

**Universal Mobile Telecommunications System (UMTS);
Low chip rate TDD Iub/Iur protocol aspects
(3GPP TR 25.937 version 4.0.0 Release 4)**



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Foreword

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Version m.t.e

where:

m indicates [major version number]

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

y the third digit is incremented when editorial only changes have been incorporated into the specification.

1 Scope

The work item “Low chip rate TDD Iub/Iur protocol aspects” is a Building Block which has been agreed at TSG RAN#8 as described in contribution [1]. Its parent feature is “Low chip rate TDD” which has been agreed at TSG-RAN#6 and updated at RAN#7. The purpose of the work item “Low chip rate TDD Iub/Iur protocol aspects” is to update the Iub/Iur interface protocol specifications and related overview specifications in RAN WG3 in support of the several aspects of the feature “Low chip rate TDD”.

The purpose of the present document is to help the TSG RAN WG3 group to specify the changes to existing specifications, needed for the introduction of the low chip rate TDD option in the UTRAN for Rel.4. It is intended to gather all information in order to trace the history and the status of the Work Task in RAN WG3. It is not intended to replace contributions and Change Requests, but only to list conclusions and make reference to agreed contributions and CRs. When solutions are sufficiently stable, the CRs can be issued.

It describes agreed requirements related to the Work Task, and split the Work Task into “Study Areas” in order to group contributions in a consistent way.

It identifies the affected specifications with related Change Requests.

It also describes the schedule of the Work Task.

This document is a ‘living’ document, i.e. it is permanently updated and presented to all TSG-RAN meetings.

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] RP-(00)0316rev, Low chip rate TDD Iub/Iur protocol aspects, Work Item Description
- [2] void.
- [3] TR 25.928 (by RAN WG1), 1.28 Mcps functionality for UTRA TDD Physical Layer
- [4] TR 25.834 (by RAN WG2), UTRA TDD Low Chip Rate Option Radio Protocol Aspects
- [5] TS 25.302, Services provided by the Physical Layer
- [6] TS 25.420, UTRAN Iur Interface: General Aspects and Principles
- [7] TS 25.430, UTRAN Iub Interface: General Aspects and Principles
- [8] TS 25.401: UTRAN Overall Description
- [9] TS 25.423, UTRAN Iur interface RNSAP signalling
- [10] TS 25.425, UTRAN Iur interface user plane protocols for CCH data streams
- [11] TS 25.427, UTRAN Iur and Iub interface user plane protocols for DCH data streams
- [12] TS 25.433, UTRAN Iub interface NBAP signalling
- [13] TS 25.435, UTRAN Iub interface user plane protocols for CCH data streams

- [14] TR 25.990: Vocabulary for the UTRAN
 [15] TS 25.402, Synchronisation in UTRAN
 [16] TR 25.921, Guidelines and Principles for protocol description and error handling

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in [14] apply. In addition, the following terms are used, as already introduced in [3] and [4]:

- 1.28 Mcps TDD The low chip rate option of TDD
 3.84 Mcps TDD The high chip rate option of TDD

3.2 Symbols

Void.

3.3 Abbreviations

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

ASC	Access Service Class
BCCH	Broadcast Control Channel
BCH	Broadcast Channel
BMC	Broadcast/Multicast Control
C-	Control-
CCCH	Common Control Channel
CCH	Control Channel
CCTrCH	Coded Composite Transport Channel
CN	Core Network
CRC	Cyclic Redundancy Check
CTCH	Common Traffic Channel
DC	Dedicated Control (SAP)
DCA	Dynamic Channel Allocation
DCCCH	Dedicated Control Channel
DCH	Dedicated Channel
DL	Downlink
DRNC	Drift Radio Network Controller
DSCH	Downlink Shared Channel
DTCH	Dedicated Traffic Channel
DwPCH	Downlink Pilot Channel
FACH	Forward Link Access Channel
FDD	Frequency Division Duplex
FPACH	Fast Physical Access Channel
GC	General Control (SAP)
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)
LCR	Low Chip Rate
MAC	Medium Access Control
Nt	Notification (SAP)
PCCH	Paging Control Channel
P-CCPCH	Primary Common Control Physical Channel
PCH	Paging Channel
PDCP	Packet Data Convergence Protocol
PDSCH	Physical Downlink Shared Channel
PDU	Protocol Data Unit
PHY	Physical layer
PhyCH	Physical Channels
P-RACH	Physical Random Access Channel
PU	Payload Unit
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
Rx	Receive
SAP	Service Access Point
SCH	Synchronization Channel
SDU	Service Data Unit
SHCCH	Shared Channel Control Channel
SIR	Signal to Interference Ratio
SRNC	Serving Radio Network Controller
SRNS	Serving Radio Network Subsystem
TCH	Traffic Channel
TDD	Time Division Duplex
TFCI	Transport Format Combination Indicator
TFI	Transport Format Indicator
TPC	Transmit Power Control
TS	Timeslot
TS	Technical Specification
Tx	Transmit
U-	User-
UE	User Equipment
UL	Uplink
UMTS	Universal Mobile Telecommunications System
UpPCH	Uplink Pilot Channel
URA	UTRAN Registration Area
USCH	Uplink Shared Channel
UTRA	UMTS Terrestrial Radio Access
UTRAN	UMTS Terrestrial Radio Access Network

4 Overview of the TDD low chip rate option

4.1 Physical layer

4.1.1 General

This section contains the basic information about frame and burst structure of the physical layer of the TDD low chip rate option. In particular, the differences to the wideband TDD option (3.84 Mcps) are highlighted. More information on the physical layer characteristics of TDD low chip rate option can be found in [3] .

The physical layer differences compared to wideband TDD are:

- Chiprate: 1.28 Mcps;
- Frame structure: Within a 10 msec frame, there are two sub-frames of 5 msec each; 7 time slots per sub-frame;
- More rigid switching point rule (TS0 is always downlink, TS1 is always uplink);
- Special guard period between TS0 and TS1;
- Special "pilot channels" DwPCH, UpPCH between TS0 and TS1;
- Fast Physical Access Channel (FPACH) for access request acknowledgement;
- Just one burst type (in the normal time slots);
- No physical synchronisation channel SCH;
- Uplink synchronisation is performed at Layer 1 for PRACH and uplink DPCH.

The main reason for these differences compared to wideband TDD are to meet the requirements for:

- Increased range (up to 11 km) without restriction on the time slot allocation;
- Fast uplink synchronisation on uplink physical channels, also on PRACH, for increased capacity;
- Optional support of smart antennas (beamforming).

4.1.2 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.

