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Contents

Foreword

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1 Scope

The present document specifies a Reliable Data Service (RDS) protocol.

The present document defines the frame structure, format of fields and procedures for operation of the RDS protocol. RDS is mainly intended to be used for acknowledged data transfer, but it also supports unacknowledged data transfer.

The present document is applicable to the UE, the SCEF and to the P-GW in the Evolved Packet System (EPS) and to the UE, the SMF, NEF and to the UPF in the 5G System (5GS).

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 23.682: "Architecture enhancements to facilitate communications with packet data networks and applications".

[3] IETF RFC 4122: "A Universally Unique IDentifier (UUID) URN Namespace".

[4] 3GPP TS 23.501: "System Architecture for the 5G System; Stage 2".

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].

For the purposes of the present document, the following terms and definitions given in 3GPP TS 23.682 [2] apply:

SCEF

For the purposes of the present document, the following terms and definitions given in 3GPP TS 23.501 [4] apply:

SMF
NEF
UPF

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].

RDS Reliable Data Service

4 Overview

4.1 General

The Reliable Data Service (RDS) protocol supports the following requirements:

- RDS supports peer-to-peer data transfers and shall provide reliable data delivery between the UE and the network. In EPS the data is transferred via a PDN connection between the UE and SCEF or P-GW. In 5GS the data is transferred between the UE and NEF or UPF via a PDU session between the UE and SMF.

- A UE can connect to multiple network entities. In EPS a UE can connect to multiple SCS/AS via the SCEF or P-GW. In 5GS a UE can connect to multiple AF via the NEF or UPF.

- RDS shall support multiple applications on the UE to simultaneously conduct data transfers with their peer entities on the network using a single PDN connection or a PDU session between the UE and the network.

- RDS shall support both acknowledged and unacknowledged data transfers.

- RDS shall support variable-length frames and shall allow detection and elimination of duplicate frames at the receiving endpoint.

4.2 Reference Model
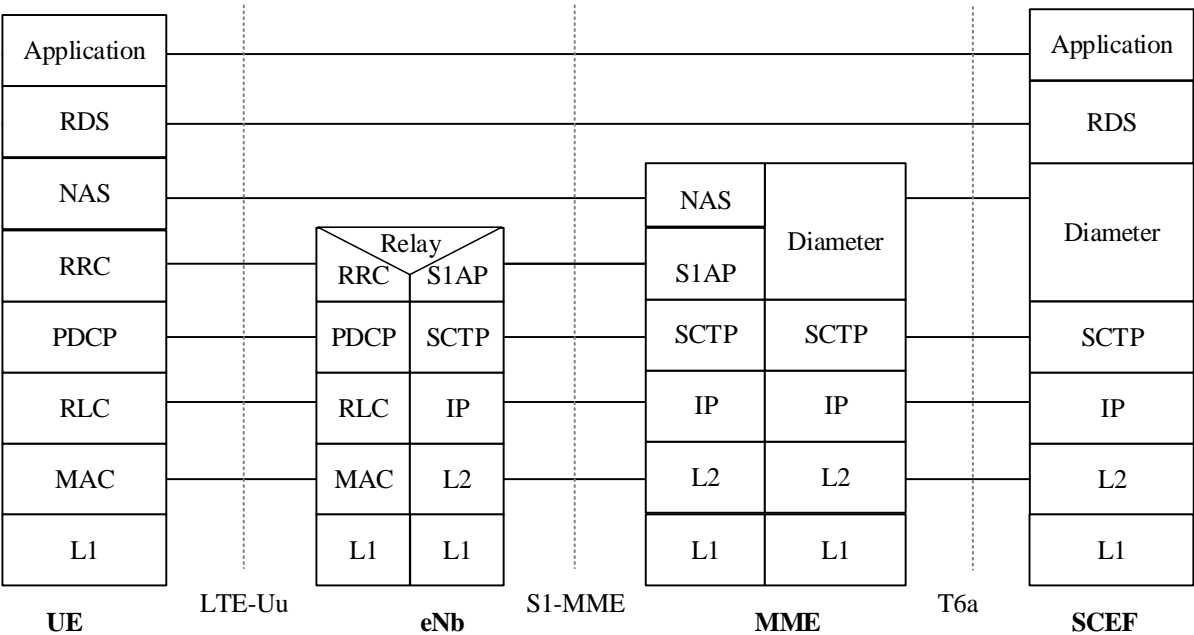
Figure 4.2-1: Protocol layering for reliable data transfer between UE and SCEF in EPS

The reference model showing the protocol layering for reliable data transfer between UE and SCEF in EPS is illustrated in figure 4.2-1.
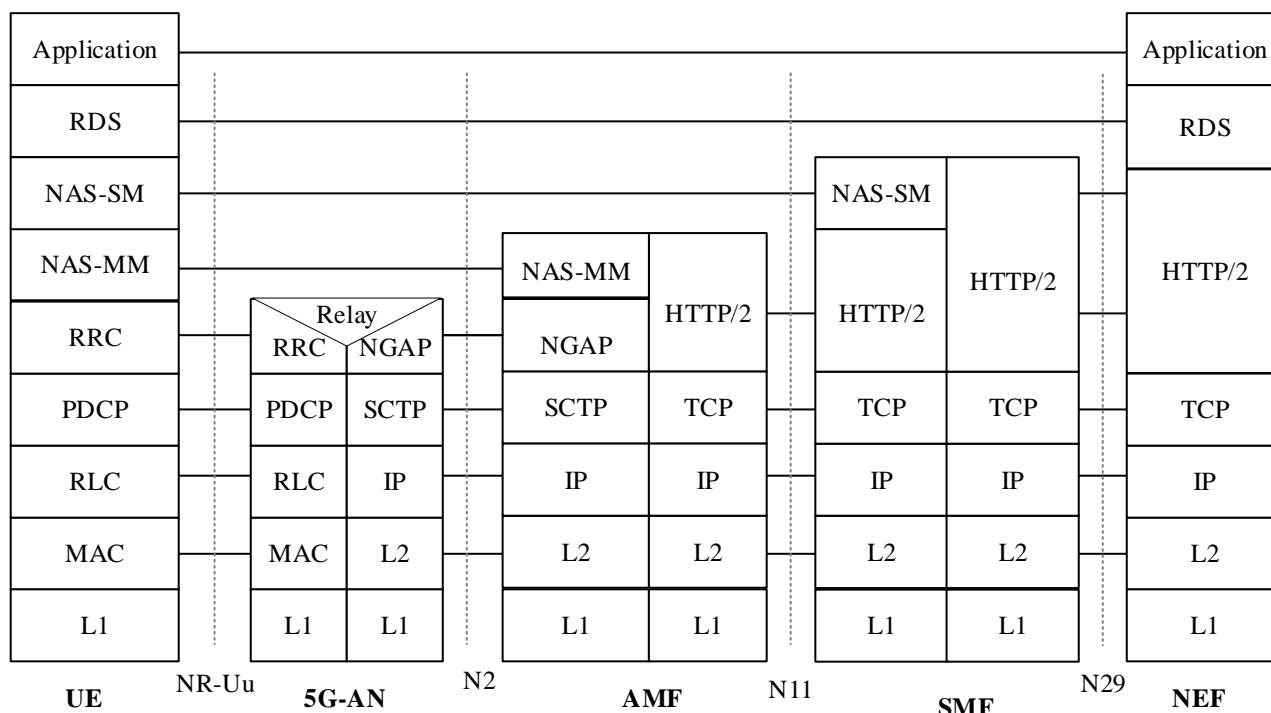
Figure 4.2-2: Protocol layering for reliable data transfer between UE and NEF in 5GS

The reference model showing the protocol layering for reliable data transfer between UE and NEF in 5GS is illustrated in figure 4.2-2.

4.3 Description of RDS protocol

4.3.1 Protocol functions

RDS establishes a peer-to-peer logical link between the UE and the network. The logical link is identified by,

-a pair of port numbers and EPS bearer ID in EPS; or

- a pair of port numbers, PDU session identity and the QoS Flow Identifier in 5GS.

Each port number is used to identify an application on the UE side or at the network side and is carried in the address field of each frame. The source port number identifies the application on the originator and the destination port number identifies the application on the receiver. When a single application on the originator conducts data transfer with a single application on the receiver, the source port number and destination port number need not be used. Each RDS frame shall consist of a header and an information field of variable length. The header shall contain information about port numbers and the frame number that is used to identify the frame and provide reliable transmission. The information field contains the payload to be transferred between the UE and the network.

In EPS,

- the UE establishes a PDN connection with the SCEF or P-GW either during Attach or through UE requested PDN connectivity. The UE shall use the EPS bearer ID to select the bearer to transfer RDS PDUs to the SCEF or P-GW. The EPS bearer ID identifies the destination (at the UE or at the SCEF or P-GW) and is not carried in the frame as it is already included in the NAS ESM message header.

In 5GS,

- the UE establishes a PDU session with the SMF through UE requested PDU session establishment procedure. The UE shall use the PDU session identity and the QoS Flow Identifier to select the flow to transfer RDS PDUs to the NEF or UPF. The PDU session identity identifies the destination (at the UE or at the NEF or UPF) and is not carried in the frame as it is already included in the NAS 5GSM message header.

Once the UE and network successfully negotiate to use RDS for a particular PDN connection or a PDU session, the PDN connection or PDU session shall transfer data only using RDS protocol.

