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Technical Specification

Universal Mobile Telecommunications System (UMTS); UTRAN Iub/Iur Interface User Plane Protocol for DCH Data Streams (3G TS 25.427 version 3.1.0 Release 1999)

Reference

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Contents

Foreword

This Technical Specification has been produced by the 3GPP.

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where:

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1 Scope

This document shall provide a description of the UTRAN Iur and Iub interfaces user plane protocols for Dedicated Transport Channel data streams as agreed within the TSG-RAN working group 3.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1] TS UMTS 25.301, Radio Interface Protocol Architecture.

[2] TS 25.401 UTRAN architecture description.

[3] TS 25.302 Services provided by the Physical Layer, Source WG2.

3 Definitions and abbreviations

3.1 Definitions

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

Transport Connection: Service provided by the transport layer and used by Frame Protocol for the delivery of FP PDU.

3.2 Abbreviations

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

CFN	Connection Frame Number
CRC	Cyclic Redundancy Checksum
CRCI	CRC Indicator
DCH	Dedicated Transport Channel
DL	Downlink
DSCH	Downlink Shared Channel
FP	Frame Protocol
FT	Frame Type
PC	Power Control
QE	Quality Estimate
TB	Transport Block
TBS	Transport Block Set
TFI	Transport Format Indicator
ToA	Time of arrival
TTI	Transmission Time Interval
UL	Uplink

4 General aspects

The specification of I_{ub} DCH data streams is also valid for I_{ur} DCH data streams.

The SRNC is responsible for creating communications inside the SRNS. The SRNC provides to the Node B the complete configuration of the Transport channels to be provided by the Node B for a given communication.

The parameters of a Transport channel are described in [1]. These Transport channels are multiplexed on the downlink by the Node B on radio physical channels, and de-multiplexed on the uplink from radio physical channels to Transport channels.

Every set of coordinated Transport channel related to one UE context that is communicated over a set of cells that are macro-diversity combined within Node B or DRNC, is carried on one transport connection. This means that there are as many transport connections as set of coordinated Transport channels and User ports for that communication.

Bi-directional transport connections are used.

4.1 DCH FP services

DCH frame protocol provides the following services:

- Transport of TBS across Iub and Iur interface.
- Transport of outer loop power control information between the SRNC and the Node B
- Support of transport channel synchronisation mechanism
- Support of Node Synchronisation mechanism
- Transfer of DSCH TFI from SRNC to Node B
- Transfer of Rx timing deviation (TDD) from the Node B to the SRNC.

4.2 Services expected from data transport

Following service is required from the transport layer:

- In sequence delivery of FP PDU

5 DCH Frame Protocol procedures

5.1 Data transfer

When there is some data to be transmitted, DCH data frames are transferred every transmission time interval between the SRNC and the Node B for downlink transfer, and between Node B and SRNC for uplink transfer.

An optional error detection mechanism may be used to protect the data transfer if needed. At the transport channel setup it shall be specified if the error detection on the user data is used.

5.1.1 Uplink

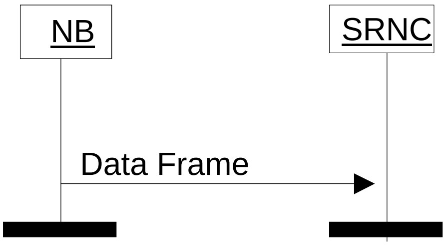

Figure 1: Uplink data transfer

Two modes can be used for the UL transmission: *normal mode* and *silent mode*. The mode is selected by the SRNC when the transport connection is setup and signaled to the Node B with the relevant control plane procedure.

- In normal mode, NodeB shall always send an UL data frame to the RNC for all the DCHs in a set of coordinated DCHs regardless of length of Transport Block of DCHs, i.e. also when it has received zero bits for a transport channel during a certain TTI.
- In silent mode and in case only one transport channel is transported on a transport bearer, the node-B shall not send an UL data frame to the RNC when it has received zero bits for a transport channel during a certain TTI.

In silent mode and in case of coordinated DCHs, when Node B receives zero bits for all the DCHs in a set of coordinated DCHs, node B shall not send an UL data frame to the RNC for this set of coordinated DCHs.

When UL synchronisation is lost or not yet achieved on the Uu, UL data frames are not sent to the SRNC.

5.1.2 Downlink

Figure 2: Downlink data transfer

If the Node B does not receive a valid FP frame in a TTI, it assumes that there is no data to be transmitted in that TTI for this transport channel.

If the node B is aware of a TFI value corresponding to zero bits for this transport channel, this TFI is assumed. When combining the TFI's of the different transport channels, a valid TFCI might result and in this case data shall be transmitted on Uu.

If the node B is not aware of a TFI value corresponding to zero bits for this transport channel or if combining the TFI corresponding to zero bits with other TFI's, results in an unknown TFI combination, the handling as described in the following paragraph shall be applied.

