Accommodating New Commercial Space Applications in the Global Legal/Regulatory Framework

An Evolutionary Approach to Launching the New Space Revolution

*Audrey L. Allison and Bruce Chesley**

Abstract

Driven by ongoing technological breakthroughs and the rapidly rising demand for broadband connectivity, innovative new telecommunication satellites and services are being designed and launched. Among these are high throughput satellites which are already delivering broadband connectivity to previously unserved swaths of the globe, including on board aircraft and to ships navigating the high seas. A new generation of proposed low-earth orbiting satellite constellations, the so-called "Mega-LEOs," are also being developed which could finally deliver a solution for the profound "digital divide" that impacts the development of most nations. However, to support the tremendous financial investments required to develop these new space systems, a supportive legal and regulatory foundation is absolutely required.

On this 50th anniversary of the Outer Space Treaty, this paper describes how existing space governance mechanisms are being employed to facilitate the introduction of the new Mega-LEOs and other space innovations. The International Telecommunication Union (ITU), a specialized agency of the United Nations (UN), has a long history of providing a stable and foundational legal regime upon which major space systems can be supported and sustained and it affords a notable example of space governance solutions for the world.

I. Background

The UN has long recognized "the fundamental importance of communications infrastructures as an essential element in the economic and

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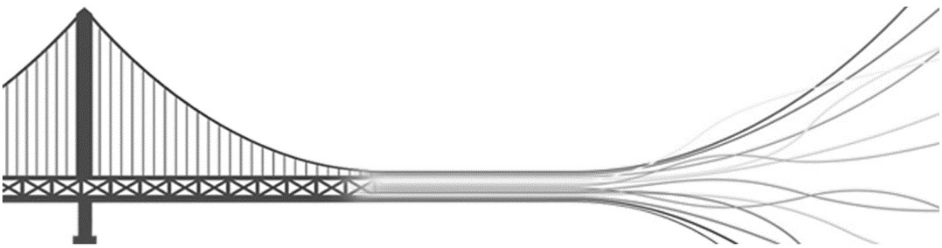
social development of all countries."[1] Its 2030 Agenda for Sustainable Development recognizes the great potential of information and communications technology and global interconnectedness to "accelerate human progress, to bridge the digital divide and to develop knowledge societies."[2]

In 1984, an independent Commission established by the ITU, a specialized UN agency devoted to the extension of telecommunications services around the world, studied the uneven build out of basic telephony services worldwide and its impact on social development. It found that 96% of the world's telephones were located in high-income or upper-middle income countries.[3] Although the situation has improved markedly since that time, spurred both by the build out of mobile telephony networks beginning in the early 1980s and the advent of the internet in the early 1990s, still "[n]early 6 billion people do not have high-speed internet, making them unable to fully participate in the digital economy."[4] [5]

Figure 1. US FCC's vision of closing the digital divide.[6]



1 United Nations General Assembly, World Communications Year: Development of Communications Infra-structures, U.N. Doc. A/RES/36/40, Fortieth Plenary, New York, 1981.

2 United Nations General Assembly, Transforming our World: The 2030 Agenda for Sustainable Development, U.N. Doc. A/RES/70/1, Seventieth Session, New York, 2015.

3 International Telecommunication Union, "Report of the Independent Commission for World Wide Telecommunications Development: The Missing Link," Geneva, 1984, pp. 13-14, https://www.itu.int/osg/spu/sfo/missinglink/The_Missing_Ling_A4-E.pdf (accessed 18.08.17).

4 Kelly, T., Twenty Years of Measuring the Missing Link, International Telecommunication Union, 18 November 2015, www.itu.int/osg/spu/sfo/missinglink/kelly-20-years.pdf (accessed 18.08.17).

5 World Bank Group, World Development Report 2016: Digital Dividends, DOI 10.1596/978-1-4648-0671-1 (2016), at xiii.

6 Pai, A., Remarks of FCC Chairman, Ajit Pai at Broad-band for All Seminar, Stockholm, Sweden, 26 June 2017, https://www.fcc.gov/about-fcc/fcc-initiatives/bridging-digital-divide-all-americans (accessed 31.08.17).