RDS shall support both single and multiple applications within the UE. RDS enables applications to reserve source and destination port numbers for their use and also subsequently release the reserved port numbers. RDS also enables applications to query their peer entities to determine which port numbers are reserved and which are available for use at any given time. RDS shall provide fuctionality for flow control and sequence control to maintain the sequential order of frames across the logical link. The UE and the network may support reservation of the source and the destination port numbers for their use and subsequent release of the reserved port numbers.

4.3.2   Acknowledged operation

In acknowledged operation the information is transmitted in order in numbered Information (I) frames. The I frames are acknowledged at the RDS layer. Error recovery and reordering mechanisms based on retransmission of acknowledged I frames are specified. Several I frames can be acknowledged at the same time. Flow control is implemented via a sliding window mechanism.

The procedure for establishment of acknowledged transfer is described in clause 6.

4.3.3   Unacknowledged operation

In unacknowledged operation the information is transmitted in numbered Unconfirmed Information (UI) frames. The UI frames are not acknowledged at the RDS layer. Error recovery and reordering mechanisms are not defined. Duplicate UI frames are discarded. Flow control procedures are not defined.

5   Frame structure and format of fields

5.1   General

The peer-to-peer transfers using RDS shall conform to the frame format as shown in figure 5.1-1. The frame header shall consist of the Address and Control field and is a minimum of 1 octet and a maximum of 3 octets long. The Information field is of variable length.
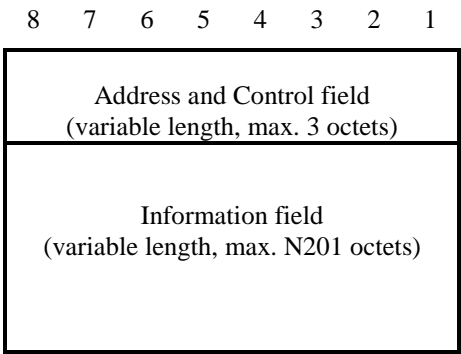
Figure 5.1-1: RDS frame format

5.2   Address and Control field

5.2.1   Address and Control field format

The Address and Control field identifies the type of frame and consists of minimum of 1 octet and maximum of 3 octets. The following types of control field frames are specified:

-    confirmed information transfer (I frame);

-    supervisory functions (S frame);

- unconfirmed information transfer (UI frame); and

- control functions (U frame).

The address and control field format for RDS is shown in figure 5.2.1-1.The description of address and control field bits is shown in Table 5.2.1-1.

Address and Control Field Bits

Format	8	7	6	5	4	3	2	1	Octet
I Format	PD	0	A	X	ADS	N(S)			1
	N(R)			R1	R2	R3	S1	S2	2
	Source Port				Destination Port				3
S Format	PD	1	1	0	ADS	A	X	X	1
	N(R)			R1	R2	R3	S1	S2	2
	Source Port				Destination Port				3
UI Format	PD	1	0	X	ADS	N(U)			1
	Source Port				Destination Port				2
U Format	PD	1	1	1	ADS	CR	X	X	1
	X	X	X	X	M4	M3	M2	M1	2
	Source Port				Destination Port				3

Figure 5.2.1-1: Address and Control field format

Table 5.2.1-1: Address and Control field bits description

Control field bits	Description
A	Acknowledgement request bit
M_n	Unnumbered function bit
N(R)	Receive sequence number
N(S)	Send sequence number
N(U)	Unconfirmed sequence number
S_n	Supervisory function bit
R_n	Selective acknowledgement bitmap bit
PD	Protocol Discriminator bit
C/R	Command / Response bit
ADS	Address bit
Source Port	Source port number
Destination Port	Destination port number
X	Spare bit

5.2.2 Protocol Discriminator bit (PD)

The PD bit indicates whether a frame is an RDS frame or belongs to a different protocol. RDS frames shall have the PD bit set to 0. If a frame with the PD bit set to 1 is received, then it shall be treated as an invalid frame.

5.2.3 Address bit (ADS)

The ADS bit controls if the Source Port and Destination Port are included in the frame format. When a single application on UE side conducts data transfer with a single application on networkside, the source and destination port numbers need not be used. The source and destination port numbers enable multiple applications on the UE side to simultaneously communicate with their peer entities on the network side using the same PDN connection or PDU session. Source Port and Destination Port are included in the frame format only if the ADS bit is set to 1.

5.2.4 Source port number (Source Port)

When a UE application starts to use the PDN connection or a PDU session to transmit RDS frames, the UE and the network establish which source port number will be used for the application on the UE side for MO traffic and which destination port number will be used for the application intended to receive the frames on the network side. Similarly for MT traffic when an application in the network starts to use the PDN connection or PDU session to transmit RDS frames, the UE and the network establish which source port number will be used for the application on the network side and which destination port number will be used for the application intended to receive the frames on the UE side. Applications on the originator side and their peer entities on receiver side can synchronize port numbers using port management functionality as described in subclause 5.4.2.6 or using means outside the scope of this specification.

Source Port is included only if the ADS bit is 1. Source Port shall have values from 0 to 15.

5.2.5 Destination port number (Destination Port)

The Destination Port is used to identify the destination application on the receiver that is receiving the frame.

Destination Port is included only if the ADS bit is 1. Destination Port shall have values from 0 to 15.

5.2.6 Information transfer frame - I

The I frame shall be used to perform an information transfer between peer entities with acknowledgement. Each I frame has a send sequence number N(S), a receive sequence number N(R) and an acknowledgement request bit A, that may be set to 0 or 1. The use of N(S), N(R), and A is defined in clause 6.

Each I frame also contains supervisory function bits S(n) and the Selective Acknowledgement bitmap R(n) which are defined in subclause 5.3.2.

5.2.7 Supervisory frame - S

The S frame shall be used to perform supervisory control functions such as acknowledge I frames. The supervisory frame has supervisory function bits S(n) that are used for encoding commands and responses which perform the supervisory control functions. Each supervisory frame has a receive sequence number N(R) and an acknowledgement request bit A, that may be set to 0 or 1. In acknowledged operation, all I and S frames contain R(n), the Selective Acknowledgement bitmap. The commands and responses are defined in subclause 5.4 and the use of S(n), N(R), A and R(n) is defined in clause 6.

5.2.8 Unconfirmed Information frame - UI

The UI frame shall be used to perform an information transfer between peer entities without acknowledgement. The UI frames contain N(U), the unconfirmed sequence number of transmitted UI frames. No verification of sequence numbers is performed for UI frames.

5.2.9 Unnumbered frame - U

The U frame shall be used to provide additional link control functions. Each U frame has Unnumbered function bits M(n) that are used to encode link control commands and response. The U frame has Command/Response bit (C/R) that identifies a U frame as either a command or a response. The U fame contains no sequence number. The commands and responses are defined in subclause 5.4 and the use of M(n) is defined in clause 6.

5.2.10 Command / Response bit (C/R)

The C/R bit identifies a frame as either a command or a response. The UE side shall send commands with the C/R bit set to 0, and responses with the C/R bit set to 1. The network side shall do the opposite; i.e., commands are sent with C/R set to 1, and responses are sent with C/R set to 0. The combinations for the network side and UE side are shown in table 5.2.10-1.

Table 5.2.10-1: C/R field bit usage

Type	Direction	C/R value
Command	Network side to UE side	1
Command	UE side to Network side	0
Response	Network side to UE side	0
Response	UE side to Network side	1

5.3 Control field parameters and associated state variables

The various parameters associated with the control field frames are described in this subclause.

5.3.1 Acknowledgement request bit (A)

All I and S frames contain the Acknowledgement Request (A) bit.

The A bit set to 1 is used to solicit an acknowledgement (i.e., an I frame or S frame) from the receiver. The A bit set to 0 is used to indicate that the receiver is not requested to send an acknowledgement.

5.3.2 Acknowledged operation variables and parameters

5.3.2.1 Send state variable V(S)

In acknowledged operation, each originator shall have an associated send state variable V(S) when using I frames. V(S) denotes the sequence number of the next in-sequence I frame to be transmitted. V(S) can take on the value 0 through (MAX SEQUENCE NUMBER -1). The value of V(S) shall be incremented by 1 with each successive I frame transmission, and shall not exceed acknowledge state variable V(A) by more than the maximum number of outstanding I frames k. The value of k may be in the range $1 \leq k \leq$ (MAX SEQUENCE NUMBER/2 -1). V(S) shall not be incremented when an I frame is retransmitted.

5.3.2.2 Acknowledge state variable V(A)

In acknowledged operation, each peer originator shall have an associated acknowledge state variable V(A) when using I frame and supervisory frame commands and responses. V(A) identifies the first I frame in the transmit window, so that V(A) - 1 equals N(S) of the last in-sequence acknowledged I frame. V(A) can take on the value 0 through (MAX SEQUENCE NUMBER -1). The value of V(A) shall be updated by the valid N(R) values received from its peer (see subclause 5.3.2.5). A valid N(R) value is in the range $V(A) \leq N(R) \leq V(S)$.

5.3.2.3 Send sequence number N(S)

In acknowledged operation, only I frames contain N(S), the send sequence number of transmitted I frames. At the time that an in-sequence I frame is designated for transmission, the value of N(S) is set equal to the value of the send state variable V(S).