At each frame, the Node B shall build the TFCI value of each CCTrCH, according to the TFI of the DCH data frames multiplexed on this CCTrCH and scheduled for that frame. In case the Node receives an unknown combination of DCH data frames, it shall transmit only the DPCCH without TFCI bits.

5.2 Timing adjustment

To keep the synchronisation of a DCH data stream SRNC includes the Connection Frame Number (CFN) to all DL DCH FP frames. The same applies to the DSCH TFI Signalling control frame.

If a DL data frame or a DSCH TFI Signalling control frame arrives outside the determined arrival window the Node B reports the measured ToA and the indicated CFN in one UL DCH FP control frame.

Figure 3: Timing Adjustment

The arrival window and the time of arrival are defined as follows:

Time of Arrival Window Endpoint (ToAWE) : ToAWE represents the time point by which the DL data shall arrive to the node B from Iub. The ToAWE is defined as the amount of milliseconds before the last time point from which a timely DL transmission for the identified CFN would still be possible taking into account the node B internal delays. ToAWE is set via control plane. If data does not arrive before ToAWE a Timing Adjustment Control Frame shall be sent by node B.

Time of Arrival Window Startpoint (ToAWS): ToAWS represents the time after which the DL data shall arrive to the node B from Iub. The ToAWS is defined as the amount of milliseconds from the ToAWE. ToAWS is set via control plane. If data arrives before ToAWS a Timing Adjustment Control Frame shall be sent by node B.

Time of Arrival (ToA) : ToA is the time difference between the end point of the DL arrival window (ToAWE) and the actual arrival time of DL frame for a specific CFN. A positive ToA means that the frame is received before the ToAWE, a negative ToA means that the frame is received after the ToAWE.

The general overview on the timing adjustment procedure is reported in [2].

5.3 Synchronisation

In synchronisation procedure the SRNC sends a DL SYNCHRONISATION control frame towards Node B. This message indicates the target CFN.

Upon reception of the DL SYNCHRONISATION control frame, Node B shall immediately respond with UL SYNCHRONISATION control frame indicating the ToA for the DL synchronisation frame and the CFN indicated in the received DL SYNCHRONISATION message.

UL SYNCHRONISATION control frame shall always be sent, even if the DL SYNCHRONISATION control frame is received by the Node B within the arrival window.

Synchronisation control frames are also used as keep alive frames, in order to maintain activity on the Iur/Iub transport bearer.

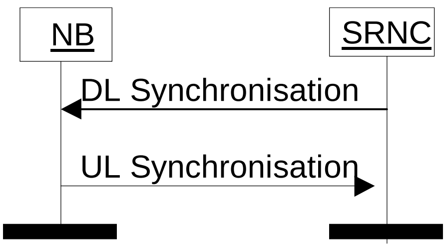

Figure 4: DCH Synchronisation procedure

5.4 Outer loop PC information transfer

Based, for example, on the CRCI values and on the quality estimate in the UL frames, SRNC modifies the Eb/No setpoint used by the Node B by including the absolute value of the new Eb/No setpoint in one control frame sent to the Node B's. This control frame can be sent via any of the transport connections dedicated to one UE.

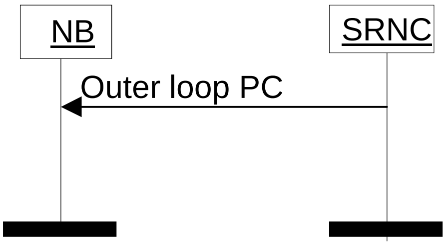

Figure 5: Outer loop power control information transfer

5.5 Node Synchronization

In the Node Synchronization procedure, the SRNC sends a DL Node Synchronization control frame to Node B containing the parameter T1. Upon reception of a DL Node Synchronization control frame, the Node B shall respond with UL Node Synchronization Control Frame, indicating t2 and t3, as well as t1 which was indicated in the initiating DL Node Synchronization control frame.

The t1, t2, t3 parameters are defined as:

T1: RNC specific frame number (RFN) that indicates the time when RNC sends the frame through the SAP to the transport layer.

T2: Node B specific frame number (BFN) that indicates the time when Node B receives the correspondent DL synchronisation frame through the SAP from the transport layer.

T3: Node B specific frame number (BFN) that indicates the time when Node B sends the frame through the SAP to the transport layer.

The general overview on the Node Synchronisation procedure is reported in [2].

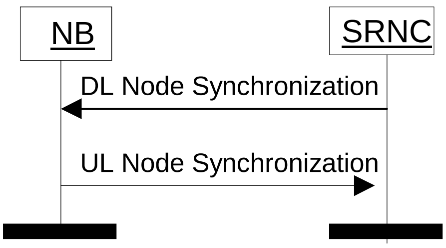

Figure 6: Node Synchronization procedure

5.6 Rx timing deviation measurement [TDD]

This procedure is applicable in TDD mode only.

