TSG RAN **TSGR-99119**
Meeting **#2**
Date **2 - 4 March 99**
Location: **Fort Lauderdale**
Agenda: **6.4**
Source: **WG 4 Chairman**

3GPP TSG RAN WG4
S4.02Av0.0.1 (1999-02)

UTRA (UE) TDD; Radio transmission and reception

3GPP

Contents

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETR 314: "Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards", which is available **free of charge** from the ETSI Secretariat. Latest updates are available on the ETSI Web server (http://www.etsi.fr/ipr).

Pursuant to the ETSI Interim IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETR 314 (or the updates on http://www.etsi.fr/ipr) which are, or may be, or may become, essential to the present document.
Foreword

1 Scope

This document establishes the minimum RF characteristics of the TDD mode of UTRA. <editor – the current version only covers the UE (mobile station aspects)>

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, subsequent revisions do apply.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1]

3 Definitions, symbols and abbreviations

3.1 Definitions

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

Power Setting	The value of the control signal, which determines the desired transmitter, output Power. Typically, the power setting would be altered in response to power control commands
Maximum Power Setting	The highest value of the Power control setting which can be used.
Maximum output Power	This refers to the measure of power when averaged over the transmit timeslot at the maximum power setting.
Peak Power	The instantaneous power of the RF envelope which is not expected to be exceeded for [99.9%] of the time
Maximum peak power	The peak power observed when operating at a given maximum output power.
Average transmit power	The average transmitter output power obtained over any specified time interval, including periods with no transmission. <Editors: This definition would be relevant when considering realistic deployment scenarios where the power control setting may vary. >
Maximum average power	The average transmitter output power obtained over any specified time interval, including periods with no transmission, when the transmit time slots are at the maximum power setting. <Editors: The average power at the maximum power setting would also be consistent with defining a long term average power>

3.2 Symbols

For the purposes of the present document, the following symbols apply:
<symbol> <Explanation>

3.3 Abbreviations

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

ACPR	Adjacent Channel Power Ratio
BS	Base Station
CW	Continuous wave (unmodulated signal)
DL	Down link (forward link)
EIRP	Equivalent Isotropic Radiated Power
FDD	Frequency Division Duplexing
FER	Frame Error Rate
PPM	Parts Per Million
RSSI	Received Signal Strength Indicator
SIR	Signal to Interference ratio
TDD	Time Division Duplexing
TPC	Transmit Power Control
UE	User Equipment
UL	Up link (reverse link)
UTRA	UMTS Terrestrial Radio Access

4 Status

The main objective of this section is to provide summary of the approval status of the various section of this document. The level of progress is defined as follows;

- No proposal exists
- A proposal(s) exists but no working assumption has been made
- A working assumption has been made .
- This section is assumed to be finalised.

Section number	Section description	Status

5 Frequency bands and channel arrangement

5.1 General

The information presented in this section is based on a chip rate of 4.096 Mcps.

Note
1. Other chip rates may be considered in future releases.

5.2 Frequency bands

UTRA/TDD is designed to operate in the following bands;

a) 1900 – 1920 MHz: Uplink and downlink transmission
   2010 – 2025 MHz Uplink and downlink transmission

b) Deployment in other frequency bands is not precluded.

5.3 TX–RX frequency separation

1.

No TX-RX frequency separation is required as Time Division Duplex (TDD) is employed. Each TDMA frame consists of 16 timeslots where each timeslot can be allocated to either transmit or receive.

5.4 Channel arrangement

5.4.1 Channel spacing

The nominal channel spacing is 5 MHz, but this can be adjusted to optimize performance in a particular deployment scenario.

5.4.2 Channel raster

The channel raster is 200 kHz, which means that the carrier frequency must be a multiple of 200 kHz.

5.4.3 Channel number

The carrier frequency is designated by the UTRA absolute radio frequency channel number (UARFCN)

6 Transmitter characteristics

6.1 General

Unless detailed the transmitter characteristic are specified at the antenna connector of the UE. For UE with integral antenna only, a reference antenna with a gain of 0 dBi is assumed.

6.2 Transmit power

6.2.1 User Equipment maximum output power

The following Power Classes define the maximum output power;

Power Class	Maximum output power	Tolerance
1	[+33] dBm	[+1dB /-3dB]
2	[+27] dBm	[+1dB /-3dB]
3	[+24] dBm	[+1dB /-3dB]
4	[+21] dBm	[+1dB /-3dB]
5	[+10] dBm	[+1dB /-3dB]
6	[0] dBm	[+1dB /-3dB]

Table 1; UE power classes.

Note

1. The maximum output power refers to the measure of power when averaged over the useful part of the transmit timeslot at the maximum power control setting.
2. The maximum output power shall be specified with respect to a defined reference condition (power control status, type of timeslot {physical channel} and averaging method). The reference conditions are for further study.
3. For multi-code operation the maximum output power will be reduced by the difference of peak to average ratio between single and multi-code transmission. The error of the maximum average power is below the prescribed value even at the multi-code transmission mode <new text is required to clarify this sentence>
4. .Power classes 5 and 6 are envisaged for unlicensed operation.
5. For UE using directive antennas for transmission, a class dependent limit will be placed on the maximum EIRP (Equivalent Isotropic Radiated Power)..

6.3 UE frequency stability

The UE carrier frequency shall be accurate to within ±[0.1] PPM compared to [signal] received from the BS (these [signals] will have an apparent error due to BS frequency error and Doppler shift). In the later case, signals] from the BS must be averaged over sufficient time that errors due to noise or interference are allowed for within the above ±[0.1]PPM figure. <Add note to status section if signal refers to carrier or chip rate and is an item for further study>

AFC	Frequency stability
ON	within ± [0.1] PPM

6.4 Output power dynamics

Power control is used to limit the interference level

6.4.1 Open loop power control

Open loop power control is the ability of the UE transmitter to sets its output power to a specified value. For the TDD mode the reciprocity of the channel allows accurate estimation of the required open loop transmit power. <add to status section more definition text is required to clarify this section>

The UE open loop power control error shall be less than [+/-9]dB.

6.4.2 Closed loop power control

Closed loop power control is the ability of the UE transmitter to adjust its output power in response to the DL received signal.

