

## RECOMMENDATION ITU-R S.744\*

**Orbit/spectrum improvement measures for satellite networks having more than one service in one or more frequency bands**

(1992)

The ITU Radiocommunication Assembly,

*considering*

- a) that for economic and practical reasons there are increasing numbers of GSO satellites having multiple networks in multiple services and/or using one or more frequency bands;
- b) that each of the networks may require different types of coordination procedures;
- c) that the GSO orbital spacing of the multi-network and/or multi-band spacecraft will be determined by the largest required orbital separation;
- d) that Annex 1 describes the difficulties associated with coordinating such satellite networks;
- e) Recommendation No. 715 of WARC ORB-88 invited the ITU-R to continue its technical studies pertaining to multi-band and multi-service satellite systems,

*recommends*

- 1 that when multiple coordination procedures are necessary with respect to a single spacecraft, individual methods should be applied to utilize all the flexibility available with full recognition of the implementation process inherent in each procedure;
- 2 that the technical and operational constraints of existing coordinated networks and of those being coordinated should be fully taken into account;
- 3 that administrations should in a cooperative spirit, take account of the preferred orbit positions, allocated frequency bands, and technical parameters of proposed satellite networks, which could assist in accommodating a new multi-network and/or multi-band satellite system, taking into account the factors outlined in Annex 1.

## ANNEX 1

**1 Introduction**

In this Annex, § 2 describes the coordination methods, the applicable allocations, and parts of the Radio Regulations. In addition, it describes the type of networks associated with the different methods.

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\* Radiocommunication Study Group 4 made editorial amendments to this Recommendation in 2001 in accordance with Resolution ITU-R 44 (RA-2000).

Section 3 is an analysis of the potential problems which may be presented when combinations of different networks are used on the same satellite.

Section 4 derives observations based on one example of a multiple network satellite.

Section 5 summarizes the findings about multi-service and multi-band satellites.

## 2 Description of the situation for networks with more than one service in one or more frequency bands

The procedural approaches for coordination and notification of frequency assignments to geostationary-satellite networks are indicated in Table 1 along with their distinguishing characteristics.

As indicated below, there are multiple combinations of frequency bands that can be put on a single satellite platform. When this occurs, multiple coordination procedures are necessary.

A single band of a satellite may also be subject to multiple coordination procedures. An example of this is the 12 GHz FSS band in which a network may be simultaneously subject to the procedures of RR Articles 11, 14 (edition of 1994) and Article 2 of Appendix S30 and even Resolution No. 33. The coordination network possibilities are described below.

TABLE 1

Method	Allocation (GHz)	Regulations
BSS Plan (SAT-77) Feeder links (ORB-88)	BSS 11.7-12.5 (Region 1) BSS 11.7-12.2 (Region 3) FSS 14.5-14.8 (Regions 1 & 3) FSS 17.3-18.1 (Regions 1 & 3)	Appendix S30 Appendix S30 Appendix S30A Appendix S30A
BSS Plan (SAT-83) Feeder links (ORB-85)	BSS 12.2-12.7 (Region 2) FSS 17.3-17.8 (Region 2)	Appendix S30 Appendix S30A
FSS Allotment Plan	FSS 4.5-4.8/6.725-7.025 FSS 10.7-10.95 FSS 11.2-11.45 FSS 12.75-13.25	Appendix S30B Former Resolution No. 107
Improved procedures (Multilateral planning meeting)	Certain FSS bands	Former Resolution No. 110
Simplified procedures (unplanned bands and services)	Remaining FSS bands and all other space services allocations	Articles 11 & 13 (edition of 1994)
Unplanned BSS	Remaining BSS bands	Resolution No. 33
Article 14 (edition of 1994)	Footnote	Article 14 (edition of 1994)

**2.1 Registered networks**

These are networks for which coordinating/registration procedures have been completed and which have had their frequency assignments and orbit locations recorded in the ITU-R Master Register. Due to already agreed coordination constraints some of these networks may have few, if any, degrees of freedom remaining to accommodate additional satellites. The flexibility available to such networks to successfully conclude subsequent coordinations will greatly depend on the level of congestion present in the orbital arc at the time coordination is undertaken.

**2.2 Assignment plans**

The networks use orbit and spectrum which are part of the assignment plans for BSS and associated feeder links (RR Appendices S30 and S30A); orbit positions and operating parameters are defined by the Plans and in practice there is little flexibility in modification of orbital position short of seeking a formal plan change; there is only limited flexibility in equipment parameters choice.

**2.3 Allotment plan networks**

Those networks use spectrum which is part of the fixed satellite allotment plan (RR Appendix S30B); the degrees of freedom will be limited by regulation. There may be some orbit position flexibility possible through use of the predetermined arc (PDA) mechanism. However, this is dependent on the stage of development of the network.

