Bringing into Use of Frequency Assignments for Non-GSO Constellations

New Regulatory Framework Required

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Abstract

Lately, a general trend has appeared towards increasing interest in the use of non-geostationary satellite orbit (non-GSO) systems for different satellite services. Such systems, if designated to provide continuous service in a wide geographical area, are known to have constellations of constantly moving satellites operated on several orbital planes. At the same time, quite a few of the existing provisions of the radio frequency spectrum management and utilization regulations were initially formulated with geostationary satellite orbit (GSO) systems in mind, mainly intended for the operation of a single satellite occupying a designated GSO location from which it appears motionless to the Earth observers. This is also applicable to the procedure of bringing frequency assignments into use.

This paper aims at describing the current regulatory framework related to bringing frequency assignments into use, assessing its applicability to non-GSO constellations, and recounting some suggestions for further improvements of the regulatory framework.

I. Introduction

Outer space is free for exploration and use by all states in accordance with international law.[1] However, it is generally and often impossible to implement this principle in practice without using the radio frequency spectrum which is indispensable for space-based systems and, therefore, one of the most sought-after parts of outer space. It is increasingly in demand from a large and growing number of services such as fixed, mobile, broadcasting, amateur, space

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1 Art. I, Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, 27 January 1967.

research, emergency telecommunications, meteorology, global positioning systems, environmental monitoring, and communication services that ensure safety of life on land, at sea and in the skies.[2] A shortage of this limited natural resource requires a special international procedure for its utilization.

The responsibilities related to the management of the radio frequency spectrum are assigned to the International Telecommunication Union (ITU)[3] headquartered in Geneva, Switzerland, which is the United Nations specialized agency for information and communication technologies uniting 193 countries and almost 800 private-sector entities and academic institutions.[4] ITU fulfils this fundamental mission through the Radiocommunication Sector (ITU-R).[5]

The core regulatory documents that establish the legal basis for the ITU are its Constitution, Convention, and the Radio Regulations[6] that complement them. The ITU main principles are rational, efficient, and economical use of radio frequencies in the interference free environment.[7]

In order to make sure that these principles are implemented the ITU Radiocommunication Bureau (Bureau),[8] among other things, registers frequency assignments.[9]

A frequency assignment means authorization to use the radio frequency spectrum,[10] which needs to be obtained through application of the relevant procedures of the Radio Regulations. For this purpose a general description of a future space-based system is to be submitted to the Bureau. Afterwards, a countdown begins showing the time left until the actual deployment of a system and ending with an important deadline set by the Radio Regulations.

2 No. 1.2.2.1, Annex 1 "Background on the Strategic Plan for the Union for 2016-2019" to Resolution 71 (Rev. Busan, 2014): Strategic Plan for the Union for 2016-2019.

3 The International Telecommunication Union was founded in Paris in 1865 as the International Telegraph Union. It took its present name in 1934, and in 1947 became a specialized agency of the United Nations. *See* more at http://www.itu.int/en/history/Pages/ITUsHistory.aspx.

4 http://www.itu.int/en/membership/Pages/member-states.aspx.

5 Nos. 43-45, Art. 7, Ch. I, the ITU Constitution.

6 The ITU Radio Regulations are an international treaty governing the use of the radio frequency spectrum as well as geostationary and non-geostationary satellite orbits. Latest edition of 2012 is available at http://www.itu.int/dms_pub/itu-s/oth/02/02/s02020000244501pdfe.pdf.

7 No. 196, Art. 44, Ch. VII, the ITU Constitution; No. 0.3, Preamble, the ITU Radio Regulations.

8 The ITU Radiocommunication Bureau is a body of the ITU Radiocommunication Sector headed by an elected Director who organizes and coordinates the work of the ITU-R. *See* Art. 16, Ch. II, the ITU Constitution; Art. 12, Sect. 5, the ITU Convention; http://www.itu.int/en/ITU-R/information/Pages/default.aspx.

9 No. 11, Art. 1, Ch. I, the ITU Constitution.

10 No. 1.18, Art. 1, Ch. I, the ITU Radio Regulations.

This is the deadline for bringing frequency assignments into use. Today, this period lasts 7 or 8 years.[11] If this time limit is not met, the consequences may be fatal – a frequency assignment may be cancelled,[12] meaning that the whole project may fail.

