

RECOMMENDATION ITU-R SM.1682

Methods for measurements on digital broadcasting signals*

(Question ITU-R 214/1)

(2004)

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.

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.

* 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 | Spectrum analyser |
| 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 – Spectrum Monitoring, Chapter 4.5 | Spectrum analyser with digitizing capabilities |
| 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 – Spectrum Monitoring, Chapter 4.2 | Frequency counter or spectrum analyser |

⁽¹⁾ A mask needs to be developed for each system. The low S/N in satellite applications should be taken into account.

⁽²⁾ In single frequency networks the operating frequency of each transmitter should be measured.

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 | Spectrum analyser or field strength meter ⁽¹⁾ |
| Channel power | At the transmitter output | Determination of the radiated power by applying the antenna factor | M _s | | Power meter. Calibrated field-strength meter and 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 – Spectrum Monitoring, Chapter 4.9 | Dedicated receiver |
| Origin of transmitted data | Result of detailed analysis of datastream | Identification of transmitter when ID code is not available | X | Handbook – Spectrum Monitoring, Chapter 4.9 | Dedicated receiver and analysing software or separate datastream analyser ⁽¹⁾ |
| Ratio between broadcasting and non-broadcasting related data | Result of detailed analysis of datastream | Compliance with rules and/or licence conditions | X | Handbook – Spectrum Monitoring, Chapter 4.9 | Dedicated receiver and analysing software or separate datastream analyser ⁽¹⁾ |
| Types of service available | Readout of system flags or status bits/frames | Compliance with rules and/or licence conditions | X | Handbook – Spectrum Monitoring Chapter 4.9 | Dedicated receiver with analysing software if needed or separate analyser |

⁽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 | ITU-R BS.1283 | 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 – Spectrum Monitoring, Chapter 4 | Dedicated receiver or vector analyser |
| Spectral purity | Observation of the RF spectrum | Determination of faulty RF stages, antennas, etc. | X | Handbook – Spectrum Monitoring, Chapter 4 | Spectrum analyser or scanning receiver |
| Composition of transport stream | Analyses of transport stream | Detection of faulty coders | X | V1.21 (2001-05) | Transport stream analyser |

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 | Spectrum analyser. Common measurement receiver or dedicated receiver. Positioning devices like (D)GPS or GLONASS receiver |
| Field strength | With fixed antenna | Determination of signal strength fluctuations | F | | Spectrum analyser. Common measurement receiver or dedicated 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 | | Dedicated receiver |
| BER and field strength | Registration with dedicated receiver | Objective quality/coverage evaluation | F, M _s | Handbook – DTTB, Chapter 5 | 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 – Spectrum Monitoring, Chapter 4.9 | 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, analysing 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 |
|---|-----------------------------------|--|--------------------|---------------|--|
| 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 | Dedicated receiver or spectrum analyser |
| 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 | Dedicated receiver or spectrum analyser |
| 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 | Dedicated receiver or signal analysis system |
| Transmission delay in single frequency networks | Manual or automated determination | Determination of network configuration | M _s , F | ITU-R SM.1600 | Dedicated receiver or signal analysis system |