



Recommendation ITU-R SM.1880-2
(09/2017)

**Spectrum occupancy measurements and
evaluation**

SM Series
Spectrum management



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Foreword

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The regulatory and policy functions of the Radiocommunication Sector are performed by World and Regional Radiocommunication Conferences and Radiocommunication Assemblies supported by Study Groups.

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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, 2017

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RECOMMENDATION ITU-R SM.1880-2

Spectrum occupancy measurement and evaluation

(2011-2015-2017)

Scope

Although automatic occupancy measurement will not completely replace manual observations, it is still well suited for most cases. Frequency channel occupancy, as well as frequency band occupancy, should have a certain level of accuracy in order to be compared or merged if necessary. By using the technique and proper method a more efficient use of existing equipment is possible.

Keywords

Spectrum occupancy measurements, frequency channel occupancy, revisit time, busy hour

The ITU Radiocommunication Assembly,

considering

- a) that the increasing demand of radiocommunication services requires the most efficient use of the radio-frequency spectrum;
- b) that good spectrum management can only satisfactorily proceed if the spectrum managers are adequately informed on the current usage of the spectrum and the trends in its demand;
- c) that results of spectrum occupancy measurements would provide important inputs into:
 - frequency allotments and assignments;
 - verification of complaints concerning channel blocking;
 - establishment of the degree of efficiency of spectrum usage;
- d) that information obtained from frequency assignment databases does not reveal the degree of loading on each frequency channel;
- e) that some administrations assign the same frequency to more than one user for shared use;
- f) that it is desirable to compare measurement results from different countries in border areas or for instance in the aeronautical or maritime mobile services bands;
- g) that automatic monitoring equipment is now in use by administrations, including methods for the analysis of records, and a number of parameters can be evaluated, which are of considerable value in enabling more efficient utilization of the spectrum;
- h) that in designing an automated system to gather occupancy data for use in spectrum management, one must determine what parameters are to be measured, the relationship among these parameters and how often measurements have to be taken to ensure the data are statistically significant;
- i) that measurement procedures and techniques should be harmonized to facilitate the exchange of measurement results between various countries;
- j) that successful merging or combining monitoring data not only depends on the data format in which the data is stored but also on the environmental and technical conditions under which the data is gathered,

recognizing

- a) that various principles and methods of spectrum occupancy measurements are in use in the different countries;
- b) that one particular method exists to get the high-accuracy frequency channel occupancy data and that such data usually is the basic to form the frequency band occupancy,

recommends

- 1 that the measurement procedures and techniques specified in Annexes 1 and 2 should be used for spectrum occupancy measurements;
- 2 that both Report ITU-R SM.2256 and the ITU Handbook on Spectrum Monitoring in force should be used as guidance for spectrum occupancy measurements and the equipment should satisfy the requirement mentioned in that Handbook;
- 3 that a common data format, that is a line-based ASCII file derived from the radio monitoring data format (RMDF), should be used following Recommendation ITU-R SM.1809.

Annex 1

1 Introduction

Annex 1 describes frequency channel occupancy measurements performed with a receiver or spectrum analyser. The signal strength of each frequency step is stored. By means of post-processing the percentage of time that the signal is above a certain threshold level is determined. An example of the procedure for such post-processing is presented in Report ITU-R SM.2256 (Annex 1). Different users of a channel often produce different field-strength values at the receiver. This makes it possible to calculate and present the occupancy caused by different users.

2 Definitions

Frequency channel occupancy measurements: Measurements of channels, not necessarily separated by the same channel distance, and possibly spread over several different frequency bands to determine whether the channel is occupied or not. The goal is to measure as many channels as possible in a time as short as possible.

Revisit time: The time taken to visit all the channels to be measured (whether or not occupied) and return to the first channel.

Observation time: The time needed by the system to perform the necessary measurements on one channel. This includes any processing overheads such as storing the results to memory/disk.

Maximum number of channels: The maximum number of channels which can be visited in the revisit time.

Transmission length: The average length of individual radio transmission duration.

Integration time: Time interval for which an individual occupancy estimate is made. Normally 5 or 15 minutes.

Duration of monitoring: The total time during which the occupancy measurements are carried out.

Preset threshold level for measurement: If a signal is received above the threshold level, the channel is considered to be occupied.

Busy hour: The highest level of occupancy of a channel in a 60-min period.

3 Requirements

3.1 Equipment

A suitable system capable of making frequency channel occupancy measurements by using frequency band registrations will consist of a radio receiver or spectrum analyser, appropriate antenna, cable, a PC/controller, with interface adaptor, suitable acquisition and post-processing software.

Other features may include GPS, for mobile/nomadic operation of the station, communications modem, for remote control and data exchange, system calibration for traceable field strength measurements, antenna switches, filters and attenuators, for multiple band and/or strong EMF exposure environments.

3.2 Site considerations

Site should be chosen such as that the expected signal strength for the emissions of interest is above the expected threshold level. The relation between these two parameters will define an area within which the measurement performed is of relevance to any station operating above a certain effective radiated power (e.r.p.) level or effective isotropic radiated power (e.i.r.p.) level.

The expected signal strength can be evaluated considering the licensed stations at the region, their emission profile and using simulation software. The threshold can be estimated considering the system sensitivity (noise floor) or previous measurements performed under similar conditions with the same equipment and configuration.

If no preliminary information is available, a site survey using portable equipment could be performed. This is especially important if the equipment placement is of definitive nature and future relocations may not be easily performed.

Measurement results should ideally be accompanied by a report of analysis performed to select the site, indicating the area and the emitters that are expected to be considered.

3.3 Time related parameters

There is a relationship between observation time, number of channels, average transmission length and the duration of monitoring.

The revisit time is directly dependent on the observation time and the number of channels. Also the processing time (data transfer between receiver and controller) influences the revisit time and should be kept as short as possible.

Revisit time = (Observation time × Number of channels of identical bandwidth) + Processing time

The observation time per channel is limited by the scanning speed of the monitoring equipment. In order to maintain a reasonably short revisit time with relatively slow equipment, the number of channels to be measured must be reduced.