6.4.2.1 Minimum Requirements

TBD

6.4.3 Power control steps

The power control step is the minimum step change in the UL transmitter output power in response to a TPC message.

6.4.3.1 Minimum Requirements

The mobile station transmitter shall have the capability of setting power with a step of [1 – 3] dB.

l

6.4.6 Power control cycles per second

The rate of change for the UL transmitter power control step is a s follows;

[100 – 800] Hz. The minimum rate of [100] Hz is to ensure that every frame is power controlled. The maximum rate may differ for open and closed loop power control.

6.4.4 Minimum transmit power

The minimum controlled output power of the UE is when the power control setting is set to a minimum value. This is when both the closed loop and open loop power control indicates a minimum transmit output power is required.

6.4.1 Minimum requirement

The minimum transmit power is [–44 dBm /4.096MHz]

6.5 Transmit ON/OFF ratio

Transmit ON/OFF ratio is defined as the ratio of the maximum output transmit power within the channel bandwidth with the transmitter ON and OFF.

The minimum requirement of transmitting ON/OFF ratio is [–50 dBm /4.096MHz].

6.6 DTX

DTX is a function with the object of minimizing interference of MS against other MS. It can minimize transmitting power from MS, when voice information, user information or control information is not occurred.

6.6.1 Minimum Requirements

The transmitting power ratio and the timing is for further study:

6.6 Output RF spectrum emissions

6.6.1 Occupied bandwidth

Occupied bandwidth is a measure of the bandwidth containing 99% of the total integrated power for transmitted spectrum and is centered on the assigned channel frequency. The occupied channel bandwidth is less than 5 MHz based on a chip rate of 4.096 Mcps.

6.6.2 Out of band emission

Out of band emissions are unwanted emissions immediately outside the [channel] bandwidth resulting from the modulation process and non-linearity in the transmitter but excluding spurious emissions. This out of band emission limit can be specified in terms of a spectrum emission mask or adjacent channel power ratio for the transmitter.

6.6.2.1 Spectrum emission mask

The emission mask will be different for the type of UE(s) and BS(s) and may depend on the power class, single / multi-code allocation slotted mode, etc and is an item for further study.

6.6.2.2 Adjacent channel power ratio (ACPR)

Adjacent channel power ratio (ACPR) is the ratio of the transmitted power within a reference bandwidth of [4.096 MHz) to the power measured within a reference bandwidth of [4.096 MHz] centered on the adjacent(s) channel(s).

6.6.2.2.1 ACPR minimum requirement

UE channel	ACPR limit
± First adjacent channel	[ ] dB
± Second adjacent channel	[ ] dB

Table 3, UE ACPR

Note

1. The ACPR due to switching transients shall not exceed the limits in the above table. In order to ensure that switching transients due to slotted or DTX mode does not degrade the ACPR value the reference measurement conditions are an item for further study.
2. The possibility is being considered of dynamically relaxing the ACP requirements for User Equipment(s) under conditions when this would not lead to significant interference (with respect to other system scenario or UMTS operators). This would be carried out under network control, primarily to facilitate reduction in UE power consumption.
3. This item is for further study and is based on system scenario and implementation

6.6.3 Spurious emissions

Spurious emissions are emissions which are caused by unwanted transmitter effects such as harmonics emission, parasitic emission, intermodulation products and frequency conversion products, but exclude out of band emissions.

The frequency boundary and the detailed transitions of the limits between the requirement for out band emissions and spectrum emissions is an item for further study. Guidance can be taken from the applicable tables from ITU-R Recommendations SM.329 and from the ERC Recommendations that are currently under progress.

6.6.3.1 Minimum Requirement

The minimum requirement is shown in Table xx

Frequency Bandwidth	**Resolution Bandwidth**	**Minimum requirement**
9kHz ≤ f < 30MHz	1kHz(for 9kHz<f<150kHz) 10kHz (for 150kHz <f <30MHz)	-36dBm
30MHz ≤ f < 1GHz	100kHz	-36dBm
1GHz ≤ f < (fc-NB*14.5)MHz [except for 1893.5MHz ≤ f ≤ 1919.6MHx]	1MHz	-30dBm
(fc-NB*14.5) MHz ≤ f < (fc+NB*14.5)MHz [except for (fc-NB*2.5) MH ≤ f < (fc+NB*2.5) MHz and 1893.5MHz ≤ f ≤ 1919.6MHx]	300kHz	-36dBm
(fc+NB*14.5)MHz ≤ f < 11GHz	1MHz	-30dBm

Table xx Minimum Requirement for spurious

Notes

1) NB----Necessary Bandwidth(,5,MHz)
2) fc-----Center frequency of the carrier.
3) f------- frequency to be prescribed.
4) [The minimum requirement –40 dBm is applied to 1893.5MHz ≤ f ≤ 1919.6MHz for further study and need to take account of other regional requirements]

6.7 Transmit intermodulation

The transmit intermodulation performance is a measure of the capability of the transmitter to inhibit the generation of signals in its non linear elements caused by presence of the wanted signal and an interfering signal reaching the transmitter via the antenna.

6.7.1 Minimum requirement

User Equipment(s) transmitting in close vicinity of each other can produce intermodulation products, which can fall into the UE, or BS receive band as an unwanted interfering signal. The UE intermodulation attenuation is defined by the ratio of the output power of the wanted signal to the output power of the intermodulation product when an interfering signal is added at a level below the wanted signal.

The requirement of transmitting intermodulation for carrier spacing 5 MHz is prescribed in Table 5.1.1.6.1.

Interference Signal Frequency Offset	5MHz	10MHz
Interference Signal Level	[-40]dBc	
Minimum Requirement	[-35dBc]	[-45]dBc

Table 5.1.1.6.1 Minimum Requirement for Transmitting Intermodulation

6.8 Modulation Accuracy

Modulation accuracy is the ability of the transmitter to generate the ideal signal. The difference between the measured and the theoretical modulated waveform is the modulation accuracy.

6.8.1 Definition

The modulation accuracy is defined by the rms. value of errors in signaling points, i.e. the square root of the value which is obtained by dividing the sum of squared errors over a slot by the number of symbols.

