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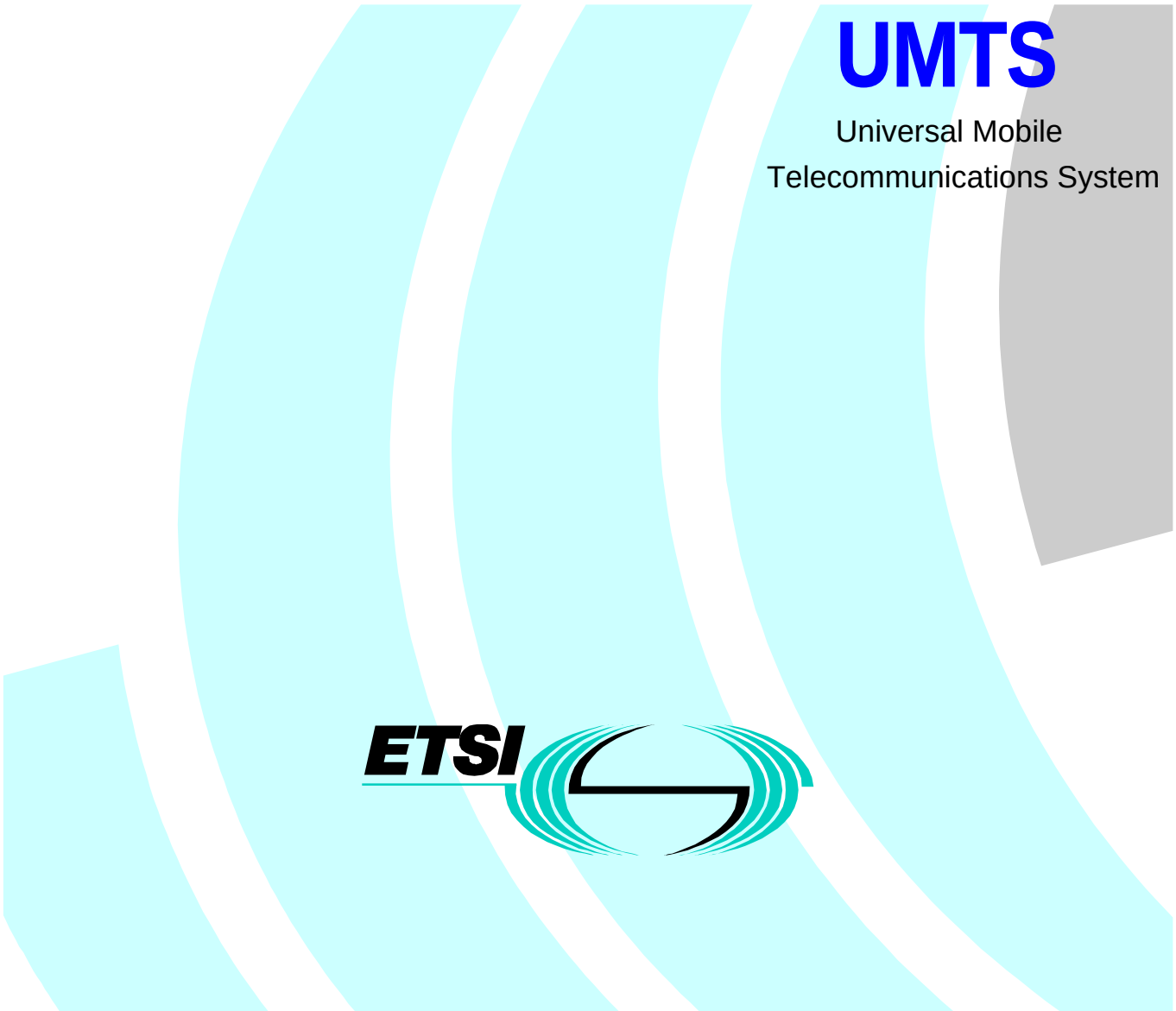
Technical Report

UMTS Terrestrial Radio Access Network (UTRAN); UTRA Layer 1 study items; (UMTS XX.18 version 1.0.0)



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Contents

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Special Mobile Group (SMG).

