Universal Mobile Telecommunications System (UMTS); UTRAN lub interface user plane protocols for CCH data streams (3GPP TS 25.435 version 5.8.0 Release 5)
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Foreword

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Version x.y.z

where:

x the first digit:
   1 presented to TSG for information;
   2 presented to TSG for approval;
   3 or greater indicates TSG approved document under change control.

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

z the third digit is incremented when editorial only changes have been incorporated in the document.
1 Scope

The present document provides a description of the UTRAN RNC-Node B (Iub) interface user plane protocols for Common Transport Channel data streams as agreed within the TSG-RAN working group 3.

NOTE: By Common Transport Channel one must understand RACH, FACH/PCH, DSCH [TDD], USCH [TDD] and HS-DSCH.

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document in the same Release as the present document.

[3] 3GPP TS 25.302: "Services provided by the Physical Layer".
[4] 3GPP TS 25.221: "Physical channels and mapping of transport channels to physical channels (TDD)".
[5] 3GPP TS 25.211: "Physical channels and mapping of transport channels onto physical channels (FDD)".
[8] 3GPP TS 25.331: "Radio Ressource Control (RRC) protocol specification".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions in [2] and the following 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 abbreviations in [2] and the following 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
- HS-DSCCH High Speed Downlink Shared Channel
- LTOA Latest Time of Arrival
- PC Power Control
- PDSCH Physical Downlink Shared Channel
- PUSCH Physical Uplink Shared Channel
- QE Quality Estimate
- TB Transport Block
- TBS Transport Block Set
- TFI Transport Format Indicator
- ToA Time of Arrival
- ToAWE Time of Arrival Window Endpoint
- ToAWS Time of Arrival Window Startpoint
- TTI Transmission Time Interval
- UL Uplink
- USCH Uplink Shared Channel

3.3 Specification Notations

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

- [FDD] This tagging of a word indicates that the word preceding the tag "[FDD]" applies only to FDD. This tagging of a heading indicates that the heading preceding the tag "[FDD]" and the section following the heading applies only to FDD.

- [TDD] This tagging of a word indicates that the word preceding the tag "[TDD]" applies only to TDD, including 3.84Mcps TDD and 1.28Mcps TDD. This tagging of a heading indicates that the heading preceding the tag "[TDD]" and the section following the heading applies only to TDD, including 3.84Mcps TDD and 1.28Mcps TDD.

- [3.84Mcps TDD] This tagging of a word indicates that the word preceding the tag "[3.84Mcps TDD]" applies only to 3.84Mcps TDD. This tagging of a heading indicates that the heading preceding the tag "[3.84Mcps TDD]" and the section following the heading applies only to 3.84Mcps TDD.

- [1.28Mcps TDD] This tagging of a word indicates that the word preceding the tag "[1.28Mcps TDD]" applies only to 1.28Mcps TDD. This tagging of a heading indicates that the heading preceding the tag "[1.28Mcps TDD]" and the section following the heading applies only to 1.28Mcps TDD.

- [FDD - …] This tagging indicates that the enclosed text following the "[FDD - " applies only to FDD. Multiple sequential paragraphs applying only to FDD are enclosed separately to enable insertion of TDD specific (or common) paragraphs between the FDD specific paragraphs.

- [TDD - …] This tagging indicates that the enclosed text following the "[TDD - " applies only to TDD, including 3.84Mcps TDD and 1.28Mcps TDD. Multiple sequential paragraphs applying only to TDD are enclosed separately to enable insertion of FDD specific (or common) paragraphs between the TDD specific paragraphs.

- [3.84Mcps TDD - …] This tagging indicates that the enclosed text following the "[3.84Mcps TDD - " applies only to 3.84Mcps TDD. Multiple sequential paragraphs applying only to 1.28Mcps TDD are enclosed separately to enable insertion of FDD and TDD specific (or common) paragraphs between the 3.84Mcps TDD specific paragraphs.
4 General aspects

4.1 Common Transport Channel Data Stream User Plane Protocol Services

Common transport channel provides the following services:

- Transport of TBS between the Node B and the CRNC for common transport channels.
- Support of transport channel synchronisation mechanism.
- Support of Node Synchronisation mechanism.

4.2 Services expected from the Data Transport Network layer

The following services are expected from the transport layer:

- Delivery of Frame Protocol PDUs.

In sequence delivery is not required. However, frequent out-of-sequence delivery may impact the performance and should be avoided.

4.3 Protocol Version

This revision of the specification specifies version 1 of the protocols.

5 Data Streams User Plane Procedures

5.1 Data Transfer

5.1.1 RACH Channels

Data Transfer procedure is used to transfer data received from Uu interface from Node B to CRNC. Data Transfer procedure consists of a transmission of Data Frame from Node B to CRNC.
5.1.2 CPCH Channels [FDD]
Void.

5.1.3 Secondary-CCPCH related transport Channels
For the FACH transport channel, a Data Transfer procedure is used to transfer data from CRNC to Node B. Data Transfer procedure consists of a transmission of Data Frame from CRNC to Node B.

For the PCH transport channel, a Data Transfer procedure is used to transfer data from CRNC to Node B. Data Transfer procedure consists of a transmission of Data Frame from CRNC to Node B.

In this case the PCH DATA FRAME may also transport information related to the PICH channel.

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. For the FACH and PCH transport channels, the TFS shall never define a Transport Block Size of zero bits.

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 the 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 secondary-CCPCH according to the TFIs of the transport channels multiplexed on this secondary-CCPCH and scheduled for that frame. [FDD - In case the Node B receives an unknown TFI combination, no pilot bits, TFCI bits or Data bits shall be transmitted.] [TDD - In case the Node B receives an unknown TFI combination, it shall apply DTX, i.e. suspend transmission on the corresponding S-CCPCH - except if this S-CCPCH provides the "beacon function", in which case the Node B shall maintain the physical layer transmission as specified in TS 25.221].