The NodeB shall, for all UEs using DCHs, monitor the receive timing of the uplink DPCH bursts arriving over the radio interface, and shall calculate the Rx Timing Deviation. If the calculated value, after rounding, is not zero, it shall be reported to the SRNC in a DCH Control Frame belonging to that UE. For limitation of the frequency of this reporting, the NodeB shall not send more than one Rx Timing Deviation value per UE in a DCH Control Frame within the Rx Timing Deviation measurement reporting period.

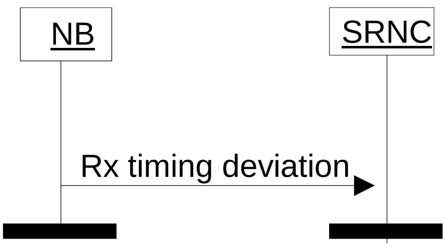

Figure 7: Rx timing deviation

5.7 DSCH TFI Signalling [FDD]

This procedure is used in order to signal the TFI of the DSCH TBS to the Node B. This allows to use the combined TFCI codeword for the signalling of the DCHs and DSCH TFIs in the radio frame.

The procedure consists in the DSCH TFI control frame sent by the SRNC to the Node B. The frame contains the DSCH TFI and the correspondent CFN.

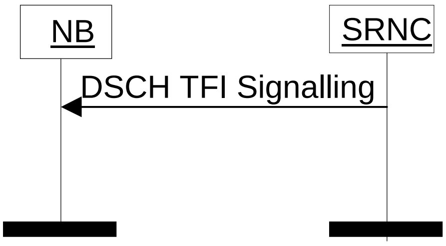

Figure 8: DSCH TFI Signalling

6 Frame structure and coding

6.1 General

The general structure of a DCH FP frame consists of a header anda payload. The structure is depicted in figure below

Figure 9: General structure of a frame protocol PDU

The header contains a CRC checksum, the frame type field and information related to the frame type.

There are two types of DCH FP frames (indicated by the Frame type field).

- DCH data frame
- DCH control frame

The payload of the data frames contains radio interface user data, quality information for the transport blocks and for the radio interface physical channel during the transmission time interval (for UL only), and an optional CRC field

The payload of the control frames contains commands and measurement reports related to transport bearer and the radio interface physical channel but not directly related to specific radio interface user data.

6.1.1 General principles for the coding

In this specification the structure of frames will be specified by using pictures similar to figure 10.

7	6	5	4	3	2	1	0	
Field 1						Field 2		Byte 1
Field 3								Byte 2
Field 3 (cont)				Field 4				Byte 3
								Byte 4

Figure 10: Example of notation used for the definition of the frame structure.

Unless otherwise indicated, fields which consist of multiple bits within a byte will have the more significant bit located at the higher bit position (indicated above frame in figure 10). In addition, if a field spans several bytes, more significant bits will be located in lower numbered bytes (right of frame in figure 10).

On the Iub/Iur interface, the frame will be transmitted starting from the lowest numbered byte. Within each byte, the bits are sent according decreasing bit position (bit position 7 first).

The parameters are specified giving the value range and the step (if not 1). The coding is done as follows (unless otherwise specified):

- Unsigned values are binary coded
- Signed values are coded with the 2's complement notation

Bits labelled "Spare" shall be set to zero by the transmitter and shall be ignored by the receiver.

6.2 Data frames

6.2.1 Introduction

The purpose of the user data frames is to transparently transport the transport blocks between Node B and Serving RNC.

The protocol allows for multiplexing of coordinated dedicated transport channels, with the same transmission time interval, onto one transport bearer.

The transport blocks of all the coordinated DCHs for one transmission time interval are included in one frame.

SRNC indicates the multiplexing of coordinated dedicated transport channels in the appropriate RNSAP/NBAP message.

6.2.2 Uplink data frame

The structure of the UL data frame is shown below.

