FSS networks that can offer both stationary and moving broadband services using a single stabilized directional antenna within existing GSO FSS technical parameters.

The ITU-R has been studying deployment of earth stations in motion (ESIM) communicating with GSO FSS space stations for a number of years. WRC-15 adopted provisions for operating ESIM communicating with GSO FSS space stations in the 29.5-30 GHz and 19.7-20.2 GHz bands under No. **5.527A** and Resolution **156 (WRC-15)**, and prior Conferences adopted provisions for operation of Earth Stations on Vessels (ESVs) on maritime vessels communicating with GSO FSS space stations portions of the C- and Ku-bands.

WRC-19 Agenda Item 1.5 provides for consideration of the 27.5-29.5 GHz and 17.7-19.7 GHz bands for ESIM. The 17.7-19.4 GHz and 19.6-19.7 GHz bands are considered separately from the 29.5-30 GHz and 19.7-20.2 GHz bands considered at WRC-15 due to the fact that the allocations, use, interference mechanisms, and required protection of incumbent services are significantly different in the 27.5-29.5 GHz and 17.7-19.7 GHz bands proposed for analysis by WRC-19.[26] Further, in some administrations and regions, portions of the 27.5-29.5 GHz band are either not available for high-density FSS applications, or ESIM are expressly prohibited in certain bands.[27]

The sharing cases requiring study in the 27.5-29.5 GHz and 17.7-19.4 GHz and 19.6-19.7 GHz bands are set out in Resolution **158 (WRC-15)** for the broadcasting-satellite service, the fixed-satellite service (geostationary and non-geostationary), the fixed-satellite service limited to feeder links for non-geostationary satellite systems in the mobile-satellite service, feeder links for the broadcasting satellite service, the mobile service, the fixed service, and the earth exploration-satellite service.

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[26] For example, MSS allocations in the 29.5-30 GHz and 19.7-20.2 GHz bands have been available for use for many years. Effectively, ESIM are MSS, and in the 29.5-30 GHz and 19.7-20.2 GHz bands could have deployed as FSS delivered MSS without any WRC action.

[27] ITU Radio Regulations, No. 5.516B (2016 ed.); 47 CFR 2.106, NG166; ECC Decision (ECC/DEC/(13)01) on the harmonized use, free circulation and exemption from individual licensing of Earth Stations on Mobile Platforms (ESOMPs) within the frequency bands 17.3-20.2 GHz and 27.5-30.0 GHz (approved March 8, 2013).

ITU-R studies leading to the conditions necessary for such protection have been identified or are nearing conclusion.

The proposal below will augment the 500 MHz + 500 MHz identified for ESIM at WRC-15, by providing additional spectrum, to support ESIM deployments. As well, specific protection mechanisms for non-geostationary mobile-satellite service feeder links are proposed in a Resolution to be incorporated by reference into the Radio Regulations.

Proposals

ARTICLE 5

Frequency allocations

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

MOD USA/1.5/1

15.4-18.4 GHz

<table>
<tr><th colspan="3">Allocation to services</th></tr>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td rowspan="2">17.7-18.1
FIXED
FIXED-SATELLITE
(space-to-Earth) 5.484A
ADD5.A15
(Earth-to-space) 5.516
MOBILE</td><td>17.7-17.8
FIXED
FIXED-SATELLITE
(space-to-Earth) 5.517
ADD5.A15
(Earth-to-space) 5.516
BROADCASTING-SATELLITE
Mobile
5.515</td><td rowspan="2">17.7-18.1
FIXED
FIXED-SATELLITE
(space-to-Earth) 5.484A
ADD5.A15
(Earth-to-space) 5.516
MOBILE</td></tr>
<tr><td>17.8-18.1
FIXED
FIXED-SATELLITE
(space-to-Earth) 5.484A
ADD5.A15
(Earth-to-space) 5.516
MOBILE
5.519</td></tr>
<tr><td>18.1-18.4</td><td colspan="2">FIXED
FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B
ADD5.A15
(Earth-to-space) 5.520
MOBILE
5.519 5.521</td></tr>
</table>

MOD USA/1.5/2

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	
18.6-18.8 EARTH EXPLORATION-SATELLITE (passive) FIXED FIXED-SATELLITE (space-to-Earth) 5.522B ADD5.A15 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 ADD5.A15 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 ADD5.A15 MOBILE except aeronautical mobile Space research (passive) 5.522A
18.8-19.3	FIXED FIXED-SATELLITE (space-to-Earth) 5.516B 5.523A ADD5.A15 MOBILE	
19.3-19.7	FIXED FIXED-SATELLITE (space-to-Earth) (Earth-to-space) 5.523B 5.523C 5.523D 5.523E ADD5.A15 MOBILE	

MOD USA/1.5/3

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 ADD5.A15 MOBILE 5.538 5.540	

28.5-29.1	FIXED FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.523A 5.539 ADD5.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 5.535A 5.539 5.541A ADD5.A15 MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540

ADD USA/1.5/4

5.A15 The operation of earth stations in motion communicating with geostationary FSS space stations in the bands 17.7-19.4 GHz and 19.6-19.7 GHz (space-to-Earth) and 27.5-29.1 GHz and 29.4525-29.5 GHz (Earth-to-Space) [shall be in accordance with shall/be subject to] Resolution **[A15] (WRC-19)**.

Reasons: Adoption of these proposals would provide the availability of additional spectrum in the above-referenced bands in both the FSS uplink and downlink directions to support ESIM deployment. The bands proposed above differ from the Resolution **158 (WRC-15)** bands referenced for study because ESIM are either expressly excluded from operation in a Region, or portions of the Resolution **158 (WRC-15)** reference spectrum is not available in an administration. Spectrum not encumbered as described above and also harmonized across all three Regions is proposed in USA/1.5/4.

ADD USA/1.5/5

DRAFT NEW RESOLUTION [A15] (WRC-19)

Use of the frequency bands 17.7-19.4 GHz and 19.6-19.7 GHz and 27.5-29.1 GHz and 29.4525-29.5 GHz by earth stations in motion (ESIM) communicating with geostationary space stations in the fixed-satellite service[1]

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

considering

a) that there is a need for global broadband mobile-satellite communications, and that some of this need could be met by allowing ESIM to communicate with space stations of geostationary-satellite orbit (GSO) fixed-satellite service (FSS) operating in the frequency bands 17.7-19.4 GHz and 19.6-19.7 GHz (space-to-Earth) and 27.5-29.1 GHz and 29.4525-29.5 GHz (Earth-to-space);

b) that appropriate regulatory and interference management mechanisms are necessary for the operation of ESIM;

c) that the frequency bands 17.7-19.4 GHz and 19.6-19.7 GHz (space-to-Earth) and 27.5-29.1 GHz and 29.4525-29.5 GHz (Earth-to-space) are also allocated to terrestrial and space services used by a variety of different systems and these existing services and their future development need to be protected from the operation of ESIM,

recognizing

a) that the administration authorising ESIM on territory under its jurisdiction has the right to require that ESIM referred to above only use those assignments associated with GSO FSS networks which have been successfully coordinated, notified, brought into use and recorded in the MIFR with a favourable finding under Article **11**, including Nos. **11.31**, **11.32** or **11.32A**, where applicable;

b) that for cases of incomplete coordination under No. **9.7** of the GSO FSS network with assignments to be used by ESIM, the operation of ESIM on those assignments needs to be in accordance with the provisions of No. **11.42** with respect to any recorded frequency assignment which was the basis of the unfavourable finding under No. **11.38;**

c) that any course of action taken under this Resolution has no impact on the original date of receipt of the frequency assignments of the GSO FSS satellite network with which ESIM communicate or on the coordination requirements of that satellite network,

further recognizing

a) that non-GSO MSS feeder link systems using the frequency band 19.3-19.7 GHz (space-to-Earth) are not subject to the provisions of RR No. **22.2**.;

b) that the use of this frequency band for other non-geostationary fixed-satellite service systems, or for the cases indicated in RR Nos. **5.523C** and **5.523E**, is not subject to the provisions of No. **9.11A**, but is subject to Articles **9** (except No. **9.11A**) and **11** procedures, and to the provisions of No. **22.2** (No. **5.523D);**

c) that ECC Decision 13 (01)] prohibits ESIM use of – among other bands – the band 29.1-29.4525; (*see, ECC Decision (ECC/DEC/(13)01) on the harmonized use, free circulation and exemption from individual licensing of Earth Stations on Mobile Platforms (ESOMPs) within the frequency bands 17.3-20.2 GHz and 27.5-30.0 GHz (approved March 8, 2013))*;

d) that in the United States, the use of the bands 19.4-19.6 GHz and 29.1-29.25 GHz by the fixed-satellite service is limited to feeder links for non-geostationary-satellite systems in the mobile-satellite service; (*see, 47 CFR 2.106, NG166)*;

e) that the band 29.1-29.25 GHz is not available for use by high density fixed-satellite service applications; (*see, ITU Radio Regulations, No. 5.516B* (2016 ed.));

resolves

1 that for any ESIM communicating with a GSO FSS space station in the frequency bands 17.7-19.4 GHz and 19.6-19.7 GHz and 27.5-29.1 GHz and 29.4525-29.5 GHz, or portions thereof, the following conditions shall apply:

1.1 with respect to space services in the 17.7-19.4 GHz and 19.6-19.7 GHz and 27.5-29.1 GHz and 29.4525-29.5 GHz bands, ESIM shall comply with the following conditions:

1.1.1 with respect to satellite networks or systems of other administrations, ESIM shall remain within the envelope of the satellite network with which these ESIM communicate;

1.1.2 for the implementation of *resolves* 1.1.1 above, the notifying administration of the GSO FSS network with which ESIM communicate shall send to the Bureau under this Resolution the relevant Appendix 4 information related to the characteristics of the ESIM intended to communicate with the space station of that GSO FSS network, including a commitment that the ESIM operation would be in conformity with the Radio Regulations and this Resolution (including its annexes, as applicable);

