ATTACHMENT A
to FCC Public Notice DA 14-1248

Recommendations presented at
27 August 2014 Meeting of
the Advisory Committee for
the 2015 World Radiocommunication Conference

Maritime Aeronautical and Radar Services

WAC/081(27.08.14)

UNITED STATES OF AMERICA

PROPOSALS FOR THE WORK OF THE CONFERENCE

Agenda Item 1.16: *to consider regulatory provisions and spectrum allocations to enable possible new Automatic Identification System (AIS) technology applications and possible new applications to improve maritime radiocommunication in accordance with Resolution **360 (WRC-12)**;*
Resolution **360 (WRC-2012)**: *Consideration of regulatory provisions and spectrum allocations for enhanced Automatic Identification System technology applications and for enhanced maritime radiocommunication*

Background Information: This agenda item addresses regulatory provisions and spectrum allocations for use by maritime safety systems for ships and ports.

Automatic Identification System (AIS) is a maritime communication and safety of navigation system operating in the VHF band and is used for vessel collision avoidance as well as the delivery of information about specific details of the vessel. Further, consequential to the introduction of the AIS-SART for search and rescue operations, the AIS channels were added to Appendix 15 of the International Radio Regulations.

With increasing demand for maritime VHF data communications, AIS has become heavily used for maritime safety, maritime situational awareness and port security. As a result, overloading of AIS1 and AIS2 has created a need for additional AIS channels. International Maritime Organization (IMO) Resolution MSC 74(69) required that AIS, "…improve the safety of navigation by assisting in the efficient navigation of ships, protection of the environment, and operation of Vessel Traffic Services (VTS), by satisfying the following functional requirements: 1) in a ship-to-ship mode for collision avoidance; 2) as a means for littoral States to obtain information about a ship and its cargo; and 3) as a VTS tool, i.e. ship-to-shore (traffic management)". The International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) has advised in its Maritime Radio Communication Plan (MRCP) that additional AIS channels are required for ship-to-ship and ship-to-shore maritime safety information (MSI) and general data communications (i.e. Area Warnings, Meteorological and Hydrological Data, Channel Management of AIS, future VHF Digital Data Channels, and Ship-shore Data Exchange).

Although satellite detection of AIS on AIS 1 and AIS 2 was proven to be possible, its effectiveness was determined to be unacceptably limited where VHF Data Link (VDL) loading is high. The need for a separate dedicated service on separate dedicated channels was confirmed by WRC-12 and two additional channels were designated. While this new designation solves the problem for satellite detection, AIS VDL loading remains a serious issue to an increasing degree in many parts of the world due to the proliferation of AIS applications, message types, services and equipment types plus the unanticipated increase in user volume. To solve this problem and protect the integrity of the AIS VDL, AIS subject matter experts recommend a revision to the AIS system which would move Application Specific Messages (ASM) to two additional channels. WRC-12 facilitated this concept in a revision of Appendix 18 and provided four candidate channels (27, 87, 28, and 88) on an experimental basis for this evaluation. Application Specific Messages are defined in Recommendation ITU-R M.1371-5, taking into account the international application identifier branch, as specified in IMO SN Circ. 289, maintained and published by IMO.

The United States supports the continued development of an international standard for the prospective new VHF Data Exchange System (VDES) and notes the progress of various international forums which have comprehensively addressed terrestrial and satellite component configurations required for new Automatic Identification System (AIS) technology applications.

To achieve these objectives for AIS, the United States proposes modifications to Appendix 18 of the Radio Regulations that would modify the channel designators to allow ASM supporting AIS applications.

Proposal:

MOD USA/1.16/1

APPENDIX 18 (Rev.WRC-~~12~~15)

Table of transmitting frequencies in the
VHF maritime mobile band

(see Article 52)

Channel designator	Notes	Transmitting frequencies (MHz)		Inter-ship	Port operations and ship movement		Public correspondence
		From ship stations	From coast stations		Single frequency	Two frequency	
…		…	…		…	…	
~~27~~	~~*z)*~~	~~157.350~~	~~161.950~~			~~x~~	~~x~~
1027		157.350	157.350		x		
2027	*za)*	161.950	161.950				
87	~~*z)*~~	157.375	157.375		x		
~~28~~	~~*z)*~~	~~157.400~~	~~162.000~~			~~x~~	~~x~~
1028		157.400	157.400		x		
2028	*za)*	162.00	162.000				
88	~~*z)*~~	157.425	157.425		x		
AIS 1	*f), l), p)*	161.975	161.975				
AIS 2	*f), l), p)*	162.025	162.025				

Reasons: AIS VDL loading remains a serious issue to an increasing degree in many parts of the world due to the proliferation of AIS applications, message types, services and equipment types plus the unanticipated increase in user volume. To solve this problem and protect the integrity of the AIS VDL, AIS subject matter experts recommend a revision to the AIS system which would move Application Specific Messages (ASM) to two additional channels.

MOD USA/AI 1.16/2

SUP

z)

Reason: This footnote applies to the designation by WRC-12 for interim experimental use of the channels, to be finally decided by WRC-15.

MOD USA/AI 1.16/3

ADD

za) From 1 January 20XX, these channels are designated exclusively for Application Specific Messages (ASM) supporting AIS applications as described in Recommendation ITU-R M.1371.

Reason: This footnote designates these channels for ASM, effective date TDB by WRC-15.

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Terrestrial Services

WAC/082(27.08.14)

PROPOSED EDITS TO NTIA DRAFT PROPOSAL ON WRC-15 AI 1.1
(REF. WAC/077(27.08.14))

UNITED STATES OF AMERICA

DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

Agenda Item 1.1: *to consider additional spectrum allocations to the mobile service on a primary basis and identification of additional frequency bands for International Mobile Telecommunications (IMT) and related regulatory provisions, to facilitate the development of terrestrial mobile broadband applications, in accordance with Resolution **233 (WRC-12)**;*

Background Information: The 2012 World Radiocommunication Conference (WRC-12) recognized a need for additional radio spectrum to support the increasing mobile data traffic, and placed consideration of additional spectrum allocations for terrestrial mobile broadband applications on the Agenda for WRC-15. Joint Task Group (JTG) 4-5-6-7 ~~was established to~~ considered spectrum requirements for IMT/terrestrial mobile broadband applications and developed sharing and compatibility studies, taking into account protection requirements of other services from concerned ITU-R Working Parties.

The radionavigation-satellite service (RNSS) has allocations ~~used~~ for Earth-to-space operations in the 5 000-5 010 MHz band and space-to-Earth and space-to-space operations in the 5 010-5 030 MHz band. Operators plan ~~or currently~~ to operate several global and regional non-geostationary satellite RNSS systems, including GPS, ~~GLONASS, Beidou,~~ QZSS, and Galileo, ~~IRNSS~~ within these bands. RNSS shares its allocations 5 000-5 010 MHz and 5 010-5 030 MHz with the aeronautical radionavigation service (ARNS), ~~also~~ which is a safety service.

RNSS systems and networks are operational at all times in all locations on Earth. RNSS signals are very low power, spread-spectrum signals coming from space that are difficult to detect. It takes special processing by RNSS receivers to extract the signal from the background noise. If a high-power, continuous in time, signal in the same frequency band, or an adjacent band, is broadcast near an RNSS receiver, it could desensitize the RNSS receiver to the degree that the RNSS receiver is unable to extract the RNSS signal from space.

There is a long history of protecting RNSS operations in the ITU. Multiple RNSS systems and networks transmit signals around-the-clock across all three ITU Regions and radiate across the entire surface of the Earth. Although these RNSS allocations are in bands that have favorable propagation and other characteristics for terrestrial mobile broadband, ~~JTG 4-5-6-7~~ the ITU did not study the use of these or adjacent bands. ~~This is indicative of the virtually universal will to protect RNSS operations on a global basis.~~

Due to the vital and global role of the RNSS, the sensitive nature of RNSS receivers, and lack of ~~demonstrated in-band and adjacent band frequency~~ relevant sharing and compatibility studies within the ITU-R, no allocation to the mobile service or identification for IMT should be considered in the bands 5 000-5 010 MHz or 5 010-5 030 MHz.

Proposal:

NOC USA/1.1/1

ARTICLE 5

Frequency allocations

5 010-5 030 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
…		
5 000-5 010	AERONAUTICAL MOBILE-SATELLITE (R) 5.443AA AERONAUTICAL RADIONAVIGATION RADIONAVIGATION-SATELLITE (Earth-to-space)	
5 010-5 030	AERONAUTICAL MOBILE-SATELLITE (R) 5.443AA AERONAUTICAL RADIONAVIGATION RADIONAVIGATION-SATELLITE (space-to-Earth) (space-to-space) 5.328B 5.443B	

Reason: To ensure the protection of current and future operation of RNSS systems around the world.

UNITED STATES OF AMERICA

DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

Agenda Item 1.1: *to consider additional spectrum allocations to the mobile service on a primary basis and identification of additional frequency bands for International Mobile Telecommunications (IMT) and related regulatory provisions, to facilitate the development of terrestrial mobile broadband applications, in accordance with Resolution **233 (WRC-12)**;*

Background Information: The 2012 World Radiocommunication Conference (WRC-12) recognized a need for additional radio spectrum to support the increasing mobile data traffic, and placed consideration of additional spectrum allocations for terrestrial mobile broadband applications on the agenda for WRC-15. Joint Task Group (JTG) 4-5-6-7 ~~was established to~~ considered spectrum requirements for IMT/terrestrial mobile broadband applications and developed sharing and compatibility studies, taking into account protection requirements of other services from concerned ITU-R Working Parties.

The radionavigation-satellite service (RNSS) has allocations ~~used~~ for space-to-Earth and space-to-space systems and networks in the 1 164-1 215 MHz, 1 215-1 300 MHz and 1 559-1 610 MHz bands. Operators plan or currently operate several global and regional non-geostationary satellite RNSS systems, including GPS, GLONASS, Beidou, QZSS, Galileo, and IRNSS, as well as a number of geostationary-orbit satellite networks that provide space-based augmentation services within these bands. Operators deploy RNSS receivers and applications by the hundreds of millions worldwide, and are pervasive in every facet of everyday life. People use RNSS receivers for safety-of-life applications (including in the Global Navigation Satellite System (GNSS)) and other ~~safety-of-life~~ applications for precision surveying, construction, agriculture, and mining, environmental monitoring (including earthquake and tsunami monitoring), precision timing applications~~,~~ often within or in conjunction with ~~all within many~~ mobile broadband devices and other handsets. RNSS shares its allocations at 1 559-1 610 MHz and, 1 164-1 215 MHz with the aeronautical radionavigation service (ARNS), ~~also~~ which is a safety service.

There is a long history of protecting RNSS operations in the ITU. Multiple RNSS systems and networks transmit signals around-the-clock across all three ITU Regions and radiate across the entire surface of the Earth. RNSS ~~frequency bands thus~~systems and networks are operational at all times in all locations on Earth. RNSS signals are very low power, spread-spectrum signals coming from space that are difficult to detect. It takes special processing by RNSS receivers to extract the signal from the background noise. If a high-power, continuous in time, signal in the same frequency band, or an adjacent band, is broadcast near an RNSS receiver, it could desensitize the RNSS receiver to the degree that the RNSS receiver is unable to extract the RNSS signal from space.

Studies in the ITU in preparation for WRC-2000 concluded that even relatively weak continuous in time signals from mobile-satellite service satellites in geostationary orbit would not be able to be provided on a co-frequency basis with the RNSS and ARNS in the 1 559-1 610 MHz band. CPM-99 concluded, in Section 2.2.1.3 of the CPM Report for WRC-2000, that "although studies were not carried out on every different type of RNSS receiver used in all the numerous applications of RNSS, it was nevertheless possible to conclude that sharing between ARNS/RNSS and MSS (space-to-Earth) is not feasible in any portion of the 1 559-1 567 MHz band." WRC-2000 ~~agreed, and~~ declined to add a co-primary MSS allocation to a portion of the RNSS band. To protect RNSS in the 1 164-1 215 MHz band, WRC-12 modified Resolution 417 to include strict power limits on high-powered terrestrial transmitters in the adjacent aeronautical radionavigation service band at 960-1 164 MHz.

Although all the RNSS allocations are in bands that have favorable propagation and other characteristics for terrestrial mobile broadband, ~~JTG 4-5-6-7~~ the ITU did not study the use of these or adjacent bands. ~~This is indicative of the virtually universal will to protect RNSS operations on a global basis.~~

Due to the vital and global role of the RNSS, the sensitive nature of RNSS receivers and ~~demonstrated~~ previous in-band and adjacent band ITU-R studies showing the infeasibility of ~~frequency~~ sharing/ ~~in~~compatibility, no allocation to the mobile service or ~~designation~~ identification for IMT should be considered in the bands 1 164-1 215 MHz, 1 215-1 300 MHz and 1 559-1 610 MHz. Furthermore, any proposed new use of a band adjacent to any of these RNSS bands would need to include regulations that would ensure that terrestrial mobile broadband systems did not cause harmful interference to RNSS receivers (e.g., guard bands, power limits, etc.).

Proposals:

NOC USA/1.1/1

ARTICLE 5

Frequency Allocations

890-1 300 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
…		
1 164-1 215	AERONAUTICAL RADIONAVIGATION 5.328 RADIONAVIGATION-SATELLITE (space-to-Earth) (space-to-space) 5.328B 5.328A	
1 215-1 240	EARTH EXPLORATION-SATELLITE (active) RADIOLOCATION RADIONAVIGATION-SATELLITE (space-to-Earth) (space-to-space) 5.328B 5.329 5.329A SPACE RESEARCH (active) 5.330 5.331 5.332	
1 240-1 300	EARTH EXPLORATION-SATELLITE (active) RADIOLOCATION RADIONAVIGATION-SATELLITE (space-to-Earth) (space-to-space) 5.328B 5.329 5.329A SPACE RESEARCH (active) Amateur 5.282 5.330 5.331 5.332 5.335 5.335A	

Reason: To ensure the protection of current and future operation of RNSS systems around the world.

NOC USA/1.1/2

ARTICLE 5

Frequency Allocations

1 525-1 610 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
…		
1 559-1610	AERONAUTICAL RADIONAVIGATION RADIONAVIGATION-SATELLITE (space-to-Earth) (space-to-space) 5.208B 5.328B 5.329A 5.314 5.362B 5.362C	

Reason: To ensure the protection of current and future operation of RNSS systems around the world.

WAC/083(27.08.14)

PROPOSED EDITS TO NTIA DRAFT PROPOSAL ON WRC-15 AI 10
(REF. WAC/080(27.08.14))

DRAFT

United States of America

PROPOSALS FOR THE WORK OF THE CONFERENCE

AGENDA ITEM 10

Agenda Item 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 Information: ~~Increasing demand for broadband data capacity is leading the industry to increasing rely on opportunities for off-loading from traditional cellular networks onto Radio Local Area Network (RLAN) and small-celled wireless infrastructure. Additionally, there is strong demand for inexpensive, widely available, high-speed internet access and networking capabilities.~~World Radiocommunication Conference 2003 allocated the 5 150-5 250 MHz, 5 250-5 350 MHz, and 5 470-5 725 MHz bands the Mobile Service for Wireless Access Systems (WAS) including Radio Local Area Network (RLAN) systems under the conditions specified in Resolution **229 (WRC-03)**. At the time, RLAN products used 20 MHz bandwidths to obtain physical layer (PHY) data rates up to 54 Mbps. Over time and in response to increasing performance requirements, there have been further developments.

Newer RLAN technologies are utilizing wider channels to meet evolving needs. For example, IEEE 802.11ac utilizes 80 MHz and 160 MHz wide channels to support very high throughput (500-1 000 Mbps) in the 5 GHz bands, ideal for applications like high-definition video as well as other high-bandwidth uses. IEEE 802.11ac products are required to support 20, 40, and 80 MHz channels, with the use of 160 MHz channels optional but supported by the standard as well.

The results of ITU-R studies indicate that the minimum spectrum requirement for RLAN using the 5 GHz frequency range in the year 2018 is estimated at 880 MHz. This figure includes spectrum of 455-580 MHz already utilised by non-IMT mobile broadband applications operating in the 5 GHz band range resulting in 300-425 MHz additional spectrum being required.[1]

To address this demand ~~for greater network data capacity,~~ WRC-15 Agenda Item 1.1 considered additional primary mobile service allocations for terrestrial mobile broadband capabilities, including the possible expansion of RLAN use into the 5350-5470 MHz band. The 5 350-5 470 MHz band is particularly attractive for RLANs for reasons that include:

- RLAN devices already operate in spectrum immediately adjacent to the 5 350-5 470 MHz band (i.e. 5 150-5 350 MHz and 5 470-5 725 MHz) subject to

[1] The ranges above are due to some of the frequency bands being identified for RLAN only in some countries.

Resolution **229 (Rev.WRC-12)**. Equipment cost and complexity for development of RLAN devices in 5 350-5 470 MHz may be less complicated than other bands not adjacent to the existing RLAN bands.

- A new international allocation to the mobile service for 5 350-5 470 MHz would facilitate contiguous spectrum for RLANs, which would increase the number of non-overlapping channels available for use. The contiguous spectrum would enable two additional 80 MHz channels as well as one additional 160 MHz channel.