The digital divide is not limited to the countries of the developing world. In the United States, for example, 39% of the rural population and 41% of those residing on Tribal lands still lack access to broadband (Fig. 1).[7] Meanwhile, the growing demand for higher bandwidth and mobility continues to increase unabated, leaving those un- or under-connected, even further behind.[8] Of those who are fortunate enough to be connected, many do not benefit from the availability of multiple, competing service providers, who are incentivized to keep prices low while constantly improving their service offerings.[9] New US Federal Communications Commission (FCC) Chairman Ajit Pai has emphasized that "my number one priority is closing the digital divide and bringing the benefits of the internet age to all Americans." [6]

Figure 2. Inmarsat-5, a Boeing 702HP high throughput satellite

7 Federal Communications Commission, 2016 Broad-band Progress Report, FCC 16-16, 29 January, 2016, https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-6A1.pdf (accessed 31.08.17).

8 Farly, M. How Fast is the Newest Viasat-2 Satellite, and Other Numbers, Viasat, 29 June 2017, www.exede.com/blog/viasat-2-satellite-numbers/) (accessed 31.08.17).

9 Wyler, G., Note from Greg Wyler, OneWeb, 19 December 2016, http://oneweb.world/#news (accessed 31.08.17).

While there is no single solution for this infrastructure challenge of our century, the promise of universal high-speed broadband coverage from space via communications satellites is becoming a brighter part of that solution in light of recent technology innovations including development of digital payloads and processing and advanced antenna technology. High throughput satellites now in service that are capable of beaming more than 100 megabits per second directly to end users, and even to those in rural or remote locations. [8] Even more promising are recently proposed large non-geostationary satellite constellations that are being developed that will offer low latency, high speed connectivity anywhere on Earth. One of these proposed "Mega-LEO" systems, a 648-satellite constellation called OneWeb, has proclaimed that it will "fully bridge the Digital Divide by 2027, making Internet access available and affordable for everyone." [9]

To foster the implementation of these ambitious new satellite systems and their ultimate contribution to the resolution of the digital divide, supporting legal and regulatory norms are needed, including space governance mechanisms. The ITU has a long, successful history of providing a stable and foundational international legal regime upon which major space systems can be supported and sustained and it affords a notable example of space governance solutions for the world.[10] On a regular basis, the ITU creates new space law to accommodate new technologies and activities in space as they develop, from radionavigation, to Earth observation, to broadband. This paper examines the efforts currently underway in the ITU to create a legal foundation to facilitate the introduction of broadband services by some of the new Mega-LEO systems – a new space revolution.

II. New Space Revolution

To deliver broadband services directly to end-user customers and to meet their growing demand for bandwidth, successive generations of communications satellites have been developed and launched, each more capable than the last.

10 Allison, A., The ITU and Managing Satellite Orbital and Spectrum Resources in the 21st Century, Springer, Cham, Switzerland, 2014. pp. 19-20.

Table 1. Evolution of Satellite Broadband to End Users (United States of America, Information Paper on the Evolution of Satellite Broadband Services to End Users, Inter-American Telecommunications Commission, Doc. CCP.II-RADIO/Doc. 4264/17, Orlando, 7 June 2017)

Years	Platform(s)	Highest Satellite Capacity	Max Number of Spot Beams per Satellite	Max Service Mbit/s (Downlink)
2006-2007	Pre-broadband	1 Gbit/s	1 (traditional transponder)	1
2008-2011	Early Broadband	10 Gbit/s	24	5
2012-2016	The Middle Tier	140 Gbit/s	72	15
2017	Today	220 Gbit/s	138	50 or more

These latest "high throughput satellites" (HTS) provide two orders of magnitude of greater throughput than previous generations (Fig. 2). They operate from geostationary orbit in Ka-band (30/20 GHz) spectrum allocations that offer a large amount (1 GHz) of bandwidth using highly directional antennas, spot beam technology and other innovations that allow large degrees of frequency reuse throughout their service areas (Table 1).

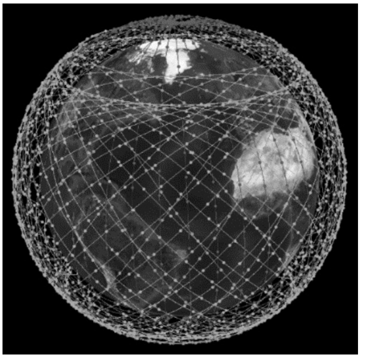
Additional technology advancements, including highly directional, multi-axis, stabilized Earth station antennas that maintain a very high degree of pointing accuracy on rapidly moving platforms, have also made possible for the delivery of satellite broadband to mobile earth stations, including those on board ships and aircraft. This new mobile capability being offered in both FSS and Mobile-Satellite Service (MSS) allocations in the Ku and Ka-bands is referred to as Earth Stations in Motion (ESIM) and is already in service, although the regulatory underpinnings are still in development, including being on the agenda for the ITU's 2019 World Radiocommunication Conference (WRC-19).[11]

