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Technical Report

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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;

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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 “TDD 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.

[1] 3G TS 25.105

[2] 3G TS 25.123

[3] 3G TS 25.142

[4] 3G TR 25.942

[5] 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:

$$L = 37 + 30\ Log_{10}(R) + 18.3\ n^{((n+2)/(n+1)-0.46)}$$

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.

Attenuation from outdoors to indoors is sketched in Figure 5.2.1.1 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

L_{OW} outdoor wall penetration loss [dB]

R is the virtual transmitter-receiver separation given in metres;

k_{wi} number of penetrated walls of type i;

L_{wi} loss of wall type i;

a = 0.8 attenuation [dB/m]

<Editor Note: a reference to the source 0f the formula is required>

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

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

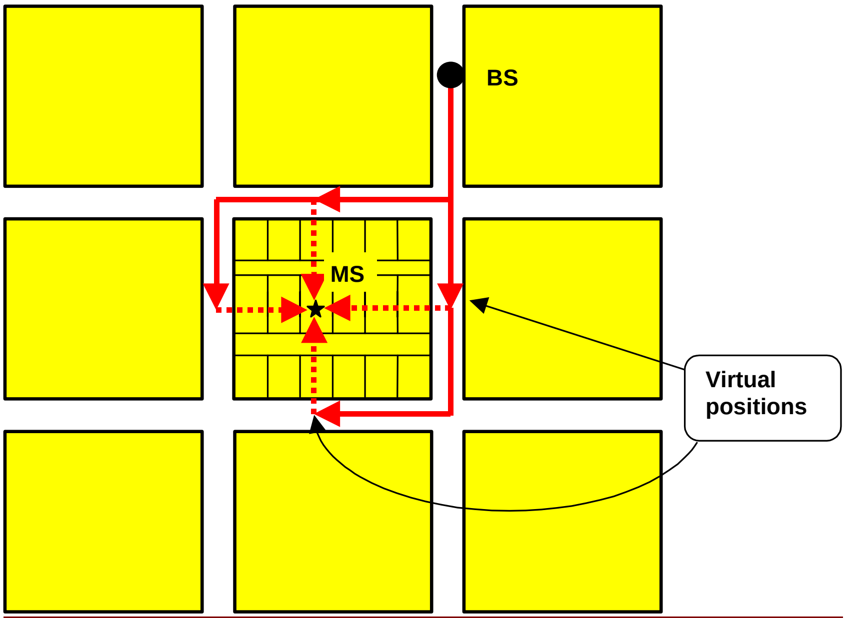

Figure 5.2.1.1. Simulation scenario and propagation model.

~~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.

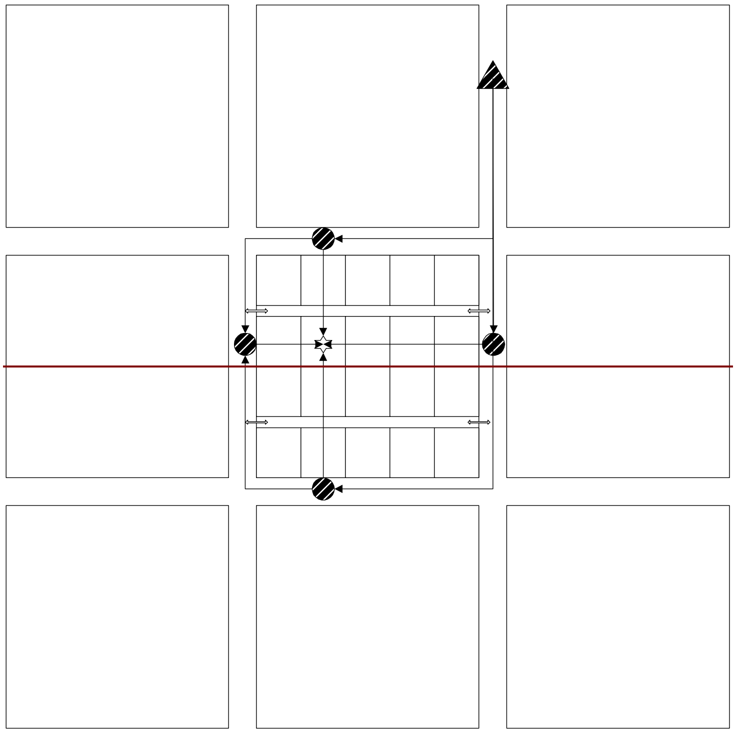

Figure 1 Simulation scenario and propagation model.

