

International Telecommunication Union

ITU-R
Radiocommunication Sector of ITU

Recommendation ITU-R SM.1682-1
(09/2011)

**Methods for measurements on digital
broadcasting signals**

SM Series
Spectrum management



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.

Electronic Publication
Geneva, 2011

© ITU 2011

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, without written permission of ITU.

RECOMMENDATION ITU-R SM.1682-1*

Methods for measurements on digital broadcasting signals**

(2004-2011)

Scope

Due to the progressive introduction of digital broadcasting systems and taking account of their complexity it is important that monitoring services dispose with guidance on measuring the digital broadcasting signals, in view to be able to enforce the rules and license conditions.

Keywords

Digital broadcast, measurement method, spectrum monitoring

The ITU Radiocommunication Assembly,

considering

- a) that digital audio and video broadcasting systems are being introduced progressively;
- b) that administrations may set rules and/or licence conditions for the use of these systems;
- c) that the monitoring service may be tasked for the enforcement of these rules and/or licence conditions;
- d) that due to the complexity of these systems, guidance on measuring these systems is needed,

recommends

1 that if a monitoring service has to measure the following parameters of digital broadcasting signals:

- frequency and bandwidth;
- power and field strength;
- extraction of transmitter identification and determination of type of service;
- sound and picture quality;
- quality of transmitted signal;
- coverage;
- RF channel characteristics;
- other technical parameters,

these measurements should be carried out as described in Annex 1.

* Radiocommunication Study Group 1 made editorial amendments to this Recommendation in the years 2018 and 2019 in accordance with Resolution ITU-R 1.

** This Recommendation should be brought to the attention of Radiocommunication Study Group 6.

Annex 1

1 Introduction

This Recommendation recommends a set of measurements to perform a variety of monitoring tasks related to these systems. The reasons for performing a specific measurement not only differ in a specific situation, but various administrations can also have unique applications for one or more of the described measurements. The mentioned measurements are as much as possible based on equipment already available at most monitoring stations. Where possible a reference to existing ITU-R Recommendations is made for each measurement.

The measurements are grouped by their main purpose for measuring and presented in tabular format with the following headings.

Parameter:	Parameter to be measured
Method:	Short description of method
Reason:	Reason for measuring the parameter in more detail, if necessary
Monitoring method:	Measurement can be performed as: M _s : mobile while stationary, M _{or} : mobile while on route, F: fixed, X: mobile or fixed
Rec.:	Reference to the latest edition of existing ITU Recommendations and the Handbook – Spectrum Monitoring
Equipment:	Equipment to be used.

2 Type of measurements

2.1 Frequency and bandwidth

Purpose

The main purpose of bandwidth measurement is the verification of the bandwidth and interference in adjacent channels.

Parameter	Measurement method	Reason	Monitoring method	Rec.	Equipment
Maximum spectrum	Mask method ⁽¹⁾	Quick determination of compliance with rules and/or licence conditions	M _s , F	ITU-R SM.328, ITU-R SM.329, ITU-R SM.443; Handbook on Spectrum Monitoring (edition 2011), Chapter 4.12	Spectrum analyzer or receiver

Parameter	Measurement method	Reason	Monitoring method	Rec.	Equipment
99% occupied bandwidth	Numerical integration of occupied spectrum	Determination of compliance with rules and/or licence conditions	M _s , F	ITU-R SM.443, Handbook on Spectrum Monitoring (edition 2011), Chapter 4.5	Spectrum analyzer with digitizing capabilities or receiver
Protection level	Indicator on receiver	System parameter test	X	ITU-R SM.378, ITU-R P.845	Dedicated receiver
Frequency ⁽²⁾	Several methods applicable	Determination of compliance with rules and/or licence conditions	M _s , F	ITU-R SM.377, Handbook on Spectrum Monitoring (edition 2011), Chapter 4.2	Frequency counter or spectrum analyzer or receiver

⁽¹⁾ A mask needs to be developed for each system. The low S/N in satellite applications should be taken into account and an on-site evaluation might be needed to properly evaluate highly selective systems.