6.8.2 Minimum Requirement

The waveform quality factor,the rms. value of vector errors shall be [12.5%] R.M.S or less. 7 **Receiver characteristics**

7.1 General

Unless detailed the receiver characteristic are specified at the antenna connector of the UE. For UE with an integral antenna only, a reference antenna with a gain of 0 dBi is assumed. UE with an integral antenna may be taken into account by converting these power levels into field strength requirements, assuming a 0 dBi gain antenna.

7.2 Diversity characteristics

A suitable receiver structure using coherent reception in both channel impulse response estimation, and code tracking procedures is assumed. Three forms of diversity are considered to be available in UTRA/TDD:

Time diversity	Channel coding and interleaving in both up link and down link
Multi-path diversity	Rake receiver or other suitable receiver structure with maximum combining. Additional processing elements can increase the delay-spread performance due to increased capture of signal energy.
Antenna diversity	Antenna diversity with maximum ratio combing in the base station and optionally in the mobile stations. Possibility for downlink transmit diversity in the base station.

Table 6, Diversity characteristics for UTRA/TDD.

7.3 Reference sensitivity level

The reference sensitivity is the minimum receiver input power measured at the antenna port at which the BIT Error Rate BER does not exceed a specific value

7.3.1 Minimum Requirements

Data rate	UE reference sensitivity level (dBm)	[FER/BER]

Note
1. Definition of the user channel needs to clarified

7.4 Maximum input level

The receiver dynamic range is the input power range at the UE [antenna port over which the BER does not exceed a specific rate. < change text to reflect max input rather than dynamic range test>

7.4.1 Minimum Requirements

The static [FER/BER] reference performance as specified in section 7.3.1 should be met over a receiver input range of [ ] dB above the specified reference sensitivity level.

7.5 Adjacent channel selectivity

Adjacent Channel Selectivity is a measure of a receiver's ability to receive a wanted signal at its assigned channel frequency in the presence of adjacent channel signal at a given frequency Offset from the center frequency of the assigned channel. Receiver selectivity performance is measured by BER

7.5.1 Minimum Requirements

The static reference performance as specified in section 7.3.1 should be met when the following signals are applied to the receiver;
- A wanted signal at the assigned channel frequency, 3dB above the static reference level
- A modulated interfering adjacent channel signal with a level of [ ] dBm

7.6 Blocking characteristics

The blocking characteristics is a measure of the receiver ability to receive a wanted signal at is assigned channel frequency in the presence of an unwanted CW signal on frequencies other than those of the spurious response or the adjacent channels; without this unwanted input signal causing a degradation of the performance of the receiver beyond a specified limit. The blocking performance shall apply at all frequencies except those at which a spurious response occur.

7.6.1 Minimum Requirement

The static reference performance as specified in section 7.3.1 should be met when the following signals are applied to the receiver;
- A wanted signal at the assigned channel frequency, 3dB above the static reference level
- A CW interfering signal at [frequency(s)] offset from the assigned channel below a level of [ ] dBm

7.7 Spurious response

Spurious response is a measure of the receiver's ability to receive a wanted signal on its assigned channel frequency without exceeding a given degradation due to the presence of an unwanted CW interfering signal at any other frequency at which a response is obtained i.e. for which the blocking limit is not met. <only applies to out of band text required>

The static reference performance as specified in clause [ ] should be met when the following signals are applied to the receiver;

- A wanted signal at the assigned channel frequency, 3 dB above the static reference level.
- A CW interfering signal below a level of [ ] dBm.
- The number of allowed spurious responses is an item for further study.

7.8 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.

7.8.1 Minimum Requirements

7.9 Spurious emissions

The Spurious Emissions Power is the power of emissions generated or amplified in a receiver that appear at the UE antenna connector.

7.9.1 Minimum Requirement

The spurious emission shall be:

1. Less than -60dBm/4.096MHz at the mobile station antenna connector, for frequencies within the UE receive band.
2. Less than -57dBm/100kHz at the mobile station antenna connector, for frequencies band from 9kHz to 1GHz.
3. Less than -47dBm/100kHz at the mobile station antenna connector, for frequencies band from 1GHz to 12.75GHz.

8 Performance requirement

8.1 General

Performance requirements are specified for a number of test environments and multi-path channel classes.

8.1.1 Test Environments

Mobile Station is measured in different environments i.e., static, indoor, outdoor to indoor and pedestrian, and vehicular environments. Each of these environments is modeled by typical channel models that are defined Annex B

Mobile Station shall be able to receive different channels transmitted from BS for it. These channels may have different bit rates and different BER/FER requirements. Table 5.4.1-1 describes shortly test environments.

Test Services	**Static**	**Indoor Office 3 km/h**	**Outdoor to Indoor and Pedestrian 3 km/h**	**Vehicular 120 km/h**
	Information Data Rate, Performance metric	Information Data Rate, Performance metric	Information Data Rate, Performance metric	Information Data Rate, Performance metric
Paging Message	TBD	-	-	-
FACH Message	TBD			
Speech	TBD	TBD	TBD	TBD
Circuit Switched Data	TBD	TBD	TBD	TBD
Packet Switched Data	TBD	TBD	TBD	TBD

Table 5.4.1-**Error! Bookmark not defined.** Test Environments for MS Performance Specifications

8.2 Dynamic reference sensitivity performance

The minimum required dynamic reference sensitivity performance is specified according to the traffic rate and the propagation conditions.

8.2.1 Demodulation in non fading Channel

8.2.1.1 Demodulation of Paging Channel

8.2.1.1.1 Minimum requirement

8.2.2.2 Demodulation of Forward Access Channel

8.2.2.2.1 Definition

8.2.2.2.3 Minimum Requirements

8.2.2.3 Demodulation of Dedicated Traffic Channel

8.2.2.3.1 Definition

8.2.2.3.1.1 Minimum Requirements

5.4.3 Demodulation of DCH in Multi-path Fading Channel

5.4.3.1 Single Link Performance

5.4.3.1.1 Definition

The reception characteristics of the Dedicated Traffic Channel (DTCH) in different multi-path fading environments are determined by the average bit error rate (BER) values. BER is measured for the each individual data rate specified for DPCH. DTCH is mapped into in Dedicated Physical Channel (DPCH).

