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Contents

Foreword

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1 Scope

The present document describes the services provided by the physical layer and the layer 2/3 functionality for support of the 1.28 Mcps low chip rate option of UTRA TDD. Based on the protocol structure existing for UTRA TDD / FDD, it is identified which modifications will be required in order to enable the layer 1 characteristics and key features of the low chip rate option.

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. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TS 25.928: "1.28 Mcps functionality for UTRA TDD Physical Layer".

[2] 3GPP TS 25.302: "Services provided by the Physical Layer".

[3] 3GPP TR 25.990: " Vocabulary for the UTRAN".

[4] 3GPP TS 25.321: "MAC Protocol Specification".

[5] 3GPP TS 25.331: "RRC Protocol Specification".

[6] 3GPP TR 25.921: " Guidelines and Principles for protocol description and error handling".

[7] 3GPP TS 25.222: "Multiplexing and Channel Coding (TDD)".

[8] 3GPP TS 25.304: "UE Procedures in Idle Mode and Procedures for Cell Reselection in Connected Mode".

[9] 3GPP TS 25.212: "Multiplexing and Channel Coding (FDD)".

[10] 3GPP TS 25.215: "Physical Layer – Measurements (FDD)".

[11] 3GPP TS 25.223: "Spreading and modulation (TDD)".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in [3] apply.

3.2 Abbreviations

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

AC Access Class
ASC Access Service Class
BCCH Broadcast Control Channel

BCH	Broadcast Channel
BMC	Broadcast/Multicast Control
C-	Control-
CCTrCH	Coded Composite Transport Channel
CN	Core Network
DCCH	Dedicated Control Channel
DCH	Dedicated Channel
DL	Downlink
DSCH	Downlink Shared Channel
DwPTS	Downlink Pilot Timeslot
FACH	Forward Link Access Channel
FDD	Frequency Division Duplex
FPACH	Fast Physical Access Channel
GP	Guard Period
HO	Handover
ITU	International Telecommunication Union
kbps	kilo-bits per second
L1	Layer 1 (physical layer)
L2	Layer 2 (data link layer)
L3	Layer 3 (network layer)
MAC	Medium Access Control
P-CCPCH	Primary Common Control Physical Channel
PCH	Paging Channel
PDCP	Packet Data Convergence Protocol
PDSCH	Physical Downlink Shared Channel
PHY	Physical layer
PhyCH	Physical Channels
PICH	Paging Indicator Channel
P-RACH	Physical Random Access Channel
PUSCH	Physical Uplink Shared Channel
RAB	Radio Access Bearer
RACH	Random Access Channel
RB	Radio Bearer
RLC	Radio Link Control
RNC	Radio Network Controller
RNS	Radio Network Subsystem
RNTI	Radio Network Temporary Identity
RRC	Radio Resource Control
RSCP	Received Signal Code Power
Rx	Receive
SAP	Service Access Point
S-CCPCH	Secondary Common Control Physical Channel
SCH	Synchronization Channel
SIR	Signal to Interference Ratio
SRNC	Serving Radio Network Controller
SRNS	Serving Radio Network Subsystem
SS	Synchronization Shift
TDD	Time Division Duplex
TFCI	Transport Format Combination Indicator
TFI	Transport Format Indicator
TPC	Transmit Power Control
Ts	Timeslot
Tx	Transmit
U-	User-
UE	User Equipment
UL	Uplink
UMTS	Universal Mobile Telecommunications System
UpPTS	Uplink Pilot Timeslot
USCH	Uplink Shared Channel
UTRA	UMTS Terrestrial Radio Access
UTRAN	UMTS Terrestrial Radio Access Network

4 Background and Introduction

TDD low chip rate option is a Release 4 work item that was agreed in RAN#7 plenary meeting. This work item involves the introduction of functionality to enable the physical layer structure of TDD low chip rate option within the existing UTRA layers.

This report identifies the required modifications within the UTRA layers 2/3. Basically, the layer 2/3 services and functions need not be changed. Emphasis must be put on the fact that it is tried to reuse existing functionality as much as possible for enabling the TDD low chip rate option. Addition or modification of some elements or parameters in comparison with the existing layer 2/3 will however be needed due to the specific physical layer structure and key features of the TDD low chip rate option and the aim of this report is to show where this is the case.

5 Overview of Physical Layer of TDD Low Chip Rate Option

This clause contains some basic information about frame and burst structure of physical layer of TDD low chip rate option. More information on physical layer characteristics of TDD low chip rate option can be found in [1].

5.1 Frame structure

For low chip rate option, the frame length is 10ms and the 10ms frame is divided into 2 sub-frames of 5ms. The frame structure for each sub-frame in the 10ms frame length is the same. The frame structure for each sub-frame is shown in Figure 1.

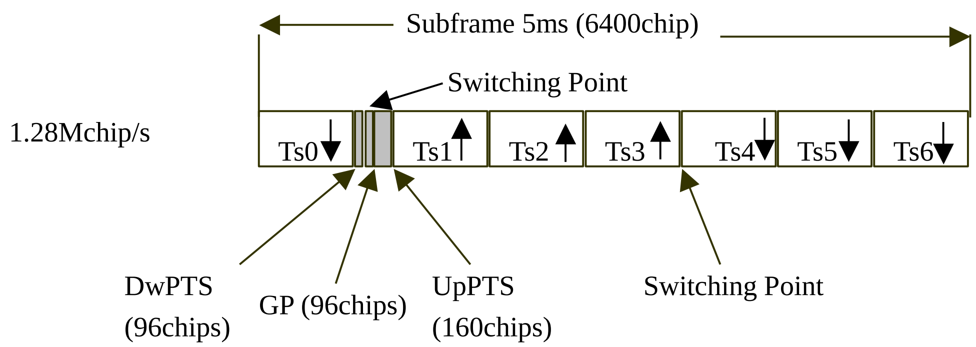

Figure 1: Structure of the sub-frame for TDD low chip rate option

Tsn (n from 0 to 6): the nth normal time slot, 864 chips duration;

DwPTS: downlink pilot time slot, 96 chips duration;

UpPTS: uplink pilot time slot, 160 chips duration;

GP: main guard period for TDD operation, 96 chips duration;

In Figure 1, the total number of normal traffic time slots for uplink and downlink is 7, and the length for each normal time slot is 864 chips duration. Among the 7 normal traffic time slots, Ts0 is always allocated as downlink while Ts1 is always allocated as uplink. The time slots for the uplink and the downlink are separated by a switching point. Between the downlink time slots and uplink time slots, the special period is the switching point to separate the uplink and downlink. In each sub-frame of 5ms for low chip rate option, there are two switching points (uplink to downlink and vice versa). The proposed frame structure has taken some new technologies into consideration, both the smart antenna (beam forming) technology and the uplink synchronisation will be well supported.

5.2 Burst Types

In correspondence to the frame structure described above, the burst structures for Tsn, DwPTS and UpPTS are proposed. The burst structure for normal time slot (Tsn) is described in Figure 2.

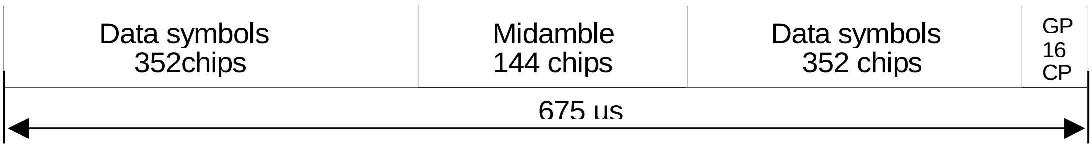

Figure 2: Burst structure for normal traffic time slot

The structure for DwPTS and UpPTS is described in Figure 3 and Figure 4.

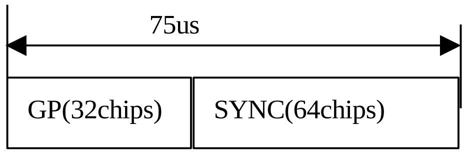

Figure 3: Structure for DwPTS

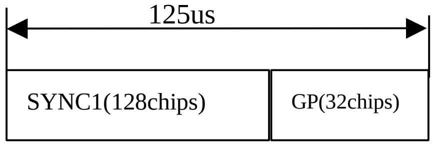

Figure 4: Structure for UpPTS

In Figure 2, the data symbols in each side of the midamble are 352 chips. The TPC bits for power control, the TFCI bits and the additional uplink synchronization bits (synchronization shift) are included in the Data symbols fields of the burst if they are needed. The amount of TFCI bits used is depending on the service and the details for TFCI, synchronization shift and TPC bits should be provided later with service mapping. For the power control symbols, the uplink synchronization control symbols and the TFCI the symbols around the midamble are used.

The GP field in Figure 2 for each time slot is used for protection between time slots to avoid the long delay multi-path interference. It should be noted that the GP of the TS0 together with the guard period in DwPTS is 48 chips long which is different with other normal guard period of 16 chips between time slots. This 'super long' guard period can be used to avoid the interference between the last normal downlink time slot and the downlink synchronization pilot burst. Otherwise, the interference to the last downlink time slot from the strong powered pilot will be serious to the traffic; and vice versa, the interference to the downlink pilot burst from the last downlink time slot will decrease the performance on downlink synchronization and cell search. Note that if the UEs serving Node B is far away and the UE makes handover measurements it will receive the beginning of the DwPTS of a close by Node B inside these 48 chips. 48 chips correspond to 11 km difference in distance to the Node B. If the other Node B is more distant to the serving Node B, big guard period can be used for receiving the DwPTS of the handover candidate Node B.

In DwPTS and UpPTS, the content of SYNC and SYNC1 field are used for downlink and uplink pilot. The GP fields are used to separate the downlink (uplink) pilot from the normal downlink (uplink) time slot.

It should be pointed out that the uplink synchronization burst (SYNC1) is not followed by a RACH immediately. First the UL synchronization burst is sent by the UE in UpPTS. This SYNC1 is used for Node B to determine the received power level and the received timing. Second, the Node B transmits timing and power control information to the UE using the FPACH (one burst message) within the next 4 frames. Then the P-RACH is transmitted. Both FPACH and P-RACH are carrying single burst messages transmitted on a normal traffic time slot (see Figure 2).