Initial studies conducted in Joint Task Group (JTG) 4-5-6-7 indicated that sharing was not possible between RLANs and incumbent services in the 5350-5470 MHz band utilizing existing mitigation measures. The existing mitigation techniques studied included a 200 mW power limit, indoor restriction, and Dynamic Frequency Selection (DFS) designed for the 5150-5350 MHz and 5470-5725 MHz frequency bands. Additionally, ~~the same~~ ITU-R W~~w~~orking P~~p~~arty~~ies~~ 5A began exploring possible new mitigation techniques to enable sharing between RLANs and incumbent services in the 5350-5470 MHz frequency bands. Unfortunately, the WRC-15 study cycle provided insufficient time to complete the development and consideration of the proposed mitigation techniques and further study is required.

Given the increased demand for high throughput RLAN services, along with the need to ensure protection of important incumbent services, the United States of America proposes a ~~future~~ WRC-19 ~~agenda item to continue the studies and consider additional mitigation measures that may enable sharing between RLANs and incumbent services in the~~ for an additional primary allocations to the mobile service allocation and identification for the implementation of wireless access systems (WAS) including radio local area networks (RLAN) in the 5350-5470 MHz frequency bands.

Proposal:

MOD USA/10/1

RESOLUTION 806 (WRC-15)

Agenda for the 2019 World Radiocommunication Conference

The World Radiocommunication Conference (Geneva, 2015),

ADD USA/10/2

1.[5 GHz] to consider, in accordance with Resolution **[5GHz] (WRC-2015)**, ~~regulatory provisions and~~ additional spectrum allocations to the mobile service in the 5350-5470 MHz bands on a primary basis and related regulatory provisions to facilitate the development of terrestrial mobile broadband applications~~, taking into account the results of studies~~;

Reasons: To enable contiguous spectrum ~~wide-band applications~~ for RLAN which would allow the use of wider channels to support very high throughput ~~at 5350-5470 MHz~~ while ensuring protection of incumbent services in the 5350-5470 MHz frequency range.

ADD USA/10/3

RESOLUTION -[5GHZ]- (WRC-15)

~~Consideration of a~~ Additional primary allocations to the mobile service ~~allocation~~ and identification for the implementation of wireless access systems (WAS) including radio local area networks (RLAN) in the 5350-5470 MHz frequency bands

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that since WRC-07 there has been tremendous growth in the demand for mobile broadband applications with multimedia capabilities;

b) that in many developing markets the main delivery mechanism for broadband access is expected to be through mobile devices;

c) that adequate and timely availability of spectrum and supporting regulatory provisions is essential to support future growth of mobile broadband systems;

d) that the band 5 350-5 460 MHz is allocated worldwide on a co-primary basis to the Earth exploration-satellite service (active) (No. **5.448B**),~~;~~

~~*e) that the band 5 350-5 460 MHz is also allocated worldwide on a primary basis to*~~ the space research service (active) (No. **5.448C**), and~~;~~

~~*f) that the band 5 350-5 460 MHz is allocated worldwide on a primary basis to*~~ the aeronautical radionavigation service (No. **5.449**);

~~*e*~~*g)* that the bands 5 350-5 470 MHz is also allocated worldwide on a primary basis to the radio-location service (No. **5.448D**);

~~*h*~~*f)* that the band 5 460-5 470 MHz is allocated worldwide on a co-primary basis to the radionavigation service (No. **5.449**),~~;~~

~~*i) that the band 5 460-5 470 MHz is also allocated worldwide on a primary basis to*~~ the EESS (active), SRS (active), and radiolocation service (No. **5.448D**);

~~*j) that there is a need to protect the existing primary services in the 5 150-5 350 MHz, 5350-5470 MHz, and 5 470-5 725 MHz bands;~~

~~*k) that studies have shown that sharing between incumbent services and mobile service applications in the frequency range 5 350-5 470 MHz is not possible with current mitigation techniques but may be possible if new or advanced mitigation techniques are developed that prove to be feasible and able to be fielded in commercially viable systems;~~

~~*l) that there is a need to specify operational restrictions for WAS, including RLANs, in the mobile service in the band 5 350-5 470 MHz in order to protect incumbent service systems;~~

~~*m) that the deployment density of WAS, including RLANs, will depend on a number of factors including intrasystem interference and the availability of other competing technologies and services,~~

noting

a) that initial studies have begun in the ITU-R based on work for consideration of potential mobile allocations and identification for terrestrial mobile allocations under WRC-15 agenda item 1.1;

b) that the regulatory provisions for RLANs to enable sharing in the frequency ranges 5150-5350 MHz and 5470-5725 MHz areis insufficient to enable sharing in the 5350-5470 MHz frequency range but sharing may be possible if new or advanced RLAN mitigation techniques are deployed;

recognizing

a) that WAS, including RLANs, play an important role in providinge effective broadband serviceolutions;

b) that there is a need for administrations it is important to ensure that WAS, including RLANs, protect incumbent service systems in the 5 350- 5470 MHz frequency bands meet the required mitigation techniques, for example, through equipment or standards compliance in conjunction with effective regulatory procedures,

c) that the results of ITU-R studies indicate that the minimum spectrum requirement for RLAN using the 5 GHz frequency range in the year 2018 is estimated at 880 MHz. This figure includes spectrum of 455-580 MHz already utilised by non-IMT mobile broadband applications operating in the 5 GHz band range resulting in 300-425 MHz additional spectrum being required.

d) that RLAN devices utilize the following frequency bands in the 5 GHz frequency range:
5 150-5 250 MHz, 5 250-5 350 MHz, 5 470-5 725 MHz and 5 725-5 850 MHz (in some countries)

e) that a new international allocation to the mobile service in the 5 350-5 470 MHz frequency bands would facilitate contiguous spectrum for RLANs thereby enabling the use of wider channel bandwiths to support higher data throughput

resolves

1) to conduct, and complete in time for WRC-19, studies for that WRC-19 considera new primary mobile allocation and identification to WAS including RLAN in the 5350-5470 MHz frequency range bands while ensuring the :

1 Pprotection of current and future deployments of incumbent services in the 5 350-5 470 MHz bands;

2 Consideration of effective operational requirements which can be implemented by WAS including RLAN to enable sharing with incumbent services,

2) to invite WRC-19 to consider the results of the above studies and take appropriate actions,

invites ITU-R

to conduct, and complete in time for WRC-19, the appropriate studies leading to on technical and operational recommendations issues to facilitate sharing between WAS including RLAN and the incumbent services.

invites administrations

to participate actively in these studies by submitting contributions to ITU-R.

ATTACHMENT

PROPOSAL FOR ADDITIONAL AGENDA ITEM FOR ~~CONSIDERATION OF~~ AN ADDITIONAL ALLOCATION TO THE MOBILE SERVICE ~~ALLOCATION~~ AND IDENTIFICATION ~~FOR RLAN~~ FOR THE IMPLEMENTATION OF WIRELESS ACCESS SYSTEMS INCLUDING RADIO LOCAL AREA NETWORKS IN THE 5350-5470 MHZ FREQUENCY BANDS

Subject: Proposed Future WRC Agenda Item for WRC-2019 for ~~consideration of~~ a n additional allocation to the ~~-~~mobile service ~~allocation~~ and identification ~~for RLAN~~ for the implementation of wireless access systems including radio local area networks in the 5350-5470 MHz frequency bands

Origin: United States of America

Proposal: To ~~consider~~ complete studies for a new primary allocation to the mobile service ~~allocation~~ and identification ~~for RLAN~~ for the implementation of wireless access systems including radio local area networks in the 5350-5470 MHz frequency bands.

Background/reason: ~~-~~
Initial studies conducted in Joint Task Group (JTG) 4-5-6-7 indicated that ~~sharing was not possible between RLANs and incumbent services in the 5350-5470 MHz band utilizing existing mitigation measures.~~ the regulatory provisions for RLANs to enable sharing in the frequency ranges 5150-5350 MHz and 5470-5725 MHz are insufficient to enable sharing in the 5350-5470 MHz frequency range. However, sharing may be possible if new or advanced RLAN mitigation techniques are deployed.~~The existing mitigation techniques studied included a 200 mW power limit, indoor restriction, and Dynamic Frequency Selection (DFS) designed for the 5150-5350 MHz and 5470-5725 MHz frequency bands. Additionally, the same~~ ITU-R W~~w~~orking P~~p~~art~~y~~~~ies~~ 5A began exploring possible new or additional RLAN mitigation techniques to enable sharing between RLANs and incumbent services in the 5350-5470 MHz frequency bands. Unfortunately, the WRC-15 study cycle provided insufficient time to complete the development and consideration of the proposed mitigation techniques before the JTG 4-5-6-7 completed its work. ~~and f~~Further study is required.

Radiocommunication services concerned: Earth Exploration-Satellite Service (active), Space Research Service (active), Aeronautical Radionavigation, Radiolocation and Radionavigation

Indication of possible difficulties: None foreseen.

Previous/ongoing studies on the issue: Studies are underway in WP 5A~~, WP 5B and WP 7C~~ to examine RLAN ~~-~~mitigation techniques. Studies have been done in WP 5B and WP 7C to define protection criteria for the respective incumbent services. JTG 4-5-6-7 conducted initial sharing studies during WRC-15 study cycle.

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

ITU-R Study Groups concerned: SG 5 and SG 7

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

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

Remarks

WAC/084(27.08.14)REV.1

WRC-15 Agenda Item 1.1

with Respect to Frequencies Above 6425 MHz

With respect to WRC-15 Agenda Item 1.1, IWG-2 considered two proposals for NOC for 6425 MHz and above: Document IWG-2/044R1 (see attachment) supported by: ARRL, EchoStar Corporation, Globalstar, Inc., Harris Wiltshire Grannis, Inmarsat, Intelsat, Iridium, Lockheed Martin Corp., SES Americom, The Boeing Company and ViaSat, Inc., and Document WAC/076 from the National Telecommunication and Information Administration.

IWG-2 did not reach consensus on the proposals, and, therefore, forwards two views on how the FCC should handle this matter. While the two proposals referenced above are effectively identical, View A proponents are conveying Document IWG-2/044R1 for consideration by the WAC. Document IWG-2/044R1 could be easily reconciled with NTIA's Document WAC/076.

View B proponents believe that there is no need for a WRC-15 Agenda Item 1.1 proposal for NOC for bands above 6425 MHz. View B is supported by Alcatel-Lucent, AT&T, Ericsson, Intel Corporation, Motorola Mobility Inc., Nokia Solutions and Networks, Samsung, Sprint Corporation, Telecommunications Management Group Inc., and Verizon. The rationale for their views on this matter is given below as "View B."

View A:

With respect to Agenda Item 1.1 approve the NOC proposal for bands above 6425 MHz as contained in Document IWG-2/044R1.

View A is supported by ARRL, EchoStar Corporation, Globalstar, Inc., Harris Wiltshire Grannis, Inmarsat, Intelsat, Iridium, Lockheed Martin Corp., SES Americom, The Boeing Company and ViaSat, Inc.

WP 5D as the expert group on International Mobile Telecommunications (IMT) systems was tasked to identify "spectrum requirements for the mobile service, including suitable bands for IMT" from which JTG 4-5-6-7 was to conduct sharing/compatibility studies. WP 5D did not identify any bands above 6425 MHz for IMT, nor were studies on bands above 6425 GHz conducted in JTG 4-5-6-7. Thus, there are no ITU-R results supporting the identification of bands above 6425 MHz for IMT.

Despite the absence of ITU-R results supporting the identification of frequency bands above 6425 MHz for IMT, keen interest remains on the part of Korea, within CEPT, and on the part of several technology companies for identifying Ka-band frequencies in particular for IMT at the earliest opportunity potentially at WRC-15.

Noting that there are already frequencies above 6 GHz with primary mobile allocations where administrations are free to implement, at their leisure, the type of high-density small cell deployments some proponents wish to deploy, we recommend that FCC join NTIA in supporting a NOC proposal for bands above 6425 MHz under Agenda Item 1.1 for WRC-15. The support by the U.S. for a NOC proposal for bands above 6425 GHz under WRC-15 Agenda Item 1.1, would not be in conflict with any U.S. domestic or foreign policy, and would not prejudice any potential future U.S. actions related to this matter.

VIEW A ATTACHMENT

Document IWG-2/044R1

Draft

United States of America

PROPOSALS FOR THE WORK OF THE CONFERENCE
AGENDA ITEM 1.1

Agenda item 1.1

1.1 to consider additional spectrum allocations to the mobile service on a primary basis and identification of additional frequency bands for International Mobile Telecommunications (IMT) and related regulatory provisions, to facilitate the development of terrestrial mobile broadband applications, in accordance with Resolution **233 (WRC-12)**;

Background

Conference Preparatory Meeting (CPM) 15-1 established a dedicated Joint Task Group (JTG-4-5-6-7) to address issues related to WRC-15 Agenda item 1.1 and 1.2. JTG 4-5-6-7 is responsible for developing draft CPM text and performing associated studies in accordance with the provisions of Resolution **233 (WRC-12)** regarding Agenda item 1.1. As part of its terms of reference, JTG 4-5-6-7 is to consider the results of studies from Working Party 5D on spectrum requirements for the mobile service, including suitable frequency ranges for IMT, from which JTG 4-5-6-7 is to conduct sharing studies for purposes of developing CPM text.

In Document 4-5-6-7/220, "Final input to Joint Task Group 4-5-6-7 on suitable frequency ranges WRC-15 Agenda Item 1.1", WP 5D has confirmed and provided to the JTG 4-5-6-7 its final input on suitable frequency ranges for IMT, which in their sum bounds the frequency range 410 MHz to 6 425 MHz as being suitable. Over several meetings, WP 5D discussed the suitability of frequencies above 6 425 MHz for IMT for consideration under WRC-15 Agenda Item 1.1.

However, as noted in Document 4-5-6-7/220, WP 5D did not include frequencies above 6425 MHz as suitable for IMT under WRC-15 under Agenda Item 1.1, as WP 5D stated that, "Working Party 5D indicated that it is continuing to consider the frequency ranges above 6 GHz in terms of their suitability for IMT".

In addition, as noted in Document 4-5-6-7/220, "WP 5D also confirms it is continuing to study the frequency ranges above 6 GHz in the light of the evolution of technology and services, in addition to the already acknowledged suitable frequency ranges in the bands below 6 GHz."

In consequence, WP 5D did not provide IMT system characteristics and deployment parameters in those frequencies and no sharing studies were conducted in any band above 6 425 MHz between IMT systems and the existing systems or applications operating in frequencies above 6 425 M Hz.

Therefore, the United States maintains that WRC-15 should not address mobile service allocations or IMT identification in any bands above 6 425 MHz under WRC-15 Agenda Item 1.1.

Proposal:

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations
(See No. **2.1**)

NOC USA/AI 1.1/1

5 570 -7 250 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
…		
5 925 -6 700	FIXED 5.457 FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B MOBILE 5.457C 5.149 5.440 5.458	
6 700-7 075	FIXED FIXED-SATELLITE (Earth-to-space) (space-to-Earth) 5.441 MOBILE 5.458 5.458A 5.458B 5.458C	
…		

.
.
.

248-3 000 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
…		
275-3 000	(Not allocated) 5.565	
…		

Reasons:

This proposal for NOC applies for 6425 MHz and above. WP 5D did not include any frequencies above 6 425 MHz as suitable for IMT, and WP 5D did not provide to JTG 4-5-6-7 IMT system characteristics and deployment parameters in those frequencies. In consequence, no sharing studies were conducted in JTG 4-5-6-7 for any band above 6 425 MHz. Therefore, WRC-15 should not address mobile service allocations or IMT identification in any bands above 6 425 MHz under Agenda Item 1.1.

View B:

The United States of America does not need a NOC proposal on bands above 6425 MHz for WRC-15 Agenda Item 1.1.

View B is supported by Alcatel-Lucent, AT&T, Ericsson, Intel Corporation, Motorola Mobility Inc., Nokia Solutions and Networks, Samsung, Sprint Corporation, Telecommunications Management Group Inc., and Verizon.

INTRODUCTION

Documents WAC/076 and IWG-2/044r1 provide draft United States WRC-15 Agenda Item 1.1 proposals for NOC for all bands above 6425 MHz. The companies listed above present View B, which advocates for no proposal regarding these bands due to a lack of any actual proposed candidate bands above 6425 MHz as well as the potential for misperceptions regarding the United States position on the possibility of IMT in these bands in the future.

GROWING DEMAND FOR MOBILE BROADBAND

According to ITU statistics, "Mobile broadband remains the fastest growing market segment, with continuous double-digit growth rates in 2014. Mobile broadband is growing fastest in developing countries, where 2013/2014 growth rates are expected to be twice as high as in developed countries (26% compared with 11.5%). By end 2014, the number of mobile-broadband subscriptions will reach 2.3 billion globally, almost 5 times as many as just six years earlier (in 2008)."[1]

Based upon the tremendous growth in demand for wireless broadband, the United States National Broadband plan (2010) recommended making "500 megahertz of spectrum newly available for broadband within 10 years, of which 300 megahertz should be made available for mobile use within five years."[2] As we now approach the 5 year deadline, nowhere near 300 MHz of spectrum newly available for broadband has been made available for mobile use.

Meanwhile, demand for mobile broadband continues to grow. In order to meet this demand, operators need access to additional spectrum and technological advances must continue. Access to additional spectrum for terrestrial mobile broadband applications is being considered under WRC-15 Agenda Item 1.1. Technological developments are also occurring: one of the key enabling features for future IMT includes potential utilization of higher frequency bands. Therefore, the companies supporting View B feel it is important for the United States to take steps to identify spectrum for IMT in bands below 6425 MHz under WRC-15 Agenda Item 1.1 as well as to not develop unnecessary proposals that could inadvertently create the perception that the United States is opposed to consideration of higher frequency bands to address the longer-term spectrum needs of IMT.

