

TTA Standard

정보통신단체표준(기술규격)
TTAT.3G-38.425(R15-15.2.0)

제정일: 2018년 9월

3GPP-(Technical Speciation
Group Radio Access Network;
NG-RAN; NR user plane protocol)



본 문서에 대한 저작권은 TTA에 있으며, TTA와 사전 협의 없이 이 문서의 전체 또는 일부를 상업적 목적으로 복제 또는 배포해서는 안 됩니다.

Copyright 20xx, Telecommunications Technology Association.

All rights reserved.

3GPP TS 38.425 V15.2.0 (2018-06)

Technical Specification

**3rd Generation Partnership Project;
Technical Specification Group Radio Access Network;
NG-RAN;
NR user plane protocol
(Release 15)**



Keywords

NR-RAN

3GPP

Postal address

3GPP support office address

650 Route des Lucioles - Sophia Antipolis
Valbonne - FRANCE
Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Internet

<http://www.3gpp.org>

Copyright Notification

No part may be reproduced except as authorized by written permission.
The copyright and the foregoing restriction extend to reproduction in all media.

© 2018, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
All rights reserved.

UMTS™ is a Trade Mark of ETSI registered for the benefit of its members
3GPP™ is a Trade Mark of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners
LTE™ is a Trade Mark of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners
GSM® and the GSM logo are registered and owned by the GSM Association

Contents

| | |
|---|----|
| Foreword | 4 |
| 1 Scope | 5 |
| 2 References | 5 |
| 3 Definitions and abbreviations | 5 |
| 3.1 Definitions | 5 |
| 3.2 Abbreviations | 5 |
| 4 General | 6 |
| 4.1 General aspects | 6 |
| 5 NR user plane protocol | 6 |
| 5.1 General | 6 |
| 5.2 NR user plane protocol layer services | 6 |
| 5.3 Services expected from the Transport Network Layer | 7 |
| 5.4 Elementary procedures | 8 |
| 5.4.1 Transfer of Downlink User Data | 8 |
| 5.4.1.1 Successful operation | 8 |
| 5.4.1.2 Unsuccessful operation | 8 |
| 5.4.2 Downlink Data Delivery Status | 9 |
| 5.4.2.1 Successful operation | 9 |
| 5.4.2.2 Unsuccessful operation | 10 |
| 5.4.3 Transfer of Assistance Information | 10 |
| 5.4.3.1 Successful operation | 10 |
| 5.5 Elements for the NR user plane protocol | 11 |
| 5.5.1 General | 11 |
| 5.5.2 Frame format for the NR user plane protocol | 12 |
| 5.5.2.1 DL USER DATA (PDU Type 0) | 12 |
| 5.5.2.2 DL DATA DELIVERY STATUS (PDU Type 1) | 12 |
| 5.5.2.3 ASSISTANCE INFORMATION (PDU Type 2) | 13 |
| 5.5.3 Coding of information elements in frames | 14 |
| 5.5.3.1 PDU Type | 14 |
| 5.5.3.2 Spare | 14 |
| 5.5.3.3 Report polling | 14 |
| 5.5.3.4 NR-U Sequence Number | 14 |
| 5.5.3.5 Desired buffer size for the data radio bearer | 15 |
| 5.5.3.6 Desired Data Rate | 15 |
| 5.5.3.7 DL Flush | 15 |
| 5.5.3.8 DL discard NR PDCP PDU SN | 15 |
| 5.5.3.9 DL Discard Blocks | 15 |
| 5.5.3.10 DL discard NR PDCP PDU SN start | 15 |
| 5.5.3.11 DL discard Number of blocks | 15 |
| 5.5.3.12 Discarded Block size | 16 |
| 5.5.3.13 Lost Packet Report | 16 |
| 5.5.3.14 Final Frame Indication | 16 |
| 5.5.3.15 Number of lost NR-U Sequence Number ranges reported | 16 |
| 5.5.3.16 Start of lost NR-U Sequence Number range | 16 |
| 5.5.3.17 End of lost NR-U Sequence Number range | 16 |
| 5.5.3.18 Highest Delivered NR PDCP SN Ind | 16 |
| 5.5.3.19 Highest successfully delivered NR PDCP Sequence Number | 17 |
| 5.5.3.20 Highest Transmitted NR PDCP SN Ind | 17 |
| 5.5.3.21 Highest transmitted NR PDCP Sequence Number | 17 |
| 5.5.3.22 Cause Report | 17 |
| 5.5.3.23 Cause Value | 17 |
| 5.5.3.24 Padding | 17 |
| 5.5.3.28 Void | 17 |
| 5.5.3.29 Retransmission flag | 18 |

| | | |
|--|--|-----------|
| 5.5.3.30 | Highest Delivered Retransmitted NR PDCP SN Ind | 18 |
| 5.5.3.31 | Highest Retransmitted NR PDCP SN Ind | 18 |
| 5.5.3.32 | Highest successfully delivered retransmitted NR PDCP Sequence Number | 18 |
| 5.5.3.33 | Highest retransmitted NR PDCP Sequence Number | 18 |
| 5.5.3.34 | Data Rate Indication | 18 |
| 5.5.3.35 | PDCP Duplication Indication | 18 |
| 5.5.3.36 | PDCP Duplication Activation Suggestion | 19 |
| 5.5.3.37 | Number of Assistance Information Field | 19 |
| 5.5.3.38 | Assistance Information Type | 19 |
| 5.5.3.39 | Radio Quality Assistance Information | 19 |
| 5.5.3.40 | Assistance Information Report Polling Flag | 19 |
| 5.5.4 | Timers | 19 |
| 5.6 | Handling of unknown, unforeseen and erroneous protocol data | 19 |
| Annex A (informative): Example of using future Extension..... | | 20 |
| A.1 | Example of using Future Extension field | 20 |
| A.1.1 | New IE Flags | 20 |
| Annex B (informative): Change history | | 21 |