5.3.2.4 Receive state variable V(R)

In acknowledged operation, each receiver shall have an associated receive state variable V(R) when using I frame and supervisory frame commands and responses. V(R) denotes the sequence number of the next in-sequence I frame expected to be received. V(R) can take on the value 0 through (MAX SEQUENCE NUMBER -1). The value of V(R) shall be incremented by one with the receipt of an error-free, in-sequence I frame whose send sequence number N(S) equals V(R).

5.3.2.5 Receive sequence number N(R)

In acknowledged operation, all I frames and S frames contain N(R), the expected send sequence number of the next in-sequence received I frame. At the time that a frame of the above types is designated for transmission, the value of N(R) is set equal to the value of the receive state variable V(R). N(R) indicates that the receiver transmitting the N(R) has correctly received all I frames numbered up to and including N(R) - 1.

5.3.2.6 Selective Acknowledgement (SACK) bitmap R(n)

In acknowledged operation, all I frames and S frames contain R(n), the SACK bitmap. At the time that a S frame is designated for transmission, the value of each bit R(n) in the bitmap shall be set to 0 or 1 depending on whether I frame number N(R) + n has been received or not. R(n) = 1 indicates that the receiver transmitting the S frame has correctly received I frame number N(R) + n. R(n) = 0 indicates that the receiver transmitting the S frame has not correctly received I frame number N(R) + n. The SACK bitmap contains (k) bits.

5.3.3 Unacknowledged operation variables and parameters

5.3.3.1 Unconfirmed send state variable V(U)

Each peer entity shall have an associated unconfirmed send state variable V(U) when using UI frame commands. V(U) denotes the sequence number of the next UI frame to be transmitted. V(U) can take on the value 0 through 7. The value of V(U) shall be incremented by 1 with each successive UI frame transmission.

5.3.3.2 Unconfirmed sequence number N(U)

Only UI frames contain N(U), the unconfirmed sequence number of transmitted UI frames. At the time that a UI frame is designated for transmission, the value of N(U) is set equal to the value of the unconfirmed send state variable V(U).

5.3.3.3 Unconfirmed receive state variable V(UR)

Each peer entity shall have an associated unconfirmed receive state variable V(UR) when using UI frame commands. V(UR) denotes the sequence number of the next in-sequence UI frame expected to be received. V(UR) can take on the value 0 through 7.

5.3.3.4 Other parameters and variables

The only other parameter defined for unacknowledged operation is the number of octets (N201) in the information field of the UI frame. See subclause 6.4.6.

5.4 Commands and responses

5.4.1 General

The following commands and responses are used by the UE side and Network side as shown in table 5.4.1-1. Each link connection shall support the appropriate set of commands and responses for the type of operation desired.

Table 5.4.1-1: Commands and responses

Frame	Commands	Responses	Encoding					
			S1	S2	M4	M3	M2	M1
S Frame or I Frame	SACK	SACK	1	1	-	-	-	-
U Frame	ERROR	ERROR	-	-	0	0	0	1
U Frame	DISCONNECT	-	-	-	0	1	0	0
U Frame	-	ACCEPT	-	-	0	1	1	0
U Frame	SET_ACK_MODE	-	-	-	0	1	1	1
U Frame	SET_PARAMETERS	SET_PARAMETERS	-	-	1	0	1	1
U Frame	MANAGE_PORT	MANAGE_PORT	-	-	1	0	1	0

5.4.2 Unnumbered (U) frames

5.4.2.1 SET_ACK_MODE command

The originator shall use the SET_ACK_MODE command to initiate acknowledged operation between the UE and network.

The receiver shall confirm acceptance of a SET_ACK_MODE command by the transmission of an ACCEPT response. Upon acceptance of SET_ACK_MODE command, the send state variable V(S), acknowledge state variable V(A), and receive state variable V(R), shall be set to 0. The transmission of a SET_ACK_MODE command indicates the clearance of any exception conditions.

Previously transmitted I frames that are unacknowledged when this command is sent shall be discarded. It is the responsibility of higher layers to recover from the possible loss of the contents of such I frames.

5.4.2.2 DISCONNECT command

The DISCONNECT command shall be transmitted in order to terminate the acknowledged operation.

No information field is permitted with the DISCONNECT command. Prior to executing the command, the receiver side receiving the DISCONNECT command shall confirm the acceptance of a DISCONNECT command by the transmission of an ACCEPT response. The originator that sends the DISCONNECT command shall terminate the acknowledge mode operation when it receives the ACCEPT or ERROR response.

Previously transmitted I frames that are unacknowledged when this command is executed shall remain unacknowledged and shall be discarded. It is the responsibility of higher layers to recover from the possible loss of the contents of such I frames.

5.4.2.3　ACCEPT response

The ACCEPT response shall be used by the originator to acknowledge the receipt and acceptance of the SET_ACK_MODE or DISCONNECT commands. The SET_ACK_MODE or DISCONNECT commands are acted upon only after the ACCEPT response is transmitted.

5.4.2.4　ERROR command / response

The ERROR unnumbered command shall be used by the originator to report to the receiver that the originator is in a state such that acknowledged operation cannot be performed. The receiver shall transmit an ERROR response to any valid command received that it cannot execute. No information field is permitted with the ERROR command or ERROR response.

5.4.2.5　SET_PARAMETERS command / response

The SET_PARAMETERS command and response is used to negotiate values of parameters between originator and receiver in both acknowledged and unacknowledged mode of transfer. These parameters shall include the version of the RDS.

If the originator wants to negotiate the value of parameters, the originator shall send a SET_PARAMETERS command including the set of parameters along with their values to the receiver. The receiver shall send a SET_PARAMETERS response, either confirming these parameter values by returning the requested values, or proposing different ones in their place. Both, the originator and the receiver shall use the negotiated values after the completion of the negotiation process.

Table 5.4.2.5-1 lists the negotiable RDS layer parameters. Figure 5.4.2.5-1 shows the SET_PARAMETERS field format. A parameter item consists of Type and Length octets followed by the value of that parameter. The Length octet indicates the number of octets that the value actually occupies.

	Bits								Octet
8	7	6	5	4	3	2	1		Octet
Type									1
Length									2
High-order octet									3
...									...
Low-order octet									n
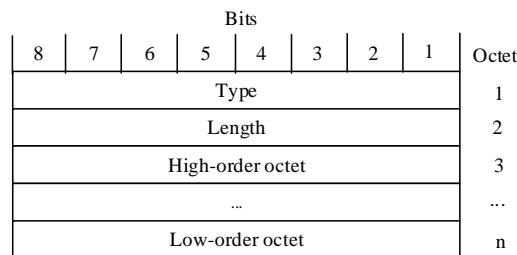
Figure 5.4.2.5-1: SET_PARAMETERS field format

Table 5.4.2.5-1: RDS layer parameters

Parameter Name	Type	Length	Format (87654321)	Range
RDS_Version	0	1	bbbbbbbb	0 through 255

5.4.2.6 MANAGE_PORT command / response

5.4.2.6.1 General

The originator and receiver may support the handling specified in subclause 5.4.2.6.

The MANAGE_PORT command and response is used to manage association of applications with source and destination port numbers between originator and receiver in both acknowledged and unacknowledged mode of transfer. The MANAGE_PORT command and response can be used to:

- reserve a combination of source and destination port numbers for use with a specific application;

- release a combination of source and destination port numbers that are reserved;

- query the list of port numbers that are reserved for use with a specific application; and

- notify the list of port numbers that are reserved for use with a specific application.

Port number 0 shall not be reserved at the originator or receiver. If an application at the originator communicates with multiple applications at the receiver, then the application does not reserve a port number at destination and shall set the Destination Port to 0. The ADS bit in the U frame header of MANAGE_PORT command and response is set to 0. Table 5.4.2.6.1-1 lists the parameters used in MANAGE_PORT command and response frames.

Table 5.4.2.6-1: MANAGE_PORT parameters

Action (Bits 1 to 4, octet 1) This field indicates the operation that the originator or receiver performs as part of MANAGE_PORT command or response and can have the following values Bits **4 3 2 1** 0 0 0 1   Reserve port 0 0 1 0   Release port 0 0 1 1   Query port 0 1 0 0   Notify port All other values are reserved. Application Id This field shall be encoded as a sequence of a sixteen octet OS Id field, a one octet OS App Id length field, and an OS App Id field. The OS Id is the operating system Identifier and it contains a UUID as specified in IETF RFC 4122 [3]. The OS App Id field contains an OS specific application identifier of variable length octets. Status (octet 2) This field is used only in the response frame in the direction from the receiver to the originator. It specifies the status of the operation and can have the following values: Bits 8 7 6 5 4 3 2 1 0 0 0 0 0 0 0 0   Success 0 0 0 0 0 0 0 1   Port not free 0 0 0 0 0 0 1 0   Port not associated with specified application All other values are reserved. Requested port numbers This field indicates the destination port numbers that the originator wants to query and shall be encoded as a bitmap of two octets as indicated below in subclause 5.4.2.6.1.1. Port numbers not available This field indicates the port numbers that are reserved and for which information is not included in the command or response frame. This field shall be encoded as a bitmap of two octets as indicated in subclause 5.4.2.6.1.2.

5.4.2.6.1.1 Requested port numbers

The port numbers that are requested are coded in the first and second octet of the Requested port numbers bitmap as follows:

bit 8	7	6	5	4	3	2	bit 1	
Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1	(reserved)	Octet 1

bit 16	15	14	13	12	11	10	bit 9	
Port 15	Port 14	Port 13	Port 12	Port 11	Port 10	Port 9	Port 8	Octet 2

A port number is requested, if the corresponding bit is set to "1". All reserved bits shall be set to "0".

