

RECOMMENDATION ITU-R SM.1447-0*

**MONITORING OF THE RADIO COVERAGE OF LAND MOBILE NETWORKS
TO VERIFY COMPLIANCE WITH A GIVEN LICENCE****

(2000)

Scope

This Recommendation provides the requirements for the administrations to consider when they monitor the radio coverage of land mobile networks to verify compliance with a given licence.

Keywords

Radio coverage, land mobile network, coverage monitoring

The ITU Radiocommunication Assembly,

considering

- a) that the number of land mobile networks using different modulation types and access techniques (CDMA, TDMA, FDMA) is increasing worldwide;
- b) that in order to ensure efficient use of the spectrum, some administrations may specify in their licence conditions that networks must fulfil certain requirements including:
 - geographical coverage, either in terms of route coverage, surface coverage, population coverage, or also possibly indoor coverage in public and/or private places – train stations, underground railways, malls, buildings in office districts, etc.,
 - minimum field strength values for different mobile terminals,
 - minimum sensitivity level (system-specific),
 - maximum BER values,
 - channel impulse response (CIR),
 - *C/I* ratio;
- c) that the minimum field strengths required for satisfactory reception of the different classes of emission in the land mobile services define the coverage area;
- d) that administrations may be interested in verifying compliance with licence conditions, to ensure appropriate operation of the station and to prevent interference to licensed stations;
- e) that surface and indoor coverage cannot be measured everywhere so that simulation tools are needed and have been developed to determine surface radio coverage, and to some extent indoor coverage;
- f) that a degree of standardization is desirable, since the land mobile service connected to the PSTN may form part of an international connection;
- g) that, in the case of cellular radio systems, cellular interference becomes more common due to frequency reuse and use of adjacent channel in nearby cells, which may cause intolerable *C/I* in given areas, so that field strength measurements only may not always suffice to assess effective coverage;
- h) that present technology relying on multichannel reception and adaptive space diversity techniques makes it possible to carry out a detailed characterization of the reception conditions from a moving vehicle, including identification of the best server base station, and of the possible interfering co-channel and adjacent channel base stations (or traffic channels), measurement of the channel impulse response, and estimates of the BER;
- i) that the identification of interfering stations is essential to decide whether interference is due to poor design of the network, or if it is caused by signals from another network or from other sources, and to decide corrective actions;

* 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 5 and Telecommunication Development Study Group 2.

j) that identification and call signs are required in the licence, to compare the spectrum management data to the monitored measurements,

noting

a) that it might be appropriate to use field strength planning and simulation tools to predict radio coverage, utilizing digital terrain maps;

b) that in some countries, licensing of public telecom services and spectrum licensing may be performed by different organizations;

c) that in a number of countries the following recommended measurements are carried out by operators and not by administrations,

recommends

that in the event an administration wishes to monitor the radio coverage of land mobile networks to verify compliance with a given licence the following be applied:

1 that a common set of technical parameters should be used to determine radio coverage using both measurement and simulation tools, an example of which is given in Annex 1;

2 that radio coverage be measured, simulated, and checked against licence or authorization terms according to the following procedures and methods:

2.1 monitoring stations should be used to monitor coverage at given points and along routes;

2.2 if indoor coverage is also to be checked, portable equipment should be used to take measurements at a reasonable number of places and at various floor levels, especially in case of towers;

2.3 the field strength of the signal at given places and/or along a route which goes through the various significant parts of the coverage area should be recorded with position data, preferably together with the BER and centre frequency;

2.4 recorded field strength values should be statistically compared to the calculated values, so that the simulation accuracy for the surface (or indoor) coverage may be estimated;

2.5 simulated coverage area maps should be validated if measurements statistically agree with calculated values. Typical criteria for a simulation in a rural area could be ± 4 dB in 90% of measurements, and in urban areas ± 6 dB in 80% of measurements;

2.6 significant discrepancies between measured and calculated values should be dealt with by successively:

- checking the validity of the simulation:
 - either the environment data used by the model (especially the digital terrain model and clutter information) need to be updated or replaced by a more accurate source, or it can be considered accurate enough;
 - either confidence in the model has been built with previous measurements of a well specified test transmitter, so that other causes of discrepancies need to be found or the global model validity needs to be reassessed, and the model recalibrated or changed;
- checking by remote measurement and then possibly *in situ* measurements the base station parameters – in particular position and altitude, power and antenna gain (e.i.r.p.) and antenna height;

2.7 areas, where co-channel, adjacent channel or external interference deteriorates the effective coverage, should be determined either from measurements or simulation results and interfering stations should be identified;

2.8 coverage of land mobile services should preferably be measured in conditions similar to the conditions encountered by the sub-user, e.g. with an antenna mounted on the rooftop of a vehicle. In that case, measurements are less repeatable (than if made at a higher antenna level), due to the geometry of the vehicle and its accessories and the configuration of nearby vehicles in the flow of road traffic. However, they better reflect actual conditions of propagation encountered by the sub-users. Field strength should be measured along the route travelled by the measurement vehicle with sufficient resolution to obtain valid statistics on its behaviour. Several methods are possible, such as:

- using short measurement samples so that peak and mean values of the field strength could be derived; as an example, for a vehicle travelling at 50 km/h in an urban area, 1 000 measurements per second correspond to about 7 samples per wavelength travelled (3 GHz signal), which is a reasonable value;

- using longer integration times, such as several hundred milliseconds or one second, which would result in loss of detailed statistics on the signal, but would still give valuable information on the average field strength level;
- 2.9 identification of base stations under investigation may be required.

ANNEX 1

Common set of technical parameters that determine radio coverage through measurement and simulation

Administrations may choose the main parameters to be registered in the spectrum management database or the elements to be monitored.

The main emission characteristics that determine the radio coverage of mobile networks are:

- carrier frequency, bandwidth and modulation,
- e.i.r.p. or typical and maximum output powers of transmitters, together with antenna characteristics (gain, polarization, feeder and coupling loss).

The main siting characteristics of the station that determine the radio coverage of mobile networks are:

- coordinates and altitude above main sea level,
- altitude above ground level*, azimuth* and elevation* angles of the antenna.

The equipment characteristics for the various land mobile services which may be specified by administrations are:

- for all systems:
 - channelling plan,
 - receiver sensitivity*,
 - co-channel and adjacent channel protection ratios*,
- for digital systems:
 - BER for recommended quality level.

The main emission characteristics that can be objectively measured to determine the radio coverage of mobile networks are:

- frequency,
- field strength**,
- co-channel and adjacent channel interference levels** and identification of interfering stations**,
- BER (see Note 1) in case of digital systems.

NOTE 1 – Measured parameter to assess objective quality of the coverage, and to be related to both the BER for the recommended quality level and to subjective measurements.

* Parameter to be used for simulation purposes.

** Measured parameter to be compared with value given by simulation.