6 Services and Functions of the Physical Layer of 1.28 Mcps TDD

6.1 General

No modifications for UTRA 1.28Mcps TDD are required according to subclause 5.1 in [2].

6.2 Overview of L1 functions

No modifications for UTRA 1.28Mcps are required according to subclause 5.2 in [2].

6.3 L1 interactions with L2 retransmission functionality

No modifications for UTRA 1.28Mcps TDD are required according to subclause 5.3 in [2].

7 Model of physical layer of the UE

7.1 Uplink models

No modifications for UTRA TDD low chip rate option are required compared to UTRA TDD 3.84 Mcps.

7.2 Downlink models

No modifications for UTRA TDD low chip rate option are required compared to UTRA TDD 3.84 Mcps.

8 Formats and configurations for L1 data transfer

8.1 General concepts about Transport Channels

The transport channel concept for UTRA TDD low chip rate option is the same as for UTRA TDD 3.84 Mcps as defined in [2].

8.2 Types of Transport Channels

A general classification of transport channels is into two groups:

- common channels; and
- dedicated channels (where the UEs can be unambiguously identified by the physical channel, i.e. code, frequency and time slot).

Common transport channel types are the same as for UTRA TDD 3.84 Mcps. Details of operation on RACH and FACH are f.f.s, e.g., power control. RACH and FACH are characterized as follows:

1. Random Access Channel(s) (RACH) characterised by:
    - existence in uplink only;
    - limited data field;

- collision risk;
- power control.

2. Forward Access Channel(s) (FACH) characterised by:
   - existence in downlink only;
   - possibility to use beam forming;
   - power control;
   - possibility to change rate fast (each 10ms).

The shared channels USCH and DSCH are used in the same way as for UTRA TDD 3.84 Mcps.

Dedicated transport channel types are the same as for UTRA TDD 3.84 Mcps. For TDD low chip rate option, DCH has the possibility to use Uplink Synchronisation to maintain timing advance:

1. Dedicated Channel (DCH) characterised by:
   - existing in uplink or downlink;
   - possibility to use beam forming;
   - possibility to change rate fast (each 10ms);
   - fast power control;
   - Possibility to use Uplink Synchronisation.

9 UE Simultaneous Physical Channels combinations

9.1 1.28 Mcps TDD Uplink

The table addresses the possible combinations of 1.28 Mcps TDD physical channels that can be supported in the uplink by one UE simultaneously on the same frequency in the TDD 1.28 Mcps option in any one 5 ms subframe. In 1.28Mcps TDD a physical channel corresponds to one code, one timeslot, one frequency.

Table 1: 1.28 Mcps TDD Uplink

	Physical Channel Combination	Transport Channel Combination	Mandatory or dependent on UE radio access capabilities	Comment
1	UpPCH	N/A	Mandatory	UpPCH is used to establish the uplink synchronisation.
2	PRACH	RACH	Mandatory	
3	UpPCH + One DPCH	One or more DCH coded into a single CCTrCH	Mandatory	One DPCH is needed as reference measurement channel. UpPCH transmission to target cell in case of handover.
4	One DPCH	One or more DCH coded into a single CCTrCH	Mandatory	The maximum number of DCHs and the maximum channel bit rate are dependent on UE radio access capabilities This combination is required for the reference measurement channel.
5	More than one DPCH	One or more DCH coded into one or more CCTrCH	Depending on UE radio access capabilities	The maximum number of DCHs, the maximum number of CCTrCH and the maximum channel bit rate are dependent on UE radio access capabilities.
6	UpPCH+ one or more DPCH	One or more DCH coded into one or more CCTrCH	Depending on UE radio access capabilities	The maximum number of DCHs, the maximum number of CCTrCH and the maximum channel bit rate are dependent on UE radio access capabilities. This configuration is required for UE that operate shared channels and dedicated channels simultaneously.
7	PRACH + one or more DPCHs	RACH + one or more DCH coded into one or more than one CCTrCH	Depending on UE radio access capabilities	The maximum number of DCHs, the maximum number of CCTrCH and the maximum channel bit rate are dependent on UE radio access capabilities. This configuration is required for UE that operate shared channels and dedicated channels simultaneously.
8	One or more PUSCH	One or more USCH coded onto one or more CCTrCH	Depending on UE radio access capabilities	This configuration is required for UE that operate shared channels.
9	UpPCH + one or more PUSCH	One or more USCH coded onto one or more CCTrCH	Depending on UE radio access capabilities	This combination may be used for shared channel operation only.
10	PRACH + one or more PUSCH	RACH + One or more USCH coded onto one or more CCTrCH	Depending on UE radio access capabilities	This combination may be used for shared channel operation only
11	One or more PUSCH + one or more DPCH	One or more USCH coded onto one or more CCTrCH + one or more DCH coded onto one or more CCTrCH	Depending on UE radio access capabilities	The maximum number of DCHs and the maximum channel bit rate are dependent on UE radio access capabilities. This configuration is required for UE that operate shared channels and dedicated channels simultaneously

	Physical Channel Combination	Transport Channel Combination	Mandatory or dependent on UE radio access capabilities	Comment
12	UpPCH + one or more PUSCH + one or more DPCH	one or more USCH coded onto one or more CCTrCH + one or more DCH coded into one or more CCTrCH	Depending on UE radio access capabilities	The maximum number of DCHs and the maximum channel bit rate are dependent on UE radio access capabilities. This combination may be used for shared channel operation.
13	PRACH + one or more PUSCH + one or more DPCH	RACH + one or more USCH coded onto one or more CCTrCH + one or more DCH coded into one or more CCTrCH	Depending on UE radio access capabilities	The maximum number of DCHs and the maximum channel bit rate are dependent on UE radio access capabilities. This combination may be used for shared channel operation.

9.2 1.28 Mcps TDD Downlink

The table addresses the possible combinations of 1.28 Mcps TDD physical channels that can be supported in the downlink by one UE simultaneously on the same frequency in any one 5ms subframe. In 1.28Mcps TDD a physical channel corresponds to one code, one timeslot, one frequency.

Depending on UE radio capabilities UEs may be required to occassionally decode P-CCPCH of its own cell in the following Physical Channel Combinations: 5, 11,12,13,14,15,16,17.

To support handover it depends on UE capabilities if a UE can support the occasional decoding of neighbour cell P-CCPCH in the physical channel combinations 8, 9, 10, 11, 15,16, 17

Table 2: 1.28 Mcps TDD Downlink

	Physical Channel Combination	Transport Channel Combination	Mandatory or dependent on UE radio access capabilities	Comment
1	FPACH	N/A	Mandatory	FPACH is used to answer the UE and to adjust the timing and synchronization shift of the UE
2	P-CCPCH	BCH	Mandatory	
3	S-CCPCH	FACH or/and PCH	Mandatory	
4	P-CCPCH +S-CCPCH	BCH + (FACH or/and PCH)	Mandatory	
5	More than one S-CCPCH	one or more FACH+ one ore more PCH	Depending on UE capabilities	
6	PICH	N/A	Mandatory	
7	FPACH + P-CCPCH + none, one or more S-CCPCH	BCH + (none,one or more FACH+ none.one ore more PCH)	Depending on UE capabilities	
8	2 DPCH	One or more DCH coded into a single CCTrCH	Mandatory	The maximum number of DCH and the maximum channel bit rate are dependent on UE radio access capabilities This channel is used as reference measurement channel
9	One or more DPCH	One or more DCH coded into one or more CCTrCH	Depending on UE radio access capabilities	The maximum number of DCHs, the maximum number of CCTrCH and the maximum channel bit rate are dependent on UE radio access capabilities.
10	FPACH + one or more DPCH	One or more DCH coded into one or more CCTrCH	Depending on UE radio access capabilities	FPACH is used to answer the UE and to adjust the timing and synchronization shift of the UE. The maximum number of DCHs, the maximum number of CCTrCH and the maximum channel bit rate are dependent on UE radio access capabilities. This configuration is required for UE that operate shared channels and dedicated channels simultaneously.
11	One or more S-CCPCH + one or more DPCH	(One or more FACH or/and PCH) + one or more DCH coded into one or more CCTrCH	Depending on UE radio access capabilities	The maximum number of DCHs, the maximum number of CCTrCH and the maximum channel bit rate are dependent on UE radio access capabilities. This configuration is required for UE that operate shared channels and dedicated channels simultaneously.
12	One or more PDSCH	One or more DSCH coded onto one or more CCTrCH	Depending on UE radio access capabilities	This configuration is required for UE that operate shared channels.
13	FPACH + one or more PDSCH	One or more DSCH coded onto one or more CCTrCH	Depending on UE radio access capabilities	This configuration is desirable but not essential for UE supporting shared channels.
14	One or more S-CCPCH +one or more PDSCH	(One or more FACH and/or PCH) + One or more DSCH coded onto one or more CCTrCH	Depending on UE radio access capabilities	This configuration is desirable but not essential for UE supporting shared channels.

	Physical Channel Combination	Transport Channel Combination	Mandatory or dependent on UE radio access capabilities	Comment
15	One or more PDSCH + one or more DPCH	One or more DSCH coded onto one or more CCTrCH + one or more DCH coded into one or more CCTrCH	Depending on UE radio access capabilities	This configuration is required for UE that operate shared channels and dedicated channels simultaneously.
16	FPACH + one or more PDSCH + one or more DPCH	one or more DSCH coded onto one or more CCTrCH + one or more DCH coded into one or more CCTrCH	Depending on UE radio access capabilities.	FPACH is used to answer the UE and to adjust the timing and synchronization shift of the UE. This configuration is desirable but not essential for UE supporting shared channels and dedicated channels simultaneously.
17	One or more S-CCPCH + one or more PDSCH + one or more DPCH	(One or more FACH and/or PCH) + one or more DSCH coded onto one or more CCTrCH + one or more DCH coded into one or more CCTrCH	Depending on UE radio access capabilities.	This configuration is desirable but not essential for UE supporting shared channels and dedicated channels simultaneously.

