**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:

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/m2/MHz, under clear sky condition:

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:

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()* 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/m2/MHz, under clear sky condition

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

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()* 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**

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

**EESS NGSO**

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

**EESS GSO**

Where () is the angle of arrival () 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)**.