



Recommendation ITU-R F.1764-1
(05/2011)

**Methodology to evaluate interference
from user links in fixed service systems
using high altitude platform stations
to fixed wireless systems in the bands
above 3 GHz**

F Series
Fixed service



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Foreword

The role of the Radiocommunication Sector is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including satellite services, and carry out studies without limit of frequency range on the basis of which Recommendations are adopted.

The regulatory and policy functions of the Radiocommunication Sector are performed by World and Regional Radiocommunication Conferences and Radiocommunication Assemblies supported by Study Groups.

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SF	Frequency sharing and coordination between fixed-satellite and fixed service systems
SM	Spectrum management
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V	Vocabulary and related subjects

***Note:** This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.*

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RECOMMENDATION ITU-R F.1764-1

**Methodology to evaluate interference from user links in fixed service systems
using high altitude platform stations to fixed wireless systems*
in the bands above 3 GHz**

(2006-2011)

Scope

This Recommendation provides a methodology for interference evaluation that could be used for sharing studies between user links in fixed service (FS) systems using high altitude platform stations (HAPS) and conventional fixed wireless systems in the frequency bands above 3 GHz. Interference situations from HAPS airships and ground stations to the fixed wireless stations are analysed. In this Recommendation, HAPS gateway links are not considered.

The ITU Radiocommunication Assembly,

considering

- a) that new technology utilizing high altitude platform stations (HAPS) in the stratosphere has been developed to provide high-capacity services;
- b) that some administrations intend to operate the systems using HAPS in the bands allocated exclusively by the Table of Frequency Allocations or by footnotes for terrestrial radiocommunication such as the fixed services;
- c) that information on architectures, including user and gateway links, of systems using high altitude platform stations in the band 5 850-7 075 MHz can be found in Recommendation ITU-R F.1891;
- d) that HAPS user links may operate in the bands 47.2-47.5 GHz and 47.9-48.2 GHz;
- e) that in some countries HAPS user links may operate in the band 27.9-28.2 GHz and 31.0-31.3 GHz on a non-harmful interference, non-protection basis,

recommends

- 1** that the methodology described in Annex 1 may be used to evaluate interference from user links in fixed service systems using high altitude platform stations to fixed wireless systems in the bands above 3 GHz.

* The term “fixed wireless system” used in this Recommendation means point-to-point fixed wireless systems. Therefore, the term “fixed wireless station” is also used.

Annex 1

Methodology for interference evaluation from user links in fixed service systems using high altitude platform stations to fixed wireless systems in the bands above 3 GHz

1 Introduction

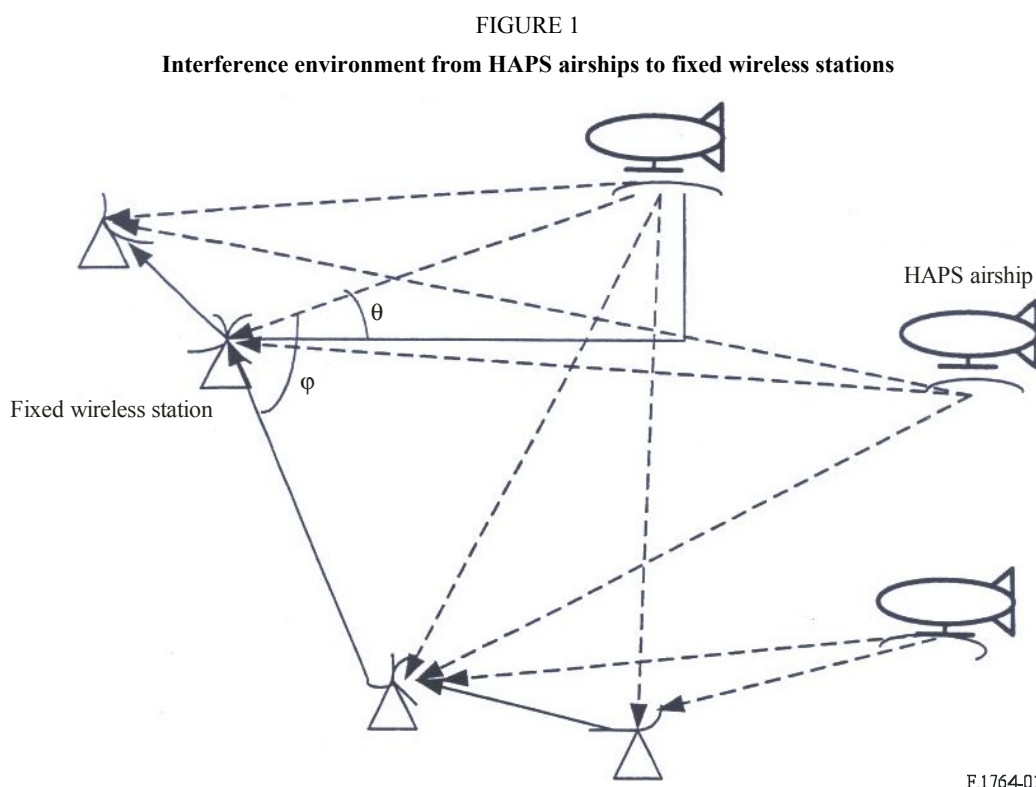
This Annex provides a methodology for interference evaluation to be used for sharing studies between user links in fixed service systems using HAPS and fixed wireless systems in the frequency bands above 3 GHz. Interference situations from HAPS airships and ground stations to fixed wireless stations are considered.