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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 specifies the NR user plane protocol functions used within NG-RAN and, for EN-DC, within E-UTRAN. NR user plane protocol functions may reside in nodes terminating either the X2-U (for EN-DC) or the Xn-U or the F1-U interface.

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*.

- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 29.281: "General Packet Radio System (GPRS) Tunnelling Protocol User Plane (GTPv1-U)".
- [3] 3GPP TS 37.340: "NR; Multi-connectivity; Overall description; Stage-2".
- [4] 3GPP TS 36.321: "Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) protocol specification".
- [5] 3GPP TS 38.321: "NR; Medium Access Control (MAC) protocol specification".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

Corresponding node: a node interacting with a node hosting NR PDCP for flow control.

Master node: as defined in TS 37.340 [3].

Secondary node: as defined in TS 37.340 [3].

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

| | |
|-------|-----------------------------|
| EN-DC | E-UTRA-NR Dual Connectivity |
| MR-DC | Multi-RAT Dual Connectivity |

4 General

4.1 General aspects

The NR user plane protocol is located in the User Plane of the Radio Network layer over either the Xn or the X2 or the F1 interface.

The NR user plane protocol is used to convey control information related to the user data flow management of data radio bearers.

Each NR user plane protocol instance is associated to one data radio bearer only.

If configured, NR user plane protocol instances exist at the Master node and the Secondary node in the context of MR-DC or at nodes hosting F1-U protocol terminations. The NR user plane protocol supports direct communication between NR user plane protocol entities, regardless of whether they terminate the same or different user plane interfaces.

NOTE: User data radio bearers may be setup for data forwarding purposes during Xn HO or during DC related mobility do not require the execution of any additional data radio bearer related user plane protocol functions related to an NR user plane protocol instance.

On each data radio bearer, the NR user plane protocol operates with RLC AM or RLC UM.

In this version of the present document, NR user plane protocol data is conveyed by GTP-U protocol means, more specifically, by means of the "NR RAN Container" GTP-U extension header as defined in TS 29.281 [2].

5 NR user plane protocol

5.1 General

The NR user plane protocol layer is using services of the transport network layer in order to allow flow control of user data packets transferred from the node hosting NR PDCP to the corresponding node.

5.2 NR user plane protocol layer services

The following functions are provided by the NR user plane protocol:

- Provision of NR user plane specific sequence number information for user data transferred from the node hosting NR PDCP to the corresponding node for a specific data radio bearer.
- Information of successful in sequence delivery of NR PDCP PDUs to the UE from the corresponding node for user data associated with a specific data radio bearer.
- Information of NR PDCP PDUs that were not delivered to the UE or the lower layers.
- Information of NR PDCP PDUs transmitted to the lower layers for user data associated with a specific data radio bearer.
- Information of downlink NR PDCP PDUs to be discarded for user data associated with a specific data radio bearer;
- Information of the currently desired buffer size at the corresponding node for transmitting to the UE user data associated with a specific data radio bearer.
- Information of the currently desired data rate in bytes at the corresponding node for transmitting to the UE user data associated with a specific data radio bearer configured for the UE at the corresponding node;
- Information of successful in sequence delivery of NR PDCP PDUs to the UE from the corresponding node for retransmission user data associate with a specific data radio bearer;

- Information of NR PDCP PDUs transmitted to the lower layers for retransmission user data associated with a specific data radio bearer.
- Information of the specific events at the corresponding node.
- Information on Radio Link Quality from the corresponding node for user data associated with a specific data bearer.

5.3 Services expected from the Transport Network Layer

The NR user plane protocol layer expects the following services from the Transport Network Layer:

- Transfer of user data.

5.4 Elementary procedures

5.4.1 Transfer of Downlink User Data

5.4.1.1 Successful operation

The purpose of the Transfer of Downlink User Data procedure is to provide NR-U specific sequence number information at the transfer of user data carrying a DL NR PDCP PDU from the node hosting the NR PDCP entity to the corresponding node.

An NR user plane instance making use of the Transfer of Downlink User Data procedure is associated to a single data radio bearer only.

The node hosting the NR PDCP entity shall assign consecutive NR-U sequence numbers to each transferred NR-U packet.

If the Assistance Information Report Polling Flag is equal to 1, the corresponding node shall send the ASSISTANCE INFORMATION DATA to the node hosting the NR PDCP.

The corresponding node shall detect whether an NR-U packet was lost and memorise the respective sequence number after it has declared the respective NR-U packet as being "lost".

The corresponding node shall transfer the remaining NR PDCP PDUs towards the UE and memorise the highest NR PDCP PDU sequence number of the NR PDCP PDU that was successfully delivered in sequence towards the UE (in case RLC AM is used) and the highest NR PDCP PDU sequence number of the NR PDCP PDU that was transmitted to the lower layers.

