

RECOMMENDATION ITU-R F.1608

Frequency sharing between systems in the fixed service using high altitude platform stations and conventional systems in the fixed service in the bands 47.2-47.5 and 47.9-48.2 GHz

(Question ITU-R 212/9)

(2003)

The ITU Radiocommunication Assembly,

considering

- a) that new technology utilizing telecommunication relays located at fixed points in the stratosphere is being developed (see Note 1);
- b) that systems utilizing one or more high altitude platform stations (HAPS) located at fixed points in the stratosphere may possess desirable attributes for high-speed broadband digital communications, including interactive video and other applications, with significant potential for frequency reuse and capable of providing service to a high density of users;
- c) that such systems would be able to provide coverage to metropolitan regions with high elevation angles, and to outlying rural areas or neighbouring countries with low elevation angles;
- d) that broadband digital services provided by such systems in the fixed service are intended to provide widespread communications information infrastructures promoting the global information infrastructure;
- e) that the radio spectrum above 30 GHz is allocated to a variety of radio services and that many different systems are already using or planning to use these allocations;
- f) that there is an increasing demand for access to these allocations;
- g) that according to No. 5.552A of the Radio Regulations (RR) the allocation to the fixed service in the bands 47.2-47.5 GHz and 47.9-48.2 GHz is designated for use by HAPS;
- h) that according to Resolution 122 (Rev.WRC-2000), administrations are urged to facilitate coordination between HAPS in the fixed service operating in the bands 47.2-47.5 GHz and 47.9-48.2 GHz and other co-primary services in their territory and adjacent territories;
- j) that because of the visible range of HAPS frequency sharing between HAPS networks and other conventional fixed service systems may present difficulties on a co-area, co-frequency basis,

recommends

- 1 that the characteristics of systems in the fixed service using HAPS given in Recommendation ITU-R F.1500 may be used in analysing sharing possibilities between HAPS systems in the fixed service and other conventional systems in the fixed service in the bands 47.2-47.5 GHz and 47.9-48.2 GHz;

2 that in analysing the sharing possibilities between systems in the fixed service using HAPS and other conventional systems in the fixed service, such as is done in Annex 2, the methodology described in Annex 1 may be used;

3 that in those areas where a ubiquitous HAPS service is envisioned, such as the urban and suburban coverage areas, co-area frequency sharing with conventional fixed service systems will be difficult. For the typical HAPS system described in Recommendation ITU-R F.1500, with symmetric service areas around the HAPS nadir point, the limit of ubiquitous service is likely to be at the outer edge of the suburban coverage area, at about 80 km from nadir;

4 that in those areas where a ubiquitous HAPS service is not envisioned, such as the rural coverage area, sharing with other fixed service systems could be feasible provided there is sufficient angular discrimination between conventional systems in the fixed service and HAPS systems operating in the fixed service. Such angular discrimination may only be possible if the conventional fixed service systems are located outside the visible range of the HAPS platform;

5 that in those areas where the HAPS coverage is limited to only the urban area coverage (UAC) or to both the UAC and the suburban area coverage (SAC), sharing with conventional fixed service systems will only be possible if they are deployed beyond the visible range of the HAPS platform;

6 that further studies could identify additional operational scenarios and mitigation techniques that could facilitate frequency sharing.

NOTE 1 – It is recognized that systems utilizing HAPS have a potential applicability to various services such as mobile and broadcasting services. This Recommendation considers the use of HAPS in the fixed service.

Annex 1

The methodology to be used in the analysis of frequency sharing between systems in the fixed service using HAPS and conventional fixed service systems

1 Introduction

This Annex provides the basis for methodology for the investigation of the interference scenarios and sharing possibilities between fixed service systems using HAPS and conventional fixed service systems.

To be specific, the frequency bands identified for the fixed service systems using HAPS are 47.2-47.5 GHz and 47.9-48.2 GHz. These bands are part of the band 47.2-50.2 GHz which is also allocated to the fixed-satellite (Earth-to-space) and mobile services.

There are some fixed service applications in the 47.2-47.5 GHz and 47.9-48.2 GHz bands; Recommendation ITU-R F.758 discusses the considerations necessary in the development of sharing criteria. The bands are not currently in use by the mobile service and no parameters are

available on which to base typical interference analysis. It should be noted, however, that the high density of small user terminals envisaged for use by the HAPS-based network (HAPN) is expected to render sharing with mobile service systems very difficult.

2 Technical characteristics

The technical characteristics for a typical HAPN operating in the bands 47.2-47.5 GHz and 47.9-48.2 GHz are given in Recommendation ITU-R F.1500. This text gives information on both the technical parameters of the equipment and on the gains and directivity of antennas mounted on a HAPS.

Technical characteristics for terrestrial fixed service systems operating in the band 47.2-50.2 GHz are given in Recommendation ITU-R F.758. Reference antenna patterns are given in Recommendation ITU-R F.699.

The propagation characteristics for free space path loss, atmospheric gaseous absorption, and hydrometeor attenuation and scattering are given in various Recommendations in the ITU-R P-Series.

3 Sharing study methodology

Recommendation ITU-R F.1500 indicates that a typical HAPN may offer up to 2 100 cells, with a 7-times frequency reuse factor, within a service diameter of 468 km. In addition there may be up to 40 gateway stations within a diameter of 181 km. Dependent on the bandwidth assigned to an individual HAPN, there may be up to 330 000 simultaneous user terminals in operation from a subscriber base of more than 5 million. Each of these user terminals will have an antenna directed towards the HAPS. The 2 100 beams from the HAPS will extend across the whole of the coverage area, with frequency reuse.