5.4.3.1.2 Minimum Requirements

5.4.3.2 Multi Link Performance

< The definition of the multi-link performance requirement is for further study >

5.4.3.1.1 Definition

5.4.3.1.2 Minimum Requirements

8.3 Rx synchronisation characterisitics

5.4.4 Synchronization Performance

5.4.4.1 Search of other Cells

5.4.4.1.1 Definition

Search of other cells test is used to check whether the MS searches and measures other BS(s) correctly during the specified operation.

5.4.4.1.2 Minimum requirements

5.4.4.2 Inter-Frequency Handover.

5.4.4.2.1 Definition

1. MS has to have the ability to make an Inter-frequency handover. This type of handover can happen within a BS or between two BS(s)
2. Currently ARIB Vol. 3 doesn't define requirements for Inter-frequency handover in a detailed way. Therefore, no tests can be defined yet.

5.4.4.2.3 Minimum Requirements

TBD

5.5 Timing requirements

5.5.1 Synchronization

5.5.1.1 Definition

The timing of the MS is determined during specified operation

5.5.1.3 Minimum Requirements

TBD

Annex A (normative): Transmit power levels versus time

Annex B (normative): Propagation conditions

5.4.1.1 Test Environments

Mobile Station is measured in different environments i.e., static, indoor, outdoor to indoor and pedestrian, and vehicular environments. Each of these environments is modeled by typical channel models that are defined in Section 5.4.1.2.

Mobile Station shall be able to receive different channels transmitted from BS for it. These channels may have different bit rates and different BER/FER requirements. Table 5.4.1 describes shortly test environments.

Test Services	**Static**	**Indoor Office 3 km/h**	**Outdoor to Indoor and Pedestrian 3 km/h**	**Vehicular 120 km/h**
	Information Data Rate, Performance metric	Information Data Rate, Performance metric	Information Data Rate, Performance metric	Information Data Rate, Performance metric
Paging Message				
FACH Message				
Speech				
Circuit Switched Data	64, 384, 2048 kbps, BER < 10^{-6}	64, 384 kbps BER < 10^{-6}	64, 384 kbps BER < 10^{-6}	64, 144 kbps BER < 10^{-6}
Packet Switched Data	TBD	TBD	TBD	TBD

Table 5.4.1-1 Test Environments for MS Performance Specifications

5.4.1.2 Channel Models

The channel model for the non fading performance measurement is an Additive White Gaussian Noise (AWGN) environment. No fading and multi-paths exist.

Modified ITU channel models[1] are used for the performance measurements in multi-path fading channels. The channel models for indoor, indoor to outdoor and pedestrian, and for vehicular environments are depicted in Table 5.4.1-1

Indoor		**Indoor to Outdoor and Pedestrian**		**Vehicular**	
Relative Delay [ns]	**Average Power [dB]**	**Relative Delay [ns]**	**Average Power [dB]**	**Relative Delay [ns]**	**Average Power [dB]**
0	0.0	0	0.0	0	0.0
244	-9.6	244	-12.5	244	-2.4
488	-33.5	488	-24.7	488	-6.5
				732	-9.4
				976	-12.7
				1220	-13.3
				1708	-15.4
				1952	-25.4

Table 5.4.1-1 Channel Models for Non-Static Environments

[1] These channel models are the same that were used in simulations and evaluations of the system presented in "Japan's Proposal for Candidate Radio Transmission Technology on IMT-2000, W-CDMA, June 1998"

5.4.1.5 Measurement Configurations (to be deleted in future revisions)

Annex C (normative): Environmental conditions

C.1 General

This normative annex specifies the environmental requirements of the UE. Within these limits the requirements of this specifications shall be fulfilled.

C.2 Environmental requirements for the UE

The requirements in this clause apply to all types of UE(s)

C.2.1 Temperature

The UE shall fulfil all the requirements in the full temperature range of:

+[15]°C – [+35]° C for normal conditions (with relative humidity of 25 % to 75 %);

-[10]°C - +[55]°C for small UE units extreme conditions (see IEC publications 68-2-1 and 68-2-2)

-[20]°C - +[55]°C For other units extreme conditions (see IEC publications 68-2-1 and 68-2-2).

Outside this temperature range the UE, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in S4.01A for extreme operation.

C.2.2 Voltage

The UE shall fulfil all the requirements in the full voltage range, i.e. the voltage range between the extreme voltages.

The manufacturer shall declare the lower and higher extreme voltages and the approximate shutdown voltage. For the equipment that can be operated from one or more of the power sources listed below, the lower extreme voltage shall not be higher, and the higher extreme voltage shall not be lower than that specified below.

Power source	**Lower extreme voltage**	**Higher extreme voltage**	**Normal conditions voltage**
AC mains	0,9 * nominal	1,1 * nominal	nominal
Regulated lead acid battery	0,9 * nominal	1,3 * nominal	1,1 * nominal
Non regulated batteries: - Leclanché/ lithium - Mercury/nickel cadmium	 0,85 * nominal 0,90 * nominal	 Nominal Nominal	 Nominal Nominal

Outside this voltage range the UE if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in S4.01A for extreme operation. In particular, the UE shall inhibit all RF transmissions when the power supply voltage is below the manufacturer declared shutdown voltage.

C.2.3 Vibration

The UE shall fulfil all the requirements when vibrated at the following frequency/amplitudes:

Frequency	**ASD (Acceleration Spectral Density) random vibration**
5 Hz to 20 Hz	0,96 m^2/s^3
20 Hz to 500 Hz	0,96 m^2/s^3 at 20 Hz, thereafter -3 dB/Octave

Outside the specified frequency range the UE, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in S4.01A for extreme operation.

History

3GPP TSG RAN WG4

Document history

UTRA (BS) TDD; Radio transmission and reception

V0.0.1	1999-02-01	Document created based on S4.01A v0.0.2 “UTRA (UE) FDD, radio transmission and reception”

Editor for UMTS S4.02(UE) is:

Edgar Fernandes

Motorola Ltd.

Tel: +44 (0) 1256 790168
Fax: +44 (0) 1256 790190
Email: edgarf@euro.css.mot.com

This document is written in Microsoft Word 7

S4.02B v0.0.1 (1999-02)

Contents

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETR 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available **free of charge** from the ETSI Secretariat. Latest updates are available on the ETSI Web server (http://www.etsi.fr/ipr).
Pursuant to the ETSI Interim IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETR 314 (or the updates on http://www.etsi.fr/ipr) which are, or may be, or may become, essential to the present document.