The present document lists the study items currently identified by the layer 1 expert group that are either related directly to a part of a XX.xy document, or of a more general nature and impact either several layer 1 documents or several sections of a document. The scope of these study items may be at the border between the layer 1 expert group and other groups.

The main objective of the present document is to be a tool for the UMTS layer 1 expert group, providing tracking information on items which are within the scope of the layer 1 expert group work. The document is not intended to be provided together with the layer 1 description to ITU.

The contents of the present document are subject to continuing work within SMG2 and SMG2 UMTS layer 1 expert group and may change following approval by either f these two groups.

1 Scope

This Technical Report lists the study items identified by the layer 1 expert group.

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.
- 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] UMTS-L1 Document XX.01: "UTRA layer 1 documentation plan".

[2] XX.02: "UTRA physical layer - general description".

[3] XX.03: "UTRA FDD, Transport and physical channels description".

[4] XX.04: "UTRA FDD, multiplexing, channel coding and interleaving description".

[5] XX.05: "UTRA FDD, spreading and modulation description".

[6] XX.06: "UTRA FDD, Radio transmission and reception description".

[7] XX.07: "UTRA FDD, physical layer procedures description*".

[8] XX.08: "UTRA FDD, additional features and options description".

[9] XX.09: "UTRA TDD, transport channels and physical channels description".

[10] XX.10: "UTRA TDD, multiplexing, channel coding and interleaving description".

[11] XX.11: "UTRA TDD, spreading and modulation description".

[12] XX.12: "UTRA TDD, Radio transmission and reception description".

[13] XX.13: "UTRA TDD, physical layer procedures description*".

[14] XX.14: "UTRA TDD, additional features and options description".

[15] XX.15: "UTRA handover".

[16] XX.16: "UTRA inter operability description".

[17] XX.17: "UTRA System scenarios".

[18] XX.18: "UTRA layer 1 documentation status and study items".

[19] XX.19: "UTRA Link level simulations results".

[20] XX.20: "Collection of UTRA system level simulation results".

[21] XX.21: "UTRA MS capability".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

definition 1: to be completed

3.2 Symbols

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

S1 symbol 1

3.3 Abbreviations

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

A1 Abbreviation 1

4 Layer 1 study items

4.1 UTRA FDD, Transport and physical channels description (XX.03)

4.1.1 Uplink physical channels

4.1.1.1 Dedicated uplink physical channels

For a single code transmission the following items need to be studied:

a) granularity still to be confirmed (smallest bandwidth 32 kbit/s);

b) RFCI signalling to be discussed in the framework of service multiplexing;

c) parameter (N_{pilot}, N_{data}, N_{TPC}, N_{TFCI}) to be fixed for different SF;

d) interaction with RACH;

e) Number and Position of pilot bits.

4.1.1.2 Common uplink channel

The following items should be studied in the framework of RACH design:

1.0 Power ramping scheme.

1.1 Should the access position be randomly re-selected from one attempt to another during the ramping cycle.

1.2 Conditional power ramping.

2.0 Evaluation of delay, throughput, interference to the other UL channels and implementation complexity (especially in the BS receiver) under different assumptions about traffic.

3.0 Provisions for fast closed loop power control for the message part of the PRACH burst – what is the performance improvement and what new physical channels are needed to enable its operation.

4.0 Exact format of downlink auxiliary channels for sending ACK/NACK/collision/inhibit indicators/ power control commands – whether new physical channels are required or e.g. FACH will suffice, what is the penalty in terms of downlink capacity.

