TSG-RAN WG3 meeting #7
Sophia Antipolis, 20-24 September 1999

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Agenda: **14.1**

Source: **Editor**

Title: **UMTS 25.427: Iur/Iub User plane protocol for DCH data streams, v.0.4.2 – Editor's proposal**

Document for: **Approval**

This document contains an editor's proposal for changes in TS25.427. Revisions show the changes respect to the version 0.4.1, submitted to WG3#7.

Main proposals:
- Structure and coding of the control frames

All the editor's note added in this version of the document are supposed to illustrate the reasons of the proposed changes, and shall be removed once the change is accepted/rejcted.

TS 25.427 V 0.4.1 (1999-09)

Technical Specification

3rd Generation Partnership Project (3GPP);
Technical Specification Group (TSG) RAN;

UTRAN Iub/Iur Interface User Plane Protocol for DCH Data Streams

3GPP

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Contents

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Note: The content has to be reviewed according to the 3GPP IPR rules.

2 Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project, Technical Specification Group TSG RAN.
The contents of this TS may be subject to continuing work within the 3GPP and may change following formal TSG approval. Should the TSG modify the contents of this TS, it will be re-released with an identifying change of release date and an increase in version number as follows:

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.

3 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.

4 References

[1]: TS UMTS 25.301, *Radio Interface Protocol Architecture*

[2]: TS 25.211 *Physical channels and mapping of transport channels onto physical channels (FDD),* Source WG1

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

5 Definitions, symbols and abbreviations

5.1 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.

5.2 Symbols

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

5.3 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

6 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.

6.1 DCH FP services

~~Editor's note: this chapter describes the services that FP provides, such as the transfer of data, synchronisation information and quality indication for PC and MDC, timing adjustment, etc.~~

DCH frame protocol provides the following services:

- Transport of TBS between the Node B and the SRNC.
- 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

6.2 Services expected from data transport

Editor's note: this chapter describes the services that are expected from the lower layer. Requirements for frame error rate, bit error rate, delay and delay variation are considered.

Following services re required from the transport layer:

- In sequence delivery of FP PDU
- Maximum delay variation for the delivery of FP PDUs in one transport connection between SRNC and Node B shall be less 1.16 seconds

Editor's note: the transport channel synchronisation mechanism provided by FP does not work if the delay variation is longer than half of the CFN cycle. This figure also includes the processing in DRNC and Node B, thus the requirement for the data transport layer should be smaller. Here the transport delay variation is set to 100 msec.

Editor's note: once the CRC mechanism is defined, some requirement on the undetected bit error rate from the transport layer can be set

7 Frame structure and coding

The general structure of a DCH FP frame consists of a header, the payload and a tail. The structure is depicted in figure 1 below.

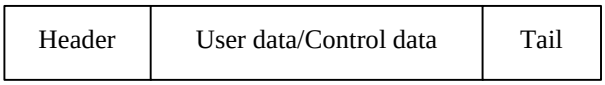


Figure 1. General structure of a frame protocol PDU

The header shall contain the ~~connection frame number and the~~ frame type field ~~and~~ information related to the frame type. The tail contains a checksum.

Editor's note: the header of the control frames does not contain the CFN.

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

- DCH data frame
- DCH control frame

The user data frames contain radio interface user data, quality information for the transport blocks and for the radio interface physical channel during the transmission time interval (UL only).

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.

~~The user data and control data shall be sent in separate frames.~~

~~Editor's note: it is common agreement that control information is only carried by control frame~~

7.1 Data frame structure

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 cordinated dedicated transport channels in the appropriate RNSAP/NBAP message. ~~For RNSAP this concerns RL Setup and RL Reconfiguration. For NBAP this concerns RL Setup and RL Reconfiguration.~~

Editor's Note: it is not necessary to refer to the specific control plane messages in the user plane specification.