⁽²⁾ In single frequency networks the operating frequency of each transmitter should be measured and frequency standards should be chosen in accordance with the uncertainty requirements, e.g. typically an SFN would require transmitter synchronization down to 10⁻⁹.

2.2 Power and field strength

Purpose

These measurements are important in cases of interference.

Parameter	Measurement method	Reason	Monitoring method	Rec.	Equipment
Field strength	With antennas at different heights	Determination of signal strength in “real life” situations	M _s	ITU-R SM.378 Handbook on Spectrum Monitoring (edition 2011), Chapter 4.4	Spectrum analyzer, receiver or field strength meter ⁽¹⁾ and a calibrated antenna
Channel power	At the transmitter output	Determination of the radiated power	M _s	Handbook on Spectrum Monitoring (edition 2011), Chapter 4.3	Power meter or receiver or spectrum analyzer or calibrated field-strength meter and a calibrated antenna

⁽¹⁾ If the victim service is a narrow-band service then the measuring bandwidth should also be narrow and the peak detector of the measuring receiver should be used.

2.3 Extraction of transmitter identification and determination of type of service

Purpose

In case of transmitting non-broadcasting related data these measurements are needed to verify the ratio between broadcasting and non-broadcasting.

Parameter	Measurement method	Reason	Monitoring method	Rec.	Equipment
Transmitter ID	ID code display on receiver	Identification of transmitter	X	Handbook on Spectrum Monitoring (edition 2011), Chapter 4.8	Dedicated receiver
Origin of transmitted data	Result of detailed analysis of datastream	Identification of transmitter when ID code is not available	X	Handbook on Spectrum Monitoring (edition 2011), Chapter 4.8	Dedicated receiver and analyzing software or separate datastream analyzer ⁽¹⁾
Ratio between broadcasting and non-broadcasting related data	Result of detailed analysis of datastream	Compliance with rules and/or licence conditions	X	Handbook on Spectrum Monitoring (edition 2011), Chapter 4.8	Dedicated receiver and analyzing software or separate datastream analyzer ⁽¹⁾
Types of service available	Readout of system flags or status bits/frames	Compliance with rules and/or licence conditions	X	Handbook on Spectrum Monitoring (edition 2011), Chapter 4.8	Dedicated receiver with analyzing software if needed or separate analyzer

⁽¹⁾ The method is not intended to detect hidden information in picture and sound services.

2.4 Sound and picture quality

Purpose

The relationship between BER and received picture and sound quality of digital broadcasting systems is not always obvious. The nature of the transmitted pictures and sound in relation to the BER determines the quality of the transmission.

Parameter	Measurement method	Reason	Monitoring method	Rec.	Equipment
Picture and sound quality	Observation of the displayed picture or produced sound ⁽¹⁾	Determination of picture and sound errors	X	Handbook on Spectrum Monitoring (edition 2011), Chapter 5.2	Dedicated receiver with reference decoder

⁽¹⁾ It might be possible to develop an automated test procedure which is calibrated with a set of aural and visual observations of a test panel.

2.5 Quality of transmitted signal

Purpose

To determine whether a reception problem is caused by poor coverage or problems in the generation of the data stream or modulator.

Parameter	Measurement method	Reason	Monitoring method	Rec.	Equipment
Amplitude and phase error	Observation and analyses of the displayed constellation diagram	Determination of faulty modulator or amplifier	X	Handbook on Spectrum Monitoring (edition 2011), Chapter 4.6	Dedicated receiver or vector analyzer
Spectral purity	Observation of the RF spectrum	Determination of faulty RF stages, antennas, etc.	X	Handbook on Spectrum Monitoring (edition 2011), Chapter 4.6	Spectrum analyzer or scanning receiver
Composition of transport stream	Analyses of transport stream	Detection of faulty coders	X	System Specific Standard Handbook on Spectrum Monitoring (edition 2011), Chapter 5.2	Transport stream analyzer

2.6 Coverage

Purpose

Determination of the field strength in order to check that coverage area complies with the theoretical coverage.