II. The Concept of Bringing into Use

The concept of bringing into use of frequency assignments to GSO satellite networks is clearly defined in the Radio Regulations. A frequency assignment is considered to have been brought into use when an operating satellite with the capability of transmitting or receiving that frequency assignment has been deployed and maintained at the notified orbital position for 90 days running.[13] The start of such 90-day period is regarded as the date of bringing the frequency assignment into use.[14]

Here, it is appropriate to recall that a GSO-system generally implies the use of a single satellite in a certain orbital position. In other words, a GSO-satellite usually brings into use the frequency assignment that it will itself utilize for the whole operational lifetime. A non-GSO system, in turn, is a constellation of satellites distributed on several orbital planes and operating together. Such systems have a wider diversity of orbital characteristics if compared with the GSO ones.

For example, each of the global navigation satellite systems GPS and GLONASS are based on at least 24 satellites spread equally on 6 and 3 orbital planes, respectively. In the Galileo satellite navigation system, 30 satellites – 27 operational and 3 back-ups – will be located on 3 orbital planes. At least 8 satellites are orbiting on each of 6 orbital planes within the GlobalStar system for satellite phone and low-speed data communications, totaling 48 satellites. The Iridium satellite constellation providing services over the Earth's entire surface consists of 66 core satellites on 6 orbital planes, 11 satellites on each.

All the above non-GSO constellations are complex but single systems from the viewpoint of their frequency inventory, deployment, and operation. Each of them require a larger radio frequency spectrum than a GSO-system: this spectrum is jointly utilized by a number of satellites constituting a constellation.

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11 The term of 7 years is set for frequency assignments in unplanned frequency bands; the term of 8 years – for frequency assignments in the planned frequency bands. *See* No. 11.44, Art. 11, Nos. 4.1.3 and 4.2.6, Appendix 30/30A, Nos. 6.1 and 8.2, Appendix 30B, the ITU Radio Regulations. As there is no plan for non-GSO frequencies, non-GSO frequency assignments can only be in unplanned frequency bands, meaning that the regulatory deadline for such assignments is currently 7 years.

12 *Ibid.*, Nos. 11.44 and 11.44.1, Art. 11, Ch. III, No. 5.3.1, Appendix 30/30A, No. 8.16, Appendix 30B.

13 *Ibid.*, No. 11.44B, Art. 11, Ch. III.

14 *Ibid.*, No. 11.44.2.

However, there are no rules for bringing into use of frequency assignments to non-GSO satellite networks, so one has to act on the analogy. As practiced by the Bureau, a frequency assignment is considered as having been brought into use when a single satellite with the capability of transmitting or receiving that frequency assignment has been deployed on one of the notified orbital planes.[15] A continuous period of at least 90 days of operation is also necessary to confirm the bringing into use.

To put it differently, the current legal framework lacks a specific provision for regulating the bringing of non-GSO frequency assignments into use, therefore, the rule related to GSO frequency assignments is actually applied to both GSO and non-GSO satellite networks. Evidently, the current practice, which is the same for very different systems, has drawbacks.

III. The Drawbacks of the Current Regime

The existing practice of considering the frequency assignment for a non-GSO constellation to be brought into use with the placement into service of just one of its satellites – irrespective of the total number of satellites and orbital planes in the constellation – can hardly secure rational, efficient, and economical use of radio frequencies.

First, when deploying a non-GSO constellation its operator may change its plans, which may lead to spectrum warehousing. For example, instead of a multitude of planned satellites much fewer may actually be launched. At the same time, immediately after the launch of the first and probably the only satellite the frequency assignment initially intended for a large constellation will be considered brought into use. This means that part of the radio frequency spectrum, which is not actually used by the operator, will be unavailable to other operators as well.

Second, operators may act unfairly by submitting frequency filings of a speculative nature, which will lead to so-called "paper satellites" – cases when satellite networks are filed with the ITU in order to block certain spectrum, rather than have it used by an operational satellite. Such blocking is possible due to the priority of a satellite network filed earlier over satellite networks filed later. For many years such filings just remain on paper freezing the radio frequency spectrum.

So far, the lack of specific rules for bringing non-GSO systems into use has not been an obstacle as the number of such systems is currently rather modest. However, one needs to take into account the overall trend for a growing interest in operating low, medium, and elliptical Earth orbits which

15 No. 3.2.2.4.4, Part 2 "Experience in the Application of Radio Regulatory Procedures and Other Related Matters", Report of the Director on the Activities of the Radiocommunication Sector, Contribution 4, World Radio Conferences (WRC) 2015 (Document 4(Add.2)(Rev.1) dated 29 September 2015).

will shortly result in a lot more diversity in the non-GSO sector.[16] Also, the number of satellites in planned non-GSO systems is increasing. Most recently, a number of frequency filings have been submitted to the ITU employing dozens and hundreds, and even thousands of satellites.[17] In these conditions it becomes evident that a proper use of the radio frequency spectrum by all satellite systems needs to be ensured.

