IWG-2/064r3 (21.03.2018)

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**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.*

**INTRODUCTION**

Article 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 delivery. Resolution **160** resolves to invite ITU-R to study additional spectrum needs of HAPS, examining the suitability of existing HAPS identifications and conducting sharing and compatibility studies for additional identifications 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.

**BACKGROUND INFORMATION**

The technological innovations and the growing urgency to expand the availability of broadband has led to a review of the current regulatory environment for delivery platforms such as HAPS. Stations operating in the stratosphere are high enough to provide service to a large area. Recent test deployments of stations delivering broadband from approximately 20 km above ground have demonstrated their maturity for the potential of such stations for providing connectivity to underserved communities with minimal ground-level infrastructure and maintenance.

Agenda item 1.14 incorporates the principle that more options for broadband delivery are better, especially for countries with less-developed infrastructures. As such, agenda item 1.14 has gained adherents because HAPS platforms can drive broadband rollout: not by supplying a service to compete with existing providers, but by providing an additional platform that existing service providers can use to augment their capacity. In this way, HAPS offers a boost, or overlay, to existing broadband providers using innovative and easily deployable backhaul platforms positioned in the upper atmosphere. WRC-15 adopted Resolution **160** to study how to facilitate access to global broadband applications delivered by HAPS in the fixed service.

Currently there are three 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 identifications due to either geographical restrictions or technical limitations which impairs their operation. The global identification for HAPS links (which is in the 47.2-47.5 GHz and 47.9-48.2 GHz band fixed-service allocations) suffers from the effects of rain fade attenuation that severely limit service provision over high-precipitation geographies. The remaining two 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 very limited amount of countries, none of which is within ITU Region 2.

**BROADBAND HAPS**

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 plane 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 solar 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 identifications. International regulatory flexibility enables 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.

**SHARING STUDIES**

ITU-R Working Party 5C (WP 5C) is the group responsible for Agenda Item 1.14. WP 5C has, in turn, established a specific HAPS working group to examine the compatibility between HAPS and services operating or planning to operate in the bands under study as per Resolution **160** (WRC 15).

*Further resolves 1* of Resolution **160** **(WRC-15)** asks that ITU-R studies on AI 1.14 “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”. WP 5C has identified a number of sharing and compatibility studies to be conducted, including adjacent band studies. The draft studies are currently located in the Working Party 5C Chairman’s Report.

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

**PROPOSAL**

The actions described above are intended to facilitate the timely introduction of broadband connectivity via HAPS operating in the Fixed service. This proposal will modify the Radio Regulations to accommodate broadband HAPS by revising some of the existing identifications and /or newly identifying HAPS in fixed allocations as appropriate. Specifically, it calls for the identification of 21.4-22 GHz, 24.25-27.5 GHz and 38-39.5 GHz bands for use by HAPS. It calls for modifications to existing footnotes in the Radio Regulations identifying HAPS and to associated Resolutions, as well as providing new Resolutions with mitigation techniques for new HAPS identifications. It will also propose a new allocation in the 24.25-25.25 GHz frequency range for Fixed Service and identification for HAPS.

**U.S. PROPOSAL**

1. **For the frequency bands 27.9 - 28.2 GHz and 31.0 – 31.3 GHz**

**MOD USA/1.14/1**

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 MOD 5.537A (REV. WRC-19)  FIXED-SATELLITE (Earth-to- space) 5.484A 5.516B 5.539  MOBILE  5.538 5.540 | |
| **…** | | |

29.9-34.2 GHz

|  |  |  |
| --- | --- | --- |
| Allocation to services | | |
| Region 1 | Region 2 | Region 3 |
| **…** | | |
| **31-31.3** | FIXED 5.338A MOD 5.543A (REV. WRC-19)  MOBILE  Standard frequency and time signal-satellite (space-to-Earth)  Space research 5.544 5.545  5.149 | |
| **…** | | |

**MOD USA/1.14/2**

**5.537A** is revised to read:

In Bhutan, Cameroon, Korea (Rep. of), the Russian Federation, India, Indonesia, Iran (Islamic Republic of), Iraq, Japan, Kazakhstan, Malaysia, Maldives, Mongolia, Myanmar, Uzbekistan, Pakistan, the Philippines, Kyrgyzstan, the Dem. People’s Rep. of Korea, Sudan, Sri Lanka, Thailand, ~~and~~ Viet Nam, and all other countries worldwide the allocation to the fixed service in the band 27.9-28.2 GHz may also be used by high altitude platform stations (HAPS) within the territory of these countries. Such use ~~of 300 MHz~~ of the fixed-service allocation by HAPS ~~in the above countries~~ is ~~further~~ limited to operation in the HAPS-to-ground direction and is subject to the provisions contained in Resolution 145. ~~and shall not cause harmful interference to, nor claim protection from, other types of fixed-service systems or 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/1.14/3**