1.1.3 upon receipt of the information provided in accordance with *resolves* 1.1.2 above, the Bureau shall examine it in relation to the requirements referred to in *resolves* 1.1.1 based on the complete information submitted to the Bureau under No. **11.2,** and complying with No. **11.28,** for the satellite network of the GSO FSS space station with which the ESIM is intended to communicate;]

1.1.4 If, following the examination referred to in *resolves* 1.1.3 above, the Bureau concludes that the ESIM characteristics are within the envelope of the satellite network, it shall publish the results in a Special Section annexed to the BR IFIC, and retain the original date of protection for the assignment being modified where the information is presented as a modification of an existing notice;]

1.1.5 if, following the examination referred to in *resolves* 1.1.3 above, the Bureau concludes that the ESIM characteristics are not within the envelope of the satellite network, the information shall be returned to the notifying administration;

1.1.6 for the protection of non-GSO FSS systems operating in the band 27.5-28.6/29.1 GHz, ESIM communicating with GSO FSS networks shall comply with the provisions contained in Annex 1 to this Resolution;

1.1.7 for the protection of non-GSO MSS feeder links operating in the band 29.4525-29.5 GHz, ESIM communicating with GSO FSS networks shall comply with the provisions of Annex 1B to this Resolution;

1.1.8 ESIM shall not claim protection from non-GSO MSS feeder link earth stations operating in the frequency bands 17.7-19.4 GHz and 19.6-19.7 GHz (space-to-Earth), and 29.4525-29.5 GHz (Earth-to-Space) in accordance with the Radio Regulations and shall not affect their future development;

[Note: renumber below]

1.1.7 ESIM shall not claim protection from non-GSO FSS systems operating in the frequency band 17.8-18.6 GHz in accordance with the Radio Regulations, including No. **22.5C**;

1.1.8 ESIM shall not claim protection from BSS feeder link earth stations operating in the frequency band 17.7-18.4 GHz in accordance with the Radio Regulations and shall not affect their future development;

1.2 with respect to terrestrial services in the 17.7-19.4 GHz and 19.6-19.7 GHz and 27.5-29.1 GHz and 29.4525-29.5 GHz frequency bands ESIM shall comply with the following conditions:

1.2.1 the receiving ESIM in the 17.7-19.4 GHz and 19.6-19.7 frequency band shall not claim protection from any stations in the terrestrial services in this band operating in accordance with the Radio Regulations and shall not affect the future development of these services;

1.2.2 the transmitting aeronautical and maritime ESIM in the 27.5-29.1 GHz and 29.4525-29.5 GHz frequency band shall not cause unacceptable interference to any stations in the terrestrial services in this band operating in accordance with the Radio Regulations and shall not affect the future development of these services, and Annex 2 applies;

1.2.3 the transmitting land ESIM in the 27.5-29.1 GHz and 29.4525-29.5 GHz frequency band shall not cause interference to any stations in the terrestrial services in this band operating in accordance with the Radio Regulations and shall not affect the future development of these services, and Annex 3 applies;

1.2.4 for the implementation of *resolves* 1.2.2 and 1.2.3 above, the notifying administration responsible for the GSO FSS satellite network with which ESIM communicate shall, in making the commitment referred to in *resolves* 1.1.2 above, be deemed to have committed that it shall, upon receipt of a report of unacceptable interference (in the case of aeronautical or maritime ESIM) or interference (in the case of land ESIM), take necessary action to immediately cease or reduce interference to an acceptable level;

1.2.5 any transmitting aeronautical or maritime ESIM that conforms to the requirements in Annex 2 to this Resolution shall be deemed to have met its obligation to terrestrial stations under *resolves* 1.2.2 above;

2 that ESIM shall not be used or relied upon for safety-of-life applications;

3 that for the implementation of this Resolution, administrations may consider relevant parts of Annex 3 when considering to authorise ESIM as well as in their bi-lateral or multi-lateral negotiations;

4 that, in addition to *resolves* 3, administrations authorizing land ESIM shall ensure that land ESIM operating in their territory do not cause unacceptable interference to terrestrial services of other countries operating in accordance with the Radio Regulations

5 that the administration responsible for the GSO FSS satellite network with which the ESIM communicate shall ensure that:

5.1 ESIM employ techniques to track the associated GSO FSS satellite without inadvertently tracking adjacent GSO satellites;

5.2 the ESIM network operator puts in place all necessary measures so that its ESIM are subject to permanent monitoring and control by a Network Control and Monitoring Centre (NCMC) or equivalent facility and are capable of receiving and acting upon at least “enable transmission” and “disable transmission” commands from the NCMC or equivalent facility (see also Annex 3);

6 that the application of this Resolution does not provide regulatory status to ESIM different from that derived from the GSO FSS network with which they communicate taking into account the provisions referred to in this Resolution,

instructs the Director of the Radiocommunication Bureau

1 to take any necessary actions for the implementation of this Resolution;

2 to take any necessary actions to assist in resolving any potential and actual interference issues;

3 to report to WRC-23 any difficulties or inconsistencies encountered in the implementation of this Resolution;

invites administrations

to collaborate, to the maximum extent practicable, for the implementation of this Resolution, in particular for resolving any potential interference.

ANNEX 1A TO DRAFT NEW RESOLUTION [A15] (WRC-19)

Provisions for ESIM to protect non-GSO FSS systems in the frequency band 27.5-28.6 GHz

1 In order to protect those non-GSO FSS referred to in *resolves* 1.1.6 of this Resolution, ESIM shall comply with the following provisions:

a. The level of equivalent isotropically radiated power (e.i.r.p.) density emitted by an ESIM in a geostationary-satellite network in the 27.5-28.6 GHz frequency band shall not exceed the following values for any off-axis angle □ which is 3° or more off the main-lobe axis of an ESIM antenna and outside 3° of the GSO:

Off-axis angle	*Maximum e.i.r.p. density*
3□ □ □ □ 7□	28 – 25 log □dB(W/40 kHz)
7□ □ □ □ 9.2□	7 dB(W/40 kHz)
9.2□ □ □ □ 48□	31 – 25 log □dB(W/40 kHz)
48□ □ □ □ 180□	1 dB(W/40 kHz)

b. For any ESIM that does not meet Condition 1.a above, outside of 3 deg of the GSO, the maximum ESIM on-axis e.i.r.p. shall not exceed 55 dBW for emission bandwidths up to and including 100 MHz. For emission bandwidths larger than 100 MHz, the maximum ESIM on-axis e.i.r.p. may be increased proportionately.

ANNEX 1B TO DRAFT NEW RESOLUTION [A15] (WRC-19)

Provisions for ESIM to protect non-GSO MSS feeder link systems in the frequency band 29.4525-29.5GHz

1 In order to protect non-GSO MSS feeder link systems referred to in *resolves* 1.1.7 of this Resolution, ESIM shall comply with the following provisions:

a. The level of equivalent isotropically radiated power (e.i.r.p.) density emitted by an ESIM in a geostationary-satellite network in the 29.1-29.5 GHz frequency band shall not exceed the following values for any off-axis angle □ off the main-lobe axis of an ESIM antenna:

Off-axis angle	*Maximum e.i.r.p. density*
0□ □.□.□□.□	28.5 dB(W/40kHz)
0.04□ < □.□□□.□	28.5 – 25 log (30□dB(W/40kHz)
0.3□.□ □ □.0.5□	-3.5 dB(W/40kHz)
□□.□ □ □ 1□	20.5 - 25 log (30□dB(W/40kHz)
1□.□ □ □.3.9□	-17.5dB(W/40 kHz)
3.9□.□ □ □ 6.5□	1□□.□ 25 log □ dB(W/40 kHz)
6.5□ < □.□.1□	□.1□dB(W/40 kHz)
10□ □.□.□□□□	□.□□log □dB(W/40 kHz)
□.□□□□	□□□dB(W/40 kHz)

b. For any ESIM that does not meet the conditions 1.a. above, it shall not transmit within 2,179 km of any current or future non-GSO MSS feeder link earth station with parameters as described in Attachment 1 to this Annex.

ATTACHMENT 1 TO ANNEX 1B

Analysis for ESIM exclusion zones to protect non-GSO MSS feeder link systems

Agenda Item 1.5 compatibility studies between ESIMs and feeder links for the non-GSO MSS have not been finalized and need further study due to the complexity of the dynamic interference environment and disagreement on parameters used for the studies to determine the full potential for interference. Reference to these ongoing studies can be found in Annex 15 to Document 4A/826 (Working Document Towards a Preliminary Draft New Report ITU-R S.[ESIM]). Table 1 below provides a static analysis that demonstrates the potential interference that an ESIM can cause to a representative non-GSO MSS feeder link system.

Table 1: Static ESIM interference analysis

ESIM static interference analysis to HIBLEO-2FL feeder link satellite receiver		
Parameter	**Value**	**Units**
ESIM maximum p.s.d.	-56.5	dBW/Hz
ESIM antenna gain	43.4	dBi
HIBLEO-2FL satellite altitude	780	km
Carrier frequency	29.3	GHz
Free space path loss	179.6	dB
HIBLEO-2FL satellite receiver G/T	2.5	dB/K
Boltzmann constant	-228.6	dBW/(K·Hz)
ESIM I/N into HIBLEO-2FL satellite receiver	**38.4**	**dB**

ESIM parameters have been duplicated from the ongoing described in the Working Document referenced above. ESIM uplink transmissions have the potential to generate interference levels that exceed non-GSO MSS feeder link satellite receiver noise floor by over 38 dB. Thus, 38.4 dB of antenna discrimination is required just to reduce the amount of interference to the level of the satellite receiver noise floor. This antenna discrimination could be applied to the ESIM antenna (if not pointing directly at the non-GSO MSS satellite) and/or the non-GSO MSS satellite antenna. A simplified example of this is shown in Figure 1.