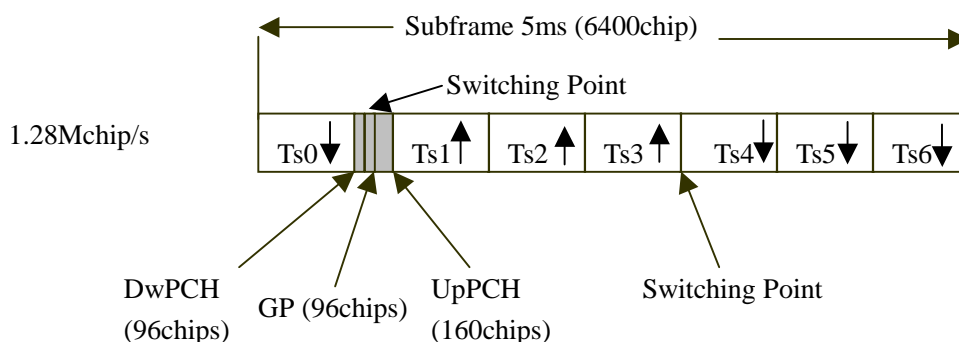


Figure 1: Structure of the sub-frame for TDD low chip rate option

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

DwPCH: downlink pilot channel, 96 chips duration;

UpPCH: uplink pilot channel, 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.

4.1.3 Burst Types

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

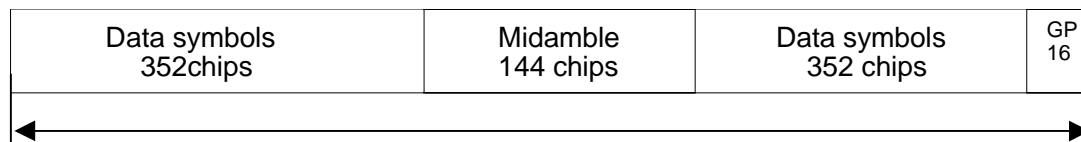


Figure 2 Burst structure for normal traffic time slot

The structure for DwPCH and UpPCH is described in Figure 3 and Figure 4.

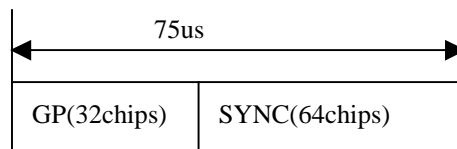


Figure 3: Structure for DwPCH

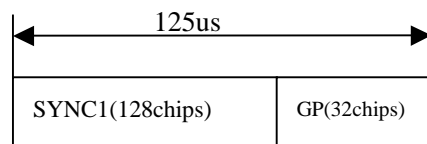


Figure 4: Structure for UpPCH

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 DwPCH 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 DwPCH of a close by Node B inside these 48 chip. 48 chip corresponds 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 DwPCH of the handover candidate Node B.

In DwPCH and UpPCH, 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) channel.

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. It 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 Fig. 2).

4.2 Transport Channel and higher layer differences compared to TDD-high

For details on the higher layers of the radio protocol of the low-chip-rate TDD option see [4].

At Transport Channel level, no significant differences compared to wideband TDD have been identified. The only points to mention are:

The “Rx Timing Deviation” measurement performed by Node B for RACH, uplink DCH, and USCH, may become obsolete since Timing advance (performed for wideband TDD at RRC level) is replaced by Fast Uplink Synchronisation which is a Layer 1 function performed by Node B with minimum higher layer interactions.

DSCH and USCH details may be different.

4.3 Other key features of low-chip-rate TDD

Smart antenna. The frame structure of 1.28 Mcps TDD has taken some new technologies into consideration, both the smart antenna (beam forming) technology and the uplink synchronisation will be well supported [4].

5 Iub/Iur aspects of Low chip rate TDD radio frame structure

5.1 Introduction

This chapter includes several properties of the radio frames used in low chip rate TDD. On the Iub and Iur interface, this will imply new parameters and information elements in the radio related control plane protocols.

The following impacts have been identified in a Liaison Statement from RAN1 to RAN3 [2].

- Different frame structure than for high chiprate TDD option;
- Different basic midamble sequences, maximum channel impulse response is scalable ($W=8, 9, 12, 16, 21, 32, 64$), depending on number of users and environment, including the association between midambles and channelisation codes;
- Use of only one burst type for physical channels except special bursts in DwPCH/UpPCH. 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;

- Support of different timeslot formats due to different number of bits and L1 control signals and midamble length;
- Support of use of 8PSK for special timeslots/all timeslots per cell;
- Beacon function is provided by DwPCH and P-CCPCH.

5.2 Requirements

In view of the Iub/Iur aspects, the requirements resulting from the different frame structure of 1.28 Mcps TDD compared to 3.84 Mcps TDD are as follows.

In NBAP and RNSAP messages, the information elements referring to time slot information, burst types, and common physical channels will have to be updated to cover both TDD chip rate options. If necessary, new IEs dedicated to 1.28 Mcps TDD will have to be introduced.

These NBAP and RNSAP protocol extensions towards Rel.4 must be done in a backward compatible way, which means, among others: A Rel.4 Node B shall be able to understand Rel.99 NBAP messages, and a Rel.99 Node B shall be able to understand and comprehend Rel.4 messages and shall execute the functions provided these are within the scope of the Rel.99 Node B.

The Release 4 versions of NBAP and RNSAP, including the changes required for support of both TDD chip rate options, shall - like the Rel.99 versions - meet the principles for protocol description and error handling established in [16].

5.3 Study areas

It has been studied how the different time slot structure and burst type can be introduced in RNSAP and NBAP in a way which meets the above mentioned requirements.

In particular, it was studied whether a "CHOICE TDD mode" could be introduced within the existing *Timeslot Info* IE, to extend this IE to include the parameters of 1.28 Mcps TDD as well. However, it has been found that this would result in a non-backward compatible change to NBAP and RNSAP: A Release 99 Node B would not understand the extended IE even if the IE would only address the 3.84 Mcps TDD option. So it was decided to introduce a new *Timeslot Information LCR* IE and some related IEs with extension "LCR" (where LCR means "Low Chip Rate"), and to introduce these as *optional* IEs (although mandatory for 1.28 Mcps TDD) in the respective messages, for the sake of backward compatibility to Rel.99, as described below.

5.4 Agreements and associated contributions

As a result of the studies, it was agreed to introduce the following new IEs in NBAP and/or RNSAP, in support of the new Frame Structure and radio burst parameters for 1.28 Mcps TDD:

Existing IE for 3.84 Mcps TDD	New Rel.4 LCR IE for 1.28 Mcps TDD	What is the difference of the 1.28 Mcps IE compared to 3.84?
<i>Time Slot</i> IE	<i>Time Slot LCR</i> IE	Range 0..6 rather than 0..14
<i>TDD Channelisation Code</i> IE	<i>TDD Channelisation Code LCR</i> IE	8PSK modulation option in case of SF = 1
<i>Midamble Shift and Burst Type</i> IE	<i>Midamble Shift LCR</i> IE	Midamble not dependent on burst type; just 1 burst type.
<i>DL Timeslot Information</i> IE	<i>DL Timeslot Information LCR</i> IE	Includes <i>Time Slot LCR</i> IE, <i>Midamble Shift LCR</i> IE, <i>DL Code Information LCR</i> IE

Existing IE for 3.84 Mcps TDD	New Rel.4 LCR IE for 1.28 Mcps TDD	What is the difference of the 1.28Mcps IE compared to 3.84?
<i>UL Timeslot Information IE</i>	<i>UL Timeslot Information LCR IE</i>	Includes <i>Time Slot LCR IE</i> , <i>Midamble Shift LCR IE</i> , <i>UL Code Information LCR IE</i>
<i>TDD DL Code Information IE</i>	<i>TDD DL Code Information LCR IE</i>	Includes <i>TDD Channelisation Code LCR IE</i>
<i>TDD UL Code Information IE</i>	<i>TDD UL Code Information LCR IE</i>	Includes <i>TDD Channelisation Code LCR IE</i>
<i>UL Time Slot ISCP Info IE</i>	<i>UL Time Slot ISCP Info LCR IE</i>	Includes <i>Time Slot LCR IE</i>
<i>DL Time Slot ISCP Info IE</i>	<i>DL Time Slot ISCP Info LCR IE</i>	Includes <i>Time Slot LCR IE</i>
<i>Neighbouring TDD Cell Information IE</i>	<i>Neighbouring TDD Cell Information LCR IE</i>	Includes <i>Time Slot LCR IE</i>

For the details of the definition of these IEs, see the proposed Change Requests to NBAP and RNSAP for introducing the 1.28 Mcps TDD option.