**5.543A** is revised to read:

In Bhutan, Cameroon, Korea (Rep. of), the Russian Federation, India, Indonesia, Iran (Islamic Republic of), Iraq, Japan, Kazakhstan, Malaysia, Maldives, Mongolia, Myanmar, Uzbekistan, Pakistan, the Philippines, Kyrgyzstan, the Dem. People’s Rep. of Korea, Sudan, Sri Lanka, Thailand, ~~and~~ Viet Nam and all other countries worldwide, the allocation to the fixed service in the band 31-31.3 GHz may also be used by systems using high altitude platform stations (HAPS) in the ground-to-HAPS or HAPS-to-ground direction. Such use of the fixed service allocation by HAPS is subject to the provisions of Resolution 145. ~~The use of the band 31.-31.3 GHz by systems using HAPS is limited to the territory of the countries listed above and shall not cause harmful interference to, nor claim protection from, other types of fixed-service systems, systems in the mobile service and systems operated under No.5.545. Furthermore, the development of these services shall not be constrained by HAPS. Systems using HAPS in the band 31-31.3 GHz 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 as given in Recommendation ITU-R RA.769. In order to ensure the protection of satellite passive services, the level of unwanted power density into a 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 the effective impact on the passive satellite does not exceed the impact under clear-sky conditions.~~ See Resolution **145 (Rev.WRC-19)**.

**MOD usa/1.14/4**

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, 201~~2~~9)

**…**

*n)* that WRC-15 decided to study additional spectrum needs for HAPS to provide broadband connectivity, the suitability of using the existing identifications on a global level, and appropriate modifications to the existing footnotes and associated resolutions in the identifications, recognizing that the existing HAPS identifications were established without reference to today’s broadband capabilities,

*resolves*

1 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 ground-to-HAPS or 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;~~

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;

4 that the administrations ~~listed in Nos. 5.537A and 5.543A~~ 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 Nos. 5.537A and 5.543A are met, and those administrations in Region 2 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~~ operate such HAPS systems consistent withthe 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 27.9-28.2 GHz and 31-31.3 GHz from HAPS in the fixed service.

1. **For the frequency band 47.2- 47.5 GHz and 47.9- 48.2 GHz**

**MOD usa/1.14/5**

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 MOD 5.552A (REV. WRC-19)  FIXED-SATELLITE (Earth-to-space) 5.552  MOBILE  5.552A | |

47.5-51.4 GHz

|  |  |  |
| --- | --- | --- |
| Allocation to services | | |
| Region 1 | Region 2 | Region 3 |
| **…** | | |
| **47.9-48.2** | FIXED 5.552A (REV. WRC-19)  FIXED-SATELLITE (Earth-to-space) 5.552  MOBILE | |
| **…** | | |

**MOD USA/1.14/6**

**5.552A** is revised to reference revised Resolution 122.

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. 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)**. (WRC-19)

**MOD** **USA/1.14/7**

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 (Geneva, 20~~07~~19)

*recognizing*

*…*

*d)* that ITU-R Studies on HAPS

*g)* that WRC-15 decided to study additional spectrum needs for HAPS to provide broadband connectivity and appropriate modifications to the existing footnotes and associated resolutions in the identifications, recognizing that the existing HAPS identifications were established without reference to today’s broadband capabilities,

*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° < θ ≤ 90°)

22.57 dB(W/MHz) for SAC (15° < θ ≤ 30°)

28 dB(W/MHz) for RAC (5° < θ ≤ 15°)

where θ is the ground terminal elevation angle in degrees;

2 that the maximum transmit e.i.r.p. density levels specified in resolves 1 may be

increased, using fading compensation techniques, by up to ~~5 dB~~ [TBD] during periods of rain;

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:



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;

…~~1 to maintain and process notices concerning HAPS that were received by the Bureau prior to 20 October 2007 and provisionally recorded in the Master International Frequency Register, only until 1 January 2012, unless the notifying administration informs the Bureau before that date that a particular assignment has been brought into use and provides the complete set of data elements of Appendix~~ **~~4~~**~~;~~

1. **For the frequency band 21.4-22 GHz**

**ADD** **USA/1.14/8**

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 GHz**  FIXED  MOBILE  BROADCASTING-SATELLITE  5.208B  5.530A 5.530B  5.530C 5.530D | | **21.4-22**  FIXED ADD RR.5xxx  MOBILE  5.530A 5.530C | **21.4-22**  FIXED  MOBILE  BROADCASTING-SATELLITE  5.208B  5.530A 5.530B  5.530C 5.530D 5.531 |

**ADD USA/1.14/9**

RR 5.xxx The allocation to the fixed service in the bands 21.4 - 22 GHz is identified for use 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 **XXX (WRC-19)**.