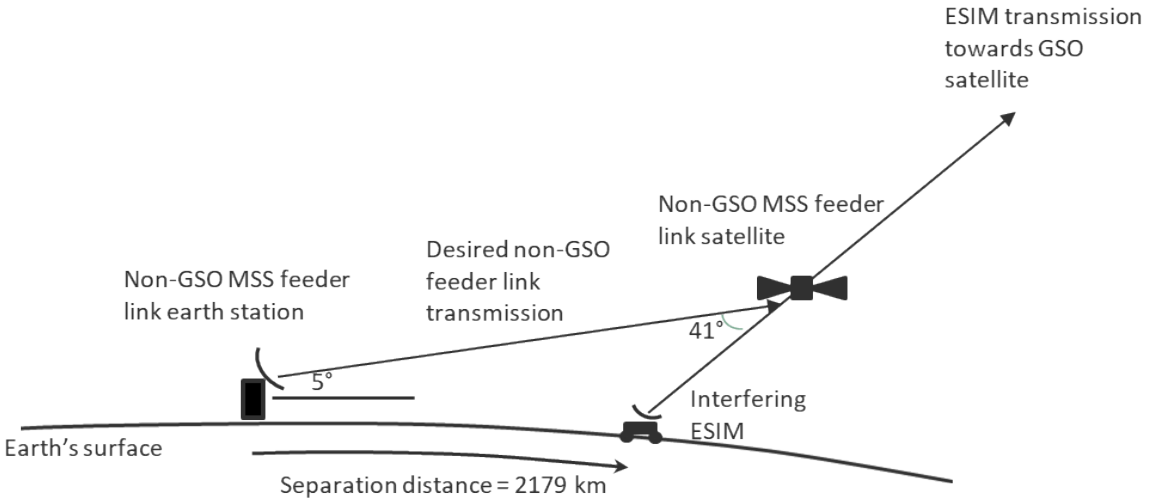

Figure 1: ESIM interference to non-GSO satellite feeder link geometry

Since there can always be a scenario in which the non-GSO MSS satellite moves through the main beam of an ESIM transmission, the antenna discrimination applied to the ESIM antenna for this case is 0 dBi, leaving all of the 38.4 dB of discrimination to be applied to the non-GSO MSS satellite receive antenna. Again referencing the above Working Document study, the HIBLEO-2FL

satellite receive antenna pattern is modeled using Recommendation ITU-R S.465-5, which assumes an off-axis gain described by the following equation:

$$G = 32 - 25 \log \varphi \text{ dBi, for } \varphi_{min} \leq \varphi < 48°.$$

For the peak satellite antenna gain of 30.1 dBi, an antenna discrimination of 38.4 dBi results in an absolute off-axis antenna gain, *G*, of -8.3 dBi. From the equation above, to meet this value of *G*, the off-axis angle, φ, is found to be equal to 41 degrees. As shown in Figure 1, for the HIBLEO-2FL satellite at its minimum elevation angle of 5 degrees, and for an ESIM near the Earth's surface, the ESIM would need to be 2179 km from the HIBLEO-2FL feeder link earth station and be at the 41 degree off-axis angle from the perspective of the HIBLEO-2FL satellite antenna. For the ESIM parameters assumed above, this is the maximum distance at which an ESIM could be from the HIBLEO-2FL feeder link earth station and produce an interference level equal to the satellite receiver noise floor (I/N = 0 dB). The particular geometry for this scenario could exist at high latitude regions in which both the HIBLEO-2FL feeder link is at its minimum elevation angle and in alignment with the ESIM link to a geostationary satellite low on the horizon.

This static analysis does not consider likelihood of interference events or percentage of time that interference levels thresholds are exceeded. Factors that would impact this result include specific locations of the non-GSO MSS feeder link earth station, ESIM and GSO satellite, the number of ESIMs transmitting near the feeder link earth station, the transmission parameters of these ESIMs including the duty cycles at which they transmit, and the specific non-GSO MSS feeder link protection criteria. However, since these factors are still being considered and debated within ITU-R Working Party 4A, a static analysis as provided above is needed to bound the ESIM interference problem. As a comparison, it's worth noting that the referenced Working Document includes a simulated analysis, for a different geographic location and for a protection criterion I/N value slightly different than the I/N = 0 dB case considered here. That analysis yields a worst-case separation distance of 1455 km.

The static analysis provided here indicates that harmful interference from ESIMs to non-GSO MSS feeder link communications could occur even at separation distances greater than 2,000 km. Simulated results based on non-GSO MSS feeder link geographic locations and ESIM-supported GSO networks could produce different separation distances, but no resolution of those simulation parameters has been agreed at this time.

ANNEX 2 TO DRAFT NEW RESOLUTION [A15] (WRC-19)

Part 1:

Provisions for maritime ESIM to protect terrestrial services operating in the frequency band 27.5-29.1 GHz and 29.4525-29.5 GHz for the implementation of resolves 1.2.2

Part 2:

Provisions for aeronautical ESIM to protect terrestrial services operating in the frequency band 27.5-29.1 GHz and 29.4525-29.5 GHz for the implementation of resolves 1.2.2

Part 1: Maritime ESIM

1 Maritime ESIM shall comply with items 1.1 and 1.2 below:

1.1 The minimum distance from the low-water mark as officially recognized by the coastal State beyond which maritime ESIM can operate without the prior agreement of any administration is 60 km in the 27.5-29.1 GHz and 29.4525-29.5 GHz frequency band. Any transmissions from maritime ESIM within the minimum distance shall be subject to the prior agreement of the concerned coastal State.

1.2 The maximum maritime ESIM e.i.r.p. spectral density towards the territory of any coastal State will be limited to 24.44 dBW in reference bandwidth of 14 MHz. Transmissions from maritime ESIM with higher e.i.r.p. spectral density levels towards the territory of any coastal state shall be subject to the prior agreement of the concerned coastal State.

Part 2: Aeronautical ESIM

1 Aeronautical ESIM communicating with GSO FSS networks shall comply with the provisions of items 1.1 and 1.2 below:

1.1 When within line-of-sight of the territory of an administration, the maximum pfd produced (in a reference bandwidth of 14 MHz) at the surface of the Earth within the territory of that administration by emissions from a single aeronautical ESIM shall not exceed:

$PFD(\delta)=-124.7$	$(dBW/m^2/14\ MHz)$	for	$0°\leq\delta\leq0.01°$
$PFD(\delta)=-120.9+1.9\cdot\log10(\delta)$	$(dBW/m^2/14\ MHz)$	for	$0.01°\leq\delta\leq0.3°$
$PFD(\delta)=-124.7$	$(dBW/m^2/14\ MHz)$	for	$0°\leq\delta\leq0.01°$
$PFD(\delta)=-120.9+1.9\cdot\log10(\delta)$	$(dBW/m^2/14\ MHz)$	for	$0.01°\leq\delta\leq0.3°$
$PFD(\delta)=-116.2+11\cdot\log10(\delta)$	$(dBW/m^2/14\ MHz)$	for	$0.3°<\delta\leq1°$
$PFD(\delta)=-116.2+18\cdot\log10(\delta)$	$(dBW/m^2/14\ MHz)$	for	$1°<\delta\leq2°$
$PFD(\delta)=-117.9+23.7\cdot\log10(\delta)$	$(dBW/m^2/14\ MHz)$	for	$2°<\delta\leq8°$
$PFD(\delta)=-96.5$	$(dBW/m^2/14\ MHz)$	for	$8°<\delta\leq90.0°$

where δ is the angle of arrival of the radio-frequency wave (degrees above the horizon).

1.2 Higher pfd levels than provided in 1.1 above produced by aeronautical ESIM on surface of the Earth within the territory of an administration that is within line-of-sight of the aeronautical ESIM shall be subject to the prior agreement of that administration.

NOTE 1 – When calculating whether an ESIM meets the pfd levels specified in provision 1.1 above, free-space propagation, atmospheric absorption, and any attenuation due to the aircraft fuselage should be considered.

ANNEX 3 TO DRAFT NEW RESOLUTION [A15] (WRC-19)

Guidelines to assist administrations to authorize ESIM in the frequency band 27.5-29.1 GHz and 29.4525-29.5 GHz

The following guidelines are provided for administrations involved in the authorization and operation of ESIM in the 27.5-29.1 GHz and 29.4525-29.5 GHz and 17.7-19.4 GHz and 19.6-19.7 frequency bands:

1. With regard to Land ESIM (L-ESIM), the administration authorizing L-ESIM may require: :

1.1 that L-ESIM operate within the territory under the jurisdiction of an administration only if authorised by that administration;

1.2 the operator of any ESIM network within which the L-ESIM operate to confirm that such L-ESIM have the capability to limit operations to the territory of administrations having authorized those L-ESIM;

1.3 The operator of the ESIM network within which the L-ESIM operate provide a point of contact for the purpose of tracing any suspected cases of interference from L-ESIM.

2. With regard to Maritime ESIM (M-ESIM), the administration authorizing M-ESIM may require: :

2.1 that M-ESIM operate within the territorial waters under the jurisdiction of an administration only if authorised by that administration.

2.2. the operator of any ESIM network within which the M-ESIM operate to confirm that such M-ESIM have the capability to limit operations to the territorial waters of administrations having authorized those M-ESIM.

2.3 The operator of the ESIM network within which the M-ESIM operate provide a point of contact for the purpose of tracing any suspected cases of interference from M-ESIM.

3. With regard to Aeronautical ESIM (A-ESIM), the administration authorizing A-ESIM may require:

3.1 that A-ESIM operate within the territorial airspace under the jurisdiction of an administration only if authorized by that administration;

3.2 the operator of any ESIM network within which the A-ESIM operate to confirm that such A-ESIM have the capability to limit operations to the territorial airspace of administrations having authorized those A-ESIM.

3.3 The operator of the ESIM network within which the A-ESIM operate provide a point of contact for the purpose of tracing any suspected cases of interference from A-ESIM.

