**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/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 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(El)* is the power flux density at the Earth’s surface per HAPS platform station in dBW/m2/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:

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 | **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/1.14/10**

**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*

1. 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**;
2. 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/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 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 (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:

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:

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* 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:

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**

**EESS NGSO**

**EESS GSO**

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:

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;

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;

1. 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/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 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;

*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/m2/MHz for more than 0.1% of deployment, without the explicit agreement from the affected administration:

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);

*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°;

4that 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:

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:

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:

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/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 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:

where:

*EIRPmax 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;

*Att618p=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/m2/MHz under clear sky conditions without the explicit agreement from 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:

*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);

*Lpol* polarization discrimination of 3dB;

clutter loss (ITU-R P.2108);

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:

Where:

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;

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° < 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 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*(ϕ) = *Gmax* − 2.5 × 10−3  for 0° < ϕ < ϕ*m*

*G*(ϕ) = 39 − 5 log (*D*/λ) − 25 log ϕ for ϕ*m* ≤ ϕ < 48°

*G*(ϕ) = −3 − 5 log (*D*/ λ) for 48° ≤ ϕ ≤ 180°

where:

*Gmax* :maximum antenna gain (dBi)

*G*(ϕ) :gain (dBi) relative to an isotropic antenna

ϕ : off-axis angle (degrees)

 expressed in the same units

 degrees

*G* : gain of the first side lobe

2  15 log (*D*/) (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  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:



where

pfd = power flux density, dB(W/m2) in a reference bandwidth, BREF

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

λ = wavelength, m

GRX = receive gain in the direction of the interferer, dBi

k = Boltzmann constant, dB(J/K)

TRX = receive system total noise temperature (including Noise Figure), K

BREF = 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.*

# 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.[[1]](#footnote-1)

…

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

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*

1. 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**;
2. 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/m2/MHzwithout the explicit agreement from the affected administration:

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/m2/MHz without the explicit agreement from the affected administration:

PFD(δ) = -113.3 (dBW/m2/1 MHz) for 0° ≤ δ ≤ 4°

PFD(δ) = -113.3 + 1.2 \* (δ - 4) (dBW/m2/1 MHz) for 4° < δ ≤ 9°

PFD(δ) = -107.3 (dBW/m2/1 MHz) for 9° < δ ≤ 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(δ) = -122.7 (dBW/m2/1 MHz) for 0° ≤ δ ≤ 2°

PFD(δ) = -122.7 + 2 \* (δ - 2) (dBW/m2/1 MHz) for 2° < δ ≤ 2.3°

PFD(δ) = -122.6 + 1.5 \* (δ - 2)(dBW/m2/1 MHz) for 2.3° < δ ≤ 7.9°

PFD(δ) = -113.9 (dBW/m2/1 MHz) for 7.9° < δ ≤ 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/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.]

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*1and *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/m2/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/m2/MHz without the explicit agreement from the affected administration:

PFD(δ) = -110.8 (dBW/m2/1 MHz) for 0° ≤ δ ≤ 4°

PFD(δ) = -110.8 + 1.5 \* (δ - 4) (dBW/m2/1 MHz) for 4° < δ ≤ 11.5°

PFD(δ) = -101.8 (dBW/m2/1 MHz) for 11.5° < δ ≤ 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)).

…

1. 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° < 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 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*(ϕ) = *Gmax* − 2.5 × 10−3  for 0° < ϕ < ϕ*m*

*G*(ϕ) = 39 − 5 log (*D*/λ) − 25 log ϕ for ϕ*m* ≤ ϕ < 48°

*G*(ϕ) = −3 − 5 log (*D*/ λ) for 48° ≤ ϕ ≤ 180°

where:

*Gmax* :maximum antenna gain (dBi)

*G*(ϕ) :gain (dBi) relative to an isotropic antenna

ϕ : off-axis angle (degrees)

 expressed in the same units

 degrees

*G* : 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/(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;

[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/(m2 · MHz)) for    0°  ≤ θ ≤   4°

−109 + 1.2 (θ −4)     dB(W/(m2 · MHz)) for    4°  < θ ≤ 11.5°

−100  dB(W/(m2 · MHz)) for  11.5°  < θ ≤ 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.

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**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.

# 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:

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)**.

*\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

**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*

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).

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(El)* is the power flux density at the Earth’s surface per HAPS platform station in dBW/m2/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:

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:

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 | **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 |
| **\* \* \*** |  |  |

**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/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 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 (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/m2/MHz for more than 0.1% of deployment, without the explicit agreement from the affected administration:

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:

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* 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/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 pfd mask, the following equation was used:

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);

*Lpol* polarization discrimination in dB;

clutter loss (ITU-R P.2108);

propagation loss (ITU-R P.452);

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:

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**

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.

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/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;

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:

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;

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;

1. 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:

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:

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:

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:

where:

*AttRe*c 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:

where:

*EIRPmax 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;

*Att618p=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.

*\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

1. 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>. [↑](#footnote-ref-1)