As the Ka-band spectrum resource becomes increasingly occupied by these new satellite broadband services, the satellite industry is seeking the next spectrum resource from which to provide the next generation of broadband capability. This next spectrum frontier is the V- or Q-band (50/40 GHz), which is allocated to the Fixed-Satellite Service (FSS), but is not yet occupied by users. Several countries brought proposals to the ITU's most recent WRC

11 International Telecommunication Union, Final Acts of the 2015 World Radiocommunication Conference, Geneva, 2015.

in 2015 (WRC-15) urging action to complete the regulations for FSS use of this spectrum as well as to extend the allocation.[12]

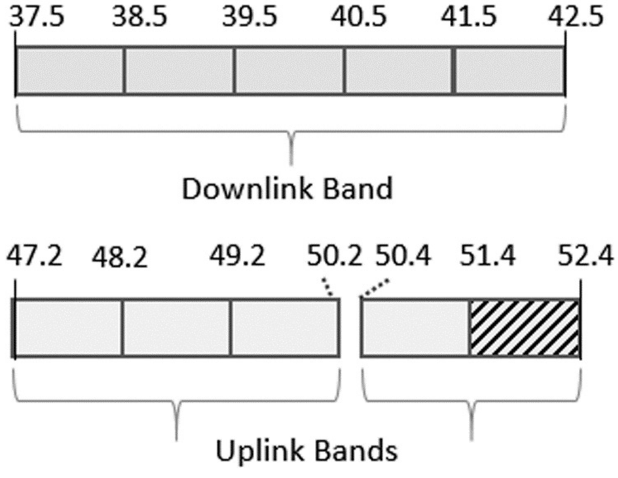
Figure 3. Proposed V-band NGSO global broadband constellation



In addition to the dramatic advances in broadband services delivery from the geostationary orbit, yet another space revolution is now underway which would provide low-latency, high speed broadband connectivity world-wide from low earth orbit. Several companies, including OneWeb, SpaceX, and Boeing, have announced plans, and submitted filings through their administrations to the ITU, to launch large constellations of low earth orbiting satellites, including hundreds or even thousands of satellites, to provide next generation broadband services. Some of these proposed systems will operate in dedicated Ku and Ka-band spectrum allocations that had been prioritized for non-geostationary systems by WRCs nearly twenty years ago for proposed NGSO-FSS systems such as Teledesic and Skybridge, which were never implemented. Today, some companies see even richer opportunities for high-speed, high-capacity broadband satellite service further up the allocation table – in the V-Band (Figure 4).

12 Member States of the Inter-American Telecommunication Commission, Proposals for the Work of the Conference, Agenda Item 10, Doc. CMR15/7(Add.24) (Add.8-9), International Telecommunication Union, Geneva, 2015.

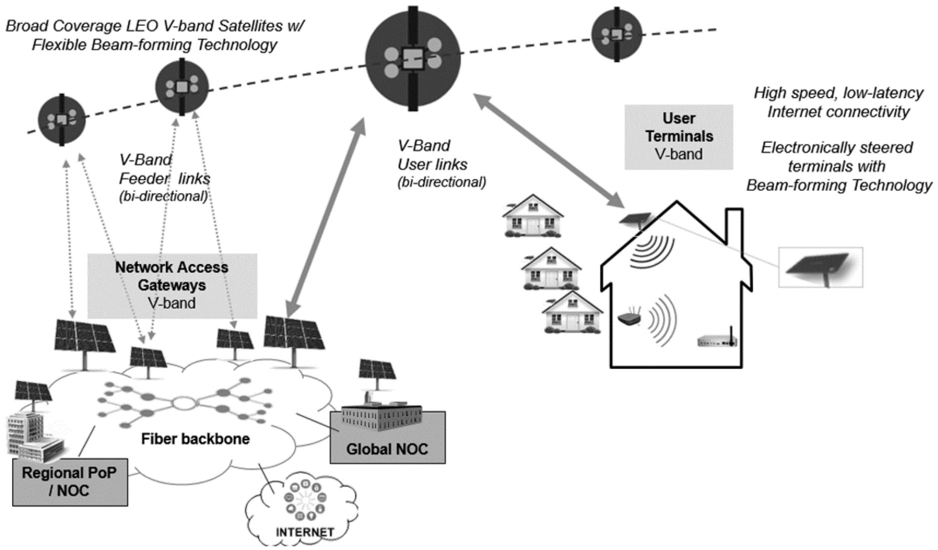
Figure 4. Proposed NGSO Frequency Plan (in GHz) utilizing the "V-band" spectrum