Items in Appendix	*A – GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK, EARTH STATION OR RADIO ASTRONOMY STATION*	*Advance publication of a geostationary-satellite network*	*Advance publication of a non-geostationary-satellite network subject to coordination under*	*Advance publication of a non-geostationary-satellite network not subject to coordination under*	*Notification or coordination of a geostationary-satellite network*	*Notification or coordination of a non-geostationary-satellite network*	*Notification or coordination of an earth station (including notification under*	*Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (Articles 4 and 5)*	*Notice for a satellite network (feeder-link) under Appendix 30A (Articles 4 and 5)*	*Notice for a satellite network in the fixed-satellite service under Appendix 30B*	*Items in Appendix*	*Radio astronomy*
* * *	* * *										* * *	
A.18	**COMPLIANCE WITH NOTIFICATION OF AIRCRAFT EARTH STATION(S)**											

Reasons: to provide guidelines for authorizing ESIM..

MOD USA/1.5/6

APPENDIX 4 (REV.WRC-15)

Consolidated list and tables of characteristics for use in the application of the procedures of Chapter III

ANNEX 2

Characteristics of satellite networks, earth stations or radio astronomy stations[2] (Rev.WRC-12)

Footnotes to Tables A, B, C and D

MOD

TABLE A

Table of characteristics to be submitted for space andradio astronomy services
(Rev.WRC -12)

A.18.a	a commitment that the characteristics of the aircraft earth station (AES) in the aeronautical mobile-satellite service are within the characteristics of the specific and/or typical earth station published by the Bureau for the space station to which the AES is associated Required only for the band 14-14.5 GHz, when an aircraft earth station in the aeronautical mobile-satellite service communicates with a space station in the fixed-satellite service				+	+					A.18.a	
A.19	**COMPLIANCE WITH § 6.26 OF ARTICLE 6 OF APPENDIX 30B**										**A.19**	
A.19.a	a commitment that the use of the assignment shall not cause unacceptable interference to, nor claim protection from, those assignments for which agreement still needs to be obtained Required if the notice is submitted under § 6.25 of Article 6 of Appendix **30B**									+	A.19.a	
A.20	**COMPLIANCE WITH *Resolves* 1.1.2 of Resolution [AI 1.5/XXX] (WRC-19)**										**A.20**	
A.20.a	indicator (yes) if an assignment for the 27.5-29.1 GHz and 29.4525-29.5 GHz and/or 17.7-19.4 GHz and 19.6-19.7 GHz17.7-19.4 GHz and 19.6-19.7 GHz band in the satellite network will be used by ESIM						**O**				A.20.a	
A.20.b	if yes under A.20.a, a commitment that the ESIM operation would be in conformity with the Radio Regulations and Resolution **[AI1.5/XXX] (WRC-19)** (including its annexes)						+				A.20.b	

Reasons: This Appendix **4** element is needed to implement *resolves* 1.1.2 of Draft New Resolution **[A1.5] (WRC-19).**

SUP USA/1.5/7

RESOLUTION 158 (WRC-15)

Use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion communicating with geostationary space stations in the fixed-satellite service

Reasons: Consequential.

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Document WAC/069 (01.10.18)

UNITED STATES OF AMERICA

DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

Agenda Item 1.6: *to consider the development of a regulatory framework for non-GSO FSS satellite systems that may operate in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space), in accordance with Resolution **159 (WRC-15);***

BACKGROUND INFORMATION:

Article **22** of the Radio Regulations contains provisions to ensure compatibility of non-GSO FSS operations with GSO networks. There are currently no defined technical provisions for sharing between non-GSO systems and GSO networks in the 50/40 GHz frequency bands. Moreover, there are no existing mechanisms in the RR establishing coordination procedures applicable to non-GSO systems operating within the FSS allocations in frequency bands in the 37.5 to 51.4 GHz range, such as application of RR No. **9.12**.

To address these issues, and the uncertainty they create among potential operators of non-GSO FSS satellite systems in this 50/40 GHz range, WRC-15 established agenda item 1.6 for WRC-19: "to consider the development of a regulatory framework for non-GSO FSS satellite systems that may operate in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space), in accordance with Resolution **159 (WRC-15).**" Resolution **159 (WRC-15)** invites administrations to contribute to the specified ITU-R studies of technical, operational issues and regulatory provisions for non-GSO fixed-satellite services satellite systems in these frequency bands while ensuring protection of GSO satellite networks in the FSS, MSS and BSS.

Additionally, as part of the regulatory framework to be developed for non-GSO satellites, *resolves 4* of Resolution **159 (WRC-15)** calls for the protection of Earth exploration-satellite service (EESS (passive) in the 50.2-50.4 GHz band and the possible revision of Resolution **750 (Rev. WRC-15)** ensuring the protection of the EESS from non-GSO FSS transmissions. Although *resolves 4* calls for the consideration of aggregate FSS interference effects, *recognizing i)* states that potential revisions to the protection of passive services will be impractical to apply to GSO FSS networks, either filed, planned or operational. This point recognized by WRC-15, which has been carefully considered by the ITU membership since then, remains true today that new GSO FSS limits would be impractical to implement and create an undue constraint to the FSS.

Non-GSO FSS systems in the 50/40 GHz band can be utilized to unlock a new and promising source of global broadband communications. Recent advances in satellite design, launch service capabilities and user terminal technology make it feasible to provide global satellite broadband services. Thanks to these recent technological advances, next-generation non-GSO satellite systems are currently being developed. These systems can greatly enhance the efficient use of existing FSS spectrum by using next-generation satellite and earth station technology. The benefits of such non-GSO satellite systems include providing worldwide connectivity and high-quality communication services to users in all geographic settings, be they urban, rural or remote, and offer tools for definitively addressing the longstanding broadband gap. Developing a regulatory framework in the 50/40 GHz band will provide regulatory certainty to allow non-GSO satellite systems to efficiently operate in these existing FSS frequency bands.

ITU-R studies have concluded that sharing between non-GSO systems and protection of GSO satellite networks is possible in these frequency bands. ITU-R Working Party 4A has also been working on the development of a new Recommendation to identify means and a methodology to define a protection criteria for sharing by FSS systems in the 50/40 GHz bands. The methodology in this Recommendation and proposed protection criteria considers both the short term performance objectives and long term time-average bandwidth efficiency to enable use of these frequency bands by non-GSO FSS systems that will ensure protection of GSO networks. ITU-R studies have confirmed that the application of the procedures in the new Recommendation allows for flexibility in the design and operation of non-GSO systems, while fully protecting GSO operations, therefore significantly enhancing spectrum efficiency of the 50/40 GHz bands.

All four methods identified by the ITU-R as potential methods to satisfy WRC-19 AI 1.6 propose a similar approach to address issues related to non-GSO and GSO sharing, including a regulatory framework based upon single entry and aggregate allowances of unavailability and time-average bandwidth efficiency and a Resolution to track aggregate effects from multiple non-GSO systems to ensure GSO protection. All four methods also propose a modification to RR Article **9** to address coordination between non-GSO FSS systems in the 50/40 GHz bands. Regarding protections of EESS (passive) and modifications to Resolution **750 (Rev. WRC-15)**, the four methods present a range of options for protection of EESS (passive) systems in the 50.2-50.4 GHz bands from non-GSO earth station transmissions.

The proposals below present a regulatory solution for providing certainty and technical provisions to allow for sharing between non-GSO FSS systems and for protection of co-frequency GSO networks and adjacent-band EESS (passive) systems under WRC-19 AI 1.6. The proposals have been developed based on the results of ITU-R studies called for in Resolution **159 (WRC-15),** and identify a methodology to allow for maximum spectrum efficiency for non-GSO FSS systems, while protecting operations of GSO networks from operations of non-GSO FSS systems. This proposal also provides a regulatory solution to ensure that aggregate emissions from operating non-GSO FSS systems do not exceed aggregate protection requirements of GSO networks.

Regarding the EESS (passive) protection from non-GSO FSS transmissions, this proposal contains limits of unwanted emission power in the adjacent band 50.2-50.4 GHz. After careful consideration of the unwanted emission power from GSO stations into EESS (passive), this proposal retains the current GSO limits to ensure the current operating environment is maintained. This proposal tracks closely with Method A in the draft CPM Report.

Proposals:

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations

MOD **USA/1.6/1**

34.2-40 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
37.5-38	FIXED FIXED-SATELLITE (space-to-Earth) **ADD 5.A16** MOBILE except aeronautical mobile SPACE RESEARCH (space-to-Earth) Earth exploration-satellite (space-to-Earth) 5.547	
38-39.5	FIXED FIXED-SATELLITE (space-to-Earth) **ADD 5.A16** MOBILE Earth exploration-satellite (space-to-Earth) 5.547	
39.5-40	FIXED FIXED-SATELLITE (space-to-Earth) 5.516B **ADD 5.A16** MOBILE MOBILE-SATELLITE (space-to-Earth) **ADD 5.B16** Earth exploration-satellite (space-to-Earth) 5.547	

40-47.5 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
40-40.5	EARTH EXPLORATION-SATELLITE (Earth-to-space) FIXED FIXED-SATELLITE (space-to-Earth) 5.516B **ADD 5.A16** MOBILE MOBILE-SATELLITE (space-to-Earth) **ADD 5.B16** SPACE RESEARCH (Earth-to-space) Earth exploration-satellite (space-to-Earth)	

40.5-41 FIXED FIXED-SATELLITE (space-to-Earth) ADD 5.484A **ADD 5.A16** BROADCASTING BROADCASTING-SATELLITE Mobile 5.547	**40.5-41** FIXED FIXED-SATELLITE (space-to-Earth) 5.516B **ADD 5.A16** BROADCASTING BROADCASTING-SATELLITE Mobile Mobile-satellite (space-to-Earth) 5.547	**40.5-41** FIXED FIXED-SATELLITE (space-to-Earth) **ADD 5.A16** BROADCASTING BROADCASTING-SATELLITE Mobile 5.547
41-42.5	FIXED FIXED-SATELLITE (space-to-Earth) 5.516B **ADD 5.A16** BROADCASTING BROADCASTING-SATELLITE Mobile 5.547 5.551F 5.551H 5.551I	
47.2-47.5	FIXED FIXED-SATELLITE (Earth-to-space) 5.552 **ADD 5.A16** MOBILE 5.552A	