5.5 Specification impact and associated Change Requests

These Iub/Iur protocol aspects have impacts on the following Specifications:

[12] (NBAP), [9] (RNSAP).

In addition, the UpPCH and the DwPCH which use the special, short time slots between TS0 and TS1, are visible in the Node B resources model in [7].

The other RAN WG3 Technical Specifications are not affected by the new radio frame structure of 1.28Mcps TDD.

5.6 Open issues

None.

6 Iub/Iur aspects of physical channel types

6.1 Introduction

6.1.1 General

In addition to the physical channels defined for UTRA TDD, three physical channels are added to support low chip rate TDD option, they are: DwPCH (Downlink Pilot Channel), UpPCH (Uplink Pilot Channel) and FPACH (Fast Physical Access CHannel). 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.

Shared channels, PUSCH and PDSCH, will be supported by TDD low chip rate option, but details are ffs [4].

The parameters of the added physical channels and of the modified PRACH, as far as the Iub interface protocols are concerned, are described in the following:

6.1.2 DwPCH

- Tx diversity mode (TSTD indicator);
- SYNC_DL code ID;
- DwPCH power.

6.1.3 UpPCH

- SYNC_DL code ID. The Node B derives this parameter from the channelisation code parameters of FPACH and PRACH in a standardised way [3], therefore the UpPCH is not explicitly configured in the Node B.

6.1.4 FPACH

- Channelisation code;
- Timeslot;
- Midamble shift.
- Max FPACH power.

6.1.5 PRACH

- Timeslot;
- Spreading Codes;
- Midamble Shift.

6.2 Requirements

In view of the Iub/Iur aspects, the requirements resulting from the specific physical channel types of 1.28 Mcps TDD compared to 3.84 Mcps TDD are as follows.

In NBAP and RNSAP messages, the information elements referring to common physical channels will have to be updated to cover both TDD chip rate options. For FPACH and DwPCH, new IEs will have to be introduced.

These NBAP and RNSAP protocol extensions towards Rel.4 must be done in a backward compatible way.

The Release 4 versions of NBAP and RNSAP, including the changes required for support of both TDD chip rate options, shall - like the Rel99 versions - meet the principles for protocol description and error handling established in [16].

6.3 Study areas

It has been studied how the changes can be introduced in RNSAP and NBAP in a way which meets the above mentioned requirements.

It was decided to introduce new *LCR* specific IEs, and to introduce these as *optional* IEs (although mandatory for 1.28Mcps TDD) in the respective messages, for the sake of backward compatibility to Rel.99.

At the same time, the IEs which are specific for 3.84 Mcps TDD and hence not applicable for 1.28 Mcps TDD, shall be made optional, in the Tabular messages and in ASN.1, to allow to omit these in 1.28 Mcps TDD related messages. This is possible in a backward compatible way, provided that these IEs have an assigned criticality in the Release 99 versions of NBAP and RNSAP. In case these IEs are in fact mandatory for either of the TDD chiprate options, it shall be noted in the "Semantics description" in the tabular format, and in ASN.1, and in the procedure text, that the presence of these IEs is conditional on the choice of the TDD chiprate option.

6.4 Agreements and associated contributions

6.4.1 TSTD Transmission

In the TSTD scheme for 1.28 Mcps TDD, two spatially separated antennas are alternately used at the base station to transmit each consecutive sub-frame of the downlink physical channels. The TSTD scheme takes advantage of the frame structure of the 1.28Mcps UTRA TDD, where the frame structure makes TSTD transmission possible with a single power amplifier.

A summary of the TSTD scheme is as follows:

- The TSTD scheme takes advantage of the sub-frame structure of 1.28Mcps TDD mode.
- Negligible additional hardware cost for base station (no additional power amplifier).
- There is little impact on UE receiver structure.
- TSTD requires minimal higher layer signalling. The higher layer only need to inform the UE that TSTD scheme is used so that UE can use appropriate power control algorithm.

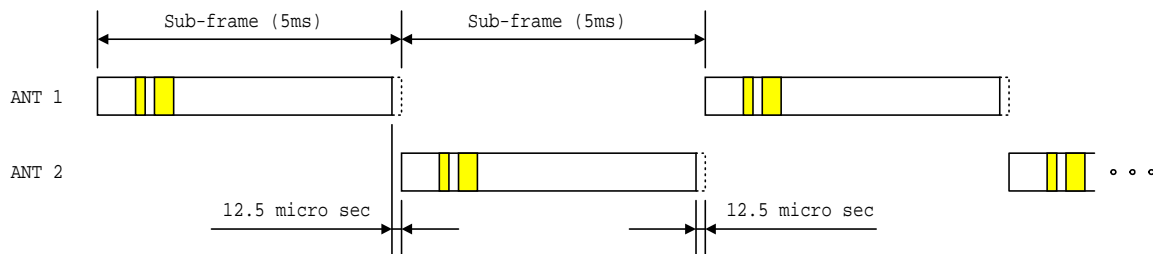


Figure 6.1: TSTD switching pattern utilizing sub-frame structure in down link

6.4.2 Tx Diversity and Beamforming

Depending on the capability of the base station and the characteristics of the physical channels, many different combinations of TSTD, STTD, and beamforming are possible. For DwPCH, STTD cannot be used due to its nature. For P-CCPCH, both of the STTD and TSTD can be used but beamforming cannot be used because P-CCPCH carries the broadcast channel BCH. On the other hand, beamforming as well as Tx diversity schemes such as STTD or TSTD can be used for DPCH.

The different transmit diversity schemes for different downlink physical channel types in 1.28Mcps TDD are described in [3].

6.4.3 Signaling support for Downlink Tx Diversity

For 3.84 Mcps TDD, CRNC determines whether a cell apply downlink Tx diversity to DCH or not and Block STTD to PCCPCH when the cell is set up. For 1.28 Mcps TDD, CRNC may determine that a cell apply TSTD to PCCPCH and DwPCH. The corresponding information should be included in CELL SETUP REQUEST message to support the downlink Tx diversity schemes for 1.28 Mcps TDD. For each Radio Link, CRNC may determine that TSTD is applied to the Radio Link. The corresponding information should be included in RADIO LINK SETUP/ADDITION RESPONSE RNSAP message and RADIO LINK SETUP/ADDITION REQUEST NBAP message.

