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Sophia Antipolis, 20-24 September 1999

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Agenda: **14.1**

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Title: **UMTS 25.427: Iur/Iub User plane protocol for DCH data streams, v.0.4.1**

Document for: Approval

Revisions show the changes due to the discussion in WG3#6.

An editor's note present in the draft version distributed on the reflector has been removed from section 8.1.2 as proposed by Alcatel.

TS 25.427 V 0.4.10 (1999-097)

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
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 Transport channel related to one UE context that is communicated over a set of cells that are macro-diversity combined within Node B, is carried on one transport connection. This means that there are as many transport connections as 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.

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.

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.

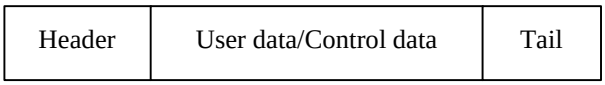


Figure 1. General structure of a frame protocol PDU

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

There are two types of DCH FP frames

- 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.

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.

It is FFS if control data can also be inserted as an optional field in the data 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.

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

Table 1 below summarises the data sent in a DCH user data frame, the two last columns shows in which direction the data is present. It is FFS if the data frame can contain some control information.

	Information element	**Description**	**Present on**	
			UL	DL
Header	Frame Type	DCH data frame	X	X
	Connection Frame Number	Connection Frame Number, indicator as to which radio frame the first data was received on uplink or shall be transmitted on downlink.	X	X
	Transport Format Indicators	List of TFI of the transport block sets contained in the frame	X	X
Payload	Quality Estimate	Used by macro diversity function	X	
	Checksum indicator	Indicates if the transport block CRC is correct	X	
	Transport Block 1 of DCH1	This contains the data to/from the radio interface	X	X
	:	*CRCOK and TB are repeated for all transport blocks in all transport block sets*		
	Checksum indicator	Indicates if the transport block CRC is correct	X	
	Transport Block N of DCH M	Last transport block in the last transport block set	X	X
TailDCH data frame checksum		Checksum of the header and payload	X	X

It is FFS if the frame protocol can also operate in a second mode (streamline mode), where only single transport block is included in the FP frame. Table 2 below summarises the structure of a user data frame using streamline mode.

	Information element	**Description**	**Present on**	
			UL	DL
Header	Frame Type	DCH data frame	X	X
	Connection Frame Number	Connection Frame Number, indicator as to which radio frame the first data of the TBS was received on uplink or shall be transmitted on downlink.	X	X
	Transport Format Indicator	TFI of the transport block set that contain the TB transported in the payload	X	X
Payload	Quality Estimate	Used by macro diversity function	X	

	~~DCH ID~~	~~Shows which DCH is transported~~	~~X~~	~~X~~
	~~Transport Block Number~~	~~The sequence number in the Transport Block Set.~~	~~X~~	~~X~~
	~~Checksum indicator~~	~~Indicates if the transport block CRC is correct~~	~~X~~	
	~~Transport Block~~	~~This contains the data to/from the radio interface~~	~~X~~	~~X~~
~~Tail~~	~~DCH data frame checksum~~	~~Checksum of the header and payload~~	~~X~~	~~X~~

~~Note: The possible use of the streamline mode shall be verified with the current MAC-L1 interaction model. A LS was sent to RAN WG2 asking for comments.~~

~~**Quality Estimate**: A quality estimate of the physical channel 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. The use and definition of the quality estimate is FFS.~~

~~**CRC indication**: shows if the transport block has a correct CRC. The UL Outer Loop Power Control may use the CRC indication.~~

~~**DCH ID**: When in streamline mode it is necessary to indicate which DCH the frame is transporting. DCH ID is the same identity that is used in the RNSAP/NBAP protocol.~~