5.0 Preamble detection probability and false alarm rate in the preamble detection.

6.0 Collisions – its probability and a possible mechanism for detection, resolution and recovery.

7.0 Power ratio between preamble and message, implications for coverage.

8.0 Reserved mode of access operation – should it be extended for long packet transmission.

9.0 Traffic models and system scenarios where the use of FAUSCH offers advantages (perhaps with some help from the L2/3 expert group).

10.0 Complete definition of access procedures including acknowledgements and re-transmissions.

11.0 Confirmation whether channel coding for the message part of PRACH is the same as for the uplink DCH.

12.0 PRACH preamble detection in case of high mobile speeds.

13.0 Multi threshold detection of the PRACH preamble and multi-level acknowledgements.

14.0 In the RACH scheme with acquisition indicator from the BTS, refinements of the scheme, for example description on the Acquisition indicator as a new channel, MS ID, transmission instant of this acquisition indicator, description of the random function characteristics, number of allowed repetitions for preamble transmission.

15.0 Evaluation of gain versus loss provided by use of ~~the non coherent~~new signature sequences for RACH preamble allowing differentially coherent detection of the RACH preamble.

16.0 Definition of appropriate modelling for uplink channel.

17.0 In FAUSCH scheme, description of the FAUSCH as a new transport channel in relation with L23 group, interval between two FAUSCH transmissions.

1) timing offset characteristics (1.25ms presently assumed but still to be confirmed).

2) guard time between preamble part and data part.

3) structure of the control part.

   a) SF of the control part (is only 256 allowed ?).

   b) N_{pilot} and N_{TFCI} bits.

   c) coding of TFCI.

4) structure and content of the data part.

5) structure of the preamble part.

   a) allowed preamble symbols ?

4.1.2 Downlink physical channels

4.1.2.1 Dedicated downlink physical channels

In a similar way to the uplink case, for the single code transmission the following items need to be studied:

1) granularity still to be confirmed (smallest bandwidth 32 kbit/s)

2) TFCI signalling to be discussed in the framework of service multiplexing

3) parameter (N_{pilot}, N_{data}, N_{TPC}, N_{TFCI}) to be fixed for different SF

4) interaction with SCH

5) Number and Position of pilot bits

In the case of multi-code, the following items should be studied:

1) structure of the DPDCH when SF different on the difference codes ? Should it be identical to the single code case ?

2) validation of working assumption in FDD document in case of identical SF.

4.1.2.2 Common downlink channels

Mapping of PCH and FACH to be studied in relation with:

a) paging capacity evaluation needed from Layer 2 group as a result of service characteristics and Mobility management procedures (location areas, routing areas...)

b) sleep mode and battery saving

c) flexibility in allocating appropriately capacity for PCH vs. PCH and possible need to time multiplex both

d) Granularity of the sleep mode on a cell by cell basis or mobile per mobile basis in relation with paging response time

- Shared channel precise design
- Impact of shared channels on network capacity
- Support for Fast Signalling Channel in uplink and downlink

4.2 UTRA FDD, Multiplexing, channel coding and interleaving description (XX.04)

4.2.1 Transport channel coding/multiplexing

4.2.1.1 Channel coding issues

1) introduction of a rate 1/4 convolutional code in addition to the rate 1/2 and 1/3.

2) Turbo codes are for study

   a) complexity issues should be considered (processing power, memory)

   b) error floors should be looked at

   c) which services (bit rates, delays, transport block size...) may use these Turbo codes

   d) generator polynomials, interleaver and termination to be selected (number of states may be 4 or 8, interleaver may be pseudo-random or other structure)

   e) flexibility to provide the desired codes rate is to be considered for all proposals

4.2.1.2 Transport channel multiplexing

4.2.1.2.1 information needed from layer 2-3 prior to detailed design

The following information needed from the layer 2-3 group before detailed design can start:

1) transport format combination set for each type of connection, where a transport format combination set corresponds to all possible cases of transport format combination encountered in the course of a call. A transport format corresponds to the set of services to be transferred at a given instant, where a service is defined in terms of bit rate, delay, size of information block....This will in particular allow layer 1 to determine the relative difference of requirement between the mixed services and from there the difference in Eb/no required.