Foreword

This ETSI Technical Report (TR) has been produced by ETSI Special Mobile Group (SMG) of the European Telecommunications Standards Institute (ETSI). This report has been elaborated by the Layer 1 expert group of SMG2 "Radio aspects", as a part of the work in defining and describing Layer 1 of the Universal Mobile Telecommunications System (UMTS) Terrestrial Radio Access (UTRA).
This report describes the radio transmission and reception parameters in UTRA/TDD.

1 Scope

This document establishes the minimum RF characteristics of the TDD mode of UTRA. <editor – the current version only covers the BS (mobile station aspects)>

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, subsequent revisions do apply.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] Reference 1

3 Definitions, symbols and abbreviations

3.1 Definitions

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

Power Setting - The value of the control signal, which determines the desired transmitter, output Power. Typically, the power setting would be altered in response to power control commands

Maximum Power Setting - The highest value of the Power control setting which can be used.

Maximum output Power This refers to the measure of power when averaged over the transmit timeslot at the maximum power setting.

Peak Power - The instantaneous power of the RF envelope which is not expected to be exceeded for [99.9%] of the time.

Maximum peak power - The peak power observed when operating at a given maximum output power.

Average Power - The average transmitter output power obtained over any specified time interval, including periods with no transmission. *<Editors: This definition would be relevant when considering realistic deployment scenarios where the power control setting may vary. >*

Maximum average power The average transmitter output power obtained over any specified time interval, including periods with no transmission, when the transmit time slots are at the maximum power setting. *<Editors: The average power at the maximum power setting would also be consistent with defining a long term average power>*

3.2 Symbols

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

<symbol> <Explanation>

3.3 Abbreviations

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

ACPR	Adjacent Channel Power Ratio
ACS	Adjacent Channel Selectivity
BER	Bit Error Rate
BS	Base Station
CW	Continuous wave (unmodulated signal)
DL	Down link (forward link)
EIRP	Equivalent Isotropic Radiated Power
FDD	Frequency Division Duplexing
FER	Frame Error Rate
PPM	Parts Per Million
RSSI	Received Signal Strength Indicator
SIR	Signal to Interference ratio
TDD	Time Division Duplexing
TPC	Transmit Power Control
UE	User Equipment
UL	Up link (reverse link)
UTRA	UMTS Terrestrial Radio Access

4 Status

The main objective of this section is to provide summary of the approval status of the various section of this document. The level of progress is defined as follows;

- No proposal exists
- A proposal(s) exists but no working assumption has been made
- A working assumption has been taken and the text contained in that section may have been update in line with that assumption
- This section is assumed to be finalised.

Section number	Section description	Status

5 Frequency bands and channel arrangement

5.1 General

The information presented in this section is based on a chip rate of 4.096 Mcps. Appropriate adjustments should be made for higher chip rate options.

5.2 Frequency bands

UTRA/TDD is designed to operate in the following bands;

a) 1900 – 1920 MHz: Uplink and downlink transmission
2010 – 2025 MHz Uplink and downlink transmission

b) Deployment in other frequency bands is not precluded.

5.3 TX–RX frequency separation

No TX-RX frequency separation is required as Time Division Duplex (TDD) is employed. Each TDMA frame consists of 16 timeslots where each timeslot can be allocated to either transmit or receive.

5.4 Channel arrangement

5.4.1 Channel spacing

The nominal channel spacing is 5 MHz, but this can be adjusted to optimize performance in a particular deployment scenario.

5.4.2 Channel raster

The channel raster is 200 kHz, which means that the carrier frequency must be a multiple of 200 kHz.

5.4.3 Channel number

The carrier frequency is designated by the UTRA absolute radio frequency channel number (UARFCN).

5A Base station classes

The requirements in this specification apply to base station intended for general-purpose applications.

In the future further classes of base stations may be defined; the requirements for these may be different than for general-purpose applications.

6 Transmitter characteristics

6.1 General

Unless detailed the transmitter characteristic are specified at the antenna connector..

6.2 Transmit power

6.2.1 Base station output power

Total power is the mean power delivered to a load with resistance equal to the nominal load impedance of the transmitter.

The total power shall remain within +**TBD** dB and **–TBD** dB of the manufacturer's rated power.

6.3 Frequency stability

Frequency stability is ability of the BS to transmit at the assigned carrier frequency.

The frequency stability of the BS shall be accurate to within ± [0.05] PPM for RF frequency generation.

6.4 Output power dynamics

Power control is used to limit the interference level. The transmitter uses a quality-based power control on the downlink.

6.4.1 Closed loop power control

Closed loop power control is the ability of the BS transmitter to adjust its output power in response to the UL received signal.

For closed loop correction on the Downlink Channel (with respect to the open loop estimate), the base station adjust its mean output power level in response to each valid power control bit received from UE on the Uplink Channel.

6.4.2 Power control steps

The power control step is the minimum step change in the DL transmitter output power in response to a TPC message from the UE.
Down link (DL) [1 - 3 dB]
Tolerance ffs.
<Need to define the transmitter power as "code domain power". This is ffs.>

6.4.3 Power control dynamic range

The power control dynamic range is the difference between the maximum and the minimum transmit output power for a specified reference condition

Down link (DL) [x dB]
<Need to define the transmitter power as "code domain power". This is ffs.>

6.4.4 Minimum transmit power

The minimum controlled output power of the BS is when the power control setting is set to a minimum value. This is when the power control indicates a minimum transmit output power is required
Down link (DL) [Maximum output power – x dB]
<The maximum output power definition is ffs.>

6.4.5 Total power dynamic range

The power control dynamic range is difference between the maximum and the minimum transmit output power for a specified reference condition

Down link (DL) 30 dB

< which

6.4.6 Power control cycles per second

The rate of change for the UL transmitter power control step is a s follows;

[100 – 800] Hz. The minimum rate of [100] Hz is to ensure that every frame is power controlled. The maximum rate may differ for open and closed loop power control.

6.4.7 Perch channel power

<The name and the use of the common control channel may need to be adapted , subject to WG1 definition.>

6.5 Transmit ON/OFF ratio

Transmit ON/OFF ratio is defined as the ratio of the maximum output transmit power within the channel bandwidth with the transmitter ON and OFF.