47.5-51.4 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
47.5-47.9 FIXED FIXED-SATELLITE (Earth-to-space) 5.552 **ADD 5.A16** (space-to-Earth) 5.516B 5.554A MOBILE	**47.5-47.9** FIXED FIXED-SATELLITE (Earth-to-space) 5.552 **ADD 5.A16** MOBILE	
47.9-48.2	FIXED FIXED-SATELLITE (Earth-to-space) 5.552 **ADD 5.A16** MOBILE 5.552A	
48.2-48.54 FIXED FIXED-SATELLITE (Earth-to-space) 5.552 **ADD 5.A16** (space-to-Earth) 5.516B 5.554A 5.555B MOBILE	**48.2-50.2** FIXED FIXED-SATELLITE (Earth-to-space) 5.516B 5.338A 5.552 **ADD 5.A16** MOBILE	
48.54-49.44 FIXED FIXED-SATELLITE (Earth-to-space) 5.552 **ADD 5.A16** MOBILE 5.149 5.340 5.555		

49.44-50.2 FIXED FIXED-SATELLITE (Earth-to-space) 5.338A 5.552 **ADD 5.A16** (space-to-Earth) 5.516B 5.554A 5.555B MOBILE	5.149 5.340 5.555
50.4-51.4	FIXED FIXED-SATELLITE (Earth-to-space) 5.338A **ADD 5.A16** MOBILE Mobile-satellite (Earth-to-space)

Reasons: To insert provisions for coordination among non-GSO satellite services

ADD USA/1.6/2

5.A16 The use of the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) by a non-GSO-satellite system in the fixed-satellite service for which complete coordination and/or notification information, as appropriate, is received by the Bureau after 1 January 2021, is subject to the application of the provisions of No. **9.12** for coordination with other non-GSO-satellite systems in the fixed-satellite service, but not with non-GSO systems in other services. Draft new Resolution **[A16] (WRC-19)** shall also apply, and No. **22.2** shall continue to apply. (WRC-19)

Reasons: To address coordination among non-GSO FSS systems in the 50/40 GHz bands

ADD USA/1.6/3

5.B16 The use of the frequency bands 39.5-40 and 40-40.5 GHz by non-GSO systems in the mobile-satellite service (space-to-Earth) and non-GSO satellite systems in the fixed-satellite service (space-to-Earth) for which complete coordination and/or notification information, as appropriate, is received by the Bureau after 1 January 2021, is subject to coordination under No. **9.12**. (WRC-19).

Reasons: To address coordination among non-GSO FSS and non-GSO mobile-satellite service (space-to-Earth) systems in the 50/40 GHz bands

ARTICLE 22

Space services

ADD USA/1.6/4

22.5L 9) A non-GSO satellite system in the fixed-satellite service in the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz, and 50.4-51.4 GHz shall not exceed a single-entry permissible allowance of 3% of time allowance for degradation in terms of C/N specified in the short-term and long-term performance objectives of GSO satellite networks . The calculation procedures given in Recommendation

ITU-R S.[50/40 GHz FSS Sharing Methodology] and the GSO reference links contained in Recommendation ITU-R S.[50/40 GHz Reference Links] shall be used for the calculation . (WRC-19)

ADD USA/1.6/5

22.5M 10) Administrations operating or planning to operate non-GSO-satellite systems in the fixed-satellite service in the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz, and 50.4-51.4 GHz shall apply the provisions of Resolution **[A16] (WRC-19)** to ensure that the aggregate interference caused by all non-GSO fixed-service satellite systems operating co-frequency in these frequency bands shall not exceed 10% of the time allowance for degradation in terms of C/N specified in the short-term and long-term performance objectives of the geostationary reference links listed in Recommendation ITU-R S.[50/40 Reference Links]. (WRC-19).

Reasons: Based on ITU-R studies, the detailed technical regulatory provisions presented above will introduce technical regulatory provisions into the Radio Regulations that will enable the introduction of non-GSO satellite systems that will protect GSO networks and provide for maximum spectral efficiency for simultaneous operations of non-GSO system and GSO network operations in the 50/40 GHz bands.

ARTICLE 9

Procedure for effecting coordination with or obtaining agreement of other administrations[1, 2, 3, 4, 5, 6, 7, 8, 9] (WRC-15)

MOD USA/1.6/6

9.35 *a)* examine that information with respect to its conformity with No. **11.31** [MOD19];

(WRC-2019)

MOD USA/1.6/7

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[MOD 19] **9.35.1** The Bureau shall include the detailed results of its examination under No. **11.31** of compliance with the limits in Tables **22-1** to **22-3** and the single entry limits in No. **22.5L** of Article **22** in the publication under No. **9.38**. (WRC-2019)

Reasons: To address the publication of the Bureau's examination of the non-GSO single entry limits.

ADD USA/1.6/8

DRAFT NEW RESOLUTION [A16] (WRC-19)

Protection of geostationary satellite networks from unacceptable interference from non-GSO satellite FSS networks and systems in the 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz, and 50.4-51.4 GHz frequency bands

The World Radiocommunication Conference (2019),

considering

a) that the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space), and 50.4-51.4 GHz (Earth-to-space) are allocated, *inter alia*, on a primary basis to the fixed-satellite service (FSS) in all Regions;

b) that the frequency bands 40.5-41 GHz and 41-42.5 GHz are allocated, on a primary basis to the broadcasting-satellite service (BSS) in all regions;

c) that the frequency bands 39.5-40 GHz and 40-40.5 GHz are allocated, on a primary basis to the mobile-satellite service (MSS) in all regions;

d) that, in accordance with No. **22.2**, non-GSO systems shall not cause unacceptable interference to GSO FSS and broadcasting-satellite service (BSS) networks and, unless otherwise specified in the Radio Regulations, shall not claim protection from GSO FSS and BSS satellite networks;

f) that non-GSO FSS systems would benefit from the certainty that would result from the quantification of technical regulatory provisions required for protection of GSO satellite networks operating in the bands referred to in *considering* a), b), and c) above;

g) that GSO FSS, MSS and BSS networks can be protected without placing undue constraints on non-GSO FSS systems in the bands in *considering a), b), and c) above*;

h) that WRC-19 modified Article **22** to limit single-entry and aggregate permissible time allowances for degradation in terms of C/N by non-GSO FSS systems to GSO satellite networks, based on Recommendation ITU-R S.[50/40 Reference Links] and Recommendation ITU-R S.[50/40 GHz Sharing Methodology], in the bands in *considering a)*;

i) that, the aggregate interference levels from multiple non-GSO FSS systems will be directly related to the actual number of systems sharing a frequency band based on the single-entry operational use of each system;

j) that the aggregate interference caused by all co-frequency non-GSO FSS systems in these bands into GSO FSS, MSS and BSS networks should not exceed the aggregate limits given in Recommendation ITU-R S.[50/40 GHz FSS Sharing Methodology] *recommends* 3;

recognizing

a) that non-GSO FSS systems are likely to need to implement interference mitigation techniques, such as orbital avoidance angles, Earth station site diversity, and GSO arc avoidance, to mutually share frequencies and to protect GSO networks;

b) that to achieve compliance with the aggregate limit in *considering j)*, administrations operating or planning to operate non-GSO FSS systems will need to agree cooperatively through consultation meetings to equitably share the permissible aggregate interference in a manner to achieve the level of protection for GSO FSS, MSS and BSS networks that is stated in No. **22.5M** of the Radio Regulations**;**

c) that it may be appropriate for representatives of administrations operating or planning to operate GSO FSS, MSS and BSS networks to be involved in the determinations made pursuant to *recognizing b)*;

d) that WRC-19 decided to apply the coordination provisions of No. **9.12** to non-GSO FSS systems for which complete coordination is received by the Bureau after 1 January 2021,

noting

a) that Recommendation ITU-R S.[50/40 GHz FSS Sharing Methodology] contains the methodology for determining conformity to the single-entry and aggregate limits to protect the GSO networks;

b) that Recommendation ITU-R S.1503 provides recommendations on how to compute the EPFD from a non-GSO FSS system into victim earth stations and satellites;

c) that Recommendation ITU-R S.[50/40 GHz FSS Reference Links] contains GSO satellite system characteristics to be considered in non-GSO/GSO frequency sharing analyses in the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz;

resolves

1 that administrations operating or planning to operate non-GSO FSS systems in the frequency bands referred to in *considering a)* above, shall, in collaboration, take all necessary steps, including, if necessary, by means of appropriate modifications to their systems or networks, to ensure that the aggregate interference into GSO FSS, MSS and BSS satellite networks caused by such systems operating co-frequency in these frequency bands does not exceed the aggregate protection limits as determined pursuant to No. **22.5M** of the Radio Regulations;

2 that to carry out the obligations in *resolves* 1 above, administrations operating or planning to operate non-GSO FSS systems shall agree cooperatively through regular consultation meetings referred to in recognizing b) to ensure that operations of all non-GSO networks do not exceed the aggregate level of protection for GSO satellite networks;

3 that to carry out the calculation of *resolves 2,* administrations shall take into account the GSO satellite characteristics listed in Recommendation ITU-R S.[50/40 GHz Reference Links] when applying the methodology contained in Recommendation ITU-R S.[50/40 GHz Sharing Methodology] and the results of the aggregate calculation calculated by validation software;

4 that administrations (including representatives of administrations operating GSO FSS, MSS and BSS networks) participating in a consultation meeting may use their own software in conjunction with any approved ITU-R software tools for the calculation and verification of the aggregate limits given in Recommendation ITU-R S.[50/40 GHz Sharing Methodology], subject to the agreement of the consultation meeting, noting that the aggregation of all systems can be performed from these results without a specialized software tool;