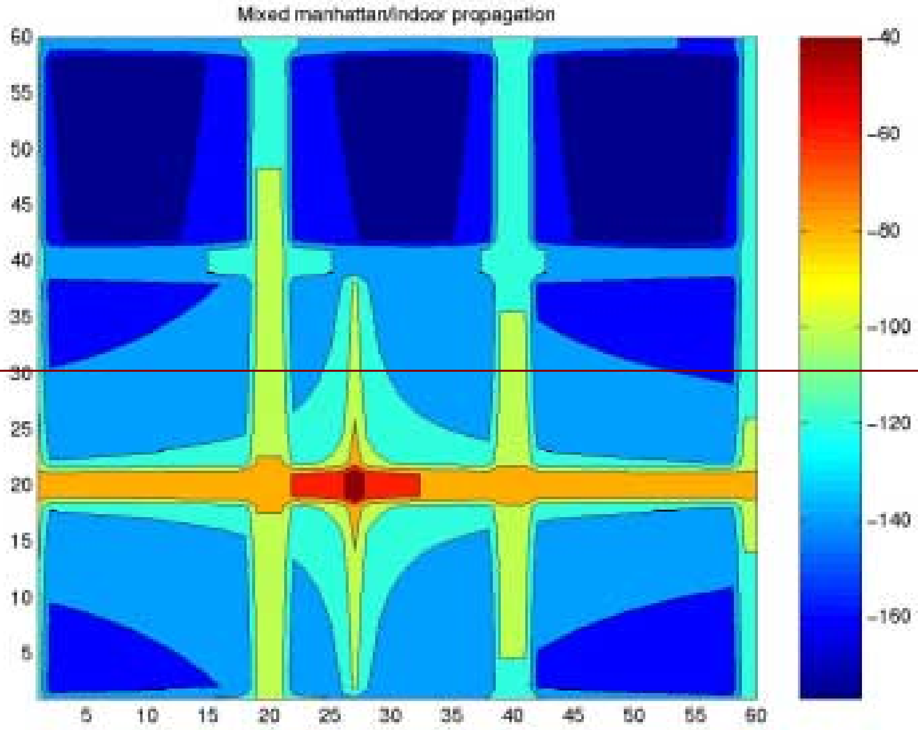

Figure 2. An example of propagation.

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 6.9dB
Outside wall loss	10 dB
Slow fading correlation length in indoors	5 meters
Slow fading deviation in indoors	12 6dB
Slow fading correlation length in outdoors	5 meters
Slow fading deviation in outdoors	10 6dB
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] 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] as:

$$\text{Path loss [dB]} = 38.25 + 20 \log10(d \text{ [m]})$$

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 3.

Table 3. Minimum Coupling Losses

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

5.4 Propagation conditions for local area base stations

The demodulation of DCH in multipath fading conditions in TS 25.105 considers three different test environments:

Case 1: Typical indoor environment delay spread, low terminal speed

Case 2: Large delay spread (12 us), low terminal speed

Case 3: Typical vehicular environment delay spread, high terminal speed

The local area BS is intended for small cells as can be usually found in indoor environments or outdoor hot spot areas. The large delay spread in case 2 is not typical for these scenarios. Therefore, it is proposed not to test the local area BS in this propagation condition.

Case 1 and case 3 propagation conditions are well applicable for the local are BS and this should be tested.

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 off masts, roof tops or high above street level. Existing requirements are used, as they are in [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 25.105

This section describes the considered changes to requirements on BS minimum RF characteristics, with respect to Release 1999 requirements in TS25.105.

~~7.1.1 Frequency error~~

7.1.1 Frequency stability

Frequency stability is ability of the BS to transmit at the assigned carrier frequency. The BS shall use the same frequency source for both RF frequency generation and the chip clock.

7.1.1.1 Minimum Requirement

This requirement is independent of the BS class. For the local area BS the same requirement as specified in chapter 6.3.1 of TS 25.105 for the wide area BS shall apply.

7.1.2 Minimum Transmit Power

7.1.3 Transmit On/Off Time Mask

The time mask transmit ON/OFF defines the ramping time allowed for the BS between transmit OFF power and transmit ON power.

7.1.3.1 Minimum Requirement

This requirement is independent of the BS class. For the local area BS the same requirement as specified in chapter 6.5.2.1 of TS 25.105 for the wide area BS shall apply.

7.1.4 Adjacent Channel Leakage power Ratio (ACLR)

7.1.5 Reference sensitivity level

7.1.6 Spectrum emission mask

7.1.7 Adjacent Channel Selectivity (ACS)

7.1.8 7.1.8 Blocking characteristics

The blocking characteristics is a measure of the receiver ability to receive a wanted signal at its assigned channel frequency in the presence of an unwanted interferer on frequencies other than those of the adjacent channels. The blocking performance shall apply at all frequencies as specified in the tables below, using a 1MHz step size.

The static reference performance as specified in clause 7.1.5.1 should be met with a wanted and an interfering signal coupled to BS antenna input using the following parameters.