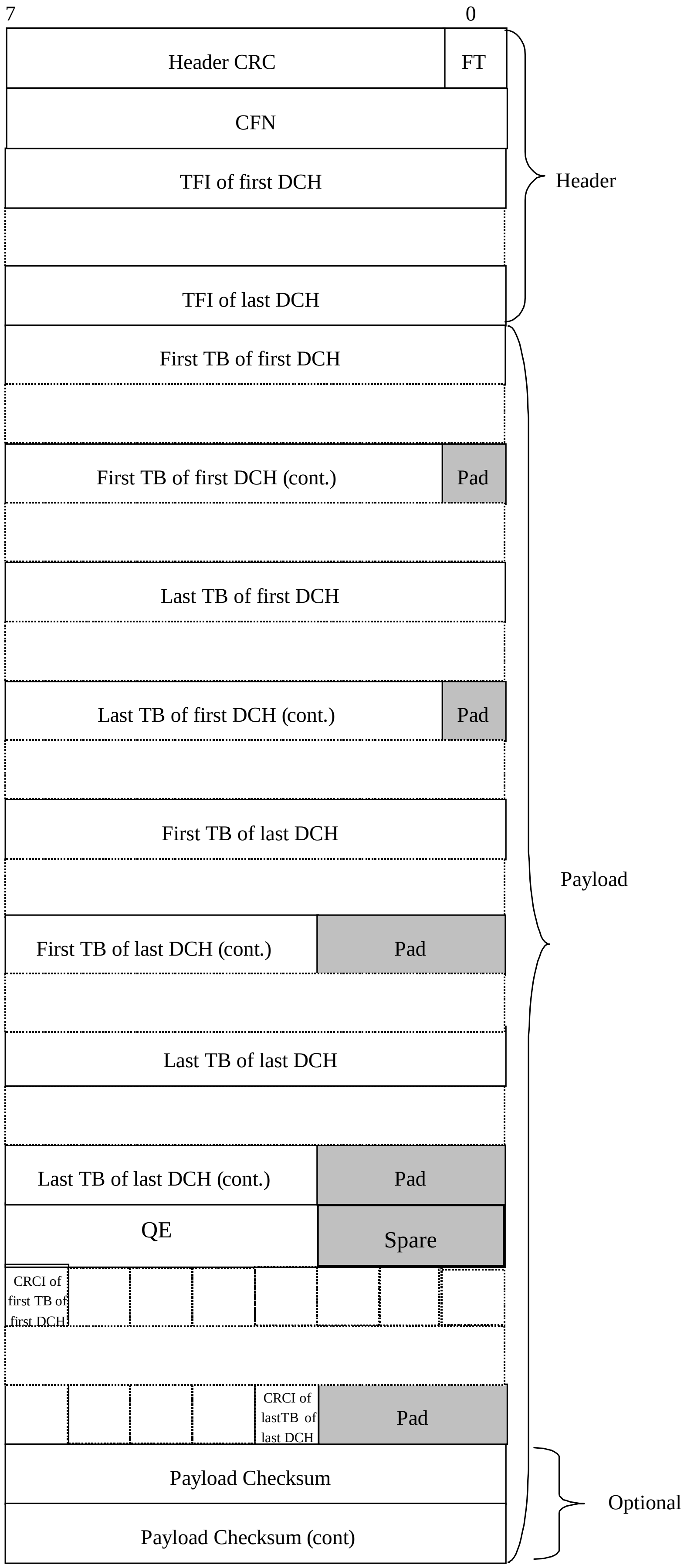

Figure 11: Uplink data frame structure

For the description of the fields see section 6.2.4.

There are as many TFI fields as number of DCH multiplexed in the same transport connection.

The DCHs in the frame structure are ordered from the lower DCH id ('first DCH') to the higher DCH id ('last DCH')

The size and the number of TBs for each DCH is defined by the correspondent TFI.

If the TB does not fill an integer number of bytes, then bit padding is used as shown in the figure in order to have the octet aligned structure (ex: a TB of 21 bits requires 3 bits of padding).

There is a CRCI for each TB included in the frame. If the CRC indicators of one data frame do not fill an integer number of bytes, then bit padding is used as shown in the figure in order to have the octet aligned structure.

The payload CRC is optional, i.e. the whole 2 bytes field may or may not be present in the frame structure (this is defined at the setup of the transport connection).

6.2.3 Downlink data frame

The structure of the DL data frame is shown below.