The corresponding node shall send the DL DATA DELIVERY STATUS if the Report Polling Flag is set, unless a situation of overload at the corresponding node is encountered.

NOTE: The Transfer of Downlink User Data procedure and the associated feedback of lost NR-U packets assist the node hosting the NR PDCP entity in avoiding NR PDCP HFN de-synchronisation. If a deployment decides to not use the Transfer of Downlink User Data procedure, NR PDCP HFN synchronization should be ensured by other means.

The node hosting the NR PDCP entity indicates to the corresponding node whether this NR-U packet is a retransmission of NR PDCP PDU.

The node hosting the NR PDCP entity can indicate to the corresponding node to either discard all NR PDCP PDUs up to and including a defined DL discard NR PDCP PDU SN or discard one or a number of blocks of downlink NR PDCP PDUs.

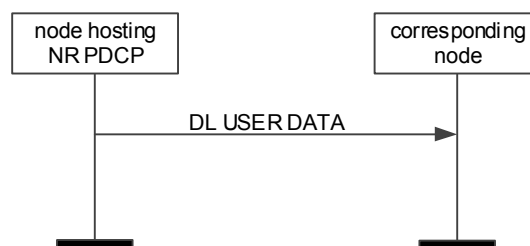


Figure 5.4.1.1-1: Successful Transfer of Downlink User Data

5.4.1.2 Unsuccessful operation

Void.

5.4.2 Downlink Data Delivery Status

5.4.2.1 Successful operation

The purpose of the Downlink Data Delivery Status procedure is to provide feedback from the corresponding node to the node hosting the NR PDCP entity to allow the node hosting the NR PDCP entity to control the downlink user data flow via the corresponding node for the respective data radio bearer. The corresponding node may also transfer uplink user data for the concerned data radio bearer to the node hosting the NR PDCP entity together with a DL DATA DELIVERY STATUS frame within the same GTP-U PDU.

The Downlink Data Delivery Status procedure is also used to provide feedback from the corresponding node to the node hosting the NR PDCP entity to allow the node hosting the NR PDCP entity to control the successful delivery of DL control data to the corresponding node.

When the corresponding node decides to trigger the Feedback for Downlink Data Delivery procedure it shall report as specified in section 5.2:

- a) in case of RLC AM, the highest NR PDCP PDU sequence number successfully delivered in sequence to the UE among those NR PDCP PDUs received from the node hosting the NR PDCP entity i.e. excludes those retransmission NR PDCP PDUs;
- b) the desired buffer size in bytes for the concerned data radio bearer;
- c) optionally, the desired data rate in bytes associated with a specific data radio bearer configured for the UE;
- d) the NR-U packets that were declared as being "lost" by the corresponding node and have not yet been reported to the node hosting the NR PDCP entity within the DL DATA DELIVERY STATUS frame;
- e) if retransmission NR PDCP PDUs have been delivered, the highest NR PDCP PDU sequence number successfully delivered in sequence to the UE among those retransmission NR PDCP PDUs received from the node hosting the NR PDCP entity;
- f) if retransmission NR PDCP PDUs have been transmitted, the highest NR PDCP PDU sequence number transmitted to the lower layers among those retransmission NR PDCP PDUs received from the node hosting the NR PDCP entity;
- g) the highest NR PDCP PDU sequence number transmitted to the lower layers among those NR PDCP PDUs received from the node hosting the NR PDCP entity i.e. excludes those retransmission NR PDCP PDUs.

NOTE: If a deployment has decided not to use the Transfer of Downlink User Data procedure, d), e) and f) above are not applicable.

As soon as the corresponding node detects the successful RACH access by the UE for the corresponding data bearer(s), the corresponding node shall send initial DL DATA DELIVERY STATUS frame to the node(s) hosting the NR PDCP entity(ies). The node hosting NR PDCP entity may start sending DL data before receiving the initial DL DATA DELIVERY STATUS frame. In case the DL DATA DELIVERY STATUS frame is sent before any NR PDCP PDU is transferred to lower layers, the information on the highest NR PDCP PDU sequence number successfully delivered in sequence to the UE and the highest NR PDCP PDU sequence number transmitted to the lower layers may not be provided.

The DL DATA DELIVERY STATUS frame shall also include a final frame indication signalling whether the frame is the last DL status report received in the course of releasing a bearer from the corresponding node. Namely, the final frame indication is signalled in cases where the corresponding node knows that the bearer will be released before the DL status report is signalled. When receiving such indication, if applicable, the node hosting the NR PDCP entity considers that no more UL or DL data is expected to be transmitted between the corresponding node and the UE.

The DL DATA DELIVERY STATUS frame may also include an indication of detected radio link outage or radio link resume. When receiving an indication of radio link outage detection, the node hosting the NR PDCP entity considers that traffic delivery over data radio bearers configured for the UE is unavailable at the corresponding node both in UL and DL. When receiving an indication of radio link resume detection, the node hosting the NR PDCP entity considers that traffic delivery over data radio bearers configured for the UE is available at the corresponding node both in UL and in DL. When receiving an indication of UL or DL radio link outage detection, the node hosting the NR PDCP entity considers that traffic delivery over DRBs configured for the UE is unavailable at the corresponding node for UL or DL, depending on the indicated outage. When receiving an indication of UL or DL radio link resume detection, the node

hosting the NR PDCP entity considers that traffic delivery over DRBs configured for the UE is available at the corresponding node in UL or in DL, depending on the indicated resume.