Table 7.1(a): Blocking requirements for operating bands defined in 5.2(a)

Center Frequency of Interfering Signal	Interfering Signal Level	Wanted Signal Level	Minimum Offset of Interfering Signal	Type of Interfering Signal
1900 – 1920 MHz, 2010 – 2025 MHz	-40 dBm	<REFSENS> + 6 dB	10 MHz	WCDMA signal with one code
1880 – 1900 MHz, 1990 – 2010 MHz, 2025 – 2045 MHz	-40 dBm	<REFSENS> + 6 dB	10 MHz	WCDMA signal with one code
1920 – 1980 MHz	-40 dBm	<REFSENS> + 6 dB	10 MHz	WCDMA signal with one code
1 – 1880 MHz, 1980 – 1990 MHz, 2045 – 12750 MHz	-15 dBm	<REFSENS> + 6 dB	—	CW carrier

Table 7.1 (b) : Blocking requirements for operating bands defined in 5.2(b)

Center Frequency of Interfering Signal	Interfering Signal Level	Wanted Signal Level	Minimum Offset of Interfering Signal	Type of Interfering Signal
1850 – 1990 MHz	-40 dBm	<REFSENS> + 6 dB	10 MHz	WCDMA signal with one code
1830 – 1850 MHz, 1990 – 2010 MHz	-40 dBm	<REFSENS> + 6 dB	10 MHz	WCDMA signal with one code
1 – 1830 MHz, 2010 – 12750 MHz	-15 dBm	<REFSENS> + 6 dB	—	CW carrier

Table 7.1 (c) : Blocking requirements for operating bands defined in 5.2(c)

Center Frequency of Interfering Signal	Interfering Signal Level	Wanted Signal Level	Minimum Offset of Interfering Signal	Type of Interfering Signal
1910 – 1930 MHz	-40 dBm	<REFSENS> + 6 dB	10 MHz	WCDMA signal with one code
1890 – 1910 MHz, 1930 – 1950 MHz	-40 dBm	<REFSENS> + 6 dB	10 MHz	WCDMA signal with one code
1 – 1890 MHz, 1950 – 12750 MHz	-15 dBm	<REFSENS> + 6 dB	—	CW carrier

7.1.9 ~~7.1.9~~ Intermodulation characteristics

Third and higher order mixing of the two interfering RF signals can produce an interfering signal in the band of the desired channel. Intermodulation response rejection is a measure of the capability of the receiver to receiver a wanted signal on its assigned channel frequency in the presence of two or more interfering signals which have a specific frequency relationship to the wanted signal.

The static reference performance as specified in clause 7.1.5.1 should be met when the following signals are coupled to BS antenna input.

- A wanted signal at the assigned channel frequency, 6 dB above the static reference level.
- Two interfering signals with the following parameters.

Table 7.5 : Intermodulation requirement

Interfering Signal Level	Offset	Type of Interfering Signal
- 48 dBm	10 MHz	CW signal
- 48 dBm	20 MHz	WCDMA signal with one code

7.1.10 7.1.10 Demodulation in static propagation conditions

The static propagation conditions are described in TS 25.105 Annex B.1.

7.1.10.1 Demodulation of DCH

The performance requirement of DCH in static propagation conditions is determined by the maximum Block Error Rate (BLER) allowed when the receiver input signal is at a specified $\hat{I}_{or}/I_{oc}$ limit. The BLER is calculated for each of the measurement channels supported by the base station.

7.1.10.1.1 Minimum requirement

This requirement is independent of the BS class. For the local are BS the same requirement as specified in chapter 8.2.1.1 of TS 25.105 for the wide area BS shall apply.

7.1.11 7.1.11 Demodulation of DCH in multipath fading conditions

The multipath fading propagation conditions are described in TS 25.105 Annex B.2.

<Editor's note: The level of the interfering AWGN signal (I_{oc}) is set in the middle of the dynamic range. The level should be changed if the reference level is changed>

7.1.11.1 Multipath fading Case 1

The performance requirement of DCH in multipath fading Case 1 is determined by the maximum Block Error Rate (BLER) allowed when the receiver input signal is at a specified $\hat{I}_{or}/I_{oc}$ limit. The BLER is calculated for each of the measurement channels supported by the base station.

7.1.11.1.1 Minimum requirement

The requirement is independent of the BS class. For the local area BS the same requirement as specified in chapter 8.3.1.1 of TS 25.105 for the wide area BS shall apply.

7.1.11.2 Multipath fading Case 2

The local are BS is not tested in multipath fading case 2.

7.1.11.3 Multipath fading Case 3

The performance requirement of DCH in multipath fading Case 3 is determined by the maximum Block Error Rate (BLER) allowed when the receiver input signal is at a specified $\hat{I}_{or}/I_{oc}$ limit. The BLER is calculated for each of the measurement channels supported by the base station.

7.1.11.3.1 Minimum requirement

The requirement is independent of the BS class. For the local area BS the same requirement as specified in chapter 8.3.3.1 of TS 25.105 for the wide area BS shall apply.

7.2 Changes in 25.123

This section describes the considered changes to requirements on UTRAN measurements, with respect to Release 1999 requirements in TS25.123.

7.3 Changes in 25.142

This section describes the considered changes to base station conformance testing, with respect to Release 1999 requirements in TS25.142.

8 Impacts to other WGs

8.1 WG1

8.2 WG2

8.3 WG3

9 Backward Compatibility

History

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