If the Node B does not receive a valid FP frame in a TTI or a frame without paging indication information, it assumes that no UE's have to be paged on the Uu in this TTI. In this case the default PICH bit pattern of all zeros shall be transmitted.

Data Frames sent on Iub for different transport channels multiplexed on one secondary-CCPCH might indicate different transmission power levels to be used in a certain Uu frame. Node-B shall determine the highest DL power level required for any of the transport channels multiplexed in a certain Uu frame and use this power level as the desired output level for the data.

In the case there is no data (i.e. no TB in the FP frame or no FP frame) in any transport channel for a given TTI and a TFCI is defined for no transmission on all transport channels multiplexed on the S-CCPCH, the TFCI transmit power is unspecified.

Note: It can be for example 0 or determined by the Node B relatively to $P_{\text{ref\_nodata}} = \min (\text{PCH Power}, \max \text{FACH1 Power}, \max \text{FACH2 Power}, ..., \max \text{FACHn Power})$ where PCH, FACH1, FACH2, ..., FACHn are the transport channels of the S-CCPCH [FDD , using the respective PO1 and PO3 offsets specified in [10]].

5.1.4 Downlink Shared Channels [TDD]

The Data Transfer procedure is used to transfer a DSCH DATA FRAME from the CRNC to a Node B.

If the Node B does not receive a valid DSCH DATA FRAME for transmission in a given TTI, it assumes that there is no data to be transmitted in that TTI for this transport channel. For the DSCH transport channel, the TFS shall never define a Transport Block Size of zero bits.

The Node B shall use the header information in the DSCH DATA FRAME to determine which PDSCH Set [3.84Mcps TDD - and Transmit Power Level if no closed loop TPC power control is used] should be used in the PDSCH Uu frames associated to the specified CFN. The specified PDSCH Set [3.84Mcps TDD - and Transmit Power Level if no closed loop TPC power control is used] shall then be used for DSCH transmission for as long as there is data to transmit or until a new DSCH DATA FRAME arrives that specifies that a different PDSCH Set [3.84Mcps TDD - and/or Transmit Power Level if no closed loop TPC power control is used] should be used. This feature enables multiple DSCH's with different TTI to be supported.

The Node B may receive a DSCH data frame which contains a TFI value corresponding to there being no data to transmit, such a DSCH DATA FRAME will have no transport blocks. On receiving such a DATA FRAME the Node B shall apply the specified PDSCH Set [3.84Mcps TDD - and Transmit Power Level if no closed loop TPC power control is used] as described above starting in the PDSCH Uu frame associated to the specified CFN. This feature enables multiple DSCH's with different TTI to be supported, the use of such a zero payload DSCH DATA FRAME solves the problem of how the Node B should determine what PDSCH Set [3.84Mcps TDD - and Transmit Power Level if no closed loop TPC power control is used] should be used in the event that transmission of a transport block set being transmitted with a short TTI comes to an end, whilst the transmission of a TBS with a long TTI continues.

Data Frames sent on Iub for different DSCH transport channels multiplexed on one CCTrCH might indicate different transmission power levels to be used in a certain Uu frame. Node-B shall determine the highest DL power level required for any of the transport channels multiplexed in a certain Uu frame and use this power level as the desired output level.
5.1.5 Uplink Shared Channels [TDD]

Data Transfer procedure is used to transfer data received from Uu interface from Node B to CRNC. Data Transfer procedure consists of a transmission of Data Frame from Node B to CRNC.

Node B shall always send an USCH DATA FRAME to the CRNC provided the Transport Format addressed by the TFI indicates that the number of Transport Blocks is greater than 0.

When UL synchronisation is lost or not yet achieved on the Uu, USCH DATA FRAMEs shall not be sent to the CRNC.

When Node B receives an invalid TFCI in the PUSCH, USCH DATA FRAMEs shall not be sent to the CRNC.

5.1.6 High Speed Downlink Shared Channels

The Data Transfer procedure is used to transfer a HS-DSCH DATA FRAME from the CRNC to a Node B.

When the CRNC has been granted capacity by the Node B via the HS-DSCH CAPACITY ALLOCATION Control Frame or via the HS-DSCH initial capacity allocation as described in [6] and the CRNC has data waiting to be sent, then the HS-DSCH DATA FRAME is used to transfer the data. If the CRNC has been granted capacity by the Node B via the HS-DSCH initial capacity allocation as described in [6], this capacity is valid for only the first HS-DSCH DATA FRAME transmission. When data is waiting to be transferred, and a CAPACITY ALLOCATION is received, a DATA FRAME will be transmitted immediately according to allocation received.

Multiple MAC-d PDUs of same length and same priority level (CmCH-PI) may be transmitted in one MAC-d flow in the same HS-DSCH DATA FRAME.

The HS-DSCH DATA FRAME includes a User Buffer Size IE to indicate the amount of data pending for the respective MAC-d flow for the indicated priority level. Within one priority level and size the MAC-d PDUs shall be transmitted by the Node B on the Uu interface in the same order as they were received from the CRNC.
5.2 Node Synchronisation

In the Node Synchronisation procedure, the RNC sends a DL NODE SYNCHRONISATION control frame to Node B containing the parameter T1. Upon reception of a DL NODE SYNCHRONISATION control frame, the Node B shall respond with UL NODE SYNCHRONISATION control frame, indicating T2 and T3, as well as T1 which was indicated in the initiating DL NODE SYNCHRONISATION 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 NODE SYNCHRONISATION control 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].

5.3 DL Transport Channels Synchronisation

CRNC sends a DL SYNCHRONISATION control frame to 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 control frame and the CFN indicated in the received message.

The procedure shall not be applied on transport bearers transporting UL traffic channels RACH or USCH.
5.4 DL Timing Adjustment

Timing Adjustment procedure is used to indicate for the CRNC the incorrect arrival time of downlink data to Node B.