The needed new IE in CELL SETUP REQUEST message for 1.28 Mcps TDD is as follows:

- *TSTD Indicator IE* for PCCPCH;
- *TSTD Indicator IE* on DwPCH.

The needed new IE in RADIO LINK SETUP/ADDITION RESPONSE RNSAP message and RADIO LINK SETUP/ADDITION REQUEST NBAP message for 1.28 Mcps TDD is as follows:

- *TSTD Indicator* IE for Radio Link.

6.5 Specification impact and associated Change Requests

These Iub/Iur protocol aspects have effects on the following Specifications:

25.430 [7], RNSAP [9], NBAP [12], 25.435 [13].

6.5.1 Impact on TS 25.433 (NBAP)

In addition to the new IEs listed in chapter 5.4 related to the Frame Structure, the following IEs need to be defined:

Existing IE for 3.84 Mcps TDD	New Rel.4 LCR IE for 1.28 Mcps TDD	What is the difference of the 1.28Mcps IE compared to 3.84?
-	<i>Max FPACH Power</i> IE	FPACH newly introduced.
-	<i>DwPCH Power</i> IE	DwPCH newly introduced.
-	<i>SYNC_DL Code ID</i> IE	DwPCH newly introduced.

In addition, new IEs are required in support of TSTD for 1.28Mcps TDD.

The needed new IE in CELL SETUP REQUEST message for 1.28 Mcps TDD is as follows

- *TSTD Indicator* IE for PCCPCH;
- *TSTD Indicator* IE on DwPCH.

The needed new IE in RADIO LINK SETUP/ADDITION RESPONSE RNSAP message and RADIO LINK SETUP/ADDITION REQUEST NBAP message for 1.28 Mcps TDD is as follows:

- *STD Indicator* IE for Radio Link.

The following examples show how the CELL SETUP REQUEST message for TDD cells in NBAP could be changed for Release 4, to include the Information Elements of the low-chip-rate TDD option in a backward compatible way.

Example: CELL SETUP REQUEST (TDD Message, TS25.433) with extensions for the low chip rate TDD option

(TS25.433 9.1.24.2 TDD Message)

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message discriminator	M		9.2.1.45		–	
Message Type	M		9.2.1.46		YES	reject
Transaction ID	M		9.2.1.62		–	
Local Cell Id	M		9.2.1.38		YES	reject
C-Id	M		9.2.1.9		YES	reject
Configuration Generation Id	M		9.2.1.16		YES	reject
UARFCN	M		9.2.1.65	Corresponds to Nt [15]	YES	reject
Cell Parameter ID	M		9.2.3.4		YES	reject
Maximum Transmission Power	M		9.2.1.40		YES	reject
Transmission Diversity Applied	M		9.2.3.26	On DCHs	YES	reject
Sync Case	M		9.2.3.18		YES	reject
Synchronisation Configuration		1			YES	reject
>N_INSYNC_IND	M		9.2.1.47A		–	
>N_OUTSYNC_IND	M		9.2.1.47B		–	
>T_RLFailure	M		9.2.1.56A		–	
DPCH Constant Value	M		Constant Value		YES	reject
PUSCH Constant Value	M		Constant Value		YES	reject
PRACH Constant Value	M		Constant Value		YES	reject
SCH Information	<u>O</u>	1		Mandatory For 3.84Mcps TDD only	YES	reject
>Common physical channel ID	M		9.2.1.13		–	
>CHOICE Sync Case						
>>Case 1					YES	reject
>>>Time Slot	M		9.2.3.23		–	
>>Case 2					YES	reject
>>>SCH Time Slot	M		9.2.3.17		–	
>SCH Power	M		DL Power 9.2.1.21		–	
>TSTD Indicator	M		9.2.1.64		–	
PCCPCH Information	<u>O</u>	1		Mandatory For 3.84Mcps TDD only	YES	reject
>Common physical channel ID	M		9.2.1.13		–	
>TDD Physical Channel Offset	M		9.2.3.20	'Offset' = 0 for low chip rate TDD	–	
>Repetition Period	M		9.2.3.16		–	
>Repetition Length	M		9.2.3.15		–	
>PCCPCH Power	M		9.2.3.9		–	
>Block STTD Indicator	M		9.2.3.1		–	
>TSTD Indicator	<u>O</u>		9.2.1.64	For low chip rate TDD	YES	reject
Time Slot Configuration	<u>O</u>	1 .. 15		Mandatory For 3.84Mcps TDD only	GLOBAL	reject
>Time Slot	M		9.2.3.23		–	
>Time Slot Status	M		9.2.3.25		–	
>Time Slot Direction	M		9.2.3.24		–	
Time Slot Configuration	<u>O</u>	1 .. 7		Mandatory	GLOBAL	Reject

LCR				For 1.28Mcps TDD only		
>Time Slot LCR	M		9.2.3.x		=	
>Time Slot Status	M		9.2.3.25		=	
>Time Slot Direction	M		9.2.3.24		=	
PCCPCH Information LCR	O	1		Mandatory For 1.28Mcps TDD only	YES	reject
>Common physical channel ID	M		9.2.1.13		=	
>Time Slot LCR	M		9.2.3.x2		=	
>TDD Physical Channel Offset	M		9.2.3.20		=	
>Repetition Period	M		9.2.3.16		=	
>Repetition Length	M		9.2.3.15		=	
>PCCPCH Power	M		9.2.3.9		=	
>Block STTD Indicator	M		9.2.3.1		=	
>TSTD Indicator	M		9.2.1.64		=	
DwPCH Information		0..1		Mandatory For 1.28Mcps TDD only	YES	reject
>Common physical channel ID	M		9.2.1.13		=	
>TSTD Indicator	M		9.2.1.64		=	
>SYNC_DL Code ID	M		9.2.3.x4		=	
>DwPCH Power	M		9.2.3.x3		=	

