**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

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 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 and 31.0-31.3 GHz,

- 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 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. ITU-R Working Party 5C developed a Preliminary New Draft Recommendation (PDNR) assessing spectrum needs for broadband HAPS at an approximate 4 GHz aggregate capacity.

**BROADBAND HAPS *(connectivity 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 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 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 *(specific applications)***

Broadband HAPS for specific applications are designed to focus on multiple usage cases, including:

* 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**

ITU-R Working Party 5C (WP 5C) is the group responsible for Agenda Item 1.14. WP 5C has, in turn, established a specific Sharing Studies Drafting 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 and carried out a number of sharing and compatibility studies, including adjacent band studies. The draft studies are currently located in the Working Party 5C Chair’s Report.

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).

The sharing and compatibility studies have been developed on a band-by-band basis as separate new reports. In general, these studies consider the impact of HAPS uplink (ground-to-HAPS) and/or downlink (HAPS-to-ground) transmissions. In most cases, the studies identify specific methods to ensure the protection of each service. The studies are based on assumptions related to the types of deployment scenarios and technical characteristics of HAPS systems which are described in the draft of a new recommendation on HAPS characteristics as well as the specific text within each sharing study.

**WP 5C MAY-JUNE 2018**

In May 2018, WP 5C completed the draft CPM text for WRC-19 Agenda Item 1.14, which contains viable methods and regulatory options to facilitate use of broadband applications via HAPS. Section 5 of the report contains draft footnotes, WRC Resolutions and modifications to the Table of Allocations for possible HAPS identifications. The draft CPM text also contains a section that characterizes the status of the studies undertaken and their results, through summaries complete with details of the pfd masks and limits for protecting incumbent services.

A power-flux density (PFD) limit can be used to ensure the protection of the fixed and mobile services from downlink emissions by HAPS platforms (HAPS-to-ground). This PFD limit 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 could be ensured through coordination at 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 this latter case of national level coordination, the use of mitigation techniques and/or geographical separation could be used to enable ubiquitous levels of 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 protection of these services is most feasible when the direction of HAPS transmission is opposite to the direction of reception of the scientific service (e.g. HAPS-to-ground with EESS passive satellite and ground-to-HAPS with EESS/SRS earth stations). 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.

**METHODS**

Methods to address Agenda Item 1.14 envisage potential global/regional HAPS designation of all existing bands and candidate bands outlined in Resolution 160. This signals that technical studies foresee the feasibility of sharing with other services in all bands with appropriate conditions to protect other services. At its May 2018 meeting, ITU-R WP 5C approved the following methods in the draft CPM text:

**Method A** – No change. The existing provisions in the Radio Regulation remain unchanged in the corresponding frequency band.

**Method B** – Designation of bands, in accordance with Resolution **160 (WRC-15)** with options. This may include, e.g. global or regional designation for HAPS, limitations regarding link directions, and inclusion of the technical conditions of operation of HAPS systems for the protection of other services. This could be achieved by new or revised footnotes to the Table of Frequency Allocations, and new or revised associated WRC Resolutions.

**Method B1** – Revision of the regulatory provisions for HAPS in the fixed service (FS) with a primary status in bands already designated for HAPS.

**Method B2** – Add new designation(s) for HAPS in bands already allocated to the FS with a primary status.

**Method B3** – Add a primary allocation to the FS and a new designation for HAPS in the band 24.25-25.25 GHz (Region 2) not already allocated to the FS.

**Method C** – Suppress the existing HAPS designation, pursuant to resolves 3 of Resolution 160 **(WRC-15)**.

| Bands | Methods and Options | | | Services Studied for Compatibility |
| --- | --- | --- | --- | --- |
| Method A (NOC) | Method B (Designate) | Method C (SUP) |
| 6 440- 6 520 MHz | √ | B1-O1 ↓  B1-O2 ↓ (NPNI) | √ | FS, MS, FSS (↑), EESS |
| 6 560- 6 640 MHz | √ | Not proposed | √ |  |
| 21.4-22 GHz (R2 only) | √ | B2-O1 ↓  B2-O2 ↓↑ (NPNI) | N/A | FS, AMS, EESS (co./adj. band), RAS |
| 24.25-25.25 GHz (R2 only) | √ | B3-O1 ↓↑  B3-O2 ↓↑ | N/A | FS, MS, ISS, FSS (↑), EESS/SRS (co./adj. band), RAS (adj. band) |
| 25.25-27.5 GHz (R2 only) | √ | B2-O1 ↓ (27-27.5 GHz only)  B2-O2 ↓↑  B2-O3 ↓↑ (NPNI) | N/A |
| 27.9-28.2 GHz | √ | B1-O1 ↓  B1-O1 ↓ (NPNI) | √ | FS, FSS (↑), MS |
| 31.0-31.3 GHz | √ | B1-O1A ↑  B1-O1B ↓  B1-O2 ↓ (NPNI) | √ | FS, EESS (adj. band), RAS (adj. band) |
| 38-39.5 GHz | √ | B2-O1A ↑  B2-O1B ↓  B2-O1C ↓↑  B2-O2 ↑ (NPNI) | N/A | FS, MS, FSS (↓), SRS (adj. band) |
| 47.2-47.5 GHz / 47.9-48.2 GHz | √ | B1 ↓↑ | √ | MS |