2) rate of modification of the transport format combination used in the course of a connection (every 10ms, 20ms). This could be a function of the connection parameters themselves.

3) what are the allowed transitions between transport format combinations ?

In addition the following will need to be taken into account:

1) the service multiplexing scheme (coding and interleaving) will need to take into account the consequences of the slotted mode.

4.2.1.2.2 design of the TFCI information mapping

1) The exact transmission scheme for the TFCI needs to take into account

   a) interaction between detection performance of TFCI alone and the user data (assuming error free TFCI) to fulfil the overall service requirements

   b) interaction between the TFCI transmission delay and the user data transmission delay to fulfil overall delay requirements. (e.g. there could be problems if the transmission delay of the TFCI is a multiple of 10 ms and if a data frame for layer 2 finishes in the middle of the 10ms).

   c) determination of the level of optimisation of the TFCI transmission scheme as a function of the service combination negotiated at connection

2) The scheme included in the XX.04 as a proposal has the following characteristics which should be compared to the requirements

   a) TFCI indicated on a 10ms basis.

   b) coding scheme based on C(6,32) channel coding which lead to 64 possibilities.

- Transport channel multiplexing in the case of variable rate transmissions using multicodes, for both uplink and downlink
- Other methods of support for slotted mode may be needed than reducing the spreading factor
- Packet coding for a prospective Hybrid ARQ mechanism
  - analysis on coding options,
  - packet size optimisation,
  - performance evaluation.

4.2.2 Slotted mode

Current descriptions assume that slotted mode is implemented either by reducing the SF or by increasing the coding rate. Another possibility is to use DTX periods created by dynamic rate-matching, in order to create idle periods at no capacity cost. This alternative can be used either as replacement of the others or as a complement, when the amount of rate-matching DTX is not sufficient. It can be used in any type of inter-system handover, but it is seen of particular interest for handover from UTRA to GSM of speech user (large amount of DTX, and very likely scenario).

4.3 UTRA FDD Spreading and Modulation Description Document (XX.05)

4.3.1 Modulation

4.3.1.1 modulation chip rate

Chip rate in the FDD mode

- Narrow band carrier options may need to be considered
- chip rate to be set considering Guard band issues and service provision fulfilment

4.3.1.2 pulse shaping

The pulse shaping should be designed taking into account:

1) spectrum mask characteristics
2) implementation issues, among which the time duration of the pulse
3) performance when sampling is not done at optimum or if channel model taps do no coincide with chip period

4.4 UTRA FDD, Radio transmission and reception description (XX.06)

4.4.1 Transmitter characteristics

4.4.1.1 Transmit power

4.4.1.1.1 MS output Power

- A first MS class has been defined in terms of Mean Power, the averaging time to calculate the Mean value, and the Peak Power are still to be defined.Other classes of MS should be defined, long term averaging power, peak power and its measurement.
- What is the level of commonality between TDD and FDD terminals ?
- Mechanism for limiting the MS output power to less than the maximum capability of the terminal
- Safety requirement fulfillment
- Number of mobile classes
- level of commonalities between UTRA versus GSM terminals, multimode terminals
- Should limits be based on services, and multicode operation
- Measure to be taken into account: at the antenna connector might not be sufficient

4.4.1.1.2 Base Station Output Power

- BS RF classes have to be defined.
- What are the limitation in TDD versus FDD ?

4.4.1.2 Output RF Spectrum emission

4.4.1.2.1 Out of band emissions

Specification of the spectrum mask

This study item should address in particular:

- definition of a spectrum mask as a function potentially of the mean output power or peak output power
- suitability of a flexible ACPR for the MS based on the environment ?
- measurement methods to specify the spectrum mask (this corresponds among other things to the measurement filter which may correspond in some cases the receiver filter, filter bandwidth as a function of the offset to carrier....)
- spectrum mask should be defined separately for the MS and BTS taking into account multi-code and power control issues.