The node hosting the NR PDCP entity, when receiving the DL DATA DELIVERY STATUS frame:

- regards the desired buffer size under b) and the data rate under c) above as the amount of data to be sent from the hosting node:
 - If the value of the desired buffer size is 0, the hosting node shall stop sending any data per bearer.
 - If the value of the desired buffer size in b) above is greater than 0, the hosting node may send up to this amount of data per bearer beyond the "Highest Delivered NR PDCP SN" for RLC AM, or the hosting node may send up to this amount of data per bearer beyond the "Highest Transmitted NR PDCP SN" for RLM UM.
 - The value of the desired data rate in c) above is the amount of data desired to be received in a specific amount of time. The amount of time is 1 sec.
 - The information of the buffer size in b) above and of the data rate in c) above is valid until the next DL DATA DELIVERY STATUS frame is transferred.
- is allowed to remove the buffered NR PDCP PDUs according to the feedback of transmitted and/or successfully delivered NR PDCP PDUs;
- decides upon the actions necessary to take for NR PDCP PDUs reported other than transmitted and/or successfully delivered.

In case of RLC AM, after the highest NR PDCP PDU sequence number successfully delivered in sequence is reported to the node hosting the NR PDCP entity, the corresponding node removes the respective NR PDCP PDUs. For RLC UM, the corresponding node may remove the respective NR PDCP PDUs after transmitting to lower layers.

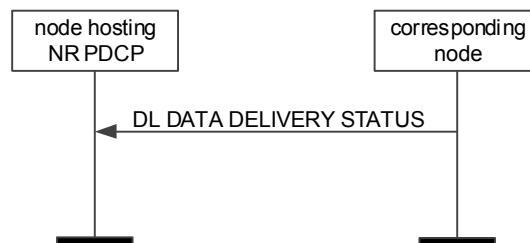


Figure 5.4.2.1-1: Successful Downlink Data Delivery Status

5.4.2.2 Unsuccessful operation

Void.

5.4.3 Transfer of Assistance Information

5.4.3.1 Successful operation

The purpose of the Transfer of Assistance Information procedure is to provide assistance information to the node hosting the NR PDCP. Such information may be taken into consideration by the node hosting the NR PDCP for UP management and optimisation procedures.

An NR user plane instance making use of the Transfer of Assistance Information procedure is associated to a single data bearer only.

The Transfer of Assistance Information procedure may be invoked if the corresponding node decides to send the Radio Quality Assistance Information and/or the PDCP duplication activation suggestion to the node hosting the NR PDCP for that particular data bearer.

The ASSISTANCE INFORMATION DATA frame may include Radio Quality Assistance Information. The information shall consist of one or more of the information indicated in the Assistance Information Type.

The ASSISTANCE INFORMATION DATA shall be sent when the corresponding node receives a DL USER DATA PDU including the Assistance Information Report Polling Flag set to 1.

The ASSISTANCE INFORMATION DATA frame may include the PDCP Duplication Activation Suggestion, which informs the node hosting the NR PDCP of the suggestion from the corresponding node on whether to activate or not activate PDCP duplication. The node hosting the NR PDCP may take this information into account to take a decision on whether to activate or not activate PDCP duplication.

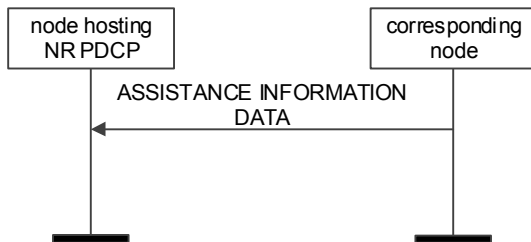


Figure 5.4.3.1-1: Successful Transfer of Assistance Information Data

5.5 Elements for the NR user plane protocol

5.5.1 General

In the present document the structure of frames is specified by using figures similar to figure 5.5.1-1.

| Bits | | | | | | | | Number of Octets | |
|------------------|---|---|---|--------------|---|---------|---|------------------|---------|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | |
| Field 1 | | | | Field 2 | | | | 1 | Octet 1 |
| Field 3 | | | | | | Field 4 | | 2 | Octet 2 |
| Field 4 continue | | | | Spare | | | | | Octet 3 |
| Spare | | | | Field 5 | | | | 1 | Octet 4 |
| Field 6 | | | | | | | | 2 | Octet 5 |
| Field 6 continue | | | | Padding Bits | | | | | Octet 6 |
| Future Extension | | | | | | | | 0-m | |
| Padding | | | | | | | | 0-3 | |

Figure 5.5.1-1: Example frame format

Unless otherwise indicated, fields which consist of multiple bits within an octet have the most significant bit located at the highest bit position of the field (according to the bit numbers indicated above frame in figure 5.5.1-1). In addition, if a field spans several octets, most significant bits are located in lower numbered octets (right of frame in figure 5.5.1-1).

The frame is transmitted starting from the lowest numbered octet. Within each octet, the bits are sent according decreasing bit position (bit position 7 first).

Bits labelled "Spare" should be set to "0" by the sender and should not be checked by the receiver.