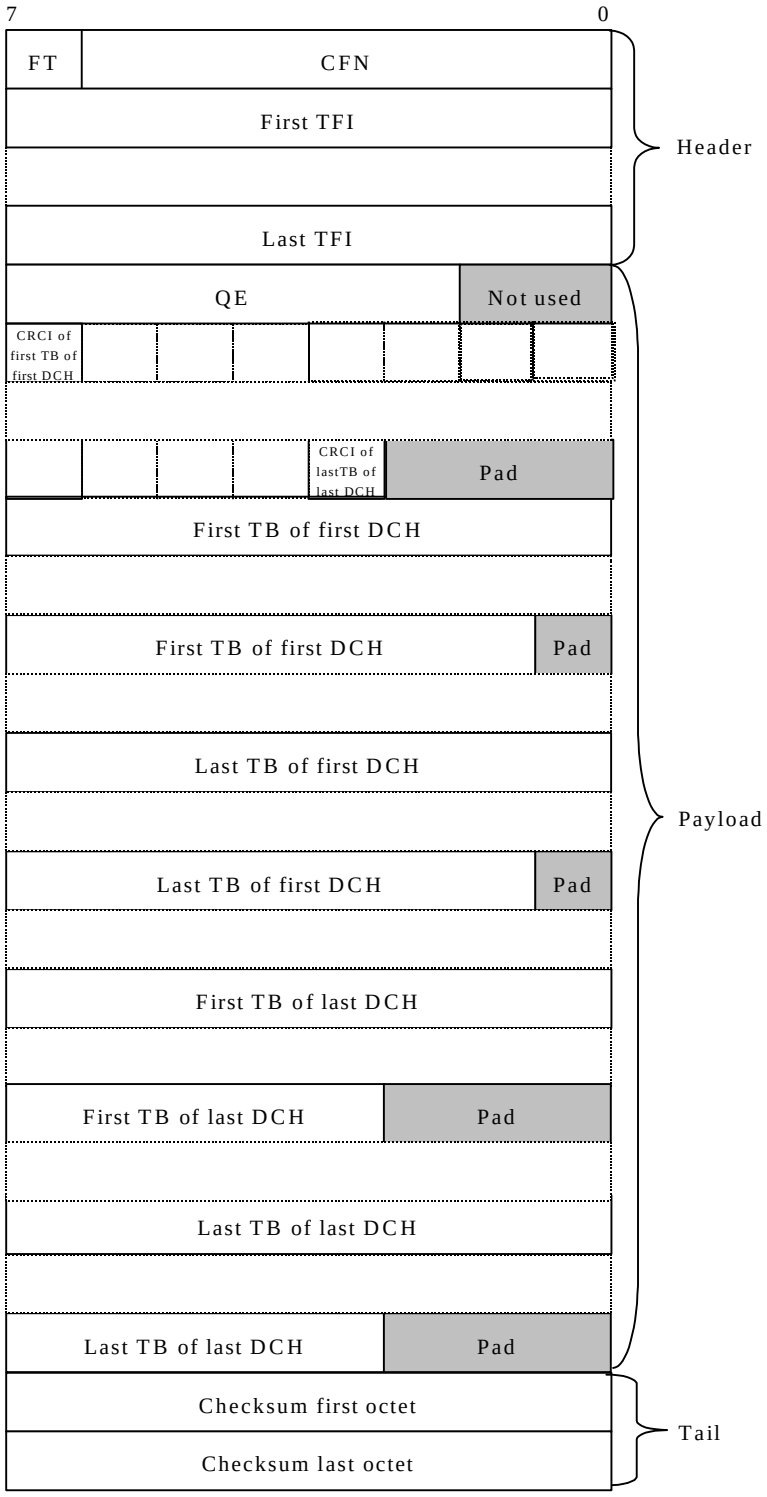
The use of separate checksums for the header and the payload is a working assumption.

~~Editor's Note: streamlining mode removed.~~

7.1.1 Uplink data frame

The structure of the UL data frame is shown below. The handling of 8 bits CFN is FFS.

Editor's note: the structure is not in line with the current length of the CFN, that is 8 bits long. The structure of the header shall be redefined.



