International Telecommunication Union

ITU-R

Radiocommunication Sector of ITU

Recommendation ITU-R SM.854-3

(09/2011)

Direction finding and location determination at monitoring stations

SM Series

Spectrum management

Foreword

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(Also available online at http://www.itu.int/publ/R-REC/en)

Series	Title
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BR	Recording for production, archival and play-out; film for television
BS	Broadcasting service (sound)
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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

RECOMMENDATION ITU-R SM.854-3*

Direction finding and location determination at monitoring stations

(1992-2003-2007-2011)

Scope

This Recommendation provides classification of bearings to determine the most likely position of an emitter using direction finding at monitoring stations.

Keywords

Direction finding, radio bearing, location determination, monitoring stations

The ITU Radiocommunication Assembly,

considering

a) that direction-finding measurements and subsequent emitter location determination by triangulation have very great significance for administrations, the Radio Regulations Board (RRB) and the Radiocommunication Bureau in the investigation of harmful interference and in their concern with efficient use of the radio-frequency spectrum;

b) that particularly the emitter location determination by triangulation is the final goal of all activities associated with direction-finding measurements and therefore appropriate interaction of direction finders (fixed and mobile) involved in the triangulation process plays a vital role;

c) that knowledge of the accuracy of a bearing as well as the accuracy of an emitter location determination is important in determining the most likely position of the emitter for domestic and international monitoring;

d) that the size of a location determination coverage area greatly depends on the configuration of direction finders in a network and it is usually considerably smaller than the overall direction finding coverage area of this network; it may even completely disappear under great distances between direction finders;

e) that the accuracy (or uncertainty) of location determination by triangulation does not remain the same throughout the overall location determination coverage area but varies within that area;

f) that many modern automatic direction finders rely on the result of statistical averaging to determine the classification of bearings;

g) that the single site location (SSL) method under HF monitoring activities could add significant availability to the locating of transmitters, having the advantage of not requiring triangulation, because it permits location by only one station, in case of skywaves independently of others;

h) that implementation of the SSL method alongside traditional direction finding leads to improved transmitter location capability,

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

recommends

1 that the Handbook on Spectrum Monitoring, 2011 edition, should be used as guidance for direction finding and emitter location functions at fixed and mobile monitoring stations;

2 that for HF direction-finding purposes, systems based on goniometer, interferometer, correlative interferometer, or Doppler techniques should be used in preference to simple rotatable loops or crossed-loop direction finders which are less reliable, given the nature of ionospheric propagation;

3 that the SSL method in the HF band can complement traditional direction-finding methods for skywave signals;

4 that SSL systems should preferably use real-time ionospheric sounders rather than ionospheric models or predictions for determination of the ionosphere;

5 that antenna arrays and signal processing technologies, such as correlative interferometry used for SSL applications, may also be suitable for establishing dense direction-finding triangulation networks, including those based on groundwave reception;

6 that computerized enhancements of direction-finding and emitter location systems should be considered for improving the accuracy and confidence factor of desired bearings and for calculating direction-finding fixes;

7 that administrations should continue the study of improvements to the SSL method to increase its immunity to changing ionospheric propagation conditions and to better distinguish between one-hop and multi-hop location results;

8 that Tables 1 and 2 should be used when deciding and classifying the accuracy that should be ascribed to the measurement of a bearing;

9 that the accuracy of the bearing should be indicated by appending the appropriate letter from the tables to the numerical value of the bearing;

10 that administrations should provide statistical data to support assigning numerical averaging values to the observational characteristics, e.g. standard deviation, number of samples, actual error, mean average of the sample.

TABLE 1

Classifications of bearings of frequencies less than or equal to 30 MHz

Class	**Bearing error (degrees)**	**Observational characteristics**					
		Signal strength	**Bearing indication**	**Fading**	**Interference**	**Bearing swing (degrees)**	**Duration of observation**
A	±2	Very good or good	Definite	Negligible	Negligible	≤ 3	Adequate
B	±5	Fairly good	Bearing fluctuation	Slight	Slight	> 3 ≤ 5	Short
C	±10	Weak	Severely fluctuating bearing	Strong	Strong	> 5 ≤ 10	Very short
D	> ±10	Scarcely perceptible	Ill-defined	Very strong	Very strong	> 10	Inadequate

TABLE 2

Classifications of bearings of frequencies greater than 30 MHz

Class	Bearing error (degrees)	Observational characteristics				
		Signal strength	Bearing indication	Interference	Bearing swing (degrees)	Duration of observation
A	±1	Very good or good	Definite	Negligible	≤ 1	Adequate
B	±2	Fairly good	Bearing fluctuation	Slight	> 1 ≤ 3	Short
C	±5	Weak	Severely fluctuating bearing	Strong	> 3 ≤ 5	Very short
D	≥ +5	Scarcely perceptible	Ill-defined	Very strong	> 5	Inadequate