The header part of the frame is always an integer number of octets. The payload part is octet aligned (by adding 'Padding Bits' when needed). The total size of the frame shall not exceed 1018 octets (see TS 29.281 [2]).

The receiver should be able to remove an additional Future Extension field that may be present. See description of Future Extension field in A.1.

Padding octets may be added at the end of the frame, see Padding in 5.5.3.24

5.5.2 Frame format for the NR user plane protocol

5.5.2.1 DL USER DATA (PDU Type 0)

This frame format is defined to allow the corresponding node to detect lost NR-U packets and is associated with the transfer of a Downlink NR PDCP PDU.

The following shows the respective DL USER DATA frame.

| Bits | | | | | | | | Number of Octets |
|---|---|---|---|-------|-------------------|--------------------------------------|---------------------|------------------|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | |
| PDU Type (=0) | | | | Spare | DL Discard Blocks | DL Flush | Report polling | 1 |
| Spare | | | | | | Assistance Info. Report Polling Flag | Retransmission flag | 1 |
| NR-U Sequence Number | | | | | | | | 3 |
| DL discard NR PDCP PDU SN | | | | | | | | 0 or 3 |
| DL discard Number of blocks | | | | | | | | 0 or 1 |
| DL discard NR PDCP PDU SN start (first block) | | | | | | | | 0 or 3 |
| Discarded Block size (first block) | | | | | | | | 0 or 1 |
| ... | | | | | | | | |
| DL discard NR PDCP PDU SN start (last block) | | | | | | | | 0 or 3 |
| Discarded Block size (last block) | | | | | | | | 0 or 1 |
| Padding | | | | | | | | 0-3 |

Figure 5.5.2.1-1: DL USER DATA (PDU Type 0) Format

5.5.2.2 DL DATA DELIVERY STATUS (PDU Type 1)

This frame format is defined to transfer feedback to allow the receiving node (i.e. the node that hosts the NR PDCP entity) to control the downlink user data flow via the sending node (i.e. the corresponding node).

The following shows the respective DL DATA DELIVERY STATUS frame. The Figure shows an example of how a frame is structured when all optional IEs (i.e. those whose presence is indicated by an associated flag) are present.

Absence of such an IE changes the position of all subsequent IEs on octet level.

| Bits | | | | | | | | Number of Octets |
|--|---|---|---|------------------------------------|--------------------------------------|--|--------------------|--|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | |
| PDU Type (=1) | | | | Highest Transmitted NR PDCP SN Ind | Highest Delivered NR PDCP SN Ind | Final Frame Ind. | Lost Packet Report | 1 |
| Spare | | | | Data rate Ind. | Highest Retransmitted NR PDCP SN Ind | Highest Delivered Retransmitted NR PDCP SN Ind | Cause Report | 1 |
| Desired buffer size for the data radio bearer | | | | | | | | 4 |
| Desired Data Rate | | | | | | | | 0 or 4 |
| Number of lost NR-U Sequence Number ranges reported | | | | | | | | 0 or 1 |
| Start of lost NR-U Sequence Number range | | | | | | | | 0 or (6* Number of reported lost NR-U SN ranges) |
| End of lost NR-U Sequence Number range | | | | | | | | |
| Highest successfully delivered NR PDCP Sequence Number | | | | | | | | 0 or 3 |
| Highest transmitted NR PDCP Sequence Number | | | | | | | | 0 or 3 |
| Cause Value | | | | | | | | 0 or 1 |
| Highest successfully delivered retransmitted NR PDCP Sequence Number | | | | | | | | 0 or 3 |
| Highest retransmitted NR PDCP Sequence Number | | | | | | | | 0 or 3 |
| Padding | | | | | | | | 0-3 |

Figure 5.5.2.2-1: DL DATA DELIVERY STATUS (PDU Type 1) Format

5.5.2.3 ASSISTANCE INFORMATION (PDU Type 2)

This frame format is defined to allow the node hosting the NR PDCP entity to receive assistance information.

The following shows the respective ASSISTANCE INFORMATION DATA frame.

| Bits | | | | | | | | Number of Octets |
|---|---|---|---|-----------------|-------|---|-----------------------------|--|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | |
| PDU Type (=2) | | | | PDCP Dupl. Ind. | Spare | | | 1 |
| Spare | | | | | | | PDCP Duplication Suggestion | 1 |
| Number of Assistance Information Fields | | | | | | | | 0 or 1 |
| Assistance Information Type | | | | | | | | 0 or (2*Number of Assistance Info Field) |
| Radio Quality Assistance Information | | | | | | | | |

Figure 5.5.2.3-1: ASSISTANCE INFORMATION DATA (PDU Type 2) Format

5.5.3 Coding of information elements in frames

5.5.3.1 PDU Type

Description: The PDU Type indicates the structure of the NR user plane frame. The field takes the value of the PDU Type it identifies; i.e. "0" for PDU Type 0. The PDU type is in bit 4 to bit 7 in the first octet of the frame.

Value range: {0=DL USER DATA, 1=DL DATA DELIVERY STATUS, 2= ASSISTANCE INFORMATION DATA -15=reserved for future PDU type extensions}

Field length: 4 bits

5.5.3.2 Spare

Description: The spare field is set to "0" by the sender and should not be interpreted by the receiver. This field is reserved for later versions.

Value range: (0–2ⁿ-1).