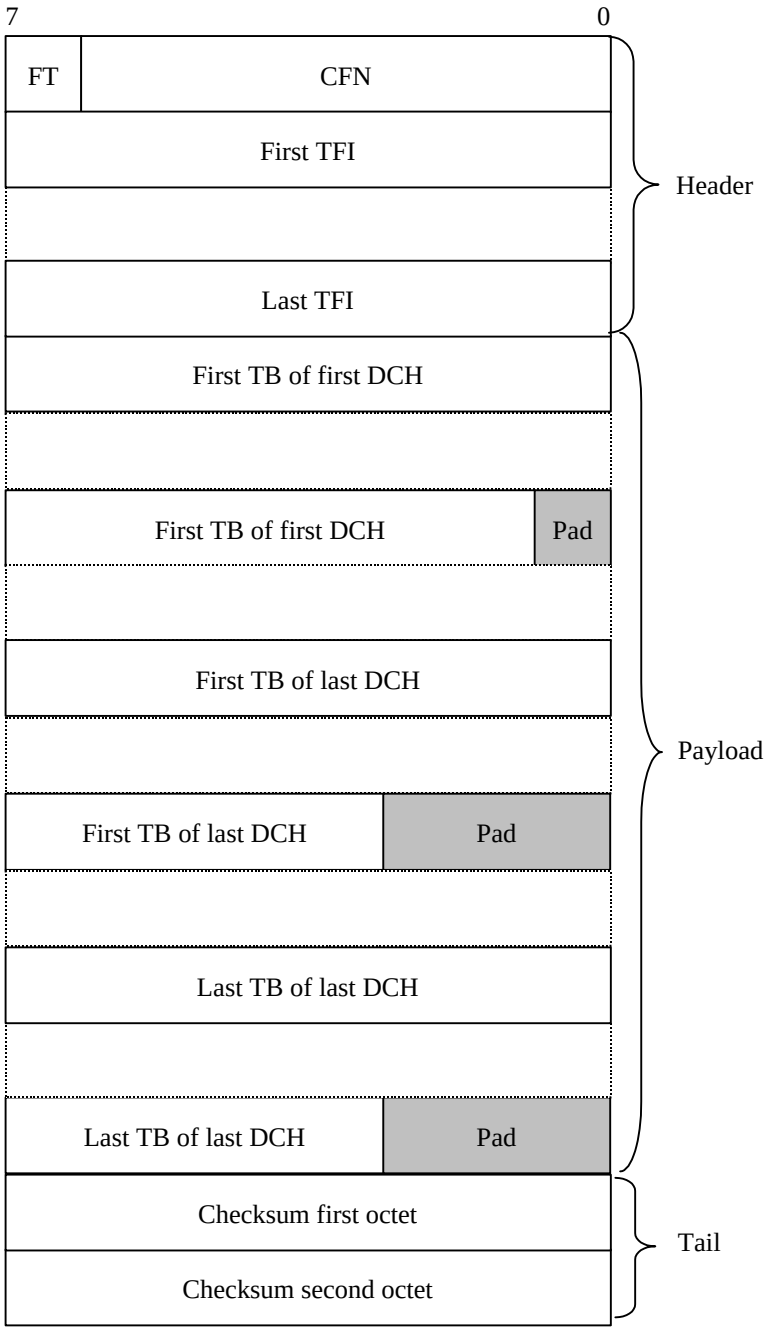
For the description of the fields see chapter 7.3.

~~Editor's note: text moved in section 8.1.1.~~

7.1.2 Downlink data frame

The structure of the UL data frame is shown below. The handling of 8 bits CFN is FFS.

Editor's note: the structure is not in line with the current length of the CFN (8 bits). The structure of the header shall be redefined.



For the description of the fields see chapter 7.3.

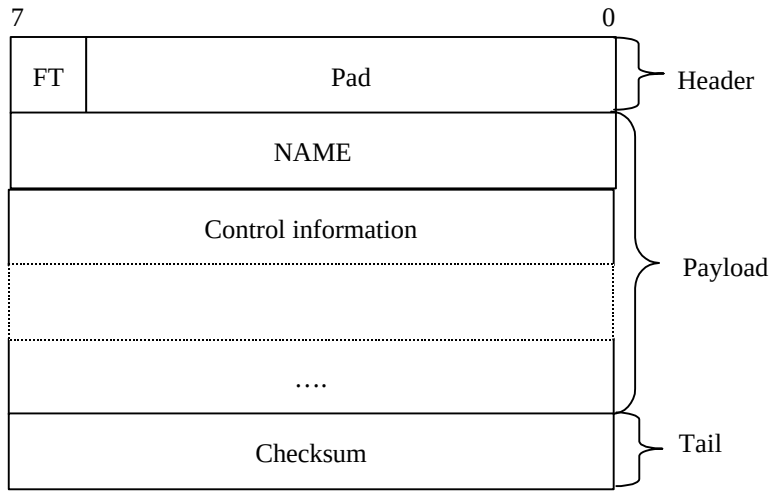
7.2 Control frame structure

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.