10 Measurements provided by the physical layer

10.1 Model of physical layer measurements

The model of physical layer measurements is common with 3.84 Mcps TDD.

10.2 UE Measurements

UE measurements specified for 3.84 Mcps TDD are also used in 1.28 Mcps TDD. Ranges and accuracy have to be adapted.

10.3 UTRAN Measurements

UTRAN measurements specified for 3.84 Mcps TDD are also used in 1.28 Mcps TDD. Ranges and accuracy have to be adapted.

10.3.1 Received SYNC_UL Timing Deviation

Definition	'Received SYNC_UL Timing Deviation' is the time difference $UpPCH_{POS} = UpPTS_{Rxpath} - UpPTS_{TS}$ Where $UpPTS_{Rxpath}$: time of the reception in the Node B of the SYNC_UL to be used in the uplink synchronization process $UpPTS_{TS}$: time instance two symbols prior to the end of the DwPCH according to the Node B internal timing

10.4 Compressed Mode to Monitor 1.28Mcps TDD

The parameters currently specified for FDD compressed mode [10] [5] support the monitoring of 1.28 Mcps TDD cells.

The transmission gap pattern length is defined in frames. A frame length of 10ms consists of two 1.28 Mcps TDD subframes of 5ms length. Because it is not possible to shift the transmission gap in consecutive pattern repetitions, it is effective to search with an appropriately long gap.

Using the double frame method [9] a transmission gap length of 14 slots is a suitable parameter setting.

Therefore, this enables UEs in FDD mode to monitor 1.28 Mcps TDD cells by means of FDD compressed mode.

11 Primitives of the physical layer

11.1 Generic names of primitives between layers 1 and 2

No modifications for UTRA TDD 1.28 Mcps are required compared to UTRA TDD 3.84 Mcps.

11.2 Generic names of primitives between layers 1 and 3

No modifications for UTRA TDD 1.28 Mcps are required compared to UTRA TDD 3.84 Mcps.

11.2.1 STATUS PRIMITIVES

No modifications for UTRA TDD 1.28 Mcps are required compared to UTRA TDD 3.84 Mcps.

11.2.2 CONTROL PRIMITIVES

No modifications for UTRA TDD 1.28 Mcps are required compared to UTRA TDD 3.84 Mcps.

11.3 Parameter definition

11.3.1 Error code

No modifications for UTRA TDD 1.28 Mcps are required compared to UTRA TDD 3.84 Mcps.

11.3.2 Event value

No modifications for UTRA TDD 1.28 Mcps are required compared to UTRA TDD 3.84 Mcps.

11.3.3 Access Information

For the UTRA TDD 1.28 Mcps the access information options are:

- Ready for RACH data transmission (when Ack on FPACH has been received);
- No response received in FPACH while maximum number of synchronisation attempts has been performed.

11.3.4 Transport Format Subset

No modifications for UTRA TDD 1.28 Mcps are required compared to UTRA TDD 3.84 Mcps.

11.3.5 Physical channel description

In addition to the physical channels defined for UTRA TDD, three physical channels are added to support low chip rate TDD option, they are: DwPTS, UpPTS and FPACH. Besides, two physical channels, Primary SCH and Secondary SCH, are not needed in low chip rate TDD option.

Because there is only one burst type in low chip rate TDD option, "burst type" defined as a parameter for physical channel is not necessary.

Due to the different RACH procedure of low chip rate TDD option, the Access Service Class selection applies to UpPTS, rather than PRACH (see subclause 14.1.4).

Shared channels, PUSCH and PDSCH, will be supported by TDD low chip rate option, The added physical channels and the modifications for PRACH are described in the following:

11.3.5.1 DwPTS

- Tx diversity mode.
- SYNC code ID

11.3.5.2 UpPTS

- SYNC1 code ID

11.3.5.3 FPACH

- Scrambling code.
- Channelisation code.
- Timeslot
- Midamble shift
- Tx diversity mode.

11.3.5.4 PRACH

- Spreading factor for data part
- Power control info:
    - UL target SIR
    - Primary CCPCH DL TX power
    - UL interference
- Access Service Class Selection:
- Timeslots
- Spreading Codes
- Midamble Shift

12 Layer 2 Services and Functions

12.1 MAC Services and Functions

12.1.1 MAC Services to upper layers

MAC services to upper layers, logical channels and mapping between logical channels and transport channels are identical for UTRA TDD 3.84 Mcps and 1.28 Mcps.

12.1.1 MAC functions

No modifications for 1.28Mcps TDD are required compared to 3.84Mcps TDD.

12.2 RLC Services and Functions

No modifications for UTRA TDD low chip rate option are required compared to UTRA TDD 3.84 Mcps

12.3 PDCP Services and Functions

No modifications for UTRA TDD low chip rate option are required compared to UTRA TDD 3.84 Mcps

12.4 Broadcast/Multicast Control - Services and Functions

No modifications for UTRA TDD low chip rate option are required compared to UTRA TDD 3.84 Mcps

13 Layer 3 - Uu Stratum Services and Functions

13.1 Uu Stratum services

Uu Stratum services are the same as for UTRA FDD / 3.84 Mcps TDD.

13.2 RRC functions

RRC functions for 1.28 Mcps TDD are common with 3.84 Mcps TDD, except for timing advance control which is maintained by L1 function Uplink Synchronization in 1.28 Mcps TDD.

13.3 RRC Protocol Aspects

13.3.1 Discussion on Physical Channel Parameters for 1.28 Mcps TDD

1.28Mcps TDD and 3.84Mcps TDD are both based on CDMA with an additional TDMA component. The most obvious difference is of course the different bandwidth that is used in the both modes. While 3.84Mcps TDD uses a chiprate of 3.84 Mcps the chip rate of 1.28Mcps TDD is 1.28 Mcps. In contrast to 3.84Mcps TDD it is foreseen to be the normal case for 1.28Mcps TDD that several frequency bands are used within one cell. For example if a frequency band of 5 MHz is available it is divided into three frequency bands of 1.6 MHz to be used for 1.28Mcps TDD.
Timing handling is a layer1 functionality due to the high accuracy requirements in 1.28Mcps TDD. Thus timing advance as an RRC functionality is not needed.
Apart from these differences there is a high potential to reuse descriptions of physical channel information in3.84Mcps TDD for 1.28Mcps TDD mode.

13.3.1.1 Parameters required to define physical channels in 1.28Mcps TDD:

- **Timeslot:** The frame structure defines seven timeslots per subframe. The timeslots of the two subframes in a 10ms frame are always associated to each other (except for the FPACH; this will be described later). The first timeslot (TS0) in a subframe is always dedicated to the downlink and the second timeslot (TS1) is always dedicated to the uplink. Thus at most six timeslots may be allocated in one direction in contrast to fourteen in 3.84Mcps TDD.

- **Channelisation code:** The handling of channelisation codes is exactly the same as in 3.84Mcps TDD.

- **Midamble shift:** The handling of midambles (basic midamble code and applied midamble shift) is basically the same as in 3.84Mcps TDD. The basic midamble code is also acquired during synchronisation process and the midamble shift is either explicitly signalled for a particular physical channel or a predefined association between channelisation codes and midamble shifts is used. This association is defined in WG1 specifications.

- **Frame allocation:** As an option the same multiframe structure (defined by an offset, repetition period and repetition length) as used in 3.84Mcps TDD can be adopted for 1.28Mcps TDD.
- **Burst type:** Only one burst type exists for 1.28Mcps TDD for traffic channels. Therefore no signalling of the used burst type is required.
- **Modulation:** The basic modulation scheme is the same as in 3.84Mcps TDD. However, in case of usage of spreading factor 1 optionally 8 PSK can be used in contrast to 3.84Mcps TDD.

13.3.1.2 Handling of coded composite transport channels of dedicated or shared type in 1.28Mcps TDD:

In 1.28Mcps TDD multiplexing chain defined in [7] can be adopted with minor modifications. These modifications require only changes that are of no importance for layer 2 and layer 3 (i.e. specification of mapping of bits on the two timeslots in the different subframes).

Thus the required parameters for the specification of coded composite transport channels are the same as in 3.84Mcps TDD mode i.e.

- **Multiple CCTrCHs:** A list of up to 8 CCTrCHs can be configured. Thus an identifier for the CCTrCHs is required (TFCS Identity)
- **2nd interleaving mode:** Whether the frame or timeslot related 2nd interleaving mode is used depends on the requirements. Same as in 3.84Mcps TDD mode.
- **Puncturing limit:** Dynamic rate matching is used both in uplink and downlink. Same as in 3.84Mcps TDD mode.
- **TFCI coding:** The channel coding can be adapted to the requirements. Same as in 3.84Mcps TDD mode.
- **TFCI existence per timeslot:** Depending on the requirements a TFCI may or may not be included in particular timeslots. Same as in 3.84Mcps TDD mode.
- **Multiple timeslots per CCTrCH:** A number of timeslots may be allocated for one CCTrCH. Same as in 3.84Mcps TDD mode.
- **Channelisation codes:** In downlink direction rather multicode configuration than variable codes can be configured. In uplink direction both multicode and variable spreading are supported. Same as in 3.84Mcps TDD mode.
- **Time info:** The concept of time limited channels can be adopted from 3.84Mcps TDD mode.

13.3.2 Parameter description for 1.28Mcps TDD

13.3.2.1 Parameters for RACH procedure specification

The random access procedure for 1.28Mcps TDD is described in detail in [1].
The SYNC1 code transmission is basically the contention based mechanism in 1.28Mcps TDD. Major similarities can be noticed between preamble transmissions in FDD and SYNC1 transmissions in 1.28Mcps TDD. Thus the parameters M (maximum number of SYNC1 transmissions) are broadcast as in FDD to control the RACH procedure. Additionally, a parameter defining the step sizes to be used for the power ramping for successive SYNC1 transmissions is proposed to be included. This gives operators further means to control the RACH procedure.

