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| processing by the Radiocommunication Bureau of notices for satellite networks in non-geostationary satellite systems |

# 1 Introduction

We are currently seeing an upward trend in the time taken for the Radiocommunication Bureau to process satellite network filings. For its part, the Radio Regulations Board commented on the matter in February of this year, when it included the following note in the summary of decisions of the Board’s 74th meeting (Document [RRB17-1/8](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=R17-RRB17.1-C-0008)):

“The Board noted the expansion of the workload of BR resulting from the increased number and complexity of satellite filings received during the last fifteen months. The Board expressed concern that this has caused an infringement of the regulatory time limit of four months for the processing of coordination requests. The Board requested the Director to make all efforts to get back to the regulatory limit as soon as possible. The Board also noted that the resolution of this problem may have financial implications that are under the responsibility of Council”.

As is noted, the delay arises from a number of factors:

1) fewer human resources in the Radiocommunication Bureau;

2) an increasing number of filings further to decisions of the 2015 World Radiocommunication Conference;

3) a sharp increase in the number and complexity of filings for non-geostationary-satellite networks in the period 2014 to 2017.

This document considers the third factor.

# 2 Upward trend in the number of filings for non-geostationary-satellite networks

As was noted in the report of the Director of the Radiocommunication Bureau to WRC-15 (Document [CMR15/4A1](https://www.itu.int/md/R15-WRC15-C-0004/en), § 2.2.2.4.1 “Submission of coordination request for non-GSO FSS systems”), since November 2014, the Bureau has received numerous requests for coordination for non-GSO systems operating in the fixed-satellite service and subject to coordination under No. 9.7B of the Radio Regulations. Those requests have included satellite systems consisting of tens of thousands (from 70 000 to more than 230 000) of satellites in more than 1 000 orbit planes, low‑earth orbit for some systems and medium-earth orbits for others, including different inclination values; so these are essentially filings for non-homogeneous orbits.

Owing to the large number of assignments in such complex systems and the limitation of the BR software tool, the Bureau could not include individual findings for each group of assignments in the SRS database. Some findings under No. 11.31 have been temporarily indicated in a tabular format shown in the note of the Bureau in the CR/C special section.

*“The Bureau also informed the administrations that submitted non-GSO satellite systems, that it would not be in be in a position to comply with the four-month time limit referred to No. 9.38 for the publication of the filing due to numerous other non-GSO satellite systems received at the same period and that their complex and technical characteristics were requiring modifications to the tools the Bureau currently uses for the examination and publication of the coordination information. However, the Bureau also informed the administrations that all efforts were undertaken for a publication as soon as possible.”*

Figure 1 represents the non-GSO satellite systems received and processed by the Bureau in the period 2014 to 2016. While the number of systems amounts to a little over 50, the number of requests for coordination of those systems and for modifications thereof amounts to over 100.

The source table is reproduced in Annex 1.

FIGURE 1

Non-geostationary satellite systems, orbital planes and number of satellites



As can be seen from the figure, non-GSO systems can have up to tens of thousands of satellites. In order to illustrate the magnitude of non-GSO constellations a logarithmic scale has been used.

The processing of these filings has undoubtedly required considerable expenditure on the part of the Bureau, while at the same time resulting in an increase in the processing delay, as shown in Figure 2.

FIGURE 2

Processing delay for non-GSO system filings



The Bureau has been unable to process the filings in a timely manner, and for most of the systems the time-frame has been exceeded by a factor of 1.5 to 2.

Furthermore, since the processing of filings for geostationary orbit (GSO) and non-GSO systems is carried out sequentially in one general queue, any increase in the processing time for non-GSO system filings will result in delays to the processing of GSO system filings.

This in turn leads to a reduction in the time available for effecting coordination, since not all administrations are prepared to engage in the coordination of filings that are published “as received”.

As has already been mentioned, this has to do with the great complexity of the filings. Unlike those for GSO systems, filings for non-GSO systems come with an additional layer of data relating to orbital planes and differing orbital characteristics.

Those characteristics are considered in the following section.