Conventional fixed service usage of the band may be either for wide bandwidth links between well-defined fixed locations, or for high-density fixed links where the location and orientation of each link may not be specified in advance. For both of these types of conventional application the link length will be limited by both terrain and screening and by atmospheric and hydrometeor absorption.

Due to the multiplicity of potential links, the methodology for undertaking sharing studies will have to be based on determining the potential interference between a pair of stations, including the appropriate antenna directivity characteristics, and calculating for many such cases using a random selection of station locations within the coverage areas and subject to appropriate frequency reuse, bandwidth, etc. considerations.

Some preliminary studies of this kind have been undertaken, with 720 million cases in the simulations. These have indicated that co-channel sharing between terrestrial fixed stations and HAPN user terminals will be very difficult, and that necessary geographical separation between a HAPN coverage and a conventional fixed service station depends on the gain, and thus on the orientation of the fixed link. For such adjacent area coverages simulation using unobstructed plane Earth paths will not be adequate and the method should include Earth curvature and the probability of screening from terrain or surface features.

Similarly for interference simulation for the HAPS terminals, adjacent area sharing depends on the location and direction of the fixed links, but in this case there is a smaller probability of diffraction screening due to the oblique paths.

Annex 2

Frequency sharing between the conventional fixed service and HAPS systems

1 HAPS in the fixed service

Recommendation ITU-R F.1500 contains details of the preferred characteristics of a typical HAPS system in the fixed service. These characteristics are given in Tables 1 to 4:

TABLE 1
HAPS coverage zones

Coverage area	Elevation angles (degrees)	Ground range (km) (HAPS at 21 km)
UAC	90-30	0-36
SAC	30-15	36-76.5
RAC	15-5	76.5-203

RAC: rural area coverage

TABLE 2
Platform station transmitter parameters

Coverage area	Transmitter power (dBW)	Antenna gain (dBi)
UAC	1.3	30
SAC	1.3	30
RAC	3.5	41

TABLE 3
User terminal transmitter parameters

Coverage area	Transmitter power (dBW)	Antenna gain (dBi)
UAC	-8.2	23
SAC	-7	38
RAC	-1.5	38

TABLE 4

Interference criteria for HAPS systems

	User terminal	HAPS
Interference criteria (dB(W/MHz))	-149	-151.6

FIGURE 1

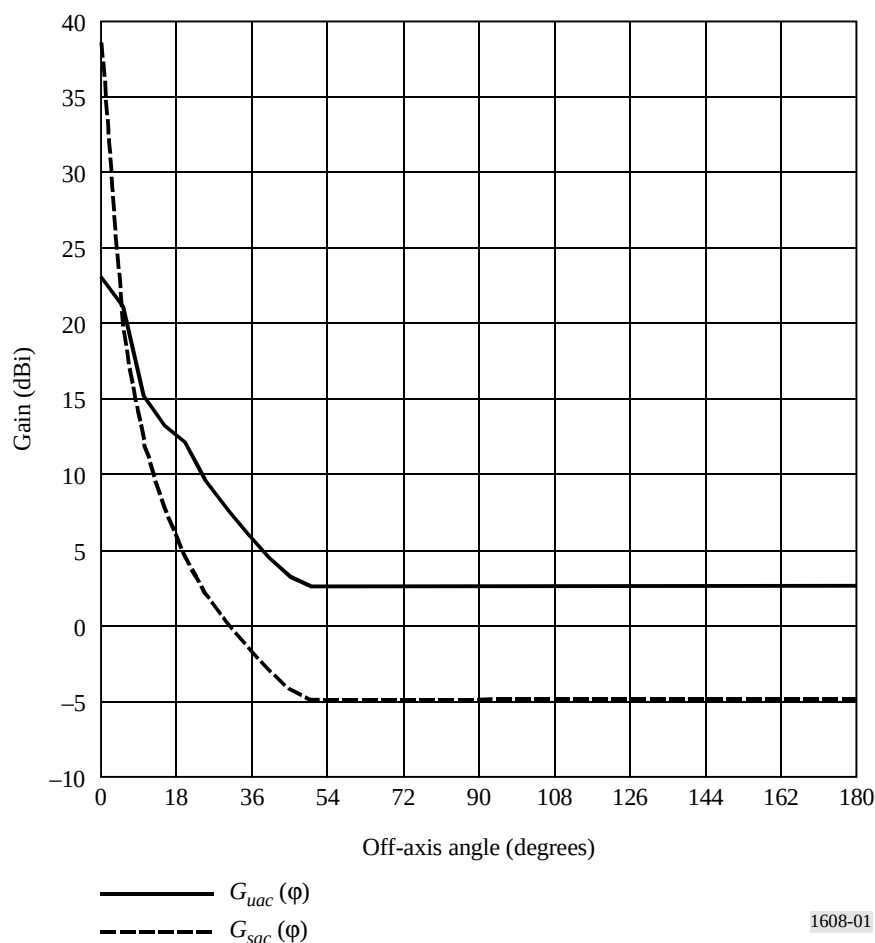
**Antenna reference radiation pattern envelopes for HAPS user terminals
(based on Recommendation ITU-R F.699)****2 Overview of other fixed service systems in the bands 47.2-47.5 GHz and 47.9-48.2 GHz**

Table 5 gives parameters of conventional fixed service systems in the 47 GHz band as provided in Recommendation ITU-R F.758.

System 1 will be used as the interference source (because it has the highest spectral e.i.r.p.), and System 3 as the victim (because it is the system most sensitive to interference).