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| **Radiocommunication Study Groups** |  |
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| Source: Document 3K/TEMP/103Subject: Clutter loss measurements | **Document 3K/FAS/1-E** |
| **15 June 2023** |
| **English only** |
| Working Party 3K |
| FASCICLE |
| Concerning Recommendation ITU-R P.2108 on clutter loss in the frequency range 30 MHz to 100 GHz Description of the method for clutter loss measurement |

Scope

This Fascicle provides methods for estimating loss through clutter at frequencies between 30 MHz and 100 GHz.

This Fascicle provides guidance on measuring clutter loss for Earth-space, aeronautical and terrestrial paths to support further development of Recommendation [ITU-R P.2108](https://www.itu.int/rec/R-REC-P.2108/en).

# 1 Clutter loss

“Clutter loss” is defined, in Recommendation ITU-R P.2108, as the difference in the transmission loss or basic transmission loss[[1]](#footnote-1) with and without the presence of terminal clutter at either end of the path with all other path details being the same.

When measuring clutter loss, *Lc (dB)*, it is obtained as the difference between the theoretically predicted free space basic transmission loss (Rec. ITU-R P.525) and the measured basic transmission loss.

# 2 Measurement scenario

The high terminal should be positioned out of the clutter being measured or at the edge of the area above the highest local clutter in the direction of measurement. There should be an unobstructed path to the top of the clutter adjacent to the cluttered terminal. Basic transmission loss between the high terminal and the top of the clutter can be approximated by free-space.

Measurements made with directional and omnidirectional antennas may be expected to give different results; antenna characteristics should, in any case, be carefully described.

Figure 1

Scenario for clutter loss measurement path



The uncluttered terminal, *Tu*, should be positioned out of the clutter being measured or at the edge of the area above the highest local clutter in the direction of the cluttered terminal, *Tc*, in order that the wave front should be essentially plane.

The measurements need to include paths on street canyons of different widths, open squares, parking places etc. to have representative statistics of all environments.

# 3 Measurements

Measurements are performed using continuous wave (CW) transmissions and a suitable receiver. The measured data should be spatially averaged to eliminate multipath fading. An alternative to spatial averaging would be frequency averaging using a wide band signal.

Estimation of the path loss requires calibration of the system from back-to-back tests where the transmitter output is connected to the input of the receiver via attenuators and all the gain settings in the receiver’s RF chain and signal conditioning are tabulated.

# 4 Antennas

The antenna at the *Tc* can be omnidirectional or scanned in azimuth.

In the case where a directional antenna is used at the *Tu*, the pointing of the antenna should ensure that the main beam passes over the roof of the buildings and the *Tc* is inside the main beam. The pointing of the antenna needs to be known to apply the antenna gain corrections at the *Tu*.

# 5 Analysis of clutter loss with respect to elevation angle

For the analysis of the clutter loss data obtained from the measurements, the elevation angle, *θ*, is defined as the angle, relative to the local horizontal, from the top of the building adjacent to the *Tc* in the direction of the *Tu*, and the *Tu*. This assumption is important when comparing measurements to the model as the measurement paths are much shorter than the Earth-space and aeronautical paths. For measurements the elevation angle should be the angle of the emissions leaving the clutter towards the uncluttered terminal as shown in Figure 2. When applying the model the angle of the emissions leaving the clutter can be considered the same as the elevation angle of the terminal on the ground.

Figure 2

Illustration of elevation angle



# 6 Parameters to be recorded

The following parameters should be recorded when performing measurements of clutter loss.

It is assumed that each measurement set will consist of a number of measurement samples or a tabulated cumulative distribution function of loss.

Researchers are asked to provide as much additional detail as possible; in particular, the geometry of the scenario. Photographs should be supplied wherever possible.

When using directional antennas, antenna pointing information should be provided.

A template excel file format for data submission is available on the CG 3K-3M-12 [share folder](https://extranet.itu.int/rsg-meetings/sg3/wp3k/cg3k3m12/Shared%20Documents/Forms/AllItems.aspx).

TABLE 1

Measurement parameters

| Parameter | Units or classification | Notes |
| --- | --- | --- |
| Frequency | GHz |  | General information relating to the measurement configuration. |
| Bandwidth of test signal | MHz | 0 MHz if CW source used |
| Averaging | Spectral / spatial / other / none | Free-format field to allow user to describe form of averaging (if any) used.Where spatial averaging has been applied the distance or area used should be provided |
| Type of antenna | Omni-directional or directional |  |
| Uncluttered terminal height, *huct* | metres |  |
| Latitude of uncluttered terminal | degrees North |  |
| Longitude of uncluttered terminal | degrees East |  |
| Cluttered terminal height, *hct* | metres |  |
| Noise floor | dBm |  |
| Polarisation | vv/hh/vh/hv/c |  |
| Number of samples |  | Sufficient number of samples should be taken to provide for statistical confidence in the results |
| Latitude of cluttered terminal | degrees North |  | Specific information relating to the individual sample. |
| Longitude of cluttered terminal | degrees East |  |
| Horizontal distance between terminals, *d* | metres | Where positioning information is not available this distance is required. |
| Elevation angle  | degrees | Angle from the top of the clutter adjacent to the cluttered terminal in the direction of the uncluttered terminal, to the uncluttered terminal. |
| Azimuth | degrees | Pointing angle of the cluttered terminal. Applicable only for measurements using a directional antenna. |
| Basic transmission loss | dB |  |
| Delta from noise floor | dB | Difference between the noise floor and the measured signal level. Measurements where delta is zero should be included for CDF analysis. |

TABLE 2

Clutter environment

| Parameter | Units or classification | Notes |
| --- | --- | --- |
| Surrounding environment | Open/ suburban/ urban/ dense urban | General information relating to the measurement area |
| Area within which samples taken | Square kilometres |
| Height of clutter adjacent to cluttered terminal, *hc* | metres | Specific information relating to the individual sample in the direction of the uncluttered terminal |
| Distance to adjacent clutter, *dc*  | degrees |

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1. Definitions of “transmission loss” and “basic transmission loss” are given in Recommendation ITU-R P.341. [↑](#footnote-ref-1)