# 3 Cost recovery for non-GSO processing

An analysis of Decision 482 (Council-13) shows it to be ill-adapted to the present situation. For non-GSO systems, the same system for calculating the processing costs is used as for GSO systems. The cost is calculated on the basis of the number of cost-recovery units. In cases where the number of units exceeds 100, a flat fee is charged, for the most part not exceeding CHF 24 620, bearing in mind that where non-GSO FSS systems are concerned it is rare to apply more than three forms of coordination.

Figure 3 shows the number of units calculated for non-GSO FSS systems using the Decision 482 method.

FIGURE 3

Number of units calculated for non-GSO FSS filings



The substantial difference between the cut-off limit of 100 units, beyond which a flat fee (the value of which depends on the number of forms of coordination but cannot exceed CHF 33 467) is charged and the actual number of units requires the use of a logarithmic scale. For certain networks this difference is more than one thousandfold.

In actual practice, the Bureau spends up to ten months on processing a filing, while the payment it receives for those ten months of work amounts to only CHF 24 620.

It can clearly be held that Decision 482 simply fails to reflect fully the present situation and the direction in which satellite systems are evolving. The differences between GSO and non-GSO systems in terms of processing costs are reflected in the following illustrations.

FIGURE 4

Simplified structure of a GSO filing



A GSO filing always relates to a single satellite, which is why the Decision 482 calculation methodology makes no reference to the spacecraft or its characteristics.

At the time when Decision 482 was adopted (Council-01), non-GSO systems were represented in a similar manner. As a rule, they consisted of one or two spacecraft performing meteorological, science service or data-relay functions. Only in rare cases did the number of satellites rise above the tens. However, even where they did, the number of frequencies used was limited by the physical availability of the spectrum allocated to the mobile-satellite service, radionavigation-satellite service or science services.

In today’s situation, administrations notifying non-GSO FSS systems are not bound by any restrictions: the amount of spectrum for FSS in the C, Ku and Ka-bands makes it tempting to notify the entire spectrum. What is more, the extremely low ceiling on the processing fee for frequency assignments to non-GSO FSS systems allows for the creation of an unlimited number of different system configurations. Indeed, the presence within a constellation of more than several thousand satellites essentially signifies the presence of several configurations of a system comprising different orbit altitudes and associated power parameters.

As a rule, notified non-GSO FSS systems have the configuration shown in Fig. 5 below.

FIGURE 5

Extended configuration of a non-GSO FSS system



Each combination of orbital planes is essentially equivalent to an individual filing for a GSO network. Furthermore, any individual orbital plane that in itself has individual power-frequency characteristics may be considered as being equivalent to a filing for a GSO network.

The processing complexity increases considerably. At best, it is possible to cover the expenditure involved in processing only a small part of the filing.

It should be noted in this regard that some 10 to 15 per cent of all modifications to published requests for the coordination of non-GSO FSS systems have to do with the correction of previously published requests. This exerts considerable pressure on the Bureau’s resources, in view of the need to process a large number non-GSO FSS filings.

It should therefore be concluded that Council Decision 482 requires closer examination to determine its relevance to the present situation, i.e. the extent to which it meets the criteria which prompted its adoption, namely the fight against paper filings and the need to transfer the cost of processing filings onto the shoulders of the notifying administration.

# 4 Increasing cost of regulatory examination for non-GSO FSS

As previously noted (see the above-mentioned report by the Director of BR to WRC-15 (§ 2.2.3.5)), in the majority of FSS frequency bands, non-GSO FSS systems have to comply with stringent equivalent power flux-density (epfd) limits.

A prerequisite for the Bureau to perform the required examination relating to compliance with the epfd limits set forth in Article 22, as established by WRC-2000, is the availability of a simulation software package that permits the calculation of epfd values.

In order to be in a position to perform its duties, the Bureau contracted two specialized software development companies that have been independently developing the epfd validation software tools for the analysis of non-GSO FSS systems, in accordance with the software specifications of Recommendation ITU-R S.1503-1.

During the discussions at WRC-15, a number of administrations expressed concern that the method for calculating interference from non-GSO FSS into GSO FSS systems under that Recommendation could not adequately model their non-GSO FSS systems.