The V-band satellite allocation includes almost 5 GHz of paired bandwidth in what is essentially green field spectrum, a true rarity in this age. Of course, the physics of these millimeter wave bands, with their short wavelengths and high susceptibility to rain and cloud fade, pose considerable technical challenges for closing satellite links, but these can now be overcome through proven technology solutions that are ready for commercialization, including phased-array antennas, beam-forming techniques, and digital processing. Harnessing the vast V-Band spectrum resource from a large constellation of low earth orbiting satellites provides unparalleled potential for affordable, truly universal broadband services that could not only finally drive the resolution of the digital divide, but could provide another mode of competition to terrestrial broadband services, where they are available. However, as the ITU observed at its WRC-15, the regulatory provisions for these higher frequency bands are incomplete, and currently do not provide for the operation of non-geostationary satellite systems. [11] [12]

One of the most ambitious V-Band global broad-band satellite proposals is detailed in a June 22, 2016, application to the FCC. The application, filed by The Boeing Company (Boeing), a manufacturer of advanced space systems, requests authority to operate a constellation of NGSO satellites to operate in V-Band spectrum to provide very high speed, low latency broad-band communications, including Internet access, to consumers, commercial, and government users, regardless of location, throughout the United States and worldwide.[13] Boeing also submitted coordination filings for this network to the Radiocommunication Bureau of the ITU.

Figure 5. Proposed V-Band Boeing NGSO architecture



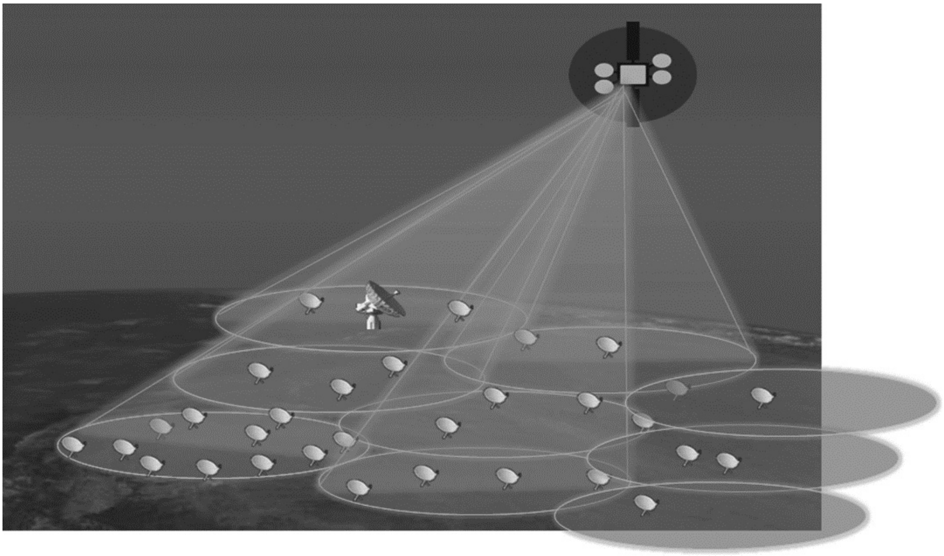
The Boeing system features a space segment comprising a constellation of low earth orbiting satellites orbiting at an altitude of approximately 1030 km; a ground segment of gateway stations capable of generating high-gain beams and connected by terrestrial networks and Network Operations Centers (NOCs); and a user terminal segment with highly directive, steerable antenna beams that track the satellites overhead (Fig. 5).

The constellation will have an initial deployment of 1,396 satellites in 35 circular-orbit planes operating at a 45 degree inclination at 1,030 km altitude, with 6 additional circular-orbit planes operating at a 55 degree inclination at 1,082 km altitude. This arrangement affords satellite visibility at an earth station elevation angle of greater than 45 degrees for all users below 60 degree latitude, the most highly populated latitude regions. The final deployment will increase the number of satellites in the constellation to 2,956, adding 12 more 55 degree inclination planes operating at an altitude

13 The Boeing Company, Application for Authority to Launch and Operate a Non-Geostationary Low Earth Orbit Satellite System in the Fixed Satellite Service, FCC File No. SAT-LOA-20160622-00058, Washington, 22 June 2016.