There is essentially no difference between a PRACH compared to a DPCH since uplink synchronisation is already achieved with the help of the SYNC1 codes. Thus the only difference between the PRACH and the DPCH is that it is assigned to be part of the random access procedure. Since similar procedures are used for 1.28Mcps TDD as for 3.84Mcps TDD similar messages are send over the RACH transport channel.

In principle the configuration of the PRACH can have the same flexibility as a DPCH.

The FPACH is a physical channel with similarities to the AICH in FDD. It carries only a small number of bits containing information to adjust the uplink transmissions (power control, synchronisation, ...). One FPACH transmission is only comprised of a single sub-frame. Due to the limited amount of required transmission capacity the FPACH uses only spreading factor 16.

When sending a SYNC1 sequence, the UE knows which FPACH, PRACH and S-CCPCH resources will be used for the access. This information is provided in system information on BCCH.

There is a predefined correspondence between a P-RACH and a FPACH, and an implicit correspondence between SYNC1 signatures and FPACHs, according to the following rule:

$$\text{FPACH/PRACH number} = N \bmod M,$$

where FPACH/PRACH number is the FPACH/PRACH description position within the IE 'PRACH system information list', (see subclause 13.3.3) e.g. the first configured PRACH/FPACH pair gets number 0, the second configured PRACH/FPACH gets number 1 and so on. This number is the parameter M in the equation above.
N is the number of the chosen signature (range 0..7). In a cell, at least one PRACH and one associated FPACH shall be configured. Up to a maximum of 8 PRACH/FPACH pairs can be configured.

The SCCPCH used for one UE is chosen in the same way as in 3.84Mcps TDD and FDD based on the Initial UE Identity in idle mode and based on the old U-RNTI in connected mode.

13.3.2.2 Parameters required to define the primary CCPCH

Essentially, the description of the PCCPCH in 1.28Mcps TDD is much simpler than in 3.84Mcps TDD because the timeslot for the PCCPCH is defined to be TS0 in 1.28Mcps TDD while the timeslot is flexible in 3.84Mcps TDD depending on the location of the SCH. Furthermore, in 1.28Mcps TDD there is in contrast to 3.84Mcps TDD only one burst type. Due to the different nature of the synchronization process there are no different synchronization cases. The usage of Block STTD is currently discussed for 1.28Mcps TDD in WG1.
Thus the only parameters describing the PCCPCH is the cell parameter id and Block STTD if it is decided.
The primary CCPCH can be used for cell identification in a similar way for the identification of cells as the Primary CPICH info in FDD and the primary CCPCH info in TDD.

13.3.2.3 Parameters required to define the secondary CCPCH

The secondary CCPCH can be described in a similar way as in 3.84Mcps TDD. Essentially, the only difference is the absence of the burst type because there is only one burst type in 1.28Mcps TDD.

13.3.2.4 Parameters required to define the PICH

Essentially, the concept for the paging indicator channel can be adopted from the 3.84Mcps TDD mode. Thus there are similar changes needed as for most of the other physical channels, i.e. the burst type is not required as a parameter.

13.3.2.5 Parameters required to define shared channels

The parameters required to define shared channels are essentially the same as those for the TDD 3.84 Mcps option. The differences reflect the differences in the physical layer parameters e.g. 8PSK is available as a modulation option. Their method of use is almost identical to that for the 3.84 Mcps option with the additions that closed loop power and timing correction can be applied to USCH transmissions. In addition the, UE can obtain timing correction before transmitting on the USCH through the completion of a SYNC1/FPACH exchange.

13.3.2.6 Additional parameters to be broadcast

This subclause identifies parameters that additionally need to be broadcast to support 1.28Mcps TDD.
Depending on the size of the cell a different amount of users can be supported in one timeslot. In order to improve the configuration of the receiver in the UE it is beneficial to provide these information in the system information. It is proposed to include the parameter W in system information block type 5. This parameter provides information about the maximum channel impulse response. This parameter depends on the amount of users that can be served and the environment. This parameter is foreseen to be cell specific.

The allowed values are W=8, 9, 12, 16, 21, 32, 64 (cp [1]). The predefined association of Midamble to Channelisation Codes depends on this parameter (cp. [1]).

1.28Mcps TDD has higher requirements on the uplink timing of transmissions than 3.84Mcps TDD. The means to preserve uplink synchronization are layer1 bits, the SS bits. The SS bits are transmitted every subframe, however, they are often not required that often. Thus the frequency of the update of the adjustment of uplink transmission can be decreased on a case by case basis. Another advantage of the reduction of the update frequency of the adjustment of the uplink transmission is the averaging effect by jointly evaluating a number of SS bits. Thus the probability of false adjustments is reduced. A parameter "Uplink synchronisation step size" is proposed with a value range (1..8) to achieve this.
Consequently, another parameter is reasonable that allows to adjust the step sizes of the uplink transmission adjustment. By providing this parameter the network can reduce the accuracy requirements on a case by case basis. The parameter "Uplink synchronisation frequency" is proposed to allow this adjustment of the step sizes for the adjustment of the uplink transmissions. A value range of (1..8) is proposed.

13.3.2.7 Parameter required to inform the usage of TSTD

Depending on the capability of the base station and the characteristics of the physical channels, TSTD can be used to overcome the time varying characteristics of the communication channel. In 1.28Mcps UTRA TDD, TSTD can be applied to P-CCPCH, DwPCH, and DPCH. In case of DPCH, UE shall have the knowledge about the usage of TSTD due to the power control of DPCH. Transmission power control of DPCH is currently discussed for 1.28Mcps in WG1. Similar as for the IE "Tx diversity indicator" for FDD, "TSTD indicator" can be defined and used to inform the application of TSTD to DPCH.

13.3.2.8 Information element for propagation delay measurement

In 1.28Mcps TDD, knowing the received timing of UpPCH or PRACH does not allow the Node B to measure the propagation delay, because the transmission timing of those physical channels are adjusted by the UE for uplink synchronization. For SRNC to measure the propagation delay when PRACH is sent, the following two measurement values can be used,

- $UpPCH_{ADV}$: Difference between the Rx timing and initial Tx timing of a UE.
- $UpPCH_{POS}$: Received starting position of the UpPCH. The reference time ($UpPCH_{POS} = 0$) is two symbols prior to the end of the DwPCH. Any received starting position of the UpPCH after that point of time is positive.

Then, SRNC can calculate the propagation delay using the above values as follows.

$$\text{Propagation Delay} = (UpPCH_{ADV} + UpPCH_{POS} - 8*16\ T_C) / 2$$

To support this propagation delay measurement, the UE shall transmit the $UpPCH_{ADV}$ to SRNC.

Following Figure 5 illustrates the timing of UpPCH transmission.

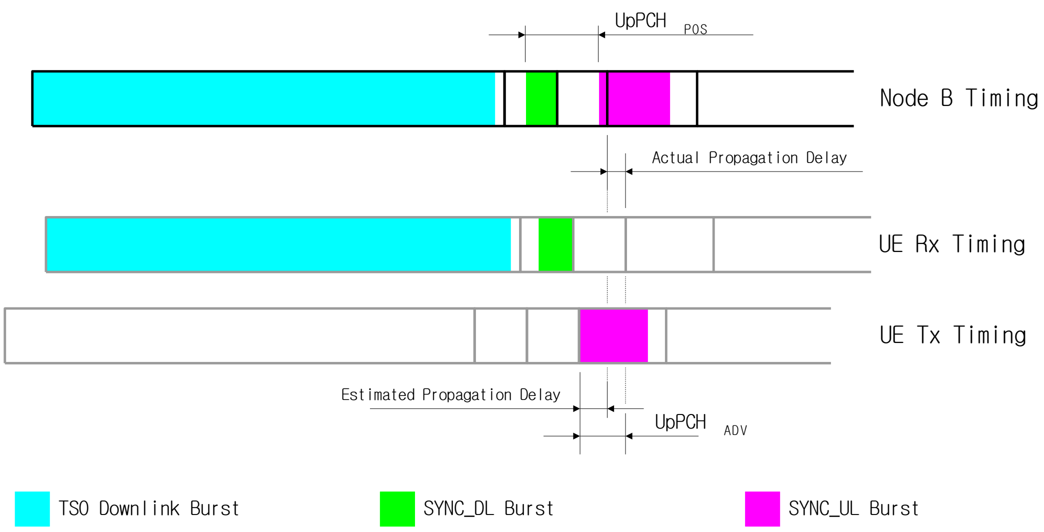

Figure 5: Timing of the UpPCH transmission.

13.3.3 Information elements for 1.28Mcps TDD

NOTE: The tabular description in this subclause is for information only. Change requests on [5] may follow different methodology to incorporate changes for release 00.

This subclause contains a tabular description of required information for physical channel description in an RRC-like format. The hierarchical structure as specified in the RRC specification is not used but could easily be applied. The differences to the 3.84Mcps TDD mode are highlighted with revision marks. The subclause numbers in the type and reference column refer to [5] (v3.3.0).

