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Contents

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

This document is a Technical Report on Release 2000 work item “FDD Base Station Classification”.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[11] 3G TS 25.104

[22] 3G TS 25.133

[33] 3G TS 25.141

[44] 3G TR 25.942

[55] UMTS 30.03

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply.

Example: text used to clarify abstract rules by applying them literally.

3.2 Symbols

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

4 General

Current TSG RAN WG4 specifications have been done according to the requirements for the macrocell base stations (NodeBs). For the UTRA evolution requirement specifications for other types of base stations are needed as well to take into account different use scenarios and radio environments. In this technical report, base station classification is described and requirements for each base station class are derived.

5 System scenarios

This section describes the system scenarios for UTRA operation that are considered when defining base station classes. It also includes typical radio parameters that are used to derive requirements.

5.1 Indoor Environment

5.1.1 Path Loss Model

The indoor path loss model expressed in dB is in the following form, which is derived from the COST 231 indoor model:

$$L = 37 + 20 \, Log_{10}(R) + \Sigma \, k_{wi} \, L_{wi} + 18.3 \, n^{((n+2)/(n+1)-0.46)}$$

where:

R transmitter-receiver separation given in metres

k_{wi} number of penetrated walls of type i

L_{wi} loss of wall type i

n number of penetrated floors

Two types of internal walls are considered. Light internal walls with a loss factor of 3.4 dB and regular internal walls with a loss factor of 6.9 dB.

If internal walls are not modelled individually, the indoor path loss model is represented by the following formula:

L = 37 + 30 Log10(R) + 18.3 n ((n+2)/(n+1)-0.46)

where:

R transmitter-receiver separation given in metres;

n number of penetrated floors

Slow fading deviation in pico environment is assumed to be 6 dB.

5.2 Mixed Indoor – Outdoor Environment

5.2.1 Propagation Model

Distance attenuation inside a building is a pico cell model as defined in Chapter 5.1.1. In outdoors UMTS30.03 model is used [5].

Attenuation from outdoors to indoors is sketched in Figure 5.1 below. In figure star denotes receiving object and circle transmitting object. Receivers are projected to virtual positions. Attenuation is calculated using micro propagation model between transmitter and each virtual position. Indoor attenuation is calculated between virtual transmitters and the receiver. Finally, lowest pathloss is selected for further calculations. Only one floor is considered.

The total pathloss between outdoor transmitter and indoor receiver is calculated as

$$L = L_{micro} + L_{OW} + \Sigma \, k_{wi} \, L_{wi} + a * R \, ,$$

where:

L_{micro} Micro cell pathloss according UMTS30.03 Outdoor to Indoor and Pedestrian Test Environment pathloss model

LOW outdoor wall penetration loss [dB]

R virtual transmitter-receiver separation given in metres;

kwi number of penetrated walls of type i;

Lwi loss of wall type i;

a = 0.8 attenuation [dB/m]

Slow fading deviation in mixed pico-micro environment shall be 6 dB.

Propagation from indoors to outdoors would be symmetrical with above models.

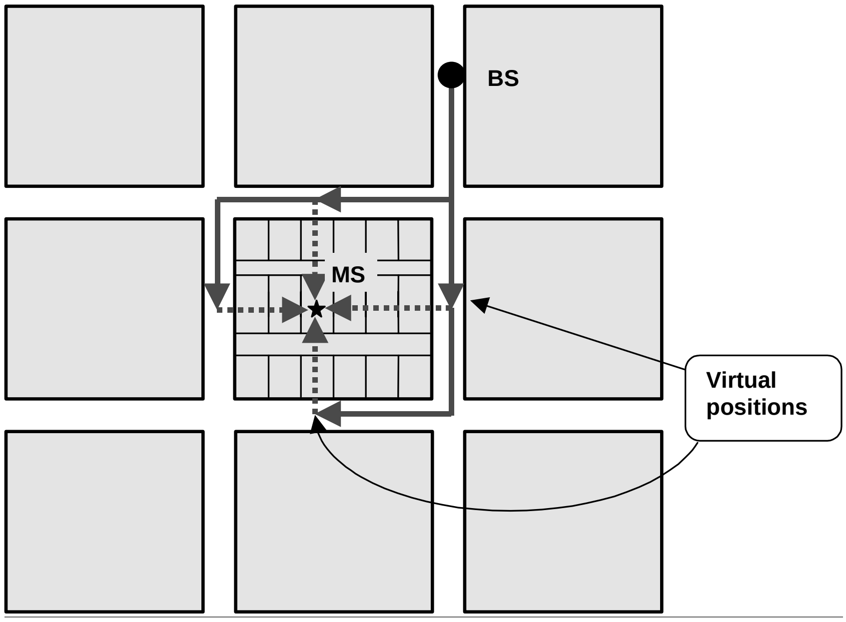

Figure 5.1: Simulation scenario and propagation model.