5.4.2.6.1.2 Port numbers not available

The port numbers that are not available are coded in the first and second octet of the Port numbers not available bitmap as follows:

bit 8	7	6	5	4	3	2	bit 1	
Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1	(reserved)	Octet 1

bit 16	15	14	13	12	11	10	bit 9	
Port 15	Port 14	Port 13	Port 12	Port 11	Port 10	Port 9	Port 8	Octet 2

A port number is not available, if the corresponding bit is set to "1". All reserved bits shall be set to "0".

5.4.2.6.2 Reserve port numbers

If the originator wants to reserve a combination of source and destination port numbers for an application, the originator shall send a MANAGE_PORT command as shown in figure 5.4.2.6.2-1 by setting the Action field to "Reseve port" and setting the Application ID field to the application to be associated with the combination of the Source Port and Destination Port numbers specified in the MANAGE_PORT command.

Figure 5.4.2.6.2-1: MANAGE_PORT command field format for Action "Reserve port"

The receiver shall send a MANAGE_PORT response as shown in figure 5.4.2.6.2-2, by setting the Action field in response frame to "Reseve port". If the destination port specified in the MANAGE_PORT command frame is not associated with any application on the receiver, the receiver shall reserve the destination port for use with the application identifier included in the MANAGE_PORT command frame, and shall set the Status field in MANAGE_PORT response frame to "Success", otherwise the Status field is set to "Port not free".

Bits

8	7	6	5	4	3	2	1	Octet
Reserved				Action				1
Status								2
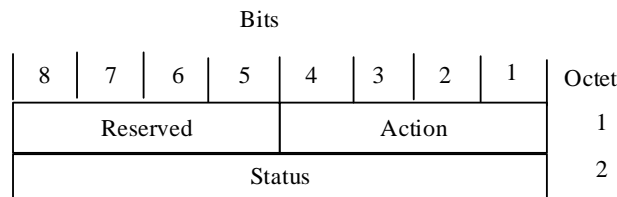
Figure 5.4.2.6.2-2: MANAGE_PORT response field format for Action "Reserve port"

If the Status field is set to "Success" in the MANAGE_PORT response frame, the originator shall reserve the Source Port for use with the application specified in the MANAGE_PORT command.

5.4.2.6.3 Release port numbers

If the originator wants to release a combination of source and destination port numbers for an application, the originator shall send a MANAGE_PORT command as shown in figure 5.4.2.6.3-1 by setting the Action field to "Release port" and setting the Application ID field to the application currently associated with the combination of the Source Port and Destination Port numbers in the MANAGE_PORT command.

Bits

8	7	6	5	4	3	2	1	Octet
Reserved				Action				1
Source Port				Destination Port				2
Application ID								3 n

Figure 5.4.2.6.3-1: MANAGE_PORT command field format for Action "Release port"

The receiver shall send a MANAGE_PORT response, by setting the Action field in response frame to "Release port". If the Destination Port specified in the header of the MANAGE_PORT command frame on the receiver is associated with the application specified in the MANAGE_POR command frame, the receiver shall release the Destination Port from use with the application identifier included in the MANAGE_PORT command frame and shall set the Status field in MANAGE_PORT response frame to "Success", otherwise the Status field is set to "Port not associated with specified application".

Bits

8	7	6	5	4	3	2	1	Octet
Reserved				Action				1
Status								2
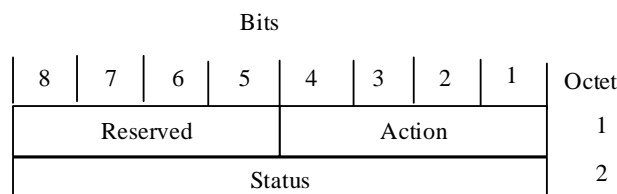
Figure 5.4.2.6.3-2: MANAGE_PORT response field format for Action "Release port"

If the Status field is set to "Success" in the MANAGE_PORT response frame, the originator shall release the Source Port from use with the application that it is associated with.

5.4.2.6.4 Query port numbers

If the originator wants to query the destination port numbers that are reserved, the originator shall send a MANAGE_PORT command as shown in figure 5.4.2.6.4-1 by setting the Action field to "Query port" and indicating the destination port numbers that it intends to query in the optional Requested port numbers. If the originator intends to query all the port numbers, then it shall not include the Requested port numbers.

Bits

8	7	6	5	4	3	2	1	Octet
Reserved				Action				1
Requested port numbers								2*
								3*

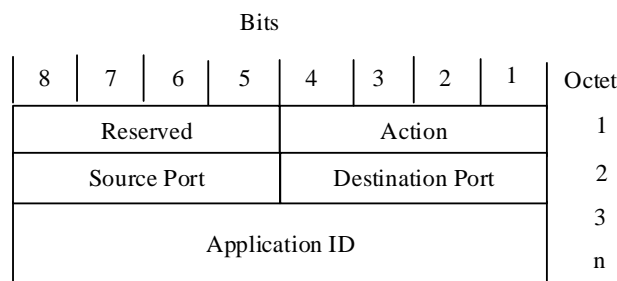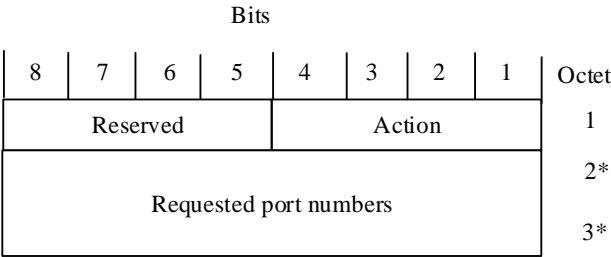**Figure 5.4.2.6.4-1:**
MANAGE_PORT command field format for Action "Query port"

The receiver shall send a MANAGE_PORT response as shown in figure 5.4.2.6.4-2, by setting the Action field in response frame to "Query port". For each destination port included in the Requested port numbers in the MANAGE_PORT command that is reserved on the receiver and is associated with an application, the receiver shall include an entry in the MANAGE_PORT response. The receiver shall set the Num Entries field in the MANAGE_PORT response to the number of destination ports entries that are included in the MANAGE_PORT response. For each destination port entry, the receiver shall include the Source Port number that the destination port is paired with and the associated Application ID. If the receiver does not have any reserved source port number for the associated Application ID, the Source Port number shall be set to 0. In the case that the entries for all the destination port numbers requested by the originator do not fit in the MANAGE_PORT response, the receiver shall include as many entries for destination port numbers as possible in the MANAGE_PORT response. For all the destination port numbers that are reserved on the receiver, for which the originator has requested information in Requested port numbers in the MANAGE_PORT command and for which information cannot be included in the MANAGE_PORT response, the receiver shall set the corresponding entry in the optional Port numbers not available bitmap. The originator can subsequently query information on these destination port numbers by sending another MANAGE_PORT command and setting Requested port numbers to Port numbers not available in the received MANAGE_PORT response. If the entries for all the destination port numbers requested by the originator fit in the MANAGE_PORT response, the receiver shall not include the optional Port numbers not available.

NOTE: The entries for all the destination port numbers requested by the originator will fit in the MANAGE_PORT

Bits

8	7	6	5	4	3	2	1	Octet
Num Entries				Action				1
Source Port 1				Destination Port 1				2*
Application ID 1								3* (3 + n1)*
Source Port 2				Destination Port 2				(4 + n1)*
Application ID 2								(5 + n1)* (5 + n1 + n2)*
......								
Source Port X				Destination Port X				(2 + 2*(X-1) + n1+ .... + n(X-1))*
Application ID X								(3 + 2*(X-1) + n1+ .... + n(X-1))* (3 + 2*(X-1) + n1+ .... + nX)*
Port numbers not available								(4 + 2*(X-1) + n1+ .... + nX)* (5 + 2*(X-1) + n1+ .... + nX)*

Figure 5.4.2.6.4-2: MANAGE_PORT response field format for Action "Query port"

5.4.2.6.5 Notify port numbers

If the originator wants to notify the receiver of the source port numbers that are reserved at the originator, the originator shall send a MANAGE_PORT command as shown in figure 5.4.2.6.5-1 by setting the Action field to "Notify port".

For each source port that is reserved on the originator and is associated with an application, the originator shall include an entry in the MANAGE_PORT command. The originator shall set the Num Entries field in the MANAGE_PORT command to the number of source ports entries that are included in the MANAGE_PORT response. For each source port that is reserved, the originator shall include the Destination Port number that the source port is paired with and the associated Application ID. If the originator does not have any reserved destination port number for the associated Application ID, the Destination Port number shall be set to 0.

In the case that the entries for all the source port numbers do not fit in the MANAGE_PORT command, the originator shall include as many entries on source port numbers as possible in the MANAGE_PORT command. For all the source port numbers that are reserved on the originator and for which information cannot be included in the MANAGE_PORT command, the originator shall set the corresponding entry in the optional Port numbers not available bitmap. The receiver can subsequently query information on these source port numbers by sending another MANAGE_PORT command by setting the Action field to "Query port" and setting Requested port numbers to Port numbers not available in the received MANAGE_PORT command. If the entries for all the source port numbers fit in the MANAGE_PORT command, the originator shall not include the Port numbers not available.

NOTE: The entries for all the source port numbers will fit in the MANAGE_PORT command for cases where the maximum length of the OS specific application identifier is equal-to or less-than 64 octets.