Field Length: n bits.

5.5.3.3 Report polling

Description: This parameter indicates that the node hosting the NR PDCP entity requests providing the downlink delivery status report.

Value range: {0=Downlink Data Delivery Status report not requested, 1= Downlink Data Delivery Status report requested}.

Field length: 1 bit.

5.5.3.4 NR-U Sequence Number

Description: This parameter indicates the NR-U sequence number as assigned by the node hosting the NR PDCP entity.

Value range: {0..2²⁴-1}.

Field length: 3 octets.

5.5.3.5 Desired buffer size for the data radio bearer

Description: This parameter indicates the desired buffer size in bytes for the concerned data radio bearer as specified in clause 5.4.2.1.

Value range: $\{0..2^{32}-1\}$.

Field length: 4 octets.

5.5.3.6 Desired Data Rate

Description: This parameter indicates the amount of data desired to be received in bytes in a specific amount of time (1 s) for a specific data radio bearer established for the UE as specified in clause 5.4.2.1.

Value range: $\{0..2^{32}-1\}$.

Field length: 4 octets.

5.5.3.7 DL Flush

Description: This parameter indicates the presence of DL discard NR PDCP PDU SN.

Value range: $\{0= \text{DL discard NR PDCP PDU SN not present}, 1= \text{DL discard NR PDCP PDU SN present}\}$.

Field length: 1 bit.

5.5.3.8 DL discard NR PDCP PDU SN

Description: This parameter indicates the downlink NR discard PDCP PDU sequence number up to and including which all the NR PDCP PDUs should be discarded.

Value range: $\{0..2^{18}-1\}$.

Field length: 3 octets.

5.5.3.9 DL Discard Blocks

Description: This parameter indicates the presence of DL discard Number of blocks, DL discard NR PDCP PDU SN start and Discarded Block size.

Value range: $\{0= \text{DL discard Number of blocks, DL discard NR PDCP PDU SN start and Discarded Block size not present}, 1= \text{DL discard Number of blocks, DL discard NR PDCP PDU SN start and Discarded Block size present}\}$.

Field length: 1 bit.

5.5.3.10 DL discard NR PDCP PDU SN start

Description: This parameter indicates the starting SN of a downlink NR PDCP PDU block to be discarded.

Value range: $\{0..2^{18}-1\}$.

Field length: 3 octets.

5.5.3.11 DL discard Number of blocks

Description: This parameter indicates the number of NR PDCP PDU blocks to be discarded.

Value range: $\{0..244\}$.

Field length: 1 octet.

5.5.3.12 Discarded Block size

Description: This parameter indicates the number of NR PDCP PDUs counted from the starting SN to be discarded.

Value range: {1..255}.

Field length: 1 octet.

5.5.3.13 Lost Packet Report

Description: This parameter indicates the presence of Number of lost NR-U Sequence Number ranges reported, Start of lost NR-U Sequence Number range and End of lost NR-U Sequence Number range.

Value range: {0= Number of lost NR-U Sequence Number ranges reported, Start of lost NR-U Sequence Number range and End of lost NR-U Sequence Number range not present, 1= Number of lost NR-U Sequence Number ranges reported, Start of lost NR-U Sequence Number range and End of lost NR-U Sequence Number range present}.

Field length: 1 bit.

5.5.3.14 Final Frame Indication

Description: This parameter indicates whether the frame is the last DL status report as described in clause 5.4.2.1.

Value range: {0=Frame is not final, 1= Frame is final}.

Field length: 1 bit.

5.5.3.15 Number of lost NR-U Sequence Number ranges reported

Description: This parameter indicates the number of NR-U Sequence Number ranges reported to be lost.

Value range: {1..161}.

Field length: 1 octet.

5.5.3.16 Start of lost NR-U Sequence Number range

Description: This parameter indicates the start of an NR-U sequence number range reported to be lost.

Value range: {0.. $2^{24}-1$ }.

Field length: 3 octets.

5.5.3.17 End of lost NR-U Sequence Number range

Description: This parameter indicates the end of an NR-U sequence number range reported to be lost.

Value range: {0.. $2^{24}-1$ }.

Field length: 3 octets.

5.5.3.18 Highest Delivered NR PDCP SN Ind

Description: This parameter indicates the presence of Highest successfully delivered PDCP Sequence Number.

Value range: {0= Highest successfully delivered PDCP Sequence Number not present, 1= Highest successfully delivered PDCP Sequence Number present}.

Field length: 1 bit.

5.5.3.19 Highest successfully delivered NR PDCP Sequence Number

Description: This parameter indicates feedback about the in-sequence delivery status of NR PDCP PDUs at the corresponding node towards the UE.

Value range: $\{0..2^{18}-1\}$.

Field length: 3 octets.

5.5.3.20 Highest Transmitted NR PDCP SN Ind

Description: This parameter indicates the presence of the Highest transmitted NR PDCP Sequence Number.

Value range: $\{0=$ Highest transmitted NR PDCP Sequence Number not present, $1=$ Highest transmitted NR PDCP Sequence Number present $\}$.

Field length: 1 bit.

5.5.3.21 Highest transmitted NR PDCP Sequence Number

Description: This parameter indicates the feedback about the transmitted status of NR PDCP PDU sequence at the corresponding node to the lower layers.

Value range: $\{0..2^{18}-1\}$.