13.3.3.1 Dedicated physical channel information

Uplink DPCH info

Information Element/Group name	Need	Multi	Type and reference	*DESCRIPTION*
~~Uplink DPCH power control info~~	~~OP~~		~~10.3.6.79~~	<u>Not required in 1.28Mcps TDD</u>
~~Uplink Timing Advance~~	~~OP~~			<u>This information element is not required in 1.28Mcps TDD</u>
UL CCTrCH List	MP	1..8		
>TFCS Identity	MD		10.3.5.21	Same as 3.84Mcps TDD
>2nd interleaving mode	MP		Enumerated(Frame, Timeslot)	Same as 3.84Mcps TDD
>Puncturing limit	MP		Real(0.40..1.0 by step of 0.04)	Same as 3.84Mcps TDD
>Repetition period	MD		Integer(1, 2,4,8,16,32,64)	Same as 3.84Mcps TDD
>Repetition length	MP		Integer(1.. Repetition period –1)	Same as 3.84Mcps TDD
>Time info	MP		10.3.6.71	Same as 3.84Mcps TDD
>TFCI coding	MP		Integer(4,8,16,32)	Same as 3.84Mcps TDD
>Timeslot list	MP	<u>1..6</u>		
>>Timeslot number	MP		<u>Integer(1..6)</u>	Reduced range compared to 3.84Mcps TDD mode.
~~>>Burst Type~~	~~MP~~		~~Enumerated(Type 1, Type 2)~~	This information is not needed in 1.28Mcps TDD because only one burst type exists.
>>Midamble Shift	MD		Integer(0..15)	Range depends on cell configuration. A fixed association between channelisation codes and midamble shift is described in [1].
>> TFCI existence	MP		Boolean	Same as 3.84Mcps TDD
>>CHOICE SF	MP			
>>> SF1			Enumerated(QPSK, 8PSK)	Modulation options in contrast to 3.84Mcps TDD mode
>>> Other				
>>>>Code list	MP	1..2		
>>>>>Channelisation Codes	MP		Enumerated((1/1),)(2/1),(2/2),(4/1)..(4/4),(8/1)..(8/8),(16/1)..(16/16))	Same as in 3.84Mcps TDD.

Downlink DPCH info

Information Element/Group name	Need	Multi	Type and reference	Semantics description
UL CCTrCH List	MP	1..8		
>TFCS Identity	MD		10.3.5.21	Same as 3.84Mcps TDD
>2nd interleaving mode	MP		Enumerated(Frame, Timeslot)	Same as 3.84Mcps TDD
>Puncturing limit	MP		Real(0.40..1.0 by step of 0.04)	Same as 3.84Mcps TDD
>Repetition period	MD		Integer(1, 2,4,8,16,32,64)	Same as 3.84Mcps TDD
>Repetition length	MP		Integer(1.. Repetition period –1)	Same as 3.84Mcps TDD
>Time info	MP		10.3.6.71	Same as 3.84Mcps TDD
>TFCI coding	MP		Integer(4,8,16,32)	Same as 3.84Mcps TDD
>Timeslot list	MP	1..6		
>>Timeslot number	MP		Integer(1..6)	Reduced range compared to 3.84Mcps TDD mode.
>>Midamble Shift	MD		Integer(0..15)	Range depends on cell configuration. A fixed association between channelisation codes and midamble shift is described in [1].
~~>>Burst Type~~	~~MP~~		~~Enumerated(Type 1, Type 2)~~	This information is not needed in 1.28Mcps TDD because only one burst type exists.
>> TFCI existence	MP		Boolean	Same as 3.84Mcps TDD
>>CHOICE SF	MP			
>>> SF1			Enumerated(QPSK, 8PSK)	Modulation options in contrast to 3.84Mcps TDD mode
>>> Other				
>>>>Code list	MP	1..16		
>>>>>Channelisation Codes	MP		Integer(1..16)	Same as 3.84Mcps TDD mode.

13.3.3.2 Shared channel information

Details of shared channels have not been decided yet for 1.28Mcps TDD. However, it is foreseen that no modifications are required for shared channels except similar changes as for dedicated channels.

13.3.3.3 RACH procedure information elements

PRACH system information list

Information element	Need	Multi	Type and reference	Semantics description
Sync1 transmission parameters	MP		Sync1 transmission parameters	
PRACH system information	MP	1 .. <maxPRACH>		
>PRACH info	MP		PRACH info See below	
>FPACH info	MP		FPACH info See below	
>Transport channel identity	MP		Transport channel identity 10.3.5.18	
>RACH TFS	MD		Transport format set 10.3.5.23	Default value is the value of "RACH TFS" for the previous PRACH in the list (note : the first occurrence is then MP)
>RACH TFCS	MD		Transport Format Combination Set 10.3.5.20	Default value is the value of "RACH TFCS" for the previous PRACH in the list (note : the first occurrence is then MP)
>PRACH partitioning	MD		PRACH partitioning 10.3.3.45	Default value is the value of "PRACH partitioning" for the previous PRACH in the list (note : the first occurrence is then MP)
>Persistence scaling factors	OP		Persistence scaling factors 10.3.6.40	If this IE is absent, value is the value of "Persistence scaling factors" for the previous PRACH in the list if value exists
>AC-to-ASC mapping	OP		AC-to-ASC mapping 10.3.6.1	Only present in SIB 5 If this IE is absent, value is the value of "Persistence scaling factors" for the previous PRACH in the list if value exists

PRACH info

Information Element/Group name	Need	Multi	Type and reference	Semantics description
2nd interleaving mode	MP		Enumerated(Frame, Timeslot)	Same as 3.84Mcps TDD
Puncturing limit	MP		Real(0.40..1.0 by step of 0.04)	Same as 3.84Mcps TDD
TFCI coding	MP		Integer(4,8,16,32)	Same as 3.84Mcps TDD
Timeslot list	MP	1..6		
>Timeslot number	MP		Integer(1..6)	Reduced range compared to 3.84Mcps TDD mode.
>Midamble Shift	MD		Integer(0..15)	Range depends on cell configuration. A fixed association between channelisation codes and midamble shift is described in [1].
>TFCI existence	MP		Boolean	Same as 3.84Mcps TDD
>Code list	MP	1..2		
>>Channelisation Codes	MP		Enumerated((1/1),)(2/1),(2/2),(4/1)..(4/4),(8/1)..(8/8),(16/1)..(16/16))	Same as in 3.84Mcps TDD.

FPACH info

This IE is not used in 3.84Mcps TDD.

Information Element/Group name	Need	Multi	Type and reference	Semantics description
Timeslot number	MP		Integer(1..6)	
Midamble Shift	MP		Integer(0..15)	
Channelisation Codes	MP		Integer((16/1)..(16/16))	

Sync1 transmission parameters

These parameters are not used in 3.84Mcps TDD. There are major similarities to the RACH transmission parameters in FDD.

Information Element/Group name	Need	Multi	Type and reference	Semantics description
Power Increment	MP		Integer(0,1,2,3)	in dB
M	MP		Integer(1,2,4,8)	Max re-transmissions of UpPTS

13.3.3.4 Common channel information elements

PCCPCH info

Information Element/Group name	Need	Multi	Type and reference	Semantics description
Cell parameter Id	MP		Integer(0..127)	
Block STTD indicator	MD		Block STTD indicator 10.3.6.5	Default value is "TRUE" The usage of Block STTD for 1.28 Mcps TDD is currently under discussion in WG1

SCCPCH info

Information Element/Group name	Need	Multi	Type and reference	Semantics description
2nd interleaving mode	MP		Enumerated(Frame, Timeslot)	Same as 3.84Mcps TDD
Puncturing limit	MP		Real(0.40..1.0 by step of 0.04)	Same as 3.84Mcps TDD
Repetition period	MD		Integer(2,4,8,16,32,64)	Same as 3.84Mcps TDD
Repetition length	MP		Integer(1.. Repetition period –1)	Same as 3.84Mcps TDD
Offset	MP		Integer(1..Repetition Period-1)	Same as 3.84Mcps TDD
TFCI coding	MP		Integer(4,8,16,32)	Same as 3.84Mcps TDD
Timeslot list	MP	1..6		
>Timeslot number	MP		Integer(1..6)	Reduced range compared to 3.84Mcps TDD mode.
>Midamble Shift	MD		Integer(0..15)	Range depends on cell configuration. A fixed association between channelisation codes and midamble shift is described in [1].
~~Burst Type~~	~~MP~~			This information is not needed in 1.28Mcps TDD because only one burst type exists.
> TFCI existence	MP		Boolean	Same as 3.84Mcps TDD
>Code list	MP	1..16		
>>Channelisation Codes	MP		Integer(1..16)	Same as 3.84Mcps TDD mode. Only spreading factor 16 is applicable.

PICH info

Information Element/Group name	Need	Multi	Type and reference	Semantics description
Channelisation code	MD		Enumerated ((16/1)...(16/16))	Same as 3.84Mcps TDD.
Timeslot	MD		Timeslot number 10.3.6.72	Same as 3.84Mcps TDD.
~~Burst type~~	~~MP~~		~~Enumerated (Typ1,Typ2)~~	
Midamble shift	MD		Integer(0..15)	Range depends on cell configuration. A fixed association between channelisation codes and midamble shift is described in [1].
Repetition period/length	MD		Enumerated((4/2),(8/2), (8/4),(16/2), (16/4), (32/2),(32/4), (64/2),(64/4))	Same as 3.84Mcps TDD.
Offset	MP		Integer (0...Repetition period -1)	Same as 3.84Mcps TDD.
Paging indicator length	MD		Integer (2, 4, 8)	Same as 3.84Mcps TDD.
N_{GAP}	MD		Integer(2, 4, 8)	Same as 3.84Mcps TDD.
N_{PCH}	MD		Integer(1 .. 8)	Same as 3.84Mcps TDD.

13.3.3.5 Additional information elements for BCH

These information are proposed to be additionally included in System information block type 5 (in addition to the parameters for common channels)

Information Element/Group name	Need	Multi	Type and reference	Semantics description
Uplink synchronisation step size	MP		Integer(1..8)	This parameter specifies the step size to be used for the adjustment of the uplink transmission timing
Uplink synchronisation frequency	MP		Integer(1..8)	This parameter specifies the frequency of the adjustment of the uplink transmission timing
W	MP		Integer(8, 9, 12, 16, 21, 32, 64)	

13.3.3.6 Additional information element for TSTD

The following information element is proposed to be additionally included in IE "Downlink DPCH info for each RL".

Information Element/Group name	Need	Multi	Type and reference	Semantics description
TSTD indicator	MD		Boolean	Default value is "TRUE"

13.3.3.7 Information element for Propagation Delay Measurement

Following information element is proposed to be additionally included in IE "Measured results on RACH" to support the propagation delay measurement.