STATUS OF HIGHER FREQUENCIES UNDER WRC-15 AI 1.1

[1] The World in ICT 2014: ICT Facts and Figures
http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2014-e.pdf

[2] Page xii http://transition.fcc.gov/national-broadband-plan/national-broadband-plan-executive-summary.pdf

As part of its preparations for WRC-15 Agenda Item 1.1, WP5D discussed the suitability of various frequency ranges both below and above 6 425 MHz for IMT. In its "Final input to Joint Task Group 4-5-6-7 on suitable frequency ranges WRC-15 Agenda item 1.1" (Document 4-5-6-7/220), WP5D provided a subset of frequency ranges between 410 MHz to 6 425 MHz as being suitable for IMT.
Joint Task Group 4-5-6-7 recently concluded its work on the development of CPM text for WRC-15 AI 1.1. Section 4.2, which details potential candidate bands, is also limited to bands between 470 MHz and 6425 MHz. In addition, no studies were performed in Joint Task Group 4-5-6-7 on any bands above 6425 MHz.
WRC-15 Agenda Item 1.1 proposals have not included any bands above 6425 MHz in Regional Preparatory Group deliberations or at the national level. The only proposals related to bands above 6425 MHz are for possible agenda items for future conferences.[3]
In summary, there is nothing to indicate that WRC-15 will consider bands above 6425 MHz under Agenda Item 1.1.

INTEREST IN HIGHER BANDS/ TECHNICAL FEASIBILTY

However, there is strong interest in the possibility of IMT utilizing frequencies above 6425 MHz in the longer term. In Document 4-5-6-7/220, "WP5D also confirms it is continuing to study the frequency ranges above 6 GHz in the light of the evolution of technology and services, in addition to the already acknowledged suitable frequency ranges in the bands below 6 GHz."
Currently, WP5D is developing a Preliminary Draft New Recommendation ITU-R M.[IMT.VISION], which addresses the framework and objectives of the future development of IMT for 2020 and beyond that fulfil the needs of future service scenarios and use cases for both the evolutionary path of existing IMT as well as for new IMT system capabilities.
WP5D is also developing a Preliminary Draft New Report ITU-R M.[IMT.ABOVE 6 GHz] to provide "information on the technical feasibility of IMT in the bands above 6 GHz." In addition, the FCC Technical Advisory Committee "Spectrum Frontiers Working Group" is chartered to look at "what spectrum bands have the potential to become the new "beachfronts". As part of its studies of higher frequency bands, the working group has made specific recommendations to the FCC including domestic activities supporting evaluation of mobile broadband feasibility and adoption of appropriate service rules to encourage further investment in key technologies and promising services. The Working Group also recommended "the Commission to take a leadership role in the relevant ITU discussions without compromising other key US positions and objectives.

View B Position

We, the above signed companies, believe that there is no need for a WRC-15 Agenda Item 1.1 proposal for NOC for bands above 6425 MHz. No country has proposed bands above 6 425 MHz as part of the

[3] For example, CEPT deliberations regarding WRC-15 Agenda Item 1.1 do not include any consideration of bands above 6425 MHz for WRC-15 Agenda Item 1.1. See the results of the most recent CEPT deliberations at http://www.cept.org/ecc/groups/ecc/cpg/page/cept-briefs-and-ecps-for-wrc-15
The only consideration of these bands is under Agenda Item 10 addressing future conference agenda items. See: http://www.cept.org/files/4200/Presentation_Regional%20org%20%20April%202014-May2014.pdf

WRC-15 Agenda Item 1.1 preparations. Sending a proposal for NOC for bands that are not being proposed will cause, at best, some confusion. However, there is cause for serious concern that sending a WRC-15 AI 1.1 proposal for no change on bands above 6425 MHz could easily cause the perception that the United States of America is opposed to further work and/or potential future use of higher frequencies bands to address growing demand for mobile broadband services in the longer term. Therefore, we respectfully submit that the United States of America should not pursue a proposal on bands above 6425 MHz for WRC-15 Agenda Item 1.1.

Space Services

WAC/085(27.08.14)

2015 WORLD RADIOCOMMUNICATION CONFERENCE

DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

Agenda Item 1.5: *to consider the use of frequency bands allocated to the fixed-satellite service not subject to Appendices 30,30A and 30B for the control and non-payload communications of unmanned aircraft systems (UAS) in non-segmented airspace in accordance with Resolution 153 (WRC-12)*

Background Information: Report ITU-R M.2171 identified the spectrum requirements for unmanned aircraft system (UAS) command and non-payload communication (CNPC) links that would be needed to support flight through non-segregated airspace. This Report states that, "The maximum amount of spectrum required for UAS CNPC links is 56 MHz for the satellite component assuming regional beams with suitable antenna discrimination. However, this estimation could rise to 169 MHz when using small aperture antenna with limited discrimination in lower frequency bands." Those requirements identified the need for both line of sight (LOS) and beyond line of sight (BLOS) spectrum. While the LOS requirements were addressed at the last World Radiocommunication Conference (WRC) held in 2012 the BLOS requirements were only partially addressed. As a result a new agenda item for the 2015 WRC (Agenda Item 1.5) was established to investigate whether fixed satellite networks, not subject to Appendix 30, 30A and 30B could be used to provide additional capacity for UAS CNPC links. This agenda item supports the addition of technical and regulatory provisions to enable use of portions of bands allocated to the fixed satellite service (FSS) for UAS CNPC links in non-segregated airspace, provided studies demonstrate compatibility with incumbent services and that the requirements of aviation authorities are satisfied.

In the context of this agenda item, a UAS consists of an Unmanned Aircraft)\(UA) with an Earth station on-board to interconnect the UA and the associated Earth station of the unmanned aircraft control station (UACS) through a satellite operating in the FSS (See Figure 1). UA are aircraft that do not carry a human pilot but that are piloted remotely, i.e. through a reliable communication link. UAS operations up to now have been limited to segregated airspace. However, it is planned to expand UAS deployment outside of segregated airspace.

The development of UAS is based on recent technological advances in aviation, electronics and structural materials, making the economics of UAS operations more favorable, particularly for more repetitive, routine and long duration applications. The current state of the art in UAS design and operation, is leading to the rapid development of UAS applications to fill many diverse requirements. There are a large variety of existing and envisioned applications of UAS in the fields of economy, public safety and science. Further details on UAS applications in non-segregated airspace can be found in Report ITU-R M.2171. The operation of UAS outside segregated airspace requires addressing the same issues as manned aircraft, namely safe and efficient integration into the air traffic control system.

More than 100 geostationary satellite communication networks operate in frequency bands allocated to the FSS in the bands 10.7-12.75, 13.75-14.5, 17.3-20.2, and 27.5-30.0 GHz. Report ITU-R M.2171 identifies a large variety of prospects for UAS that would need to fly long-distances (worldwide) through airspaces controlled by civil air traffic control (ATC). Immediate access to this globally existing capacity would provide great advantages for UAS fleet operators fostering new applications, enabling faster

developments of new markets, while providing planning stability for significant investments. Studies under this agenda item investigated the link feasibilities and sharing conditions for using UAS CNPC links over typical frequency spectrum allocated in several FSS allocations.

Report ITU-R M.2233 contains examples of technical characteristics for UA CNPC including FSS systems operating in portions of the frequency ranges 10.95-14.5 GHz and 17.3-30.0 GHz. These examples indicated that it may be possible to operate UAS CNPC links in these bands while meeting the desired link performance. It is recognized that a further Report may be available by the time of WRC-15.

The proposal found below sets forth the basis for accomplishing the objective of using frequency bands allocated to the FSS for safe operation of UAS CNPC links. It includes text for a footnote to the appropriate FSS bands which points to a Resolution that spells out the conditions of use for supporting safe and efficient operation of UAS.

Proposal:

ADD USA/1.5/1

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations
(See No. 2.1**)**

10-11.7 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
10.7-11.7 FIXED FIXED-SATELLITE (space-to-Earth) 5.441 5.484A 5.XXX (Earth-to-space) 5.484 MOBILE except aeronautical mobile	**10.7-11.7** FIXED FIXED-SATELLITE (space-to-Earth) 5.441 5.484A 5.XXX MOBILE except aeronautical mobile	

11.7-14 GHz

<table>
<tr><th colspan="3">Allocation to services</th></tr>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td rowspan="2">11.7-12.5
FIXED
MOBILE except aeronautical mobile
BROADCASTING
BROADCASTING-SATELLITE
5.492

5.487 5.487A</td><td>11.7-12.1
FIXED 5.486
FIXED-SATELLITE (space-to-Earth) 5.484A 5.488 5.XXX
Mobile except aeronautical mobile
5.485</td><td rowspan="2">11.7-12.2
FIXED
MOBILE except aeronautical mobile
BROADCASTING
BROADCASTING-SATELLITE
5.492

5.487 5.487A</td></tr>
<tr><td>12.1-12.2
FIXED-SATELLITE (space-to-Earth) 5.484A 5.488
5.XXX
5.485 5.489</td></tr>
<tr><td rowspan="2">12.2-12.7
FIXED
MOBILE except aeronautical mobile
BROADCASTING
BROADCASTING-SATELLITE
5.492

5.487A 5.488 5.490</td><td>12.2-12.5
FIXED
FIXED-SATELLITE (space-to-Earth)5.XXX
MOBILE except aeronautical mobile
BROADCASTING

5.484A 5.487</td></tr>
<tr><td>12.5-12.75
FIXED-SATELLITE (space-to-Earth) 5.484A 5.XXX (Earth-to-space)

5.494 5.495 5.496</td><td>12.7-12.75
FIXED
FIXED-SATELLITE (Earth-to-space)
MOBILE except aeronautical mobile</td><td>12.5-12.75
FIXED
FIXED-SATELLITE (space-to-Earth) 5.484A 5.XXX
MOBILE except aeronautical mobile
BROADCASTING-SATELLITE 5.493</td></tr>
<tr><td>13.75-14</td><td colspan="2">FIXED-SATELLITE (Earth-to-space) 5.484A 5.XXX
RADIOLOCATION
Earth exploration-satellite
Standard frequency and time signal-satellite (Earth-to-space)
Space research
5.499 5.500 5.501 5.502 5.503</td></tr>
</table>

14-14.5 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
14-14.25	FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B 5.484A 5.506 5.506B 5.XXX RADIONAVIGATION 5.504 Mobile-satellite (Earth-to-space) 5.504B 5.504C 5.506A Space research 5.504A 5.505	
14.25-14.3	FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B 5.484A 5.506 5.506B 5.XXX RADIONAVIGATION 5.504 Mobile-satellite (Earth-to-space) 5.504B 5.506A 5.508A Space research 5.504A 5.505 5.508	
14.3-14.4 FIXED FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B 5.484A 5.506 5.506B 5.XXX MOBILE except aeronautical mobile Mobile-satellite (Earth-to-space) 5.504B 5.506A 5.509A Radionavigation-satellite 5.504A	**14.3-14.4** FIXED-SATELLITE (Earth-to-space) 5.457A 5.484A 5.506 5.506B 5.XXX Mobile-satellite (Earth-to-space) 5.506A Radionavigation-satellite 5.504A	**14.3-14.4** FIXED FIXED-SATELLITE (Earth-to-space) 5.457A 5.484A 5.506 5.506B 5.XXX MOBILE except aeronautical mobile Mobile-satellite (Earth-to-space) 5.504B 5.506A 5.509A Radionavigation-satellite 5.504A
14.4-14.47	FIXED FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B 5.484A 5.506 5.506B 5.XXX MOBILE except aeronautical mobile Mobile-satellite (Earth-to-space) 5.504B 5.506A 5.509A Space research (space-to-Earth) 5.504A	
14.47-14.5	FIXED FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B 5.484A 5.506 5.506B 5.XXX MOBILE except aeronautical mobile Mobile-satellite (Earth-to-space) 5.504B 5.506A 5.509A Radio astronomy 5.149 5.504A	

17.3-18.4 GHz

<table>
<tr><th colspan="3">Allocation to services</th></tr>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td>17.3-17.7
FIXED-SATELLITE
(Earth-to-space) 5.516
(space-to-Earth) 5.516A
5.516B 5.XXX
Radiolocation
5.514</td><td>17.3-17.7
FIXED-SATELLITE
(Earth-to-space) 5.516
BROADCASTING-SATELLITE
Radiolocation
5.514 5.515</td><td>17.3-17.7
FIXED-SATELLITE
(Earth-to-space) 5.516
Radiolocation
5.514</td></tr>
<tr><td rowspan="2">17.7-18.1
FIXED
FIXED-SATELLITE
(space-to-Earth) 5.484A
(Earth-to-space) 5.516
MOBILE</td><td>17.7-17.8
FIXED
FIXED-SATELLITE
(space-to-Earth) 5.517
(Earth-to-space) 5.516
BROADCASTING-SATELLITE
Mobile
5.515</td><td rowspan="2">17.7-18.1
FIXED
FIXED-SATELLITE
(space-to-Earth) 5.484A
(Earth-to-space) 5.516
MOBILE</td></tr>
<tr><td>17.8-18.1
FIXED
FIXED-SATELLITE
(space-to-Earth) 5.484A
(Earth-to-space) 5.516
MOBILE
5.519</td></tr>
<tr><td>18.1-18.4</td><td colspan="2">FIXED
FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B 5.XXX
(Earth-to-space) 5.520
MOBILE
5.519 5.521</td></tr>
</table>

18.4-20.2 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
18.4-18.6	FIXED FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B 5.XXX MOBILE	
18.6-18.8 EARTH EXPLORATION-SATELLITE (passive) FIXED FIXED-SATELLITE (space-to-Earth) 5.522B 5.XXX MOBILE except aeronautical mobile Space research (passive) 5.522A 5.522C	**18.6-18.8** EARTH EXPLORATION-SATELLITE (passive) FIXED FIXED-SATELLITE (space-to-Earth) 5.516B 5.522B 5.XXX MOBILE except aeronautical mobile SPACE RESEARCH (passive) 5.522A	**18.6-18.8** EARTH EXPLORATION-SATELLITE (passive) FIXED FIXED-SATELLITE (space-to-Earth) 5.522B 5.XXX MOBILE except aeronautical mobile Space research (passive) 5.522A
…		
19.7-20.1 FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B 5.XXX Mobile-satellite (space-to-Earth) 5.524	**19.7-20.1** FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B 5.XXX MOBILE-SATELLITE (space-to-Earth) 5.524 5.525 5.526 5.527 5.528 5.529	**19.7-20.1** FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B 5.XXX Mobile-satellite (space-to-Earth) 5.524
20.1-20.2	FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B 5.XXX MOBILE-SATELLITE (space-to-Earth) 5.524 5.525 5.526 5.527 5.528	

27.5-29.9 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
27.5-28.5	FIXED5.537A FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 5.XXX MOBILE 5.538 5.540	
28.5-28.6~~29.1~~	FIXED FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.523A 5.539 5.XXX MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540	
28.6-29.1	FIXED FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.523A 5.539 MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540	
...		
29.5-29.9 FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 5.XXX Earth exploration-satellite (Earth-to-space) 5.541 Mobile-satellite (Earth-to-space) 5.540 5.542	**29.5-29.9** FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 5.XXX MOBILE-SATELLITE (Earth-to-space) Earth exploration-satellite (Earth-to-space) 5.541 5.525 5.526 5.527 5.529 5.540 5.542	**29.5-29.9** FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 5.XXX Earth exploration-satellite (Earth-to-space) 5.541 Mobile-satellite (Earth-to-space) 5.540 5.542

29.9-30 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
29.9-30	FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 5.XXX MOBILE-SATELLITE (Earth-to-space) Earth exploration-satellite (Earth-to-space) 5.541 5.543 5.525 5.526 5.527 5.538 5.540 5.542	

Reasons: To provide a footnote allowing the use of UAS CNPC links in the fixed-satellite service not subject to Appendices 30, 30A and 30B.

ADD USA/1.5/2

5.XXX The FSS in this frequency band may also be used for the control and non-payload communication of unmanned aircraft systems. Such use shall be in accordance with Resolution **[FSS-UA-CNPC] (WRC-15**).