~~Table 3 below summarises the data sent in a control frame, the two last columns shows in which direction the data is valid:~~

	~~Information element~~	~~Description~~	~~Valid On~~	
			~~UL~~	~~DL~~
~~Header~~	~~Frame Type~~	~~DCH Control Frame~~	~~X~~	~~X~~
~~Payload~~	~~NAME~~	~~Name of command or measurement report~~	~~X~~	~~X~~
	~~Parameters~~	~~Parameters of the command or measurement report~~	~~X~~	~~X~~
~~Tail~~	~~DCH control frame checksum~~	~~Checksum of the header and payload data~~	~~X~~	~~X~~

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



Note: the length and definition of the Checksum field is FFS.

'NAME' defines the type of the control frames, as indicated in 7.3.2.

~~Following Control information are identified~~
The length of the payload is variable accordingly to the control frame type.

The payload of the control frames is defined in the following sections (the coding of the parameters is reported in section 7.3.2).~~.~~

7.2.1 UL Outer loop power control

In order to adjust the target value for the inner loop the SRNC shall send a control frame to set a new target value in the Node Bs, see also reference [3].

Table below shows the structure of the payload when control frame is used for the UL outer loop power control. This control information is sent in DL only

NAME	UL Outer Loop Power Control
Parameters	New Eb/N0 target

7.2.2 Timing Adjustment

Timing adjustment control frame is used on the UL to notify SRNC that the data is received too late or too early.

Table below shows the structure of the payload when control frame is used for the timing adjustment. This control information is sent in UL only

NAME	Timing Adjustment
Parameters	Time of Arrival (TOA): time difference between the arrival of the DL frame with respect to TOAWE (based on the CFN value in the frame)
	CFN

The range of the Timing Adjustment report parameter (TOA) is plus minus half the CFN size. The resolution of the timing adjustment report parameter is 125 μs.

7.2.3 DL synchronisation

DL synchronisation control frames are used to achieve and maintain the synchronisation of the DCH user plane accordingly to the synchronisation procedure.

Table below shows the structure of the payload when control frame is used for the user plane synchronisation. This control information is sent in DL only

NAME	DL Synchronisation
Parameters	CFN

7.2.4 UL synchronisation

UL synchronisation control frames are used to achieve and maintain the synchronisation of the user plane accordingly to the synchronisation procedure.

Table below shows the structure of the payload when the control frame is used for the user plane synchronisation (UL). This control information is sent in UL only

NAME	DL Synchronisation
Parameters	CFN
	Time of Arrival (ToA)

7.2.5 DL signalling for DSCH

This downlink control frame is used to indicate the TFI used on the DSCH to each Node B involved in the UE active set. The Node B takes into account those TFI bits during the DSCH TTI period.

Table below shows the structure of the payload when the control frame is used for signalling TFI bits used on the DSCH. This control information is sent in DL only

NAME	DL signalling for DSCH
Parameters	CFN : indicates the first frame number when the TFI needs to be taken into account for TFCI building in Node B
	DSCH TFI : indicates the TFI of the DSCH

7.2.6 DL Node Synchronization

DL Node Synchronization control frames are sent by the RNC to the Node B in order to measure the offset between the RFN and the BFN according to the Node Synchronization procedure. This control frame is sent in DL only, and is sent on the transport bearer used to convey “channel”.

NAME	DL Node Synchronization
Parameters	t1, Time when the RNC sends the frame.

~~*Note,t1 is the RNC specific frame time (RFN) in the range 0-40959.875 ms, and the resolution is 0.125 ms.*~~

Editor's Note: text moved in 7.3.2.2.6.

7.2.7 UL Node Synchronization

UL Node Synchronization control frames are sent by the Node B to the RNC as a response to the DL according to the Node Synchronization procedure. This control frame is sent in UL only, and is sent on the transport bearer used to convey “channel”.

NAME	UL Node Synchronization
Parameters	t1, Time when sending frame the RNC. (from DL Node Synchronization Frame).
	t2, Time when Node B receive~~d~~s the DL
	t3, Time when Node B sends the frame

~~Note,t2, and t3 are the Node B specific frame time (BFN) in the range 0-40959.875 ms, and the resolution is 0.125 ms. For t1, see the DL Node Synchronization control frame.~~

Editor's Note: text moved in 7.3.2.2.6 and 7.3.2.2.7.