Timing Adjustment procedure is initiated by the Node B if a DL frame arrives outside of the defined arrival window.

If the DL frame has arrived before the ToAWS or after the ToAWE Node B includes the ToA and the target CFN as message parameters for TIMING ADJUSTMENT 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. 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].

5.5 Dynamic PUSCH Assignment [TDD]

Procedure for dynamic allocation of physical resources to uplink shared channels (USCH) in the Node B. The control frame includes a parameter "PUSCH Set Id" which is a pointer to a pre-configured table of PUSCH Sets in the Node B.

When this control frame is sent via a certain Iub USCH data port, then it applies to that USCH and in addition to any other USCH channel which is multiplexed into the same CCTrCH in the Node B.

The time limitation of the PUSCH allocation is expressed with the parameters "Activation CFN" and "Duration".

**Node B behaviour:** When the Node B receives the "DYNAMIC PUSCH ASSIGNMENT" from the CRNC in the USCH frame protocol over an Iub USCH data port within a Traffic Termination Point, it shall behave as follows:

1) The Node B shall extract the PUSCH Set Id.

2) It shall extract the parameters "Activation CFN" and "Duration" which identify the allocation period of that physical channel.

3) It shall retrieve the PUSCH Set which is referred to by the PUSCH Set Id.

4) It shall identify the CCTrCH to which the USCH is multiplexed, and hence the TFCS which is applicable for the USCH.

5) Within the time interval indicated by Activation CFN and Duration, the Node B shall make the specified PUSCH Set available to the CCTrCH.
5.6 DSCH TFCI Signalling [FDD]

Void.

5.7 Timing Advance [3.84 Mcps TDD]

This procedure is used in order to signal to the Node B the adjustment to be performed by the UE in the uplink timing.

The Node B shall use the CFN and timing adjustment values to adjust its layer 1 to allow for accurate impulse averaging.

5.7A Outer Loop PC Information Transfer [1.28 Mcps TDD]

Based, for example, on the CRCI values and on the quality estimate in the USCH data frames, CRNC modifies the SIR target of the associated CCTrCH by including the absolute value of the new SIR target in the OUTER LOOP PC control frame sent to the Node B.

At the reception of the OUTER LOOP PC control frame from the CRNC via a Transport Bearer used for an USCH, the Node B shall immediately update the SIR target used for the inner loop power control for the respective CCTrCH with the specified value.

The OUTER LOOP PC control frame can be sent via any of the transport bearers carrying USCHs which belong to the CCTrCH for which the UL SIR Target shall be adjusted.
5.8 General

5.8.1 Association between transport bearer and data/control frames

Table 1 shows how the data and control frames are associated to the transport bearers. ‘yes’ indicates that the control frame is applicable to the transport bearer, ‘no’ indicates that the control frame is not applicable to the transport bearer.

Table 1

<table>
<thead>
<tr>
<th>Transport bearer used for</th>
<th>Associated data frame</th>
<th>Timing Adjustment</th>
<th>DL Transport Channels Synchronisation</th>
<th>Node Synchronisation</th>
<th>Dynamic PUSCH Assignment</th>
<th>Timing Advance</th>
<th>Outer Loop PC Info Transfer</th>
<th>HS-DSCH Capacity Request</th>
<th>HS-DSCH Capacity Allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>RACH</td>
<td>RACH DATA FRAME</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>FACH</td>
<td>FACH DATA FRAME</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>PCH</td>
<td>PCH DATA FRAME</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>DSCH</td>
<td>DSCH DATA FRAME</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>USCH</td>
<td>USCH DATA FRAME</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>HS-DSCH</td>
<td>HS-DSCH DATA FRAME</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.8.2 DSCH / USCH transport bearer replacement [TDD]

As described in NBAP [6], transport bearer replacement can be achieved for a DSCH or USCH by using the Synchronised Radio Link Reconfiguration Preparation procedure in combination with the Synchronised Radio Link Reconfiguration Commit procedure. The following steps can be discerned:

1) The new transport bearer is established after which 2 transport bearers exist in parallel.
2) The transport channel(s) is/are switched to the new transport bearer.
3) The old transport bearer is released.

**DSCH transport bearer replacement, step 1:**

Communication on the old transport bearer continues as normal. In addition, the Node B shall support DSCH DATA FRAMEs, the DL Transport Channel Synchronisation procedure (see sub-clause 5.3) and the DL Timing Adjustment procedure (see sub-clause 5.4) on the new bearer. This enables the CRNC to determine the timing on the new transport bearer. DSCH DATA FRAMEs transported on the new transport bearer shall not be transmitted on the Uu Interface before the CFN indicated in the RADIO LINK RECONFIGURATION COMMIT message.

**USCH transport bearer replacement, step 1:**

Communication on the old transport bearer continues as normal.

**DSCH / USCH Transport Bearer Replacement step 2:**

Regarding step 2), the moment of switching is determined as follows:
The DSCH DATA FRAMEs or USCH DATA FRAMEs shall be transported on the new transport bearer from the CFN indicated in the RADIO LINK RECONFIGURATION COMMIT message.

Starting from this CFN the Node B shall support all applicable Common Transport Channels frame protocol procedures on the new transport bearer and no requirements exist regarding support of Common Transport Channels frame protocol procedures on the old transport bearer.

**DSCH / USCH Transport Bearer Replacement step 3:**

Finally in step 3), the old transport bearer is released.

### 5.9 HS-DSCH Capacity Request

![Figure 12B: HS-DSCH Capacity Request procedure](image)

The HS-DSCH Capacity Request procedure provides means for the CRNC to request HS-DSCH capacity by indicating the user buffer size in the CRNC for a given priority level.

The CRNC is allowed to reissue the HS-DSCH Capacity Request if no CAPACITY ALLOCATION has been received within an appropriate time threshold.

