

RECOMMENDATION ITU-R F.1760

Methodology for the calculation of aggregate equivalent isotropically radiated power (a.e.i.r.p.) distribution from point-to-multipoint high-density applications in the fixed service operating in bands above 30 GHz identified for such use*

(2006)

Scope

This Recommendation provides a methodology which may be used to derive the a.e.i.r.p. for transmitting point-to-multipoint (P-MP) and multipoint -to-multipoint (MP-MP) high-density applications in the fixed service (HDFS) stations in bands above 30 GHz which may be used by administrations wishing to assess the potential interference from P-MP HDFS stations to other services.

The ITU Radiocommunication Assembly,

considering

- a) that an estimate of the aggregate equivalent isotropically radiated power (a.e.i.r.p.) from a deployment of point-to-multipoint (P-MP) high-density applications in the fixed service (HDFS) stations may be required by administrations to assess the potential interference from P-MP HDFS stations to other victim services on a national and bilateral basis;
- b) that using automatic transmitter power control (ATPC) in P-MP transmitters would reduce the aggregated radiated power;
- c) that the determination of a.e.i.r.p. could be improved by considering the topology, demographic data and deployment model within the defined area,

recognizing

- 1 that No. 5.547 of the Radio Regulations (RR) identifies the bands 31.8-33.4 GHz, 37-40 GHz, 40.5-43.5 GHz, 51.4-52.6 GHz, 55.78-59 GHz and 64-66 GHz as being available for high-density applications in the fixed service (HDFS),

noting

- a) that Resolution 75 (WRC-2000) invites ITU-R to develop, as a matter of urgency, the technical basis for determining the coordination area for the receiving earth station in the space research service (deep space) with HDFS transmitting stations in the 31.8-32.3 GHz and 37-38 GHz bands;
- b) that Resolution 79 (WRC-2000) invites ITU-R to conduct studies on the coordination distance between radio astronomy stations operating in the 42.5-43.5 GHz band and HDFS systems,

recommends

- 1 that the methodology described in Annex 1 may be used to determine the a.e.i.r.p. distribution from transmitting P-MP HDFS stations operating in bands above 30 GHz.

* This Recommendation also applies to multipoint -to-multipoint (MP-MP) high-density applications in the fixed service (HDFS).

Annex 1

Methodology for the calculation of aggregate equivalent isotropically radiated power (a.e.i.r.p.) distribution from P-MP high-density applications in the fixed service operating in bands above 30 GHz

1 Introduction

Resolution 75 (WRC-2000) requests the development of the technical basis for determining the coordination area for coordination between receiving earth stations in the space research service (deep space) and transmitting stations of high-density applications in the fixed service (HDFS), in the 31.8-32.3 GHz and 37-38 GHz frequency bands. In addition, Resolution 79 (WRC-2000) invites ITU-R to conduct studies on the coordination distance between radio astronomy stations operating in the 42.5-43.5 GHz band and HDFS systems.

This Recommendation provides methodologies which may be used to derive the a.e.i.r.p. for transmitting P-MP HDFS stations which may be used by administrations wishing to assess the potential interference from P-MP HDFS stations to other victim services in their national and bilateral discussions. The methodologies in this recommendation may be used as a basis for further study by administrations wishing to answer the *resolves* under Resolutions 75 (WRC-2000) and 79 (WRC-2000).

WRC-2000 adopted the RR 5.547 that identified certain bands above 30 GHz to be available for high-density applications in the fixed service. System specific characteristics are not identified, but it is expected that large numbers of terminals would be deployed within specified areas associated with traditional fixed service systems. These high density fixed service (P-MP HDFS) systems may have hundreds of terminals within a cell, and may consist of thousands of cells. This could give rise to a significant aggregation of e.i.r.p., and new approaches must be considered to model such effects.

One such approach, presented in the methodology below, is to determine the distribution of aggregate equivalent isotropically radiated power (a.e.i.r.p.) from P-MP HDFS stations dispersed over a defined area called a building block (BB). The a.e.i.r.p. takes into account:

- variation in transmitter and receiver heights;
- variation in station location and hop length;
- variation in antenna azimuth and associated gain towards a point on the horizon;
- variation in transmit power control.

These parameters can be convolved using an interference equation and Monte Carlo simulation to produce a distribution of a.e.i.r.p. at a receiving test point located on the horizon. Using this method, each cell can be modelled as an a.e.i.r.p. distribution that represents potentially large numbers of transmitters within the area defined by the BB.