ADD USA/1.5/3

RESOLUTION [FSS-UA-CNPC] (WRC-15)

Provision related to Earth stations on board unmanned aircraft which operate with geostationary satellites in the fixed-satellite service for the control and non-payload communications of unmanned aircraft systems in non-segregated airspaces

The World Radiocommunication Conference (Geneva, 2015),

considering

a) that worldwide use of unmanned aircraft systems (UAS) ,which includes the unmanned aircraft (UA) and the unmanned aircraft control station (UACS), is expected to increase significantly in the near future;

b) that UA need to operate seamlessly with piloted aircraft in non-segregated airspace;

c) that the operation of UAS in non-segregated airspace requires reliable control and non-payload communication (CNPC) links, in particular to relay air traffic control communications and for the remote pilot to control the flight;

d) that there is a demand for UAS CNPC links via satellite communication networks for communications beyond the radio horizon while operating in non-segregated airspace;

e) that there is a need to provide internationally harmonized use of spectrum for UAS CNPC links;

f) that the use of fixed satellite service (FSS) frequency assignments by UAS CNPC links should take into account their Article 11 notification status;

considering further

a) that there is a need to limit the amount of communication equipment onboard a UA;

b) that, as a dedicated satellite system for UAS CNPC links is not likely to be implemented in the short or medium term, it is necessary to take into account the existing and future satellite systems to accommodate the growth in UAS operations;

c) that there are various technical methods that may be used to increase the reliability of digital communication links, e.g. modulation, coding, redundancy, etc. that can be used to ensure safe operation of UAS in all air space;

d) that UAS CNPC relate to the safe operation of UAS and have certain technical, operational, and regulatory requirements;

e) that the requirements in *considering further d)* can be specified for UAS use of FSS networks,

noting

a) that Report ITU-R M.2171 provides information on the vast number of applications for UAS needing access to non-segregated airspaces;

recognizing

a) that appropriate technical and operational provisions can be implemented in the ITU-R to enhance the robustness of the UAS CNPC links;

b) that Recommendation 724 (WRC-07) states that the FSS is not a safety service;

c) that the respective roles of ICAO and the ITU must be fully understood to ensure appropriate separation of provisions to be addressed in the Radio Regulations and regulatory and operational matters that need to be addressed by ICAO.

resolves

1 that earth stations on-board UA can communicate with a space station operating in the fixed satellite service, including while the UA is in motion;

2 that the use of such links and their associated performance requirements shall be in accordance with the international standards and recommended practices (SARPS) and procedures established by ICAO consistent with Article 37 of the Convention on International Civil Aviation;

3. that a fixed satellite service earth station on an unmanned aircraft shall be considered as an earth station operating in the fixed satellite service;

4. that the FSS stations operating in frequency bands supporting these CNPC links shall conform to the applicable technical provisions of the radio regulations;

5 that the use of UAS CNPC links is for safe operation and regularity of flight and requires absolute international protection;

6 that the freedom from harmful interference to UAS CNPC links is imperative to ensure safe operation and administrations shall act immediately when their attention is drawn to any such harmful interference;

7 that the FSS operator will ensure that the assignments associated with the FSS networks to be used for UAS CNPC links have obtained the necessary protected status under the provisions of No. 11.32, 11.32A, 11.42, or 11.42A including the examinations made by the BR and have been successfully registered in the MIFR;

8 that, real time interference monitoring and predicting interference risks, and planning solutions for potential interference scenarios, shall be addressed in the specific agreements between FSS operators and UAS operators with guidance from Aviation Authorities,

encourages concerned administrations

1 to cooperate with administrations which license UAS CNPC while seeking agreement under the above mentioned provisions,

instructs the Secretary-General

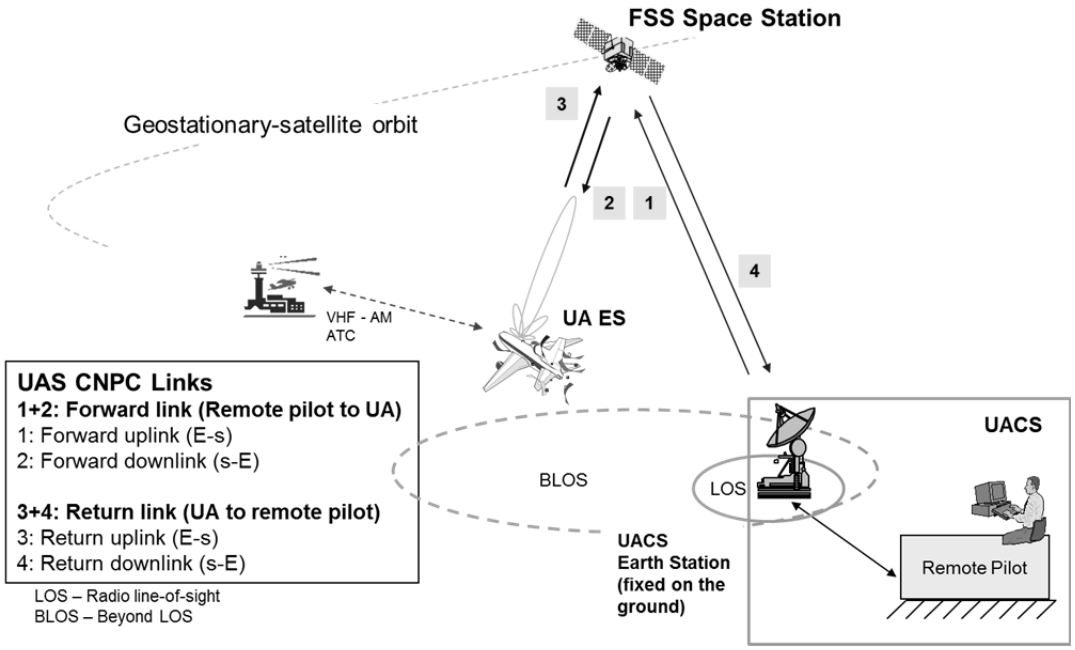
to bring this Resolution to the attention of the Secretary-General of the International Civil Aviation Organization (ICAO),, and that the International Telecommunications Union (ITU) and the International Civil Aviation Organization (ICAO) will carry out their mutual responsibilities in a cooperative manner.

Instructs the ITU-R

to develop the typical conditions for operation of CNPC links, and then, ICAO will develop further operational conditions to ensure safe UAS operation,

FIGURE 1

Elements of UAS architecture using the FSS



WAC/086(27.08.14)

2015 WORLD RADIOCOMMUNICATION CONFERENCE

REVISED DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

AGENDA ITEM 1.7: *to review the use of the band 5 091-5 150 MHz by the fixed-satellite service (Earth-to-space) (limited to feeder links of the non-geostationary mobile-satellite systems in the mobile-satellite service) in accordance with Resolution* ***114 (Rev.WRC-12)***

ISSUE: This agenda item invites the ITU-R to conduct appropriate studies to review the use of the band 5 091-5 150 MHz by feeder links (Earth-to-space) of non-geostationary mobile-satellite systems with respect to the aeronautical radionavigation service in accordance with Resolution **114 (WRC-12).**

BACKGROUND:

At WRC-95, a Primary allocation, subject to **5.444A,** was made to the fixed-satellite service in the 5 091-5 150 MHz band for feeder links to non-GSO mobile-satellite service systems, in the Earth-to-space direction.

The 5 091-5 150 MHz frequency band was originally designated for expansion of the international standard Microwave Landing System (MLS) for planned assignments which could not be satisfied in the 5 030-5 091 MHz frequency band and MLS had priority over other uses in the band. At WRC-07, the priority to MLS was removed in the 5 091-5 150 MHz frequency band and the sunset date for assignments to the FSS in this band was extended from 2012 to 2016 (a date after which no new assignments should be made to the FSS). Recommendation ITU-R S.1342 describes a method for determining coordination distances between international standard MLS stations operating in the band 5 030-5 090 MHz and FSS stations providing Earth-to-space feeder links in the 5 091-5 150 MHz band.

At WRC-07, an additional allocation subject to **5.444B** was made, in the 5 091-5 150 MHz band, to the aeronautical mobile service (AMS) for use by surface applications at airports, aeronautical telemetry transmissions from aircraft stations and aeronautical security transmissions. The latter application was suppressed by WRC-12. Compatibility between the newly allocated aeronautical mobile service planned usage and the existing fixed-satellite service usage was demonstrated by extensive studies carried out by the ITU-R in the lead up to WRC-07.

The fixed-satellite service allocation at 5091-5150 MHz is currently used by the HIBLEO-4FL and HIBLEO-X systems and has been used compatibly with other services since 1998. The extensive studies undertaken in preparation for WRC-07 resulted in the creation of No. **5.444B** and Resolutions **748 (WRC-07)**, **418 (WRC-07)** and **419 (WRC-07)**[1] and demonstrated compatibility between the fixed-satellite service and each of the aeronautical mobile (route) service applications.

[1] Resolution 419 (WRC-07) was suppressed at WRC-12.

The operator of the HIBLEO-4FL and HIBLEO-X systems has completed initial phase of the replenishment of its satellite constellation. As these new spacecraft are replacements for existing equipment, they will also utilize the 5 091-5 150 MHz range for feeder links in the Earth-to-space direction. The replacement satellites are expected to remain in service beyond the year 2025.

As a result of these developments, continued FSS use of the 5 091-5 150 MHz band for feeder links of the MSS, Earth-to-space, is required. Taking into account the time constraints contained in **5.444A**, it is necessary to comply with Resolution **114 (WRC-03)** prior to 2018. Recognizing the considerable effort expended in studying the compatibility between the Earth-to-space feeder links of the MSS systems and the Aeronautical Mobile Service in preparation for WRC-07, and since the interference budgets and scenarios studied before remain the same for the HIBLEO-4FL and HIBLEO-X replacement spacecraft, study of technical and operational issues can and should be limited to the sharing of this band between new systems of the aeronautical radionavigation service (ARNS) and the FSS providing feeder links of the non-GSO systems in the MSS.

The continued use of this allocation by feeder uplinks is of great importance in providing ongoing service by MSS systems to developing countries, under-served areas and critical response in the event of natural disasters and other civil emergencies.

Work finalized in ITU-R WP 4A on Agenda Item 1.7 in preparation for WRC-15 has resulted in the development of a single suitable method to satisfy the requirements of Resolution **114 (WRC-12)**. Method A objectives are:

- to maintain the primary allocation to the earth to space feeder links,
- to suppress the time limitation dates in **RR 5.444A**,
- that the regulatory provisions of Resolution 114 be retained as revised by WRC-15,
- that coordination between FSS earth stations and ARNS is required in certain circumstances,
- that flexibility for deploying AM(R)S has been improved while protecting the FSS, and
- to move the allocation to the FSS from footnote to the Table of Frequency Allocations.

Note: Since Resolution **748 (Rev. WRC-12)** and Recommendation ITU-R M.1827 are parts of the Radio Regulations, modifications to these documents are included in this proposal.

PROPOSAL:

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations
(See No. **2.1**)

MOD USA/1.7/1

4 800-5 570 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**

5 091-5 150	FIXED-SATELLITE (Earth-to-space) MOD 5.444A AERONAUTICAL MOBILE 5.444B AERONAUTICAL MOBILE-SATELLITE (R) 5.443AA AERONAUTICAL RADIONAVIGATION 5.444 ~~5.444A~~
5 150-5 250	FIXED-SATELLITE (Earth-to-space) 5.447A MOBILE except aeronautical mobile 5.446A 5.446B AERONAUTICAL RADIONAVIGATION 5.446 5.446C 5.447 5.447B 5.447C

Reasons: Consequential to rendering the fixed-satellite service allocation without time limits.

MOD USA/1.7/2

5.444A ~~*Additional allocation:* the band 5 091-5 150 MHz is also allocated to the fixed-satellite service (Earth-to-space) on a primary basis. This~~ The use of the allocation to the fixed-satellite service (Earth-to-space) in the band 5 091-5 150 MHz is limited to feeder links of non-geostationary satellite systems in the mobile-satellite service and is subject to coordination under No. **9.11A**. The use of the band 5 091-5 150 MHz by feeder links of non-geostationary satellite systems in the mobile-satellite service shall be subject to application of Resolution **114 (Rev.WRC-15)**. Moreover, to ensure that the aeronautical radionavigation service is protected from harmful interference, coordination is required for feeder-link earth stations of the non-geostationary satellite systems in the mobile-satellite service which are separated by less than 450 km from the territory of an Administration operating ground stations in the aeronautical radionavigation service.

~~In the band 5 091-5 150 MHz, the following conditions also apply:~~

~~– prior to 1 January 2018, the use of the band 5 091-5 150 MHz by feeder links of non-geostationary satellite systems in the mobile-satellite service shall be made in accordance with Resolution **114(Rev.WRC-03)***;~~

~~after 1 January 2016, no new assignments shall be made to earth stations providing feeder links of non-geostationary mobile-satellite systems;~~

~~– after 1 January 2018, the fixed-satellite service will become secondary to the aeronautical radionavigation service.~~

Reasons: to remove time limits from the fixed-satellite service allocation (limited to feeder links of non-geostationary systems in the mobile-satellite service), while keeping all the other applicable regulatory provisions, i.e. No. **9.11A** and Resolution **114 (Rev.WRC-15)**.

MOD USA/1.7/3

APPENDIX 7

TABLE 10 (WRC-15)

Predetermined coordination distances

Frequency sharing situation		**Coordination distance (in sharing situations involving services allocated with equal rights) (km)**
Type of earth station	**Type of terrestrial station**	
Ground-based in the bands below 1 GHz to which No. **9.11A** applies. Ground-based mobile in the bands within the range 1-3 GHz to which No. **9.11A** applies	Mobile (aircraft)	500
Aircraft (mobile) (all bands)	Ground-based	500
Aircraft (mobile) (all bands)	Mobile (aircraft)	1 000
Ground-based in the bands: 400.15-401 MHz 1 668.4-1 675 MHz	Station in the meteorological aids service (radiosonde)	580
Aircraft (mobile) in the bands: 400.15-401 MHz 1 668.4-1 675 MHz	Station in the meteorological aids service (radiosonde)	1 080
Ground-based in the radiodetermination-satellite service (RDSS) in the bands: 1 610-1 626.5 MHz 2 483.5-2 500 MHz 2 500-2 516.5 MHz	Ground-based	100
Airborne earth station in the radiodetermination-satellite service (RDSS) in the bands: 1 610-1 626.5 MHz 2 483.5-2 500 MHz 2 500-2 516.5 MHz	Ground-based	400
Receiving earth stations in the meteorological-satellite service	Station in the meteorological aids service	The coordination distance is considered to be the visibility distance as a function of the earth station horizon elevation angle for a radiosonde at an altitude of 20 km above mean sea level, assuming 4/3 Earth radius (see Note 1)
Non-GSO MSS feeder-link earth stations (all bands)	Mobile (aircraft)	500 (see Note 2)
Ground-based in the bands in which the frequency sharing situation is not covered in the rows above	Mobile (aircraft)	500

NOTE 1 – The coordination distance, d (km), for fixed earth stations in the meteorological-satellite service vis-à-vis stations in the meteorological aids service assumes a radiosonde altitude of 20 km and is determined as a function of the physical horizon elevation angle ε_h (degrees) for each azimuth, as follows:

$$d = 100 \quad \text{for} \quad \varepsilon_h \geq 11°$$

$$d = 582 \left(\sqrt{1 + (0.254\ \varepsilon_h)^2} - 0.254\ \varepsilon_h \right) \text{ for } \quad 0° < \varepsilon_h < 11°$$

$$d = 582 \quad \text{for} \quad \varepsilon_h \leq 0°$$

The minimum and maximum coordination distances are 100 km and 582 km, and correspond to physical horizon angles greater than 11° and less than 0°. (WRC-2000)

NOTE 2 – For the coordination distance in the band 5 091-5 150 MHz vis-à-vis stations in the aeronautical radionavigation service, see. No. **5.444A**. (WRC-15)

Reason: In order to avoid any confusion the coordination distance vis-à-vis a specific service determined by a specific footnote (i.e. No. **5.444A**) needs to be specified.

MOD USA/1.7/4

RESOLUTION 114 (REV.WRC-~~12~~15)

~~Studies on c~~Compatibility between ~~new systems of~~ the aeronautical radionavigation service and the fixed-satellite service (Earth-to-space) (limited to feeder links of the non-geostationary mobile-satellite systems in the mobile-satellite service) in the frequency band 5 091-5 150 MHz

The World Radiocommunication Conference (Geneva, ~~2012~~2015),

considering

a) the current allocation of the frequency band 5 000-5 250 MHz to the aeronautical radionavigation service;

b) the requirements of both the aeronautical radionavigation and the fixed-satellite (FSS) (Earth-to-space) (limited to feeder links of non-geostationary satellite (non-GSO) systems in the mobile-satellite service (MSS)) services in the above-mentioned band,

recognizing

a) that priority must be given to the microwave landing system (MLS) in accordance with No. **5.444** and to other international standard systems of the aeronautical radionavigation service in the frequency band 5 030-5 091~~150~~ MHz;

b) that, in accordance with Annex 10 of the Convention of the International Civil Aviation Organization (ICAO) on international civil aviation, it may be necessary to use the frequency band 5 091-5 150 MHz for the MLS if its requirements cannot be satisfied in the frequency band 5 030-5 091 MHz;

c) that the FSS providing feeder links for non-GSO systems in the MSS will need continuing access to the frequency band 5 091-5 150 MHz ~~in the short~~long ~~term~~,

noting

a) that Recommendation ITU-R S.1342 describes a method for determining coordination distances between international standard MLS stations operating in the band 5 030-5 091 MHz and FSS earth stations providing Earth-to-space feeder links in the band 5 091-5 150 MHz;

b) the small number of FSS stations to be considered~~;~~,

~~*c)* the development of new systems that will provide supplemental navigation information integral to the aeronautical radionavigation service,~~

resolves

1 that administrations authorizing stations providing feeder links for non-GSO systems in the MSS in the frequency band 5 091-5 150 MHz shall ensure that they do not cause harmful interference to stations of the aeronautical radionavigation service~~;~~,

~~2 that the allocation to the aeronautical radionavigation service and the FSS in the frequency band 5 091-5 150 MHz should be reviewed at a future competent conference prior to 2018;~~

~~3 that studies be undertaken on compatibility between new systems of the aeronautical radionavigation service and systems of the FSS providing feeder links of the non-GSO systems in the MSS (Earth-to-space),~~

invites administrations

when assigning frequencies in the band 5 091-5 150 MHz ~~before 1 January 2018~~ to stations of the aeronautical radionavigation service or to stations of the FSS providing feeder links of the non-GSO systems in the MSS (Earth-to-space), to take all practicable steps to avoid mutual interference between them,

~~*invites ITU-R*~~

~~to study the technical and operational issues relating to sharing of this band between new systems of the aeronautical radionavigation service and the FSS providing feeder links of the non-GSO systems in the MSS (Earth-to-space),~~

~~*invites*~~

~~1 ICAO to supply technical and operational criteria suitable for sharing studies for new aeronautical systems;~~

~~2 all Members of the Radiocommunication Sector, and especially ICAO, to participate actively in such studies,~~

instructs the Secretary-General

to bring this Resolution to the attention of ICAO.