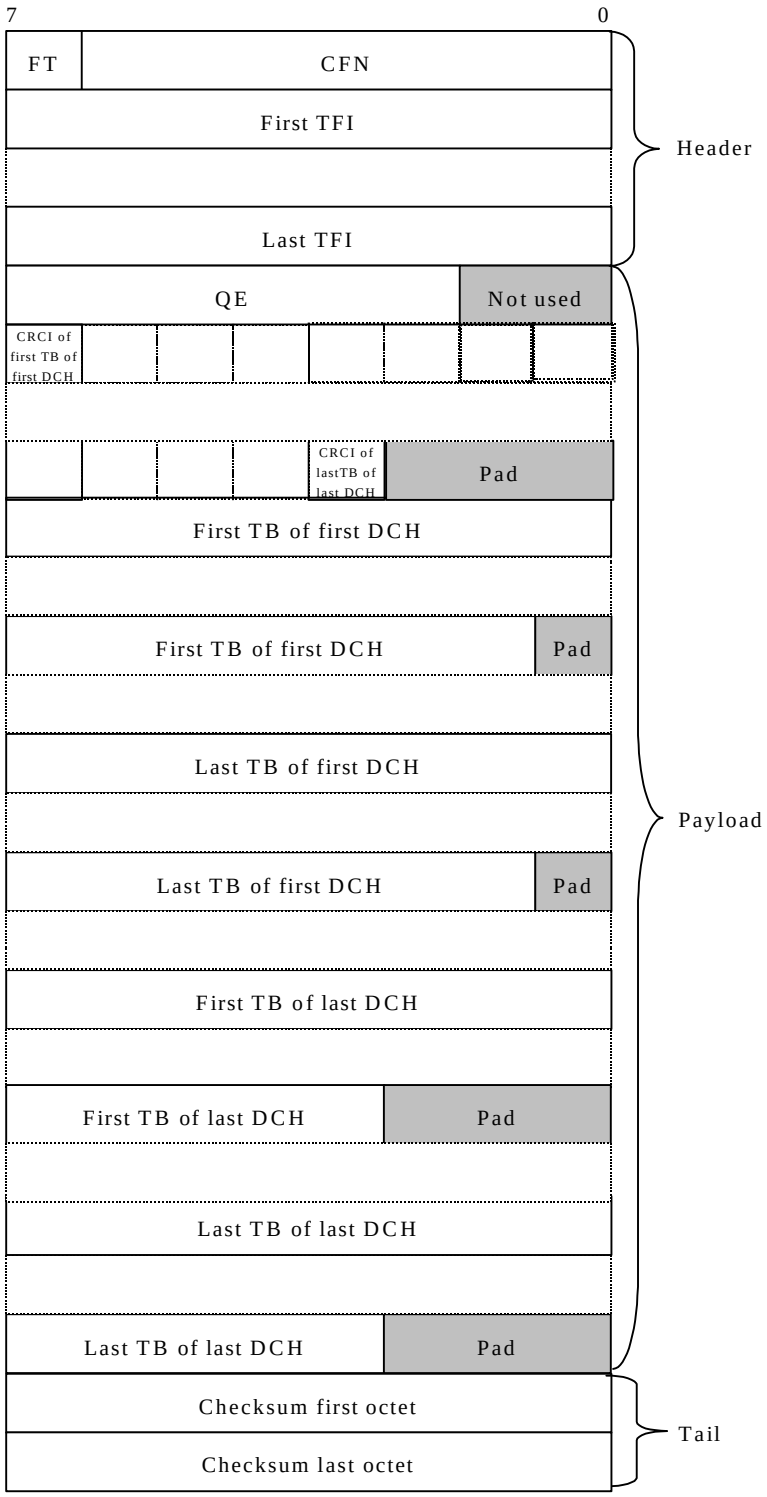
~~**Transport Block Number**: When transporting the user data in streamline mode it is possible to lose a single transport block due to overflow in an AAL2 buffer. To ensure that the corresponding transport block from each macro diversity branch is combined it is necessary to include the sequence number for each transport block in the protocol.~~

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.

