

RECOMMENDATION ITU-R PN.1058

DIGITAL TOPOGRAPHIC DATABASES FOR PROPAGATION STUDIES

(Question ITU-R 202/3)

(1994)

The ITU Radiocommunication Assembly,

considering

- a) that the application of propagation prediction models requires topographical information;
- b) that future propagation prediction models will be able to make use of more detailed topographic information;
- c) the need to provide practical engineering advice on the preparation of digital topographic maps for propagation prediction;
- d) that data exchange is required between different administrations;
- e) that it is desirable to establish a worldwide topographic database,

recommends

- 1. that topographic databases should use either the Universal Transverse Mercator or a latitude-longitude spherical coordinate grid system;
- 2. that the horizontal spacing of data values in a topographic database should be determined in accordance with § 2 and 3 of Annex 1;
- 3. that topographic databases should unambiguously identify sea and lake surfaces, including their heights;
- 4. that topographic databases should contain information about ground cover, either man-made or natural, and include details of the type and height of the ground cover;
- 5. that the additional information contained in Annex 1 should be taken into account when setting up a topographic database.

ANNEX 1

1. Introduction

Digital topographic databases established for the purpose of propagation predictions need to contain information which is related to the type of prediction being undertaken. For frequencies above about 30 MHz, information about the terrain height and ground cover is currently needed. For detailed propagation predictions for frequencies above about 1 000 MHz, especially in urban areas, information about the location, size and orientation of individual buildings is currently needed in addition to terrain height information.

It is to be expected that increasingly sophisticated prediction models will be developed which will permit more detailed propagation predictions but which will also demand more detailed information and, potentially, a reduced horizontal spacing for the data samples.

The purpose of this Annex is to provide guidance on the type of information which should be contained within topographic databases and on suitable values of horizontal spacing for the data samples.

It must be noted that a very wide range of uses for topographic databases can be foreseen and also that a very wide range of ground cover information can be identified. In any individual geographic region, it is unlikely that all types of ground cover will be found and this has an important implication with regard to the data storage. While a universal set of ground cover information could be developed, many of the categories would be irrelevant in the majority of specific topographic database applications. This implies a requirement for unnecessary storage capacity.

circumstances, it does not seem appropriate at present to develop a set of ground cover categories which would be used in the same way in all applications. Guidance can, however, be given on the categories which have been found appropriate and those which seem likely to be worth further investigation.

No universal storage format can be proposed for similar reasons to those given above. However, it is considered to be desirable that propagation prediction computer routines should access the database by means of suitable interface software. In this way, the contents and structure of the database may be modified as more information becomes available and, with suitable changes to the interface software, the propagation prediction routines are unaffected.

In order to effect a satisfactory exchange of a topographic database, for example between administrations or from a supplier to a customer, it is essential either that suitable interface software is supplied with the database or that full information about the database contents and storage scheme are supplied.

2. Horizontal spacing values in a macroscopic topographic database

It is generally most convenient if terrain height values are stored for locations which form a regularly spaced grid over the whole of the geographic area under consideration. Standard compression techniques may be used to reduce the data storage for areas of uniform height, for example, seas or lakes, but it requires extra processing to extract the data. In most cases this is likely to be fairly small compared with the time taken to access data on a mass-storage device (usually optical or magnetic disk).

Considerable savings may be made by relating the horizontal spacing of the values stored to the location-to-location variation of the element being stored. For example, if there is a fairly uniform mean terrain slope with little variation from the mean value over a large area, it may be worthwhile to consider a special storage scheme which minimizes the space required and the access time needed. There is relatively little experience on which to base any proposals in this respect. Most topographic databases use a regularly-spaced grid for the whole area under consideration and rely on standard data compression techniques to deal with cases where the data values are constant.

In practice, horizontal spacings in the range 20 to 1 000 m, or the equivalent in arc-seconds, are in widespread use. A value of 50 m has been found to be suitable where the geographic area contains some mountainous regions (mean terrain slope in excess of 40%). A value of 500 m has been found to be suitable for flat terrain (ground slope of 4% or less). However, to allow for future development of propagation prediction methods, it is advisable to choose smaller horizontal spacing values rather than larger ones.

In principle, there is no reason why the horizontal spacings for ground cover and terrain height values should be the same; however, in practice this is found to be more convenient.

3. Urban area topographic databases

Special considerations apply in the case of topographic propagation predictions in urban areas, especially at frequencies above about 1 000 MHz where reflections from building surfaces need to be taken into account. In such cases, very detailed information is needed, including the height and shape of the buildings and possibly, the location and width of the streets, although the latter information may, in some cases, be derived as the area not covered by buildings.

Two different approaches have been found useful in such cases. The first approach is an extension of the general concept outlined in § 2 using a horizontal spacing of 5 to 10 m and storing the building height information as part of the ground cover data (see Note 1). In this case, the mean orientation of the buildings may only be derived approximately. In the second approach, a vector database is set up which holds the coordinates, in three dimensional form, of the vertices which define the shape of each building (see also § 5). In both cases, the heights stored may be absolute values or values relative to the local mean ground height. There is currently insufficient evidence to indicate which of these two approaches provides the better basis for propagation calculations.

Note 1 – Irregularly shaped buildings may be stored as a combination of sub-buildings with different heights.