

RECOMMENDATION ITU-R P.1791*

**Propagation prediction methods for assessment of the impact
of ultra-wideband devices**

(Question ITU-R 211/3)

(2007)

Scope

This Recommendation provides methods valid for a frequency range from 1-10 GHz to calculate an ultra-wideband (UWB) path loss in indoor and outdoor operating environments for line-of-sight (LoS) and obstructed path categories and to assess the power received by a conventional narrow-band receiver from a UWB transmitter.

The ITU Radiocommunication Assembly,

considering

- a) that ultra-wideband (UWB) technology is a rapidly emerging wireless technology;
- b) that devices using UWB technology use multiple high data-rate streams and cover large bandwidth;
- c) that knowledge of the propagation characteristics is essential for assessment of the impact of UWB devices;
- d) that there is a need both for empirical (i.e. site-general) models and advice for interference assessment, and for deterministic (or site-specific) models for some detailed propagation predictions,

noting

- a) that Recommendation ITU-R P.525 provides the calculation of attenuation in free space;
- b) that Recommendation ITU-R P.528 provides propagation curves for aeronautical mobile and radionavigation services using the VHF, UHF and SHF bands;
- c) that Recommendation ITU-R P.618 provides propagation data and prediction methods for Earth-space links;
- d) that Recommendation ITU-R P.452 describes the procedure for the evaluation of microwave interference between stations on the surface of the Earth in the frequency range of about 0.7 GHz to 30 GHz;
- e) that Recommendation ITU-R P.1238 provides guidance on indoor propagation over the frequency range 900 MHz to 100 GHz;
- f) that Recommendation ITU-R P.1411 provides propagation methods for short paths in outdoor situations, in the frequency range from about 300 MHz to 100 GHz;

* This Recommendation should be brought to the attention of Radiocommunication Study Group 1.

- g) that Recommendation ITU-R P.1546 provides guidance on propagation for systems that operate over distances of 1 km and greater, and over the frequency range 30 MHz to 3 GHz;
- h) that Recommendation ITU-R P.530 provides propagation data and prediction methods for the design of terrestrial line-of-sight (LoS) systems,

recommends

- 1 that the information and methods in Annex 1 should be used for calculating path losses of UWB devices between 1 GHz and 10 GHz;
- 2 that the information in Annex 2 should be used to assess the power received by a conventional narrow-band receiver from a UWB transmitter.

Annex 1

1 Introduction

The frequency dependence of the UWB LoS transmission loss actually results from the antenna characteristics. Therefore, the traditional path-loss model typically used for narrow-band signal propagation modelling is useful in computing the path loss experienced by UWB signals.

A considerable number of UWB propagation studies and experiments have been performed in a great variety of conditions, thus allowing the derivation of UWB propagation models and their parameters.

Both indoor and outdoor environments are foreseen for UWB devices. Detailed knowledge of the particular indoor site, including geometry, materials, furniture, etc. is required when performing propagation studies. In the case of outdoor propagation, information on buildings and trees is essential for propagation calculations. These factors usually result in multipath, which a UWB receiver is capable of resolving. Therefore, a UWB propagation model should capture both the path loss and multipath characteristics of the typical environment where UWB devices are expected to operate. Models that represent the propagation characteristics in the environment in a general manner are more suitable to achieve this goal. These models do not usually require a lot of input information by the user in order to carry out the calculations.

This Recommendation defines operating environments, path-loss categories, and provides methods for estimating UWB path loss in these conditions. It is to be used to determine the UWB link budget.

2 Physical operating environments

Environments described in this Recommendation are categorized solely from the radio propagation perspective. Two different environments are identified for indoor propagation and one for outdoor propagation. They are considered to be the most typical. Table 1 lists the three environments. Recognizing that there is a wide variety of environments within each category, it is not intended to model every possible case but to give propagation models that are representative of environments frequently encountered.