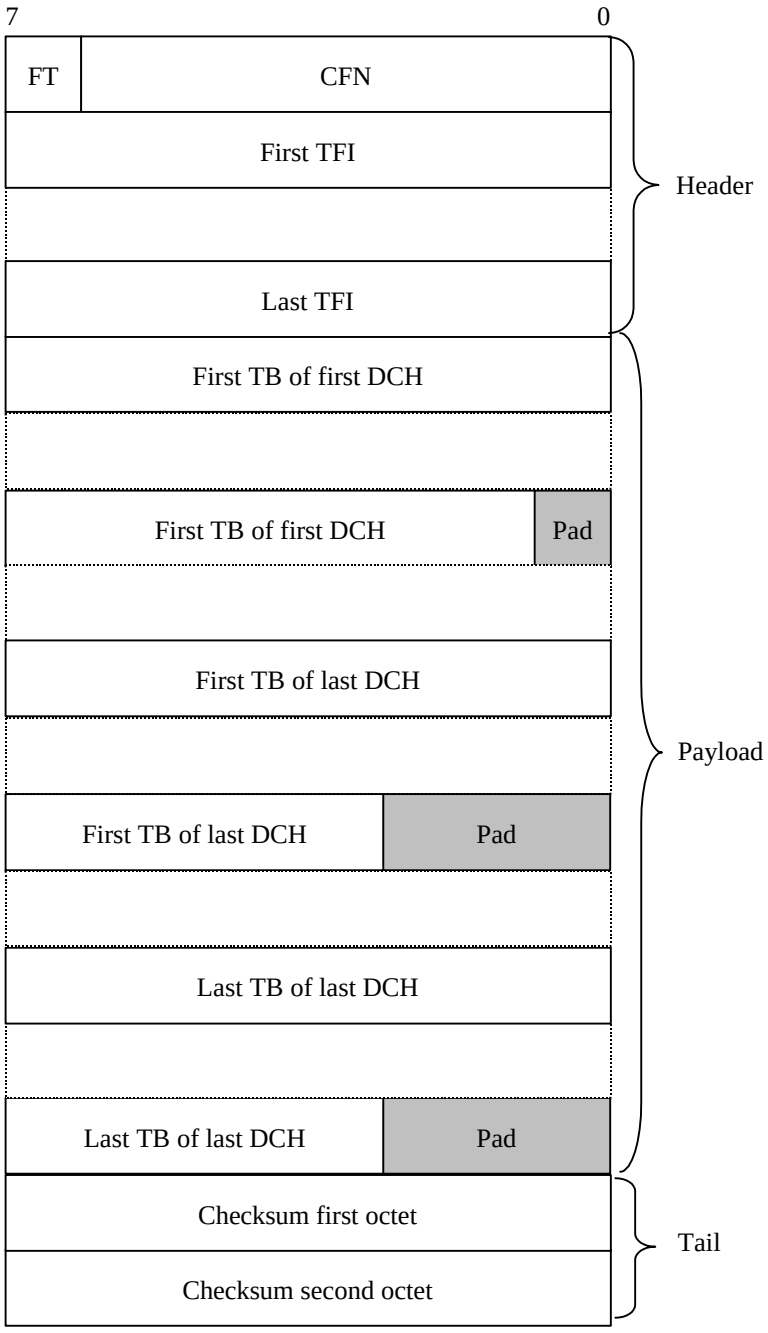
~~When UL synchronisation is lost of not yet achieved, UL data frames are not sent to the SRNC.~~

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

Following Control information are identified.

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)~~Time of Arrival (ToA): time difference between the arrival of the DL frame with respect to the optimal time (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.
~~The range of the Timing Adjustment report parameter (ToA) is equivalent to the Radio frame period multiplied by the maximum CFN value. The resolution of the timing adjustment report parameter is 1 msec. (TBC).~~

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
	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.

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 received 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.

~~**Silence detection:**~~

~~Editor's Note: a payload structure need to be defined in order to carry the command (transmit silence and reception silence bit) necessary for the silence detection procedure, as agreed in WG3 #4.~~

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.

~~7.2.1~~7.2.8 Uplink control frame

~~7.2.2~~7.2.9 Downlink control frame

7.3 Coding

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: {data, 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: {0-127}
Field length: 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}
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: {Correct, 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].