It also provides an example of interference evaluation at 6 GHz¹. This frequency is assumed only to show an example of the interference evaluation.

2 Calculation methodology of interference from fixed service systems using HAPS to fixed wireless systems

2.1 Interference from HAPS airships to fixed wireless stations

Figure 1 shows the interference situation from HAPS airships to fixed wireless stations.



¹ It is recognized that the frequency 6 GHz is not in a band allocated exclusively for terrestrial radiocommunication. It was chosen for this analysis to facilitate the development of the methodology because of the prevalence of available technical data for the terrestrial system.

Currently most FS systems employ digital modulation. In the case of digital point-to-point (P-P) and point-to-multipoint (P-MP) FS systems, it is appropriate to evaluate interference in terms of fractional degradation of performance values of routes, FDP_{route} , as defined in Recommendation ITU-R F.1107, assuming that the interference level is time-invariant.

For digital P-P fixed service systems with n hops operating at frequencies where multipath fading generally predominates and acknowledging that, in general, the performance objectives for multi-hop P-P FS systems are specified on a route basis as follows:

$$FDP_{route} = 100 \frac{\sum_{k=1}^n (I_k)}{n \times N_T} \% \quad (1)$$

where:

N_T : receiver thermal noise

I_k : aggregate interference falling into the k -th receiver from visible HAPS airships.

NOTE 1 – This model reflects a multi-hop fixed wireless station system for baseline interference studies, reflecting the period when microwave systems provided long-haul high-capacity traffic. However, with the development of metropolitan, national and international fibre optic networks, such systems are rapidly being replaced with back-haul systems carrying a diverse variety of traffic and connecting to the fibre network. Hence, most modern deployments contain mainly short links. Therefore, any analysis based upon 50-hop end-to-end degradation of performance caused by interference may no longer be applicable. Instead, each hop would need to be protected individually.

The aggregate interference received at a digital fixed wireless station can be determined by summing the contributions from all visible HAPS airships. Each contribution can be determined as follows:

$$I_D = F(\theta) + G(\varphi) + 10 \log \left(\frac{\lambda^2}{4\pi} \right) - L_{fr} \quad (2)$$

where:

$F(\theta)$: pfd of HAPS airship according to the angle of arrival above the horizontal plane, θ (dB(W/(m² · MHz)))

$G(\varphi)$: antenna gain of fixed wireless station to the direction of HAPS airship, φ (dBi)

λ : wavelength of the carrier (m)

L_{fr} : feeder loss of fixed wireless station (dB).

2.2 Interference from HAPS ground stations to a fixed wireless station

Figure 2 shows the interference situation from HAPS ground stations to a fixed wireless station.

The interference power from a HAPS ground station to a fixed wireless station is obtained by equation (3):

$$I_G = P_{HG} - L_{fh} + G(\theta_{H-R}) - L_b(p) + G(\theta_{R-H}) - L_{fr} \quad (3)$$

where:

P_{HG} : transmission power density from HAPS ground station (dB(W/MHz))

L_{fh} : feeder loss of the HAPS ground station (dB)