WRC-15 decided (Document [CR/389](https://www.itu.int/md/R00-CR-CIR-0389/en), § 3.2.2.4.2), that *in cases where the software cannot adequately model certain non-geostationary satellite FSS systems, Resolution 85 (WRC-03) will continue to be applied until an update to Recommendation ITU-R S.1503 improving the modelling of those non-GSO systems has been agreed within ITU-R and has been implemented in the epfd validation software. This would not preclude the Bureau to undertake verification of the non-GSO FSS systems that can be modelled with the existing version of the software.*

*Should there be an update to Recommendation ITU-R S.1503 then there would be a consequential requirement for an update to the verification software which would have financial implications and require additional funding. The Bureau would then be in a position to complete the verification of compliance of those FSS systems that could not have been modelled with the current software.*

The Russian Federation, like any administration making extensive use of satellites in the geostationary orbit, is concerned that such statements regarding the inability of software to model adequately certain non-geostationary satellite FSS systems could be used in an attempt to avoid the responsibilities arising from compliance with Article 22 of the Radio Regulations.

The Council could therefore consider the question of appropriate funding for further development of the software, as foreseen in the relevant WRC-15 decisions.

# 5 Conclusions and proposals

The Russian Federation proposes that consideration be given to a range of actions for resolving the complications affecting the Bureau’s processing of filings for non-GSO FSS systems.

1) It has been shown that Council Decision 482 does not fully accommodate the cases of non-GSO FSS systems recently encountered by the Bureau. Nor does Decision 482 take account of other considerations arising from the allocation by WRC-15 of a significant amount of additional spectrum for FSS and MSS. The fact is that a notice submitted after WRC-15 will contain a greater number of assignments, comprising not only previously existing allocations but also allocations made by WRC‑15, by comparison with a notice submitted before WRC-15. However, the maximum cost-recovery amount does not take account of the greater number of new assignments and increasing costs being borne by the Bureau.

 It would thus be useful to consider the possibility of revising Council Decision 482 in the light of the changed realities. Another option, not requiring any change to Council Decision 482, would involve the Council recommending to the Bureau that individual non‑GSO filings (API/coordination/ notification) containing:

a) non-homogeneous satellite orbits with differing altitudes and inclinations, or

b) different constellation configurations

 be separated into filings containing each individual constellation or individual types of satellite orbit, for the purposes of processing. This would serve to ensure that the amount paid for the processing of complex non-GSO FSS filings was in line with the Bureau’s actual costs.

2) The increasing complexity of non-GSO FSS filings and the heavier burden that is imposed by their processing and regulatory examination calls for considerable efforts on the part of the Bureau. Given that filings for non-GSO FSS satellite networks are still being received, this trend can only increase.

 The Director of BR informed WRC-15 of the emerging difficulties. However, for reasons including lack of familiarity with the situation, WRC-15 was unable to respond adequately to the issues raised, such as the bringing into use of non-GSO FSS systems, determination of the flexibility of notified parameters, coordination of non-GSO FSS systems, and overfiling of orbital configurations. In the light of these factors, it is desirable to increase the Bureau’s presence during the early stages of any discussion of non-GSO FSS issues, and to ensure that administrations are informed earlier as to the potential problems.

 It would thus appear advisable to concentrate the Bureau’s efforts and boost the expertise being focused on this issue. As has previously been the case in the Bureau’s history, such challenges, associated with, for example, satellite network planning, have successfully been met through, among other things, the Bureau’s capacity for organizational adaptation.