~~Editor's note: Shall the control frames be inserted in the following section, i.e. divided in UL and DL? If not, the following section shall be removed.~~

~~7.2.8Uplink control frame~~

~~7.2.9Downlink control frame~~

7.3 Coding

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

- Lower value (in the range) coded as a sequence of 0's
- Higher value in the range coded as a sequence of 1's

7.3.1 Coding of data frames

7.3.1.1 Header

7.3.1.1.1 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

7.3.1.1.2 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 TS 25.211 reference [2].
Value range: {0-255~~127~~}
Field length: 8~~7~~ bits

~~Editor's note: Current length of the CFN is 8 bits, what reported above shall be updated.~~

7.3.1.1.3 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

7.3.1.2 Payload

Also in order to facilitate encoding of the data we propose that each transport block is octet aligned and that all the CRC indicators are given as a list before transport block sets.

7.3.1.2.1 Quality Estimate (QE)

Description: : The quality estimate is defined as the Physical Channel BER (see Ref. [25.302]). 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} 0: worst quality, 63: best quality.
Field length: 6 bits
Note: See reference [5] for justification of the field length.

Note: The decision to use the physical channel BER as a quality indicator shall be confirmed once the Physical Channel BER, to be defined in WG2, is proved to be easy to be measured, suitable to be used for MDC combining and outer loop power control.

7.3.1.2.2 CRC indicator (CRCI)

Description: Shows if the transport block has a correct CRC. The UL Outer Loop Power Control may use the CRC indication.
Value range: {0=Correct, 1=Not Correct}
Field length: 1 bit

7.3.1.2.3 Transport Block (TB)

Description: A block of data to be transmitted or have been 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 the specified by the TFI, except for the last TB that can be shorter.

7.3.1.3 Tail

7.3.1.3.1 Cyclic Redundancy Checksum

Description: A CRC is needed on the frame protocol header and payload in order to ensure that the transmission has been correct.
Value range: -
Field length: 16 bits (FFS)

Working assumption is that the CRC field contains separately the checksums of the header and of the payload.

7.3.2 Coding of control frames

7.3.2.1 Header

7.3.2.2 Payload

7.3.2.2.1 NAME

Description: Indicates the type of the control information (information elements and length) contained in the payload (=type of control frame).
Value range: see table below
Field length: 6 bits.

Type of control frame	Value
Outer loop power control	00 0001
Timing adjustment	00 0010
DL synchronisation	00 0011
UL synchronisation	00 0100
DL signalling for DSCH	00 0101
DL Node synchronisation	00 0110
UL Node synchronisation	00 0111

Other values are for future use.

7.3.2.2.2 Eb/No setpoint

Description: Value (in dB) of the reference Eb/No to be used for the UL inner loop power control.
Value range: -
Field length: 9 bits:

7.3.2.2.3 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: {-1270, +1280 msec, step 1 msec}
Field length: 9 bits

7.3.2.2.4 CFN

The CFN value in the control frame is coded as in 7.3.1.1.2.

7.3.2.2.5 DSCH TFI

The DSCH TFI in the control frame is coded as in.7.3.1.1.3.

7.3.2.2.6 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: 0-40959.875 ms, and the resolution is 0.125 ms. The maximum value is coded with {100 1111 1111 1111 1111}
Field length: 19 bits

7.3.2.2.7 T2

Description: Node B specific frame number (BFN) that indicates the time when Node B received the DL synchronisation frame through the SAP from the transport layer.
Value range: 0-40959.875 ms, and the resolution is 0.125 ms. The maximum value is coded with {100 1111 1111 1111 1111}
Field length: 19 bits

7.3.2.2.8 T3

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

Value range: 0-40959.875 ms, and the resolution is 0.125 ms. The maximum value is coded with {100 1111 1111 1111 1111}
Field length: 19 bits

7.3.2.3 Tail

7.3.2.3.1 Cyclic Redundancy Checksum

Description: A CRC is needed on the frame protocol header and payload in order to ensure that the transmission has been correct.
Value range: -
Field length: 16 bits (FFS)

8 DCH FP procedures

8.1 Data transfer

~~Editor's Note: this chapter describes when and how often a DCH data frame is transferred. Handling of DTX and loss of synchronisation in Node B is described as well.~~

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.

8.1.1 Uplink

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 case of coordinated DCHs, ~~W~~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 of not yet achieved, UL data frames are not sent to the SRNC.

8.1.2 Downlink

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.

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.

8.2 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.