Reasons: Consequential changes as a result of rendering the fixed-satellite service allocation (limited to feeder links of non-geostationary systems in the mobile-satellite service) without time limits.

MOD USA/1.7/5

RESOLUTION 748 (REV.WRC-~~12~~15)

Compatibility between the aeronautical mobile (R) service and the fixed-satellite service (Earth-to-space) in the band 5 091-5 150 MHz

The World Radiocommunication Conference (Geneva, ~~2012~~2015),

considering

a) that the allocation of the 5 091-5 150 MHz band to the fixed-satellite service (FSS) (Earth-to-space) is limited to feeder links of non-geostationary-satellite (non-GSO) systems in the mobile-satellite service (MSS);

b) that the frequency band 5 000-5 150 MHz is currently allocated to the aeronautical mobile-satellite (R) service (AMS(R)S), subject to agreement obtained under No. **9.21**, and to the aeronautical radionavigation service (ARNS);

c) that WRC-07 allocated the band 5 091-5 150 MHz to the aeronautical mobile service (AMS) on a primary basis subject to No. 5.444B;

d) that the International Civil Aviation Organization (ICAO) is in the process of identifying the technical and operating characteristics of new systems operating in the AM(R)S in the band 5 091-5 150 MHz;

e) that the compatibility of one AM(R)S system, to be used by aircraft operating on the airport surface, and the FSS has been demonstrated in the 5 091-5 150 MHz band;

f) that ITU-R studies have examined potential sharing among ~~AMS~~aeronautical applications and the FSS in the band 5 091-5 150 MHz ~~and have shown that the aggregate interference from aeronautical telemetry and AM(R)S should total no more than 3% $\Delta T_s/T_s$~~;

g) that the frequency band 117.975-137 MHz currently allocated to the AM(R)S is reaching saturation in certain areas of the world, and therefore that band would not be available to support additional surface applications at airports;

h) that this new allocation is intended to support the introduction of applications and concepts in air traffic management which are data intensive, and which will support data links that carry safety-critical aeronautical data,

recognizing

a) that in the frequency band 5 030-5 091 MHz priority is to be given to the microwave landing system (MLS) in accordance with No. **5.444**;

b) that ICAO publishes recognized international aeronautical standards for AM(R)S systems;

c) that Resolution **114 (Rev.WRC-~~12~~15)** applies to the sharing conditions between the FSS and ARNS in the 5 091-5 150 MHz band,

noting

a) that the number of FSS transmitting stations required may be limited;

b) that the use of the band 5 091-5 150 MHz by the AM(R)S needs to ensure protection of the current or planned use of this band by the FSS (Earth-to-space);

c) that ITU-R studies describe methods for ensuring compatibility between the AM(R)S and FSS operating in the band 5 091-5 150 MHz, and compatibility has been demonstrated for the AM(R)S system referred to in *considering e)*,

resolves

1 that any AM(R)S systems operating in the band 5 091-5 150 MHz shall not cause harmful interference to, nor claim protection from, systems operating in the ARNS;

2 that any AM(R)S systems operating in the frequency band 5 091-5 150 MHz shall meet the SARPs requirements published in Annex 10 of the ICAO Convention on International Civil Aviation and the requirements of Recommendation ITU-R M.1827-1, to ensure compatibility with FSS systems operating in that band;

3 that, in part to meet the provisions of No. **4.10**, the coordination distance with respect to stations in the FSS operating in the band 5 091-5 150 MHz shall be based on ensuring that the signal received at the AM(R)S station from the FSS transmitter does not exceed −143 dB(W/MHz), where the required basic transmission loss shall be determined using the methods described in Recommendations ITU-R P.525-2 and ITU-R P.526-11,

invites

1 administrations to supply technical and operational criteria necessary for sharing studies for the AM(R)S, and to participate actively in such studies;

2 ICAO and other organizations to actively participate in such studies,

instructs the Secretary-General

to bring this Resolution to the attention of ICAO.

Reason: To improve the operational flexibility of the aeronautical-mobile (Route) service and to reflect the revision of Recommendation ITU-R M.1827.

NOTE: Resolution **748 (Rev.WRC-12)** is referred to in *recognizing c)* of Resolution **418 (Rev.WRC-12)**. Should WRC-15 revise Resolution **748 (Rev.WRC-12)**, a consequential update of the reference would be need in Resolution **418 (Rev.WRC-12)**.

WAC/087(27.08.14)

2015 WORLD RADIOCOMMUNICATION CONFERENCE

DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

AGENDA ITEM 1.8: *to review the provisions relating to earth stations located on board vessels (ESVs), based on studies conducted in accordance with Resolution* ***909 [COM6/14] (WRC-12)***

ISSUE: This agenda item invites the ITU-R to conduct appropriate studies to review the provisions relating to ESVs which operate in the FSS in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz and consider possible modifications to Resolution **902 (WRC 03)** in order to reflect current ESV technologies and technical characteristics that are being used or planned to be used, while protecting the other services with allocations in the same frequency bands, in accordance with Resolution **909 (WRC-12).**

BACKGROUND

Consideration of ESVs in the ITU started in 1997 when WARC-97 placed ESVs on the WRC-2000 agenda (agenda item 1.8) via its Resolution **721**. That topic was covered both in the study period 1997-2000 and in the study period 2000-2003. At WRC-03 the ITU-R adopted footnotes **5.457A** and **5.457B**, in addition to Resolution **902 (WRC-03)**, which established conditions for ESV operations.

Resolution **902 (WRC-03)** contains technical and operational conditions for ESVs such as minimum antenna diameter and maximum transmitted power levels, and establishes 300 km and 125 km as the minimum distances from the low-water mark, as officially recognized by the coastal State, beyond which ESVs can operate without the prior agreement of any administration in the 5 925-6 425 MHz band and 14-14.5 GHz band respectively.

The technical studies used to develop Resolution **902 (WRC-03)** were based on the assumptions contained in Recommendations ITU-R S.1587 and ITU-R SF.1650. The former versions of these Recommendations are no longer representatives of all current ESV systems. For example, some of the typical ESVs in the frequency band 5 925-6 425 MHz may operate today with e.i.r.p. density levels that are more than 20 dB lower than those used in Recommendation ITU-R SF.1650. As a consequence, ESV operations at lower power may be geographically restricted by the same constraints derived on the basis of ESV systems with much higher interference potential.

Given the current use of ESV transmissions employing spread spectrum techniques, the assumption of ESV carriers occupying only 2.346 MHz is no longer valid, and therefore the ESV e.i.r.p. levels transmitted toward the horizon should be expressed in terms of e.i.r.p. in the receive bandwidth of the FSRs (assumed as 11.2 MHz for C-band and 14 MHz for Ku-band).

Additionally, the minimum C-band antenna diameter of 2.4 m prescribed in Resolution **902 (WRC-03)** is no longer typical of C-band ESVs, and the latest version of Recommendation ITU-R S.1587 already contemplates systems equipped with 1.2 m antenna diameters.

RESULTS OF UPDATED STUDIES

Recent US studies addressing WRC-15 Agenda Item 1.8 used the same methodology contained in Recommendation ITU-R SF.1650 but assumed ESV antenna diameters of 1.2 m for C-band ESVs and lower values of power density transmitted by the ESVs for both C and Ku bands.

Based on these studies, it was determined that the same level of protection afforded to other services allocated in the frequency bands 5 925-6 425 MHz and 14-14.5 GHz by the WRC-03 ESV related decisions can be ensured if the following protection distances are enforced for C and Ku-bands:

Values for 6 GHz band ESVs

Maximum e.i.r.p. transmitted toward the horizon (dBW in 11.2 MHz)	Minimum distance from low- water mark* (km)
20.8	323
10.8	227
0.8	130
-9.2	64

* Low-water mark as officially recognized by the coastal State.

Values for 14 GHz band ESVs

Maximum e.i.r.p. transmitted toward the horizon (dBW in 14 MHz)	Minimum distance from low- water mark* (km)
16.3	125
6.3	85
-3.7	29

* Low-water mark as officially recognized by the coastal State.

All parameters that need to be updated as a result of these studies are captured in Resolution **902 (WRC-03)**, and therefore there is no need to modify text in the main body of the Radio Regulations to satisfy the agenda item. The proposed modifications to Resolution **902 (WRC-03)** are described below.

ESVs transmitting maximum e.i.r.p. spectral density levels such that the required protection distances determined by the new regulatory conditions adopted by WRC-15 are shorter than those determined by WRC-03 may operate in accordance with the regulatory conditions adopted by WRC-15 from the date these regulatory conditions come into force.

ESVs transmitting maximum e.i.r.p. spectral density levels such that the required protection distances determined by the new regulatory conditions adopted by WRC-15 are larger than those determined by WRC-03 will have one year from the date the new regulatory conditions come into force to conform to the new conditions adopted by WRC-15.

Finally, No. **5.509** was suppressed by WRC-07 and therefore the reference to it in Annex 1 to Resolution **902** should be deleted.

Proposal:

USA/1.8/1

MOD

RESOLUTION 902 (REV. WRC-~~03~~15)

Provisions relating to earth stations located on board vessels which operate in fixed-satellite service networks in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz

The World Radiocommunication Conference (Geneva, ~~2003~~2015),

considering

a) that there is a demand for global wideband satellite communication services on vessels;

b) that the technology exists that enables earth stations on board vessels (ESVs) to use fixed-satellite service (FSS) networks operating in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz;

c) that ESVs are currently operating through FSS networks in the bands 3 700-4 200 MHz, 5 925-6 425 MHz, 10.7-12.75 GHz and 14-14.5 GHz under No. **4.4**;

d) that ESVs have the potential to cause unacceptable interference to other services in the bands 5 925-6 425 MHz and 14-14.5 GHz;

e) that, with respect to the bands considered in this Resolution, global coverage is only available in the band 5 925-6 425 MHz and that only a limited number of geostationary FSS systems can provide such global coverage;

f) that, without special regulatory provisions, ESVs could place a heavy coordination burden on some administrations, especially those in developing countries;

g) that, in order to ensure the protection and future growth of other services, ESVs need to operate under certain technical and operational limitations;

h) that, within ITU-R studies, based on agreed technical assumptions, minimum distances from the low-water mark as officially recognized by the coastal State have been calculated, beyond which an ESV will not have the potential to cause unacceptable interference to other services in the bands 5 925-6 425 MHz and 14-14.5 GHz;

i) that, in order to limit the interference into other networks in the FSS, it is necessary to establish maximum off-axis e.i.r.p. density limits on ESV emissions;

j) that establishing a minimum antenna diameter for ESVs has an impact on the number of ESVs that will ultimately be deployed, hence it will reduce interference into the fixed service,

noting

a) that ESVs may be assigned frequencies to operate in FSS networks in the bands 3 700-4 200 MHz, 5 925-6 425 MHz, 10.7-12.75 GHz and 14-14.5 GHz pursuant to No. **4.4** and shall not claim protection from, nor cause interference to, other services having allocations in these bands;

b) that the regulatory procedures of Article **9** apply for ESVs operating at specified fixed points,

resolves

a) that ESVs transmitting in the 5 925-6 425 MHz and 14-14.5 GHz bands shall operate under the regulatory and operational provisions contained in Annex 1 and the technical limitations in Annex 2 of this Resolution~~,~~;

b) that ESVs transmitting maximum e.i.r.p. spectral density levels such that the required protection distances established in this Resolution are shorter than those contained in Resolution **902**

(WRC-03) may operate in accordance with the regulatory conditions established in this Resolution from the date it comes into force;

c) that ESVs transmitting maximum e.i.r.p. spectral density levels such that the required protection distances established in this Resolution are larger than those contained in Resolution **902 (WRC-03)** will have one year from the date this Resolution comes into force to conform to the conditions established herein,

encourages concerned administrations

to cooperate with administrations which license ESVs while seeking agreement under the above-mentioned provisions, taking into consideration the provisions of Recommendation **37 (WRC-03)**,

instructs the Secretary-General

to bring this Resolution to the attention of the Secretary-General of the International Maritime Organization (IMO).

ANNEX 1 TO RESOLUTION 902 (REV. WRC-03 15)

Regulatory and operational provisions for ESVs transmitting in the 5 925-6 425 MHz and 14-14.5 GHz bands

1 The administration that issues the licence for the use of ESVs in these bands (licensing administration) shall ensure that such stations follow the provisions of this Annex and thus do not present any potential to cause unacceptable interference to the services of other concerned administrations.

2 ESV service providers shall comply with the technical limitations listed in Annex 2 and, when operating within the minimum distances as identified in item 4 below, with the additional limitations agreed by the licensing and other concerned administrations.

3 In the 3 700-4 200 MHz band and 10.7-12.75 GHz range, ESVs in motion shall not claim protection from transmissions of terrestrial services operating in accordance with the Radio Regulations.

4 The minimum distances from the low-water mark as officially recognized by the coastal State beyond which ESVs can operate without the prior agreement of any administration are 300 kmgiven in Table 1 for the 5 925-6 425 MHz band and 125 km in Table 2 for the 14-14.5 GHz band, taking into account the technical limitations in Annex 2. Any transmissions from ESVs within the minimum distances shall be subject to the prior agreement of the concerned administration(s).

5 The potentially concerned administrations referred to in the previous item 4 are those where fixed or mobile services are allocated on a primary basis in the Table of Frequency Allocations of the Radio Regulations:

Frequency bands	Potentially concerned administrations
5 925-6 425 MHz	All three Regions
14-14.25 GHz	Countries listed in No. **5.505**, except those listed in No. **5.506B**
14.25-14.3 GHz	Countries listed in Nos. **5.505**, and **5.508** and **5.509**, except those listed in No. **5.506B**
14.3-14.4 GHz	Regions 1 and 3, except countries listed in No. **5.506B**

14.4-14.5 GHz	All three Regions, except countries listed in No. **5.506B**

6 The ESV system shall include means of identification and mechanisms to immediately cease emissions, whenever the station does not operate in compliance with the provisions of items 2 and 4 above.

7 Cessation of emissions as referred to in item 6 above shall be implemented in such a way that the corresponding mechanisms cannot be bypassed on board the vessel, except under the provisions of No. **4.9**.

8 ESVs shall be equipped so as to:

– enable the licensing administration under the provisions of Article **18** to verify earth station performance; and

– enable the cessation of ESV emissions immediately upon request by an administration whose services may be affected.

9 Each licence-holder shall provide a point of contact to the administration with which agreements have been reached for the purpose of reporting unacceptable interference caused by the ESV.

10 When ESVs operating beyond the territorial sea but within the minimum distance (as referred to in item 4 above) fail to comply with the terms required by the concerned administration pursuant to items 2 and 4, then that administration may:

– request the ESV to comply with such terms or cease operation immediately; or

– request the licensing administration to require such compliance or immediate cessation of the operation.

Table 1: Values for 5 925-6 425 MHz band ESVs

Maximum e.i.r.p. transmitted toward the horizon (dBW in 11.2 MHz)	Minimum distance from low- water mark* (km)
20.8	323
10.8	227
0.8	130
-9.2	64

* Low-water mark as officially recognized by the coastal State.

Table 2: Values for 14-14.5 GHz band ESVs

Maximum e.i.r.p. transmitted toward the horizon (dBW in 14 MHz)	Minimum distance from low- water mark* (km)
16.3	125
6.3	85
-3.7	29

* Low-water mark as officially recognized by the coastal State.

ANNEX 2 TO RESOLUTION 902 (REV. WRC-~~03~~15)

Technical limitations applicable to ESVs transmitting in the bands 5 925-6 425 MHz and 14-14.5 GHz

	5 925-6 425 MHz	14-14.5 GHz
Minimum diameter of ESV antenna	~~2.4~~1.2 m	~~1.2 m~~[1] 60 cm
Tracking accuracy of ESV antenna	±0.2° (peak)	±0.2° (peak)
Maximum ESV e.i.r.p. spectral density toward the horizon	17 dB(W/MHz)	12.5 dB(W/MHz)
Maximum ESV e.i.r.p. towards the horizon	20.8 dBW	16.3 dBW
Maximum off-axis e.i.r.p. ~~density~~[2] density[1]	See below	See below

~~[1] While operations within the minimum distances are subject to specific agreement with concerned administrations, licensing administrations may authorize the deployment of smaller antenna sizes down to 0.6 m at 14 GHz provided that the interference to the terrestrial services is no greater than that which would be caused with an antenna size of 1.2 m, taking into account Recommendation ITU-R SF.1650. In any case, the use of smaller antenna size shall be in compliance with the tracking accuracy of ESV antenna, maximum ESV e.i.r.p. spectral density toward the horizon, maximum ESV e.i.r.p. towards the horizon and maximum off-axis e.i.r.p. density limits in the Table above and the protection requirements of the FSS intersystem coordination agreements.~~

[~~2~~1] In any case, the e.i.r.p. off-axis limits shall be compliant with the FSS intersystem coordination agreements that may agree to more stringent off-axis e.i.r.p. levels.