5 that administrations, in carrying out their obligations under *resolves* 1, shall take into account only those non-GSO FSS systems with frequency assignments in the frequency bands referred to in *considering a)* above that have met the criteria listed in Annex 2 to this Resolution through appropriate information provided to consultation meetings referred to in *resolves* 2;

6 that administrations, in developing agreements to carry out their obligations under *resolves* 1, shall establish mechanisms to ensure that all potential FSS system and network notifying administrations and operators are given full visibility of, and the opportunity to participate in, the consultation process;

7 that in the absence of an agreement reached at consultation meetings referred to in *resolves* 2, each non-GSO FSS system shall be operated in accordance with single-entry limits calculated by the

apportionment of the aggregate levels commensurate to the number of non-GSO systems operating so as to assure equitable sharing of the aggregate limit among all non-GSO systems in operation;

8 that the administrations participating at the consultation meetings referred to in *resolves 2* shall designate one convener to be responsible for communicating to the Bureau, such as shown in Annex 1, that the results of the aggregate non-GSO system operational calculation and sharing determinations made in application of *resolves* 1 above, without regard to whether such determinations result in any modifications to the published characteristics of their respective systems, providing a draft record of each Consultation meeting, and posting the approved record for posting by the Bureau to the ITU website;

instructs the Radiocommunication Bureau

1 to participate in the consultation meetings mentioned in *resolves* 2 above and observe carefully the results of the aggregate calculation performed according to *resolves* 1;

2 to publish in the International Frequency Information Circular (BR IFIC), the information referred to in *resolves* 8,

urges administrations

to provide the Radiocommunication Bureau and all participants to the consultation meetings with access to independent software used in conjunction with *resolves 4*;

ANNEX 1 TO RESOLUTION [A16] (WRC-19)

List of GSO FSS system characteristics and format of the result of the aggregate calculation to be provided to BR for publication for information

GSO FSS, GSO MSS, GSO BSS AND NON-GSO SYSTEM CHARACTERISTICS TO BE USED IN THE CALCULATION OF AGGREGATE EMISSIONS FROM NON-GSO FSS SYSTEMS

A. GSO FSS, GSO MSS and GSO BSS Characteristics

Recommendation ITU-R S.[50/40 GHz FSS Reference links]

B. Non-GSO satellite system constellation parameters

For each non-GSO satellite system, the following parameters should be provided to BR for publication in the aggregate calculation:

– System administration;

– Number of space stations used in aggregate calculation;

– Single entry use of each non-GSO FSS systems.

C. Results of the aggregate calculation

Results of aggregate calculation including systems studied and assessment results

ANNEX 2 TO RESOLUTION [A16] (WRC-19)

List of criteria for the application of *resolves* 3

1 Submission of Notification Publication Information.

2 Entry into satellite manufacturing or procurement agreement, and entry into satellite launch agreement.

The non-GSO FSS system operator should possess:

i) clear evidence of a binding agreement for the manufacture or procurement of its satellites; and

ii) clear evidence of a binding agreement to launch its satellites.

The manufacturing or procurement agreement should identify the contract milestones leading to the completion of manufacture or procurement of satellites required for the service provision, and the launch agreement should identify the launch date, launch site and launch service provider. The notifying administration is responsible for authenticating the evidence of agreement.

The information required under this criterion may be submitted in the form of a written commitment by the responsible administration.

3 As an alternative to satellite manufacturing or procurement and launch agreements, clear evidence of guaranteed funding arrangements for the implementation of the project would be accepted. The notifying administration is responsible for authenticating the evidence of these arrangements and for providing such evidence to other interested administrations in furtherance of its obligations under this Resolution.

Reasons: To provide a methodology to ensure that aggregate GSO satellite network protection levels are never exceeded and to provide a mechanism to monitor the aggregate limits from the operation of actual non-GSO FSS systems

MOD USA/1.6/9
MOD

RESOLUTION 750 (REV.WRC-19)

Compatibility between the Earth exploration-satellite service (passive) and relevant active services

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

…

EESS (passive) band	Active service band	Active service	Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band[1]
1 400- 1 427 MHz	1 427- 1 452 MHz	Mobile	−72 dBW in the 27 MHz of the EESS (passive) band for IMT base stations −62 dBW in the 27 MHz of the EESS (passive) band for IMT mobile stations[2, 3]
23.6-24.0 GHz	22.55-23.55 GHz	Inter-satellite	−36 dBW in any 200 MHz of the EESS (passive) band for non-GSO (non-GSO) inter-satellite service (ISS) systems for which complete advance publication information is received by the Bureau before 1 January 2020, and −46 dBW in any 200 MHz of the EESS (passive) band for non-GSO ISS systems for which complete advance publication information is received by the Bureau on or after 1 January 2020
31.3-31.5 GHz	31-31.3 GHz	Fixed (excluding HAPS)	For stations brought into use after 1 January 2012: −38 dBW in any 100 MHz of the EESS (passive) band. This limit does not apply to stations that have been authorized prior to 1 January 2012
50.2-50.4 GHz	49.7-50.2 GHz	Fixed-satellite (E-to-s)[4]	For GSO and non-GSO stations brought into use after the date of entry into force of the Final Acts of WRC-07 and non-GSO stations brought into use before [1 January 2021]: −10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi −20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi
50.2-50.4 GHz	49.7-50.2 GHz	Fixed-satellite (E-to-s)[4]	For non-GSO stations brought into use after [1 January 2021]: −13 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi −23 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi
50.2-50.4 GHz	50.4-50.9 GHz	Fixed-satellite (E-to-s)[4]	For GSO and non-GSO stations brought into use after the date of entry into force of the Final Acts of WRC-07 and non-GSO stations brought into use before [1 January 2021]: −10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi −20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi
50.2-50.4 GHz	50.4-50.9 GHz	Fixed-satellite (E-to-s)[4]	For non-GSO stations brought into use after [1 January 2021]: −13 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi −23 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi
52.6-54.25 GHz	51.4-52.6 GHz	Fixed	For stations brought into use after the date of entry into force of the Final Acts of WRC-07: −33 dBW in any 100 MHz of the EESS (passive) band

EESS (passive) band	Active service band	Active service	Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band[1]

[1] The unwanted emission power level is to be understood here as the level measured at the antenna port.

[2] This limit does not apply to mobile stations in the IMT systems for which the notification information has been received by the Radiocommunication Bureau by 28 November 2015. For those systems, −60 dBW/27 MHz applies as the recommended value.

[3] The unwanted emission power level is to be understood here as the level measured with the mobile station transmitting at an average output power of 15 dBm.

[4] The limits apply under clear-sky conditions. During fading conditions, the limits may be exceeded by earth stations when using uplink power control.

Document WAC/070 (01.10.18)

UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEW FOR THE WORK OF THE CONFERENCE

Agenda Item 1.7*: to study the spectrum needs for telemetry, tracking and command (TT&C) in the space operation service for non-geostationary (NGSO) satellites with short duration missions, to assess the suitability of existing allocations to the space operation service and, if necessary, to consider new allocations, in accordance with Resolution* ***659 (WRC-15)***

BACKGROUND:

The term "short duration mission" used in Resolution **659 (WRC-15)** refers to a mission having a limited period of validity of typically not more than 3 years, where the operator does not launch replenishment or replacement spacecraft. SD missions might provide a useful alternative means for satisfying some scientific and commercial space requirements purposes. Thus, the objective of WRC-19 Agenda Item 1.7 is to better quantify the spectrum requirements for NGSO satellites with short duration (SD) missions, and to determine what if any suitable revisions to the Radio Regulations may be needed to adequately accommodate these types of satellite missions.

WRC-19 Agenda Item 1.7 invites studies to accommodate spectrum requirements for TT&C in the space operation service, below 1 GHz, for NGSO satellites with short duration missions (SD-NGSO) in existing bands not subject to No. **9.21**. The lead group for the conduct of the studies is ITU-R WP-7B. Thus far, studies have concluded that the Space Operations Service (SOS) applications are not able to co-exist with current usage. Consequently, the study efforts have shifted to considering the feasibility of possible new spectrum allocation(s) or an upgrade of an existing allocations within the frequency ranges 150.05-174 MHz and 400.15-420 MHz (e.g., so that RR No. **9.21** does not apply).

Compatibility studies have shown that current technical and operational characteristics of SD-NGSO may not protect global maritime distress and safety service (GMDSS) frequencies for space, coast, ship and aircraft station frequencies between 156-163 MHz, nor frequencies used for the safety of life COSPAS/SARSAT system in the band 406-406.1 MHz. One Administration has suggested that studies should consider using existing SOS allocations in the 137-138 MHz and 148-149.9 MHz bands for SD-NGSO, however no studies considered to date by ITU-R WP-7B have assessed the compatibility of that concept with aeronautical mobile (R) service systems operating in adjacent allocated spectrum which is used heavily worldwide for all aspects of air traffic control in all airspace.

Considering the impact to safety services, no regulatory method has been considered for possible solutions to remove RR No. **9.21** for existing space operation service Earth-to-space ground stations to ensure incumbent protection from harmful interference. In addition, technical studies for both methods proposing a new SOS (Earth-to-space) allocation between 403-405 MHz has shown varying conclusions regarding the feasibility of sharing. Finally, studies have raised concern about using the existing SOS (s-E) allocation in the 137-138 MHz due to possible impacts on aeronautical systems operating below 137 MHz.

The frequency band 117.975 – 137 MHz is allocated worldwide to the AM(R)S service and is used to transmit Air Traffic Control (ATC) and Airline Operational Control (AOC) communications in all phases of flight and in all airspace. The upper portion of this frequency band, 136-137 MHz, is primarily used for air-ground digital communications to supplement existing voice communications. The highest assignable channel, 136.975 MHz, is the Very High Frequency Data Link Mode 2 (VDL M2) Common Signaling Channel (CSC) as specified in Annex 10 to the Convention on International Civil Aviation Volume III 6.1.2.3.