UMTS30.03 Manhattan scenario [5] in outdoors and UMTS30.03 pico cell scenario [5] in indoors are used so that the size of building is stretched to fit building in the Manhattan model. Alternatively, both Manhattan building block could be reduced and indoor building stretched so that their sizes correspond each other.

Path loss inside a building is a Motley-Keenan model as defined in [5]. In outdoors UMTS30.03 model is used. Parameters for both models are as defined in [5]. Attenuation from outdoors to indoors is sketched in Figure 1 below. In figure star denotes receiving object and triangle transmitting object. Co-ordinates of receivers (stars) are projected to places denoted by black dots that act as "virtual" transmitters.

First, attenuation is calculated by using Manhattan propagation model between transmitter and each projected coordinate. Next wall attenuation is added to the calculated distance attenuation. Then indoor attenuation is calculated between virtual transmitters and the receiver. Finally, lowest path loss is selected for further calculations. In UMTS30.03 indoor model no wall attenuation for inside wall is considered. If inside walls need to be considered COST indoor model may be used instead of Motley-Keenan model. Since propagation between outdoors and indoors is modeled, it is not feasible to model more than one floor in the building.

An example calculation of propagation model is shown in Figure 2. Wall attenuation inside building is not taken into account.

Propagation from indoors to outdoors is symmetrical with above models.

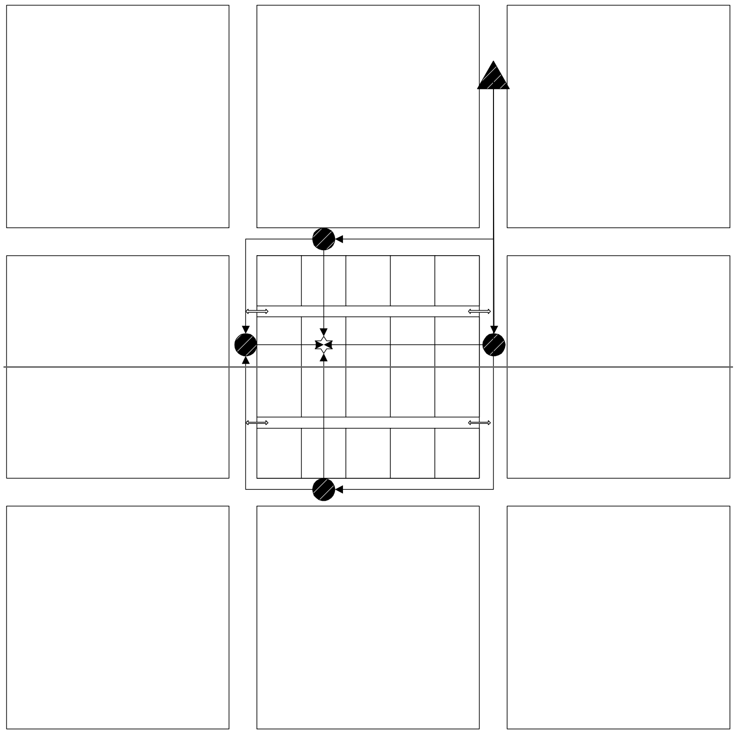

Figure 1 Simulation scenario and propagation model.

