WRC-15 Agenda Item 10

With Respect to Broadband over HAPS

IWG-2 members were not able to reach consensus on a proposal for WRC-15 agenda item 10 regarding broadband over High Altitude Platform Stations (HAPS) and, therefore, forwards two views on how the FCC should handle this matter.

View A is supported by Alcatel-Lucent and Harris, Wiltshire and Grannis.

View B is supported by DirecTV, EchoStar Corporation, Inmarsat, Intelsat, New Wave Spectrum Partners LLC, SES Americom and 21st Century Fox.

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VIEW A

VIEW A:

The last several years have witnessed substantial investment in the U.S. in research and development in unmanned aerial systems (UAS), including for the delivery of broadband communications. Recent test deployments of broadband provided from stations on lightweight, solar-powered aircraft operating at approximately 20 km above ground in the stratosphere have demonstrated the potential of providing connectivity to underserved communities with minimal ground-level infrastructure and maintenance. Stations operating at 20 km are high enough to provide service to a large footprint but low enough to provide dense coverage at low latency. These stations, located in the stratosphere above weather incidents, are also resilient to storms below and therefore can be an effective tool during and after a natural disaster.

Industry estimates that the economic impact of the commercial UAS industry will be more than $80 billion over the next decade.[1] President Barack Obama has recognized both the "positive economic impact" of commercial UAS use and its capacity to provide, as compared to manned aircraft, lower-cost operation and augmented capabilities[2] for a range of services. Most commercial deployments to date have been of *low altitude* UAS. Industry has also invested in research and development of UAS operating at higher altitudes, including for broadband communications. U.S. policymakers have recognized that "UAS could provide Internet service to remote areas by remaining aloft for months at a time—far longer than manned aircraft."[3]

While tests of unmanned aircraft at high altitudes for Internet service are recent, high altitude platform stations (HAPS) have been studied by the ITU-R for about two decades. High Altitude Platform Stations (HAPS) are defined in Article 1.66A of the Radio Regulations as "*[a] station located on an object at an altitude of 20 to 50 km and at a specified, nominal, fixed point relative to the Earth.*" Some entities are developing unmanned aircraft that will circle for several months at approximately 20 km in the stratosphere to maintain coverage of a constant service area on the ground. Such nominally fixed aircraft, which could be considered HAPS, are one promising model for delivery of broadband from a high altitude station, and can be used by broadband providers to offer service to underserved communities.

The ITU-R has identified three bands that may prove viable for broadband delivery from HAPS in developing countries, but most of these are subject to challenging technical restrictions, have limited geographic participation, or may not provide sufficient capacity to deliver broadband at the speeds consumers have come to expect. In the last few years, lightweight aircraft technology

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1 *See, e.g., The Economic Impact of Unmanned Aerial Systems Integration in the United States*, The Association of Unmanned Vehicle Systems International (AUVSI) (March 2013), available at http://www.auvsi.org/econreport

2 *See* https://www.whitehouse.gov/the-press-office/2015/02/15/presidential-memorandum-promoting-economic-competitiveness-while-safegua

3 John B. Morris Jr., *Testimony of John B. Morris, Jr., Assoc. Adm'r - Office of Policy Analysis and Dev., NTIA, Before the Subcommittee on Aviation Operations, Safety, and Security Comm. on Commerce, Science, and Transp. United States Senate* (Mar. 25, 2015) http://www.ntia.doc.gov/speechtestimony/2015/te stimony-associate-administrator-morris-senate-commerce-committee-unmanned-aircraft-systems.

has improved immensely, making broadband from HAPS platforms viable. As President Obama has recognized, UAS "technology continues to improve rapidly, and increasingly UAS are able to perform a variety of missions with greater operational flexibility and at a lower cost than comparable manned aircraft."[4]

With demand for broadband continuing to grow, the identifications for HAPS, now limited, may need to be expanded, geographically and spectrally, in order to allow lightweight, nominally fixed-position UAS to deliver broadband consistent with user demand. The geographic limitations imposed by existing regulations are especially acute in Caribbean, South American, and Central American nations within Region 2. Global identifications facilitating the delivery of broadband from HAPS would provide the economies of scale necessary to make this technology affordable in underserved areas, especially those with terrain features that make it challenging to deploy service and those that have suffered natural or other disasters.