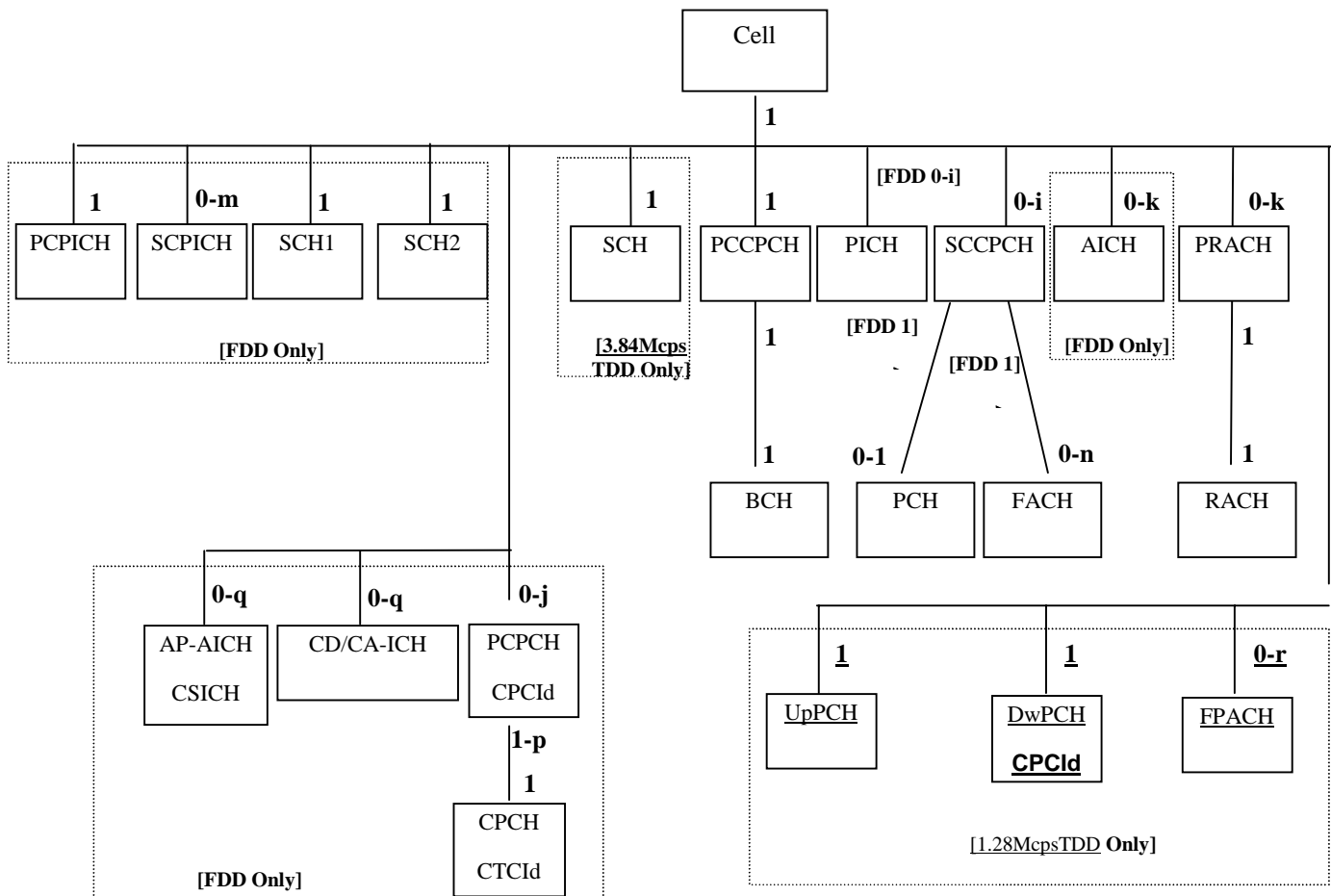
Figure x2: Example for a Release 4 message with backward compatible additions for 1.28 Mcps TDD

6.5.2 Impact on TS 25.430

In chapter 6 “Node B logical Model over Iub” of TS25.430 [7],

In the section 6.2.4.1 “common resource”, the common resource in Node B are described in Figure 3, and it only include FDD mode and 3.84Mcps TDD option, So it is suggested that to modify the figure to include 1.28Mcps TDD option also.

The following figure is recommended:



CPCId = Common Physical Channel Identifier

CTCId = Common Transport Channel Identifier

[TDD - The number of PICH = the number of PCH]

[FDD - The number of AICH = the number of PRACH]

[TDD – PCH and FACHs can be mapped on one or more SCCPCH]

Figure X: Common resources in a Node B that are managed by the CRNC

6.6 Open issues

None.

7 lub/lur aspects of transport channel features

7.1 Introduction

7.1.1 General

The transport channel concept for UTRA TDD low chip rate option is the same as for UTRA TDD 3.84 Mcps as defined in [5]. Some differences exist with respect to the features of some of the transport channels.

7.1.2 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 ffs, 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 details of shared channels USCH and DSCH are ffs.

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

7.1.3 System information broadcast

For the low chip rate TDD a predefined PCCPCH that carries system information transmitted on BCH is proposed. The PCCPCH uses two codes of spreading factor 16 in a predefined timeslot (TS0). Two codes of spreading factor 16

provide a data rate of all in all 35.2 kbit/s, which is certainly sufficient to allow the same transport format as in FDD and high chip rate TDD. It might be possible to use a bigger transport block size or apply stronger coding. However, this does not prevent low chip rate TDD from using exactly the same principles for system information broadcast. In principle the same kind of information needs to be broadcast. Modifications are only required to support the physical layer of low chip rate TDD.

As a conclusion only some new information elements need to be broadcast but no changes to the principles of system information broadcast are foreseen.

7.1.4 Usage of RACH

The proposed RACH procedure in low chip rate TDD provides large flexibility. The PRACH basically allows the same configuration possibilities as a DPCH. Thus the allowed transport formats can be adjusted according to the actual needs. The configuration to be used for the PRACH transmissions is broadcast on BCH. This assures that the required signalling e.g. for initial access can be realized with the same messages as currently defined. Only differences of detail of the messages requiring the RACH are foreseen. However, the details of the realization of a similar concept for Access Service Classes are currently under further study.

As a conclusion there are no major problems identified that will result in problems of the usage of the principles of the current NBAP/RNSAP protocol.

7.1.5 Common downlink channels

The common channels can also be configured to provide sufficient capacity for the messages that need to be transmitted on common downlink channels. The exact configuration is as in FDD and high chip rate TDD broadcasted on BCH.

BCH is mapped on the P-CCPCH while PCH, PICH and FACH can be time multiplexed on the S-CCPCH. These physical channels are using channelisation codes of SF 16.

7.2 Requirements

The Iub/Iur protocols shall support all the above mentioned features with reuse of the existing protocol principles.

7.3 Study areas

The study areas related to the Transport Channel differences are the same as for the Physical Channel differences between 1.28Mcps and 3.84Mcps TDD, discussed in chapter 6.3.

7.4 Agreements and associated contributions

See the proposed Change Requests.

7.5 Specification impact and associated Change Requests

It is expected that this Iub/Iur protocol aspects has impacts on the following Specifications:

RNSAP [9], 25.433 [12].

7.6 Open issues

None.

8 lub/lur aspects of Uplink synchronisation

8.1 Introduction

This aspect includes the following items:

- Special Layer1-Synchronisation Shift (SS) symbols;
- Number of used SS symbols can take 3 values;
- SS-symbols are transmitted once per subframe.

In principle, this feature replaces the "Timing advance" function which is performed by higher layer interaction in 3.84 Mcps TDD.

8.1.1 The establishment of uplink synchronization

8.1.1.1 Preparation of uplink synchronization by downlink synchronization

When a UE is powered on, it first needs to establish the downlink synchronisation with the cell as describe in [3] about cell search procedure. Only after the UE can establish and maintain the downlink synchronisation, it can start the uplink synchronisation procedure.

8.1.1.2 Establishment uplink synchronization

Although the UE can receive the downlink synchronization signal from the Node B, the distance to Node B is still uncertain which would lead unsynchronised uplink transmission. Therefore, the first transmission in uplink direction is performed in a special Channel UpPCH to reduce interference in traffic time-slots.

The timing used for the SYNC1 burst are set e.g. according to the received power level of DwPCH and/or P-CCPCH.

At the detection of the SYNC1 sequence in the searching window, the Node B will evaluate the received power levels and timing, and reply by sending the adjustment information to UE to modify its timing and power level for next transmission and for establishment of the uplink synchronisation procedure. . Within the next 4 sub-frames, the Node B will send the adjustment information to the UE (in a single subframe message in the FPACH) The uplink synchronisation procedure, normally used for a random access to the system, can also be used for the re-establishment of the uplink synchronisation when uplink is out of synchronisation.