Bits

8	7	6	5	4	3	2	1	Octet
Num Entries				Action				1
Source Port 1				Destination Port 1				2*
Application ID 1								3* (3 + n1)*
Source Port 2				Destination Port 2				(4 + n1)*
Application ID 2								(5 + n1)* (5 + n1 + n2)*
......								
Source Port X				Destination Port X				(2 + 2*(X-1) + n1+ .... + n(X-1))*
Application ID X								(3 + 2*(X-1) + n1+ .... + n(X-1))* (3 + 2*(X-1) + n1+ .... + nX)*
Port numbers not available								(4 + 2*(X-1) + n1+ .... + nX)* (5 + 2*(X-1) + n1+ .... + nX)*

Figure 5.4.2.6.5-1: MANAGE_PORT command field format for Action "Notify port"

There is no response frame sent by receiver when it receives the MANAGE_PORT command with Action field set to "Notify port".

5.4.3 Information (I) and Supervisory (S) frames

5.4.3.1 General

The function of the information (I) frame is to transfer, sequentially-numbered frames containing information fields provided by upper layers. This frame shall only be used in acknowledge operation.

Numbered I frames shall also carry supervisory information. A separate S frame is sent when there is no information field to be transferred. Whether an I or S frame is transmitted as a command or as a response is insignificant in the acknowledge operation.

5.4.3.2 Selective Acknowledgement (SACK) command / response

The supervisory frame containing the SACK bitmap shall be used by a receiver to acknowledge a single or multiple I frames. Frames up to and including N(R) - 1, and frames indicated by the SACK bitmap, are deemed to have been received correctly. The format of the SACK control field is shown in figure 5.2.1-1.

In addition to indicating the status of received I frames, the I or S frame containing the SACK bitmap with the A bit set to 1 may be used by the originator to request an acknowledgement from receiver.

6 Protocol procedures

6.1 Overview

This clause describes the RDS protocol procedures between the UE and network for acknowledged data service.

6.2 Procedures

6.2.1 Types of RDS procedures

The following RDS protocol procedures are defined:

- Establishment of acknowledged transfer;

- Acknowledged information transfer;

- Termination of acknowledged transfer;

- Unacknowledged information transfer;

- Reserve port numbers;

- Release port numbers;

- Query port numbers; and

- Notify port numbers.

6.2.2 Establishment of acknowledged transfer procedure

6.2.2.1 General

The purpose of the establishment of acknowledged transfer procedure is for the originator to establish acknowledged transmission of information with the receiver. All frames other than U and UI frames received during the establishment of acknowledged transfer procedure shall be ignored.

6.2.2.2 Establishment of acknowledged transfer procedure initiation

The originator shall initiate the establishment of acknowledged transfer procedure when upper layers indicate information is to be transmitted using acknowledged operation. The originator and the receiver identify the source and destination port numbers before initiating establishment of acknowledged transfer procedure.

The originator initiates the establishment of acknowledged transfer procedure by transmitting a SET_ACK_MODE command to receiver. When a single application on the originator conducts data transfer with a single application on the receiver, the Source Port and Destination Port numbers need not be used; otherwise the originator shall set the Source Port to the port number of the source application on the originator and the Destination Port to the port number of the destination application on the receiver. The originator shall clear all exception conditions, discard all queued I frames, reset the retransmission counter and timer T200 shall be set.

If a logical link between the UE and network identified without port numbers exists and the originator needs to initiate establishment of an additional acknowledged transfer procedure, the additional logical link between the UE and network shall be identified with port numbers while the first logical link can remain without port numbers.

Originator   Receiver

SET_ACK_MODE

ACCEPT

– OR –

SET_ACK_MODE

ERROR
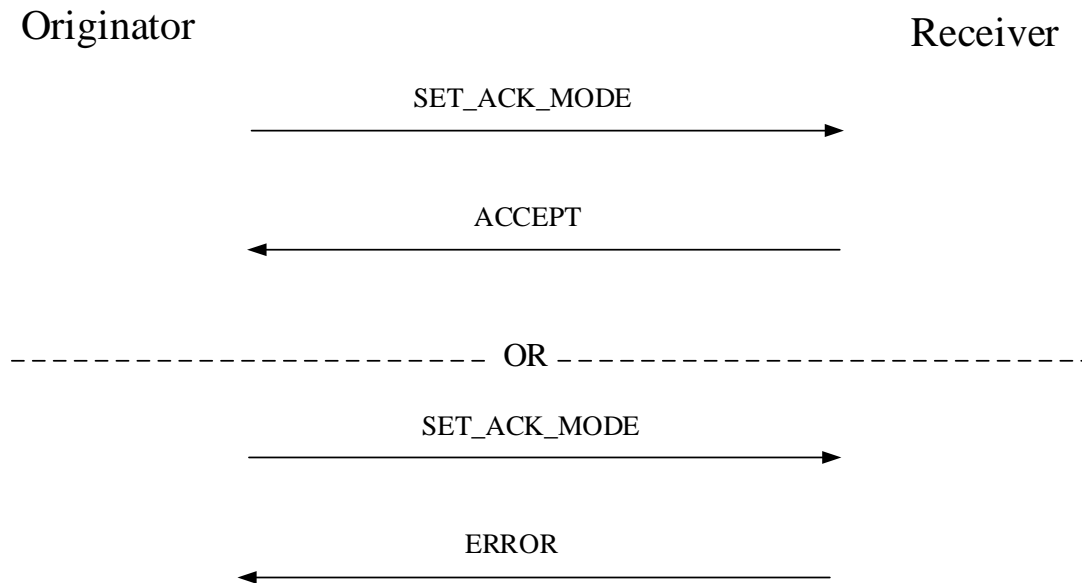
Figure 6.2.2.2-1: Establishment of acknowledged transfer procedure

6.2.2.3   Establishment of acknowledged transfer procedure accepted by receiver

Upon receiving a SET_ACK_MODE command, the receiver checks if the Destination Port number contained in the SET_ACK_MODE command corresponds to an application on the receiver.

If the check is successful and if the application accepts to enter acknowledged transfer mode, the receiver shall send an ACCEPT response to the originator. When a single application on the originator conducts data transfer with a single application on the receiver, the Source Port and Destination Port numbers need not be used; otherwise the receiver shall set the Source Port to the port number of the application on the receiver and the Destination Port to the port number of the application on the originator. The receiver shall reset timer T200 if active, clear all exception conditions and set $V(S)$, $V(R)$ and $V(A)$ to 0.

6.2.2.4   Establishment of acknowledged transfer procedure completed by originator

Upon receipt of the ACCEPT response and if the Destination Port number corresponds to the application which initiated the establishment of acknowledged transfer procedure, the originator enters acknowledged mode transfer. The originator shall reset timer T200 if active, clear all exception conditions and set $V(S)$, $V(R)$ and $V(A)$ to 0 and the establishment of acknowledged transfer procedure is successfully completed.

6.2.2.5   Establishment of acknowledged transfer procedure not accepted by receiver

Upon receiving a SET_ACK_MODE command if the Destination Port number contained in the SET_ACK_MODE command,

-    is not supported by the receiver; or

-    corresponds to an application that is not able to perform acknowledged transfer mode,

then the receiver shall send an ERROR response to the originator.

6.2.3 Acknowledged information transfer procedure

6.2.3.1 General

The purpose of the acknowledged information transfer procedure is for the originator to transfer I frames to receiver and receive acknowledgements for these frames from receiver.

The originator shall store the history of the transmitted I frames, and shall remember the I-frame transmission sequence. The history is used to decide which I frames to retransmit. Due to retransmission, the history is not necessarily an in-order sequence.

A frame within the receive window is either:

- received: the frame has been correctly received; or

- not received: the frame has not been correctly received.

A frame within the transmit window is either:

- not yet transmitted: the frame has not yet been transmitted;

- transmitted: the frame has been (re-) transmitted, but the originator does not know if the frame has been received by the receiver;

- acknowledged: the frame has been acknowledged by the receiver; or

- marked for retransmission: the originator has decided to retransmit this I frame.

I frames shall be transmitted in ascending N(S) order. When I frames are retransmitted, the frame with the lowest N(S) shall be retransmitted first. This is used by the receiver to detect lost frames.

6.2.3.2 Transmitting I frames and requesting acknowledgements

If the originator has received information to be transmitted from upper layers, the information is inserted in an I frame. The control field parameters N(S) and N(R) shall be assigned the values V(S) and V(R), respectively. V(S) shall be incremented by 1 at the end of the transmission of the I frame.

The originator shall request an acknowledgement from the receiver by transmitting an I or S frame with the A bit set to 1. The originator may request an acknowledgement at any time. An acknowledgement shall be requested when:

- the last I frame in a sequence of one or more I frames is transmitted; or

- V(S) = V(A) + k as a result of the transmission of the I frame.

The originator shall transmit a frame in the following order of priority:

- If there are any I frames marked for retransmission then the originator shall increment by 1 the retransmission count variable for the I frame with the lowest send sequence number N(S). If the retransmission count variable exceeds the value of N200, then the originator shall initiate the Establishment of acknowledged operation procedure as described in subclause 6.2.2. If the retransmission count variable does not exceed the value of N200, then the originator shall retransmit the I frame.

- If the originator has a new I frame to transmit, if V(S) < V(A) + k (where k is the maximum number of outstanding I frames) then the new I frame shall be transmitted.