One administration has suggested using existing SOS allocations in the 137-138 MHz band for the SD-NGSO downlink. Assuming the characteristics in the DN Report for SD-NGSO uplink and downlink, the SOS emissions below 137 MHz will be too high to protect the AM(R)S service. Similarly, proposed use of the existing SOS (E-s) allocation in the 148-149.9 MHz band using the stated characteristics will result in required separation distances that would not be supportable operationally.

The Draft CPM (Method C) proposes thresholds for coordination similar to those for MSS in 137-138 MHz, which is specified in Annex 1 of Appendix **5** of the RR and removal of No. **9.21** in RR No. **5.218**. The coordination for MSS (space-to-Earth) in 137-138 MHz is done under RR No. **9.11A**, requiring meeting a pfd threshold on the earth's surface for coordination with terrestrial services. SOS ground station assignments in the 148-149.9 MHz band are required to be coordinated under RR No. **9.21**, which was deemed not suitable for SD-NGSO in Resolution **658** (**WRC-15**). However, no studies considered to date by ITU-R WP-7B have assessed the feasibility of implementing SD mission spectrum utilization under the 'Method C' option with adequate means for ensuring protection of heavily used AM(R)S systems operating adjacent bands.

PRELIMINARY VIEW

WP-7B should continue studies examining the feasibility of accommodating SD in bands below 1 GHz while ensuring protection of incumbent and adjacent band services. WP 7B should continue collaborating with other WPs to facilitate studies for WRC-19.

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Regulatory Issues

Document WAC/071 (01.10.18)

UNITED STATES OF AMERICA
DRAFT PROPOSAL FOR WRC-19

Agenda Item 7: *to consider possible changes, and other options, in response to Resolution 86 (Rev. Marrakesh, 2002) of the Plenipotentiary Conference, an advance publication, coordination, notification and recording procedures for frequency assignments pertaining to satellite networks, in accordance with Resolution **86 (Rev.WRC-07)**, in order to facilitate rational, efficient and economical use of radio frequencies and any associated orbits, including the geostationary-satellite orbit;*

Issue B – Application of coordination arc in the Ka-band, to determine coordination requirements between the FSS and other satellite services

Background Information: WRC-19 agenda item 7, Issue B, proposes the introduction of the coordination arc with a value of 8 degrees as coordination criteria between fixed-satellite service (FSS) and mobile-satellite service (MSS) systems and between MSS systems, in the frequency bands 29.5-30 GHz (Earth-to-space)/19.7-20.2 GHz (space-to-Earth) in all 3 Regions. The introduction of an 8 degree coordination arc would serve as a substitution of the existing coordination trigger of $\Delta T/T > 6\%$. Currently, when determining whether coordination under RR No. **9.7** is required between FSS vs FSS satellite networks, a coordination arc of 8º is the coordination criteria applied in the frequency bands 29.5-30 GHz (Earth-to-space)/19.7-20.2 GHz (space-to-Earth). Results of ITU-R studies show that earth station terminals used in the MSS and FSS for these frequency bands are quite similar. Therefore, it could be considered that the coordination arc that currently triggers coordination between FSS systems could be applied to trigger coordination between MSS and FSS systems and between MSS systems.

Introduction of the coordination arc of 8 degrees would reduce the number of Administrations identified for coordination, thereby reducing the number of coordination processes and resulting in a reduction of required resources in Administrations, operators, and Bureau. Administrations will continue to have the possibility to request application of RR No. **9.41** for inclusion of additional affected satellite networks, taking into account the $\Delta T/T > 6\%$ criteria. In this proposal, it is proposed to implement the modifications to the Radio Regulations in accordance with Method B.

Proposal:

APPENDIX 5 (Rev.WRC-15)

Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9

MOD USA/AI7/1

TABLE 5-1 (Rev.WRC-19)

Technical conditions for coordination

(see Article **9**)

Reference of Article 9	**Case**	**Frequency bands (and Region) of the service for which coordination is sought**	**Threshold/condition**	**Calculation method**	**Remarks**
No. **9.7** GSO/GSO	A station in a satellite network using the geostationary-satellite orbit (GSO), in any space radiocommunication service, in a frequency band and in a Region where this service is not subject to a Plan, in respect of any other satellite network using that orbit, in any space radiocommunication service in a frequency band and in a Region where this service is not subject to a Plan, with the exception of the coordination	1) 3 400-4 200 MHz 5 725-5 850 MHz (Region 1) and 5 850-6 725 MHz 7 025-7 075 MHz	i) Bandwidth overlap, and ii) any network in the fixed-satellite service (FSS) and any associated space operation functions (see No. **1.23**) with a space station within an orbital arc of □7° of the nominal orbital position of a proposed network in the FSS		With respect to the space services listed in the threshold/condition column in the frequency bands in 1), 2), 2*bis*), 3), 3*bis*), 4), 5), 6), 7) and 8), an administration may request, pursuant to No. **9.41**, to be included in requests for coordination, indicating the networks for which the value of □*T*/*T* calculated by the method in § 2.2.1.2 and 3.2 of Appendix **8** exceeds 6%. When the Bureau, on request by an affected administration,
		2) 10.95-11.2 GHz 11.45-11.7 GHz 11.7-12.2 GHz (Region 2) 12.2-12.5 GHz (Region 3) 12.5-12.75 GHz (Regions 1 and 3)	i) Bandwidth overlap, and ii) any network in the FSS or broadcasting-satellite service (BSS), not subject to a Plan, and any associated space operation functions (see No. **1.23**) with a space station within an orbital arc of □6° of the nominal orbital position of a		

	between earth stations operating in the opposite direction of transmission	12.7-12.75 GHz (Region 2) and 13.75-14.8 GHz	proposed network in the FSS or BSS, not subject to a Plan iii) in the band 14.5-14.8 GHz any network in the space research service (SRS) or FSS not subject to a Plan and any associated space operation functions (see No. **1.23**) with a space station within an orbital arc of ±6° of the nominal orbital position of a proposed network in the SRS or FSS not subject to a Plan		studies this information pursuant to No. **9.42**, the calculation method given in § 2.2.1.2 and 3.2 of Appendix **8** shall be used

TABLE 5-1 (*continued*) (Rev.WRC-19)

Reference of Article 9	**Case**	**Frequency bands (and Region) of the service for which coordination is sought**	**Threshold/condition**	**Calculation method**	**Remarks**
No. **9.7** GSO/GSO (*cont.*)		2*bis*) 13.4-13.65 GHz (Region 1)	i) Bandwidth overlap, and ii) any network in the space research service (SRS) or any network in the FSS and any associated space operation functions (see No. **1.23**) with a space station within an orbital arc of ±6° of the nominal orbital position of a proposed network in the FSS or SRS		
		3) 17.7-19.7 GHz, (Regions 2 and 3), 17.3-19.7 GHz (Region 1) and 27.5-29.5 GHz	i) Bandwidth overlap, and ii) any network in the FSS and any associated space operation functions (see No. **1.23**) with a space station within an orbital arc of □8° of the nominal orbital position of a proposed network in the FSS		

		3*bis)* 19.7-20.2 GHz and 29.5-30 GHz	i) Bandwidth overlap, and ii) any network in the FSS or in the MSS and any associated space operation functions (see No. **1.23**) with a space station within an orbital arc of □8° of the nominal orbital position of a proposed network in the FSS or in the MSS.		
		4) 17.3-17.7 GHz (Regions 1 and 2)	i) Bandwidth overlap, and ii) a) any network in the FSS and any associated space operation functions (see No. **1.23**) with a space station within an orbital arc of □8° of the nominal orbital position of a proposed network in the BSS, or b) any network in the BSS and any associated space operation functions (see No. **1.23**) with a space station within an orbital arc of □8° of the nominal orbital position of a proposed network in the FSS		

TABLE 5-1 (*continued*) (Rev.WRC-19)

Reference of Article 9	**Case**	**Frequency bands (and Region) of the service for which coordination is sought**	**Threshold/condition**	**Calculation method**	**Remarks**
No. **9.7** GSO/GSO (*cont.*)		5) 17.7-17.8 GHz	i) Bandwidth overlap, and ii) a) any network in the FSS and any associated space operation functions (see No. **1.23**) with a space station within an orbital arc of □8° of the nominal orbital position of a proposed network in the BSS,		

			or b) any network in the BSS and any associated space operation functions (see No. **1.23**) with a space station within an orbital arc of □8° of the nominal orbital position of a proposed network in the FSS NOTE – No. **5.517** applies in Region 2.		
		6) 18.0-18.3 GHz (Region 2) 18.1-18.4 GHz (Regions 1 and 3)	i) Bandwidth overlap, and ii) any network in the FSS or meteorological-satellite service and any associated space operation functions (see No. **1.23**) with a space station within an orbital arc of □8° of the nominal orbital position of a proposed network in the FSS or the meteorological-satellite service		

TABLE 5-1 (*continued*) (Rev.WRC-19)

Reference of Article 9	**Case**	**Frequency bands (and Region) of the service for which coordination is sought**	**Threshold/condition**	**Calculation method**	**Remarks**
No. **9.7** GSO/GSO (*cont.*)		6*bis*) 21.4-22 GHz (Regions 1 and 3)	i) Bandwidth overlap; and ii) any network in the BSS and any associated space operation functions (see No. **1.23**) with a space station within an orbital arc of ±12° of the nominal orbital position of a proposed network in the BSS (see also Resolutions **554 (WRC-12)** and **553 (WRC-12)**).		No. **9.41** does not apply.
		7) Bands above 17.3 GHz,	i) Bandwidth overlap, and		

		except those defined in § 3), 3*bis*) and 6)	ii) any network in the FSS and any associated space operation functions (see No. **1.23**) with a space station within an orbital arc of □8° of the nominal orbital position of a proposed network in the FSS (see also Resolution **901 (Rev.WRC-07)**)		
		8) Bands above 17.3 GHz except those defined in § 4), 5) and 6*bis*)	i) Bandwidth overlap, and ii) any network in the FSS or BSS, not subject to a Plan, and any associated space operation functions (see No. **1.23**) with a space station within an orbital arc of □16° of the nominal orbital position of a proposed network in the FSS or BSS, not subject to a Plan, except in the case of a network in the FSS with respect to a network in the FSS (see also Resolution **901 (Rev.WRC-07)**)		

TABLE 5-1 (*continued*) (Rev.WRC-19)

Case	Frequency bands (and Region) of the service for which coordination is sought	Threshold/condition	Calculation method	Remar
	9) All frequency bands, other than those in 1), 2), 2*bis*), 3), 3*bis*), 4), 5), 6), 6*bis)*, 7) and 8), allocated to a space service, and the bands in 1), 2), 2*bis*), 3), 3*bis*), 4), 5), 6), 6*bis*), 7) and 8) where the radio service of the proposed network or affected networks is other than the space services listed in the threshold/ condition column, or in the case of coordination of space stations operating in the opposite direction of transmission	i) Bandwidth overlap, and ii) Value of $\Delta T/T$ exceeds 6%	Appendix **8**	In application of of Appendix **30** f operation functio guardbands defin of Annex 5 of Ap the threshold/con specified for the bands in 2) appli In application of of Appendix **30A** space operation f using the guardba in § 3.1 and 4.1 o Appendix **30A**, t threshold/conditi for the FSS in the applies

Reasons: Extend the coordination arc to consider MSS in the frequency bands 29.5-30 GHz and 19.7-20.2 GHz.