8.1.2 Maintenance of uplink synchronisation

For the maintenance of the uplink synchronization, the midamble field of each uplink burst can be used.

In each uplink time slot the midamble in each UE is different. The Node B can estimate the power level and timing shift by measuring the midamble field of each UE in the same time slot. Then, in the next available downlink time slot, the Node B will signal the Synchronisation Shift (SS) and the Power Control (PC) commands to enable the UE to properly adjust respectively its Tx timing and Tx power level.

These procedures guarantee the reliability of the uplink synchronisation. The uplink synchronization can be checked once per TDD sub-frame. The step size in uplink synchronization is configurable and re-configurable and can be adapted from 1/8 chip to 1 chip duration. The following updates for UL synchronization are possible: 1 step up; 1 step down; no update.

[Explanation difference:]

For high chip rate option, uplink synchronisation is mentioned in 4.3 of TS25.224. But the implementation method is a little different with the low chip rate option. For low chip rate option, the establishment of the UL synchronization is done by using the UpPCH and the FPACH.

It allocates a unique channel UpPCH for UE to establish uplink synchronisation in the access procedure. The benefit of this method is when the UE wants to do random access, the P-RACH will have minimum interference to other traffic channel. Vice versa, it will also reduce the interference from traffic channels to P-RACH.

8.2 Requirements

The Iub/Iur protocols shall support the above mentioned features for uplink synchronisation with reuse of the existing protocol principles.

8.3 Study areas

The impact of the "uplink synchronisation" feature on the Iub/Iur protocols have been studied. One basic consequence has been identified: Due to this layer-1 function, the "Rx timing deviation" measurement performed by Node B for 3.84 Mcps TDD and reported to CRNC and SRNC, becomes obsolete. Therefore this measurement is deleted both from the Iub and Iur frame protocols for RACH, DCH, and USCH, and from the NBAP measurement procedure.

It has also been studied how this removal of the "Rx Timing Deviation" measurement from NBAP affects the UE positioning methods. The decision was that UE positioning in TDD does not need this measurement; the knowledge about the currently applied timing advance, and hence the signal roundtrip delay, is available in the UE and must be retrieved from the UE on request. This is an RRC procedure for which the Iub/Iur protocols are transparent.

In addition, it has been studied how the requirement for continuous synchronisation of uplink channels in 1.28 Mcps TDD affects the RRM strategies because of the need for downlink commands during uplink transmission. However this issue has no impact on the Iub/Iur protocols.

8.4 Agreements and associated contributions

See the proposed Change Requests.

8.5 Specification impact and associated Change Requests

It is expected that this Iub/Iur protocol aspects has impacts on the following Specifications:

25.401 [8] , RNSAP [9], 25.425 [10], 25.427 [11], NBAP [12], 25.435 [13], 25.402 [15].

8.5.1 Impact on TS 25.401

In chapter 6 "UTRAN Architecture" of TS25.401 [8], some details might be added to the third paragraph:

"A Node B can support FDD mode, TDD mode or dual-mode operation. There are two options in TDD mode, 1.28Mcps TDD option and 3.84Mcps TDD option."

In chapter 7 "UTRAN functions description" of TS25.401 [8]:

In the section 7.2.4.14 "[TDD - Timing Advance]", some details might be added because the function implementation is quite different between 1.28Mcps TDD option and 3.84Mcps:

"This function is used in uplink to align the uplink radio signals from the UE to the UTRAN. In 3.84Mcps TDD option, Timing advance is based on uplink burst timing measurements performed by the Node B L1, and on Timing Advance commands sent downlink to the UE. In 1.28Mcps TDD option, the *Timing Advance* function can be achieved by uplink synchronization procedure."

In addition, in chapter 9 "Synchronisation" of TS25.401 [8], the "uplink synchronisation" function might be added to the list of UTRAN functions related to synchronisation.

8.5.2 Impact on TS 25.402

In chapter 4 "Synchronisation Issues" of TS25.402, the issue "uplink synchronization" for 1.28Mcps TDD might be included in the section 4.1 "general" of TS25.402:

Different synchronisation issues are identified within UTRAN, i.e.:

- Network Synchronisation;
- Node Synchronisation;
- Transport Channel synchronisation;
- Radio Interface Synchronisation;
- Time Alignment handling.
- Uplink synchronization

So the Synchronisation Issues Model of Figure 1 in TS25.402 might be changed for including uplink synchronisation. The details are FFS.

It is suggested that add the summary of Uplink synchronization into new section 4.X and the details into a new chapter X of TS25.402.

Since the *Timing Advance* function implementation is quite different between 1.28Mcps TDD option and 3.84Mcps, it is suggested for section 8.3 “TDD Radio interface Synchronisation”, to change the title of section 8.3.4 “Timing Advance” to “Timing Advance for 3.84Mcps” and add a new section 8.3.X “Uplink synchronization for 1.28Mcps”.

8.5.3 Impact on TS 25.425

In principle, the “uplink synchronisation” feature in 1.28Mcps TDD replace or complement the “time advance” function which is performed by higher layer interaction in 3.84Mcps.

In chapter 6.2.1 “RACH/CPCH [FDD] Channels”, the RACH/CPCH[FDD] Data Frame structure showed in Figure 9 shall be changed as follows:

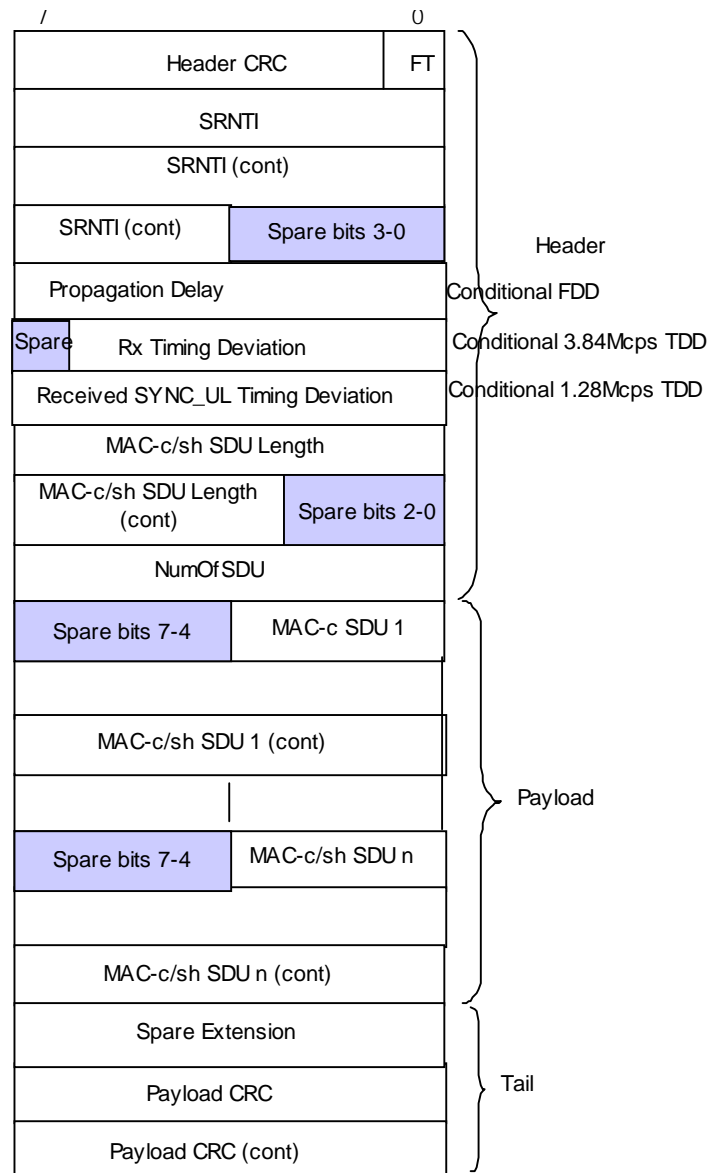


Figure 9: RACH/CPCH [FDD] Data Frame structure and the description shall be changed as follows: “Rx Timing Deviation is a conditional Information Element which is only present when the Cell supporting the RACH Transport Channel is a 3.84Mcps TDD Cell”.

Additional description shall be added as follows: “Received SYNC_UL Timing Deviation is a conditional Information Element which is only present when the Cell supporting the RACH Transport Channel is a 1.28Mcps TDD Cell”.

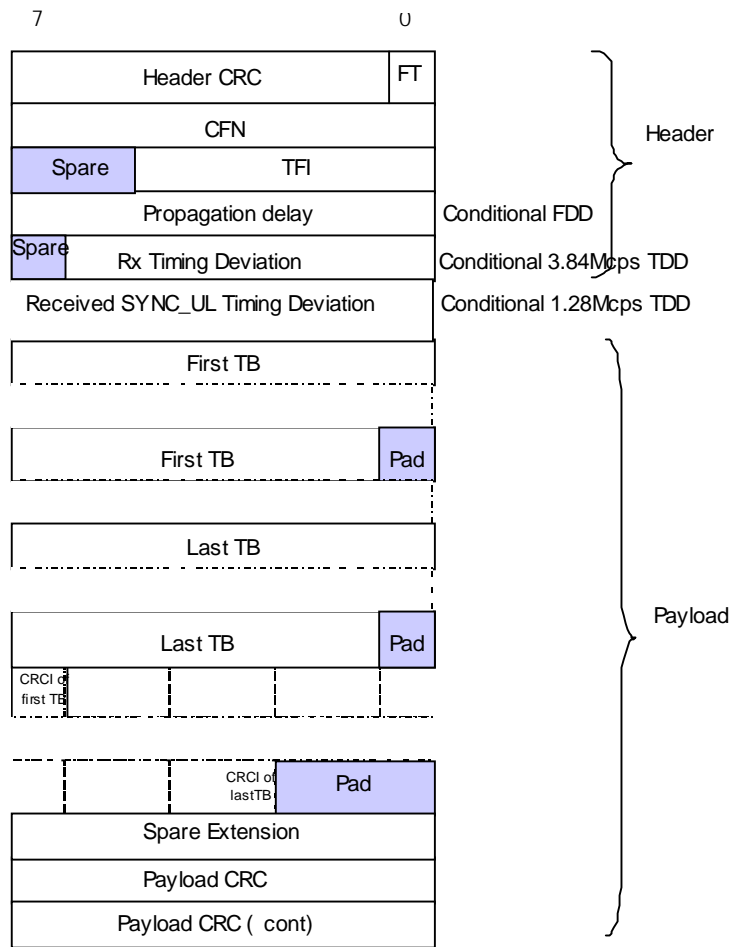
8.5.4 Impact on TS 25.427

The same reason as above, the title of chapter 5.6 “Rx timing deviation measurement [TDD]” shall be changed to “Rx timing deviation measurement [3.84Mcps TDD]”, because the procedure is applicable in 3.84Mcps TDD option only.

8.5.5 Impact on TS 25.435

The same reason as above, the title of chapter 5.7 “Timing Advance [TDD]” shall be changed to “Timing Advance [3.84Mcps TDD]”.

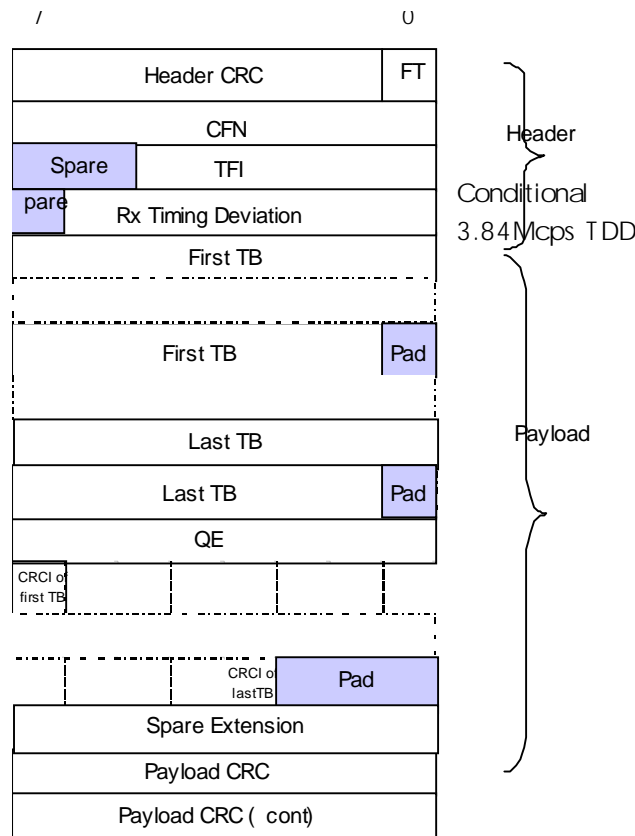
In chapter 6.2.1 “RACH channels”, the RACH Data Frame structure showed in Figure 13 shall be changed as follows:



And the description shall be changed as follows: “Rx Timing Deviation is a conditional Information Element which is only present when the Cell supporting the RACH Transport Channel is a 3.84Mcps TDD Cell.”

Additional description shall be added as follows: “Received SYNC_UL Timing Deviation is a conditional Information Element which is only present when the Cell supporting the RACH Transport Channel is a 1.28Mcps TDD Cell”.

In chapter 6.2.6 “Uplink Shared Channels [TDD]”, the USCH Data Frame structure showed in Figure 21 shall be changed as follows:



8.5.6 Impact on other WG3 Specifications and TRs

It is expected that the Iub/Iur aspects of uplink synchronisation have an impact also on the Specifications [9] and [12] because it may influence the physical channel handling procedures. In this TR (25.937), these aspects are covered implicitly in chapter 6 where the physical channel types are addressed.

8.6 Open issues

None.

9 Iub/Iur aspects of Measurements

9.1 Introduction

This aspect includes the following bullets:

- Ranges and accuracy have to be adapted for the low chip rate option.

In principle, this issue relates to:

- measurements to be performed by Node B and to be reported to DRNC/SRNC, and
- measurements performed by UE, reported to SRNC or CRNC, and used by SRNC, DRNC or Node B.