Off-axis limits

For earth stations on board vessels operating in the 5 925-6 425 MHz band, at any angle φ specified below, off the main-lobe axis of an earth-station antenna, the maximum e.i.r.p. in any direction within 3° of the GSO shall not exceed the following values:

5 925-6 425 MHz

Angle off-axis	*Maximum e.i.r.p. per 4 kHz band*
2.5° ≤ φ ≤ 7°	(32 − 25 log φ) dB(W/4 kHz)
7° < φ ≤ 9.2°	11 dB(W/4 kHz)
9.2° < φ ≤ 48°	(35 − 25 log φ) dB(W/4 kHz)
48° < φ ≤ 180°	−7 dB(W/4 kHz)

For ESV operating in the 14-14.5 GHz band, at any angle φ specified below, off the main-lobe axis of an earth station antenna, the maximum e.i.r.p. in any direction within 3° of the GSO shall not exceed the following values:

14.0-14.5 GHz

Angle off-axis	*Maximum e.i.r.p. per 40 kHz band*
2° ≤ φ ≤ 7°	(33 − 25 log φ) dB(W/40 kHz)
7° < φ ≤ 9.2°	12 dB(W/40 kHz)
9.2° < φ ≤ 48°	(36 − 25 log φ) dB(W/40 kHz)
48° < φ ≤ 180°	−6 dB(W/40 kHz)

Regulatory Issues

WAC/088(27.08.14)

United States of America
Draft Proposals for the Work of the WRC-15

Agenda Item 7 *to consider possible changes and other options, in response to Resolution 86 (Rev. Marrakech, 2002) of the Plenipotentiary Conference, an advance publication, coordination, notification, and recording procedures for frequency assignments pertaining to satellite networks, in accordance with Resolution* ***86 (Rev. WRC-07)*** *to facilitate rational, efficient, and economical use of radio frequencies and any associated orbits including the geostationary-satellite orbit.*

Background Information: The unplanned FSS frequency bands are highly utilized worldwide. In fact, it is becoming more and more difficult for a new operator to have access to satellite communications resources in the conventional unplanned FSS frequency bands. As a result, use of the Appendix **30B** FSS bands has become more attractive, especially for developing countries and new satellite operators. As of November 2013, there are 247 satellite networks submitted to the ITU under Article 6 of Appendix **30B** of the Radio Regulations (RR) and 60 satellite networks in Notification stage under Article 8 of the same Appendix (*Source: ITU's website – Space Plans Query System*).

The World Radiocommunication Conference (Geneva, 2012) (WRC-12) introduced additional provisions in the RR, namely RR No. **11.44.2** and RR No. **11.44B**, in order to better define the bringing into use of a frequency assignment to a space station in the geostationary satellite orbit (GSO). In addition, item A.2.a of RR Appendix **4** was modified in order to make a reference to RR Nos. **11.44.2** and **11.44B** in determining the date of bringing into use of a frequency assignment to a GSO space station, including frequency assignments in RR Appendices **30**, **30A** and **30B**. WRC-12 also modified RR No. **11.49** and added RR No. **11.49.1** so as to extend the period allowed for suspension of the use of a frequency assignment to space station to three (3) years, and at the same time to specify the conditions for bringing a recorded frequency assignment back into use.

Similarly, § 5.2.10, § 5.2.11 and footnote 20bis were added in RR Appendix **30** and § 5.2.10, § 5.2.11 and footnote 24bis in RR Appendix **30A** in relation to the suspension of use of a frequency assignment in the Regions 1 and 3 List, where all are in line with the practices described in RR Nos. **11.49** and **11.49.1**.

Furthermore, WRC-12 approved the application of the extension of the suspension period from two years to three years in regard to RR Appendix **30B** via an agreement contained in its Plenary Minutes (see paragraph 9 of WRC-12 Document 553), thus harmonizing the practices in RR Appendix **30B** with the ones in RR Article **11** and RR Appendices **30** and **30A** (Rev.WRC-12). The Bureau applied this WRC-12 decision by proposing an adequate Rule of Procedure which was approved in the 60th meeting of the Radio Regulations Board (see Annex to Document RRB12-2/6). However, there are no such provisions in procedures of the FSS Plan in RR Appendix **30B**, and therefore corresponding amendments to the RR still need to be prepared for approval by WRC-15.

In view of the above, an alignment of RR Appendix **30B** with RR Article **11** and RR Appendices **30** and **30A** in relation to the suspension of use of a frequency assignment is proposed.

Proposals:

APPENDIX 30B (REV.WRC-12)

Provisions and associated Plan for the fixed-satellite service in the frequency bands 4 500-4 800 MHz, 6 725-7 025 MHz, 10.70-10.95 GHz, 11.2-11.45 GHz and 12.75-13.25 GHz

* * * * *

ARTICLE 6 (REV.WRC-12)

Procedures for the conversion of an allotment into an assignment, for the introduction of an additional system or for the modification of an assignment in the List[1, 2] (WRC-07)

* * * * *

MOD USA/AI 7/1

6.33 When:

i) an assignment is no longer required; *or*

ii) an assignment recorded in the List and brought into use has been suspended for a period exceeding ~~two~~three years and ending after the expiry date specified in § 6.31; *or*

iii) an assignment recorded in the List has not been brought into use within the eight-year period following the receipt by the Bureau of the relevant complete information under § 6.1 (or within the extended period in the event of an extension under § 6.31*bis*), with the exception of assignments submitted by new Member States where § 6.35 and 7.7 apply,

the Bureau shall:

a) publish in a Special Section of its BR IFIC the cancellation of the related Special Sections and the assignments recorded in the Appendix **30B** List;

b) if the cancelled assignment is the result of a conversion of an allotment without modification, reinstate the allotment in the Appendix **30B** Plan;

c) if the cancelled assignment is the result of the conversion of an allotment with modifications, reinstate the allotment with the same orbital location and technical parameters of the cancelled assignment except for its service area, which shall be the national territory of the administration whose allotment is being reinstated; *and*

d) update the reference situation for the allotments of the Plan and the assignments of the List. (WRC-12)

Reasons: To align the supsension provisions in Appendix **30B** with those in Article **11** and Appendices **30** and **30A**, consistent with the decision captured in the Plenary minutes of WRC-12.

* * * * *

ARTICLE 8 (REV.WRC-12)

Procedure for notification and recording in the Master Register of assignments in the planned bands for the fixed-satellite service[11, 12] (WRC-07)

* * * * *

MOD USA/AI 7/2

8.17 Wherever the use of a ~~recorded~~frequency assignment to a space station recorded in the Master Register is suspended for a period ~~not~~ exceeding six ~~eighteen~~ months, the notifying administration shall, as soon as possible, but no later than six months from the date on which the use was suspended, inform the Bureau of the date on which such use was suspended. When the recorded assignment is brought back into use, the notifying administration shall so inform the Bureau, as soon as possible. ~~and the date on which the assignment is to be brought back into regular use.~~ The~~is latter~~ date on which the recorded assignment is brought back into use [ADD 14bis] shall ~~not exceed~~ be not later than three ~~two~~ years from the date of suspension. If ~~the~~a recorded frequency assignment is not brought back into use within ~~two~~three years from the date of suspension, the Bureau shall cancel the assignment.

ADD USA/AI 7/3

14 *bis* The date of bringing back into use of a frequency assignment to a space station in the geostationary-satellite orbit shall be the date of the commencement of the ninety-day period defined below. A frequency assignment to a space station in the geostationary-satellite orbit shall be considered as having been brought back into use when a space station in the geostationary-satellite orbit with the capability of transmitting or receiving that frequency assignment has been deployed and maintained at the notified orbital position for a continuous period of ninety days. The notifying administration shall inform the Bureau within thirty days from the end of the ninety-day period.

Reasons: To align the supsension provisions in Appendix **30B** with those in Article **11** and Appendices **30** and **30A**, consistent with the decision captured in the Plenary minutes of WRC-12. Footnote 14bis aligns with the text of RR No. **11.49.1**

Editorial Note: It should be noted that this proposal would be made consistent with any other proposed modification to No. 11.49.

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WAC/089(27.08.14)

United States of America
Draft Proposals for the Work of the WRC-15

Agenda Item 7 *to consider possible changes, and other options, in response to Resolution 86 (Rev. Marrakech, 2002) of the Plenipotentiary Conference, an advance publication, coordination, notification and recording procedures for frequency assignments pertaining to satellite networks, in accordance with Resolution **86 (Rev.WRC-07)** to facilitate rational, efficient, and economical use of radio frequencies and any associated orbits, including the geostationary-satellite orbit;*

Background Information:

Appendix **30** contains provisions for use of the BSS Plans and Regions 1 and 3 List, as well as for modifying the Plan (in the case of Region 2) or the List (in the case of Regions 1 and 3). It is a self-contained Appendix, including provisions for modifying the Plan or List (Article **4**), notifying Plan or List assignments and for coordinating other services in the frequency bands vis a vis the Plan and List (Articles **6** and **7**). Appendix **30** also contains detailed criteria for sharing between the Plan/List and other services. In particular, the relevant provisions and associated technical criteria are:

- Article **4** of Appendix **30** → procedure for proposed modifications to the BSS Plan or List to coordinate with unplanned FSS or BSS.
- Article **7** of Appendix **30** → procedure for unplanned BSS or FSS networks to coordinate with BSS Plan or List assignments or previously filed modifications to the Plan or List.
- Annex 1 to Appendix **30** → criteria to determine if a proposed modification to the BSS Plan or List needs to coordinate with unplanned FSS or BSS networks.
  - The criteria here is a power-flux density (pfd) mask.
- Annex **4** to Appendix **30** → criteria to determine if an unplanned FSS or BSS network needs to coordinate with the BSS Plan or List assignments or previously filed modifications to the Plan or List.
  - The criteria here is a pfd mask.
- Annex 6 to Appendix **30** → summary of the assumptions used to develop the power flux density (pfd) levels contained in Annexes 1 and 4 to Appendix **30**.
- Annex 7 to Appendix **30** → orbital position limitations on modifications to the BSS Plan or List; specifically applicable to Region 2 BSS in 12.2-12.7 GHz and to Region 1 BSS in 11.7-12.2 GHz. Annex 7 also contains associated e.i.r.p. limits for Region 1 BSS in a portion of the arc.

Annex 6 is particularly useful in understanding the derivation of the Annex 1 and 4 pfd limits, with respect to the earth stations considered and the desired $\Delta T/T$ value.

The focus of the present review is on the orbital position limitations on modifications to the BSS Plans and List contained Annex 7 to Appendix **30**. These limitations were designed to facilitate

sharing with the fixed-satellite service (FSS) in the shared part of the orbital arc between the Regions. In the Ku band frequencies, the BSS allocations are not global, so, for example, 11.7-12.2 GHz is BSS in Region 1 and FSS in Region 2. These orbital position limitations were maintained at WRC-2000 during the last Regions 1 and 3 planning conference, as during a planning conference, many new BSS slots could be adopted at once which could significantly limit the future access of FSS to the shared portion of the orbital arc.
Based on a review of the studies regarding the orbital separations allowed between BSS and FSS from the coordination triggers in Annexes 1 and 4 of Appendix **30** , representative BSS and FSS systems serving different regions can exist successfully with orbital separations as small as 0.5 and 2 degrees, depending on the carrier parameters and geographic discrimination assumed. These small orbital separations suggest that additional measures, such as the orbital position limitations in Annex 7, are no longer needed outside of a planning conference.
Other factors to consider include:

- Both BSS and FSS may proceed at the same time to access the shared orbit resource outside of a planning conference.
- Special consideration may need to be given to operational systems implemented under the Annex 7 regime.
- Parity between the regions and services – BSS is subject to orbital position limitations while FSS in the same frequency bands are not.

Proposal:
MOD USA/AI 7/1

ANNEX 7 (REV.WRC-03)

Orbital position limitations

~~A In applying the procedure of Article 4 for proposed modifications to the Region 2 Plan or for proposed new or modified assignments in the Regions 1 and 3 List, administrations should observe the following criteria:~~

~~1) No broadcasting satellite serving an area in Region 1 and using a frequency in the band 11.7-12.2 GHz shall occupy a nominal orbital position further west than 37.2° W or further east than 146° E.~~

~~2) No broadcasting satellite serving an area in Region 2 that involves an orbital position different from that contained in the Region 2 Plan shall occupy a nominal orbital position:~~

~~*a)* further east than 54° W in the band 12.5-12.7 GHz; *or*~~

~~*b)* further east than 44° W in the band 12.2-12.5 GHz; *or*~~

~~*c)* further west than 175.2° W in the band 12.2-12.7 GHz.~~

~~However, modifications necessary to resolve possible incompatibilities during the incorporation of the Regions 1 and 3 feeder-link Plan into the Radio Regulations shall be permitted.~~

3) The purpose of the following orbital position and e.i.r.p. limitations is to preserve access to the geostationary satellite orbit by the Region 2 fixed satellite service in the band 11.7-12.2 GHz. Within the orbital arc of the geostationary satellite orbit between 37.2° W and 10° E, the orbital position associated with any proposed new or modified assignment in the Regions 1 and 3 List of additional uses shall lie within one of the portions of the orbital arc listed in Table 1. The e.i.r.p. of such assignments shall not exceed 56 dBW, except at the positions listed in Table 2.

TABLE 1

Allowable portions of the orbital arc between 37.2° W and 10° E for new or modified assignments in the Regions 1 and 3 Plan and List

Orbital position	37.2° W to 36° W	33.5°W to 32.5°W	30° W to 29° W	26° W to 24° W	20° W to 18° W	14° W to 12° W	8° W to 6° W	4° W [1]	2° W to 0°	4° E to 6° E	9° E [1]

[1] Proposed new or modified assignments in the List which involve this orbital position shall not exceed the power flux-density limit –138 dB(W/(m^2 · 27 MHz)) at any point in Region 2.

TABLE 2

Nominal positions in the orbital arc between 37.2° W and 10° E at which the e.i.r.p. may exceed the limit of 56 dBW

Orbital position	37° W ±0.2°	33.5° W	30° W	25° W ±0.2°	19° W ±0.2°	13° W ±0.2°	7° W ±0.2°	4° W [1]	1° W ±0.2°	5° E ±0.2°	9° E [1]

[1] Proposed new or modified assignments in the List which involve this orbital position shall not exceed the power flux-density limit –138 dB(W/(m^2 · 27 MHz)) at any point in Region 2.

B The Region 2 Plan is based on the grouping of the space stations in nominal orbital positions of ±0.2° from the centre of the cluster of satellites. Administrations may locate those satellites within a cluster at any orbital position within that cluster, provided they obtain the agreement of administrations having assignments to space stations in the same cluster. (See § 4.13.1 of Annex 3 to Appendix **30A**.)

Reason: Representative BSS and FSS systems serving different Regions can exist successfully with orbital separations as small as 0.5 and 2 degrees, depending on the carrier parameters and geographic discrimination assumed and therefore Paragraph A of Annex 7 to Appendix **30** is no longer necessary.

WAC/090(27.08.14)

ALTERNATIVE PROPOSAL TO NTIA DRAFT PROPOSAL ON WRC-15 AI 7
(REF. WAC/078(27.08.14))

UNITED STATES OF AMERICA

PROPOSALS FOR THE WORK OF THE CONFERENCE

Agenda Item 7: *to consider possible changes in response to Resolution 86 (Rev. Marrakesh, 2002) of the Plenipotentiary Conference, advance publication, coordination, notification and recording procedures for frequency assignments pertaining to satellite networks, in accordance with Resolution* ***86 (Rev.WRC-07)*** *to facilitate rational, efficient, and economical use of radio frequencies and any associated orbits, including the geostationary-satellite orbit* (Issue C and [Y])

Background Information: There has been a longstanding requirement in Article 9 of the Radio Regulations, under No. **9.1**, for the Radiocommunication Bureau to wait a required six months after receiving the advanced publication information (API) for satellite networks requiring coordination under Section II of Article 9 before accepting the coordination request information, even if both sets of information are submitted to the Bureau (BR) at the same time. While this six-month delay may have served a purpose in years past when there was a substantial amount of technical data included in, the API for administrations to consider and potentially comment upon, this is no longer the case. As a consequence of the simplification of the Radio Regulations at WRC-95, the API for satellite networks requiring coordination under Section II of Article 9 includes very limited information (e.g. orbital position and frequency bands) and, as such, there is little for administrations to review and comment. This required six month delay therefore serves no purpose other than to delay the overall start of coordination process for satellite networks.

In addition to creating a delay to the start of the coordination process, the six-month period adds considerable uncertainty as to the potential availability of frequency assignments at any given orbital location. Whereas the SRS database maintained by the ITU BR can be queried and carefully examined in the process of searching for and identifying a potential orbital location at which a new satellite network could be launched and operated in a given frequency band, once an API for this new network is submitted there is six months of uncertainty as the filing administration must wait to see if another administration, which may have an API in the vicinity that has already been submitted to the ITU and is still valid, files a coordination request in advance of the BR's receipt of the coordination request associated with the new API. Discussion within the ITU-R has revealed that one of the primary reasons for administrations periodically submitting multiple API requests at every 2 or 3 degrees, or even every 6 degrees, around the geostationary orbit is precisely to circumvent this six-month delay between Bureau receipt of the API and CR/C. Six- months after the first "batch" of APIs is accepted by the BR from an administration, the administration is then in a position to subsequently submit a CR/C to the BR at virtually any orbital position. As long as the administration submits the next batch of APIs within 18 months of the first batch this workaround solution continues.