The attached View A would invite WRC-19, consistent with the ITU's goals to promote reliable broadband access in underserved and remote communities, to consider, on the basis of ITU-R studies undertaken during the study cycle, appropriate regulatory actions, potentially including expansion of the frequency ranges of existing identifications for HAPS within existing fixed service allocations, identifying additional frequency ranges for use by HAPS, and revising geographic, technical, and regulatory restrictions associated with existing HAPS identifications.

4 *See supra* at n.2.

ATTACHMENT TO VIEW A:

Draft

United States of America

PROPOSALS FOR THE WORK OF THE CONFERENCE

Agenda item 10

10 to recommend to the Council, items for inclusion in the agenda for the next WRC, and to give its views on the preliminary agenda for the subsequent conference and on possible agenda items for future conferences, in accordance with Article 7 of the Convention;

Background

Recent test deployments of broadband provided from stations on lightweight, solar-powered aircraft operating at approximately 20 km above ground in the stratosphere have demonstrated the potential of providing connectivity to underserved communities with minimal ground-level infrastructure and maintenance. Stations operating at 20 km are high enough to provide service to a large footprint but low enough to provide dense coverage at low latency. Thus, they can provide a high quality of service to underserved communities. These stations are also highly resilient in the face of natural disasters and therefore can be an effective tool for disaster recovery.

Significant investment in unmanned aerial systems (UAS) for commercial applications has occurred in the last few years. Industry estimates that the economic impact of the commercial UAS industry will be more than $80 billion over the next decade.[1] U.S. President Barack Obama has recognized both the "positive economic impact" of commercial UAS use and its capacity to provide, as compared to manned aircraft, lower-cost operation and augment existing capabilities[2] for a range of services. Most commercial deployments to date have been of low altitude UAS. Industry has also invested in research and development of UAS operating at higher altitudes, including for broadband communications. U.S. policymakers have recognized that "UAS could

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1 See e.g. *The Economic Impact of Unmanned Aerial Systems Integration in the United States*, The Association of Unmanned Vehicle Systems International (AUVSI) (March 2013), available at http://www.auvsi.org/econreport

2 https://www.whitehouse.gov/the-press-office/2015/02/15/presidential-memorandum-promoting-economic-competitiveness-while-safegua

provide Internet service to remote areas by remaining aloft for months at a time—far longer than manned aircraft."[3]

While tests of unmanned aircraft at high altitudes for Internet service are recent, high altitude platform stations (HAPS) have been studied by the ITU-R for about two decades, beginning for WRC-1997. High Altitude Platform Stations (HAPS) are defined in Article 1.66A of the Radio Regulations as "*[a] station located on an object at an altitude of 20 to 50 km and at a specified, nominal, fixed point relative to the Earth.*" Some entities are developing unmanned aircraft that will circle for several months at approximately 20 km in the stratosphere to maintain coverage of a constant service area on the ground. Such nominally fixed aircraft, which could be considered HAPS, are one promising model for delivery of broadband from a high altitude, and can be used by broadband providers to offer service to underserved communities.

The initial HAPS identification provided for HAPS use in the fixed service at 47.2-47-5 GHz and 47.9-48.2 GHz.[4] Because of concern with rain fade in that range, WRC-2000 agreed on HAPS identification for 27.9 – 28.2 GHz (fixed downlink),[5] paired with 31.0 – 31.3 GHz (fixed uplink) outside Region 2.[6] Also at WRC-2000, the bands 1 885 – 1 980 MHz, 2 010 – 2 025 MHz and 2 110 – 2 170 MHz were identified for HAPS operating as IMT base stations. In WRC-12, five countries joined a footnote for a HAPS designation in the fixed service for 6 440 – 6 520 MHz (HAPS-ground) and 6 560-6 640 MHz (ground-HAPS).

Despite these designations, few HAPS systems have been deployed.[7] However, in the last few years, lightweight aircraft technology has improved immensely, making broadband from HAPS platforms viable. As President Obama has recognized, UAS "technology continues to improve rapidly, and increasingly UAS are able to perform a variety of missions with greater operational flexibility and at a lower cost than comparable manned aircraft."[8]

In addition, since 1997, demand for broadband has increased markedly. The designations for HAPS, now geographically limited, may need to be expanded, geographically and spectrally, in order to allow lightweight, nominally fixed-position UAS to deliver broadband consistent with user demand. The geographic limitations imposed by existing regulations are especially acute in Caribbean, South American, and Central American nations within Region 2. Global identifications facilitating the delivery of broadband from HAPS would provide the economies of scale necessary to make this technology affordable in underserved areas, especially those with terrain features that make it challenging to deploy conventional terrestrial networks and those that have suffered natural or other disasters.