Information Element/group name	Need	Multi	Type and reference	Semantics description
$UpPCH_{ADV}$	MP		Integer (0..352)	In chips, For 1.28Mcps TDD

13.3.4 IE change example for 1.28Mcps TDD

NOTE: The tabular description in this subclause is for information only. Change requests on [5] may follow different methodology to incorporate changes for release 00.

It has been decided to distinguish the differences of FDD and TDD with the help of the CHOICE mode notation as described in [5] and [6]. This notation is suitable to both outline the desired commonalties between both modes and shows also the differences in an easy-to-read manner.
In order to include information elements that are specific for 1.28Mcps TDD into the existing [5] a similar principle could be used. An example how the differences between 1.28 Mcps TDD and 1.28 Mcps TDD could be shown is given in the table below.

10.3.6.49 Primary CCPCH info

Information Element/Group name	Need	Multi	Type and reference	Semantics description
CHOICE *mode*	MP			
>FDD				
>>TX Diversity indicator	MD		Boolean	Default value is "TRUE"
>TDD				
>>CHOICE TDD mode				
>>>3.84Mcps				
>>>>CHOICE SyncCase	OP			
>>>>>Sync Case 1				
>>>>>>Timeslot	MP		Integer (0...14)	PCCPCH timeslot
>>>>>Sync Case 2				
>>>>>>Timeslot	MP		Integer(0..6)	
>>>1.28Mcps			Null	(No data)
>>Cell parameters ID	OP		Integer (0...127)	The Cell parameters ID is described in [11].
>>Block STTD indicator	MD		Block STTD indicator 10.3.6.5	Default value is "TRUE". The usage of Block STTD is currently under discussion in WG1

Example for inclusion of 1.28 Mcps TDD in tabular format

The principles how 1.28 Mcps TDD option can be included in the tabular format of [5] have been described. It is proposed to apply a notation as shown in the above example in order to represent 1.28 Mcps TDD in [5] in R2000.

14 Key Procedures of TDD Low Chip Rate Option

14.1 RACH Procedure

14.1.1 Basic RACH Mechanism

The RACH mechanism that has been defined for the 1.28 Mcps TDD [1] is a two-step process that is similar to the two-step process that has been adopted for UTRA FDD.

Uplink Pilot Timeslot UpPTS is used for transmission of random access signatures, called SYNC1. The UpPTS is located in each 5 ms subframe and it is composed of 128 chips of SYNC1 and 32 chips of guard period. There should be 256 different SYNC1codes for the whole system and each 8 SYNC1 codes are allocated in a code group. Each 8 SYNC1 codes group corresponds to one SYNC code which is an identity of a cell and used for DL synchronization purpose.

When a RACH access is made with the 1.28 Mcps TDD option the following steps are completed:

i) The UE randomly chooses its SYNC1 code for cell access out of the 8 possible SYNC1 codes of the code group that is indicated through the used SYNC sequence in DwPTS. The UE transmits using this SYNC1 code in the UpPTS. It then monitors the burst of FPACH physical channel associated with the chosen SYNC1 sequence for acknowledgement.

ii) Acknowledgement on the FPACH will permit transmission of the RACH message in the PRACH resources that are associated with the FPACH. The acknowledgement contains the time corrections and power settings that are to be used with the PRACH transmission. The acknowledgement should be received within 4 sub-frames of the SYNC1 transmission being made.

After sending the RACH message, the UE will receive response by FACH on S-CCPCH indicating whether the UE random access has been accepted or not.

When sending a SYNC1 sequence, the UE knows which FPACH and PRACH resources will be used for the access. This information is provided in system information on BCCH.

The SYNC1 process can be repeated, up to a maximum number of times, including a power ramping of the SYNC1 transmissions. Figure 6 shows the random access transmission sequence for 1.28Mcps TDD.

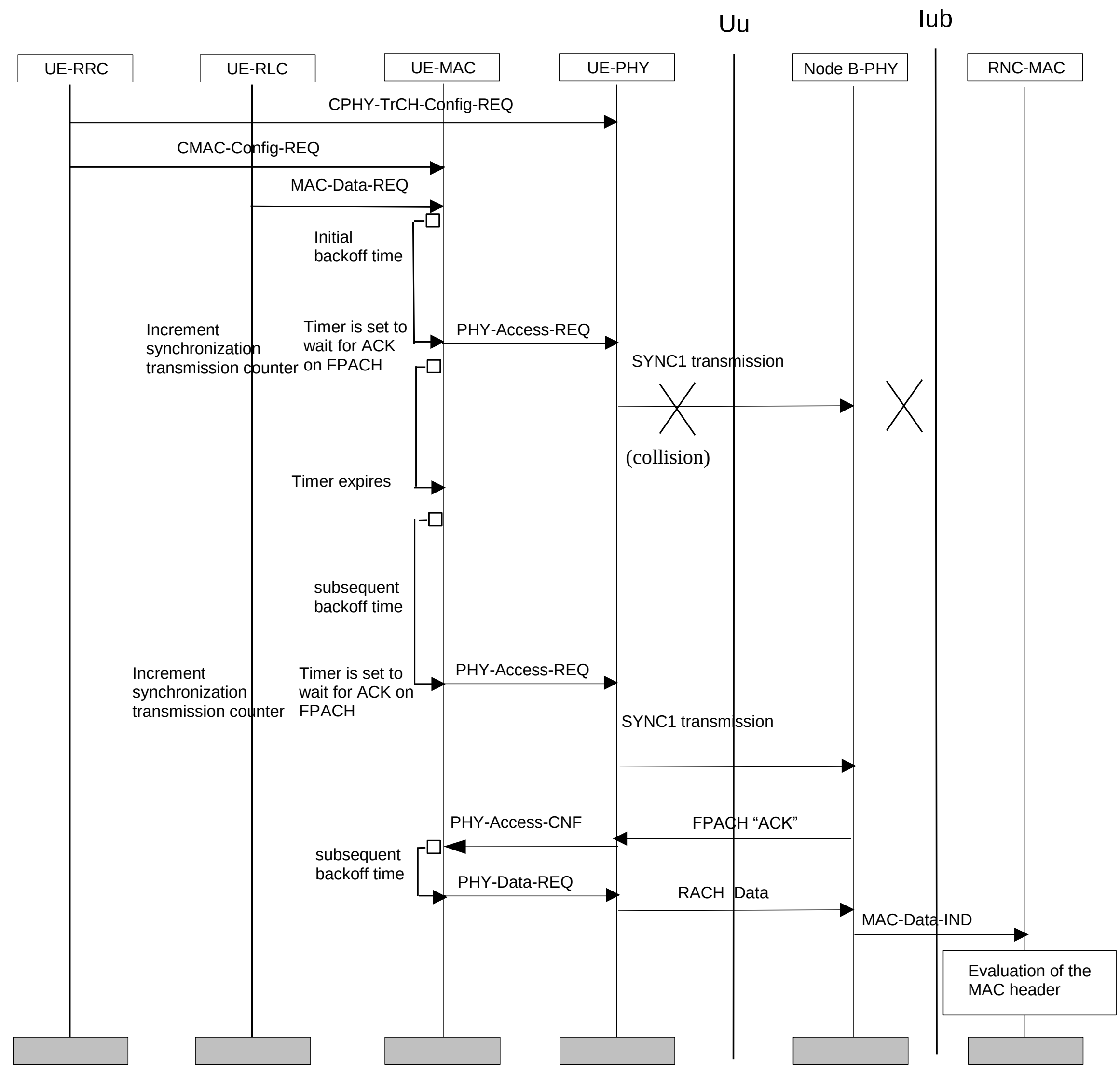

Figure 6: Random access transmission sequence

14.1.2 Control of RACH Transmissions for 1.28 Mcps TDD

The RACH transmissions are performed by the UE as shown in figure 7.

NOTE: The figure shall illustrate the operation of the transmission control procedure as specified below. It shall not impose restrictions on implementation.

UE MAC receives the following RACH transmission control parameters from RRC with the CMAC-Config-REQ primitive:

- a set of Access Service Class (ASC) parameters, which includes for each ASC, i=0,…,NumASC an identification of a PRACH partition and a persistence value P_i (transmission probability),
- maximum number of synchronisation attempts Mmax.

When there is data to be transmitted, MAC selects the ASC from the available set of ASCs, which consists of an identifier *i* of a certain PRACH partition and an associated persistence value P_i.

Based on the persistence value P_i, the UE MAC decides whether to start the L1 PRACH procedure in the present transmission time interval or not. If transmission is allowed, the PRACH transmission procedure (starting with the selection and transmission of a SYNC1 burst) is initiated by the sending of a PHY-ACCESS-REQ primitive. MAC then waits for access information from L1 via the PHY-ACCESS-CNF primitive. If transmission is not allowed, a new persistency check is performed in the next transmission time interval. The persistency check is repeated until transmission is permitted.

If the synchronisation burst has been acknowledged on the FPACH, L1 access information with parameter "ready for RACH data transmission" is indicated to MAC with a PHY-ACCESS-CNF primitive. Then data transmission is requested with a PHY-DATA-REQ primitive, and the PRACH transmission procedure shall be completed with transmission of the PRACH message on the P-RACH resources associated with the FPACH.

If PHY received no acknowledgement on the FPACH and the maximum number of synchronisation attempts permitted has not been exceeded, then a new persistency test is performed in the next transmission time interval and the PHY-ACCESS-REQ procedure is repeated. The timer T_2 ensures that two successive persistency tests are separated by at least one transmission time interval. If the maximum number of synchronisation attempts is exceeded then MAC abandons the RACH procedure and the message is discarded.