Due to the different power control and uplink synchronisation concept, different measurements are expected.

9.2 Requirements

The Iub/Iur protocols shall support all the above mentioned features with reuse of the existing protocol principles.

9.3 Study areas

9.3.1 Propagation delay measurement

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 from the reference time (UpPCH_{POS} = 0) where is two symbols prior to the end of the DwPCH. Any received starting position of the UpPCH after the reference time is positive.

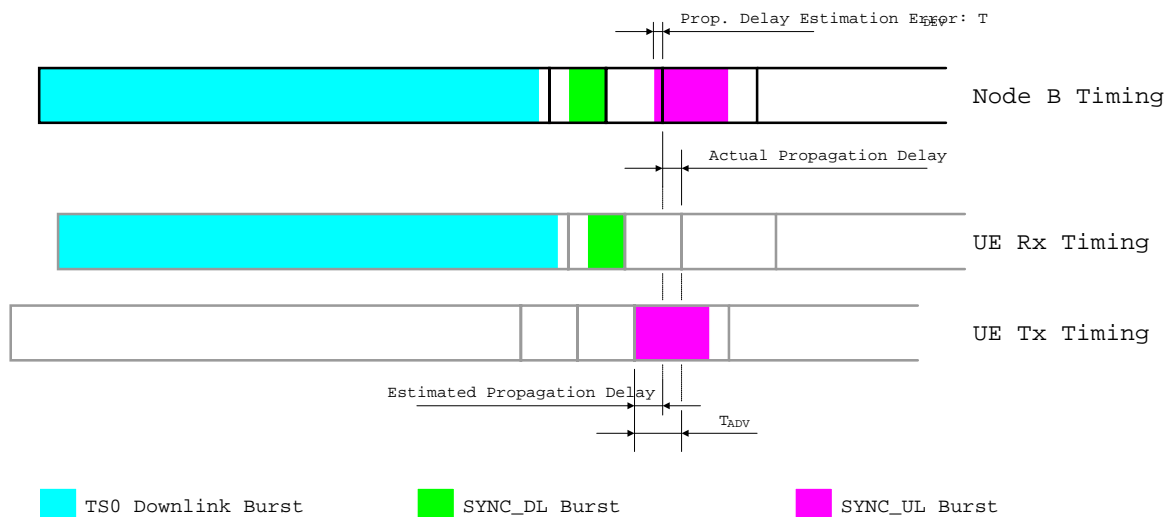


Figure 1: Timing of the UpPCH Transmission.

Definition	<p>'Received SYNC_UL Timing Deviation' is the time difference</p> $UpPCH_{POS} = UpPTS_{Rxpath} - UpPTS_{TS}$ <p>where</p> <p>UpPTS_{Rxpath}: time of the reception in the Node B of the SYNC_UL to be used in the uplink synchronization process</p> <p>UpPTS_{TS}: time instance two symbols prior to the end of the DwPCH according to the Node B internal timing</p> <p>UE can calculate Round Trip Time (RTT) towards the UTRAN after the reception of the FPACH containing UpPCH_{POS} transmitted from the UTRAN.</p> <p>Round Trip Time RTT is defined by</p> $RTT = UpPCH_{ADV} + UpPCH_{POS} - 8 * 16 T_C$ <p>Where</p> <p>UpPCH_{ADV}: the amount of time by which the transmission of UpPCH is advanced in time relative to the end of the guard period according to the UE Rx timing.</p>
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Since $UpPCH_{ADV}$ is already known to the UE, the UE can transmit the value $UpPCH_{ADV}$ to SRNC using RRC message. $UpPCH_{POS}$ can be measured by Node B and it can be transmitted to SRNC using RACH Frame. Then SRNC can calculate the propagation delay using $UpPCH_{POS}$ signalled by UE and $UpPCH_{ADV}$ signalled by Node B.

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

9.4 Agreements and associated contributions

See the proposed Change Requests.

9.5 Specification impact and associated Change Requests

It is expected that this Iub/Iur protocol aspects has impacts on the following Specifications:

RNSAP [9], 25.425 [10], 25.427 [11], NBAP [12], 25.435 [13].

9.6 Open issues

None.

10 Information elements for 1.28Mcps TDD

10.1 Discussion on physical channel parameter for 1.28Mcps

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. 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 due to the high accuracy requirements in 1.28Mcps TDD layer1 functionality. Thus it's no need to transfer timing advance information over Iub interface.

Apart from these differences there is a high potential to reuse descriptions of the description of physical channel information for the 3.84Mcps TDD for 1.28Mcps TDD mode.

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 timeslot 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:** The same optional 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.

10.2 Information elements for low chip rate TDD

The following describes the IEs for 1.28Mcps TDD, based on the tabular format representation in the NBAP specification [12]. It is expected that the description is also valid for RNSAP [9].

10.2.1 Time Slot LCR

The Time Slot LCR represents the minimum time interval inside a Radio Frame that can be assigned to a Physical Channel.

IE/Group name	Presence	Range	IE type and reference	Semantics description
Time slot LCR	M		Integer(0..6)	

10.2.2 Midamble shift LCR

This information element indicates midamble allocation in 1.28Mcps TDD.

IE/Group name	Presence	Range	IE type and reference	Semantics description
Midamble Allocation Mode	M		Enumerated (Default midamble, Common midamble, UE specific midamble)	
Midamble Shift	C-UE		Integer(0..15)	

Condition	Explanation
<i>UE</i>	This information element is only sent when the value of the "Midamble Allocation Mode" IE is "UE-specific midamble".

10.2.3 TDD Channelisation Code LCR

The Channelisation Code Number indicates which Channelisation Code is used for a given Physical Channel. In TDD the Channelisation Code is an Orthogonal Variable Spreading Factor code that can have a spreading factor of 1, 2, 4, 8 or 16.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CHOICE SF				
>SF=1			Enumerated(QPSK,8PSK)	Modulation options in contrast to 3.84Mcps TDD mode
>Otherwise				
>>TDD Channelisation Code			ENUMERATED ((1/1), (2/1), (2/2), (4/1),...(4/4), (8/1), (8/8), (16/1)... (16/16) ,...)	

CHOICE SF	Condition under which the given SF is chosen
SF =1	"spreading factor" is set to 1
Otherwise	"spreading factor" is set to a value distinct from 1

See also chapters 5.4 and 6.4 for information on the IEs needed for 1.28 Mcps TDD.

11 Project Plan

11.1 General

It is intended to focus on the basic features of low-chip-rate TDD first, and then on the advanced features.

Basic features includes:

- L1 interface;
- Primitives to MAC, RRC;
- Uplink synchronisation;
- Support of RACH, FACH, PCH, BCH, DCH;
- Cell selection/reselection;
- Handover (set of measurements);
- Incorporation of basic features of the smart antenna concept.

Advanced features include:

- Support of USCH/DSCH;
- Support of Iur;
- Baton handover;
- Extended functionality and completion of smart antenna concept;
- Alignment with UTRA LCS concept.

Annex A: Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
03/2001	11	RP-010151	-	-	Approved at TSG RAN #11 and placed under Change Control	2.0.0	4.0.0

History

Document history		
V4.0.0	March 2001	Publication