### 5.10 HS-DSCH Capacity Allocation

![Figure 12C: HS-DSCH Capacity Allocation procedure](image)

HS-DSCH Capacity Allocation procedure is generated within the Node B. It may be generated either in response to a HS-DSCH Capacity Request or at any other time.

The Node B may use this message to modify the capacity at any time, irrespective of the reported user buffer status.

The HS-DSCH CAPACITY ALLOCATION frame is used by the Node B to control the user data flow. HS-DSCH Credits IE indicates the number of MAC-d PDUs that the CRNC is allowed to transmit for the MAC-d flow and the associated priority level indicated by the Common Transport Channel Priority Indicator IE.

The Maximum MAC- d PDU length, HS-DSCH Credits, HS-DSCH Interval and HS-DSCH Repetition Period IEs indicates the total amount of capacity granted. Any capacity previously granted is replaced.
If $HSDSC\text{h \ Credits } IE = 0$ (e.g. due to congestion in the Node B), the CRNC shall immediately stop transmission of MAC-d PDUs. If $HSDSC\text{h \ Credits } IE = 2047$, the CRNC can transmit MAC-d PDUs with unlimited capacity.

The IEs used in the HS-DSCH CAPACITY ALLOCATION Control Frame are the Common Transport Channel Priority Indicator, $HSDSC\text{h \ Credits}$, Maximum MAC-d PDU Length, $HSDSC\text{h \ Interval}$ and the $HSDSC\text{h \ Repetition \ Period}$.

If the $HSDSC\text{h \ Repetition \ Period } IE = \text{"unlimited repetition period"}$ it indicates that the CRNC may transmit the specified number of MAC-d PDUs for an unlimited period according to the bounds of Maximum MAC-d PDU Length, $HSDSC\text{h \ Credits}$ and $HSDSC\text{h \ Interval}$ IEs.

6 Frame Structure and Coding

6.1 General

The general structure of a Common Transport Channel frame consists of a header and a payload. This structure is depicted in figure 13.

| Header | Payload: Data or Control Information |

**Figure 13: General Frame Structure**

The header shall contain the Frame Type field and information related to the frame type.

There are two types of frames (indicated by the Frame Type field).

- Data frame.
- Control frame.

In the present document the structure of frames will be specified by using pictures similar to figure 14.

```
7  6  5  4  3  2  1  0

Field 1  Field 2

Field 3

Field 3 (cont)  Field 4

Spare Extension

Byte 1

Byte 2

Byte 3
```

**Figure 14: Example 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 14). In addition, if a field spans several bytes, more significant bits will be located in lower numbered bytes (right of frame in figure 14).

On the Iub 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 2's complement binary coded.

The Spare Extension indicates the location where new IEs can in the future be added in a backward compatible way. The Spare Extension shall not be used by the transmitter and shall be ignored by the receiver.

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

6.2 Data frame structure

6.2.1 RACH Channels

The RACH DATA FRAME includes the CFN corresponding to the SFN of the frame in which the payload was received. If the payload was received in several frames, the CFN corresponding to the first Uu frame in which the information was received shall be indicated.

![RACH DATA FRAME structure](image)

**Figure 15: RACH DATA FRAME structure**

*Propagation Delay* is a conditional Information Element which is only present when the Cell supporting the RACH Transport Channel is a FDD Cell.

*Rx Timing Deviation* is a conditional Information Element which is only present when the Cell supporting the RACH Transport Channel is a 3.84 Mcps TDD Cell.

*Received SYNC UL Timing Deviation* is a conditional Information Element which is only present when the Cell supporting the RACH Transport Channel is a 1.28Mcps TDD Cell.
6.2.2 CPCH Channels [FDD]
Void.

6.2.3 FACH Channels

FACH DATA FRAME includes the CFN corresponding to the Uu frame at which this data in which the payload (FACH TBS) has to be transmitted. If the payload is to be sent in several frames, the CFN corresponding to the first frame shall be indicated.

![Figure 17: FACH DATA FRAME structure](image)

6.2.4 PCH Channels

The PCH DATA FRAME includes the paging indication information and paging messages [FDD - To page one User Equipment, two consecutive PCH DATA FRAMEs with consecutive CFN numbers are transmitted, the first frame contains the Paging Indication Information and the second contains the Paging Message.] [TDD – To page one User Equipment, one or more PCH DATA FRAMEs are transmitted.]

[TDD - If two or more consecutive frames are used, the first frame contains the Paging Indication Information and the rest contain the Paging Messages. If PI-bitmap and PCH TBS are both transmitted within the PCH DATA FRAME, the CFN is related to the PCH TBS only. The PI bitmap is mapped to the PICH frames, transmitted at the beginning of the paging block.]

The paging messages are transmitted in S-CCPCH frames. The CFN in the PCH DATA FRAME header corresponds to the Cell SFN of the frame in which the start of the S-CCPCH frame is located. [TDD - If the paging messages are to be sent in several frames, the CFN corresponding to the first frame shall be indicated.]

[FDD - The timing of the PICH frame (containing the paging indication information) is \( \tau_{PICH} \) prior to the S-CCPCH frame timing [5]].

In contrast to all other Common Transport Channel data frames, which use a CFN of length 8, the PCH DATA FRAME includes a CFN of length 12.
The Node B has no responsibility to ensure the consistency between the paging indication information and the corresponding paging messages. E.g. if the paging indication information is lost over the Iub, the paging messages might be sent over the Uu while no UE is actually listening.

"Not Used" bits shall be set to 0 by the RNC and ignored by the Node B.

