



Recommendation ITU-R P.1409-1
(02/2012)

**Propagation data and prediction methods
for systems using high altitude platform
stations and other elevated stations in the
stratosphere at frequencies greater than
about 1 GHz**

P Series
Radiowave propagation

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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Series of ITU-R Recommendations

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Series	Title
BO	Satellite delivery
BR	Recording for production, archival and play-out; film for television
BS	Broadcasting service (sound)
BT	Broadcasting service (television)
F	Fixed service
M	Mobile, radiodetermination, amateur and related satellite services
P	Radiowave propagation
RA	Radio astronomy
RS	Remote sensing systems
S	Fixed-satellite service
SA	Space applications and meteorology
SF	Frequency sharing and coordination between fixed-satellite and fixed service systems
SM	Spectrum management
SNG	Satellite news gathering
TF	Time signals and frequency standards emissions
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 P.1409-1*

Propagation data and prediction methods for systems using high altitude platform stations and other elevated stations in the stratosphere at frequencies greater than about 1 GHz

(1999-2012)

Scope

This Recommendation provides information on the propagation methods appropriate in the consideration of radiocommunication systems or networks involving the use of high altitude platform stations, or other stations in the stratosphere.

The ITU Radiocommunication Assembly,

considering

- a) that the Radio Regulations include provisions designating the use of systems employing high altitude platform stations in the fixed service at about 47 GHz and in the mobile service at about 2 GHz;
- b) that some of the frequency bands designated are also allocated for use by other services;
- c) that studies have been made into systems and networks using elevated platforms, which may be at lower heights in the stratosphere,

recommends

1 that the propagation mechanisms and effects set out in Annex 1 be taken into account in the design of systems using high altitude platform stations and other elevated platforms in the stratosphere, and in studies of sharing and compatibility.

Annex 1**1 Introduction**

The following mechanisms and effects should be considered, as appropriate, when undertaking system design or sharing studies for systems employing high altitude platform stations and other elevated platforms in the stratosphere:

- free-space basic transmission loss;
- atmospheric attenuation due to gaseous absorption in the troposphere; (it is sufficient to assume that all this attenuation occurs at heights below that of a platform);
- rain attenuation;
- cloud attenuation; (for time percentages smaller than about 1% the effects of cloud attenuation are included within the rain attenuation prediction method);

* Radiocommunication Study Group 3 made editorial amendments to this Recommendation in the year 2019 in accordance with Resolution ITU-R 1.

- back scatter from the Earth's surface; (back scatter from the top of rain cells or from the melting layer is expected to be less important);
- rain scatter;
- tropospheric scintillation.

The effects of ducting within the troposphere are not expected to be important as an interference mode for the slant paths (elevation angles well above 1°) to or from platform stations.

2 Prediction methods

For most cases other information contained in ITU-R Recommendations should be used as follows:

2.1 Frequency sharing between ground-based stations of high altitude platform networks and other elevated platform networks, and other terrestrial stations

The method of Recommendation ITU-R P.620 should be used for the evaluation of coordination distance, and Recommendation ITU-R P.452 should be used for detailed evaluation.

2.2 Frequency sharing between space stations and ground-based stations of high altitude platform networks and other elevated platform networks

The method described in Recommendation ITU-R P.619 provides relevant information.

2.3 Frequency sharing between high altitude platform networks and other elevated platform networks, and other terrestrial stations

The method described in Recommendation ITU-R P.619 provides relevant information for this case also, since all losses except those due to free-space spreading occur below the height of the platform.

2.4 Frequency sharing between platform stations and space stations

For the direct path between a platform station and a space station, it is necessary to consider free-space basic transmission loss and also the effects on the path through the ionosphere as described in Recommendation ITU-R P.531.

In addition, propagation paths should be considered which involve ground scatter or ground reflection. Until further information becomes available the following guidance can be given.

In some cases, smooth surfaces with areas greater than 0.6 of the first Fresnel reflection zone may cause glints of good reflection with specular geometry. The signal in such cases may be determined from the e.i.r.p. in the appropriate direction, including the atmospheric attenuation loss due to two traverses of the troposphere for the slant angle involved, and assuming a reflection coefficient of –10 dB (some particular cases may have higher reflection coefficients).

More generally the Earth's surface may be considered as rough. In this case, it may be appropriate to assume radiation from the area wholly illuminated by the beam from the platform station into the half-space above the Earth's surface, again with a typical scatter coefficient of –10 dB, i.e. assume a source on the Earth's surface radiating isotropically with a power given by: the actual transmitter power, reduced by the atmospheric attenuation loss due to the two traverses of the troposphere for the slant angles involved, further reduced by 10 dB for the reflection coefficient, and then increased by 3 dB since the radiation is only into a half space. (See Recommendation ITU-R P.680-3 for further information on sea reflection.)

3 The prediction of system performance for systems using high altitude and other elevated platform stations

The method of Recommendation ITU-R P.618 should be used, noting that effects due to the ionosphere will not apply.