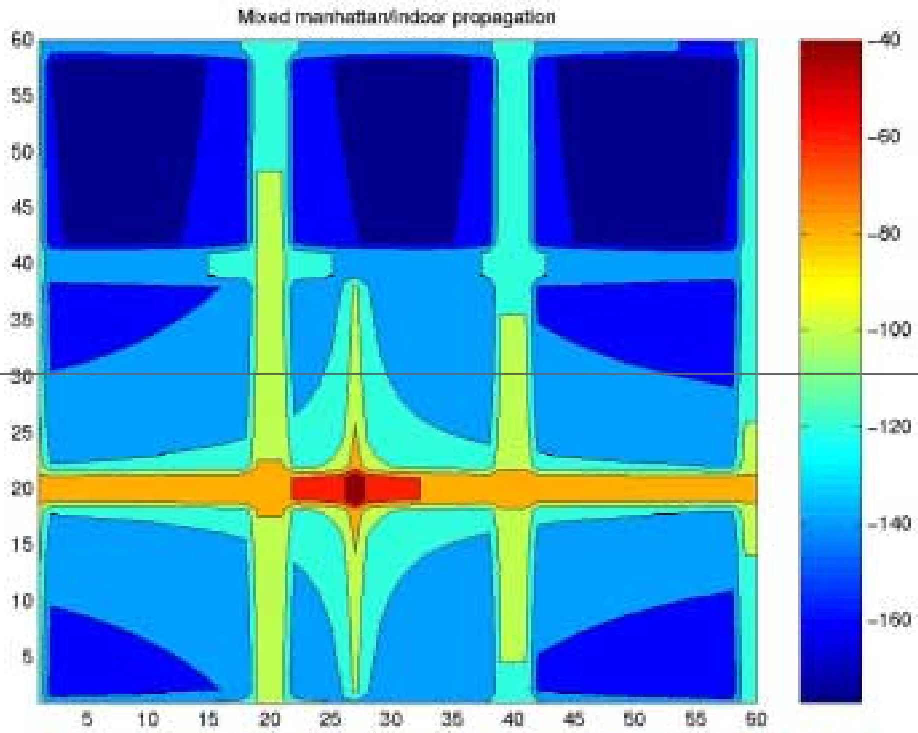

Figure 2. An example of propagation.

In the scenario users may go inside/outside only through defined entrance points. In those entrance points attenuation is defined as a linear combination of outside propagation and inside propagation so that sudden drop in the signal is avoided. There is defined area inside a building in which propagation indoor to outdoor is calculated as

$$L_{entrance} = (1 - w(r)) \cdot L_{outdoor} + w(r) \cdot L_{Indoor},$$

where

w(r) weight for indoor and outdoor propagation

L_{indoor} propagation calculated between receiver and transmitter by using mixed indoor-outdoor model

$L_{outdoor}$ path loss calculated by using outdoor model

r distance to wall

Weight is defined as

$$w(r) = r / R$$

where

R size of area in which entrance propagation is calculated

r distance from wall, getting values [0, R]

Slow fading is time correlated as in UMTS30.03 model. Decorrelation length of slow fading shall be 5 meters in both environments. Standard deviation of slow fading shall be 10 dB and 12 dB for outdoors and indoors, respectively.

Parameters related to propagation models are summarised in Table 5.1.

Table 5.1:. Parameters related to mixed indoor - outdoor propagation model

Parameter	value
Inside wall loss	5 6.9 dB
Outside wall loss	10 dB
Slow fading correlation length in indoors	5 meters
Slow fading deviation in indoors	12 6 dB
Slow fading correlation length in outdoors	5 meters
Slow fading deviation in outdoors	10 6 dB
Building size	110 x 110 meters
Street size	110 x 15 meters
Room size	22 x 25 meters
Number of rooms	5 rooms in 4 rows
Corridor size	110 x 5 meters
Number of corridors	2
Size of entrance point	5 meters
Number of base stations	4 .. 6
BS coordinates	tba

5.2.2 Mobility Model

The mobility model is UMTS30.03 model for indoors and Manhattan [5]. To the indoor model a possibility to leave a building is added. Correspondingly, outdoor users may enter indoors. Four entrance points are defined through which users may enter indoors or outdoors. Entrance points are seen as continuation of corridors inside building. An outdoor user may go inside with certain probability (10 %) when it locates in street aligned with entrance point. An indoor user may go outside with certain probability if it locates at one of the corridors. Parameters of mobility model are set so that system remains stable or load in indoors and outdoors is not affected due to users going inside/outside, i.e., number of users going inside should equal to number of users going outside.

Table 2. Parameters for mobility model

Parameter	Value
Probability to go inside(outside)	10 %

5.3 Minimum coupling loss (MCL)

Minimum Coupling Loss (MCL) is defined as the minimum distance loss including antenna gain measured between antenna connectors.