- If the originator has an acknowledgement to transmit then the originator shall transmit an S frame.

When requesting an acknowledgement, the originator shall set timer T201 and associate the timer with the I frame currently being transmitted, or, if the A bit is transmitted in an S frame, with the I frame last transmitted.
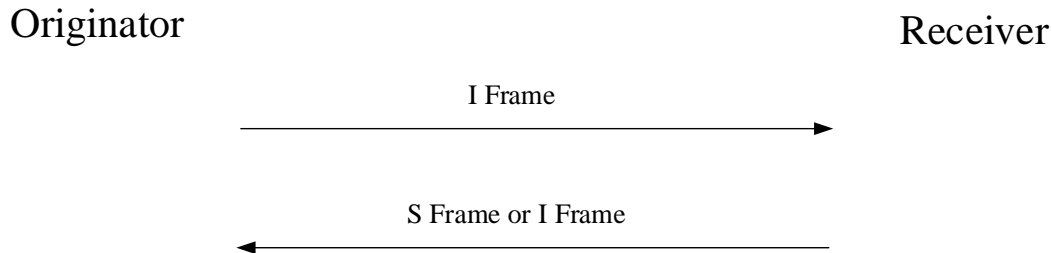
<div align="center">Originator</div>

<div align="right">Receiver</div>

<div align="center">I Frame</div>

<div align="center">⟶</div>

<div align="center">S Frame or I Frame</div>

<div align="center">⟵</div>

Figure 6.2.3.2-1: Acknowledged information transfer procedure

6.2.3.3 Receiving I frames and sending acknowledgements

When the receiver receives a valid I frame whose N(S) is equal to the current V(R), the receiver shall:

- pass the contents of the Information field to the appropriate upper layer entity;

- increment its V(R) by 1; and

- respond with a I or S frame containing the SACK bitmap, if the A bit of the received I frame was set to 1.

When the receiver receives a valid I frame whose N(S) is not in the range $V(R) \le N(S) < V(R) + k$, the receiver shall discard the frame as a duplicate.

When the receiver receives a valid I frame where $V(R) < N(S) < V(R) + k$, then the receiver shall store the I frame until all frames from V(R) to N(S) - 1 inclusive are correctly received. Once all the frames are correctly received the receiver shall then:

- pass the contents of the Information field to the appropriate upper layer entity; and

- set its V(R) = N(S) + 1.

Whenever the receiver detects an error in the sequence of received I frames, it shall transmit an I or S frame.

If the receiver receives an I frame with a higher N(S) than the N(S) of the previously received I frame, and if there are I frames missing between these two N(S) values, then the receiver shall assume that the missing I frames have been lost. If the receiver receives an I frame with a lower N(S) than the N(S) of the previously received I frame, it can assume that its peer originator has (re-) started retransmission due to the reception of an acknowledgement.

6.2.3.4 Receiving acknowledgements

On receipt of a valid I or S frame , the originator shall, if N(R) is valid, treat the N(R) contained in this frame as an acknowledgement for all the I frames it has transmitted with an N(S) up to and including the received N(R) - 1. A valid N(R) value is one that is in the range $V(A) \le N(R) \le V(S)$. If N(R) is not valid, then the received SACK bitmap shall be disregarded.

V(A) shall then be set to N(R).

On receipt of a valid I or S frame containing the SACK bitmap, the originator shall consider all I frames with the corresponding bit set to 1 in the SACK bitmap as acknowledged.

If timer T201 is active and associated with an acknowledged I frame, then timer T201 shall be reset.

The originator shall determine which I frames to retransmit by analysing it's I frame transmission sequence history and the acknowledgements received. An unacknowledged I frame that was transmitted prior to an acknowledged I frame shall be considered lost and shall be marked for retransmission. Acknowledged I frames shall be removed from the I frame transmission sequence history.

6.2.4   Termination of acknowledged transfer procedure

6.2.4.1   General

The purpose of the termination of acknowledged transfer procedure is to terminate the acknowledged transmission of information between the UE side and the network side. All frames other than U and UI frames received during the termination of acknowledged transfer procedure shall be ignored and all queued I frames shall be discarded.

6.2.4.2   Termination of acknowledged transfer procedure initiation

The originator or receiver shall initiate the termination of acknowledged transfer procedure when upper layers indicate termination of acknowledged operation.

The originator initiates the termination of acknowledged transfer procedure by transmitting a DISCONNECT command. When a single application on the originator conducts data transfer with a single application on the receiver, the Source Port and Destination Port numbers need not be used; otherwise the originator shall set the Source Port to the port number of the source application on the originator and the Destination Port to the port number of the destination application on the receiver. The originator shall reset the retransmission counter and timer T200 shall be set.
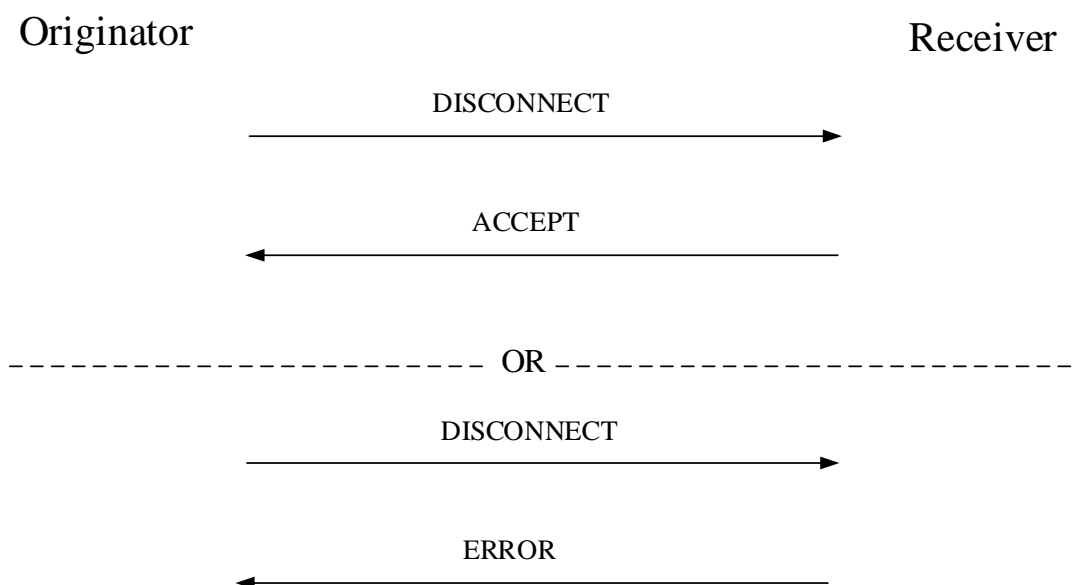
Figure 6.2.4.2-1: Termination of acknowledged transfer procedure

6.2.4.3   Termination of acknowledged transfer procedure accepted by receiver

Upon receiving a DISCONNECT command, the receiver checks if the Destination Port number contained in the DISCONNECT command corresponds to an application on the receiver.

If the check is successful the receiver shall send an ACCEPT response to the originator. When a single application on the originator conducts data transfer with a single application on the receiver, the Source Port and Destination Port numbers need not be used; otherwise the receiver shall set the Source Port to the port number of the application on the receiver and the Destination Port to the port number of the application on the originator.

6.2.4.4   Termination of acknowledged transfer procedure completed by originator

Upon receipt of the ACCEPT response and if the Destination Port number corresponds to the application which initiated the termination of acknowledged transfer procedure, the originator terminates acknowledged transfer mode. The originator shall reset timer T200 if active, and the termination of acknowledged transfer procedure is successfully completed.

6.2.4.5 Termination of acknowledged transfer procedure not accepted by receiver

Upon receiving a DISCONNECT command if the Destination Port number contained in the DISCONNECT command

- is not supported by the receiver; or

- corresponds to an application that is not in acknowledged transfer mode,

then the receiver shall send an ERROR response to the originator.

6.2.5 Unacknowledged information transfer procedure

6.2.5.1 General

The purpose of the unacknowledged information transfer procedure is for the originator to perform unacknowledged transmission of information to the receiver. No error recovery mechanisms are defined for unacknowledged operation

6.2.5.2 Unacknowledged information transfer procedure initiation

The originator shall initiate the unacknowledged information transfer procedure when information from upper layers is to be transmitted using unacknowledged operation. The originator and the receiver negotiate the use of source and destination port numbers before initiating unacknowledged information transfer.

The originator initiates the unacknowledged information transfer procedure by transmitting a UI frame to receiver. When a single application on the originator conducts data transfer with a single application on the receiver, the Source Port and Destination Port numbers need not be used; otherwise the originator shall set the Source Port to the port number of the source application on the originator and the Destination Port to the port number of the destination application on the receiver. The originator shall set the unconfirmed sequence number $N(U)$ in UI frame to the value of unconfirmed send state variable $V(U)$.

Originator   Receiver

UI
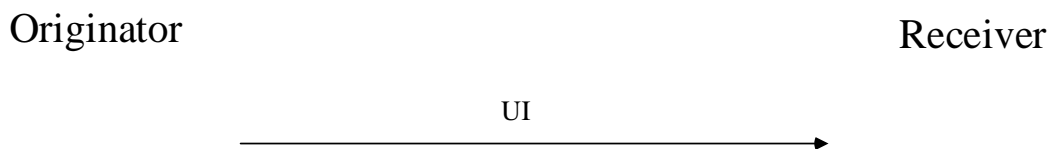
Figure 6.2.5.2-1: Unacknowledged information transfer procedure

6.2.5.3 Unacknowledged information transfer procedure accepted by receiver

Upon receiving a UI frame the receiver passes the contents of the Information field to the appropriate upper layer corresponding to the Destination Port. The receiver shall set the unconfirmed receive state variable $V(UR)$ to $N(U) + 1$.