of 1,082 km and adding 21 orbit planes inclined at a near-polar orbit of 88 degrees operating at an altitude of 970 km.[14]

Figure 6. Boeing NGSO Space Segment Architecture



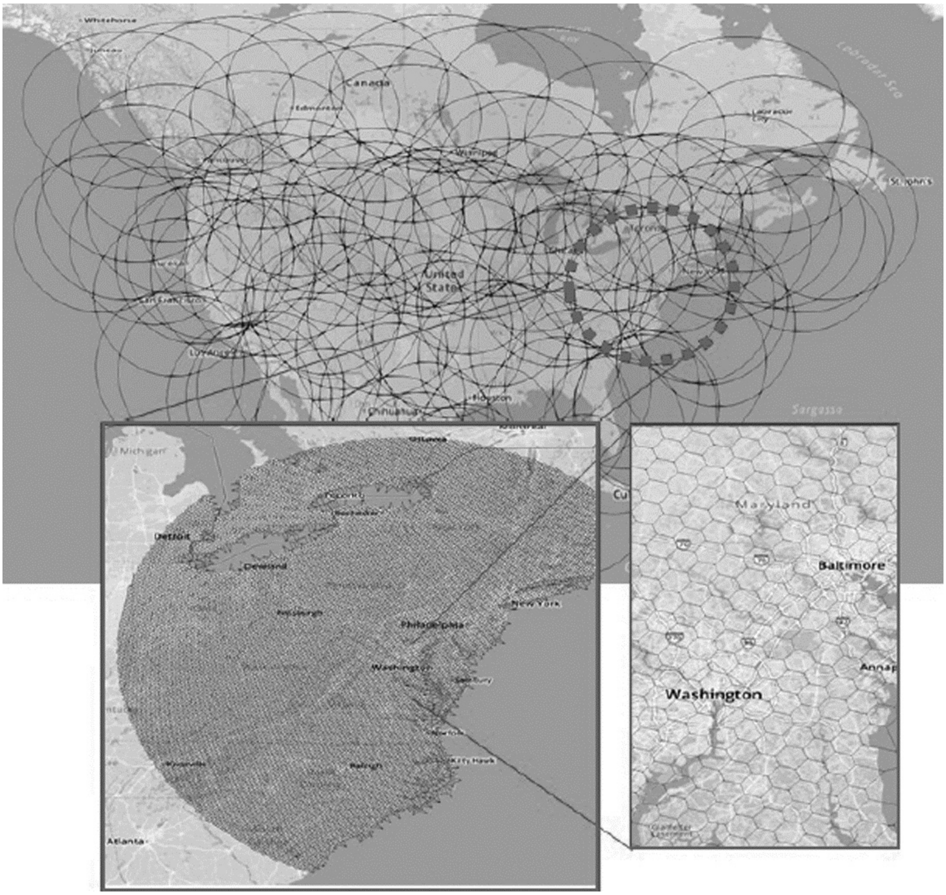
The ground segment will utilize bi-directional links operating with all allocated V-band FSS spectrum, sharing and re-using the entire uplink and downlink frequency bands within the coverage footprint of each satellite. The gateways provide the uplinks and downlinks to the space segment and are connected to the network operations center by terrestrial fiber.

The phased array antennas will enable the re-use of the entire uplink and downlink frequency band within the coverage footprint of the satellite by advanced beam-forming, digital processing technologies to generate narrow spot beams on the Earth's surface. Narrow spot beams with low sidelobes will enable frequency re-use among thousands of cells within each satellite footprint (Fig. 6). The user terminals and gateways will operate in the same spectrum and employ advanced technologies to communicate with multiple satellites. User-terminals will be mapped into cells, and the payload coverage beams will be directed towards those cells as the LEO satellites passes overhead. Each LEO satellite will be able to form beams corresponding to

14 National Telecommunications and Information Ad-ministration, United States Frequency Allocation Chart, Jan. 2016, https://www.ntia.doc.gov/page/2011/united-states-frequency-allocation-chart (accessed 31.08.17).

Earth-surface cell diameters ranging from 8 to 11 km within the satellite coverage footprint (Fig. 7).