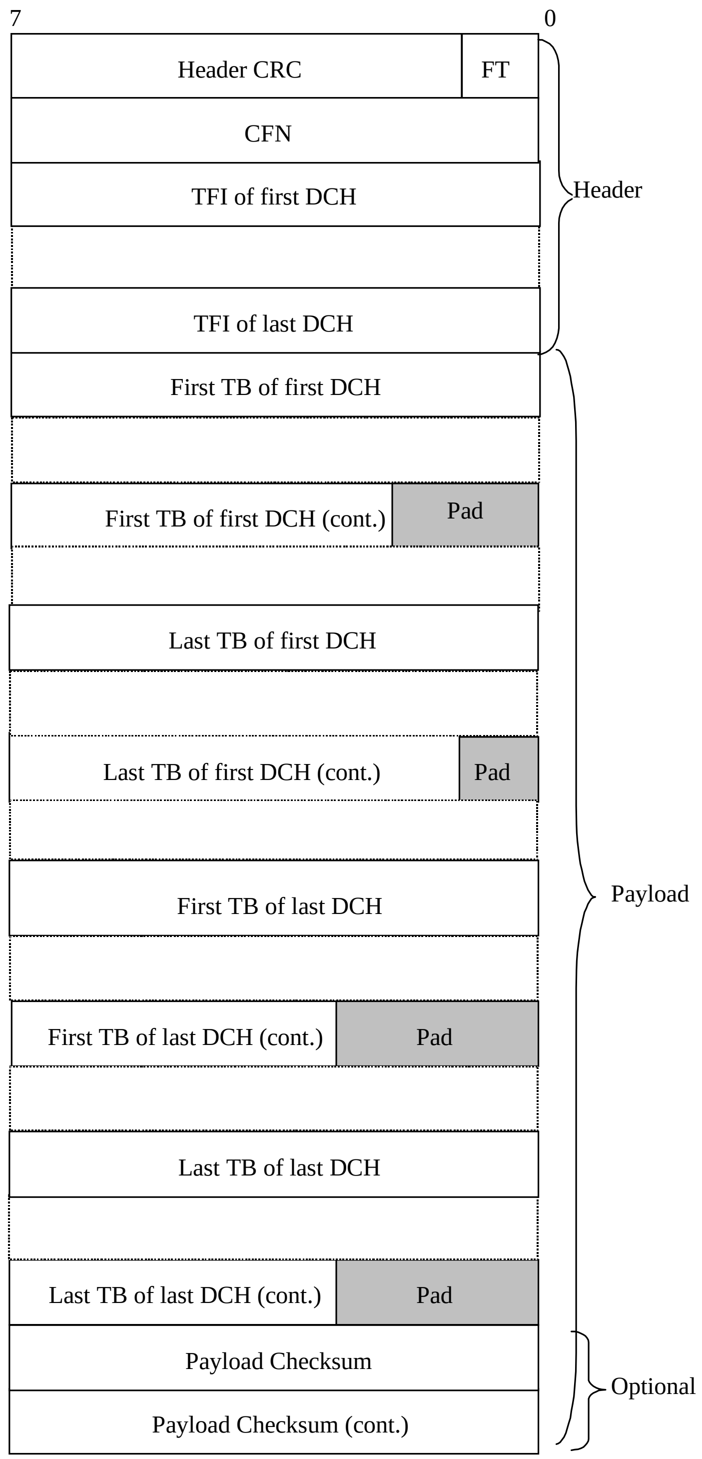

Figure 12: Downlink data frame structure

For the description of the fields see section 6.2.4.

There are as many TFI fields as number of DCH multiplexed in the same transport connection.

The DCHs in the frame structure are ordered from the lower DCH id ('first DCH') to the higher DCH id ('last DCH')

The size and the number of TBs for each DCH is defined by the correspondent TFI.

If the TB does not fill an integer number of bytes, then bit padding is used as shown in the figure in order to have the octet aligned structure (ex: a TB of 21 bits requires 3 bits of padding).

The payload CRC is optional, i.e. the whole 2 bytes field may or may not be present in the frame structure (this is defined at the setu p of the transport connection).

6.2.4 Coding of information elements in data frames

6.2.4.1 Header CRC

Description: Result of the CRC applied to the remaining part of the header, i.e. from bit 0 of the first byte, (the FT field) to the bit 0 (included) of the last byte of the header) with the corresponding generator polynomial: $G(D) = D^7+D^6+D^2+1$.

Field Length: 7 bits

6.2.4.2 Frame Type (FT)

Description: describes if it is a control frame or a data frame.

Value range: {0=data, 1=control}.

Field Length: 1 bit

6.2.4.3 Connection Frame Number (CFN)

Description: indicator as to which radio frame the first data was received on uplink or shall be transmitted on downlink. See reference [2].

Value range: {0-255}

Field length: 8 bits

6.2.4.4 Transport Format Indicator (TFI)

Description: TFI is the local number of the transport format used for the transmission time interval. For information about what the transport format includes see TS 25.302 reference [3].

Value range: {0-255}

Field length: 8 bits

6.2.4.5 Quality Estimate (QE)

Description: The quality estimate is derived from the [FDD - DPDCH or DPCCH][TDD - DPCH] Physical Channel BER.

[FDD - In case there is user data to be included in the DCH FP frame the QE shall be derived from the DPDCH Physical Channel BER.]

[FDD - When there is no user data to be included in the DCH FP frame the QE shall be derived from the DPCCH Physical Channel BER.]

[TDD – The QE shall be derived from the DPCH Physical Channel BER.]

The quality estimate shall be set to the Physical channel BER and be measured in the unit BER_dB (see Ref 25.215). The quality estimate is needed in order to select a transport block when all CRC indications are showing bad (or good) frame. The UL Outer Loop Power Control may also use the quality estimate.

Value range: {0-63}, granularity 1

Field length: 6 bits

6.2.4.6 Transport Block (TB)

Description: A block of data to be transmitted or received over the air interface. The transport format indicated by the

TFI describes the transport block length and transport block set size. See TS 25.302 reference [3].