6.2.5.4 Unacknowledged information transfer procedure completed by originator

Upon transmission of the UI frame the unacknowledged information transfer procedure is completed by the originator.

6.2.5.5 Unacknowledged information transfer procedure not accepted by receiver

Upon receiving a UI frame,

- if the Destination Port number is not in use by the receiver; or

- if $N(U)$ of the received UI frame is in the range $(V(UR) – k') \le N(U) < V(UR)$ and if a UI frame with the same $N(U)$ has already been received,

then the UI frame is discarded by the receiver without any further action. The value of k' may be in the range 1 < k' < MAX SEQUENCE NUMBER/2.

6.2.6 Reserve port numbers procedure

6.2.6.1 General

The originator and the receiver use the reserve port number procedure if they support the handling as specified in subclause 5.4.2.6. The purpose of the reserve port numbers procedure is for the originator to reserve a combination of source and destination port numbers for use with a specific application. All frames other than U and UI frames received during the reserve port numbers procedure shall be ignored. It is optional for the receiver to support the reserve port number functionality.

6.2.6.2 Reserve port numbers procedure initiation

The originator shall initiate the reserve port numbers procedure when upper layers indicate information is to be transferred using a specific application. The upper layers may identify the source and destination port numbers to be reserved based on the available port numbers at originator and receiver before initiating the reserve port numbers procedure.

The originator initiates the reserve port numbers procedure by transmitting a MANAGE_PORT command to the receiver. The originator shall set the Source Port to the port number to be reserved on the originator, the Destination Port to the port number to be reserved on the receiver, the Action field to "Reserve port" and the Application ID field to the identifier of the application to be associated with the combination of the Source Port and Destination Port numbers specified in the MANAGE_PORT command. The originator shall clear all exception conditions, discard all queued I frames, reset the retransmission counter and timer T200 shall be set.

6.2.6.3 Reserve port numbers procedure accepted by receiver

If the receiver supports the reserve port number functionality then upon receiving a MANAGE_PORT command with the Action field set to "Reserve port", the receiver checks if the Destination Port number contained in the MANAGE_PORT command is associated with any application on the receiver.

If the check is successful the receiver shall reserve the Destination Port for use with the application identifier included in the MANAGE_PORT command. The receiver shall send a MANAGE_PORT response to the originator by setting the Action field in response frame to "Reserve port" and the Status field in MANAGE_PORT response frame to "Success". The receiver shall reset timer T200 if active and clear all exceptions.

6.2.6.4 Reserve port numbers procedure completed by originator

Upon receipt of the MANAGE_PORT response with the Action field set to "Reserve port", and if the Status field is set to "Success", the originator shall reserve the Source Port for use with the application identifier included in the MANAGE_PORT command. The originator shall reset timer T200 if active, clear all exception conditions and the reserve port numbers procedure is successfully completed.

6.2.6.5 Reserve port numbers procedure not accepted by receiver

If the receiver supports the reserve port number functionality then upon receiving a MANAGE_PORT command with the Action field set to "Reserve port", if the Destination Port number contained in the MANAGE_PORT command is already reserved for use with another application on the receiver then the receiver shall send a MANAGE_PORT response to the originator by setting the Action field in response frame to "Reserve port" and the Status field in MANAGE_PORT response frame to "Port not free".

6.2.7 Release port numbers procedure

6.2.7.1 General

The originator and the receiver use the release port number procedure if they support the handling as specified in subclause 5.4.2.6. The purpose of the release port numbers procedure is for the originator to release a combination of

source and destination port numbers that have been reserved for use with a specific application. All frames other than U and UI frames received during the release port numbers procedure shall be ignored. It is optional for the receiver to support the release port number functionality.

6.2.7.2 Release port numbers procedure initiation

The originator shall initiate the release port numbers procedure when upper layers indicate that information transfer using a specific application is over and that it is permissible to release the combination of ports used by this application.

The originator initiates the release port numbers procedure by transmitting a MANAGE_PORT command to the receiver. The originator shall set the Source Port to the port number to be released on the originator, the Destination Port to the port number to be released on the receiver, the Action field to "Release port" and the Application ID field to the identifier of the application that is associated with the combination of the Source Port and Destination Port numbers specified in the MANAGE_PORT command. The originator shall clear all exception conditions, discard all queued I frames, reset the retransmission counter and timer T200 shall be set.

6.2.7.3 Release port numbers procedure accepted by receiver

If the receiver supports the release port number functionality then upon receiving a MANAGE_PORT command with the Action field set to "Release port", the receiver checks if the Destination Port number contained in the MANAGE_PORT command is reserved on the receiver for use with the application specified by the Application ID field in the MANAGE_PORT command.

If the check is successful the receiver shall release the Destination Port from use with the application identifier included in the MANAGE_PORT command. The receiver shall send a MANAGE_PORT response to the originator by setting the Action field in response frame to "Reserve port" and the Status field in MANAGE_PORT response frame to "Success". The receiver shall reset timer T200 if active and clear all exceptions.

6.2.7.4 Release port numbers procedure completed by originator

Upon receipt of the MANAGE_PORT response with the Action field set to "Release port", and if the Status field is set to "Success", the originator shall release the Source Port from use with the application identifier included in the MANAGE_PORT command. The originator shall reset timer T200 if active, clear all exception conditions and the release port numbers procedure is successfully completed.

6.2.7.5 Release port numbers procedure not accepted by receiver

If the receiver supports the release port number functionality then upon receiving a MANAGE_PORT command with the Action field set to "Release port", if the Destination Port number contained in the MANAGE_PORT command is not reserved on the receiver for use with specified application identifier in the MANAGE_PORT command then the receiver shall send a MANAGE_PORT response to the originator by setting the Action field in response frame to "Release port" and the Status field in MANAGE_PORT response frame to "Port not associated with specified application".

6.2.8 Query port numbers procedure

6.2.8.1 General

The originator and the receiver use the query port number procedure if they support the handling as specified in subclause 5.4.2.6. The purpose of the query port numbers procedure is for the originator to query the list of port numbers that are reserved for use with a specific application. All frames other than U and UI frames received during the query port numbers procedure shall be ignored. It is optional for the receiver to support the query port number functionality.

6.2.8.2 Query port numbers procedure initiation

The originator shall initiate the query port numbers procedure when upper layers indicate the need to determine any port numbers on receiver that are available for use with an application.

The originator initiates the query port numbers procedure by transmitting a MANAGE_PORT command to the receiver by setting the Action field to "Query port" and setting Requested port numbers to the destination port numbers that it intends to query. If the originator intends to query all the port numbers, then it shall not include the Requested port numbers. The originator shall clear all exception conditions, discard all queued I frames, reset the retransmission counter and timer T200 shall be set.

6.2.8.3　　Query port numbers procedure accepted by receiver

If the receiver supports the query port number functionality then upon receiving a MANAGE_PORT command with the Action field set to "Query port", the receiver shall send a MANAGE_PORT response to the originator by setting the Action field in response frame to "Query port". For each Destination Port that is reserved on the receiver for use by an application, the receiver shall include an entry in the MANAGE_PORT response. The receiver shall set the Num Entries field in the MANAGE_PORT response to the number of entries that are included in the MANAGE_PORT response. For each Destination Port that is reserved on the receiver, the receiver shall include the Source Port number that the Destination Port is paired with and the Application ID of the application to be used with the reserved Destination Port. If the receiver does not have any reserved Source Port number for the associated Application ID, the Source Port number shall be set to 0. If the entries for all the source port numbers do not fit in the MANAGE_PORT response, the receiver shall include as many entries on source port numbers as possible. For all the source port numbers that are reserved on the receiver and for which information cannot be included in the MANAGE_PORT response, the receiver shall set the corresponding entry in the Port numbers not available bitmap. If the entries for all the destination port numbers requested by the originator fit in the MANAGE_PORT response, the receiver shall not include the optional Port numbers not available bitmap. The receiver shall reset timer T200 if active and clear all exceptions.

6.2.8.4　　Query port numbers procedure completed by originator

Upon receipt of the MANAGE_PORT response with the Action field set to "Query port", the originator shall make a note of all Destination Ports that are reserved for use with an application and may pass this information to upper layers. If the Port numbers not available bitmap is not set to zero, the originator can subsequently query information on these source port numbers by sending another MANAGE_PORT command by setting the Action field to "Query port" and setting Requested port numbers to Port numbers not available in the received MANAGE_PORT response. The originator shall reset timer T200 if active, clear all exception conditions and the query port numbers procedure is successfully completed.

6.2.9　　Notify port numbers procedure

6.2.9.1　　General

The originator and the receiver use the notify port number procedure if they support the handling as specified in subclause 5.4.2.6. The purpose of the notify port numbers procedure is for the originator to notify the receiver of the list of port numbers that are reserved for use with a specific application. All frames other than U and UI frames received during the notify port numbers procedure shall be ignored. It is optional for the receiver to support the notify port number functionality.

6.2.9.2　　Notify port numbers procedure initiation

The originator shall initiate the notify port numbers procedure when a Source Port on the originator may be reserved for use with an application.