RESOLUTION XXX (WRC‑19)

**Use of the bands 21.4-22 GHz by fixed links for high altitude platform stations in the fixed service**

The World Radiocommunication Conference (Geneva, 2019),

*considering*

1. 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;
2. that WRC-97 made provision for the operation of high altitude platform stations (HAPS), also known as stratospheric repeaters, within a 2 × 300 MHz portion of the fixed-service allocation in the bands 47.2-47.5 GHz and 47.9-48.2 GHz;
3. 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 so WRC-2000 identified 27.9-28.2 GHz paired with 31-31.3 GHz in the fixed service for use by HAPS;
4. that WRC-15 decided to study additional spectrum needs for fixed HAPS links to provide broadband connectivity, including in the band 21.4-22 GHz, recognizing that the existing HAPS identifications were established without reference to today’s broadband capabilities;

*resolves*

1. that the use of HAPS within the fixed-service allocation within the 21.4-22 GHz band shall be limited to operation in the HAPS-to-ground direction;
2. that systems using HAPS in the band 21.4-22 GHz, in accordance with *resolves* 1 above, shall not cause harmful interference to the Earth Exploration Satellite Service (Passive) having a primary allocation in the band 21.4-22 GHz, taking into account the protection criterion given in the relevant ITU-R Recommendation [TBD]. 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 21.4-22 GHz shall be limited to [TBD] dB(W/MHz) under clear-sky conditions and may be increased up to [TBD] 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,

*instructs the Director of the Radiocommunications Bureau*

to implement this resolution.

1. **For the frequency band 24.25-27.5 GHz**

**ADD USA/1.14/10**

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**  RADIONAVIGATION  ADD FIXED  ADD RR 5.yyy | **24.25-24.45**  RADIONAVIGATION  FIXED ADD RR 5.xxx  MOBILE |
| **24.45-24.65**  FIXED  INTER-SATELLITE | | **24.45-24.65**  INTER-SATELLITE  RADIONAVIGATION  ADD FIXED, RR 5.yyy | **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**  INTER-SATELLITE  RADIOLOCATION-SATELLITE (Earth-to-space)  ADD FIXED, RR 5.yyy | **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-SATELLITE  (Earth-to-space) 5.535  ADD FIXED, RR 5.yyy | **24.75-25.25**  FIXED  FIXED-SATELLITE  (Earth-to-space) 5.535  MOBILE |

25.25 – 27.5 GHz

|  |  |  |
| --- | --- | --- |
| Allocation to services | | |
| Region 1 | Region 2 | Region 3 |
| **…** | | |
| **25.25-25.5**  FIXED ADD RR 5.yyy  INTER-SATELLITE 5.536  MOBILE  Standard frequency and time signal-satellite (Earth-to-space) | | |
| **25.5-27.0**  EARTH EXPLORATION SATELLITE (space-to-Earth) 5.536B  FIXED ADD RR 5.yyy  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 RR 5.yyy  FIXED-SATELLITE (Earth-to-space)  INTER-SATELLITE 5.536 5.537  MOBILE | |

**ADD USA/1.14/11**

A new allocation to Article 5 is added in Region 2 for Fixed Service for the 24.25-25.25 GHz band and designated for use by HAPS. The use of the band 24.25-27.5 GHz for HAPS is subject to the provisions of RR 5.yyy and Resolution **YYY (WRC-19)**.

RR 5.yyy The allocation to the fixed service in the bands 24.25-27.5 GHz in Region 2 is identified for use by high altitude platform stations. Such use of the fixed service allocation by HAPS is subject to the provisions of Resolution YYY **(WRC-19)**.

RESOLUTION YYY (WRC‑19)

**Use of the bands 24.25-27.5 GHz by fixed links for high altitude platform stations in the fixed service**

[TBD]

1. **For the frequency band 38 – 39.5 GHz**

**ADD USA/1.14/12**

ARTICLE 5

Frequency allocations

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

37.5 – 39.5 GHz

|  |  |  |
| --- | --- | --- |
| Allocation to services | | |
| Region 1 | Region 2 | Region 3 |
| **…** | | |
| **38.0-39.5 GHz**  FIXED ADD RR 5.zzz  FIXED-SATELLITE (space-to-Earth)  MOBILE  Earth exploration-satellite (space-to-Earth)  5.547 | | |

**ADD USA/1.14/13**

A new identification for HAPS in the global Fixed service allocation in 38-39.5 GHz is added for fixed links under new RR 5.zzz. The use of the band 38.0 – 39.5 GHz for HAPS is subject to the provisions of Resolution **ZZZ (WRC-19)**.

RR. zzz The allocation to the fixed service in the 38.0 – 39.5 GHz band is identified for use by high altitude platform stations (HAPS). Such use of the bands 38.0 – 39.5 GHz is limited to operation in the ground-to-HAPS direction and is subject to the provisions of Resolution **ZZZ (WRC-19)**.

RESOLUTION ZZZ (WRC‑19)

**Use of the bands 38.0 – 39.5 GHz by fixed links for high altitude platform stations in the fixed service**

**…**

[TBD]