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[3] John B. Morris Jr., *Testimony of John B. Morris, Jr., Assoc. Adm'r - Office of Policy Analysis and Dev., NTIA, Before the Subcommittee on Aviation Operations, Safety, and Security Comm. on Commerce, Science, and Transp. United States Senate* (Mar. 25, 2015) http://www.ntia.doc.gov/speechtestimony/2015/te stimony-associate-administrator-morris-senate-commerce-committee-unmanned-aircraft-systems.

[4] ITU Radio Reg. § 5.552A.

[5] ITU Radio Reg. § 5.537A.

[6] ITU Radio Reg. § 5.543A.

[7] At least one system was deployed, the SkyNet system in Japan. *See* http://cdn.intechopen.com/pdfs-wm/9006.pdf. But generally speaking, HAPS has not seen widespread commercial deployment.

[8] See supra at n.2.

In addition to expanded geographic reach, additional spectrum may be required to support modern broadband service. Therefore, the frequency bands currently allocated to the Fixed Service should be studied for additional identifications for HAPS.

Further studies on appropriate bands for links supporting HAPS would facilitate deployment of reliable broadband access in underserved communities, rural and remote areas, consistent with the ITU's goals. The following proposal puts forth a new agenda item for WRC-19 to consider the results of studies on the delivery of broadband applications by HAPS, and related ITU-R Recommendations and Resolutions, and take appropriate action.

Proposals

MOD USA/10/1

RESOLUTION 808 (WRC-15)

Agenda for the 2019 World Radiocommunication Conference

The World Radiocommunication Conference (Geneva, 2015),

Reasons: To modify the agenda for WRC-19 to add a new item.

ADD USA/10/2

2.x to consider, on the basis of ITU-R studies in accordance with Resolution [USA/10/XX], appropriate regulatory actions, potentially including expansion of the frequency ranges of existing identifications for HAPS within existing fixed service allocations, identifying additional frequency ranges for use by HAPS in accordance with Resolution [USA/10/XX], and revising geographic, technical, and regulatory restrictions associated with existing HAPS identifications.

Reasons: To facilitate access by underserved communities, as well as residents in rural and remote areas, to affordable and reliable broadband services.

ADD USA/10/3

RESOLUTION [USA/10/XX] (WRC-15)

Facilitating access to broadband applications delivered from HAPS

The World Radiocommunication Conference (Geneva, 2015),

considering

a) that the ITU is committed to bringing the benefits of modern communication technologies to people everywhere in an efficient, safe, easy and affordable manner;
b) that existing identifications for high altitude platform stations (HAPS) are in a limited number of countries and therefore underserved communities in many countries do not benefit from global economies of scale;

c) there is an urgent need for greater broadband connectivity and telecommunications services in underserved communities and in rural and remote areas;
d) that some entities are testing the delivery of broadband over lightweight, solar-powered aircraft that are designed to circle at approximately 20 kilometers for several months at a nominal fixed point relative to the ground below;
e) that current technologies can be used to deliver broadband services from base stations operating at high altitudes;
f) that high altitude platform stations can provide broadband connectivity in remote areas, including mountainous, coast, and sandy desert areas;
g) that high altitude platform stations can provide broadband connectivity with minimal ground network infrastructure, and therefore can be effective for disaster recovery;
h) that HAPS, which operate at a fixed point relative to the earth as defined in the radio regulations, are one promising model for delivering mobile broadband;