\* The terms O1, O2, O3 refer to the options developed for each method; the ↓ and ↑ symbols describe direction of HAPS transmission, and the term NPNI refers to application of a no-protection and no-interference status.

**PROPOSALS:**

# For the 21.4-22 GHz Band

MOD USA/1.14/1

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 identification in the 21.4-22 GHz band.*

ADD USA/1.14/2

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). Such use of the fixed-service allocation by HAPS is limited to the HAPS-to-ground direction and is subject to the provisions of Resolution**[B114-21B2-O1] (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/1.14/3

DRAFT NEW RESOLUTION [B114-21B2-O1] (WRC‑19)

Use of the bands 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

Note: No text has been developed, it may be proposed in contributions to CPM19-2

recognizing

Note: No text has been developed, it may be proposed in contributions to CPM19-2

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/m2/MHz, under clear sky condition, without the explicit agreement from the affected administration:

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

In order to compensate for additional propagation impairments in the main beam of the HAPS due to rain, any exceedance of the pfd mask shall be limited by a value equivalent to the level of rain fading up to a maximum of 20 dB.

To verify the compliance with the propose 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(El)* is the power flux density at the Earth’s surface per HAPS platform station in dBW/m2/MHz.

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:

where El is the elevation angle in° (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,

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.*

# For the 24.25-27.5 GHz Band

MOD USA/1.14/4

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 | **24.45-24.65**  FIXED  INTER-SATELLITE  MOBILE  RADIONAVIGATION |
|  | 5.533 | 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/1.14/5

**5.C114** The allocation to the fixed service in the band 24.25-25.25 GHz is designated for 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 24.25-25.25 GHz band.*

MOD USA/1.14/6

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 25.5-27.5 GHz band in Region 2 allowing HAPS to operate in the fixed service allocation.*

ADD USA/1.14/7

**5.D114** The allocation to the fixed service in the band 25.25-27.5 GHz is designated for 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 25.25-27.25 GHz band.*

ADD USA/1.14/8

DRAFT NEW RESOLUTION [C114]

**Use of the bands 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*

Note: No text has been developed, it may be proposed in contributions to CPM19-2

*resolves*

1 that for the purpose of protecting the fixed service systems in neighbouring administrations in the bands 24.25-27.5 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 dBW/m2/MHz, under clear sky condition, without the explicit agreement from the affected administration:

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

To compensate for additional propagation impairments in the main beam of the HAPS due to rain, the pfd mask can be increased in the corresponding beam by a value equivalent to the level of rain fading, but limited to a maximum of 20 dB.

To verify the compliance with the proposed 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;

2 that for the purpose of protecting the mobile service systems in neighbouring administrations in the band 24.25-25.25 GHz and 27-27.5 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 masks in dBW/m2/MHz, under clear sky condition, without the explicit agreement from the affected administration:

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

In order to compensate for additional propagation impairments in the main beam of the HAPS due to rain, any exceedance of the pfd mask shall be limited by a value equivalent to the level of rain fading.

To verify the compliance with the proposed 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;

3 that for the purpose of protecting the mobile service systems in neighbouring administrations in the band 24.25-27.5 GHz, the power flux density limit per HAPS ground 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, without the explicit agreement of the affected administration:

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:

Where:

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

*d:* is the distance between the HAPS ground station and the border of the neighbouring administration (elevation angle dependent);

*Lpol*: is the polarization discrimination in dB;

: is the clutter loss (ITU-R P.2108);



: is propagation loss (ITU-R P.452);

: is the body loss (dB), only applicable to the user equipment (UE);



4 that for the purpose of protecting the Inter Satellite service, 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°;

5 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 -10.8 dBW/MHz for off‑nadir angle higher than 95°;

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

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

7 that for the purpose of protecting the Earth Exploration Satellite passive services the EIRP per HAPS ground stations, in the band 23.6-24 GHz, shall not exceed -36 dBW/200 MHz,

8 that in order to ensure the protection of fixed satellite services from the HAPS ground station, [TBD];

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

10 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 *resolves* 4, 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.