5.3.1 MCL for Local Area scenario

The minimum coupling loss between UEs is independent of the scenario, therefore the same minimum coupling loss is assumed for all environments.
Local area BSs are usually mounted under the ceiling, on wall or some other exposed position. In [4][4] chapter 4.1.1.2 a minimal separation of 2 metres between UE and indoor BS is assumed. Free space path loss is defined in [4][4] as:

Path loss [dB] = 38.25 + 20 log10(d [m])

Taking into account 0 dBi antenna gain for Local area BS and UE and a body loss of 1 dB at the terminal, a MCL of 45.27 dB is obtained. The additional 2 dB cable loss at the BS as proposed in TR 25.942 is not considered.

The assumed MCL values are summarised in table 35.2.

Table 35.2:. Minimum Coupling Losses

	MCL
MS ↔ MS	40 dB
Local area BS ↔ MS	45 dB
Local area BS ↔ Local area BS	45 dB

6 Base station classes

This section describes how the base station classes are defined.

6.1 Base station class criteria

Minimum Coupling Loss between BS and UE is used as criteria for classification. Two classes are defined: Wide Area BS class and Local Area BS class.

Wide Area BS class assumes relatively high MCL, as is typically found in outdoor macro and outdoor micro environments, where the BS antennas are located in masts, roof tops or high above street level. Existing requirements are used, as they are in [1][1], for the Wide Area BS class.

Local Area BS class assumes relatively low MCL, as is typically found indoors (offices, subway stations etc) where antennas are located on the ceilings or walls or possibly built-in in the BS on the wall. Low-CL can also be found outdoors on hot spot areas like market place, high street or railway station. New requirements, as defined in this TR, are set for the Local Area BS class.

7 Changes with respect to Release 99

7.1 Changes in 25.104

This section describes the considered changes to requirements on BS minimum RF characteristics, with respect to Release 1999 requirements in TS25.104.

7.1.1 Frequency error

7.1.1.1 New requirement

In the present system the mobile has to be designed to work with a Doppler shift caused by speeds up to 250 km/h at 2100 MHz. This corresponds to a frequency offset of

[Doppler shift, Hz] = [UE velocity, m/s] * [Carrier frequency, Hz] / [speed of light, m/s]

= (250 * 1000/3600) * 2.1 * 10^9 / (3 *10^8) Hz

≈ 486 Hz

At present, the BS requirement is 0.05 ppm, corresponding to 105 Hz at 2100 MHz.

In this case, the mobile must be able to successfully decode signals with offset of

[present UE decode offset, Hz] = [frequency error, Hz] + [max. Doppler shift, Hz]

= 486 Hz + 105 Hz

= 591 Hz

The frequency error requirement for local area BS class is proposed to be relaxed to 0.1ppm.

[frequency error, ppm] = 0.1 ppm

This corresponds to a maximum UE speed of 155km/h.

[max. new Doppler shift] = [present UE decode offset] - [frequency error, Hz]

= 591 Hz – 210 Hz

= 301 Hz

[UE velocity, km/h] = [speed of light, km/h] * [Doppler shift, Hz] / [Carrier frequency, Hz]

= (3 *10^8 * 301 * 3600) / (2.1 * 10^9 * 1000)

= 155 km/h

7.1.1.2 Text proposal for 6.3.1 Minimum requirement

The modulated carrier frequency ~~of the BS shall be accurate to within ± 0.05 ppm~~ is observed over a period of one power control group (timeslot).

Table 6.n: Frequency error minimum requirement

BS class	accuracy
wide area BS	±0.05 ppm
local area BS	±0.1 ppm

7.1.2 Adjacent Channel Leakage power Ratio (ACLR)

7.1.3 Reference sensitivity level

7.1.4 Spectrum emission mask

7.1.5 Adjacent Channel Selectivity (ACS)

7.1.6 Blocking characteristics

7.1.7 Intermodulation characteristics

7.1.8 Demodulation in static propagation conditions

7.1.9 Demodulation of DCH in multipath fading conditions

7.1.10 Demodulation of DCH in moving propagation conditions

7.1.11 Demodulation of DCH in birth/death propagation conditions

7.2 Changes in 25.133

This section describes the considered changes to requirements on UTRAN measurements, with respect to Release 1999 requirements in TS25.133.

7.3 Changes in 25.141

This section describes the considered changes to base station conformance testing, with respect to Release 1999 requirements in TS25.141.

8 Impacts to other WGs

8.1 WG1

8.2 WG2

8.3 WG3

9 Backward Compatibility

History

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Annex <X>: Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**