Field length: the length of the TB is specified by the TFI.

6.2.4.7 CRC indicator (CRCI)

Description: Indicates the correctness/incorrectness of the TB CRC received on the Uu interface. For every transport block included in the data frame a CRCI bit will be present, irrespective of the presence of a TB CRC on the Uu interface. If no CRC was present on the Uu for a certain TB, the corresponding CRCI bit shall be set to "0".

Value range: {0=Correct, 1=Not Correct}

Field length: 1 bit

6.2.4.8 Payload Cyclic Redundancy Checksum

Description: CRC for the payload. This field is optional. It is the result of the CRC applied to the remaining part of the payload, i.e. from the bit 7 of the first byte of the payload to the bit 0 of the byte of the payload before the CRC field, with the corresponding generator polynomial:
$G(D) = D^{16}+D^{15}+D^{2}+1$.

Field length: 16 bits

6.3 Control frames

6.3.1 Introduction

Control Frames are used to transport control information between SRNC and Node B.

On the uplink, these frames are not combined – all frames are passed transparently from Node B to SRNC. On the downlink, the same control frame is copied and sent transparently to all the Node Bs from the SRNC.

The structure of the control frames is shown in the figure below:

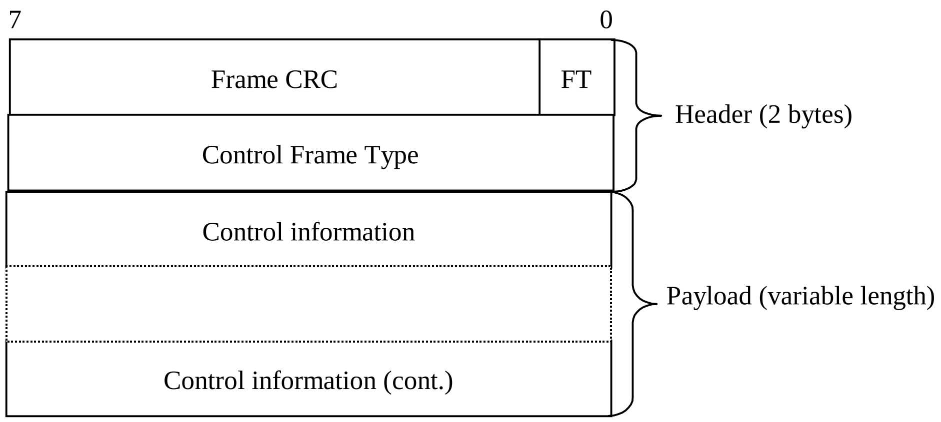

Figure 13: General structure of the control frames

Control Frame Type defines the type of the control frame.

The structure of the header and the payload of the control frames is defined in the following sections.

6.3.2 Header structure of the control frames

6.3.2.1 Frame CRC

Description: It is the result of the CRC applied to the remaining part of the frame, i.e. from bit 0 of the first byte of the header (the FT field) to bit 0 of the last byte of the payload, with the corresponding generator polynomial:
$G(D) = D^7+D^6+D^2+1$.

Field Length: 7 bits

6.3.2.2 Frame Type (FT)

Description: describes if it is a control frame or a data frame.

Value range: {0=data, 1=control}.

Field Length: 1 bit

6.3.2.3 Control Frame Type

Description: Indicates the type of the control information (information elements and length) contained in the payload.

Value The values are defined in the following table:

Control frame type	Coding
Outer loop power control	0000 0001
Timing adjustment	0000 0010
DL synchronisation	0000 0011
UL synchronisation	0000 0100
DL signalling for DSCH	0000 0101
DL Node synchronisation	0000 0110
UL Node synchronisation	0000 0111
Rx Timing Deviation	0000 1000

Field length: 8 bits

6.3.3 Payload structure and information elements

6.3.3.1 Timing Adjustment

6.3.3.1.1 Payload structure

Figure below shows the structure of the payload when control frame is used for the timing adjustment.

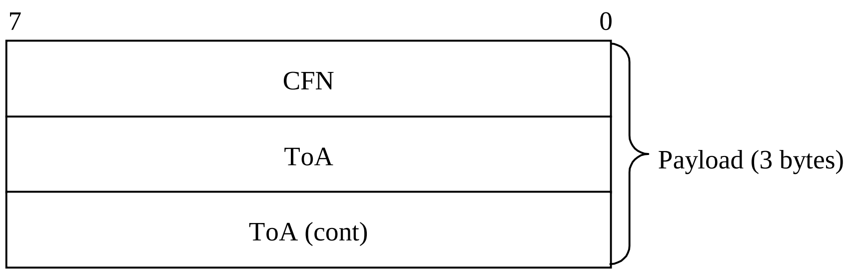

Figure 14: Structure of the payload for the Timing Adjustment control frame

6.3.3.1.2 CFN

The CFN value in the control frame is coded as in section 6.2.4.3.