Note: Consequential modifications of Appendix **5** should be considered.

**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.

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.

11 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, the pfd of a HAPS ground station shall not exceed -147 dB(W/m2/400 MHz) for continuum observations and -161 dB(W/m2/250 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;

12 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 -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:

where

*EIRPmax 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;

*Att618p=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 thepower 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;

13 that *resolves* 6 and 7 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,

*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.*

# For the 27.9-28.2 GHz and 31.0-31.3 GHz Bands

MOD USA/1.14/9

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 identification in the 27.9-28.2 GHz band and to suppress the existing HAPS related footnote.*

ADD USA/1.14/10

5.E114The allocation to the fixed service in the band 27.9-28.2 GHz is designated for worldwide 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 **[E114-28+31B1-O1] (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/1.14/11

5.537A

MOD USA/1.14/12

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 identification in the 31-31.3 GHz band and to suppress the existing HAPS related footnote.*

ADD USA/1.14/13

5.F114The 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. Such use of the fixed-service allocation by HAPS is subject to the provisions of Resolution **[E114-28+31B1-O1] (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/1.14/14

5.543A

ADD USA/1.14/15

DRAFT NEW RESOLUTION [E114-28+31B1-O1] (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

Note: No text has been developed, it may be proposed in contributions to CPM19-2.

recognizing

Note: No text has been developed, it may be proposed in contributions to CPM19-2.

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 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, under clear sky condition, without the explicit agreement from the affected administration:

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

In order to compensate for additional propagation impairments in the main beam of the HAPS due to rain, any exceedance of the pfd mask shall be limited by a value equivalent to the level of rain fading up to a maximum of 20 dB.

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

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;

2 that for the purpose of protecting the mobile service systems in neighboring administrations in the band 27.9-28.2 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, under clear sky condition, without the explicit agreement from the affected administration:

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

In order to compensate for additional propagation impairments in the main beam of the HAPS due to rain, any exceedance of the pfd mask shall be limited by a value equivalent to the level of rain fading.

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

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);

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 downlink shall be less than -9.7 dBW/MHz in any direction for off-nadir angle higher than 95°;

4 that for the purpose of protecting the fixed service systems in neighboring administrations in the band 31-31.3 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, under clear sky condition, without the explicit agreement from the affected administration:

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

In order to compensate for additional propagation impairments in the main beam of the HAPS due to rain, any exceedance of the pfd mask shall be limited by a value equivalent to the level of rain fading up to a maximum of 20 dB.

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

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);

5 that in order to ensure the protection of EESS (passive), 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;

6 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:

7 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:

where:

*AttRe*c P.452-16: is the attenuation in dB based on Recommendation ITU-R P.452-16 propagation model with p = 2%;

e.i.r.p.: is the maximum HAPS EIRP density level in dBW/MHz/500MHz (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 dB(W/m²/500MHz);

8 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:

where:

*EIRPmax clear sky*: is the maximum EIRP towards the RAS station at which the HAPS platform station operates under clear sky condition in dB(W/500 MHz);

*Az:* is the azimuth from the HAPS platform toward the RAS station;

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

*Att618p=2%:* is the attenuation from recommendation 618 corresponding to p=2% of the time at the radio astronomy location;

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

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

9 that *resolves* 8 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.*

# For the 38-39.5 GHz Band

MOD USA/1.14/16

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 identification in the 38-39.5 GHz band.*

ADD USA/1.14/17

**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). 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.*

# For the 47.2-47.5 GHz and 47.9-48.2 GHz Bands

MOD USA/1.14/18

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 identification in the 47.2-47.5 GHz band.*

MOD USA/1.14/19

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 identification in the 47.9-48.2 GHz band.*

MOD USA/1.14/20

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). 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)

***Reasons:*** *To modify footnote 5.552A to reflect an updated Resolution 122 with allowances for increases in EIRP density levels during periods of rain.*

MOD USA/1.14/21

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

…

recognizing

…

*c)* 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;

…

resolves

…

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 20 dB during periods of rain;

…

invites administrations

…

instructs the Director of the Radiocommunication Bureau

…

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