6.2.5 Downlink Shared Channels [TDD]

DSCH DATA FRAME includes a CFN indicating the SFN of the PDSCH in which the payload shall be sent. If the payload is to be sent over several frames, the CFN corresponding to the first frame shall be indicated.
6.2.6 Uplink Shared Channels [TDD]

USCH DATA FRAME includes the CFN in which the payload was received. If the payload was received in several frames, the CFN corresponding to the first frame will be indicated.
Figure 21: USCH DATA FRAME structure

6.2.6A HS-DSCH Channels
6.2.7 Coding of information elements in data frames

6.2.7.1 Header CRC

**Description:** Cyclic Redundancy Checksum calculated on the header of a data frame with polynom: X^7+X^6+X^2+1.

The CRC calculation shall cover all bits in the header, starting from bit 0 in the first byte (FT field) up to the end of the header. See subclause 7.1.

**Value range:** {0..127}.

**Field length:** 7 bits.

6.2.7.2 Frame Type

**Description:** Describes if it is a control frame or a data frame.

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

**Field Length:** 1 bit.
6.2.7.3 Connection Frame Number (CFN)

**Description:** Indicator as to which radio frame the first data was received on uplink or shall be transmitted on downlink. The value range and field length depend on the transport channel for which the CFN is used.

- **Value range (PCH):** \(\{0..4095\}\).
- **Value range (other):** \(\{0..255\}\).
- **Field length (PCH):** 12 bits.
- **Field length (other):** 8 bits.

6.2.7.4 Transport Format Indicator

**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 [3].

- **Value range:** \(\{0..31\}\).
- **Field length:** 5 bits.

6.2.7.5 Propagation Delay [FDD]

**Description:** One-way radio interface delay as measured during RACH access.

- **Value range:** \(\{0..765\text{ chips}\}\).
- **Granularity:** 3 chips.
- **Field length:** 8 bits.

6.2.7.6 Rx Timing Deviation [3.84Mcps TDD]

**Description:** Measured Rx Timing Deviation as a basis for timing advance. This value should consider measurements made in all frames and all timeslots that contain the transport blocks in the payload. In case the Timing Advance Applied IE indicates ”No” (see [6]) in a cell, the Rx Timing Deviation field shall be set to \(N = 0\).

- **Value range:** \(-256 \ldots +256\text{ chips}\).
  
  \[N*4 –256 \leq \text{RxTiming Deviation} < (N+1)*4 – 256\text{ chips}\].

  With \(N = 0, 1, \ldots, 127\).

- **Granularity:** 4 chips.
- **Field length:** 7 bits.

6.2.7.6A Received SYNC UL Timing Deviation [1.28Mcps TDD]

**Description:** Measured Received SYNC UL Timing Deviation as a basis for propagation delay.

- **Value range:** \(\{0, \ldots, +256\text{ chips}\}\)
- **Granularity:** 1 chip.
- **Field length:** 8 bits.

6.2.7.7 Transport Block

**Description:** A block of data to be transmitted or have been received over the radio interface. The transport format indicated by the TFI describes the transport block length and transport block set size. See [3].
6.2.7.8 CRC Indicator

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.

6.2.7.9 Payload CRC

Description: Cyclic Redundancy Checksum calculated on the payload of a data frame with polynom \( X^{16}+X^{15}+X^2+1 \).

The CRC calculation shall cover all bits in the data frame payload, starting from bit 7 in the first byte up to bit 0 in the byte before the payload CRC. See subclause 7.1.

Field length: 16 bits.

6.2.7.10 Transmit Power Level

Description: Preferred transmission power level during this TTI for the corresponding transport channel. The indicated value is the negative offset relative to the maximum power configured for the physical channel(s) used for the respective transport channel. [1.28Mcps TDD - The Node B shall ignore the Transmit Power Level in the TDD DSCH DATA FRAME.] [3.84Mcps TDD - The Node B shall ignore the Transmit Power Level in the TDD DSCH DATA FRAME if closed loop TPC power control is used.]

Value range: \{0 .. 25.5\ dB\}.

Granularity: 0.1 dB.

Field length: 8 bits.

6.2.7.11 Paging Indication (PI)

Description: Describes if the PI Bitmap is present in the payload.

Value range: \{0=no PI-bitmap in payload, 1=PI-bitmap in payload\}.

Field length: 1 bit.

6.2.7.12 Paging Indication bitmap (PI-bitmap)

Description: Bitmap of Paging Indications PI0..PIN-1. Bit 7 of the first byte contains PI0, Bit6 of the first byte contains PI1,…, Bit7 of the second byte contains PI8 and so on.

Value range: [FDD - \{18, 36, 72 or 144 Paging Indications\}.

[3.84Mcps TDD – \{30, 34, 60, 68, 120 and 136\} Paging Indications for 2 PICH frames, 60, 68, 120, 136, 240 and 272] Paging Indications for 4 PICH frames].

[1.28Mcps TDD – \{44, 88 and 176\} Paging Indications for 2 PICH frames, 88, 176 and 352] Paging Indications for 4 PICH frames].

Field length: [FDD - 3, 5, 9 or 18 bytes (the PI-bitmap field is padded at the end up to an octet boundary)].

[3.84Mcps TDD – 4, 5, 9, 15, 17, 30 or 34 bytes (the PI-bitmap field is padded at the end up to an octet boundary)].

[1.28Mcps TDD – 6, 11, 22 or 44 bytes (the PI-bitmap field is padded at the end up to an octet boundary)].
6.2.7.13 Rx Timing Deviation on RACH [3.84Mcps TDD]
Void.

6.2.7.14 PDSCH Set Id [TDD]
Description: A pointer to the PDSCH Set which shall be used to transmit the DSCH DATA FRAME over the radio interface.
Value range: {0..255}.
Field length: 8 bits.

6.2.7.15 Code Number [FDD]
Void.

6.2.7.16 Spreading Factor (SF) [FDD]
Description: The spreading factor of the PDSCH.
Spreading factor = 0   Spreading factor to be used = 4.
Spreading factor = 1   Spreading factor to be used = 8.
Spreading factor = 6   Spreading factor to be used = 256.
Value Range: {4,8,16,32,64,128, 256}.
Field length: 3 bits.