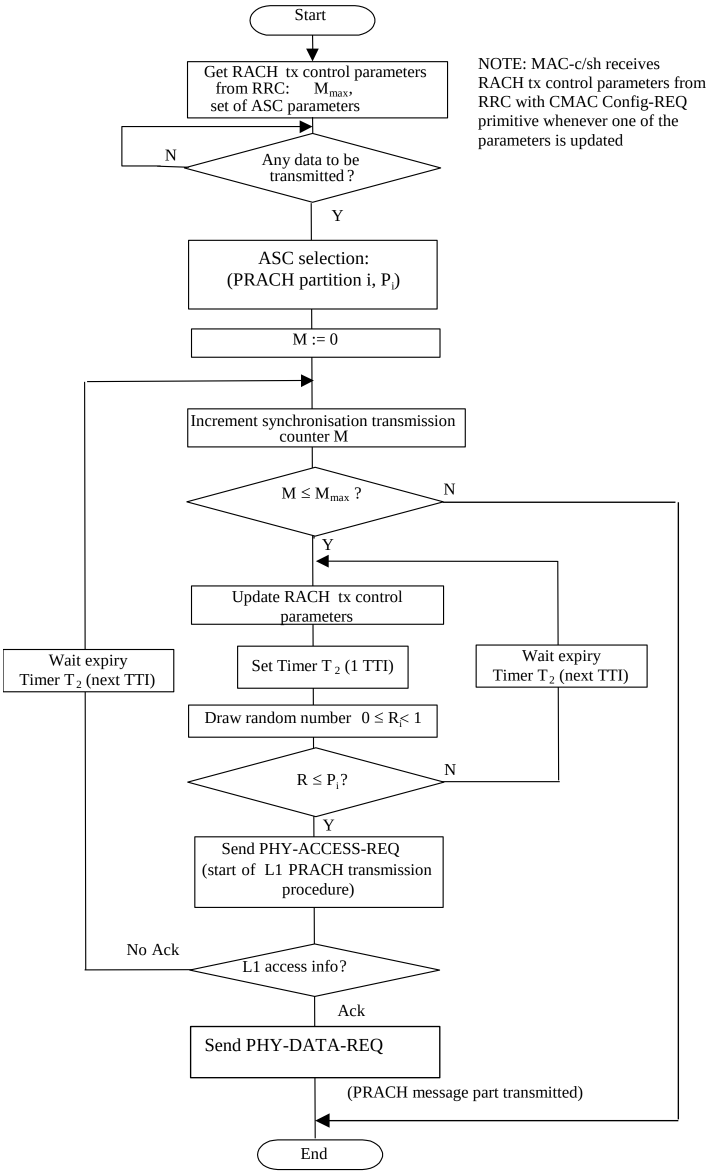

Figure 7: RACH transmission control procedure for 1.28 Mcps TDD (UE side, informative)

14.1.3 Modifications of Primitives to Support RACH

Due to the specific RACH procedure in 1.28 Mcps TDD, some modifications to the primitives are needed.

Specifically, the RACH transmission control elements assigned to CMAC-CONFIG-Req primitive between MAC and RRC as defined in [4] must contain the maximum number of synchronisation attempts:

RACH transmission control elements:

- *Set of ASC parameters (identifier for PRACH partitions, persistence values)*
- *Maximum number of preamble ramping cycles (FDD) or synchronisation attempts (1.28 Mcps TDD) M_{max}*
- *Minimum and maximum number of time units between two preamble ramping cycles, N_{BO1min} and N_{BO1max} (FDD only)*

In the primitives between L1 and MAC, some modification in the parameter access information is needed which is used in PHY-Access-CNF:

Access Information:

- *Ready for RACH data transmission (in case of FDD mode: when Ack on AICH has been received, in case of 1.28 Mcps TDD: when Ack on FPACH has been received).*
- *timeout, no response on AICH or AP-AICH or FPACH has been received while maximum number of access preamble transmissions / synchronisation attempts has been performed;*

The following values of this parameter apply to FDD only:

- *NACK on AICH or AP-AICH has been received;*
- *ready for CPCH data transmission (CD or CD/CA information received on CD-ICH or CD/CA-ICH, respectively);*
- *mismatch of CD-ICH or CD/CA-ICH signatures;*
- *no response on CD-ICH or CD/CA-ICH received;*
- *timeout, no CD/CA-ICH received.*

FPACH physical channel has to be added to **Physical Channel Description** used in CPHY-RL-Setup-REQ and CPHY-RL-Modify-REQ between L1 and L3, see subclause 11.3.5. PRACH description has to be slightly modified.

14.1.4 ASC/AC concept for 1.28 Mcps TDD

The difference in RACH procedure requires that the ASC/AC concept used in the 1.28 Mcps option is slightly different from that of the 3.84 Mcps option.

1. TDD 3.84 Mcps

   In TDD 3.84 Mcps RACH access is a one stage process, in which RACH transmission is repeated until an acknowledgement is obtained.

2. TDD 1.28 Mcps

   In 1.28 Mcps TDD, RACH access is a 2-stage process, governed by the SYNC1 transmission, as described in 14.1.1 above. SYNC1 transmission is repeated until an acknowledgement is obtained, so permitting transmission on the RACH, using pre-assigned resources.

It is therefore necessary to apply partitioning to the SYNC1 signal, rather than to the PRACH signal. It is proposed that the Access Service Class concept for PRACH partitioning for the UTRA TDD 3.84 Mcps, as defined in [5], is used for partitioning the SYNC1 signal in the UTRA TDD low chip rate option.

Access Classes (AC) and Access Service Classes (ASC) govern access to UpPTS, by allowing different priorities of UpPTS usage to different UEs (SYNC1 is transmitted on UpPTS). The Access Class to which a UE belongs is stored on its SIM. For initial access, the Access Service Class to be used for UpPTS is derived from the UEs Access Class by the AC-to-ASC Mapping information element, which is broadcast in BCH. The AC-to-ASC mapping as it is currently specified for FDD and 3.84 Mcps TDD remains the same for 1.28 Mcps TDD.

The UpPTS resources are divided into UpPTS partitions, consisting of sets of frames defined by frame repetition period and offset. Each Access Service Class maps to a UpPTS partition, so defining the frames on which that Access Service Class may transmit a SYNC1 code, and has a persistence value Pi, which defines the probability that the Access Service

Class will transmit a SYNC1 code on its allocated frames. The transmitted SYNC1 code is chosen randomly from the available set of signatures within the two subframes of the allowed frames for this Access Service Class.

With regard to the persistence value concept, no modification is required compared to 3.84 Mcps TDD.

14.2 Uplink Synchronization Procedure

Uplink Synchronization is a L1 function of 1.28 Mcps TDD. It is described in [1].

For the support of Uplink Synchronization, some parameters have to be introduced into RRC signalling, see subclause 13.2. No further impact on L23 protocols could be identified.

15 Cell (Re)Selection

15.1 States and Transitions in Idle Mode

No modifications compared to [8] are required.

15.2 Cell Selection Process

15.2.1 Initial and Stored Information Cell Selection

The initial and stored information cell selection procedures are basically the same as in 3.84 Mcps TDD.

However, the cell search process in 1.28 Mcps TDD is different from 3.84 Mcps TDD. The UE uses the SYNC code in DwPTS to acquire downlink synchronization to a cell. During this procedure, the UE needs to identify which of the 32 possible SYNC sequences is used. During the second step of the initial cell search procedure, the UE receives the midamble of the P-CCPCH. The location of the P-CCPCH is always known as it is sent directly before the DwPTS. Each SYNC code corresponds to a group of 4 different basic midamble codes which are again associated with a scrambling code. If the UE has determined the correct midamble code, it can read the system information on BCH.

For the stored information cell selection, stored information of carrier frequencies and optionally also information on cell parameters from previously received measurement control information elements is required. In 1.28 Mcps TDD, these parameters are the same as in 3.84 Mcps TDD (frequency information and optionally cell parameter ID).

15.2.2 Cell Selection Criteria

Cell selection Criteria are the same as in 3.84 Mcps TDD. P-CCPCH RSCP is used as measurement to determine the quality value $Q_{rxlevmeas}$.

Detailed ranges for the P-CCPCH RSCP measurement for 1.28 Mcps TDD are to be defined by WG4. The ranges of the parameters required to determine S_{rxlev} are f.f.s.

15.3 Immediate Cell Evaluation Process

The immediate cell evaluation process is the same as in 3.84 Mcps TDD.

15.4 Cell Reselection in Idle Mode

15.4.1 Measurement Rules for Cell-Reselection

No modifications compared to 3.84 Mcps TDD are required. The ranges of the measurement thresholds broadcast in system information are f.f.s.

15.4.2 Cell Reselection Criteria

No modifications compared to 3.84 Mcps TDD are required

15.4.3 Cell Reselection Parameters in system information broadcasts

Basically, the same parameters as in 3.84 Mcps TDD have to be broadcast for 1.28 Mcps TDD as well. The ranges for $Q_{rxlevmin}$, $S_{searchHCS}$, $S_{searchRATn}$, $S_{HCS,RATm}$, $S_{intrasearch}$, $S_{intersearch}$, $S_{limit,SearchRATm}$ are f.f.s.

15.5 Cell Status and Cell Reservations / Access Control

No modifications for 1.28 Mcps TDD are required.

15.6 Cell Reselection in Connected Mode

No modifications compared to 3.84Mcps TDD are required.

16 Handover Procedures

16.1 Handover Between 1.28 Mcps TDD Cells

Handover between 1.28 Mcps cells uses similar procedures and signalling to those that are specified for handover between 3.84 Mcps TDD cells. The differences are primarily contained in the procedures that are used by the UE to achieve synchronisation with the target cell when the handover takes place between unsynchronised cells.

The handover is initiated by the UTRAN in response to measurement reports made within the network and reported by the UE. The UE is instructed to make the handover by a PHYSICAL CHANNEL RECONFIGURATION message that contains a P-CCPCH info IE that is different from that which is stored in the UE.

If the IE 'Uplink Timing Advance Control' included in the 'Uplink DPCH info', in the PHYSICAL CHANNEL RECONFIGURATION message, indicates that timing advance is not enabled, then the UE hands over to the new cell without making a timing correction. It configures the new channels and transmits a PHYSICAL CHANNEL RECONFIGURATION COMPLETE message on the DCCH using AM RLC. RLC confirmation of its delivery enables the UE to resume transmissions on the new channels. The PHYSICAL CHANNEL RECONFIGURATION message may include an initial power level for uplink transmission in the new cell, if so, this power level shall be applied.

