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**Technical and operational requirements for  
GSO FSS earth stations on mobile platforms  
in bands from 17.3 to 30.0 GHz**

**S Series**  
**Fixed-satellite service**



International  
Telecommunication  
Union

## Foreword

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*Note: This ITU-R Report was approved in English by the Study Group under the procedure detailed in Resolution ITU-R 1.*

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## REPORT ITU-R S.2223

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on mobile platforms in bands from 17.3 to 30.0 GHz**

(Question ITU-R 70-1/4)

(2011)

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**1 Introduction**

GSO fixed-satellite service networks are being used at an increasing rate to provide services to earth stations mounted on mobile platforms. GSO FSS networks are currently providing valuable broadband telecommunications services to aircraft, ships, trains and other vehicles in the 14.0-14.5 GHz (Earth-to-space) and 10.7-12.7 GHz (space-to-Earth) bands, e.g. Resolution 902 (WRC-03). The growing demand for service to these mobile platforms has caused service providers to turn to the 17.3-30.0 GHz FSS band to meet the need for increased broadband speed, capacity, and efficiency.

Advances in satellite antenna technology, particularly the development of 3-axis stabilized antennas capable of maintaining a high degree of pointing accuracy even on rapidly moving platforms, have allowed the development of mobile earth stations with very stable pointing characteristics. Similarly, the application of low power density waveforms has likewise enabled the use of smaller antennas and lower performance pointing systems while still maintaining off-axis e.i.r.p. density within prescribed limits. When properly managed and controlled, the technical characteristics of these mobile earth stations are indistinguishable from fixed earth stations when viewed from an interference perspective to FSS networks.

This Report presents technical and operational requirements for FSS earth stations on mobile platforms in bands from 17.3 to 30.0 GHz. The Report describes how such earth stations operating in FSS allocations between 17.3-30.0 GHz can be designed and operated in compliance with the existing requirements applicable to other types of FSS earth stations. By complying with these existing requirements, earth stations on mobile platforms will not create unacceptable levels of interference to other FSS systems and terminals operating in the same bands or sub-bands. This Report is intended to provide guidance to administrations and FSS network operators wishing to implement earth stations on mobile platforms in FSS allocations in the 17.3-30.0 GHz band.

## **2 Background**

It has been recognized within ITU-R that various technically and operationally different networks have been implemented to provide service to earth stations on mobile platforms using FSS networks in bands below 17 GHz and that additional such networks are planned for implementation in bands from 17.3 to 30.0 GHz. It is envisioned that these planned networks may provide access to a variety of broadband communication applications (Internet, e-mail, VoIP, and access to internal corporate networks) to and from mobile platforms such as ships, aircraft, and land-based vehicles.

The circulation of FSS earth stations on mobile platforms is usually a subject of a number of national and international rules and regulations including satisfactory conformance to mutually agreed technical standards and operational requirements. As such, there is a need for identifying the technical and operational requirements for FSS earth stations on mobile platforms in order to provide a common technical basis for facilitating the implementation of FSS earth stations by various national and international authorities. Such identification would also facilitate the development of mutual recognition arrangements for international operation of FSS earth stations on mobile platforms.

As this Report is addressing FSS earth station operation on mobile platforms in the frequency range from 17.3 to 30 GHz, it is important to recognize that there are allocations to the FSS in this range that are shared with terrestrial services, and that sharing with terrestrial services requires coordination or the development of other sharing mechanisms. The identification of technical and operational requirements for such FSS earth stations operating in this frequency range could assist administrations in preventing harmful and/or unacceptable interference to other GSO FSS networks and in the development of sharing criteria for terrestrial networks. Such technical and operational characteristics should be continuously and accurately measurable and controllable.

## **3 Essential sharing requirements**

### **3.1 Technical and operational requirements in frequency bands not shared with terrestrial services**

It is clear that implementation of FSS earth stations on mobile platforms would be simplified in bands that are not shared with terrestrial services as this reduces the sharing situation to one of sharing between satellite networks. In such cases, in order to address potential interference with other co-frequency GSO FSS networks, it is essential that FSS earth stations on mobile platforms comply with the off-axis e.i.r.p. limits contained in Recommendation ITU-R S.524-9, or with any other limits coordinated with neighbouring satellite networks. In addition, any network of such earth stations should be operated such that the aggregate off-axis e.i.r.p. levels produced in the Earth-to-space direction by all co-frequency earth stations within such networks, in the direction of neighbouring satellite networks, are no greater than the off-axis e.i.r.p. levels produced by other specific and/or typical FSS earth station(s) operated in conformance with Recommendation ITU-R S.524-9, or with any other limits coordinated with neighbouring satellite networks. These requirements will ensure that such earth stations are essentially equivalent to stationary FSS earth stations from the perspective of static uplink interference potential.

