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Technical Specification

3rd Generation Partnership Project (3GPP);
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UTRAN Iub/Iur Interface User Plane Protocol for DCH Data Streams

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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*

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
DCH	Dedicated Transport Channel
DL	Downlink
FP	Frame Protocol
PC	Power Control
TB	Transport Block
TBS	Transport Block Set
TFI	Transport Format Indicator
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

~~Two different message types are to be used for both the downlink and uplink Dedicated Transport Channel Frame protocol in the Iur and Iub interfaces.~~
~~- DCH data frame~~
~~- DCH control frame~~
~~The DCH control frame shall be used for inband signalling between SRNC and Node B in cases where the normal DCH data frame can not be utilised. The DCH control frame shall not carry any data targeted to or received from the air interface. Typical use for the DCH control frame would be synchronisation of the user plane and transport of UL outer loop power control commands.~~

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 t ormation 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.

Editor's note: the bulleted list contained in chapter 2,.2 of R3-99451 is not reported here because it contains justification in favour of the proposal that are not relevant in a technical specification.

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

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, RL Addition and RL Reconfiguration. For NBAP this concerns RL Setup and RL Reconfiguration.

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
Tail	DCH 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

Editor's 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.

7.1.1 Uplink data frame

~~Every Transmission Time Period, for each Transport channel, the Node B sends to the SRNC the following information:~~

~~**Information element**~~	~~**Description**~~
~~message type~~	~~Uplink DCH data frame~~
~~Transport Format Indicator~~	~~The TFI identifies the format of the transport channel as received from the radio interface~~
~~CFN~~	~~Indicator to which radio frame the data was received In case the TBS spans over multiple radio frames, CFN refers to the first radio frame.~~
~~Transport Bloc Set~~	~~This contains the data received from the radio interface~~
~~Quality indicator~~	~~The results of air interface CRC checksum is reported for each transport Block as quality indicator for Macrodiversity Combining and/or Outer Loop power control information. Other Quality indications (such as Received Power level) are FFS.~~
~~Timing adjustment command~~	~~Needed for synchronisation purposes~~

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

7.1.2 Downlink data frame

~~Every Transmission Time Period, for each Transport channel, the SRNC provides to the Node B the following information:~~

~~**Information element**~~	~~**Description**~~
~~message type~~	~~Downlink DCH data frame~~
~~Transport Format Indicator~~	~~The TFI identifies the format of the transport channel to be used on the radio interface~~
~~CFN~~	~~Indicator to which radio frame the data shall be transmitted. In case the TBS spans over multiple radio frames, CFN refers to the first radio frame.~~
~~Transport Bloc Set~~	~~This contains the data to be sent on the radio interface~~
~~Outer Loop Power Control (optional)~~	~~This may update the target outer loop power control~~

7.2 Control frame structure

Control Frames are used to transport control information between SRNC and Node B. These frames are not combined on the uplink but the frames are sent to all node Bs on the downlink.

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.

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

Timing Adjustment: 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	Timing adjustment report: time difference between the arrival of the DL frame with respect to the optimal time (based on the CN value in the frame)
	CFN (FFS)

Initial synchronisation: Depending on the outcome of the system synchronisation it might be necessary to synchronise CFN between RNC and node B especial if the new cell is located in a DRNS. A few control frames are probably also needed the get the first timing offset correct in the RNC.

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	Synchronisation
Parameters	CFN

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.

7.2.1 Uplink control frame

~~Uplink control frames contain the following information:~~

~~**Information element**~~	~~**Description**~~
~~message type~~	~~Uplink DCH control frame~~
~~CFN~~	~~FFS~~
~~Timing adjustment command~~	~~Needed for synchronisation purposes~~

7.2.2 Downlink control frame

~~Downlink control frames contain the following information:~~

~~**Information element**~~	~~**Description**~~
~~message type~~	~~Downlink DCH control frame~~
~~CFN~~	~~Used for link synchronisation~~
~~Outer Loop Power Control (optional)~~	~~This may update the target outer loop power control~~

7.3 Coding

7.3.1 Coding of data frames

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.

8.2 Timing adjustment

To synchronise and keep the synchronisation of a DCH data stream SRNC includes a Connection Frame Number (CFN) to all DL DCH FP frames. If there is no data to be transmitted to the UE via the DCH transport bearer then DL DCH Control frames can be sent instead of DL DCH data frames.
Upon reception of a DL DCH FP frame, 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.
~~According to the measured time difference, node B should set a proper value for the~~ ~~Timing adjustment command~~ Node B reports the arrival of the DL frame with respect to the optimal time (based on the CFN value in the frame) in ~~the~~ one

UL DCH FP control frame. ~~If there is no UL data to be transmitted to the SRNC via the DCH transport bearer then a UL DCH Control frame can be sent.~~
(The initial value for the parameters is FFS)

8.3 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.

8.4 Silence 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. *Normal* mode
2. *Silent* 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.

8.4.1 Transitions 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		√						

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.

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