6.3.3.1.3 Time of arrival (ToA)

Description: time difference between the arrival of the DL frame with respect to TOAWE (based on the CFN value in the frame).

Value range: {-1280, +1279.875 msec }

Granularity: 125 µs

Field length: 16 bits

6.3.3.2 DL synchronisation

6.3.3.2.1 Payload structure

Figure below shows the structure of the payload when control frame is used for the user plane synchronisation.

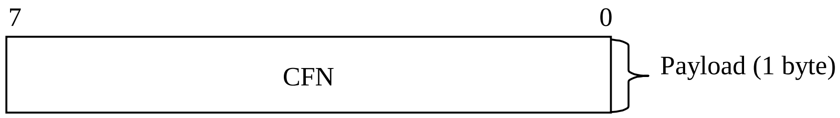

Figure 15: Structure of the payload for the DL synchronisation control frame

6.3.3.2.2 CFN

The CFN value in the control frame is coded as in section 6.2.4.3.

6.3.3.3 UL synchronisation

6.3.3.3.1 Payload structure

Figure below shows the structure of the payload when the control frame is used for the user plane synchronisation (UL).

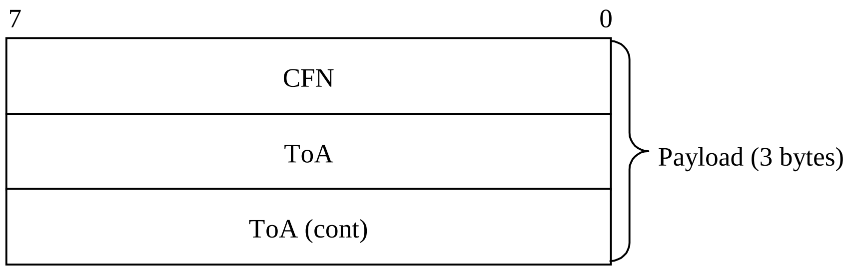

Figure 16: Structure of the UL Synchronisation control frame

6.3.3.3.2 CFN

The CFN value in the control frame is coded as in section 6.2.4.3.

6.3.3.3.3 Time of arrival (ToA)

See section 6.3.3.1.3.

6.3.3.4 UL Outer loop power control

6.3.3.4.1 Payload structure

Figure below shows the structure of the payload when control frame is used for the UL outer loop power control.

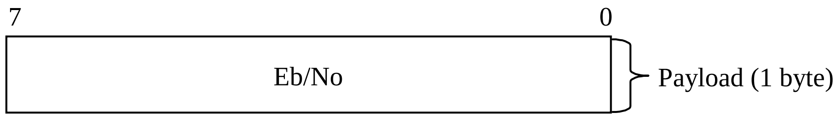

Figure 17: Structure of the payload for outer loop PC control frame

6.3.3.4.2 Eb/No setpoint

Description: Value (in dB) of the reference Eb/No to be used for the UL inner loop power control.

Value range: {0…25.5 dB}, step 0.1 dB

Field length: 8 bits

6.3.3.5 DL Node Synchronization

6.3.3.5.1 Payload structure

Figure below shows the structure of the payload for the DL Node Synchronisation control frame.

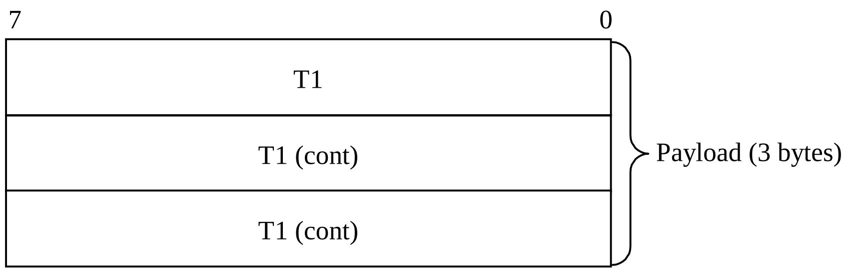

Figure 18: Structure of the payload for the DL Node Synchronisation control frame

6.3.3.5.2 T1

Description: RNC specific frame number (RFN) that indicates the time when RNC sends the frame through the SAP to the transport layer.

Value range: as defined in section 6.3.3.6.2.

Field length: 24 bits

6.3.3.6 UL Node Synchronization

6.3.3.6.1 Payload structure

The payload of the UL Node synch control frames is shown in the figure below.