IV. A New Approach

The simplest solution, which seems to be quite obvious, would be to demand that all satellites in a non-GSO constellation start operating before the expiry of the regulatory deadline. A frequency assignment to a non-GSO satellite network will be considered brought into use only if this is achieved. In other words, for a constellation consisting of 100 satellites to be brought into use, all these satellites need to start operating not later than 7 years after the frequency filing was submitted. However, certain non-GSO constellations may take many months and possibly years to launch all the satellites required for the full deployment of the system and such deployment may continue beyond the 7-year regulatory period.

When discussing a new approach to the issue of the bringing frequency assignments to non-GSO satellite networks into use it is important to take into account that the operator of a large non-GSO constellation should not

16 *See* Juliet Van Wagenen, NSR Forecasts $175 Billion in Non-GEO Revenue, http://www.satellitetoday.com/technology/2016/03/25/nsr-forecasts-175-billion-in-non-geo-revenue/ (25 March 2016).

17 Shortly there may be implemented the following non-GSO projects with varying numbers of satellites: the OptiSAR constellation of 16 satellites – 8 tandem pairs in 2 orbital planes – designed by UrtheCast to become the world's first fully-integrated, multispectral optical and synthetic aperture radar constellation of Earth observation satellites; a constellation based on a Canadian filing called CANPOL-2 which is designed as an 8-plane architecture with 9 satellites per plane in low and highly elliptical Earth orbit – up to 72 satellites in total; a Liechtenstein filing on behalf of a project registered under the name 3ECOM-1 which proposes 24 satellites in each of 12 orbital planes, or 264 satellites in total; OneWeb which intends to launch 648 satellites that will orbit in 20 orbital planes; another Canadian filing, this one registered under the name COMSTELLATION, that would use 794 satellites in low Earth orbit flying in 12 orbital planes; Thales Group of France with a filing called MCSat, covering one series of between 800 and more than 4,000 satellites at different altitudes and different orbital architectures in low, medium, and highly elliptical Earth orbit; SpaceX which has also announced plans to build a 4,000-satellite constellation; and one of the most ambitious of the recent frequency filings in terms of the number of planned satellites made through Norway for several satellite networks called STEAM, described as 4,257 satellites distributed among 43 orbital planes. *See* Peter B. de Selding, Signs of a Satellite Internet Gold Rush in Burst of ITU Filings, http://spacenews.com/signs-of-satellite-internet-gold-rush/#sthash.dEwT5BlO.dpuf (23 January 2015).

be subject to excessive time constraints when deploying its constellation inasmuch as it has to launch a multitude of satellites in contrast to the operator of a GSO system.

A possible new approach, successfully accommodating the interests of various parties, may be the one suggested by the Director of the Bureau.[18] It was recommended that the bringing into use should be phased with several milestones.

First is the end of the 7-year time limit, where either one satellite or a percentage of the total number of satellites needs to be deployed in order to bring the frequency assignment designated for the whole constellation into use. The completion of the deployment of the entire constellation must occur within a reasonable period after the bringing into use in either one or two steps – for instance, the original date of bringing into use plus 3 years and 6 years. Failure to meet one of these three milestones would result in either the cancellation of the frequency assignment at the end of the 7-year time limit, or the adjustment of the frequency assignment based on the actual number of satellites in operation at the end of the 3-year and 6-year milestone.

Let us review this suggested new approach using a hypothetical example. Let us assume that a frequency filing has been made for a non-GSO constellation based on 2 orbital planes with 5 satellites on each totaling 10 satellites. At the end of the 7-year period, being the first milestone, the minimum number of satellites required – e.g. 10% – must bring into use a frequency assignment intended for the operation of the whole non-GSO system. This means that as soon as 1 satellite is deployed the milestone has been duly met. 3 years later, by the second milestone, another group of satellites, e.g. 40%, needs to be put into operation. That is another 4 satellites must become operational within this timeframe. After another 3 years, at the third and final milestone, the remaining 50% of the non-GSO constellation must be put into operation. In other words, with the launch of the last 5 satellites the third milestone will be duly met.

If the requirements for each of the three milestones are fulfilled in a timely manner, the frequency assignment that was brought into use with the first satellite will continue to be considered brought into use in full as filed. However, if the operator misses any of the suggested milestones, the bringing into use of the frequency assignment will either be deemed failed (if the first milestone is not met) or deemed to have only occurred with respect to the part of the radio frequency spectrum that is actually used by operational satellites (if the second or the third milestone is not met). The frequencies that were filed but not brought into use will be cancelled.

18 No. 3.2.2.4.4, Part 2 "Experience in the Application of Radio Regulatory Procedures and Other Related Matters", Report of the Director on the Activities of the Radiocommunication Sector, Contribution 4 (Rev. 1), World Radio Conferences (WRC) 2015 (Document 4(Add.2)(Rev.1) dated 29 September 2015).