recognizing

a) the importance of protecting existing services and users;
b) that HAPS is not a service but a type of station from which either mobile or fixed services may be provided;
c) that certain bands are presently identified for use by HAPS in limited areas of the world, including the 1 885 – 1 980 MHz,[1] 2 010 – 2 025 MHz, and 2 110 – 2 170 MHz mobile allocations[2] as well as the fixed allocations in the 6 440 – 6 520 MHz paired with 6 560 – 6 640 MHz[3]; and 27.9 – 28.2 GHz,[4] paired with 31.0 – 31.3 GHz[5] bands;
d) that the severe geographical or technical limitations in identifications for HAPS in *recognizing c)* result in no current global identifications for HAPS to deliver broadband;
e) that the existing HAPS identifications were established without reference to today's broadband needs;
f) that Recommendation ITU-R M.1456 noted that links between two High Altitude Base Stations (HAPS) and links between HAPS and HAPS system ground stations will need to be studied and coordinated;
g) that Resolution 233 (WRC-12) noted that mobile broadband systems can help reduce the digital divide between urban and rural areas, including underserved communities;
h) that Resolution 233 (WRC-12) also noted the need to continually take advantage of technological developments to increase the efficient use of spectrum and facilitate spectrum access;

1 ITU Radio Reg. §§ 5.388A-5.388B.
2 *Id.*.
3 ITU Radio Reg. § 5.457.
4 ITU Radio Reg. § 5.537A.
5 ITU Radio Reg. § 5.543A.

i) that Resolution 233 (WRC-12) further noted that harmonized worldwide bands and harmonized frequency arrangements for mobile broadband systems are highly desirable in order to achieve the benefits of economies of scale;

Resolves to invite ITU-R

1) to study additional spectrum requirements, taking into account:

   – technical and operational characteristics of HAPS systems, including the evolution of HAPS through advances in technology and spectrally-efficient techniques, and their deployment;

   – the possibility of modifying the geographic, technical, and regulatory restrictions associated with existing HAPS footnote identifications listed in *recognizing c)* to facilitate access to broadband, taking into account the technical characteristics of newer configurations of stratospheric broadband systems and the evolving user needs, particularly in underserved, rural, and remote areas and areas suffering from disasters;

2) to conduct studies on the feasibility of identifying fixed service allocations for the use of HAPS in the frequency ranges of 5 925 MHz – 15.35 GHz, 21.2 GHz – 22.0 GHz, and 23.6 - 29.1 GHz which are not subject to Appendices 30, 30A, and 30B;

3) to study sharing and compatibility between broadband applications delivered over high altitude platform stations and existing services;

4) to develop ITU-R Recommendations and Reports, as appropriate, taking into account *resolves to invite ITU-R* 1, 2, and 3 above.

further resolves to invite WRC-19

to consider, on the basis of the studies conducted under the *resolves to invite ITU-R* above, appropriate regulatory actions, potentially including expansion of the frequency ranges of existing identifications for HAPS within existing fixed service allocations, identifying additional frequency ranges for use by HAPS in accordance with *resolves to invite ITU-R* 2, and revising geographic, technical, and regulatory restrictions associated with existing HAPS identifications.

Reasons: To facilitate the delivery of current generation of broadband services to underserved communications over affordable and reliable infrastructure.

ATTACHMENT

PROPOSAL FOR FUTURE AGENDA ITEM FOR BROADBAND FROM HIGH ALTITUDE BASE STATIONS

Subject: Proposed Future WRC Agenda Item for WRC-2019 to consider the results of studies on the delivery of broadband applications by HAPS, and whether changes are needed to the set of existing bands identified for use by HAPS and ITU-R Recommendations and Resolutions to facilitate the delivery of broadband to underserved communities, taking actions as appropriate.

Origin: United States of America

Proposal: To study high altitude platform station operations for broadband.

Background/reason:
Test deployments of broadband provided from stations operating at approximately 20 km above ground in the stratosphere have demonstrated the potential of providing connectivity to underserved communities with minimal ground-level infrastructure and maintenance. Stations operating at 20 km are high enough to provide service to a large footprint but low enough to provide dense coverage at low latency. Thus, they can provide a high quality of service to underserved communities at reasonable cost. These stations are also highly resilient in the face of natural disasters and therefore can be an effective tool for disaster recovery. The ITU-R has recognized that broadband systems contribute to global economic and social development and that broadband systems can help reduce the digital divide between urban and rural areas, including underserved communities. Studies are required, however, to ensure that existing ITU-R HAPS identifications are sufficient to enable the current generation of broadband technologies to be delivered over HAPS and to possibly identify additional ranges for identifications.