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Document WAC/072 (01.10.18)

IWG-4 PROPOSED EDITS TO NTIA PROPOSAL ON WRC-19 AGENDA ITEM 7 ISSUE C5

UNITED STATES OF AMERICA

DRAFT PROPOSAL FOR THE WORK OF THE CONFERNCE

Agenda Item 7: *to consider possible changes, and other options, in response to Resolution 86 (Rev. Marrakesh, 2002) of the Plenipotentiary Conference, an advance publication, coordination, notification and recording procedures for frequency assignments pertaining to satellite networks, in accordance with Resolution **86 (Rev.WRC-07)**, in order to facilitate rational, efficient and economical use of radio frequencies and any associated orbits, including the geostationary-satellite orbit;*

Issue C5 – Bureau reminder to notifying administrations per RR No. **11.46**

Background Information: Issue C is a collection of several different topics that are viewed as being straightforward and for which consensus was readily achieved within ITU-R. The issues address such things as resolving inconsistencies in regulatory provisions, clarifying certain existing practices, or increasing transparency in the regulatory process.

Pursuant to RR No. **11.46**, the Bureau allows Notifying Administrations six months to resubmit their notified frequency assignments, which were returned due to an unfavorable finding with respect to RR Nos. **11.32**, **11.32A** or **11.33**. Any notification resubmitted beyond six months is considered as a new notification with a new date of receipt and would be subject to cost recovery fees. However, neither RR No. **11.46** nor any other provision in the Radio Regulations requires the Bureau to send a reminder to the Notifying Administration at any point during the six-month period. If the Notifying administration resubmits the notice to the Bureau beyond the required six-month period, the Bureau assigns a new date of receipt and reviews whether the notice complies with the period in RR No. **11.44.1** or RR No. **11.43A** and takes the appropriate action. In the case that a notice resubmitted beyond the six-month deadline is receivable, cost recovery fees would be required for the resubmitted assignments. Addressing this lack of a reminder would be beneficial to Administrations who may have experienced difficulties receiving or addressing the Bureau's return of notice and the need to ensure that frequency assignments that are in use are properly recorded in the Master Register.

A single method has been identified to address this issue. It would be considered advantageous to Notifying Administrations if the Bureau sends a reminder of the option to resubmit returned frequency assignments under RR No. **11.37** or **11.38**. Modification of RR No. **11.46** requiring the Bureau to remind the Notifying Administration of the six-month deadline would aid Administrations who may have had difficulties in receiving the communication of returned frequency assignments.

Proposal:

ARTICLE 11

Notification and recording of frequency assignments[1, 2, 3, 4, 5, 6, 7, 8] (WRC-15)

MOD USA/AI7(C5)/1

11.46 In applying the provisions of this Article, any resubmitted notice which is received by the Bureau more than six months after the date on which the original notice was returned by the Bureau shall be considered to be a new notification with a new date of receipt[X]. For frequency assignments to a space station, should the new date of receipt of such a notice not comply with the period specified in No. **11.44.1** or No. **11.43A**, as appropriate, the notice shall be returned to the notifying administration in the case of No. **11.44.1**, and the notice shall be examined as a new notice of a change in the characteristics of an assignment already recorded with a new date of receipt in the case of No. **11.43A**. (WRC-19)

Reasons: To include a reference to a footnote provision requiring the Bureau to send a reminder two months prior to the end of the six-month period referred to in No. **11.46**.

ADD USA/AI7(C5)/2

[X] **11.46.1** If the resubmitted notice is not received by the Bureau within four months from the date on which the original notice was returned by the Bureau, the Bureau shall shall promptly send a reminder to the notifying administration.

Reasons: To implement the requirement for reminders during the six-month period and reduce the risk of a resubmission beyond the end six-month period referred to in No. **11.46.**

Document WAC/073 (01.10.18)

UNITED STATES OF AMERICA
DRAFT PROPOSAL FOR THE WORK OF THE CONFERENCE

Agenda Item 7: *to consider possible changes, and other options, in response to Resolution 86 (Rev. Marrakesh, 2002) of the Plenipotentiary Conference, an advance publication, coordination, notification and recording procedures for frequency assignments pertaining to satellite networks, in accordance with Resolution **86 (Rev.WRC-07)**, in order to facilitate rational, efficient and economical use of radio frequencies and any associated orbits, including the geostationary-satellite orbit;*

Issue D – Identification of those specific satellite networks and systems with which coordination needs to be effected under RR Nos. **9.12**, **9.12A** and **9.13**

Background Information: At the 2012 World Radiocommunication Conference (WRC-12) modifications to RR No. **9.36.2** to Article **9** of the Radio Regulations were adopted to decrease the administrative workload related to the identification of the satellite networks, systems and earth stations, as applicable, with which coordination needs to be effected under RR Nos. **9.7**, **9.7A** and **9.7B**. The Bureau now publishes a "definitive list" of those networks, systems and earth stations with which coordination under RR Nos. **9.7**, **9.7A** and **9.7B** needs to be effected once a coordination request (a new one or a modification to an existing one, as appropriate) for a satellite network or system is processed. Such a list is published in the relevant Special Section of the BR International Frequency Information Circular (BR IFIC). However, in the cases of coordination under RR Nos. **9.12**, **9.12A** and **9.13**, the Bureau does not publish a list of the satellite networks or systems potentially affected to complement the list of administrations potentially affected by incoming satellite networks or systems that they do provide.

Bearing in mind that, according to RR No. **9.36.1**, the list of administrations identified for coordination under RR Nos. **9.12**, **9.12A** and **9.13** is only for information purposes, each of those potentially affected administrations needs to carry out the following tasks:

1 Identify, together with each of its operators, those GSO networks and non-GSO systems that may be affected by the new satellite system requesting coordination;

2 Compile, in case the administration is responsible for more than one operator, a comprehensive list covering all the GSO networks and non-GSO systems with which coordination is required;

3 Transmit to the administration having filed a CR/C (a new one or a modification to an existing one, as appropriate) and to the Bureau its comments on or disagreement to the request for coordination pursuant to RR No. **9.52**.

The above process could be simplified if a pre-compiled list of satellite networks or systems considered as potentially affected would be available, for information purposes only, in the cases

of coordination under RR Nos. **9.12**, **9.12A** and **9.13** as it is currently for the cases of RR Nos. **9.7**, **9.7A** and **9.7B** in the CR/C Special Section. In this proposal, it is proposed to implement the modifications to the Radio Regulations in accordance with Method D2.

Proposal:

ARTICLE 9

Procedure for effecting coordination with or obtaining agreement of other administrations[1, 2, 3, 4, 5, 6, 7, 8, 9] (WRC-15)

Section II − Procedure for effecting coordination[12, 13]

Sub-Section IIA − Requirement and request for coordination

MOD USA/AI7(D)/1

[20] **9.36.1** In the case of coordination under Nos. **9.12, 9.12A** and **9.13**, as appropriate, the Bureau shall also identify the satellite networks or systems with which coordination may need to be effected. The list of administrations identified by the Bureau under Nos. **9.11** to **9.14** and **9.21** and the list of satellite networks or systems identified by the Bureau under Nos. **9.12, 9.12A** and **9.13** are only for information purposes, to help administrations comply with this procedure. (WRC-19)

Reasons: This modification is required in order to have the list of potentially affected satellite networks or systems published in addition to the list of administrations.

Sub-Section IIC − Action upon a request for coordination

MOD USA/AI7(B)/2

9.52C For coordination requests under Nos. **9.11** to **9.14** and **9.21**, an administration not responding under No. **9.52** within the same four-month period shall be regarded as unaffected and, in the cases of Nos. **9.11** to **9.14**, the provisions of Nos. **9.48** and **9.49** shall apply. Furthermore, for coordination under Nos. **9.12**, **9.12A** and **9.13**, any satellite network or system identified under No. **9.36.1** but not confirmed in the response provided by administrations under No. **9.52** within the same four-month period shall be regarded as unaffected and the provisions of Nos. **9.48** and **9.49** shall also apply. (WRC-19)

Reasons: This modification is required to indicate the consequence for not identifying satellite networks or systems in the response provided under No. **9.52**.

MOD USA/AI7(D)/3

9.53A Upon expiry of the deadline for comments in respect of a coordination request under Nos. **9.11** to **9.14** and **9.21**, the Bureau shall, according to its records, publish a Special Section, indicating the list of administrations having submitted their disagreement and the list of satellite networks or systems upon which their disagreement is based, as appropriate, or other comments within the regulatory deadline. (WRC-19)

Reasons: This modification is required in order to have the definitive list of affected satellite networks or systems published in addition to the list of administrations.

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