The originator initiates the notify port numbers procedure by transmitting a MANAGE_PORT command to the receiver by setting the Action field to "Notify port". For each Source Port that is reserved on the originator for use by an application, the receiver shall include an entry in the MANAGE_PORT command. The originator shall set the Num Entries field in the MANAGE_PORT command to the number of entries that are included in the MANAGE_PORT response. For each Source Port that is reserved on the originator, the originator shall include the Destination Port number that the Source Port is paired with and the Application ID of the application to be used with the reserved Source Port. If the originator does not have any reserved Destination Port number for the associated Application ID, the Destination Port number shall be set to 0. If the entries for all the source port numbers do not fit in the MANAGE_PORT command, the originator shall include as many entries on source port numbers as possible. For all the source port numbers that are reserved on the originator and for which information cannot be included in the MANAGE_PORT command, the originator shall set the corresponding entry in the Port numbers not available bitmap. If the entries for all the source port numbers fit in the MANAGE_PORT command, the originator shall not include the

Port numbers not available bitmap. The originator shall clear all exception conditions, discard all queued I frames and reset the retransmission counter.

6.2.9.3 Notify port numbers procedure accepted by receiver

If the receiver supports the notify port number functionality then upon receipt of the MANAGE_PORT command with the Action field set to "Notify port", the receiver shall make a note of all Source Ports that are reserved for use with an application on the originator and may pass this information to upper layers. The receiver shall clear all exception conditions and the notify port numbers procedure is successfully completed.

If the Port numbers not available bitmap is included in the MANAGE_PORT command, the receiver can subsequently query information on these source port numbers by sending a MANAGE_PORT command by setting the Action field to "Query port" and setting Requested port numbers to Port numbers not available in the received MANAGE_PORT command as described in subclause 6.2.8.

6.3 Abnormal cases

6.3.1 Expiry of timer T200

Timer T200 is set when a U frame with any of the following commands is transmitted.

- SET_ACK_MODE;

- DISCONNECT;

- SET_PARAMETERS; and

- MANAGE_PORT.

If timer T200 expires before a response to the sent command is received then the originator shall retransmit the command, and shall reset and start timer T200 and increment the retransmission counter. After retransmission of the command N200 times, the originator shall abort the operation and notify the upper layers.

6.3.2 Expiry of timer T201

On expiry of timer T201, the originator shall increment by 1 the retransmission count variable for the I frame associated with timer T201. If the value of the retransmission count variable does not exceed N200, the originator shall reset and start timer T201, and retransmit the I frame with the A bit set to 1. If the value of the retransmission count variable exceeds N200, the originator shall send the ERROR command to the receiver and initiate the establishment of acknowledged transfer procedure to re-establish the acknowledged transfer mode with the receiver.

6.3.3 Collision during reserving the same port number between originator and receiver

If the originator is trying to reserve a combination of source port number on the originator and a destination port number on the receiver by sending a MANAGE_PORT command to the receiver and if it receives another MANAGE_PORT command from the receiver trying to reserve the same port number on the originator then,

a) if both the originator and the receiver are trying to reserve the same combination of port numbers with the same application identifier, then the originator shall accept the MANAGE_PORT command from the receiver, reserve the Destination Port for use with the application identifier included in the MANAGE_PORT command and send a MANAGE_PORT response to the receiver by setting the Action field in response frame to "Reserve port" and the Status field in MANAGE_PORT response frame to "Success"; or

b) otherwise the originator shall not accept the MANAGE_PORT command from the receiver and shall send a MANAGE_PORT response to the receiver by setting the Action field in response frame to "Reserve port" and the Status field in MANAGE_PORT response frame to "Port not free".

6.4 List of RDS Parameters

6.4.1 General

The following parameters are applicable for Reliable Data Service (RDS).

6.4.2 RDS version number (Version)

The RDS version number (Version) is an RDS layer parameter. The default version number is 0.

6.4.3 Retransmission timers (T200 and T201)

The default value of timers T200 and T201 is 250 seconds.

6.4.4 Maximum number of retransmissions (N200)

The default value of N200 is 3.

6.4.5 Maximum number of outstanding I frames (k)

k is the maximum number of sequentially-numbered I frames that may be outstanding (i.e. unacknowledged) at any given time. k is also denoted as window size. The default value of k is 3. The value of MAX SEQUENCE NUMBER is 8.

6.4.6 Maximum length of Information Field (N201)

The default value of N201 is 1520 octets.

Annex A (informative):
Change history

<table>
<tr><td colspan="8" align="center">Change history</td></tr>
<tr><td>Date</td><td>Meeting</td><td>TDoc</td><td>CR</td><td>Rev</td><td>Cat</td><td>Subject/Comment</td><td>New version</td></tr>
<tr><td>2017-04</td><td>CT1 #103</td><td>C1-171464</td><td>-</td><td>-</td><td>-</td><td>TS skeleton generated for submission at CT1 #103</td><td>0.0.0</td></tr>
<tr><td>2017-04</td><td>CT1 #103</td><td>-</td><td>-</td><td>-</td><td>-</td><td>Incorporated agreed P-CRs for TS 24.250 from CT1 #103 - C1-171467, C1-171618, C1-171619, C1-171621, C1-171930, C1-171932, C1-171933, C1-171935. C1-171936 and editorial clean-up by the rapporteur.</td><td>0.1.0</td></tr>
<tr><td>2017-05</td><td>CT1 #104</td><td>-</td><td>-</td><td>-</td><td>-</td><td>Incorporated agreed P-CRs for TS 24.250 from CT1 #104 - C1-172240, C1-172404, C1-172406, C1-172621, C1-172622, C1-172623, C1-172624, C1-172625. C1-172626 and editorial clean-up by the rapporteur.</td><td>0.2.0</td></tr>
<tr><td>2017-06</td><td>CT-76</td><td>CP-171107</td><td></td><td></td><td></td><td>Version 1.0.0 created for presentation to TSG CT for information and approval</td><td>1.0.0</td></tr>
<tr><td>2017-06</td><td>CT-76</td><td></td><td></td><td></td><td></td><td>Version 14.0.0 created after approval at CT76</td><td>14.0.0</td></tr>
<tr><td>2017-12</td><td>CT-78</td><td>CP-173060</td><td>0002</td><td></td><td>F</td><td>RDS handling when retransmission count exceeds N200</td><td>14.1.0</td></tr>
<tr><td>2017-12</td><td>CT-78</td><td>CP-173060</td><td>0003</td><td>1</td><td>F</td><td>Max Length of RDS information Field</td><td>14.1.0</td></tr>
<tr><td>2017-12</td><td>CT-78</td><td>CP-173060</td><td>0004</td><td>1</td><td>F</td><td>Clarification on SACK bitmap usage</td><td>14.1.0</td></tr>
<tr><td>2017-12</td><td>CT-78</td><td>CP-173060</td><td>0006</td><td>1</td><td>F</td><td>Clarification on identification of RDS connections for multiple applications</td><td>14.1.0</td></tr>
<tr><td>2017-12</td><td>CT-78</td><td>CP-173079</td><td>0005</td><td>1</td><td>C</td><td>Support for Reliable Data Service with PtP SGi Tunneling</td><td>15.0.0</td></tr>
<tr><td>2018-12</td><td>CT-82</td><td>CP-183075</td><td>0008</td><td></td><td>A</td><td>Define variables and parameters for unacknowledged operation</td><td>15.1.0</td></tr>
<tr><td>2019-03</td><td>CT-83</td><td>CP-190108</td><td>0011</td><td>3</td><td>B</td><td>Enhancing RDS for dynamic port management</td><td>16.0.0</td></tr>
<tr><td>2019-06</td><td>CT-84</td><td>CP-191128</td><td>0012</td><td>1</td><td>B</td><td>Updates to Scope for support of RDS in 5GS</td><td>16.1.0</td></tr>
<tr><td>2019-06</td><td>CT-84</td><td>CP-191128</td><td>0013</td><td>4</td><td>B</td><td>Updates to Overview for support of RDS in 5GS</td><td>16.1.0</td></tr>
<tr><td>2019-06</td><td>CT-84</td><td>CP-191128</td><td>0014</td><td></td><td>B</td><td>Updates to field format and procedures for support of RDS in 5GS</td><td>16.1.0</td></tr>
<tr><td>2019-06</td><td>CT-84</td><td>CP-191147</td><td>0015</td><td>3</td><td>B</td><td>Procedures for port number management</td><td>16.1.0</td></tr>
<tr><td>2019-06</td><td>CT-84</td><td>CP-191128</td><td>0016</td><td></td><td>B</td><td>Change Title of TS 24.250</td><td>16.1.0</td></tr>
<tr><td>2019-12</td><td>CT-86</td><td>CP-193116</td><td>0021</td><td>2</td><td>F</td><td>Abnormal cases for port number management</td><td>16.2.0</td></tr>
<tr><td>2020-09</td><td>CT-89e</td><td>CP-202166</td><td>0023</td><td>1</td><td>F</td><td>Reference model for RDS in 5GS</td><td>16.3.0</td></tr>
<tr><td>2020-09</td><td>CT-89e</td><td>CP-202166</td><td>0025</td><td>2</td><td>F</td><td>Updates to Manage Port Command for long Application Identifiers</td><td>16.3.0</td></tr>
</table>

History

Document history		
V16.2.0	October 2020	Publication
V16.3.0	October 2020	Publication