4.5 UTRA FDD, Physical layer procedures description (XX.07)

- AiSMA: Acquired indication Sense Multiple Access for RACH scheme

4.5.1 Idle mode tasks

- cell selection and cell re-selection performance requirements to be agreed
- cell selection and re-selection procedure to be described further (correlation procedure, threshold, performance in multi-path....)
- verification that the synchronisation channel structure and cell selection and re-selection procedure allow to fulfil the cell selection and re-selection performance requirements

4.5.2 Open loop transmit diversity

The operation of open-loop transmit diversity in the case of more than 2 transmission antennas needs to be evaluated. It is desirable to allow such operation with minimal incremental complexity over the 2 antenna case, for which STTD has been selected.

4.6 UTRA FDD, Additional features and option description (XX.08)

- Support for location services.
- Use of multiple antennas at the MS
- Use of directive antennas at the MS

4.7 UTRA TDD, Transport channels and physical channels description (XX.09)

- Shared channel concept
- Support for Fast Signalling Channel in uplink and downlink

4.8 UTRA TDD, Multiplexing, channel coding and interleaving description (XX.10)

< editor's note: the following study items are listed here in relation to the harmonisation proposal for TDD, provided that it is studied further. The editor is looking for guidance on the presentation of these study items>

- BCCH slot allocation
- RACH design and capacity
- Complexity related to JD in handsets

4.9 UTRA TDD, Spreading and modulation description (XX.11)

4.10 UTRA TDD, Radio transmission and reception description (XX.12)

- Long term average power, and delta value definition
- Mechanism for control the MS output power to less than the maximum capability of the terminal
- Safety requirement fulfillment
- Number of mobile classes
- What is the level of commonality between TDD and FDD terminals ?
- level of commonalities between UTRA versus GSM terminals, multimode terminals
- Should limits be based on services, and multicode operation
- Measure to be taken into account: at the antenna connector might not be sufficient

4.11 UTRA TDD, Physical layer procedures description (XX.13)

< editor's note: the following study items are listed here in relation to the harmonisation proposal for TDD, provided that it is studied further. The editor is looking for guidance on the presentation of these study items>

4.11.1 Channel Allocation

Dynamic Channel Allocation is under study

4.11.2 Power control

Fast power control is under study

4.12 UTRA TDD, Additional features description (XX.14)

- Downlink transmit diversity scheme
- Support for location services.
- Use of multiple antennas at the MS
- Use of directive antennas at the MS
- Joint Predistortion scheme

4.13 UTRA Handover (XX.15)

4.13.1 Inter-frequency handover scenarios

Scenarios will need to be agreed in order to define:

- the maximum number of UMTS carriers to monitor when operating in UMTS mode. This would correspond to the maximum number of UMTS carriers in the equivalent of the BA list
- the number of GSM carriers to monitor when operating in UMTS mode. This would correspond to the maximum number of GSM carriers in the BA list
- when both GSM and UMTS carriers are present in the BA list and when operating in UMTS mode then the ratio UMTS carriers vs. GSM carriers will need to be agreed
- number of UMTS carriers when operating in GSM mode

4.13.2 inter-frequency handover from UMTS to UMTS and or GSM

4.13.2.1 measurement requirement

Based on the scenarios defined earlier, measurements requirements will need to be agreed. A first list of items addressed in the requirement could be:

- Measurement reporting period
- Number of samples to average over per measurement reporting period on a per UMTS carrier
- should the measurement requirement as far as GSM carriers are concerned be the same as in 05.08 or tightened ?