The methodology is defined in three stages:

Stage 1 definition of P-MP HDFS system parameters;

Stage 2 deployment model;

Stage 3 convolution of system parameters to obtain the a.e.i.r.p. distribution.

These stages are described in the sections below, and an example application is presented in Appendix 1.

1.1 Use of Monte Carlo simulation

In order to calculate the a.e.i.r.p. distributions it is necessary to take into account the variation in input parameters, such as station locations and antenna azimuths. This can be done using a statistical modelling approach, such as a Monte Carlo methodology.

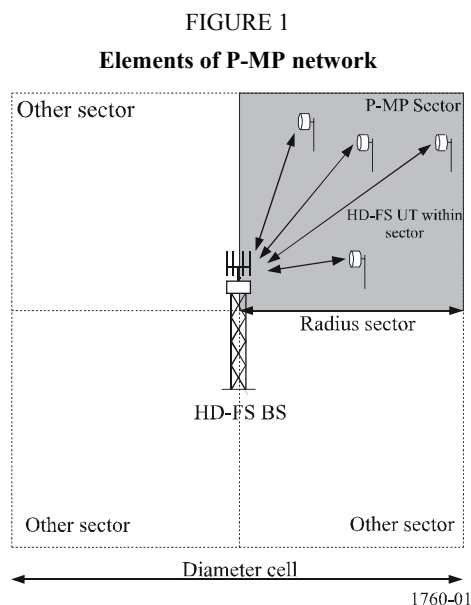
The Monte Carlo methodology is based on the principal of sampling random variables from their defined probability distributions. These distributions are defined in terms of maximum and minimum system parameters when defining the P-MP HDFS reference system (see § 3.2 below).

In order to get statistically meaningful results, a suitable number of samples are required when using the Monte Carlo approach. To determine the a.e.i.r.p. distributions, at least 10 000 samples should be taken.

1.2 Types of P-MP HDFS network

A number of architectures could be used to provide P-MP HDFS services. Two such are point-to-multipoint (P-MP) and multipoint-to-multipoint (MP-MP).

Figure 1 shows the elements of a P-MP system.



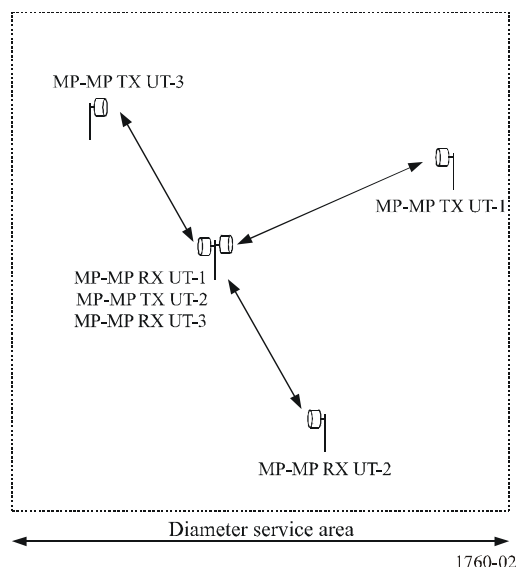
The architecture comprises:

- an area defined as the cell over which service is provided;
- at a location within this cell, typically the centre, is located the base station (BS);
- the cell is divided into a set of sectors, with service provided for each by a separate antenna;
- within each sector are located user terminals (UT)s;
- each UT has an antenna that points at the BS.

Note that a cell can consist of a single sector.

Figure 2 shows the elements of a MP-MP system.

FIGURE 2
Elements of MP-MP network



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The architecture comprises:

- an area over which service is provided;
- each node or user terminal (UT) is connected to at least one other;
- additional UTs can be connected to existing nodes.

2 Description of a.e.i.r.p. distribution methodology

2.1 Stage 1 – P-MP HDFS system parameters

The first stage is to define the P-MP HDFS system parameters. This can be done using the template Table 1.

TABLE 1
P-MP HDFS model parameters

Parameter	Value	Units	Comment
Architecture	User specified	–	Either P-MP or MP-MP
Transmitter	User specified	–	Specify whether BS, UT or MP-MP
Tx antenna radiation pattern	User specified	–	
Tx peak antenna gain	User specified	dBi	
Tx height (above terrain): Min height Max height	User specified User specified	m m	For P-MP systems, specify max height only. For MP-MP systems, antenna height selected at random between min and max value
Number of cells	User specified	–	No. cells modelled for P-MP systems within BB size
Number of sectors per cell	User specified	–	Default is 1 for MP-MP systems