If the IE 'Uplink Timing Advance Control' indicates that timing advance is enabled and the IE 'Synchronisation Mode' indicates that the target cell is synchronised then the UE executes a synchronised handover procedure. It calculates the timing offset for the target cell, configures the new channels and transmits the PHYSICAL CHANNEL RECONFIGURATION COMPLETE message. Transmissions can then be resumed on the new channels, using the initial power setting if one has been provided. This is illustrated in figure 8.

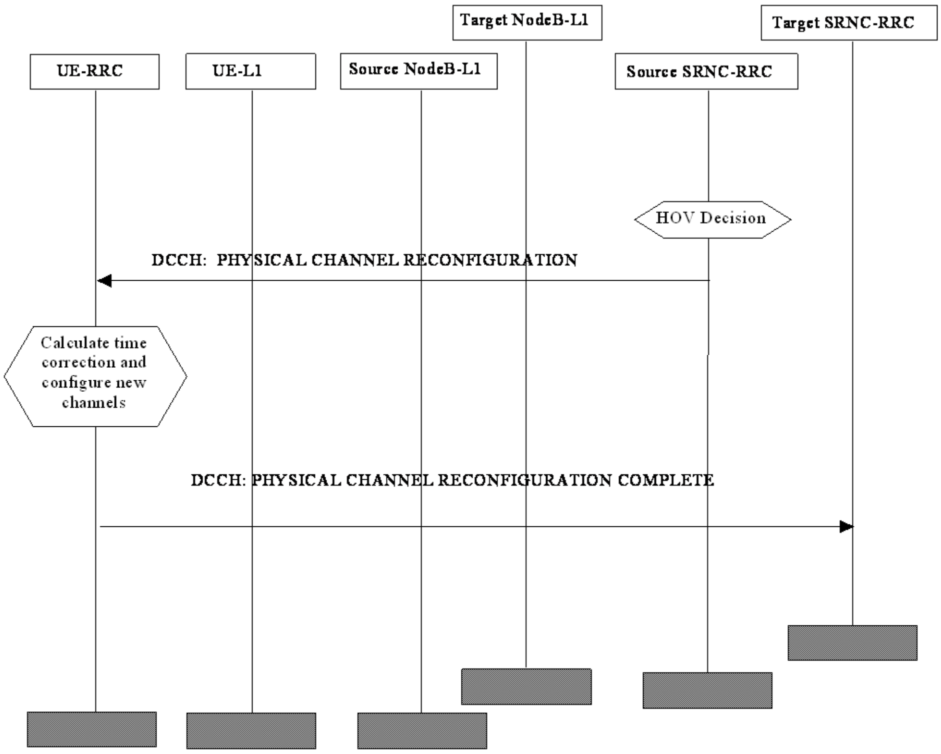

Figure 8: Synchronized Handover

If the IE 'Uplink Timing Advance Control' indicates that timing advance is enabled and the IE 'Synchronisation Mode' indicates that the target cell is unsynchronised then the UE executes an unsynchronised handover procedure. The procedure differs from that specified for 3.84 Mcps TDD because the use of type 3 bursts is replaced by synchronisation through a SYNC1(UpPTS) – FPACH exchange.

The UE transmits successively (every four sub-frames) in the UpPTS until a response is received on the FPACH. The UTRAN may specify, in the PHYSICAL CHANNEL RECONFIGURATION message, the synchronisation code set and PRACH partition that are to be applied to the UpPTS transmissions. The FPACH response will provide a timing and power correction to the UE. Following completion of the synchronisation procedure the UE is able to configure the new channels, transmit the PHYSICAL CHANNEL RECONFIGURATION COMPLETE message and resume transmissions. This is illustrated in figure 9.

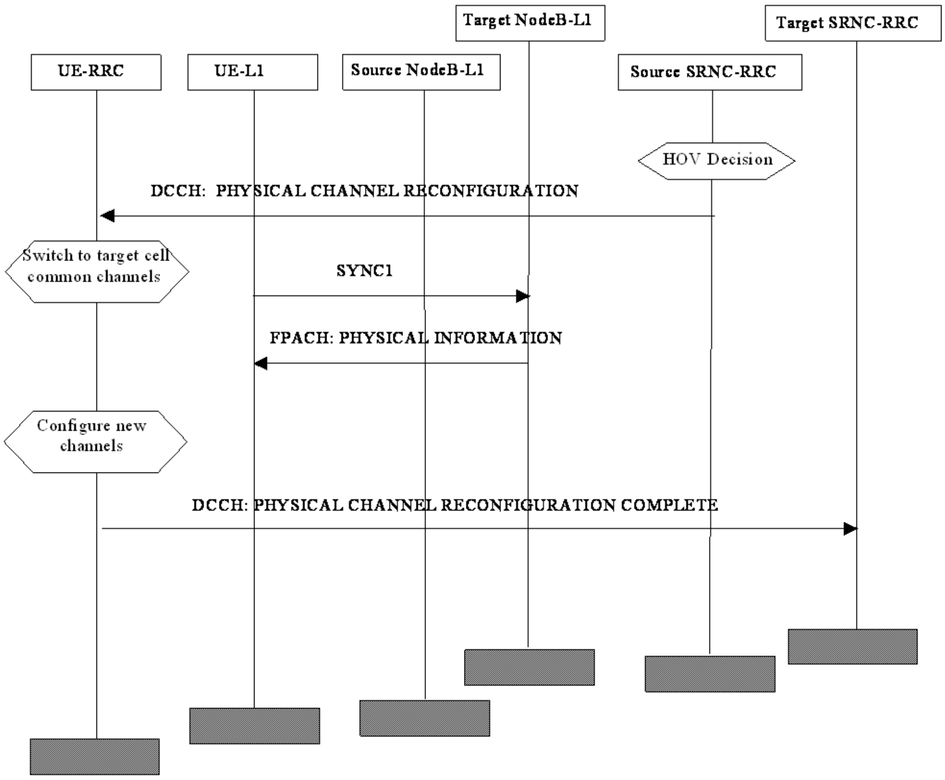

Figure 9: Unsynchronized Handover

16.2 Handover from UMTS FDD and 3.84 Mcps TDD Cells to a 1.28 Mcps TDD Cell

Handover from cells of UMTS TDD 3.84 and UMTS FDD systems to a cell of a UMTS TDD 1.28 Mcps system is similar to unsynchronised handover between cells of type UMTS TDD 1.28 Mcps as described in subclause 16.1.

The handover is initiated by the transfer, to the UE, of a 'Physical Channel Reconfiguration' message (or its equivalent). The message will contain target cell parameters and the physical resources to be used in the cell.

The UE will synchronise with the target cells transmissions and completes a SYNC1/FPACH exchange to obtain initial timing and power settings. The UE is then able to transmit on the assigned physical channels and should transmit a 'Physical Channel Reconfiguration Complete' on the DCCH using AM RLC. If the UE does not successfully execute the handover, it returns to its old system, resynchronises with it, and transmits a 'Physical Channel Reconfigure Failure' message on the DCCH using AM RLC.

16.3 Handover to UMTS FDD and 3.84 Mcps TDD Cells from a 1.28 Mcps TDD Cell

Handover from a TDD 1.28 Mcps cell to an FDD cell will be identical to that from a TDD 3.84 Mcps cell to an FDD cell [5]. Whilst handover, from a TDD 1.28 Mcps cell to a TDD 3.84 Mcps cell will be equivalent to that from FDD to TDD 3.84 Mcps. Should the handover fail, the UE will resynchronise with its original cell using the SYNC1/FPACH procedure and reconfigure to its previously assigned physical resources. It then transmits the 'Physical Channel Reconfiguration' message on the DCCH.

16.4 Handover from 1.28 Mcps TDD Cells to Cells of a Non-UMTS System

UMTS 1.28 Mcps TDD will support hard handover from 1.28 Mcps TDD cells to cells of an external system, e.g. GSM cells, provided that the UE has the capability to do so.

The handover procedure is identical to that specified in [5] for handover between cells of a UMTS system and cells of another radio access system.

16.5 Handover from Cells of a Non-UMTS System to Cells of 1.28 Mcps TDD

UMTS 1.28 Mcps TDD will support handover from cells of external systems, e.g. GSM, provided that the UE has the capability to do so.

The handover procedure is similar to that described for Inter-system handover to UTRAN in [5], although to enable the UE to obtain timing and initial power settings the 1.28 Mcps synchronisation procedure is executed before the UE transmits on the assigned channels.

The UE will have received a HANDOVER TO UTRAN COMMAND in its source network. This will have conveyed to the UE a U-RNTI, the traffic and physical channel parameters and the physical channel resources that are to be used in the 1.28 Mcps TDD cell.

The UE will synchronise with the target cells transmissions and perform a SYNC1/ FPACH exchange using parameters assigned to it in the HANDOVER TO UTRAN COMMAND message. This will provide the UE with initial timing and power settings. When the SYNC1/FPACH exchange is successfully completed, the UE will initiate the signalling, radio bearer and transport channels and configure the physical channels as defined in the HANDOVER TO UTRAN COMMAND message.

The UE will then transmit a HANDOVER TO UTRAN COMPLETE message on the DCCH using AM RLC. Should the UE fail to complete access to the new cell it will seek recovery in the system from which the handover was initiated. Receipt of the HANDOVER TO UTRAN COMPLETE message enables the UTRAN to report to the external network that resources assigned to the UE can be released.

17 Recommendations

(void)

Annex A: Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
12/2000	RP-10	RP-000556	-		Approved at TSG-RAN #10 and placed under Change Control	-	4.0.0
03/2001	RP-11	RP-010037	001		Tx diversity	4.0.0	4.1.0
	RP-11	RP-010037	002		Propagation delay measurement	4.0.0	4.1.0
	RP-11	RP-010037	003	1	Update of TR 25.834	4.0.0	4.1.0