

RECOMMENDATION ITU-R S.1431

**METHODS TO ENHANCE SHARING BETWEEN NON-GSO FSS SYSTEMS
(EXCEPT MSS FEEDER LINKS) IN THE FREQUENCY BANDS
BETWEEN 10-30 GHz**

(2000)

The ITU Radiocommunication Assembly,

considering

- a) that WRC-97 confirmed the application of No. S9.12 of the RR (referred to in Resolution 46 (Rev.WRC-97)) in the bands 18.8-19.3 GHz (space-to-Earth) and 28.6-29.1 GHz (Earth-to-space) for use by non-GSO FSS systems;
- b) that the use of these bands will be in accordance with RR No. S5.523A;
- c) that the services using these bands are to coordinate their use of frequencies in accordance with Resolution 46 (Rev.WRC-97);
- d) that Resolution 130 (WRC-97) provides the regulatory framework for the use of non-GSO FSS systems in certain frequency bands;
- e) that Resolution 130 (WRC-97) calls for further studies relating to the sharing criteria to be applied for determining the need for coordination between non-GSO FSS systems;
- f) that several non-GSO FSS systems are proposed to operate in the Resolution 130 (WRC-97) frequency bands and the RR No. S5.523A frequency bands;
- g) that studies have shown, without the use of interference mitigation techniques, it will be impracticable for multiple non-GSO FSS systems to share the same frequency band unless they employ truly homogeneous orbital characteristics;
- h) that, to promote efficient spectrum sharing, methods need to be identified to enhance sharing between multiple non-GSO FSS systems in the same frequency band;
- j) that studies have shown that there are several different interference mitigation techniques that may allow multiple non-GSO FSS systems to share the same frequency band;
- k) that there are system performance and interference reduction trade-offs involved in the use of certain frequency sharing methods;
- l) that, in the Resolution 130 (WRC-97) frequency bands, non-GSO FSS systems are required to protect GSO FSS systems,

recommends

- 1** that the mitigation techniques described in Annex 1 of this Recommendation should be considered for use to achieve satisfactory sharing between co-frequency, co-directional non-GSO FSS satellite networks.

ANNEX 1

Mitigation techniques

This Annex provides a summary of mitigation techniques that may be used by non-GSO FSS systems to facilitate sharing between such networks. Seven techniques for mitigating interference between non-GSO FSS networks have been identified and studied. This Annex does not represent an exhaustive list of mitigation techniques, others may be identified in the future. These interference mitigation techniques and combinations thereof are useful to different degrees in facilitating sharing between non-GSO FSS networks.

1 Homogeneous orbits

Several non-GSO FSS systems can share the same frequency band when they employ nearly identical orbital parameters (height, inclination, etc.) and that either their orbital planes are interleaved, or their orbital planes are coincident while their satellites within a plane are interleaved, or both. Some studies have shown that interference mitigation techniques might be required if the two systems are not truly homogeneous and further studies are required to determine the level of difference between orbital and transmission characteristics that can be tolerated before the systems are no longer considered homogeneous.

2 Avoidance of in-line interference events

2.1 Satellite diversity (switching to another satellite)

The use of satellite diversity has been considered as a mitigation technique to avoid main beam-to-main beam interference by switching traffic to an alternative satellite in view whenever such in-line coupling instances occur (see Note 1). This technique has a number of system design and network operational implications which network operators have to consider before implementing it.

NOTE 1 – In-line events occur when one non-GSO satellite is directly between an earth station and another non-GSO satellite.

Satellite diversity means that near main beam-to-main beam coupling situations are avoided by the non-GSO system selecting another visible satellite whenever the current satellite approaches an in-line event with a satellite operating in another non-GSO FSS system. Satellite diversity implies performing a handover (switching) process due to reselecting the satellite for interference avoidance. Satellite diversity may require a complex process involving cooperation among the systems involved. The ability to share spectrum using this technique depends on whether the considered systems can avoid near in-line situations dynamically with the prior information of non-GSO satellite locations. It should be noted that most proposed systems intend to implement some type of satellite switching methodology to avoid the GSO arc.

To enhance interference mitigation (and, hence, sharing) through satellite diversity, it is necessary for non-GSO FSS systems to be designed to have multiple satellites capable of serving a given earth station location simultaneously. Statistics have been compiled for several proposed 14/11 GHz and 30/20 GHz-band LEO and MEO systems and have shown that the majority of the systems have at least two satellites in view of earth station locations at most latitudes of interest.

Two levels of the implementation of satellite diversity have been identified:

- a) avoidance of near in-line events with all satellites of other non-GSO FSS systems;
- b) avoidance of near in-line events with satellites of other non-GSO FSS systems that are capable of serving, at the considered point in time, that given earth station location.

Both of these options will require close cooperation between the satellite systems once operational. Option a) requires knowledge of the orbital characteristics of other satellite systems. Option b) requires this knowledge and may require the knowledge of the beam pointing algorithm and traffic of the satellites in the other systems. It is therefore more complex to implement option b) than option a). However, using the option b) may allow for a wider angle of avoidance since more visible satellites may be available for a given non-GSO FSS system. In the Resolution 130 (WRC-97) frequency bands, non-GSO FSS systems are required to protect GSO systems. In all proposed non-GSO FSS systems, this is done through some type of avoidance of the GSO arc (either earth-based or satellite-based). Using the knowledge of which satellites in other non-GSO FSS systems are not serving a particular area due to GSO arc avoidance will decrease the number of satellites that need to be avoided, thereby increasing the number of satellites that a given non-GSO FSS system has available to it for switching.

The satellite diversity technique involves the identification of a suitable diversity switching angle for non-GSO FSS systems to facilitate co-frequency, co-directional sharing with other non-GSO FSS systems.