It seems that this approach will help achieve a balance of interests. On the one hand, any surplus of radio frequency spectrum, which is not actually in operation, will not be blocked and will again become accessible to all interested users as the established milestones expire. On the other hand, if it is impossible to deploy a filed non-GSO constellation in full, its operator will not lose the entire radio frequency spectrum filed earlier and will keep its satellite network, although not in full but within the limits of the portion actually used.

It is beyond any doubt that the milestones and the number of satellites to be put into operation by each of them are merely suggestions and subject to further discussions. Moreover, any other possible alternatives for bringing into use of frequency assignments for non-GSO constellations can also be considered.

V. Concluding Remarks

As any new rule related to bringing frequency assignments into use requires revision of the Radio Regulations, such a new rule can only be approved by an ITU World Radiocommunication Conference (WRC).[19]

For the first time the issue of bringing into use of frequency assignments to non-GSO satellite systems was raised before the WRC in 2015.[20] WRC-15 reviewed the Bureau's experience in the application of radio regulatory procedures with respect to the issue in question and recognized a lack of specific provisions in the Radio Regulations.[21] However, WRC-15 was unable to arrive at a particular solution and invited the ITU-R to consider drafting regulatory provisions requiring additional milestones for non-GSO systems beyond the 7-year deadline currently existing under the Radio Regulations.

During the interval between WRCs, these are the ITU-R Study Groups[22] that are in charge of the development of technical bases for WRCs' decisions. Study Group 4 "Satellite Services" and its Working Party 4A, in particular, are involved in the examination of topics such as efficient management and utilization of the orbit/spectrum resource. Therefore, it was the Working

19 World Radio Conferences are the highest body of the ITU-R, which are held every 3 to 4 years to review and, if necessary, revise the ITU Radio Regulations and address any radiocommunication matter of worldwide character. *See* Art. 13, Ch. II, the ITU Constitution; Art. 7, Sect. 5, the ITU Convention; http://www.itu.int/ru/ITU-R/conferences/wrc/Pages/default.aspx.

20 WRC-15 took place in Geneva, Switzerland, from 2 to 27 November 2015. *See* more at http://www.itu.int/en/ITU-R/conferences/wrc/2015/Pages/default.aspx.

21 No. 3.21, the Minutes of the Seventh Plenary Meeting of WRC-15 (Document 504-E dated 20 November 2015).

22 The ITU-R Study Groups consist of more than 4,000 specialists from administrations, telecommunications industry, and academic organizations throughout the world. *See* more at http://www.itu.int/en/ITU-R/study-groups/Pages/default.aspx.

Party that was identified to take responsibility for the preparatory work on the issue under discussion.[23]

In the course of its first meeting after WRC-15, Working Party 4A started reviewing a new issue concerning the possible need to change the Radio Regulations related to bringing frequency assignments to non-GSO systems into use. No relevant study has been done as yet, and the meeting only came up with a preliminary analysis and comments on the factors[24] that should be considered in the future studies.

This means that we are actually at the very beginning of the study process and can not only learn about future amendments to the Radio Regulations aimed at improving radio frequency spectrum management and utilization, but also follow the process of their discussion, adjustment, and approval.

Before the next WRC, which will be held in 2019,[25] ITU-R should determine mechanisms for non-GSO systems to strike the right balance among the various interests of the radio frequency spectrum users.[26] Anyway, the final word rests with WRC-19 that will have to shape a new regulatory framework to secure rational, efficient, and economical utilization of such unique limited natural resource in the interference free environment.

23 In order to organize and coordinate the conference preparatory studies for WRC-19, based on the outputs from the WRC-15, the 2019 Conference Preparatory Meeting (CPM-19) held its first session (CPM19-1) in Geneva from 30 November to 1 December 2015. *See* more at http://www.itu.int/en/ITU-R/study-groups/rcpm/Pages/cpm-19.aspx.

24 Issue A: Factors Related to the Bringing Into Use of Frequency Assignments of Non-GSO Systems Subject to Coordination, Annex 22 "Working Document Toward Preliminary Draft CPM Text for WRC-19 Agenda Item 7", Working Party 4A Chairman's Report (Document 4A/63-E dated 13 May 2016).

25 WRC-2019 will take place in Geneva, Switzerland, from 28 October to 22 November 2019. *See* Resolution 1380 "Place, dates and agenda of the World Radiocommunication Conference (WRC-19)" (Document C16/130-E dated 2 June 2016).

26 The results of the ITU-R studies will be used in the preparation of the Report of CPM-19, which is to be published 6 months before WRC-19.