International Telecommunication Union

ITU-R

Radiocommunication Sector of ITU

Recommendation ITU-R BO.1776-1

(01/2012)

Maximum power flux-density for the broadcasting-satellite service in the band 21.4-22.0 GHz in Regions 1 and 3

BO Series

Satellite delivery

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 Annex 1 of 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.*

Electronic Publication
Geneva, 2012

RECOMMENDATION ITU-R BO.1776-1

Maximum power flux-density for the broadcasting-satellite service in the band 21.4-22.0 GHz in Regions 1 and 3

(2006-2012)

Scope

This Recommendation addresses the maximum power flux-density (pfd) at high elevation angle on the Earth's surface produced by emissions from a space station in the broadcasting-satellite service (BSS) to be used in studies on sharing for the BSS in the band 21.4-22.0 GHz in Regions 1 and 3.

The ITU Radiocommunication Assembly,

considering

a) that the BSS systems in the 21.4-22.0 GHz band have the possibility to deliver wide RF band signals, however high e.i.r.p. of the space station (i.e. high pfd at the receiving earth station) is needed to compensate for the total link attenuation due to atmospheric effects;

b) that service availability of the BSS in the band 21.4-22.0 GHz in Regions 1 and 3 should be aimed at a high percentage to progress, to the maximum extent, towards more reliable high definition television (HDTV) broadcasting services;

c) that Recommendation ITU-R BO.1659 shows that high service availabilities of more than 99% over the year are expected in Regions 1 and 3 by transmitting an e.i.r.p. leading to a pfd value that equals –105 dB(W/(m^2 · 1 MHz)) for areas with high rain rates to compensate for rain attenuation in the band 21.4-22.0 GHz;

d) that satellite link performance is dependent on not only pfd at the receiving earth station but also, *inter alia*, figure of merit of receiving earth station;

e) that rain attenuation is dependent on not only rainfall rate but also, *inter alia*, elevation angle, altitude and latitude of the earth station;

f) that required service availability of each BSS system is related to the operational requirements,

recommends

1 that, in order to compensate for the total link attenuation due to atmospheric effects calculated for high annual service availability, –105 dB(W/(m^2 · 1 MHz)) should be considered as the maximum pfd at high elevation angle on the Earth's surface under free-space conditions to be used in sharing studies for the BSS in the band 21.4-22.0 GHz (see Annex 1 for examples in different cities in Regions 1 and 3);

2 that the following Notes should be considered as part of this Recommendation.

NOTE 1 – For countries not subject to high total link attenuation, a lower value than the value in *recommends* 1 above could be considered as the maximum pfd at the Earth's surface produced by a space station in the BSS to be used in sharing studies for the BSS in the band 21.4-22.0 GHz in Regions 1 and 3.

NOTE 2 – The above-mentioned total link attenuation includes attenuation due to rain and clouds, scintillation, and gaseous attenuation due to water vapour and oxygen. A general method for calculating total link attenuation is given in Recommendation ITU-R P.618.

Annex 1

Attainable annual service availability and total link attenuation in some example cities in Regions 1 and 3, assuming −105 dB(W/(m^2 · 1 MHz)) as the pfd at the Earth's surface produced by emissions from a BSS space station in the band 21.4-22.0 GHz

Tables 1a and 1b show examples of attainable annual service availability and total link attenuation (in brackets) in some cities in Regions 1 and 3 when applying –105 dB(W/(m^2 · 1 MHz)) as the pfd at the Earth's surface produced by emissions from a BSS space station in the band 21.4-22.0 GHz under free-space conditions. The required *C*/*N* values for each modulation scheme are assumed as 5.6 dB and 7.5 dB for QPSK and 10.7 dB for 8-PSK, including a hardware implementation margin and satellite hardware loss margin, with reference to the Nyquist noise bandwidth. A receiving antenna diameter of 45 cm was assumed. From these Tables, it can be confirmed that annual service availability can be attained for these cities in the range of between 99.78 and 99.99%.

TABLE 1a

Annual service availability and total link attenuation of 21 GHz band BSS downlink in some example cities in Region 3

		Tokyo	**Seoul**	**Bangkok**	**Wellington**
Elevation angle (degrees)		38.0	44.9	73.5	42.3
Rainfall rate for 0.01% of the year (mm/h)		48.0	50.6	87.1	41.7
pfd (dB(W/(m^2 · 1 MHz))		–105.0	–105.0	–105.0	–105.0
Overall *C*/*N*	5.6 dB	99.98% (21.9 dB)	99.98% (22.1 dB)	99.88% (21.8 dB)	99.99% (21.1 dB)
	7.5 dB	99.97% (20.0 dB)	99.97% (20.2 dB)	99.85% (19.8 dB)	99.99% (19.1 dB)
	10.7 dB	99.95% (16.7 dB)	99.95% (17.0 dB)	99.78% (16.6 dB)	99.99% (15.9 dB)

NOTE – The locations presented in Table 1a give only examples of the service availability and total link attenuation in Region 3.

TABLE 1b

Annual service availability and total link attenuation of 21 GHz band BSS downlink in some example cities in Region 1

		Moscow	Paris	Istanbul	Pretoria
Elevation angle (degrees)		26.5	33.2	40.7	59.9
Rainfall rate for 0.01% of the year (mm/h)		31.7	31.8	38.9	53.2
pfd (dB(W/(m^2 · 1 MHz))		–105.0	–105.0	–105.0	−105.0
Overall *C*/*N*	5.6 dB	99.99% (22.0 dB)	99.99% (21.9 dB)	99.99 (21.9 dB)	99.97% (22.1 dB)
	7.5 dB	99.99% (20.1 dB)	99.99% (20.0 dB)	99.99% (20.0 dB)	99.97% (20.2 dB)
	10.7 dB	99.98% (16.8 dB)	99.99% (16.7 dB)	99.99% (16.7 dB)	99.95% (16.9 dB)

NOTE – The locations presented in Table 1b give only examples of the service availability and total link attenuation in Region 1.