The minimum requirement of transmitting ON/OFF ratio is [–x dBm /4.096MHz].

6.6 Output RF spectrum emissions

6.6.1 Occupied bandwidth

Occupied bandwidth is a measure of the bandwidth containing 99% of the total integrated power for transmitted spectrum and is centered on the assigned channel frequency. The occupied channel bandwidth is less than 5 MHz based on a chip rate of 4.096 Mcps.

<Needs to be reviewed for the conformance specification.>

6.6.2 Out of band emission

Out of band emissions are unwanted emissions immediately outside the [channel] bandwidth resulting from the modulation process and non-linearity in the transmitter but excluding spurious emissions. This out of band emission limit can be specified in terms of a spectrum emission mask or adjacent channel power ratio for the transmitter.

6.6.2.1 Spectrum emission mask

The emission mask of the base station is an item for further study.

6.6.2.2 Adjacent channel power ratio (ACPR)

Adjacent channel power ratio (ACPR) is the ratio of the transmitted power from one carrier within a reference bandwidth of [4.096 MHz] to the power measured within a reference bandwidth of [4.096 MHz] centered on the adjacent(s) channel(s).

BS channel	ACPR limit
± First adjacent channel	[ ] dBc
± Second adjacent channel	[ ] dBc

Table 4, BS ACPR

Note
In order to ensure that switching transients do not degrade the ACPR value the reference measurements conditions are an item for further study.

6.6.3 Spurious emissions

Spurious emissions are emissions which are caused by unwanted transmitter effects such as harmonics emission, parasitic emission, intermodulation products and frequency conversion products, but exclude out of band emissions. This is measured at the base station RF output port.

The frequency boundary and the detailed transitions of the limits between the requirement for out band emissions and spectrum emissions is an item for further study. Guidance can be taken from the applicable tables from ITU-R Recommendations SM.329,ERC Recommendations and regulatory input from other regions.

{From ARIB Vol. 5; Section 6.1.1.4; Note: This ARIB content partly maps also on XX.06 sections 6.6.1 and 6.6.2, because of somewhat different definitions of spurious emissions.}

6.1.1.4 Spurious Emissions

6.1.1.4.3 Minimum requirement

The spurious emission level against the mean output power of the base station in the Transmission band shall not exceed the limits specified below.

In the (a) Concerned Operator's System Bands and the (b) Other Bands Within Cellular Band, the spurious emission level within a [**]kHz bandwidth shall not exceed a level Specified in the Table 6.1.1.4-2. In the (c) Other Bands, the spurious emission level within a 1MHz bandwidth shall not exceed a level specified in the Table 6.1.1.4-2. Each transmission band is defined as follows:

(a) Concerned Operator's System Bands: The bands of the concerned operator's system used for this CDMA system.
(b) Other Bands Within Cellular Band: The 2.0G-band including other operator's cellular system bands, but excluding the (a) Concerned Operator's System Bands.
(c) Other Bands: Other bands entirely consisting of all frequencies, but excluding the above bands (a) and (b).

Table 6.1.1.4-2. Spurious Emission Limits When Transmitting.

Measurement Band	Maximum Spurious Emission Level
Concerned Operator's System Bands	Shown the Adjacent channel leakage power in 6.1.1.3
Other Bands Within Cellular Band	-[**]dB/[**]kHz or [**] μW(-[**]dBm)/[**]kHz, whichever the level is smaller.
Other Bands	If the mean transmission power is no more than 25W: 25μW(-16dBm)/1MHz or less. If the mean transmission power is more than 25W: -60dBc/1MHz or less, and 20mW(+13dBm)/1MHz or less. [current rules in each country shall apply.]

6.7 Transmit intermodulation

The transmit intermodulation performance is a measure of the capability of the transmitter to inhibit the generation of signals in its non linear elements caused by presence of the wanted signal and an interfering signal reaching the transmitter via the antenna.

6.7.2 BS intermodulation attenuation

The transmit intermodulation shall be defined by the ratio of the output power of subject transmitted signal to the output power of intermodulation product when an interference signal (that differs from frequency of subject signal) is added at a level [**]dB lower than that of the subject signal. The frequency of the interference signal shall be [**]MHz or more off the subject signal, however, as for interference signal whose frequency is in the range of 5MHz to 10MHz off the subject signal, adjacent channel leakage power is used instead of the output of intermodulation product.

6.1.1.5.3 Minimum requirement

The Transmit intermodulation level against the mean output power per carrier of the base station shall not exceed the limits specified below.

[If the mean transmission power is no more than 25W : 25μW(-16dBm) / 1MHz or less.]
[If the mean transmission power is more than 25W : -60dBc/1MHz or less, and 20mW (+13dBm) / 1MHz or less.]
<This is based on ARIB input. Further input for co-located cellular systems is needed.>

6.8 Modulation Accuracy

Modulation accuracy is the difference between the measured and the theoretical modulated waveform. Modulation accuracy is measuread as the root-mean-square value of the error of the vector of the ideal signal point .

The Modulation accuracy shall not be worse than [12.5] %.

7 Receiver characteristics

7.1 General

Unless detailed the receiver characteristic are specified at each antenna connector of the BS.

<Definition of requirements for antenna diversity is ffs.>

7.3 Reference sensitivity level

The reference sensitivity is the minimum receiver input power measured at the antenna connector at which the FER/BER does not exceed the specific value indicated in section 7.3.1. The signal power is equally applied to each antenna connector for diversity.

7.3.1 BS reference sensitivity level

For the different services with corresponding data rates, the reference sensitivity level of the BS shall be specified in table 8 below.

Data rate	BS reference sensitivity level (dBm)	[FER/BER]

Table 8, BS reference sensitivity levels

Note

1. The performance will need to be specified for different classes of base station(s) identified in clause 5A and is an item for further study.

7.3.2 Maximum Frequency Deviation for Receiver Performance

The need for such a requirement is for further study.

7.4 Dynamic range

The receiver dynamic range is the input power range at each BS antenna connector over which the [FER/BER] does not exceed a specific rate.

The static [BER/FER] reference performance as specified in clause 7.3.1 should be met over a receiver input range of [30] dB above the specified reference sensitivity level for [channel type ffs].