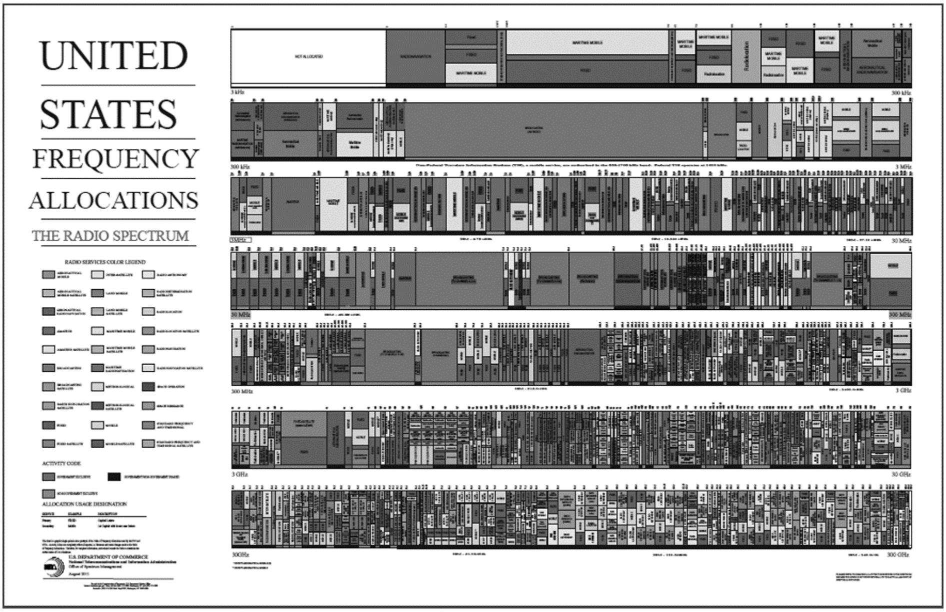
Figure 7. NGSO System Coverage Footprints and Cells



II. Space Governance for Mega-LEOS

Like all wireless telecommunications systems, satellites require assured, reliable access to radiofrequency spectrum in order to operate and to perform their missions. The capability for their signals to be received from low power transmissions through the atmosphere and weather systems from the distance of the Earth's orbit provides satellite operators a considerable challenge compared to their brethren operating on the ground.

Figure 8. US Table of Frequency Allocations



Radiofrequency spectrum is a limited, natural resource belonging to each nation within its territory (Fig. 8). Use of spectrum is controlled through national regulation and licensing regimes. Nations participate as Member States of the ITU and are party to its many treaties, including the international Radio Regulations, under which they are bound to protect the authorized operations of other countries' radio stations from harmful interference from their own radio operations.

Satellite systems are inherently international radio systems. In most cases, their signals illuminate more than a single nation's territory and are capable of being received (and causing harmful interference to radio stations) in multiple nations. They also have the potential to interfere with the radio operations of other nations' satellites in orbit. Satellites therefore require international recognition and protection for harmful interference to the spectrum they use from their position in orbit, in addition to protection of their associated ground network. The ITU and its Radio Regulations provide the basis for international coordination and registration of these satellite networks.[10] In 2017, there are 1,459 satellites in operation, half of them communications satellites, with operators from 59 different nations (some as members of regional consortia).[15]

15 Satellite Industry Association, 2017 State of the Satellite Industry Report, 2017, p. 8, www.sia.org/wp-content/uploads/2017/07/SIA-SSIR-2017.pdf (accessed 31.08.17).

The 1967 Treaty on Principles Governing the Activities of Space in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies (OST), concluded fifty years ago, provides the legal foundation for all of our activities in space, including use of the orbits by satellites.[16] Under its provisions, outer space, including the geostationary and other satellite orbits, is the province of all humankind and not subject to national appropriation by means of use or occupancy. The UN and its Committee on Peaceful Uses of Outer Space (COPUOS) recognize the ITU and its treaty provisions for ensuring equitable access to the geostationary orbit as fulfilling the requirements of OST.[17] [18] In its Annual Report to COPUOS in 2016, the ITU reported that 89 administrations had submitted coordination filings for satellite networks concerning a total of 5,737 proposed satellite networks.[19]

Figure 9. The ITU's Radio Regulations

16 United Nations, United Nations Treaties and Principles on Outer Space, New York, 2002.

17 International Telecommunication Union, International Telecommunication Convention (Nairobi, 1982), Geneva, 1982, p. 153.

18 United Nations General Assembly, Report of the Committee on Peaceful Uses of Outer Space, U.N. Doc. Supplement 20 (A/55/20), Fifty-fifth Session, New York, 2000, pp. 16-17.