Field length: 3 octets.

5.5.3.22 Cause Report

Description: This parameter indicates the presence of Cause Value.

Value range: $\{0=$ Cause Value not present, $1=$ Cause Value present $\}$.

Field length: 1 bit.

5.5.3.23 Cause Value

Description: This parameter indicates specific events reported by the corresponding node.

Value range: $\{0=$ UNKNOWN, $1=$ RADIO LINK OUTAGE, $2=$ RADIO LINK RESUME, $3=$ UL RADIO LINK OUTAGE, $4=$ DL RADIO LINK OUTAGE, $5=$ UL RADIO LINK RESUME, $6=$ DL RADIO LINK RESUME, $7-228=$ reserved for future value extensions, $229-255=$ reserved for test purposes $\}$

Field length: 1 octet.

5.5.3.24 Padding

Description: The padding is included at the end of the frame to ensure that the NR user plane protocol pdu length (including padding and the Future Extension) is $(n*4-2)$ octets, where n is a positive integer. If there is any Future Extension, the padding should be added after the Future Extensions.

Field Length: 0–3 octets.

5.5.3.28 Void

Void.

5.5.3.29 Retransmission flag

Description: This parameter indicates whether the NR PDCP PDU is a retransmission NR-U packet sent by the node hosting the NR PDCP to the corresponding node.

Value range: {0= Not a retransmission NR-U packet, 1= Retransmission NR-U packet}.

Field length: 1 bit.

5.5.3.30 Highest Delivered Retransmitted NR PDCP SN Ind

Description: This parameter indicates the presence of highest successfully delivered retransmitted PDCP Sequence Number.

Value range: {0= Highest successfully delivered retransmitted PDCP Sequence Number not present, 1= Highest successfully delivered retransmitted PDCP Sequence Number present}.

Field length: 1 bit.

5.5.3.31 Highest Retransmitted NR PDCP SN Ind

Description: This parameter indicates the presence of highest retransmitted NR PDCP Sequence Number.

Value range: {0= Highest Retransmitted NR PDCP Sequence Number not present, 1= Highest Retransmitted NR PDCP Sequence Number present}.

Field length: 1 bit.

5.5.3.32 Highest successfully delivered retransmitted NR PDCP Sequence Number

Description: This parameter indicates feedback about the in-sequence delivery status of NR PDCP PDUs of the retransmission data at the corresponding node towards the UE.

Value range: {0.. 2^{18} -1}.

Field length: 3 octets.

5.5.3.33 Highest retransmitted NR PDCP Sequence Number

Description: This parameter indicates the feedback about the transmitted status of NR PDCP PDU of the retransmission data at the corresponding node to the lower layers.

Value range: {0.. 2^{18} -1}.

Field length: 3 octets.

5.5.3.34 Data Rate Indication

Description: This parameter indicates the presence of the Desired Data Rate.

Value range: {0= Desired Data Rate Information is not present, 1= Desired Data Rate Information is present}.

Field length: 1 bit.

5.5.3.35 PDCP Duplication Indication

Description: This field indicates the presence of the PDCP Duplication Activation Suggestion.

Value range: {0= PDCP Duplication Activation Suggestion not present, 1= PDCP Duplication Activation Suggestion present}.

Field length: 1 bit.

5.5.3.36 PDCP Duplication Activation Suggestion

Description: This parameter indicates the suggestion given by the corresponding node on whether PDCP duplication should be activated or not.

Value range: {0= Do not duplicate, 1= Duplicate}.

Field length: 1 bit.

5.5.3.37 Number of Assistance Information Field

Description: This field indicates the number of Assistance Information Type and Radio Quality Assistance Information pairs concatenated.

Value range: {0..2⁸-1}.

Field length: 1 octets.

5.5.3.38 Assistance Information Type

Description: This field describes the type of radio quality assistance information provided by the corresponding node to the node hosting the NR PDCP. The DL Radio Quality Index is a numerical index expressing the radio quality of the DRB in DL, where the value 0 represents the lowest quality. The UL Radio Quality Index is a numerical index expressing the radio quality of the DRB in UL, where the value 0 represents the lowest quality. The averaging window for the Average CQI, Average HARQ Failure and Average HARQ Retransmission is set by means of configuration. Power Headroom Report is reported over MAC control element from UE as defined in 3GPP TS 36.321[4] and 3GPP TS 38.321[5]

Value range: {0=UNKNOWN, 1=Average CQI, 2=Average HARQ Failure, 3=Average HARQ Retransmissions, 4=DL Radio Quality Index, 5= UL Radio Quality Index, 6= Power Headroom Report, 7-228=reserved for future value extensions, 229-255=reserved for test purposes}.

Field length: 1 octets.

5.5.3.39 Radio Quality Assistance Information

Description: This parameter indicates one of the assistance information indicated by the Assistance Information Type.

Value range: {0..2⁸-1}.

Field length: 1 octets.

5.5.3.40 Assistance Information Report Polling Flag

Description: This parameter indicates that the node hosting the NR PDCP entity requests the corresponding node to send an ASSISTANCE INFORMATION DATA PDU.

Value range: {0= Assistance Information Data not requested, 1= Assistance Information Data requested}.

Field length: 1 bit.

5.5.4 Timers

Not applicable.

5.6 Handling of unknown, unforeseen and erroneous protocol data

Void.