6.2.7.17 Power Offset [FDD]
Void.

6.2.7.18 MC Info [FDD]
Void.

6.2.7.19 Spare Extension
Description: Indicates the location where new IEs can in the future be added in a backward compatible way.
Field length: 0-32 octets.

6.2.7.20 Quality Estimate (QE) [TDD]
Description: The quality estimate is derived from the Transport channel BER.
If the USCH FP frame includes TB's for the USCH then the QE is the Transport channel BER for the selected USCH. If no Transport channel BER is available the QE shall be set to 0.
The quality estimate shall be set to the Transport channel BER and be measured in the units TrCH_BER_LOG respectively (see [6]). The UL Outer Loop Power Control may use the quality estimate.
Value range: {0..255}. 

ETSI
Granularity: 1.
Field length: 8 bits.

6.2.7.21 Common Transport Channel Priority Indicator (CmCH-PI)
Description: CmCH-PI, configured via the Scheduling Priority Indicator in NBAP [6], is the relative priority of the data frame and the SDUs included.
Value range: \(0-15\), where 0=lowest priority, 15=highest priority.
Field length: 4 bits.

6.2.7.22 User Buffer Size
Description: Indicates the users’ buffer size (i.e. the amount of data in the buffer) in octets for a given Common Transport Channel Priority Indicator level.
Value range: \(0-65535\).
Field length: 16 bits.

6.2.7.23 MAC-d PDU Length
Description: The value of that field indicates the length of every MAC-d PDU in the payload of the HS-DSCH DATA FRAME in number of bits.
Value range: \(0-5000\).
Field Length: 13 bits.

6.2.7.24 NumOfPDU
Description: Indicates the number of MAC-d PDUs in the payload.
Value range: \(1-255\).
Field Length: 8 bits.

6.2.7.25 MAC-d PDU
Description: A MAC-d PDU contains the MAC-d PDU as defined in [9].
Field length: See the value of the MAC-d PDU Length IE.

6.3 Control frame structure

6.3.1 Introduction
The Common Control Channel control frames are used to transport control information between the CRNC and the Node B. Figure 22 defines the Control Frame structure for common transport channels.
6.3.2 Coding of information elements of the Control frame header

6.3.2.1 Frame CRC

**Description:** Cyclic Redundancy Checksum calculated on a control frame with polynomial: \( X^7 + X^6 + X^2 + 1 \).

The CRC calculation shall cover all bits in the control frame, starting from bit 0 in the first byte (FT field) up to the end of the control frame. See subclause 7.1.

**Value range:** \( \{0..127\} \).

**Field length:** 7 bits.

6.3.2.2 Frame Type (FT)

Refer to subclause 6.2.7.2.

6.3.2.3 Control Frame Type

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

**Value:** Values of the Control Frame Type parameter are defined in table 2.

<table>
<thead>
<tr>
<th>Type of control frame</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTER LOOP POWER CONTROL</td>
<td>0000 0001</td>
</tr>
<tr>
<td>TIMING ADJUSTMENT</td>
<td>0000 0010</td>
</tr>
<tr>
<td>DL SYNCHRONISATION</td>
<td>0000 0011</td>
</tr>
<tr>
<td>UL SYNCHRONISATION</td>
<td>0000 0100</td>
</tr>
<tr>
<td>Reserved Value</td>
<td>0000 0101</td>
</tr>
<tr>
<td>DL NODE SYNCHRONISATION</td>
<td>0000 0110</td>
</tr>
<tr>
<td>UL NODE SYNCHRONISATION</td>
<td>0000 0111</td>
</tr>
<tr>
<td>DYNAMIC PUSCH ASSIGNMENT</td>
<td>0000 1000</td>
</tr>
<tr>
<td>TIMING ADVANCE</td>
<td>0000 1001</td>
</tr>
<tr>
<td>HS-DSCH Capacity Request</td>
<td>0000 1010</td>
</tr>
<tr>
<td>HS-DSCH Capacity Allocation</td>
<td>0000 1011</td>
</tr>
</tbody>
</table>

**Field Length:** 8 bits.

The "Reserved Value" for the Control Frame Type IE shall not be used by the SRNC. A control frame whose Control Frame Type IE is set to the "Reserved Value" shall be ignored by the Node B.
6.3.3 Payload structure and information elements

6.3.3.1 TIMING ADJUSTMENT

6.3.3.1.1 Payload Structure

Figures 23 and 24 shows the structure of the payload when control frame is used for the timing adjustment.

**Figure 23: TIMING ADJUSTMENT payload structure (non-PCH transport bearers)**

**Figure 24: TIMING ADJUSTMENT payload structure (PCH transport bearer)**

6.3.3.1.2 CFN

Refer to subclause 6.2.7.3.

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 in the frame). The value range and field length depend on the transport channel for which the CFN is used.

**Value range (PCH):** \([-20480\, \text{ms}, +20479.875\, \text{ms}\].

---

**ETSI**
Value range (other): [-1280ms, +1279.875ms].

Granularity: 125µs.

Field length (PCH): 20 bits.

Field length (other): 16 bits.

6.3.3.1.4 Spare Extension

Description: Indicates the location where new IEs can in the future be added in a backward compatible way.

Field length: 0-32 octets.

6.3.3.2 DL SYNCHRONISATION

6.3.3.2.1 Payload Structure

Figures 25 and 26 shows the structure of the payload when control frame is used for the user plane synchronisation.

![Figure 25: DL SYNCHRONISATION payload structure (non-PCH transport bearers)](image1)

![Figure 26: DL SYNCHRONISATION payload structure (PCH transport bearers)](image2)

6.3.3.2.2 CFN

Refer to subclause 6.2.7.3.

