International Telecommunication Union

ITU-R

Radiocommunication Sector of ITU

Recommendation ITU-R P.1144-10

(08/2019)

Guide to the application of the propagation methods of Radiocommunication Study Group 3

P Series

Radiowave propagation

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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.

Policy on Intellectual Property Right (IPR)

ITU-R policy on IPR is described in the Common Patent Policy for ITU-T/ITU-R/ISO/IEC referenced in Resolution ITU-R 1. Forms to be used for the submission of patent statements and licensing declarations by patent holders are available from http://www.itu.int/ITU-R/go/patents/en where the Guidelines for Implementation of the Common Patent Policy for ITU-T/ITU-R/ISO/IEC and the ITU-R patent information database can also be found.

Series of ITU-R Recommendations

(Also available online at http://www.itu.int/publ/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.1144-10

Guide to the application of the propagation methods of Radiocommunication Study Group 3

(1995-1999-2001-2001-2007-2009-2012-2015-06/2017-12/2017-2019)

Scope

This Recommendation provides a guide to the Recommendations of Radiocommunication Study Group 3, which contain propagation prediction methods. It advises users on the most appropriate methods for particular applications as well as the limits, required input information, and output for each of these methods.

Keywords

Radiowave propagation, prediction methods, digital products, spatial interpolation, height reference system

The ITU Radiocommunication Assembly,

considering

that there is a need to assist users of the ITU-R Recommendations P Series (developed by Radiocommunication Study Group 3),

recommends

1 that the information contained in Table 1 should be used for guidance on the application of the various propagation methods contained in the ITU-R Recommendations P Series (developed by Radiocommunication Study Group 3);

2 that the information contained in Table 2 and Annex 1 should be used for guidance on the use of the various digital maps of geophysical parameters necessary for the application of the propagation methods in *recommends* 1 above.

NOTE – For each of the ITU-R Recommendations in Table 1, there are associated information columns to indicate:

Application: the service(s) or application for which the Recommendation is intended.

Type: the situation to which the Recommendation applies, such as point-to-point, point-to-area, line-of-sight, etc.

Output: the output parameter value produced by the method of the Recommendation, such as path loss.

Frequency: the applicable frequency range of the Recommendation.

Distance: the applicable distance range of the Recommendation.

% *time*: the applicable time percentage values or range of values of the Recommendation; % time is the percentage of time that the predicted signal is exceeded during an average year.

% *location*: the applicable per cent location range of the Recommendation; % location is the percentage of locations within, say, a square with 100 to 200 m sides that the predicted signal is exceeded.

Terminal height: the applicable terminal antenna height range of the Recommendation.

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Input data: a list of parameters used by the method of the Recommendation; the list is ordered by the importance of the parameter and, in some instances, default values may be used.

The information, as shown in Table 1, is already provided in the Recommendations themselves; however, the Table allows users to quickly scan the capabilities (and limitations) of the Recommendations without the requirement to search through the text.

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TABLE 1

ITU-R radiowave propagation prediction methods

Method	Title	Application	Type	Output	Frequency	Distance	% time	% location	Terminal height	Input data
Rec. ITU-R P.368	Ground-wave propagation curves for frequencies between 10 kHz and 30 MHz	All services	Point-to-point	Field strength	10 kHz to 30 MHz	1 to 10 000 km	Not applicable	Not applicable	Ground-based	Frequency Ground conductivity
Rec. ITU-R P.452	Prediction procedure for the evaluation of interference between stations on the surface of the Earth at frequencies above about 0.1 GHz	Services employing stations on the surface of the Earth; interference	Point-to-point	Path loss	100 MHz to 50 GHz	Not specified but up to and beyond the radio horizon	0.001 to 50 Average year and worst month	Not applicable	No limits specified, within the surface layer of the atmosphere. (Not suitable for aeronautical applications)	Path profile data Frequency Percentage time Tx antenna height Rx antenna height Latitude and longitude of Tx Latitude and longitude of Rx Meteorological data Polarization
Rec. ITU-R P.528	Propagation curves for aeronautical mobile and radionavigation services using the VHF, UHF and SHF bands	Aeronautical mobile	Point-to-area	Path loss	125 MHz to 15.5 GHz	0 to 1 800 km (for aeronautical applications 0 km horizontal distance does not mean 0 km path length)	1 to 99	Not applicable	H1: Minimum of 1.5 m H2: Minimum of 1.5 m	Distance Tx height Frequency Rx height Percentage time
Rec. ITU-R P.530	Propagation data and prediction methods required for the design of terrestrial line-of-sight systems	Line-of-sight fixed links	Point-to-point line-of-sight	Path loss Diversity improvement (clear air conditions) XPD(2) Outage Error performance	Approximately 150 MHz to 100 GHz	Up to 200 km if line-of-sight	All percentages of time in clear-air conditions; 1 to 0.001 in precipitation conditions(1) And worst month for attenuation	Not applicable	High enough to ensure specified path clearance	Distance Tx height Frequency Rx height Percentage time Path obstruction data Climate data Terrain information

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TABLE 1 (*continued*)

Method	Title	Application	Type	Output	Frequency	Distance	% time	% location	Terminal height	Input data
Rec. ITU-R P.533	Method for the prediction of the performance of HF circuits	Broadcasting Fixed Mobile	Point-to-point	Basic MUF Sky-wave field strength Available receiver power Signal-to-noise ratio LUF Circuit reliability	2 to 30 MHz	0 to 40 000 km	All percentages	Not applicable	Not applicable	Latitude and longitude of Tx Latitude and longitude of Rx Sunspot number Month Time(s) of day Frequencies Tx power Tx antenna type Rx antenna type
Rec. ITU-R P.534	Method for calculating sporadic-E field strength	Fixed Mobile Broadcasting	Point-to-point via sporadic E	Field strength	30 to 100 MHz	0 to 4 000 km	0.1 to 50	Not applicable	Not applicable	Distance Frequency
Rec. ITU-R P.617	Propagation prediction techniques and data required for the design of trans-horizon radio-relay systems	Trans-horizon fixed links	Point-to-point	Path loss	> 30 MHz	100 to 1 000 km	0.001 to 99.999	Not applicable	No limits specified within the surface layer of the atmosphere. (Not suitable for aeronautical applications)	Frequency Tx antenna gain Rx antenna gain Path geometry
Rec. ITU-R P.618	Propagation data and prediction methods required for the design of Earth-space telecommunicatio n systems	Satellite	Point-to-point	Path loss Diversity gain and (for precipitation condition) XPD(2)	1 to 55 GHz	Any practical orbit height	0.001-5 for rain attenuation; 0.001-50 for total attenuation, 0.001-1 for XPD(2) Also worst month for attenuation	Not applicable	No limit	Meteorological data Frequency Elevation angle Height of earth station Separation and angle between earth station sites (for diversity gain) Antenna diameter and efficiency (for scintillation) Polarization angle (for XPD(2))
Rec. ITU-R P.619	Propagation Data Required for the Evaluation of Interference Between Stations in Space and those on the Surface of the Earth	Satellite	Point-to-point	Basic transmission loss for single-entry interference Clear-air basic transmission loss for multiple-entry interference	0.1 to 100 GHz	Any practical orbit height	0.001 to 50	Not applicable	No limit	Frequency Earth-station elevation angle Angular path separation Path length Gaseous attenuation Scintillation “gain” Maximum allowed attenuation of the wanted signal

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