The United States proposes modifications to Article 9 of the Radio Regulations to address the six-month delay between the Bureau receipt of an API and CR/C, which no longer serves a useful

purpose. Under the current practice, the BR publishes an API submitted under No. **9.1** within 3 months according to the provisions of No. **9.2B**. Administrations may submit comments within 4 months under No. **9.3**, however, the coordination cannot start any sooner than 6 months after BR receipt of the API. With the six-month delay between API and CR/C, the timing for comments on an API and start of coordination are already in close alignment. A modified scenario with no 6 month delay would allow for coordination to start immediately, even before receiving administration comments under No. **9.3**.

Another issue raised under this Agenda Item is that of multiple advance publication and multiple requests in excess of what is actually required and practically implementable in which many of these satellite networks are usually suppressed after the expiry of the regulatory deadline time-limit of seven years as a result of not being brought into use or not being notified to the BR. The ITU-R has also identified this proposal as a method to mitigate excessive satellite network filings (Issue [Y]).

Proposal:

ARTICLE 9

Procedure for effecting coordination with or obtaining agreement of other administrations[1, 2, 3, 4, 5, 6, 7, 8, 8*bis*] (WRC-12)

Section I − Advance publication of information on satellite networks or satellite systems

General

MOD USA/7/1

9.1 Before initiating any action under this Article or under Article **11** in respect of frequency assignments for a satellite network or a satellite system, an administration, or one[9] acting on behalf of a group of named administrations, shall, prior to the coordination procedure described in Section II of Article **9** below, where applicable, send to the Bureau a general description of the network or system for advance publication in the International Frequency Information Circular (BR IFIC) not earlier than seven years and preferably not later than two years before the planned date of bringing into use of the network or system (see also No. **11.44**). The characteristics to be provided for this purpose are listed in Appendix **4**. The coordination or notification information may also be communicated to the Bureau at the same time~~; it shall be considered as having been received by the Bureau not earlier than six months after the~~

~~date of receipt of the information for advance publication, where coordination is required by Section II of Article 9~~. Where coordination is not required by Section II, notification shall be considered as having been received by the Bureau not earlier than six months after the date of publication of the advance publication information. (WRC-15~~03~~)

Reasons: To address the unnecessary requirement for the Radiocommunications Bureau to wait six months after receipt of the advanced publication information before receiving the coordination request information for satellite networks requiring coordination under Section II of Article 9.

MOD USA/7/2

9.5B If, upon receipt of the BR IFIC containing information published under No. **9.2B**, any administration considers its existing or planned satellite systems or networks or terrestrial stations[11] to be affected, it may send its comments to the publishing administration, so that the latter may take those comments into consideration ~~when initiating the coordination procedure~~. A copy of these comments may also be sent to the Bureau. Thereafter, both administrations shall endeavor to cooperate in joint efforts to resolve any difficulties, with the assistance of the Bureau, if so requested by either of the parties, and shall exchange any additional relevant information that may be available. (WRC-2015~~00~~)

Reasons: To address the unnecessary requirement for the Radiocommunications Bureau to wait six months after receipt of the advanced publication information before receiving the coordination request information for satellite networks requiring coordination under Section II of Article 9.

WAC/091(27.08.14)

UNITED STATES OF AMERICA
DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

Agenda Item 9.0 - *to consider and approve the Report of the Director of the Radiocommunication Bureau, in accordance with Article 7 of the Constitution.*

Background Information:

The global demand for broadband communications continues unabated and is not location specific. Such demand includes requirements of connectivity for users on vessels, aircraft and vehicles that operate both at fixed locations and while in motion, often in very remote parts of the globe. The ITU for many years has been and continues to address ways of meeting this important need. State of the art 30/20 GHz GSO FSS satellite networks and earth stations that employ advanced technology available today are capable of meeting the connectivity requirements of broadband users on vehicles and vessels, including high-throughput applications.

Advances in satellite manufacturing and directional earth station technology, particularly the development of multi-axis stabilized earth station antennas capable of maintaining a high degree of pointing accuracy while stationary or on rapidly moving platforms, have made earth stations with very stable pointing characteristics both available and practical. These earth stations can operate in the same interference environment, and comply with same regulatory and technical constraints as typical GSO FSS earth stations. Satellite network operators are designing, coordinating, and bringing into use GSO FSS networks that can offer both stationary and moving broadband services using a single stabilized directional antenna within existing GSO FSS technical parameters.

The ITU-R, which has been studying deployment of earth stations in motion operating with GSO FSS networks for many years, has adopted Report S.2223, "Technical and operational requirements for GSO FSS earth stations on mobile platforms in bands from 17.3 to 30.0 GHz". Additional technical work continues in the ITU-R, with the Preliminary Draft New Recommendation, ITU-R S.[GSO FSS E/S in 29.5-30.0 GHz], "Technical and operational requirements for earth stations on moving platforms operating with geostationary FSS satellite networks in the bands 29.5-30.0/19.7-20.2 GHz" ("Recommendation"), expected to be approved prior to WRC-15. The 'upper 500 MHz' of the 30/20 GHz band was studied first because the band is predominately allocated to satellite services. The FSS (Earth-to-space) bands between 27.5-29.5 GHz are shared on a global basis with the fixed and mobile services as well as other users and, therefore, more study on use of these bands by earth stations in motion is required. The Recommendation provides technical and operational guidelines to Administrations that wish to deploy earth stations on moving platforms communicating with geostationary space stations in the fixed-satellite service in the bands 19.7-20.2 GHz and 29.5-30.0 GHz. The Recommendation includes a set of recommended off-axis e.i.r.p. spectral

density levels for earth stations in motion as well as an overview of various satellite tracking and pointing techniques that will enable these earth stations to communicate with GSO space stations in the FSS without causing interference at levels in excess of that caused by conventional FSS earth stations.

Currently, in accordance with No. **5.526**, of the Radio Regulations, a satellite network which is both in the FSS and in the MSS can include links between the FSS portion of the network and earth stations in motion using frequency assignments in the bands 19.7-20.2 GHz (space-to-Earth) and 29.5-30.0 GHz (Earth-to-space) in Region 2 and in the bands 20.1-20.2 GHz (space-to-Earth) and 29.9-30.0 GHz (Earth-to-space) in Regions 1 and 3. The Radiocommunication Bureau in implementing this footnote introduced a new class of earth station, UC, to be used by Administrations when filing an earth station while in motion associated with a space station in the FSS in the bands listed in No. 5.526 (see CR/358). The CR also noted that in the absence of particular criteria the BR's findings will be based on existing criteria for FSS links in the relevant bands, as appropriate. Thus, the demand for broadband satellite communications to single earth stations that are used at fixed locations and while in motion can be met in 500 megahertz in Region 2 but only 100 megahertz in Regions 1 and 3. Given that the demand from many users of these satellite services, e.g., shipping companies, is global and cannot be met in only 100 megahertz of spectrum, the United States proposes to complement No. **5.526** by adding a new footnote to the FSS allocation in all three regions in the 29.5-30 GHz and 19.7-20.2 GHz bands to make clear in the Radio Regulations that earth stations while stationary or in motion may communicate with GSO FSS networks on the same basis as conventional FSS earth stations. The US also proposes an associated Resolution that provides technical and operational guidance, based on the studies in the ITU-R, for administrations when deploying earth stations that will operate while in motion.

Adoption of this proposal will provide 500 megahertz in both the uplink and downlink to support these important and growing global broadband requirements, on an equal basis in all three Regions and result in rational and efficient use of the radio spectrum resource. Adoption of this proposal will also allow the coordination, notification and recording of these earth stations on an equal basis in all three Regions.

Proposals:

[USA/AI 9.0/1]

MOD

ARTICLE 5

Frequency allocations
Section IV – Table of Frequency Allocations

Allocation to services		
Region 1	**Region 2**	**Region 3**
19.7-20.1 FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B ADD 5.XXX Mobile-satellite (space-to-Earth) 5.524	**19.7-20.1** FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B ADD 5.XXX MOBILE-SATELLITE (space-to-Earth) 5.524 5.525 5.526 5.527 5.528 5.529	**19.7-20.1** FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B ADD 5.XXX Mobile-satellite (space-to-Earth) 5.524
20.1-20.2	FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B ADD 5.XXX MOBILE-SATELLITE (space-to-Earth) 5.524 5.525 5.526 5.527 5.528	

.....

29.5-29.9 FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 ADD 5.XXX Earth exploration-satellite (Earth-to-space) 5.541 Mobile-satellite (Earth-to-space) 5.540 5.542	**29.5-29.9** FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 ADD 5.XXX MOBILE-SATELLITE (Earth-to-space) Earth exploration-satellite (Earth-to-space) 5.541 5.525 5.526 5.527 5.529 5.540	**29.5-29.9** FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 ADD 5.XXX Earth exploration-satellite (Earth-to-space) 5.541 Mobile-satellite (Earth-to-space) 5.540 5.542
29.9-30	FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 ADD 5.XXX MOBILE-SATELLITE (Earth-to-space) Earth exploration-satellite (Earth-to-space) 5.541 5.543 5.525 5.526 5.527 5.538 5.540 5.542	

[USA/AI9.0/2]
ADD

5.XXX In the bands 19.7-20.2 GHz and 29.5-30 GHz networks in the fixed-satellite service may include links between earth stations at unspecified points or while in motion, through one or more satellites for point-to-point and point-to-

multipoint communications. Operation of earth stations while in motion shall be in accordance with Resolution XXX.

Reason: Adoption of this proposal would provide the availability of 500 megahertz in both the uplink and downlink to support important and growing global broadband communication requirements for users on ships, airplanes, and land vehicles, on an equal basis in all three Regions and result in rational and efficient use of the radio spectrum resource. This also allows the coordination, notification and recording of these earth stations on an equal basis in all three Regions.

[USA/AI 9.0/3]

ADD

RESOLUTION XXX (WRC-15)

Use of the frequency bands 19.7-20.2 GHz and 29.5-30.0 GHz by earth stations in motion operating in geostationary satellite orbit fixed-satellite service networks

The World Radiocommunication Conference (Geneva, 2015)

considering

a) that the bands 19.7-20.2 GHz and 29.5-30.0 GHz are globally allocated on a primary basis to the FSS and that there are a large number of geostationary satellite orbit (GSO) FSS satellite networks operating in these frequency bands;

b) that there is an increasing need for mobile communications, including global broadband satellite services, and that some of this need can be met by allowing earth stations that can operate while stationary or in motion on platforms (such as ships, aircraft and land vehicles) to communicate with space stations of the FSS operating in the frequency bands 19.7-20.2 GHz and 29.5-30.0 GHz;

c) that this Conference has adopted No. **5.XXX** in order to address this need;

d) that GSO FSS networks in the bands 19.7-20.2 GHz and 29.5-30.0 GHz, are required to be coordinated in accordance with the provisions of Article **9** and **11** of the Radio Regulations;

e) that earth stations in motion are currently operating in GSO FSS networks in the bands 19.7-20.2 GHz and 29.5-30.0 GHz, and there are plans to expand the use of such earth stations with operational and future GSO FSS networks;

f) that the ITU-R has studied the technical and operational use of these earth stations in motion in the referenced bands;

considering further

a) that some administrations have addressed this matter nationally or regionally by adopting technical and operational criteria for the operation of earth stations in motion in GSO FSS networks;

b) that a consistent approach to deployment of these earth stations in motion will support this important and growing global broadband communication requirement;

c) that these earth stations in motion will operate consistent with the coordination agreements between administrations applicable to the GSO FSS networks with which they communicate;

resolves

1 that administrations authorizing earth stations in motion operating in GSO FSS networks in the band 19.7-20.2 GHz and 29.5-30.0 GHz require that GSO FSS operators employing earth stations in motion:

a. comply with the off-axis e.i.r.p. density levels given in Annex 1 or other levels mutually coordinated with other affected satellite network operators and their administrations;

b. employ techniques such as those described in Annex 2 that allow the tracking of the wanted GSO FSS satellite and that are resistant to capturing and tracking adjacent GSO satellites;

c. immediately reduce or cease transmission when the earth station antenna mispointing would result in exceeding the levels referred to in *resolves 1a)*;

d. be subject to permanent monitoring and control by a Network Control and Monitoring Center (NCMC) or equivalent facility and that these earth stations be capable to receive and act upon at least “enable transmission” and “disable transmission” commands from the NCMC. In addition, it should be possible for the NCMC to monitor the operation of an earth station in motion to determine if it is malfunctioning;

e. maintain points of contact for the purpose of tracing any suspected cases of interference from Earth stations in motion; and

f. not claim greater protection for such earth stations in the 19.7-20.2 GHz band than the level afforded to stationary earth stations.

ANNEX 1

Off axis e.i.r.p. density levels for earth stations in motion operating in geostationary satellite orbit fixed-satellite service networks in the band 29.5-30.0 GHz

This Annex provides a set of recommended off-axis e.i.r.p. levels for earth stations in motion operating in the band 29.5-30.0 GHz. However, as stated in resolves 1a, other levels may be coordinated between satellite operators and administrations.

Earth stations in motion operating in GSO FSS networks transmitting in the band 29.5-30.0 GHz should be designed in such a manner that at any angle, θ, which is 2° or more from the vector from the earth station antenna to the wanted GSO FSS satellite (see Figure 1 below for the reference geometry of an earth station in motion compared to an earth station at a fixed location), the e.i.r.p. density in any direction within 3° of the GSO, should not exceed the following values:

Angle θ	**Maximum e.i.r.p. per 40 kHz**
$2° \leq \theta \leq 7°$	$(19 - 25 \log \theta)$ dB(W/40 kHz)
$7° < \theta \leq 9.2°$	–2 dB(W/40 kHz)
$9.2° < \theta \leq 48°$	$(22 - 25 \log \theta)$ dB(W/40 kHz)
$48° < \theta \leq 180°$	–10 dB(W/40 kHz)

NOTE 1– The values above should be maximal values under clear-sky conditions. In case of networks employing uplink power control, these levels should include any additional margins above the minimum clear-sky level necessary for the implementation of uplink power control. When uplink power control (UPC) is used and rain fade makes UPC necessary, the levels stated above may be exceeded for the duration of that rain fade period. When uplink power control is not used and the e.i.r.p. density levels given above are not met, different values could be used in compliance with the values agreed to through bilateral coordination of GSO FSS satellite networks.

NOTE 2 – The e.i.r.p. density levels for angles of θ less than 2° may be determined from GSO FSS coordination agreements taking into account the specific parameters of the two GSO FSS satellite networks.

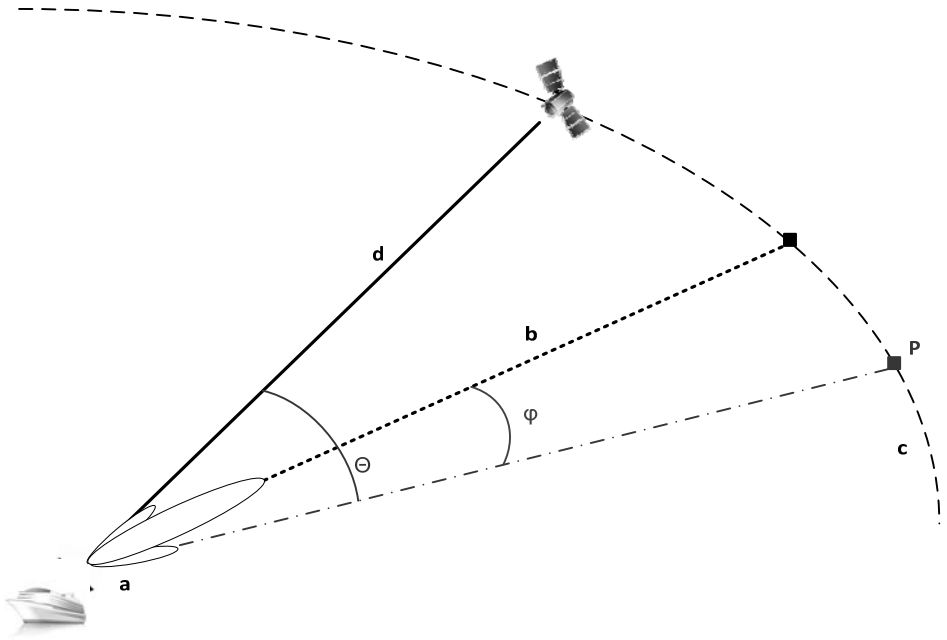
NOTE 3 – For geostationary space stations in the fixed-satellite service with which the earth stations in motion are expected to transmit simultaneously in the same 40 kHz band, e.g., employing code division multiple access (CDMA), the maximum e.i.r.p. density values should be decreased by 10 log(N) dB, where N is the number of earth stations in motion that are in the receive satellite beam of the satellite with which these earth stations are communicating and that are expected to transmit simultaneously on the same frequency.

NOTE 4 – potential aggregate interference from earth stations in motion operating with satellites using multi-spot frequency reuse technologies should be taken into account in coordination between the GSO FSS satellite operators and their administrations.

NOTE 5 – Earth stations in motion operating in the band 29.5-30.0 GHz that have lower elevation angles to the GSO will require higher e.i.r.p. levels relative to the same terminals at higher elevation angles to achieve the same power flux-densities (pfds) at the GSO due to the combined effect of increased distance and atmospheric absorption. Earth stations with low elevation angles may exceed the above levels by the following amount:

Elevation angle to GSO (ε)	**Increase in e.i.r.p. spectral density (dB)**
$\varepsilon < 5°$	2.5
$5° < \varepsilon \leq 30°$	$3 - 0.1\,\varepsilon$

Figure 1 below illustrates the definition of angle θ [1].