6.3.3.2.3 Spare Extension

Refer to subclause 6.3.3.1.4.
6.3.3.3 UL SYNCHRONISATION

6.3.3.3.1 Payload Structure

Figures 27 and 28 shows the structure of the payload when the control frame is used for the user plane synchronisation (UL).

![Figure 27: UL SYNCHRONISATION payload structure (non-PCH transport bearers)](image1)

![Figure 28: UL SYNCHRONISATION payload structure (PCH transport bearers)](image2)

6.3.3.3.2 CFN
Refer to subclause 6.2.7.3.

6.3.3.3.3 Time of Arrival (TOA)
Refer to subclause 6.3.3.1.3.

6.3.3.3.4 Spare Extension
Refer to subclause 6.3.3.1.4.
6.3.3.4 DL NODE SYNCHRONISATION

6.3.3.4.1 Payload Structure

The payload of the DL Node synchronisation control frames is shown in figure 29.

![Figure 29: DL NODE SYNCHRONISATION payload structure](image)

6.3.3.4.2 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:** \{ 0 .. 4095 \} ms.

**Granularity:** 0.125 ms.

**Field length:** 24 bits.

6.3.3.4.3 Spare Extension

Refer to subclause 6.3.3.1.4.

6.3.3.5 UL NODE SYNCHRONISATION

6.3.3.5.1 Payload Structure

The payload of the UL Node synchronisation control frames is shown in figure 30.
6.3.3.5.2  T1

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

Value range: \{0 .. 40959.875\ ms\}.

Granularity: 0.125ms.

Field length: 24 bits.

6.3.3.5.3  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\}.

Granularity: 0.125ms.

Field length: 24 bits.

6.3.3.5.4  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\}.

Granularity: 0.125ms.
Field length: 24 bits.

6.3.3.5.5 Spare Extension
Refer to subclause 6.3.3.1.4.

6.3.3.6 DYNAMIC PUSCH ASSIGNMENT [TDD]

6.3.3.6.1 Payload structure
The payload of the Dynamic PUSCH Assignment control frames is shown in figure 31.

![Payload structure diagram](image)

Figure 31: DYNAMIC PUSCH ASSIGNMENT payload structure

6.3.3.6.2 PUSCH Set Id
Description: Identifies a PUSCH Set from the collection of PUSCH Sets which have been pre-configured in the Node B, for the respective cell in which the USCH exists. The PUSCH Set Id is unique within a cell.
Value range: \{0..255\}.
Field length: 8 bits.

6.3.3.6.3 Activation CFN
Description: Activation CFN, specifies the Connection Frame Number where the allocation period of that PUSCH Set starts.
Value range: Integer \{0..255\}.
Field length: 8 bits.

6.3.3.6.4 Duration
Description: Indicates the duration of the activation period of the PUSCH Set, in radio frames.
Value range: 0..255 means: 0 to 255 radio frames, i.e. 0 to 2550 msec.
Field length: 8 bits.

6.3.3.7 DSCH TFCI SIGNALLING [FDD]

6.3.3.7.1 Payload structure
Void.

6.3.3.7.2 TFCI (field 2)
Void.
6.3.3.7.3  Spare Extension
Void.

6.3.3.8  TIMING ADVANCE [3.84Mcps TDD]

6.3.3.8.1  Payload structure
Figure 33 shows the structure of the payload when the control frame is used for timing advance.

<table>
<thead>
<tr>
<th>Octets</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-32</td>
<td>Spare Extension</td>
</tr>
<tr>
<td>1</td>
<td>TA</td>
</tr>
<tr>
<td>1</td>
<td>CFN</td>
</tr>
<tr>
<td></td>
<td>Payload</td>
</tr>
</tbody>
</table>

![Figure 33: TIMING ADVANCE payload structure](image)

6.3.3.8.2  CFN
Refer to subclause 6.2.7.3.

6.3.3.8.3  TA
Description: UE applied UL timing advance adjustment.
Value range: \( \{0 .. 252 \text{ chips}\} \).
Granularity: 4 chips.
Field length: 6 bits.

6.3.3.8.4  Spare Extension
Refer to subclause 6.3.3.1.4.

6.3.3.9  OUTER LOOP POWER CONTROL [1.28 Mcps TDD]

6.3.3.9.1  Payload structure
Figure 34 shows the structure of the payload when control frame is used for the UL outer loop power control.
6.3.3.9.2 SIR Target

**Description**: Value (in dB) of the SIR target to be used by the UL inner loop power control.

SIR Target is given in the unit UL_SIR_TARGET where:

- \( \text{UL}_\text{SIR\_TARGET} = 000 \)  \( \Rightarrow \) SIR Target = -8.2 dB
- \( \text{UL}_\text{SIR\_TARGET} = 001 \)  \( \Rightarrow \) SIR Target = -8.1 dB
- \( \text{UL}_\text{SIR\_TARGET} = 002 \)  \( \Rightarrow \) SIR Target = -8.0 dB
- ...
- \( \text{UL}_\text{SIR\_TARGET} = 254 \)  \( \Rightarrow \) SIR Target = 17.2 dB
- \( \text{UL}_\text{SIR\_TARGET} = 255 \)  \( \Rightarrow \) SIR Target = 17.3 dB

**Value range**: \([-8.2 \ldots 17.3 \text{ dB}]\).

**Granularity**: 0.1 dB.

**Field length**: 8 bits.

6.3.3.9.3 Spare Extension

Refer to subclause 6.3.3.1.4.

6.3.3.10 HS-DSCH CAPACITY REQUEST

**Figure 35: CAPACITY REQUEST payload structure**

HS-DSCH Capacity Request is sent for each priority group to indicate the user buffer size. The control frame is sent by the SRNC when the SRNC considers the user buffer status needs an increased buffer reporting frequency. This may be sent to signal an event, such as, data arrival or user-buffer discard. This control frame is used to improve
user-buffer reporting above the level produced by the user-buffer reporting associated with the HS-DSCH DATA FRAMES.

