

ITU-R

Radiocommunication Sector of ITU

Recommendation ITU-R P.1406-2 (07/2015)

Propagation effects relating to terrestrial land mobile and broadcasting services in the VHF and UHF bands

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

(Also available online at <http://www.itu.int/pub/R-REC/en>)

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.1406-2

**Propagation effects relating to terrestrial land mobile and
broadcasting services in the VHF and UHF bands**

(Question ITU-R 203/3)

(1999-2007-2015)

Scope

This Recommendation provides information on various aspects of propagation which are likely to affect the terrestrial land mobile and broadcasting services. These aspects should be taken into account in the design and planning of such services.

The ITU Radiocommunication Assembly,

considering

a) that there is a need for information on aspects of propagation likely to affect terrestrial land mobile and broadcasting services,

noting

that Recommendation ITU-R P.2040 provides guidance on the effects of building material properties and structures on radiowave propagation,

recommends

1 that the information contained in Annex 1 should be taken into account in the design and planning of such services.

Annex 1**1 Introduction**

This Recommendation provides information on various aspects of propagation which are likely to affect the terrestrial land mobile and broadcasting services. These aspects should be taken into account in the design and planning of such services.

2 Attenuation due to land cover

These losses are likely to be of great importance for the land mobile service. They will depend on the category of the terrain, the extent of vegetation, and on the location, density and height of buildings. Table 1 summarizes the applicability of the various available ITU-R Recommendations:

TABLE 1
Recommendations discussing land cover

ITU-R P.	Applicability
1546	Antenna height corrections
452	Clutter losses
833	Attenuation in vegetation (especially trees)
1058	Terrain databases
1146	Antenna height corrections
1812	Vegetation and clutter losses
1238	Planning of indoor radiocommunication systems
2040	Effects of building materials and structures

3 Signal strength variability

3.1 General

The strength of the signal received will vary with both time and location. The signal may be composed of direct, diffracted, reflected, and refracted components. The quality of the reception will depend upon several factors such as the receiving environment, frequency shifts, time delays, and type of modulation. Similarly, unwanted transmissions may also be received from other sources sharing the same frequencies as, or adjacent frequencies to, the wanted signal. These, too, will have to be taken into account in assessing the quality of service. These unwanted transmitters may be so distant from the receiver that the extent of the temporal variation created by the various forms of abnormal propagation will need to be quantified. This may involve a situation in which the risk of interference has to be accepted for a defined percentage of time at various receiving locations in order to allow the network(s) to operate.

In summary, the assessment of reception and the definition of the service area involve the analysis of wanted and unwanted signals in both time and location domains, and the extent of the correlation between them.

3.2 Fading regimes

A reduction in signal strength occurs when the receiver is in the shadow of trees or buildings or of terrain obstacles or other objects. The signal then arrives at the receiver after being diffracted over or around these obstacles, or being reflected from other objects. If the size and shape of the obstacles are known, an attempt can be made to calculate from theory the additional path loss that they create. Otherwise, if only general information about the environment is available, an estimate of path loss can be made from measurements made in similar situations. In any case, on a sufficiently small scale, a theoretical estimate will not be possible, and an estimate based on measurements will be necessary. Such an estimate must be statistical in nature. Typically, it consists of a median path loss for a specified area, and a measure of its variance.

The signal may vary explicitly with time because of atmospheric variations, but over distances of less than about 50 km, this kind of variation is relatively unimportant. More important in the land mobile service is spatial variability, which is seen as time variability by a moving receiver.

It is convenient to divide spatial variability into two regimes, rapid fading due to multipath, which occurs on the scale of a few wavelengths, and slower fading due to changes in shadowing. In analysing measurements, the two can be separated in the following way: a number of