19 International Telecommunication Union, ITU Radio-communication Bureau (BR) 2016 Annual Space Report to the STS-16 on the Use of the Geostationary-Satellite Orbit (GSO) and Other Orbits, Geneva, 2016, www.itu.int/en/ITU-R/space/snl/SNL Report/SNS-ref-list-2016_e.pdf (accessed 31.08.17).

The ITU's Radio Regulations are adopted and regularly amended by WRCs that are convened about every four years to decide on matters of international radiocommunication. The Radio Regulations, a treaty-level document, are four volumes (over 2,000 pages) containing the outcomes of these WRCs, including amendments to the International Table of Frequency Allocations which lays out which frequency bands are to be used by particular radio services in the world's three radio regions; procedures for coordination and registration of satellite and terrestrial frequency assignments to obtain international recognition; allotment and assignment plans where some capacity is reserved for particular countries in particular services; and detailed standards that have haven incorporated by reference into the treaty (Fig. 9).[10] Having recently celebrated the 110th anniversary of their initial drafting in 1906, the current Radio Regulations were adopted in 1995 by that year's WRC, and have been steadily updated by the WRCs of 1997, 2000, 2003, 2007, 2012, and 2015.[20] Their next opportunity for amendment is October-November, 2019 when WRC-19 will be convened.[21]

The Radio Regulations include provisions for how an administration obtains international recognition for its frequency assignments and associated orbital positions that are in conformance with the Radio Regulations, typically including completion of coordination and notification requirements detailed in Articles 9 and 11. The ITU's Radiocommunication Bureau reviews filings submitted by the notifying administrations for satellite networks, examines them for conformance with the Radio Regulations, and records the completed assignments in the Master International Frequency Registry with a favorable finding. These recorded assignments afford the notifying administration and the satellite network operators international recognition for that assignment; all others are required to avoid causing harmful interference to that assignment. Thus, these recorded assignments attain priority over later users of the spectrum and orbital resource.[10]

Clearly, the satellite industry derives great benefit from the space governance mechanisms of the ITU. Importantly, this global legal regime also supports the continuous innovation and growth of the satellite industry as technology has continued to develop with the regular process of updating the Radio Regulations, including changes to spectrum allocations; technical, operational and regulatory measures for operating within these allocations; and coordination and notification procedures. As more new services and applications seek to share the same spectrum resources, proponents must demonstrate how their proposed use will not cause harmful interference to the current or planned operations of the incumbent service. As spectrum

20 International Telecommunication Union, Radio Regulations, International Telecommunication Union, Geneva, 2016, p. iii.

becomes increasingly valued and put to use, this effort can become increasingly difficult, both in a technical and political sense.

WRCs are convened by the ITU to consider items on an agenda that was recommended by the previous WRC and approved by the ITU Council. The WRC-19 agenda contains 25 items agreed by WRC-15, after long and difficult deliberations.[21] The ITU, its Member States, and Sector Members (non-state members including inter-governmental satellite organizations, private satellite operators, and manufacturers) spend the period between WRCs in preparation for the next one, with technical studies taking place in the ITU-R Study Groups and their Working Parties, based on the contributions developed by membership. Thus, the satellite industry directly contributes to the results of WRCs, even though they are non-voting observers at the WRC itself.

World Radio Conferences of the 1990s and 2000s were characterized by the adoption of new global satellite spectrum allocations. One example is the 1992 World Administrative Radio Conference in Malaga-Torremolinos, which approved the global MSS “Big LEO” allocation and regulatory provisions for coordination of new NGSO systems. These actions fostered the launch of the Iridium and Globalstar satellite systems that operate worldwide today. Since 2007, WRCs have been marked by the burgeoning spectrum needs of the terrestrial mobile wireless industry and its manufacturers.[22] WRCs now devote considerable attention to whether advanced international mobile telecommunications systems (IMT) can operate in various global and regional spectrum allocations, including satellite allocations, below 6 GHz. WRC-07 and WRC-15 debated whether IMT systems could share with FSS in in the C-band downlink, 3400-4200 MHz, which studies had shown to be profoundly problematic. At the conclusion of WRC-15, the conference reached a Solomonic outcome that maintained the satellite allocation without IMT from 3600-4200 MHz worldwide, but identified the lower band for IMT use in two of the three regions.[11]

Just as controversial at WRC-15 was the consideration of proposals for the items to be recommended for inclusion in the WRC-19 agenda. This included competing proposals for additional spectrum for IMT above 6 GHz (to power future 5G systems); spectrum allocations for High Altitude Platform Stations (envisioned by Google and Facebook) and the additional spectrum allocations and regulation changes to support satellite innovations, including ESIMs, V-Band satellites, and mega-LEO systems (Table 2).