<The effect of applying mast head LNAs to the dynamic range specification is ffs.>

7.5 Adjacent channel selectivity

Adjacent channel selectivity (ACS) is a measure of the receiver ability to receive a wanted signal at is assigned channel frequency in the presence of a modulated signal in the adjacent channel

The static reference performance as specified in clause 7.3.1 should be met when the following signals are applied to the receiver;

- A wanted signal at the assigned channel frequency, 3 dB above the static reference level.

- A modulated interfering adjacent channel signal with a level of [ ] dBm.

7.6 Blocking characteristics

The blocking characteristics is a measure of the receiver ability to receive a wanted signal at is assigned channel frequency in the presence of an unwanted interferer on frequencies other than those of the spurious response or the adjacent channels; without this unwanted input signal causing a degradation of the performance of the receiver beyond a specified limit. The blocking performance shall apply at all frequencies except those at which a spurious response occur.

The static reference performance as specified in clause 7.3.1 should be met when the following signals are applied to the receiver;

- A wanted signal at the assigned channel frequency, 3 dB above the static reference level.
- An interfering signal at [frequency(s)] offset from the nominal assigned channel below a level of [ ] dBm.
- *< Editor The frequency range (in band/out of band) and level of the interfering signal is an item for further study>*
- *<The definition of the exemptions needs to be reconsidered, since it is unclear.>*

7.7 Spurious response

Spurious response is a measure of the receiver's ability to receive a wanted signal on its assigned channel frequency without exceeding a given degradation due to the presence of an unwanted CW interfering signal at any other frequency at which a response is obtained i.e. for which the blocking limit is not met.

The static reference performance as specified in clause 7.3.1 should be met when the following signals are applied to the receiver;

- A wanted signal at the assigned channel frequency, 3 dB above the static reference level.
- A CW interfering signal below a level of [ ] dBm.
- The number of allowed spurious responses is an item for further study.

7.8 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 7.3.1 should be met when the following signals are applied to the receiver;

- A wanted signal at the assigned channel frequency, 3 dB above the static reference level.
- A CW interfering signal at frequency [10 MHz] and a [CW] signal at frequency [20.1 MHz] with a level of [ ] dBm.

7.9 Spurious emissions

<Text to be added.>

8 Performance requirement

8.1 General

Performance requirements are specified for a number of test environments and multi-path channel classes.

8.2 Dynamic reference sensitivity performance

The minimum required dynamic reference sensitivity performance is specified according to the traffic rate and the propagation conditions.

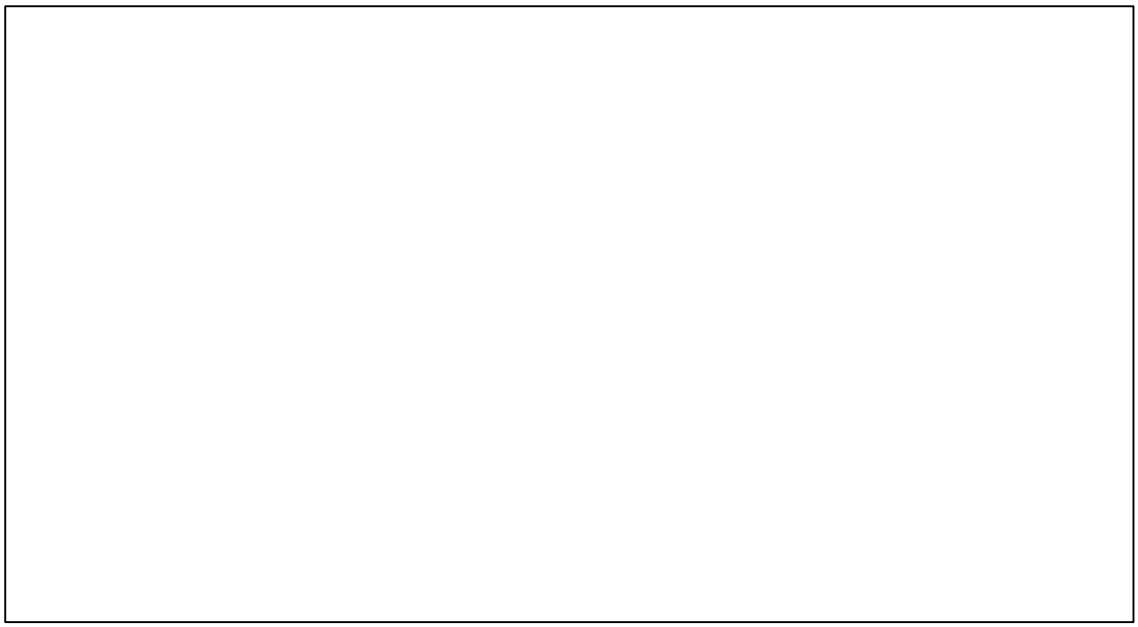
8.2.2 BS sensitivity performance

6.4.1 Performance in AWGN channel

The performance requirement in AWGN channel is determined by the E_b/I_0 required for BER=10^{-3}, 10^{-6}. The BER is calculated for each of the possible data services.

6.4.1.1 Channel model

Refer to Figure XXX for a functional block diagram of the test setup.



6.4.1.2 Single link performance

The required E_b/I_0 is described in Table XXX.

Table XXX E_b/I_0 required for BER=10^{-3}, 10^{-6}

Data services (BER)	Data rates (kbps)	Required E_b/I_0
Speech (10^{-3})	8	T.B.D.
Long Constrained Delay data bearer services (10^{-6})	64 2048	T.B.D. T.B.D.
Unconstrained Delay Data bearer services (10^{-6})	64 2048	T.B.D. T.B.D.

6.4.1.3 Multi link performance

The required E_b/I_0 is described in Table XXX.

Table XXX E_b/I_0 required for BER=10^{-3}, 10^{-6}

Data services (BER)	Number of active links	Data rates (kbps)	Required E_b/I_0
Speech (10^{-3})	N	8	T.B.D.