Realizing that earth stations on mobile platforms operate in a dynamic environment (i.e. the position and orientation of the platform can change with time), it is important to address this aspect in specifying an essential set of technical and operational requirements. The design, coordination and operation of earth stations on mobile platforms should be such that, in addition to the static requirements discussed above, the interference levels generated by such earth stations account for the following factors:

- Mispointing of the earth station antenna. Where applicable, this includes, at least, motion-induced antenna pointing errors, effects caused by bias and latency of their pointing systems, tracking error of open or closed loop tracking systems, misalignment between transmit and receive apertures for systems that use separate apertures, and misalignment between transmit and receive feeds for systems that use combined apertures.
- Variations in the antenna pattern of the earth station antenna. Where applicable, this includes, at least, effects caused by manufacturing tolerances, ageing of the antenna and environmental effects. Networks using certain types of antennas, such as phased arrays, should account for variation in antenna pattern with scan angles (elevation and azimuth). Networks using phased arrays should also account for element phase error, amplitude error and failure rate.
- Variations in the transmit e.i.r.p. from the earth station. Where applicable, this includes, at least, effects caused by measurement error, control error and latency for closed loop power control systems, and motion-induced antenna pointing errors.

FSS earth stations on mobile platforms that use closed loop tracking of the satellite signal need to employ an algorithm that is resistant to capturing and tracking adjacent satellite signals. Such earth stations must be designed and operated such that they immediately inhibit transmission when they detect that unintended satellite tracking has occurred or is about to occur. Such earth stations must also immediately inhibit transmission when their mispointing would result in off-axis e.i.r.p. levels in the direction of neighbouring satellite networks above those of other specific and/or typical FSS earth stations operating in compliance with Recommendation ITU-R S.524-9 or with any other limits coordinated with neighbouring satellite networks. These earth stations also need to be self-monitoring and, should a fault be detected which can cause harmful interference to FSS networks, must automatically mute any transmissions.

In addition to these autonomous capabilities, FSS earth stations on mobile platforms should be subject to the monitoring and control by a Network Control and Monitoring Center (NCMC) or equivalent facility and these earth stations should be able to receive at least “enable transmission” and “disable transmission” commands from the NCMC. It should be possible for the NCMC to monitor the operation of the earth station to determine if it is malfunctioning.

### **3.2 Technical and operational requirements in frequency bands shared with terrestrial services**

Where FSS earth stations on mobile platforms operate in frequency bands and geographical areas that are shared with terrestrial services, in addition to the guidelines in § 3.1, coordination or development of other sharing mechanisms will be required.

### **3.3 Other issues**

The operation of FSS earth stations on mobile platforms does introduce several issues, which have not yet been addressed in this Report. These being:

- Three types of FSS earth stations on mobile platforms are envisioned within this Report: ship mobile platform, aircraft mobile platform, land mobile platform. This can be seen as mixing the definition of maritime mobile-satellite, aeronautical mobile-satellite and land

mobile-satellite with that of FSS, and of operation of these mobile platforms not in conformance with the current definitions within the Radio Regulations. However, the operation of earth stations on mobile platforms (ESOMP) discussed in this Report follows a similar approach to that taken in the 4/6 GHz and 12/14 GHz bands to permit the operation of similar earth stations on mobile platforms in FSS networks, e.g. Resolution 902 (WRC-03).

- A natural consequence of operating FSS earth stations on mobile platforms is the circulation of these stations within other countries. It should be noted that such circulation requires appropriate administrative and procedural arrangements to ensure that the sovereignty of the country in which these mobile platforms are intended to operate are preserved. In addition, the responsibility for earth stations normally falls on the administration within which the earth station is operated or the administration of the country of registration. It is presumed that this issue would be discussed and agreed between the ESOMP operator and the licensing authority in each administration in which the ESOMPs will operate when the ESOMP operator seeks the necessary authority to operate. However, these issues have not been addressed in detail in this Report.
  - As FSS earth stations on mobile platforms cannot be notified as FSS terminals, this will complicate the coordination between these FSS earth stations and the terrestrial services. In such cases, normally the coordination of the earth stations on mobile platforms is conducted on an area wide, or service area, basis, as the position of the earth station is not fixed. This issue has not been addressed in detail in this Report.
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