6.3.3.10.1 Common Transport Channel Priority Indicator (CmCH-PI)
Refer to subclause 6.2.7.21.

6.3.3.10.2 User Buffer Size
Refer to subclause 6.2.7.22.

6.3.3.10.3 Spare Extension
Refer to subclause 6.3.3.1.4.

### 6.3.3.11 HS-DSCH CAPACITY ALLOCATION

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<tr>
<td>HS-DSCH Repetition Period</td>
<td></td>
</tr>
<tr>
<td>Spare Extension</td>
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**Figure 36: CAPACITY ALLOCATION payload structure**

The CAPACITY ALLOCATION Control Frame describes an allocation that the SRNC may use. When the *HS-DSCH Credits* IE has a value of 0 it signifies that there is no resources allocated for transmission and to thus stop transmission. When the *HS-DSCH Credits* IE has a value of 2047, it signifies unlimited capacity for transmission of PDUs. When the *HS-DSCH Repetition Period* IE has a value of 0, it signifies that the allocation (*Maximum MAC-d PDU Length*, *HS-DSCH Credits* and *HS-DSCH Interval* IEs) can be repeated without limit.

6.3.3.11.1 Common Transport Channel Priority Indicator (CmCH-PI)
Refer to subclause 6.2.7.21.

6.3.3.11.2 Maximum MAC-d PDU Length

**Description:** The value indicates the maximum allowable PDU size among the MAC-d PDU sizes configured via NBAP [6].

**Value range:** Refer to subclause 6.2.7.23.
Field length: Refer to subclause 6.2.7.23.

6.3.3.11.3 HS-DSCH Credits

**Description:** The *HS-DSCH Credits* IE indicates the number of MAC-d PDUs that a CRNC may transmit during one HS-DSCH Interval granted in the HS-DSCH CAPACITY ALLOCATION Control Frame.

**Value range:** \{0-2047, where 0=stop transmission, 2047=unlimited\}.

**Field length:** 11 bits.

6.3.3.11.4 HS-DSCH Interval

**Description:** The value of this field indicates the time interval during which the *HS-DSCH Credits* granted in the HS-DSCH CAPACITY ALLOCATION Control Frame may be used. The first interval starts immediately after reception of the HS-DSCH CAPACITY ALLOCATION Control Frame, subsequent intervals start immediately after the previous interval has elapsed. This value is only applied to the HS-DSCH transport channel.

**Value range:** \{0-2550 ms\}. Value 0 shall be interpreted that none of the credits shall be used.

**Granularity:** 10ms.

**Field Length:** 8 bits.

6.3.3.11.5 HS-DSCH Repetition Period

**Description:** The value of this field indicates the number of subsequent intervals that the *HS-DSCH Credits* IE granted in the HS-DSCH CAPACITY ALLOCATION Control Frame may be used. These values represent an integer number of Intervals (see subclause 6.3.3.11.4). This field is only applied to the HS-DSCH transport channel.

**Value range:** \{0-255, where 0= unlimited repetition period\}.

**Field Length:** 8 bits.

6.3.3.11.6 Spare Extension

Refer to subclause 6.3.3.1.4.

### 7 Frame protocol error handling

A received frame protocol frame with unknown Information element or with illegal Information element value shall be ignored. Frame protocol frames sent with a CFN in which the radio resources assigned to the associated Iub data port are not available, shall be ignored.

#### 7.1 Error detection

Error detection is provided on frames through a Cyclic Redundancy Check. The CRC for the payload is 16 and for the header and control frames is 7 bits.

#### 7.1.1 CRC Calculation

The parity bits are generated by one of the following cyclic generator polynomials:

\[
g_{CRC_{16}}(D) = D^{16} + D^{15} + D^2 + 1. \\
g_{CRC_{7}}(D) = D^{7} + D^{6} + D^2 + 1.
\]

Denote the bits in a frame by \(a_1, a_2, a_3, \ldots, a_A\), and the parity bits by \(p_1, p_2, p_3, \ldots, p_L\). Here, \(A\) is the length of a protected data and \(L\) is 16 or 7 depending on the CRC length.
The encoding is performed in a systematic form, which means that in GF (2), the polynomial for the payload.

\[ a_1D^{A+15} + a_2D^{A+14} + \ldots + a_A D^6 + p_1D^{15} + p_2D^{14} + \ldots + p_{15}D^1 + p_{16} \]

yields a remainder equal to 0 when divided by \( g_{CRC16}(D) \), the polynomial for the header and control frames.

\[ a_1D^{A+6} + a_2D^{A+5} + \ldots + a_A D^7 + p_1D^6 + p_2D^5 + \ldots + p_6D^1 + p_7 \]

yields a remainder equal to 0 when divided by \( g_{CRC7}(D) \).

7.1.1.1 Relation between input and output of the Cyclic Redundancy Check

The bits after CRC attachment are denoted by \( b_1, b_2, b_3, \ldots, b_{B_i} \), where \( B_i = A_i + L_i \).

The parity bits for the payload are attached at the end of the frame:

\[ b_k = a_k \quad \text{for} \quad k = 1, 2, 3, \ldots, A_i \]

\[ b_k = p_{(k-A_i)} \quad \text{for} \quad k = A_i + 1, A_i + 2, A_i + 3, \ldots, A_i + L_i \]

The parity bits for the frame header and the control frames are attached at the beginning of the frame:

\[ b_k = p_k \quad \text{for} \quad k = 1, 2, 3, \ldots, L_i \]

\[ b_k = a_{(k-L_i)} \quad \text{for} \quad k = L_i + 1, L_i + 2, L_i + 3, \ldots, L_i + A_i \]
Annex A (informative):
Change History

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