**2.4 Networks subject to multilateral planning meeting procedures**

These networks are those to which a multilateral planning meeting (MPM) applies. Coordination is based on RR Articles 11 and 13 (edition of 1994). The MPM will probably apply to congested orbital arcs where there will be little degree of freedom.

**2.5 Unplanned band networks**

Networks in unplanned bands use the procedures in RR Articles 11 and 13 (edition of 1994).

**3 Multiple coordination procedure pairs**

Satellite networks, in accordance with the categories described above which require multiple coordinations, can be examined in pairs. The pairs of networks below correspond to the coordination procedure possibilities described in the sections above; i.e. 1 in § 2.1, 2 in § 2.2, 3 in § 2.3, 4 in § 2.4, and 5 in § 2.5.

The basis for the pairing analyses may be explained by reference to Fig. 1.

FIGURE 1

Satellite A and B coordination procedures



Satellite A has frequencies that must be coordinated under procedures 1, 2 and 5. Satellite B has frequencies liable to procedures 5, 3 and 4. Networks in satellites A and B must coordinate with each other because they are using the same, unplanned (5) fixed satellite spectrum. In addition, satellite A may also have to coordinate using procedures 1 and 2, and satellite B may also have to coordinate using procedures 3 and 4. Thus, the pairs below refer to the impact on coordination when one of the pair of procedures is on satellite A and the other is on B:

- 1 & 5 Bilateral (or multilateral) coordination, as appropriate, will be conducted between administrations responsible for the networks under the current procedures of RR Articles 11 and 13 (edition of 1994).
- 5 & 2 These apply to already coordinated satellite networks which are part of multilateral
- 5 & 3 planning meetings (MPM), the allotment plan or the BSS plan and feeder-link
- 5 & 4 assignment plan, and also have frequency assignments which are part of unplanned band allocations. Some of these situations may be particularly difficult, because the networks involved have fixed orbital positions.
- 4 & 3 When there is a multilateral coordination (improved procedures) involving a satellite network in the allotment plan, there may be some degree of flexibility for the network using allotment frequencies due to the flexibility built into the allotment plan with the predetermined Arc Concept.
- 2 & 4 A multilateral coordination can accommodate the consequential effects of fixed satellite frequencies on BSS assignment plan satellites, through multiple ways of making adjustments. In addition, the BSS could use its plan modification provisions.
- 1 & 4 There are many registered networks which are in the bands which might have multilateral coordinations. These networks were coordinated under RR Articles 11 and 13 (edition of 1994), and have status. However, administrations with registered systems may participate in a multilateral negotiation.
- 2 & 3 This coordination may need to utilize the full flexibility available in both Plans when an administration's assignment in a BSS Plan is in the orbital arc of its allotment. If it is, and the conversion of the allotment into an assignment is in conformity with the Plan, the coordination with other FSS systems has been accomplished.
- 1 & 2 The coordination problems are non-existent since they are mutually exclusive. If the system is in the Master Register, it has completed coordination/notification, and will have already avoided or cleared coordination with frequencies of the BSS assignment plans.
- 1 & 3 During the course of developing the Allotment Plan existing systems (RR Appendix S30B) were accommodated. Any further satellite network would have to be incorporated through a plan modification procedure.

#### **4 Experience with coordination of multi-service, multi-band satellites**

From a review of one example, the following observations can be made:

In general it is true that in the preliminary phase of the coordination of a satellite system, any extra constraints on e.g. the orbital position, may cause an additional burden on the coordination process.

However, it must also be pointed out that after launching and as the process of coordination continues with new systems, other constraints may be equally important. It is obvious that in the operational phase of any satellite, an orbital relocation would be quite difficult to achieve. The reason for this difficulty is that in this phase normal coordination agreements have already been reached with other existing systems, and a relocation would have an impact on these coordination agreements.

## 5 Summary

It is recognized that it is necessary to develop overall criteria for optimizing the orbital positioning of satellite networks which have more than one service in one or more frequency bands. Some of the points to be taken into account include:

- when multiple coordinations occur individual methods should be applied to utilize all the flexibility available with full recognition of the implementation process inherent in each procedure;
- the constraints of coordinated/registered networks and of those being coordinated should be fully taken into account;
- administrations could in a cooperative spirit, take account of the desired orbit positions, frequency bands, and parameters of a proposed satellite network, which could assist in accommodating a new multi-band/service satellite;
- constraints imposed by the procedures can lead to difficulty in reducing interference levels for all services in a multi-service satellite. This was recognized for the fixed-satellite service in Recommendation ITU-R S.670. The recommended flexibility in relocation would facilitate the resolution of interference problems if it could be applied to all procedures and services.

Additional technical information needs to be developed to illustrate the problems associated with such multiple coordination satellites particularly when one of the networks on the satellite has an orbit position fixed by a plan.

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