Parameter	Measurement method	Reason	Monitoring method	Rec.	Equipment
Field strength	With antennas on different heights, both stationary or along a route	Determination of physical signal quality in “real life” situations	M_s, M_{or}	ITU-R SM.1447 ITU-R SM.1875 Handbook on Spectrum Monitoring (edition 2011), Chapter 4.11	Spectrum analyzer or receiver and a calibrated antenna. Positioning devices like (D)GPS or GLONASS receiver
Field strength	With fixed antenna	Determination of signal strength fluctuations	F	Handbook on Spectrum Monitoring (edition 2011), Chapter 5.2	Spectrum analyzer or receiver and a calibrated antenna. Positioning devices like (D)GPS or GLONASS receiver

Parameter	Measurement method	Reason	Monitoring method	Rec.	Equipment
BER after different decoding stages	Registration with dedicated receiver	Determination of decoded signal quality in “real life” situations	X	Handbook on Spectrum Monitoring (edition 2011), Chapter 5.2 ITU-R BT.1735	Dedicated receiver
BER and field strength	Registration with dedicated receiver	Objective quality/coverage evaluation	F, M _s	DTTB Handbook, Chapter 5 Handbook on Spectrum Monitoring (edition 2011), Chapter 5.2 ITU-R BT.1735	Dedicated receiver

2.7 RF channel characteristic

Purpose

The measurement of the RF channel characteristics can be useful to determine if reception problems at a particular location are caused by a receiver malfunction or signal propagation effects.

Parameter	Measurement method	Reason	Monitoring method	Rec.	Equipment
RF channel characteristic	Determination of the relative level and time delay of the reflected signal portion compared to the direct signal	Determination of reflections at a particular receiving site	M _s	Handbook on Spectrum Monitoring, (edition 2011) Chapter 4.8	Dedicated receiver with correlator ⁽¹⁾

⁽¹⁾ Taking into account the properties of the transmitted signal and the fact that it is difficult to switch off broadcasting transmitters for measurements, it is advisable to develop a correlation type of measurement.

2.8 Technical parameters of the system

Purpose

Besides the identification of unknown digital systems, analyzing the datastream is also useful to determine compliance with the relevant recommendations for a particular known system. It is also possible to say something about the quality of the transmitted signal and the behaviour of a single transmitter in a synchronized network.

Parameter	Measurement method	Reason	Monitoring method	Rec.	Equipment
General standard compliance	Manual or automated determination	Determination of compliance with an established standard	X	Handbook on Spectrum Monitoring (edition 2011), Chapter 5.2	Dedicated receiver or protocol analyzer

Parameter	Measurement method	Reason	Monitoring method	Rec.	Equipment
Number of carriers in an OFDM system	Manual or automated determination	Identification of a system or determination of compliance with an established standard	M _s , F	ITU-R SM.1600 Handbook on Spectrum Monitoring (edition 2011), Chapters 4.6, 4.8 and 5.2	Dedicated receiver or spectrum analyzer or receiver
Carrier spacing	Manual or automated determination	Identification of a system or determination of compliance with an established standard	M _s , F	ITU-R SM.1600 Handbook on Spectrum Monitoring (edition 2011), Chapters 4.6, 4.8 and 5.2	Dedicated receiver or spectrum analyzer or receiver
Carrier symbol rate	Manual or automated determination	Identification of a system or determination of compliance with an established standard	M _s , F	ITU-R SM.1600 Handbook on Spectrum Monitoring (edition 2011), Chapters 4.6, 4.8 and 5.2	Dedicated receiver or signal analysis system or receiver
Transmission delay in single frequency networks	Manual or automated determination	Determination of network configuration	M _s , F	ITU-R SM.1600 Handbook on Spectrum Monitoring (edition 2011), Chapters 4.6, 4.8 and 5.2	Dedicated receiver or signal analysis system or receiver