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

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

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 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.

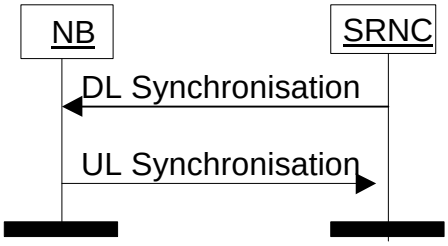


Figure 1. DCH Synchronisation procedure.

~~1.3~~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 ToAW~~S~~E 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.

~~1.4~~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.

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 RNC 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.

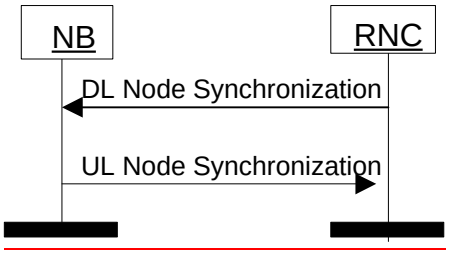


Figure X. "Channel" Node Synchronization procedure.

1.5Silence detection

For the DCHs characterised by discontinuous transmission, the Iub/Iur FP shall prevent the sending of unnecessary empty FP frames (frame with TFI indication zero bits in the TBS), but it must be ensured that the receiving end does not consider the missed reception of the frame as an transport error, resulting e.g. to incorrect timing adjustments in Iub/Iur DCH FP.

To handle these requirements, two different modes are defined in the receiving side of one FP connection (I.e. in node B for DL Iub/Iur DCH FP and in SRNC for UL Iub/Iur DCH FP):

1.N*ormal* mode
2.S*ilent* mode.

If a FP frame containing a TBS is not received during a transmission time interval, the receiver shall act according to its mode:

Normal mode: If the receiver in *normal mode* does not receive an expected FP frame, it considers this as a transmission failure. As consequence, the TX side – when the RX side is not known to be in silent mode – is mandated to send an FP frame for every Transmission time interval, even if the frames do not contain data (empty frame).

Silent Mode: If the RX side in *silent mode* does not receive an expected FP frame, it considers it as an empty frame. Thus the TX side, when the RX side is known to be in *silent mode*, is not mandated to send empty FP frames.
All kind of frames can be sent both in normal and silent mode.
The FP provides the receiver side a mechanism to signal to the transmitting side the transition between modes as described in the following chapter.

8.5.1Transitions between modes

Each DL /UL DCH FP frame contains silence indications, TRANSMIT SILENCE and RECEPTION SILENCE. The former indication is for transmitting direction and the latter for the receiving direction.

When silence detection is not used, both TRANSMIT SILENCE and RECEPTION SILENCE indications are off.

When transmitter (SRNC or Node B) wants to suspend the transmission of empty frames, it sets first the TRANSMIT SILENCE indication ON in all the transmitted frames (empty or non empty frames). When receiver (node B or SRNC) notices that the indication is set ON then it switches into the silent mode and notify this to transmitter setting the RECEPTION SILENCE indication ON in the frames going to the other direction (empty of non empty frames).

When transmitter notices that the receiver has reacted to the mode change (receives frame(s) with RECEPTION SILENCE indication on), it is not anymore forced to send empty frames.

When the transmitter decides to restore the normal mode (i.e. always transmit a frame in one transmission time interval), it switches the TRANSMIT SILENCE indication off in the transmitted frames. When the receiver in silent mode

~~receives the first frame with TRANSMIT SILENCE indication off, it switches to normal mode, and sets its RECEPTION SILENCE indication off.~~

~~Note that:~~

- ~~The use of the silence detection for the DL need to be verified~~
- ~~The use of the silence detection in UL is FFS~~
- ~~Working assumption is that the TRANSMIT SILENCE and RECEPTION SILENCE bits are carried only by separate control frames, and the use of data frame is FFS.~~
- ~~In silence mode there shall be some keep alive frames (empty frames sent with a certain periodicity)~~

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

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