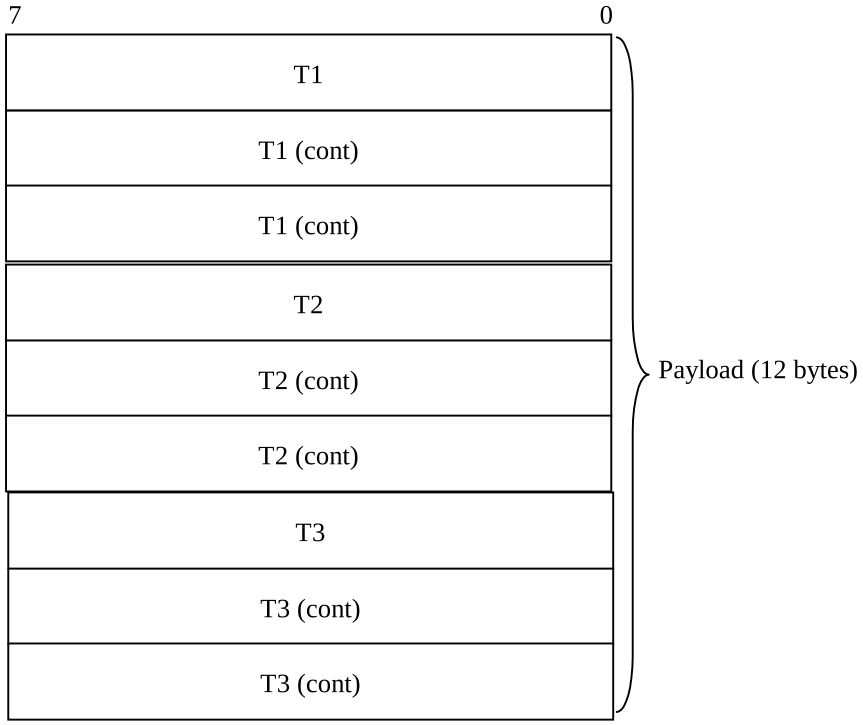

Figure 19: Structure of the payload for UL Node Synchronisation control frame

6.3.3.6.2 T1

Description: T1 timer is extracted from the correspondent DL synchronisation control frame.

Value range: 0-40959.875 ms, and the resolution is 0.125 ms.

Field length: 24 bits

6.3.3.6.3 T2

Description: Node B specific frame number (BFN) that indicates the time when Node B received the correspondent DL synchronisation frame through the SAP from the transport layer.

Value range: 0-40959.875 ms, and the resolution is 0.125 ms.

Field length: 24 bits

6.3.3.6.4 T3

Description: Node B specific frame number (BFN) that indicates the time when Node B sends the frame through the SAP to the transport layer.

Value range: 0-40959.875 ms, and the resolution is 0.125 ms.

Field length: 24 bits

6.3.3.7 Rx Timing Deviation

6.3.3.7.1 Payload structure

Figure below shows the structure of the payload when the control frame is used for the Rx timing deviation.

Figure 20: Structure of the payload for Rx timing deviation control frame

6.3.3.7.2 Rx Timing Deviation

Description: Measured Rx Timing deviation.

Value range: {-512, +508 chips, step 4 chips}. **Field length**: 8 bits

6.3.3.8 DSCH TFI signalling

6.3.3.8.1 Payload structure

Figure below shows the structure of the payload when the control frame is used for signalling TFI bits used on the DSCH.

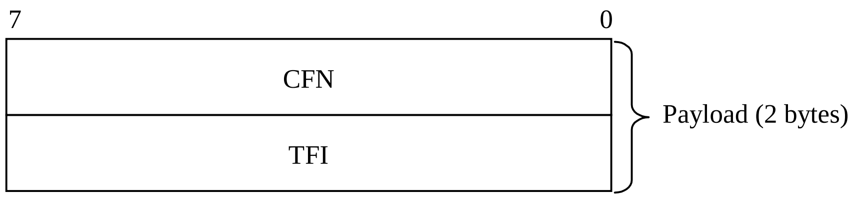

Figure 21: Structure of the payload for the DSCH DL signaling control frame

6.3.3.8.2 DSCH TFI

Description: TFI of the associated DSCH TBS.

The DSCH TFI in the control frame is coded as in section 6.2.4.4.

7 Handling of Unknown, Unforeseen and Erroneous Protocol Data

7.1 General

A Frame Protocol frame with illegal or not comprehended parameter value shall be ignored.

8 List of open issues

The open issues that may have impact on the FP specification are the following:

- Version handling and backward compatibility.
- Decoding of the UL TFCI and need of the UL normal mode.

Annex A (informative): Change History

Change history					
TSG RAN#	Version	CR	Tdoc RAN	New Version	Subject/Comment
RAN_05	-	-	-	3.0.0	Approved at TSG RAN #5 and placed under Change Control
RAN_06	3.0.0	-	RP-99758	3.1.0	Approved at TSG RAN #6
RAN_06	3.0.0	-	RP-99759	3.1.0	Approved at TSG RAN #6
RAN_06	3.0.0	005	RP-99760	3.1.0	Approved at TSG RAN #6

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History

Document history		
V3.1.0	January 2000	Publication