Annex A (informative): Example of using future Extension

A.1 Example of using Future Extension field

| New IE flag 7(E) | New IE flag 6 | New IE flag 5 | New IE flag 4 | New IE flag 3 | New IE flag 2 | New IE flag 1 | New IE flag 0 | 1 Octet New IE Flags |
|------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|----------------------|
| New IE 1 | | | | | | | | 3 Octets |
| New IE 2 | | | | | | | | 2 Octets |

Figure X.Y: Example of Future Extension field

In the Example of the Future Extension field, New IE flag 0 indicates if the New IE 1 is present or not. New IE flag 1 indicates if the new IE 2 is present or not.

A.1.1 New IE Flags

Description: The *New IE Flags* IE is only present if at least one new IE is present. The *New IE Flags* IE contains flags indicating which new IEs that are present following the *New IE Flags* IE. The last bit position of the *New IE Flags* IE is used as the Extension Flag to allow the extension of the *New IE Flags* IE in the future. Extension octets of the *New IE Flags* IE shall follow directly after the first octet of the *New IE Flags* IE. When an extension octet of the *New IE Flags* IE is present, then all previous extension octets of the *New IE Flags* IE and the *New IE Flags* IE shall also be present, even if they have all their flag bits indicating no presence of their respective new IEs.

Annex B (informative): Change history

| Change history | | | | | | | |
|----------------|------------|--|------|-----|-----|--|-------------|
| Date | Meeting | TDoc | CR | Rev | Cat | Subject/Comment | New version |
| 2017-04 | R3#95b | R3-171173 | - | - | - | TS skeleton | 0.0.0 |
| 2017-04 | R3#95b | R3-171318 | - | - | - | Merged TPs from R3#95b: R3-171346 | 0.0.0 |
| 2017-05 | R3#96 | R3-171743 | - | - | - | Editorial changes | 0.0.2 |
| 2017-06 | R3#ad-hoc2 | | - | - | - | Submission | 0.1.0 |
| 2017-10 | R3#97bis | R3-173978 R3-174222 | - | - | - | Incorporated agreed pCRs from R3#97bis | 0.2.0 |
| 2017-11 | R3#98 | R3-174957 R3-174792 R3-175031 R3-174982 | - | - | - | Incorporated agreed pCRs from R3#98 | 0.3.0 |
| 2017-12 | RP-78 | | | | | TS submitted to RAN plenary for Approval | 1.0.0 |
| 2017-12 | RP-78 | | | | | TS approved by RAN plenary | 15.0.0 |
| 2018-03 | RP-79 | RP-180468 | 0001 | 1 | F | Rapporteur's update to TS38.425 | 15.1.0 |
| 2018-03 | RP-79 | RP-180468 | 0002 | - | F | Corrections to NR UP protocol | 15.1.0 |
| 2018-03 | RP-79 | RP-180468 | 0003 | 1 | B | Data Retransmission Indication | 15.1.0 |
| 2018-03 | RP-79 | RP-180468 | 0006 | 2 | F | Avoiding exceeding the max size of the NR RAN Container | 15.1.0 |
| 2018-03 | RP-79 | RP-180468 | 0010 | 2 | F | Clarification and correction on U-plane for EN-DC | 15.1.0 |
| 2018-03 | RP-79 | RP-180468 | 0014 | 1 | F | Correction of frame structure and Spare extension | 15.1.0 |
| 2018-03 | RP-79 | RP-180468 | 0015 | 1 | F | Triggering of DDDS delivery | 15.1.0 |
| 2018-03 | RP-79 | RP-180468 | 0016 | - | F | Correction to DL Discard | 15.1.0 |
| 2018-03 | RP-79 | RP-180468 | 0017 | 1 | F | Clarifications on UP IE presence | 15.1.0 |
| 2018-06 | RP-80 | RP-181238 | 0022 | 1 | F | Correction on Initial DDDS triggering | 15.2.0 |
| 2018-06 | RP-80 | RP-181238 | 0024 | 1 | F | Clarification of the use of the desired buffer size | 15.2.0 |
| 2018-06 | RP-80 | RP-181238 | 0028 | 1 | F | Correction of Reporting PDCP SN | 15.2.0 |
| 2018-06 | RP-80 | RP-181373 | 0029 | - | F | Correction the max value of one octet | 15.2.0 |
| 2018-06 | RP-80 | RP-181272 | 0032 | 3 | F | Introduction of assistance information for DL PDCP duplication (38.425 Baseline CR covering RAN3 agreements) | 15.2.0 |
| 2018-06 | RP-80 | RP-181239 | 0034 | 1 | F | Final Frame Indication | 15.2.0 |
| 2018-06 | RP-80 | RP-181238 | 0035 | - | F | Correction on padding | 15.2.0 |
| 2018-06 | RP-80 | RP-181238 | 0037 | 1 | F | UL and DL outage | 15.2.0 |
| 2018-06 | RP-80 | RP-181239 | 0039 | 1 | F | Various corrections for the NR UP | 15.2.0 |
| 2018-06 | RP-80 | RP-181239 | 0045 | 1 | F | Rapporteur's update to TS38.425 v15.1.0 | 15.2.0 |
| 2018-06 | RP-80 | RP-181239 | 0047 | - | F | Correction on length for retransmission | 15.2.0 |