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| **Recommendation ITU-R SM.854-3**  **(09/2011)** |
| **Direction finding and location determination at monitoring stations** |
| **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)

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| 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 |

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| ***Note***: *This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.* |

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RECOMMENDATION ITU-R SM.854-3[[1]](#footnote-1)\*

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,

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 |

1. \* Radiocommunication Study Group 1 made editorial amendments to this Recommendation in the year 2019 in accordance with Resolution ITU‑R 1. [↑](#footnote-ref-1)