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21 International Telecommunication Union, Place, Date and Agenda of the World Radiocommunication Conference (WRC-19) (Resolution 1380 (MODIFIED 2017), Doc. C17/141, International Telecommunication Union, Geneva, 26 May 2017.

22 International Telecommunication Union, Final Acts of the 1992 World Administrative Radiocommunication Conference (Malaga-Torremolinos), Geneva, 1992.

Table 2. Overlapping frequency bands of WRC-19 agenda items (Rancy, F., Results of the First Session of the Conference Preparatory Meeting for WRC-19 (CPM19-1), Administrative Circular CA/226, International Telecommunication Union, Geneva, 22 December 2015)

1.6 NGSO FSS **Res. 159 [COM6/18]** **Frequencies in GHz**	**1.13 IMT** **Res 238 [COM6/20]** **Frequencies in GHz**	**1.14 HAPS** **Res. 160 [COM6/21]** **Frequencies in GHz**	**9.1 (issue 9.1.9)** **Res. 162 [COM6/24]** **Frequencies in GHz**
	24.25-27.5	24.25-27.5 (Region 2)	
37.5-39.5 (s-E*)	37-40.5	38-39.5 (globally)	
39.5-42.5 (s-E*)	40.5-42.5		
47.2-50.2 (E-s*)	47.2-50.2		
50.4-51.4 (E-s*)	50.4-52.6		51.4-52.4 (E-s*)
E-s*: Earth-to-space; s-E: space-to-Earth			

Now the world is preparing the studies to support proposals on these overlapping agenda items for eventual decisions by WRC-19.

III. WRC-19

Although the FSS V-band allocations were adopted many years ago, the detailed regulations for use of the allocation were not drawn up ahead of the development of the technology that would be developed in the future to harness this resource. Now that time is upon us.

There are currently no regulatory provisions for sharing between NGSO systems and GSO networks in the V-band. Furthermore, there are no protection requirements for V-Band GSO satellite networks. In the absence of other provisions, No. 22.2 of the Radio Regulations specifies that NGSO systems shall not cause unacceptable interference to GSO FSS and broadcasting-satellite service (BSS) networks. Article 22 defines regulatory provisions to facilitate sharing between GSO and NGSO systems, but these provisions, termed equivalent power flux density (epfd) limits, are only defined for the 3-30 GHz frequency range.

WRC-19 Agenda Item 1.6 and Resolution 159 (WRC-15) urge the development of a regulatory framework to enable NGSO systems to operate in the following frequency bands allocated to the FSS: 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space), and 50.4-51.4 GHz (Earth-to-space).[11] [12] This Agenda Item is to study and develop technical provisions that would allow NGSO systems to operate while protecting GSO networks from unacceptable interference.

The studies supporting Agenda Item 1.6 are currently underway in the ITU Radiocommunication Sector's Study Group 4 (Satellite Services) and its Working Party 4A (Efficient Orbit/Spectrum Utilization for FSS and BSS). The ITU-R is developing a Report on technical and regulatory provisions for 50/40 GHz (V-band) GSO/NGSO sharing. The objective is to identify means to enable use of the 50/40 GHz frequency bands by NGSO systems that will ensure appropriate protection of GSO FSS networks, thereby significantly enhancing spectrum use. WP4A is undertaking work to define a new technical Recommendation to define appropriate protection criteria, taking into account the unique properties of the 50/40 GHz band to establish appropriate protection criteria and maximum permissible levels of interference for emissions between FSS networks.

Meanwhile, ITU-R participants are preparing for the related WRC-19 Agenda Items, including Agenda Item 1.13, Identification of frequency bands for development of IMT above 24 GHz, which is addressing sharing and compatibility studies for sharing with FSS; Agenda Item 1.14 on High Altitude Platform Stations; and Agenda Item 7, regarding the coordination of Mega-LEO systems, and how to calculate the Date of Bringing into Use of these constellations.

IV. Conclusion

A new revolution in space systems is now upon us with the potential to lead to the creation of new providers of high-speed, low latency broadband services directly to end users no matter their location. These new space systems will contribute to the closing of the digital divide and foster sustainable social development worldwide. These new space systems require stable space governance mechanisms as a foundation to support their tremendous investments of time and resources.

The ITU's 2019 World Radio Communication Conference offers an important opportunity to take global regulatory decisions to enable these new space systems, including Mega-LEO systems, to help bring about this space revolution.