ANNEX 1

Non-GSO systems

Table A1

Data used in respect of non-GSO systems submitted for coordination

| Number | Number of orbital planes | Total numberof satellites | Total number of cost-recovery units | Number of coordination provisions applied | Processing time (months) |
| --- | --- | --- | --- | --- | --- |
| 1 | 3 | 27 | 6 | 2 | 3.90 |
| 2 | 3 | 30 | 41 | 5 | 7.23 |
| 3 | 6 | 66 | 146 | 2 | 6.17 |
| 4 | 29 | 891 | 3 760 | 3 | 6.70 |
| 5 | 29 | 891 | 702 | 3 | 7.70 |
| 9 | 67 | 2 692 | 1 000 | 2 | 8.23 |
| 10 | 1 | 1 | 2 | 2 | 4.53 |
| 11 | 8 | 51 | 5 067 | 6 | 6.93 |
| 12 | 3 | 24 | 20 | 2 | 6.67 |
| 13 | 1 | 1 | 2 | 3 | 4.30 |
| 14 | 5 | 7 | 6 561 | 6 | 4.43 |
| 15 | 12 | 288 | 10 624 | 3 | 7.37 |
| 16 | 19 | 312 | 17 664 | 3 | 7.20 |
| 17 | 18 | 774 | 3 760 | 3 | 7.13 |
| 18 | 43 | 3 993 | 10 782 | 2 | 6.80 |
| 19 | 43 | 3 993 | 24 420 | 3 | 6.80 |
| 20 | 1 008 | 72 576 | 150 444 | 2 | 6.47 |
| 21 | 102 | 2 772 | 44 352 | 3 | 6.93 |
| 22 | 102 | 2 772 | 8 064 | 2 | 7.60 |
| 23 | 38 | 1 104 | 96 390 | 2 | 6.37 |
| 24 | 22 | 744 | 69 552 | 3 | 7.40 |
| 25 | 3 | 36 | 102 564 | 3 | 6.93 |
| 26 | 97 | 797 | 192 | 6 | 8.97 |
| 27 | 32 | 840 | 198 953 | 3 | 10.30 |
| 28 | 12 | 288 | 10 752 | 3 | 8.67 |
| 29 | 174 | 1 428 | 35 883 | 7 | 8.17 |
| 30 | 8 | 48 | 3 826 | 3 | 7.27 |
| 31 | 2 | 4 | 8 733 | 6 | 7.60 |
| 32 | 1 | 2 | 1 | 2 | 4.60 |
| 33 | 8 | 72 | 724 | 3 | 5.77 |
| 34 | 8 | 72 | 570 | 5 | 7.57 |
| 35 | 2 | 2 | 2 | 6 | 4.73 |
| 36 | 1 | 1 | 3 | 1 | 4.23 |
| 37 | 584 | 4 672 | 144 | 6 | 4.47 |
| 38 | 2 | 4 | 6 | 3 | 4.17 |
| 39 | 1 | 5 | 12 | 3 | 7.53 |
| 40 | 1 | 10 | 12 | 3 | 7.53 |
| 41 | 8 | 38 | 52 | 3 | 5.10 |
| 42 | 6 | 60 | 292 | 3 | 5.10 |
| 43 | 18 | 774 | 3 850 | 3 | 4.97 |
| 44 | 1 | 1 | 1 | 3 | 7.70 |
| 45 | 1 | 3 | 1 | 3 | 6.67 |
| 46 | 6 | 60 | 281 | 3 | 6.90 |
| 47 | 1 | 1 | 3 | 3 | 6.37 |
| 48 | 9 | 57 | 42 | 3 | 7.20 |
| 49 | 1 | 1 | 10 | 3 | 5.87 |
| 50 | 6 | 24 | 636 | 3 | 6.10 |
| 51 | 1 | 3 | 2 | 2 | 6.17 |
| 52 | 5 | 10 | 3 | 3 | 6.47 |
| 53 | 400 | 6 400 | 1 504 | 6 | 7.13 |
| 54 | 1 | 2 | 9 480 | 4 | 7.40 |
| 55 | 1 | 2 | 10 216 | 4 | 7.40 |
| 56 | 2 | 4 | 8 733 | 6 | 7.60 |
| \* This table may include a non-exhaustive list of non-GSO systems for which the request for publication was received and published after 2014. Filings for non-GSO systems may contain different classes of station, and the list is not limited solely to non-GSO FSS. |

FIGURE A1

Received and published requests for coordination over time



This illustrates the slowdown in the publication rate in 2014 as the number of filings received increases, reflecting primarily the complexities encountered in the processing of non-GSO filings during that period.

FIGURE A2

Example of the calculation of the cost of processing a filing in SpaceCap



FIGURE A3

Example of a CR/C publication containing different beam and orbit configurations



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