RESOLUTION 168 (WRC-19)

Use of the frequency band 38-39.5 GHz by high-altitude platform stations in the fixed service

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

considering

a) that there is a need for greater broadband connectivity in underserved communities and in rural and remote areas;

b) that WRC-15 invited the ITU Radiocommunication Sector (ITU-R) to study additional spectrum needs for fixed high-altitude platform station (HAPS) links to provide broadband connectivity and to facilitate the use of HAPS links on a global or regional basis, recognizing that the existing HAPS identifications were established without reference to today's broadband capabilities;

c) that Report ITU-R F.2439 provides updated deployment and technical characteristics of broadband HAPS systems;

d) that Report ITU-R F.2438 contains worldwide spectrum needs of HAPS systems;

e) that ITU-R has conducted studies dealing with compatibility between systems using HAPS and existing services in the frequency band 38-39.5 GHz, leading to Report ITU-R F.2475,

considering further

that current technologies, such as HAPS, can be used to deliver broadband applications for broadband connectivity and disaster-recovery communications with minimal ground network infrastructure,

recognizing

a) that, during periods of rain, the equivalent isotropically radiated power (e.i.r.p.) of the HAPS beam suffering rain fade may be increased by a level commensurate with the level of rain fade, by up to 20 dB above the e.i.r.p. under clear-sky conditions indicated in Appendix **4**;

b) that existing services shall be protected from HAPS operations, and no undue constraints shall be imposed on the future development of existing services by HAPS,

resolves

1 that, for the purpose of protecting fixed-service systems in the territory of other administrations in the frequency band 38-39.5 GHz, the power flux-density (pfd) level per HAPS produced at the surface of the Earth in the territory of other administrations shall not exceed the following limits, developed for clear-sky conditions, unless the explicit agreement of the affected administration is provided at the time of notification of HAPS:

-137	dB(W/(m² · MHz))	for	$0° \le \theta \le 13°$
$-137 + 3.125\ (\theta - 13)$	dB(W/(m² · MHz))	for	$13° < \theta \le 25°$

$-99.5 + 0.5\ (\theta - 25)$	dB(W/(m² · MHz))	for	$25° < \theta \leq 50°$
-87	dB(W/(m² · MHz))	for	$50° < \theta \leq 90°$

where θ is the angle of arrival of the incident wave above the horizontal plane, in degrees;

2 that, with regard to the protection of fixed-service stations with pointing elevation beyond 15°, an administration believing that unacceptable interference may still be caused shall, within four months of the date of publication of the relevant International Frequency Information Circular (BR IFIC), provide its comments with relevant justification to the notifying administration;

3 that, for the purpose of protecting mobile-service systems in the territory of other administrations in the frequency band 38-39.5 GHz, the power flux-density (pfd) level per HAPS produced at the surface of the Earth in the territory of other administrations shall not exceed the following limits, developed for clear-sky conditions, unless the explicit agreement of the affected administration is provided at the time of notification of HAPS:

-107.8	dB(W/(m² · MHz))	for	$0° \leq \theta \leq 4°$
$-107.8 + 1.5\ (\theta - 4)$	dB(W/(m² · MHz))	for	$4° < \theta \leq 10°$
-98.8	dB(W/(m² · MHz))	for	$10° < \theta \leq 90°$

where θ is the angle of arrival of the incident wave above the horizontal plane, in degrees.

The limits above take into account the 3 dB aggregate loss due to polarization mismatch, and body loss was not taken into account;

4 that, for the purpose of protecting mobile-service systems operating in the frequency band 38-39.5 GHz in the territory of neighbouring administrations, coordination of a transmitting HAPS ground station is required when the pfd in dB(W/(m² · MHz)) at the border of a neighbouring administration exceeds a pfd limit of −110.8 dB(W/(m² · MHz)), and the pfd values shall be verified considering a percentage of time of 1% in the relevant propagation model of the most recent version of Recommendation ITU-R P.452 and a mobile-station antenna height of 20 m;

5 that, for the purpose of protecting earth stations in the geostationary-satellite (GSO) fixed-satellite service (FSS) (space-to-Earth) in the territory of other administrations, the pfd in the territory of other neighbouring administrations shall not exceed the following values, unless the explicit agreement of the affected administration is provided at the time of notification of HAPS:

$-169.9 + 1954\ \alpha^2$	dB(W/(m² · MHz))	for	$0° \leq \alpha < 0.136°$
-133.9	dB(W/(m² · MHz))	for	$0.136° \leq \alpha < 1°$
$-133.9 + 25 \log \alpha$	dB(W/(m² · MHz))	for	$1° \leq \alpha < 47.9°$
-91.9	dB(W/(m² · MHz))	for	$47.9° \leq \alpha \leq 180°$

where α is the minimum angle between the line to the HAPS (taking into account the HAPS location tolerance) and the lines to the GSO arc, in degrees, at any point on the territory of other administrations.

To calculate the pfd produced by a HAPS platform, the following equation shall be used:

$$pfd = e.i.r.p. - 10\log\left(4\pi d^2\right) - Att_{gaz}$$

where:

d: distance in metres between the HAPS and the GSO FSS earth station

Att_{gaz}: attenuation in dB due to atmospheric gases on the HAPS-to-GSO FSS earth station path (Recommendation ITU-R P.676)

e.i.r.p.: maximum HAPS e.i.r.p. spectral density in the direction of the GSO FSS earth station in dB(W/MHz);

6 that, for the purpose of protecting non-geostationary-satellite (non-GSO) systems in the FSS (space-to-Earth) in the territory of other administrations from HAPS interference, administrations implementing HAPS shall seek explicit agreement with any other administration when the distance between the HAPS nadir point and any point on such other administration's border is less than the distance calculated by the following formula, where the minimum earth station elevation angle is 10 degrees; this does not preclude lower elevation angles being used for the operation of earth stations; and this distance can be decreased by explicit agreement of affected administrations on a case-by-case basis:

$$d = \frac{\pi R}{180}\left(90 - \theta - \text{asin}\left(\frac{R}{R+h}\cos\theta\right)\right)$$

where:

R: Earth's radius (6 371 km)

θ: minimum elevation angle at the non-GSO FSS earth station (10°)

h: HAPS altitude (km);

7 that, in making assignments to HAPS systems (HAPS ground stations and HAPS) in the fixed service in the frequency band 38-39.5 GHz, administrations shall protect the space research service (SRS) (space-to-Earth) in the frequency band 37-38 GHz from harmful interference by unwanted emissions, taking into account the SRS (space-to-Earth) protection level of −217 dB(W/Hz) at the input of the SRS receiver with 0.001% exceedance due to atmospheric and precipitation effects, as referred to in the relevant ITU-R Recommendations;

8 that, for the purpose of protecting earth stations in the GSO and non-GSO FSS (space to-Earth) in the territory of neighbouring administrations, coordination of a transmitting HAPS ground station is required when the pfd in dB(W/(m² · MHz)) at the border of a neighbouring administration exceeds a pfd limit of −111.3 dB(W/(m² · MHz)) for non-GSO 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 of the most recent version of Recommendation ITU-R P.452 and an FSS earth station antenna height of 10 m;

9 that the notifying administration for the HAPS system shall send to the Radiocommunication Bureau (BR) a commitment that the HAPS operation shall be in conformity with the Radio Regulations, including this Resolution;

10 that administrations planning to implement a HAPS system in the frequency band 38-39.5 GHz shall notify the frequency assignments by submitting all mandatory elements of Appendix **4** to BR for the examination of compliance with respect to this Resolution with a view to their registration in the Master International Frequency Register;

11 that the notifying administration for the HAPS system shall send to BR a commitment that, upon receiving an unacceptable interference report with relevant justification on exceedance of the limits set in this Resolution, the notifying administration for the HAPS system shall take the required action to eliminate or reduce interference to an acceptable level,

resolves further

that, should an administration operating HAPS agree, with its neighbouring administrations, to levels higher than the limits contained in this Resolution, such agreement shall not affect other administrations that are not party to that agreement,

instructs the Director of the Radiocommunication Bureau

to take all necessary measures to implement this Resolution,

invites the ITU Radiocommunication Sector

to develop a Recommendation to provide technical guidance to facilitate the implementation of HAPS operations while ensuring the protection of non-GSO FSS earth stations.