4.13.2.2 handover from FDD to TDD or FDD or GSM

The design of the slotted mode for FDD or more generally the location of the monitoring window should allow handover from UMTS FDD mode to UMTS FDD, TDD or GSM. The BA list may indeed contain simultaneously carrier in GSM, FDD or TDD according to the scenarios to be defined earlier in this whole section. The slotted mode should consider the synthesiser switching time which may shorten the measurement window.

4.13.2.3 handover from TDD to FDD or TDD or GSM

Similarly the design of the slotted mode for TDD or more generally the location of the monitoring window should allow handover from UMTS FDD mode to UMTS FDD, TDD or GSM. The BA list may indeed contain simultaneously carrier in GSM, FDD or TDD according to the scenarios to be defined earlier in this whole section.

4.13.3 Soft handover scenarios

Assuming that the soft handover is mobile assisted, Scenarios for soft handover should be agreed, in particular the number of cells to monitor to prepare the soft handover

4.13.4 Measurement for soft handover preparation

The measurement needs to prepare the soft handover should be clarified. Impact on the system design should be derived ? Would there be a need for the second slotted mode proposed in the framework of location services ?

4.14 UTRA Inter operability description (XX.16)

The structure of the synchronisation channels in UMTS should be designed in order to allow handover from GSM to UMTS. In addition this study items should also allow to define the measurement requirements in terms e.g.:

- number of measurement samples per UMTS carrier in the BA list per monitoring period per carrier depending on the size of the BA list
- period between synchronisation verification

4.15 System scenarios (XX.17)

4.16 Collection of UTRA system level simulation results(XX.20)

4.17 UTRA Mobile Station capability description (XX.21)

5 General study items

5.1 Guard bands issues

5.1.1 Guard band evaluation methodology

The methodology needs to be agreed based either on worst case or statistical evaluation.

Assumptions in terms of scenarios will need to be listed for either of the two modes: FDD and TDD. The assumptions will covers as a minimum the following items:

- MS and BTS transmit power
- MCL for a worst case approach or network layout for a statistical approach.
- Power amplifiers characteristics

As far as the TDD mode is concerned, up to downlink interference will need to be considered as a function of synchronisation in adjacent cells and up/dl switching points location.

5.1.2 Guard band evaluation for the FDD mode

5.1.3 Guard band evaluation for the TDD mode

5.1.4 Coexistence TDD-FDD modes in adjacent bands

5.2 Study items on the TDD mode exclusively

5.2.1 Usage of TDD mode (micro/pico cells, vehicular or not)

5.2.2 Global asymmetry uplink/downlink

5.2.3 Switching point issue

Pros and cons of switching point being the same or different in neighbouring cells

5.2.4 MS to MS transmission

To e completed based on UMTS L1 xx/98 from Vodafone entitled "Layer 1 Study Item: Mobile Station to Mobile Station Transmission".

5.3 Refinements of the TDD part

5.4 Possibilities and impact of residential use for FDD and TDD modes

5.5 Level of synchronisation needed in the system

History

Document history		
Date	**Version**	**Comment**
19th May 1998	0.0.0	proposed first draft
24th May 1998	0.0.1	Second draft incorporating study items identified during Layer 1 #3 meeting and decisions.
17th June 1998	0.0.2	Third draft incorporating suggestions made at the SMG2 plenary #26 in Sunne and decisions made at layer 1#4 meeting.
July 1998	0.0.3	Fourth draft incorporating decisions made at SMG2 UMTS L1 #4 meeting.
October 1998	0.1.0	Fifth draft restructuring the document according to the XX documents and the decisions made at SMG2 UMTS L1 #6 meeting.
November 1998	0.2.0	Sixth draft to include study items suggested on the ETSI reflector between L1#7 and L1#8, and MS Power issues identified in L1#8.
November 1998	0.3.0	Seventh draft to include remarks made during the L1#8 meeting, except from RACH study items list which is provided separately to SMG2 and will be included in the next version.
January 1999	0.4.0	Eighth draft in order to include modification due to L1#9 and L1#10 meeting
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