[1] In Figure 1 proportions are illustrative and not to scale.

where:

a represents the earth station in motion;

b represents the boresight of the earth station antenna;

c represents the geostationary satellite orbit (GSO);

d represents the vector from the earth station in motion to the wanted GSO FSS satellite;

φ represents the angle between the boresight of the earth station antenna and a point P on the GSO arc;

ϑ represents the angle between the vector d and point P on the GSO arc;

P represents a generic point on the GSO arc which angles ϑ and φ are referred to.

.

ANNEX 2

Satellite tracking and pointing techniques of earth stations in motion operating in geostationary satellite orbit fixed-satellite service networks in the bands 19.7-20.2 GHz and 29.5-30.0 GHz

1 Introduction

Earth stations operating while in motion employ relatively high gain directional antennas with multiple-axis stabilization that allows the signal quality of the link between the earth station antenna and the wanted GSO FSS satellite (and vice versa) to be high. To maintain the signal quality it is also necessary for these earth stations to maintain high pointing accuracy towards the wanted GSO FSS satellite. This Annex describes algorithms that may be employed by earth stations that operate in motion for tracking of the wanted satellite as well as techniques that reduce the possibility of capturing and tracking an adjacent GSO satellite.
There are well-known techniques for antenna tracking of a GSO FSS satellite which can be classified into two categories: those that make use of *open-loop* algorithms and those that make use of *RF closed-loop* algorithms. The following subsections provide a brief description of each of the two types.

1.1 Open-loop pointing technique

An *open-loop* pointing technique employs a process of calculating the azimuth A and elevation E based upon the position of the earth station antenna on the earth (i.e., its latitude and longitude, acquired, for example, through a GPS signal) and the nominal longitude of the wanted satellite. The following equations show the relationship between the variables mentioned above:

$$A = \arctan\left(\frac{\tan L}{\sin l}\right) \tag{1}$$

$$\varepsilon = \arctan\left(\frac{\cos \Phi - \frac{R_E}{R_E + R_0}}{\sin \Phi}\right) \tag{2}$$

where:

l is the earth station latitude;

L is the earth station relative longitude[2];

$\cos \Phi = \cos l \cos L$;

R_E is the earth radius;

R_0 is the altitude of the satellite.

Due to the movement (relative to the earth station) of the GSO FSS satellite within its *station-keeping box*, depending on the width of the main beam of the earth station antenna, the azimuth and elevation angles of that antenna might need to be adjusted at consecutive instants in order for the link between the earth station and the satellite not to be deteriorated or – eventually – lost. By employing an *open-loop* pointing strategy, the angles are calculated in advance for each instant by taking into account the predicted apparent movement of the GSO satellite. Earth

[2] The relative longitude is defined as the absolute value of the difference from the longitude of the earth station to that of the GSO satellite.

stations in motion typically operate as part of a network and under control of a network management system. One method employed by network operators is to broadcast satellite ephemeris data as part of a system bulletin board message that is repeated regularly. Earth stations operating in motion may download this updated ephemeris information and use it as part of the pointing solution to maintain accurate pointing toward the GSO satellite over time. This information is then used by the Antenna Control Unit (ACU), as well as information about the orientation of the antenna platform from an inertial reference unit (IRU) to calculate the earth station antenna pointing angles to the GSO satellite.

1.2 RF closed-loop tracking technique

The second technique – RF closed-loop tracking – employs an algorithm that minimizes the pointing error by analysis of a pre-determined signal received from the wanted GSO satellite. Since earth stations in motion can change their position on the earth continuously and GSO FSS spacecraft move about within their orbital station keeping limits, this technique may be more accurate than the open-loop method. The *RF closed-loop* automatic tracking technique consists in adjusting, at successive steps, the antenna pointing by maximising the strength of a reference signal or a carrier transmitted by the wanted space station. In addition to an accuracy that can be very high (up to $0.05 \cdot \theta_{3dB}$ [3]), an advantage of this procedure is its autonomy, since the information used for tracking does not rely on the accuracy of the orbital data of the wanted GSO FSS satellite.

Furthermore, the precision with which the earth station in motion points at the wanted GSO FSS satellite can be increased and maintained by an *inertial platform* in which the earth station antenna is installed. Such platforms are equipped with angular rate gyroscopes that can accurately measure the angular speed in pitch, yaw and roll to allow the servo-loops of the ACU to account for the platform's motion.

Figure 2a and *Figure 2b* provide example block diagrams for earth station antenna systems using *open-loop* pointing and using *RF closed-loop* tracking, respectively. The figures illustrate the relationships between the different elements composing the typical antenna system used by an earth station in motion to perform the pointing and tracking of the wanted satellite network.

[3] θ_{3dB} is the 3 dB angular width of the earth station in motion antenna and can be approximated by the following:

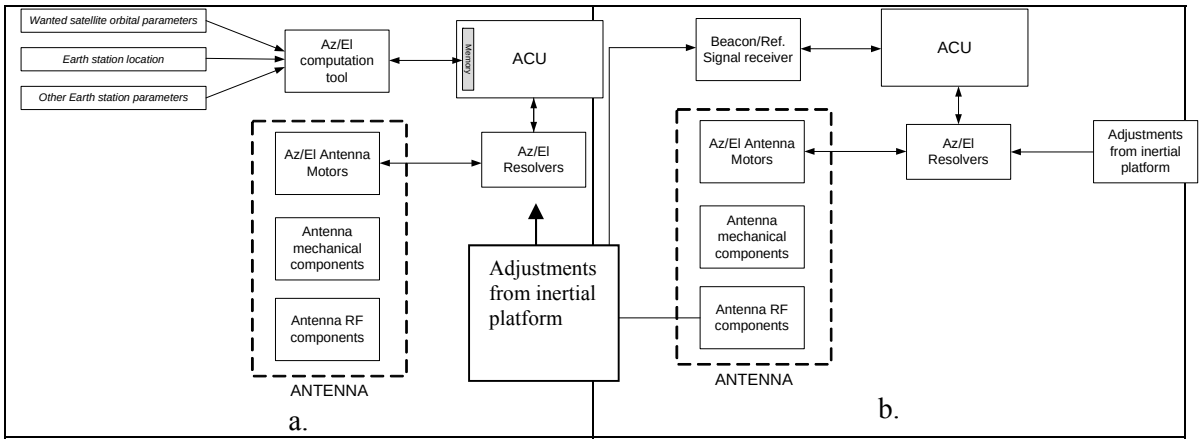
$$\theta_{3dB} = 70 \frac{\lambda}{D}$$

where:

λ is the transmission wavelength (in m); and

D is the earth station antenna diameter (in m).

FIGURE 2



2 Summary

Meeting the limits specified in Annex 1 of this Resolution helps to minimize potential harmful interference from mis-pointing of earth stations in motion.

Taking into account the pointing accuracy and tracking capabilities of earth stations in motion, it is important to implement measures to ensure that GSO FSS satellite networks located near the wanted GSO FSS satellite do not receive harmful interference from these earth stations. This Annex provides two example measures that can be applied to ensure that earth stations in motion comply with the e.i.r.p. density limits specified above.

In the case of the open-loop pointing technique, the maximum mis-pointing of the earth station is determined by design and operational knowledge of wanted GSO satellite station keeping manoeuvers and the maximum transmitted e.i.r.p of the earth station is set accordingly to ensure that the recommended limits are met.

In the case of the *RF closed-loop* tracking technique, the antenna pointing is continuously adjusted by maximising a pre-determined signal received from the wanted GSO FSS satellite. The choice of the signal is up to the satellite operator – some employ a separate carrier, such as a satellite beacon, while others use the same wide band carrier as that used for the forward link. The technical parameters of the signal employed by the RF closed-loop algorithm are important and should be coordinated between GSO FSS satellite network operators. This is to ensure, the pointing error to the wanted geostationary satellite can be determined instantaneously, so that continuous adjustments to the transmitted e.i.r.p. can be applied, as needed.

In the case of both open and closed loop systems, the earth station ceases transmission if it loses its wanted GSO FSS satellite acquisition.

Reason: Adoption of this proposal would provide the availability of 500 megahertz in both the uplink and downlink to support important and growing global broadband communication requirements for users on ships, airplanes, and land vehicles, on an equal basis in all three Regions and result in rational and efficient use of the radio spectrum resource. This also allows the coordination, notification and recording of these earth stations on an equal basis in all three Regions.

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WAC/092(27.08.14)

UNITED STATES OF AMERICA

DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

Agenda Item 9.1.8: **Resolution 757 (WRC-12) Regulatory aspects of nano and pico satellites**

Background Information:

Resolution 757 resolves to invite WRC-18 to consider whether modifications to the regulatory procedures for notifying satellite networks are needed to facilitate the deployment and operation of nano and pico satellites, and to take appropriate action. It further invites studies to consider modifications to enable the deployment and operation of such satellites taking into account the short development time, short mission time, and unique orbital characteristics.

It was the US view that studies of the characteristics of nano and pico satellites should continue, and that, depending on the results of such studies, consideration be given to the development of appropriate regulations to ensure that their operation is consistent and compatible with the radiocommunication regulations presently applicable to other satellite networks and systems as to their protection, ITU-R service, regulatory status and control

ITU-R Working Party 7B has developed two reports, a Preliminary Draft New Report ITU-R SA.[NANO/PICOSAT Characteristics]on nano and pico satellites in response to Question 254/7 and Preliminary Draft New Report ITU-R SA.[NANO/PICOSAT Current practice].which provides useful information on these type of satellites. It has been indicated that the number of these type of satellites is likely to grow. Considering h) of Resolution 757 notes that these type of satellites , "may have limited orbit control capabilities and therefore have unique orbital characteristics".

An indication of the situation today is given by an excerpt from the PDNR of Current Practice.

> "The database contains 253 satellite systems (311 satellites, as of January 2014) operated by 33 countries. Based on mass and dimensions, 187 satellites might be categorized as nanosatellites while 118 might be categorized as picosatellites. The remaining satellites are either missing mass and dimension values or might be categorized as microsatellites based on these characteristics. Table 1 shows the increase of launches in the last ten years.
>
> From this table it is evident that picosatellites and nanosatellites are not a rare side issue anymore, even though it is believed that there will be a saturation level in launches in the upcoming years. From these satellite systems only 81 have applied for an ITU API, whereas 38 have reached notification status (it should be noted that for some systems, the notification is still pending). 144 satellite operators have coordinated their system with IARU. The average time between the date when the ITU receives the API application and the actual launch is only 13.9 months. Although it is believed that the notified systems will increase due to the raising awareness of mandatory regulatory procedures."

The ITU-R Study Groups have concluded that additional efforts should be undertaken by the BR, Administrations, and others to help increase knowledge and raise awareness about the applicable regulatory procedures for notifying satellite networks among those entities involved in development and launch of nanosatellites and picosatellites. Some Administrations have initiated development of guidance concerning authorization of spectrum for use by small, satellites, including satellites that fall into the categories of picosatellites, nanosatellites and CubeSats. Increased familiarity with the applicable rules could help ameliorate some of the regulatory challenges that operators have experienced with many nanosatellite and picosatellite operations that can impact missions. Some administrations have taken steps domestically to advise nanosatellite and picosatellite operators of the applicable ITU filing requirements, and it could be explored how ITU may be able to provide additional support.

Given that nano and picosatellites use the same frequency bands as those of other space services that are subject to Articles 9 and 11 regulatory procedures, it may be difficult to achieve changes to the Radio Regulations without resulting in harmful interference to other services or adding unnecessary complications to the Radio Regulations procedures already in place and used widely by Administrations. Moreover, placing nanosatellites and picosatellites under a different regime could add complexity to the regulatory procedures which would compromise the very purpose of these satellites which are primarily of a research nature.

The specific proposals follow.

Proposals:

MOD USA/AI 9.1.8/1

Modify Resolution 757(WRC-12)

RESOLUTION 757 (REV. WRC-15~~(WRC-12)~~

Regulatory aspects for nanosatellites and picosatellites

The World Radiocommunication Conference (Geneva, 2015~~2~~),

considering

a) that nanosatellites and picosatellites, commonly described as ranging in mass from 0.1 to 10 kg and measuring less than 0.5 m in any linear dimension, have physical characteristics that differ from those of larger satellites;

b) that nanosatellites and picosatellites are satellites which typically have a short (1-2 years) development time and are low cost, often using off-the-shelf components;

c) that the operational lifetime of these satellites ranges from several weeks up to a few (< 5) years depending on their mission;

d) that nanosatellites and picosatellites are being used for a wide variety of missions and applications, including remote sensing, space weather research, upper atmosphere research, astronomy, communications, technology demonstration and education, as well as commercial applications, and therefore may operate under various radiocommunication services;

e) that these satellites are typically launched as secondary payloads;

f) that some missions performed with these satellites require the simultaneous launch and operation of several such satellites;

g) that, currently, many nanosatellites and picosatellites use spectrum allocated to the amateur satellite service, the earth exploration satellite service and the MetSat service in the frequency range 30-10 ~~3~~ 000 MHz ~~although their missions are potentially inconsistent with these services~~;

h) that nanosatellites and picosatellites may have limited orbit control capabilities ~~and therefore have unique orbital characteristics~~;

i) that based on input from the BR referenced in a Report under development on Current Practice, only a portion of these type satellites have been adhering to the appropriate sections of Article 9 and 11 of the Radion Regulations ~~the standing Agenda item 7 of WRCs has up to now not led to consideration of regulatory procedures for notifying nanosatellites and picosatellites~~,

~~*further considering*~~

~~*a)* that successful and timely development and operation of nanosatellites and picosatellites may require regulatory procedures which take account of the short development cycle, the short lifetimes and the typical missions of such satellites;~~

~~*b)* that the existing provisions of the Radio Regulations for coordination and notification of satellites under Articles **9** and **11** may need to be adapted to take account of the nature of these satellites,~~

recognizing

the provisions of Resolution 642, "Relating to the bringing into use of earth stations in the amateur satellite service";

resolves ~~to invite WRC-18~~

1 to request that administrations apply the existing ~~consider whether modifications to the~~ regulatory procedures for notifying satellite networks in connection with ~~are needed to facilitate~~ the deployment and operation of nanosatellites and picosatellites, ~~and to take the appropriate actions,~~

2 to urge administrations considering the authorization and launch of nanosatellites and picosatellites to advise their operators/ users of such satellites of the radio regulation requirements to be followed in order to ensure compatibity, their protection and the protection of other satellite services using the same frequencies.,

~~*invites ITU-R*~~

~~to examine the procedures for notifying space networks and consider possible modifications to enable the deployment and operation of nanosatellites and picosatellites, taking into account the short development time, short mission time and unique orbital characteristics,~~

~~*instructs the Director of the Radiocommunication Bureau*~~

~~to report to WRC-15 on the results of these studies,~~

~~*invites administrations and Sector Members*~~
~~to participate actively in the studies by submitting contributions to ITU-R.~~

Reasons: The original purpose of this Resolution has been fulfilled by the Reports prepared by ITU-R WP-7B. The Reports indicate the difficulties which would be caused by modification of the RR, and the necessity of educating the importance for operators of Nano/Pico satellites to follow the applicable Article 9 and 11 of the Radio Regulations. Therefore, the Resolution should be modified to reflect these needs.

MOD USA/AI 9.1.8/2

Modify Resolution 808 Agenda for WRC-19

RESOLUTION 808 (WRC-12)

Preliminary agenda for the 2018 World Radiocommunication Conference

The World Radiocommunication Conference (Geneva, 2012),

considering

a) that, in accordance with No. 118 of the ITU Convention, the general scope of the agenda for WRC-18 should be established four to six years in advance;

b) Article 13 of the ITU Constitution relating to the competence and scheduling of world radiocommunication conferences and Article 7 of the Convention relating to their agendas;

c) the relevant resolutions and recommendations of previous world administrative radio conferences (WARCs) and world radiocommunication conferences (WRCs),

resolves to give the view

that the following items should be included in the preliminary agenda for WRC-18:

1 to take appropriate action in respect of those urgent issues that were specifically requested by WRC-15;

2 on the basis of proposals from administrations and the Report of the Conference Preparatory Meeting, and taking account of the results of WRC-15, to consider and take appropriate action in respect of the following items;

2.1 to consider regulatory actions, including spectrum allocations, to support GMDSS modernization and implementation of e-navigation in accordance with Resolution **359 (WRC-12)**;

~~2.2 to consider the appropriate regulatory procedures for notifying satellite networks needed to faciliitate the deployment and operation of nanosatellites and picosatellites in accordance with Resolution 757(WRC-12)~~;

3 to examine the revised ITU-R Recommendations incorporated by reference in the Radio Regulations communicated by the Radiocommunication Assembly, in accordance with Resolution **28 (Rev.WRC-03)**, and to decide whether or not to update the corresponding references in the Radio Regulations, in accordance with the principles contained in Annex 1 to Resolution **27 (Rev.WRC-12)**;

4 to consider such consequential changes and amendments to the Radio Regulations as may be necessitated by the decisions of the Conference;

5 in accordance with Resolution **95 (Rev.WRC-07)**, to review the resolutions and recommendations of previous conferences with a view to their possible revision, replacement or abrogation;

6 to review, and take appropriate action on, the Report from the Radiocommunication Assembly submitted in accordance with Nos. 135 and 136 of the Convention;

Reasons: Given the analyses carried out by ITU-R WP-7B the purpose for this agenda item has been fulfilled and while the operators need to be better educated on how to follow the existing RR it is indicated that modification of the existing Articles 9 and 11 should not be carried out. Therefore, this agenda item is not necessary for the next WRC.