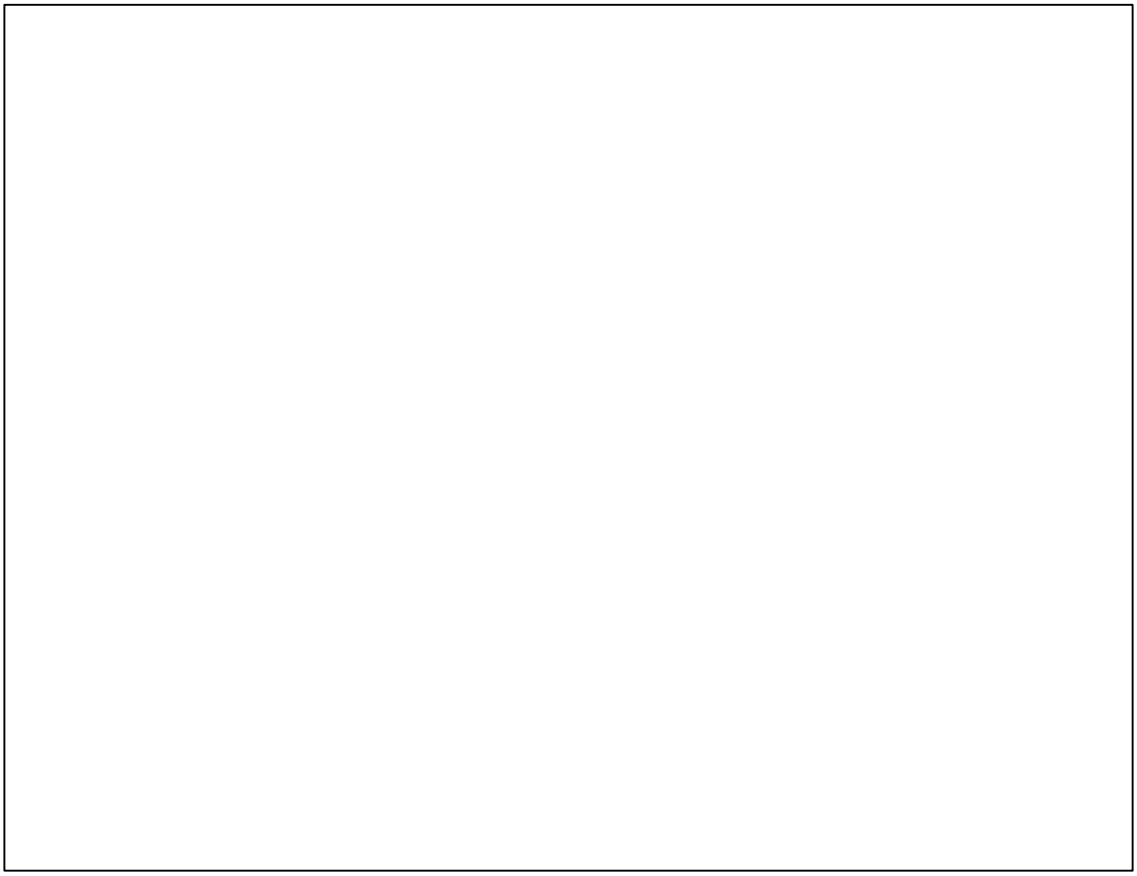
< The definition of the multi-link performance requirement is for further study >

6.4.2 Performance in multipath fading channels

The performance requirement of reverse link with/without TPC in multipath fading channels is determined by the E_b/I_0 required for BER=10^{-3}, 10^{-6}. The BER is calculated for each of the possible data services.

6.4.2.1 Channel models

Refer to Figure XXX for a functional block diagram of the test setup.



6.4.2.2 Single link performance

6.4.2.2.1 Performance without TPC

The required E_b/I_0 is described in Table XXX.

Table XXX E_b/I_0 required for BER=10^{-3}, 10^{-6}

Data services (BER)	Indoor (A), 3km/h		Pedestrian (A), 3km/h		Vehicular (A), 120km/h	
	Data rates	Required E_b/I_0	Data rates	Required E_b/I_0	Data rates	Required E_b/I_0
Speech (10^{-3})	8kbps	T.B.D.	8kbps	T.B.D.	8kbps	T.B.D.
Long Constrained Delay data bearer services (10^{-6})	64kbps 2048kbps	T.B.D. T.B.D.	64kbps 384kbps	T.B.D. T.B.D.	64kbps 144kbps 384kbps	T.B.D. T.B.D. T.B.D.
Unconstrained Delay Data bearer services (10^{-6})	64kbps 2048kbps	T.B.D. T.B.D.	64kbps 384kbps	T.B.D. T.B.D.	64kbps 144kbps 384kbps	T.B.D. T.B.D. T.B.D.

6.4.2.2.2 Performance with TPC

The required E_b/I_0 is described in Table XXX.

Table XXX E_b/I_0 required for BER=10^{-3}, 10^{-6}

Data services (BER)	Indoor (A), 3km/h		Pedestrian (A), 3km/h		Vehicular (A), 120km/h	
	Data rates	Required E_b/I_0	Data rates	Required E_b/I_0	Data rates	Required E_b/I_0
Speech (10^{-3})	8kbps	T.B.D.	8kbps	T.B.D.	8kbps	T.B.D.
Long Constrained Delay data bearer services (10^{-6})	64kbps 2048kbps	T.B.D. T.B.D.	64kbps 384kbps	T.B.D. T.B.D.	64kbps 144kbps 384kbps	T.B.D. T.B.D. T.B.D.
Unconstrained Delay Data bearer services (10^{-6})	64kbps 2048kbps	T.B.D. T.B.D.	64kbps 384kbps	T.B.D. T.B.D.	64kbps 144kbps 384kbps	T.B.D. T.B.D. T.B.D.

6.4.2.3 Multi link performance

The required E_b/I_0 is described in Table XXX.

Table XXX E_b/I_0 required for BER=10^{-3}, 10^{-6}

Data services (BER)	Number of active links	Data rates (kbps)	Required E_b/I_0
Speech (10^{-3})	N	8	T.B.D.

< The definition of the multi-link performance requirement is for further study >

Annex A (normative): Transmit power levels versus time

Annex B (normative): Propagation conditions

Annex C (normative): Environmental conditions

History

Document history		
V0.0.1	1999-02-19	Document created based on S4.01B v0.0.2 “UTRA (BS) FDD, radio transmission and reception”
Editor This document is written in Microsoft Word 7		