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

~~Editor's note: The additional proposed text "as described in the data transfer procedure below" has been removed, because not anymore applicable. Note to be removed after the document approval.~~

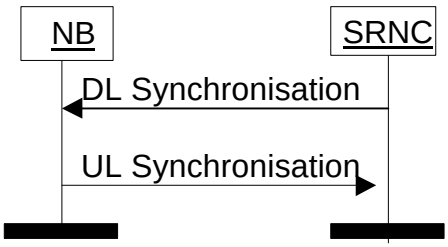


Figure 1. DCH Synchronisation procedure.

8.3 Timing adjustment

To keep the synchronisation of a DCH data stream SRNC includes a Connection Frame Number (CFN) to all DL DCH FP frames
If DL frame arrives outside the determined arrival window, node B should evaluate the time difference between the optimal arrival time for the DL DCH FP frame to be transmitted in the indicated CFN and the actual measured arrival time of the DL DCH FP frame (ToA: time of arrival).
Node B reports the measured ToA and the indicated CFN in one UL DCH FP control frame.

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.

(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

(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.

Editor's Note: In WG3#6 meeting it was agreed to include in 25.401 a new description of the timing adjustment procedure, more complete and with the values of the parameters (Tdoc 875). That the description should be moved, or copied in this section.

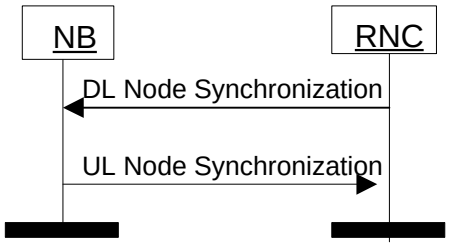
8.4 Outer loop PC information transfer

~~Editor's Note: this chapter describes when and how often an the outer loop power control information is transferred in a DCH frame, considering also the case when multiple DCH are associated to one UE.~~

Based 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.

8.5 Node Synchronization

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



~~Figure X. "Channel"~~DCH Node Synchronization procedure.

Editor's Note: modification accordingly to comments from Ericsson on the reflector.

9 Annex A (Informative) Document Stability Assessment Table

Section 1 to 3 are not considered in this table.

Section	Content missing	Incomplete	Restructuring needed	Checking needed	Editorial work required	Finalisation needed	Almost stable	Stable
4					√			
5					√			
6		√			√			
7.1							√	
7.2							√	
7.3						√		
8.1						√		
8.2							√	
8.3					√		√	
8.4							√	
8.5					√		√	

9.1 List of open issues

The open issues identified by the editor are the following:

1. Exact definition of the CRC in the tail of the FP frame
2. Handling of the 8 bits CFN in the current byte aligned structure for the header of the FP data frame.
3. Backward compatibility and definition of the compatibility information

4. Coding of the parameters (especially control frames)
5. Definition of performances and response time of the procedures (if needed)
6. Handling of abnormal conditions (if something shall be specified)

10 History

Document history		
0.0.1	15.02.1999	Document Structure (proposal)
0.0.2	February 1999	Introduction of text from 'Merged Description of the Iub interface'
0.0.3	29.03.99	Initial list in chapter 7 reintroduced. Connection ID added in the UL and DL data frame structure.
0.1.0	15.03.1999	Approved by WG3
0.1.1	April 1999	Minor editorial changes
0.2.0	June 1999	Restructured and approved by WG3 #4.
0.2.1	June 1999	Major changes due to the discussion in WG3 #4 of documents R3-99451 and R3-99417 (Frame structure), R3-99518 (Silence detection), R3-99452 (Outer loop power control), R3-99535 (Timing adjustment). Assessment table added.
0.3.0	July 1999	Revisions proposed in version 2.1 are approved by WG3 #5.
0.3.1	July 1999	Changes from WG3 #5 discussion (details on the synchronisation procedures as in Tdocs R3-99663 and R3-99636).
0.4.0	August 1999	Revisions proposed in version 0.3.1 are approved by WG3 #6.
0.4.1	September 1999	Changes from WG3#6 discussion. Main: - Introduction of the bit level frame structures and definition of the parameters. - Introduction of the Node Synchronisation procedure and control frames - Removal of the silence detection, and clarification on the data tranfer - Removal of the streamlining mode - Introduction of the DSCH TFCI control frame
0.4.1	September 1999	Editor's proposal. Main work on the coding of the control frames.
Rapporteur for 3GPP RAN 25.427 is:		
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