



Report ITU-R SM.2504-0
(07/2022)

**Methods for the estimation of coverage
for terrestrial radio services
based on population**

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**Methods for the estimation of coverage for terrestrial radio services
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Summary

One of the primary responsibilities of radio service operators is to provide quality service to the population within a certain territory. In some countries, a condition for obtaining an operator's licence is to provide a predefined minimum coverage, which may include a certain percentage of the population.

This Report describes methods and techniques for the estimation of population coverage as applied to terrestrial radio services.

1 Scope

One objective when planning the topology of a terrestrial radio service is to cover the largest possible territory. Radio operators make efforts to cover the maximum number of people with the respective services. There are several reasons why it is beneficial to estimate population coverage of a radio service. For example:

- it provides a national regulatory authority (NRA) with independent and reliable information on population coverage of different radio technologies in the country;
- such information is often made available by the NRA to consumers and government organizations.

Different countries apply different policies to verify coverage, and for that reason it would be difficult to harmonise one approach across all the countries. In some cases, coverage requirements are included in the rights of use (or licence conditions) for the radio network operators, but not population coverage. Further, there is no harmonisation for the estimation of coverage based on both area and population. Different countries use different coverage requirements and criteria.

NRAs, telecommunication network operators (TNOs) and research agencies often use different approaches and methods for estimating population coverage, and measurement results can be different based on the approach, making comparison of the measurements results impractical.

Generally, two types of coverage criteria are used:

- Area coverage: the operator needs to cover a percentage of the territory,
- Population coverage: the operator needs to cover a percentage of the population.

These methods and procedures may be applied broadly to the estimation of population coverage for many types of terrestrial radio networks.

2 Terms, definitions and abbreviations

Coverage area (of a terrestrial transmitting station) is the area associated with a given service and a specified frequency within which, under specified technical conditions, radiocommunications may be established with one or several receiving stations [1].

Service area is the area within which a mobile station can access the radio service. A service area may contain several networks. One service area may consist of one country, be a part of a country, or comprised of several countries [1].

In some cases, the term ‘geographic coverage’ instead of the term ‘area coverage’ is used. The geographic coverage is defined as the percentage of the territorial area where the service is available.

The term ‘population coverage’ is defined as the percentage of the population to which the service is available.

The term ‘covered population’ is defined in the context of a specific terrestrial radio service and network as follows:

“The ‘covered population’ is the number of ‘objects’ located in the covered area which have availability to use the service provided by a terrestrial radio network”. The definition of the term ‘object’ is addressed in § 3 of this Report.

Abbreviations

DPSA	Digital preferred service area
DTBN	Digital terrestrial broadcasting network
DVB-T	Digital video broadcast – terrestrial
DVB-T2	Digital video broadcasting – second generation terrestrial
EU	European Union
NRA	National Regulatory Authority
NUTS	Nomenclature of territorial units for statistics (Nomenclature des unités territoriales statistiques (<i>fr.</i>))
QoS	Quality of service
RF	Radio frequencies
TNO	Telecommunication network operator

3 Objects and metrics of population coverage estimation

Estimation of population coverage must be performed with the understanding that classification of the population based on different radio technologies varies from country to country. Classes of population used in the estimation of population coverage are referred to as ‘objects’, and are described below:

- inhabitants
- householders
- homes
- users
- subscribers.

The population coverage measurement can be performed with the following service characteristics:

- RF properties
- Quality of Service (QoS).

RF properties typically relate to the received signal power at a specific measurement location. In most cases, the received signal power determines the coverage area. However, QoS determines the service area.

Quantitatively, the population coverage within a test area can be estimated using the following parameters:

- total number of objects, $N_{cov.}$, registered in the test area with radio services
- total number of objects within the test area, $N_{tot.}$
- coverage parameter, $C_{\%}$, the percentage of objects within the covered area.

The parameter $C_{\%}$ is calculated by dividing $N_{cov.}$ by $N_{tot.}$ within the test area:

$$C_{\%} = \frac{N_{cov.}}{N_{tot.}} \cdot 100\% \quad (1)$$

In practice, it is a very complicated problem to estimate the number of objects in large territories. In these cases, the population coverage, $C_{\%}$, can be calculated with equation (2):

$$C_{\%} = \frac{DP \cdot S_{cov.}}{N_{tot.}} \cdot 100\% \quad (2)$$

where:

DP : population density (density of objects) in the territory $S_{tot.}$

$S_{cov.}$: coverage area within the territory $S_{tot.}$

To define the parameter DP , population density data is needed. Fortunately, this information is generally available from national authorities.

The methods to estimate the coverage area for rural and urban (or suburban) territories are different. For example, one new methodology was developed to classify land types across Europe. An area with households representing a population less than one hundred contained in one square kilometre is classified as 'rural'. The use of these different classifications will produce different results.

4 Background

4.1 Different approaches

Approaches to estimation of population coverage are very different in different countries. The main differences lie in the application of:

- radio technologies
- objects
- parameters and metrics.

Different approaches are also needed considering the size of the coverage area of different services (based on the radius of coverage from a single transmitter). For example, a broadcasting network may transmit over 100 km, while broadband networks may transmit less than a few kilometres. Different measurement parameters or class of objects may be needed to determine coverage calling for a different approach.

In any case, two considerations are essential to the process of measuring, estimating and reporting on population coverage:

- radio service performance metrics
- presentation of population coverage.

Population coverage estimations should always be performed by an experienced research team using the most current available data.