Radiocommunication services concerned: Amateur, Amateur-satellite, Broadcasting-Satellite, Earth Exploration Satellite, Fixed, Fixed-Satellite (space-to-Earth, and Earth-to-space), Inter-Satellite, Meteorological Satellite, Mobile, Mobile Satellite, Radio Astronomy. Radiolocation, Radiolocation-satellite, Radionavigation, Radionavigation-Satellite, Space research (space-to-Earth, and Earth-to-space), Standard frequency and time signal-satellite (space-to-Earth, and Earth-to-space).

Indication of possible difficulties: None foreseen.

Previous/ongoing studies on the issue: Recs. ITU-R F.1569, F.1570, F.1607, F.1609, F.1612, F.1764, F.1891, and F.2011, provide requirements and studies on the provision of HAPS operating in the fixed service. Recs. ITU-R M.1456 and M.1641 provide requirements and studies on the provision of mobile services from HAPS using certain bands around 1.9/2.1 GHz. Recs. ITU-R SF.1601 and SM.1633 provide propagation, interference mitigation, compatibility, and other technical analyses regarding the operation of HAPS.

Studies to be carried out by: SG 5	***with the participation of:*** SG 4 and SG 7

ITU-R Study Groups concerned: SG 4, 5, 6, and 7

ITU resource implications, including financial implications (refer to CV126): Minimal

Common regional proposal: Yes/No ***Multicountry proposal:*** Yes/No
Number of countries:

Remarks

VIEW B

VIEW B: Alternative Formulation of Potential Future Agenda Item Regarding HAPS That Limits Frequency Bands to be Studied and Provides Protection for Existing Services

View B (attached) proposes revisions to the draft proposal in View A for a future agenda item to address the use of HAPS for mobile broadband services.

View B is supported by DirecTV, EchoStar Corporation, Inmarsat, Intelsat, New Wave Spectrum Partners LLC, SES Americom and 21st Century Fox.

There are four areas where View B proponents differ from View A proponents on the formulation of the potential future WRC agenda item to accommodate HAPS:

First, in *resolves to invite ITU-R* 2, the View B proponents do not agree to the broad frequency band ranges that are included for study. We find the ranges are too broad – particularly with the formulation in the latest version of View A, which calls for studies on the entire ranges of 5925 MHz-15.3 GHz and 23.6-29.1 GHz (other than the App. 30/30A/30B bands), rather than "portions" of those bands as proposed prior to the latest iteration. We are not prepared to endorse studies of HAPS feasibility in several frequency ranges that are heavily used for FSS services (including the C-band uplink spectrum, Ku-band uplink and downlink spectrum, and Ka-band uplink spectrum). We could endorse *resolves to invite ITU-R 2* if it were revised to read as follows:

> "2) to conduct studies on the feasibility of identifying portions of the fixed service allocations in the frequency ranges of 7.075-8.5 GHz, 10.0-10.68 GHz, 14.8-15.35 GHz, 21.2-21.4 GHz, 22.0-23.6 GHz and 24.75-27.0 GHz which are not subject to Appendices 30 and 30B for the use of HAPS;

Second, the View B proponents do not agree to the formulation of the *resolves to invite ITU-R* insofar as they fail completely to address protection of existing services. In prior versions of the draft proposal in View A, there was language that called for taking account of the requirements of existing services and users in bands to be studied (including both bands currently identified for HAPS and bands to be considered anew). The View B proponents had proposed consolidating this language as it initially appeared in *resolves to invite ITU-R* 1 and 4 from Document IWG-2/063R4 into a new version of *resolves to invite ITU-R* 3 that replicated the core protections for existing services that is found in this well-balanced aspect of Resolution 233 (WRC-12) for IMT/mobile broadband. Unfortunately, in the version of the draft proposal that is included in View A, the View A proponent retained the removal of the protection concept from *resolves to invite ITU-R* 1 and 4, and rejected in full the consolidated, balanced approach to *resolves to invite ITU-R* 3 the View B proponents had proposed. This is a dramatic and significant step backwards on the path to possible consensus, and is unacceptable to the View B proponents. As a result, there are no provisions in the *resolves* of the View A draft resolution calling for protection of existing services. We could endorse *resolves to invite ITU-R* 3 if it were revised to read as follows:

> "3) that the studies referred to in *resolves to invite ITU-R* 1 and 2 include sharing and compatibility studies with services already having allocations in the current and potential future bands identified for HAPS and in adjacent bands, as appropriate, taking into account the current and planned use of these bands by the existing services, as well as the applicable studies already performed in ITU-R;"

Third, a minor change should be made to the *further resolves to invite WRC-19* to improve readability and remove ambiguity. In particular, we are confused by the proposed reference generally to "identifying additional frequency ranges for use by HAPS …" when even in the View A version, those additional ranges are limited to bands with current fixed service allocations.

Finally, with respect to the phrasing of the proposed WRC-19 agenda item itself, the View A proponents have now proposed to integrate the idea that the potential bands for identification for HAPS would not be limited to fixed service allocations. Although the wording now states that any identification of additional frequency ranges for HAPS beyond fixed service allocations would be "in accordance with" the proposed resolution, the View B proponents emphasize that their view of the frequency allocations to be considered for any expansion of HAPS would be limited to specific fixed service allocations, as explained above. Accordingly, the View B proponents prefer that any formulation of the proposed agenda item for HAPS be limited to consideration of any additional frequency ranges that are within existing fixed service allocations.

In the Attachment to View B, we show all of the changes we propose to the draft proposal in View A to make this acceptable. We have reproduced here only the agenda item, *resolves to invite ITU-R* and *further resolves to invite WRC-19* portions of the proposal. We have no disagreement with the reasons or the early portions of the Draft Resolution USA/10/XX, Facilitating access to broadband applications derived from HAPS. We neither agree nor disagree with the background section of the proposal, where the View A proponents apparently envision that HAPS platforms of the type they wish to study would also be considered on some level to be unmanned aerial systems (UAS).

ATTACHMENT TO VIEW B:

I. Changes to Draft WRC-19 Agenda Item:

ADD USA/10/2

2.x to consider, on the basis of ITU-R studies in accordance with Resolution [USA/10/XX], appropriate regulatory actions, potentially including expansion of the frequency ranges of existing identifications for HAPS within existing fixed service allocations~~, identifying additional frequency ranges for use by HAPS~~ in accordance with Resolution [USA/10/XX], and revising geographic, technical, and regulatory restrictions associated with existing HAPS identifications.

II. Changes to Resolves Portion of Draft Resolution USA/10/XX, Facilitating access to broadband applications derived from HAPS:

~~*Resolves*~~ *resolves to invite ITU-R*

1) to study additional spectrum requirements, taking into account:

   – technical and operational characteristics of HAPS systems, including the evolution of HAPS through advances in technology and spectrally-efficient techniques, and their deployment;

   – the possibility of modifying the geographic, technical, and regulatory restrictions associated with existing HAPS footnote identifications listed in *recognizing c)* to facilitate access to broadband, taking into account the technical characteristics of newer configurations of stratospheric broadband systems and the evolving user needs, particularly in underserved, rural, and remote areas and areas suffering from disasters;

2) to conduct studies on the feasibility of identifying portions of the fixed service allocations in the frequency ranges of 7.075-8.5 GHz, 10.0-10.68 GHz, 14.8-15.35 GHz, 21.2-21.4 GHz, 22.0-23.6 GHz and 24.75-27.0 ~~5 925 MHz – 15.35 GHz 21.2 GHz – 22.0 GHz, and~~

~~23.6 - 29.1~~ GHz which are not subject to Appendices 30~~, 30A,~~ and 30B for the use of HAPS;

3) that the studies referred to in *resolves to invite ITU-R* 1 and 2 include sharing and compatibility studies with services already having allocations in the current and potential future bands identified for HAPS and in adjacent bands, as appropriate, taking into account the current and planned use of these bands by the existing services, as well as the applicable studies already performed in ITU-R~~to study sharing and compatibility between broadband applications delivered over high altitude platform stations and existing services~~;

4) to develop ITU-R Recommendations and Reports, as appropriate, taking into account *resolves to invite ITU-R* 1, 2, and 3 above.

further resolves to invite WRC-19

to consider, on the basis of the studies conducted under the *resolves to invite ITU-R* above, appropriate regulatory actions, potentially including expansion of the frequency ranges of existing identifications for HAPS within existing fixed service allocations, ~~identifying additional frequency ranges for use by HAPS in accordance with *resolves to invite ITU-R* 2,~~ and revising geographic, technical, and regulatory restrictions associated with existing HAPS identifications.