U-N-I-S-I-G

ERTMS/ETCS – Class 1
FIS for the RBC/RBC Handover
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Company	Technical Approval	Management approval
ALSTOM		
ANSALDO		
BOMBARDIER		
INVENSYS		
SIEMENS		
THALES		

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2. TABLE OF CONTENTS

3. INTRODUCTION

3.1 Scope

3.1.1.1 This document specifies the functional interface for the RBC/RBC communication to perform an RBC/RBC Handover according to the principles and procedures in the SRS [Subset-026].

3.1.1.2 Ensuring the coherence of the rules and the appropriate interworking of the two communicating RBCs, in terms of service performance and safety, is the responsibility of the specific implementation and is outside the scope of this document.

3.2 References

3.2.1.1 This document incorporates by dated or undated references, provisions from other publications. These normative references are cited at the appropriate place in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this document only when incorporated in it by amendment or revision.

Reference	Date	Title
Subset-023	03.00	ERTMS/ETCS Class 1; Subset-023; Glossary; version 2.0.0
Subset-026	02.06	ERTMS/ETCS Class 1; Subset-026; SRS; version 2.3.0
Subset-040	03.00	ERTMS/ETCS Class 1; Dimensioning and Engineering rules; Subset-040; version 2.0.0
Subset-054	03.00	Assignment of values to ETCS variables, version 2.0.0
Subset-098	05.07	ERTMS/ETCS Class 1; RBC-RBC safe communication interface; Subset-098; version 1.0.0
Subset-108	01.08	ERTMS/ETCS Class 1; Subset-108; Interoperability-related consolidation on TSI Annex A documents; version 1.2.0

3.3 Terms, definitions and abbreviations

3.3.1.1 For general Unisig terms, definitions and abbreviations refer to [Subset-023]. New terms and abbreviations relevant for RBC/RBC Handover and used in this document are specified here.

Term	Definition
EoA interval	Part of track from one EoA/LoA location to the next EoA/LoA location, as defined by the trackside design
NRBC message	Message sent to or received from a neighbour RBC
RBC/RBC Handover protocol	The protocol for information exchange between RBCs, to support the RBC/RBC Handover.
RBC/RBC Handover transaction	The sequence of (NRBC) messages between RBCs to support the passing of an engine from one RBC to an adjacent RBC (neighbour RBC).
RBC/RBC communication entity	An application entity responsible for RBC/RBC Handover protocol handling, for one or more handovers depending on implementation
Route related information	Information about the current state of the route in advance of the border [Subset-026 section 3.15.1.2.2.]

Abbreviations

Abbreviation	Definition
ACK	Acknowledgement
BG	Balise group
ETCS ID	ETCS IDentification
HOV	Handover
NRBC	Neighbour RBC
RBC_{ACC}	Accepting RBC
RBC_{HOV}	Handing over RBC
RRI	Route Related Information
SAP	Service access point
TOR	Taking Over Responsibility

4. RBC/RBC HANDOVER

4.1 Overview

4.1.1.1 For an efficient handover, communication between two radio block centres is required when a train is about to move from one radio block centre supervision area to the adjacent one (Figure 1).

4.1.1.2 This communication consists of NRBC (Neighbour RBC) messages as specified in chapter 6.

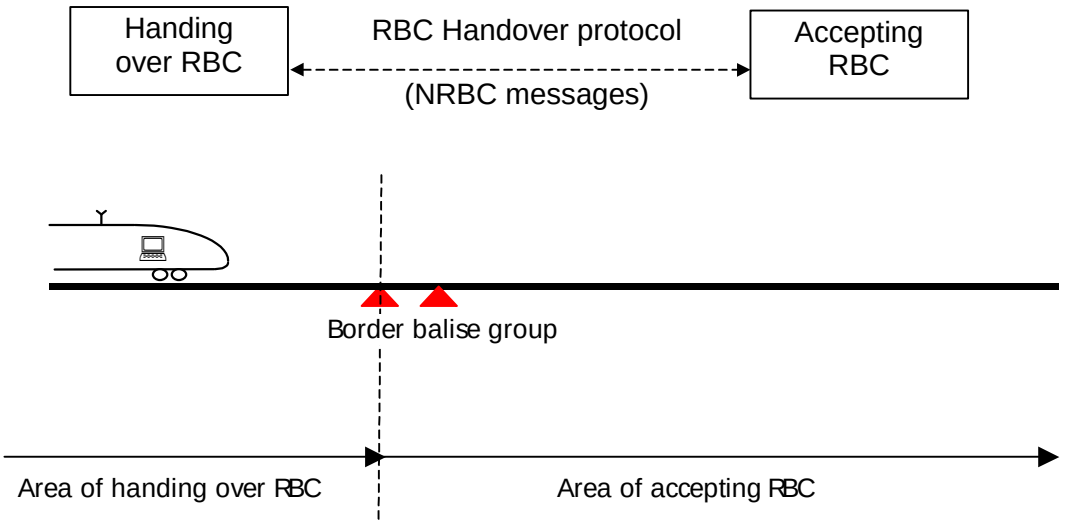


Figure 1 RBC/RBC Handover

4.2 Task description for RBC/RBC Handover

4.2.1 General

4.2.1.1 This informative section explains how tasks are shared between the RBCs, in accordance with the requirements of [Subset-026].

4.2.2 Handing Over RBC

4.2.2.1 The handing over RBC is responsible to send information about an approaching train to the accepting RBC area (i.e. pre-announcement).

4.2.2.2 The handing over RBC is responsible to request route related information when necessary, i.e. for efficient handover when a train is moving towards a border, and is allowed to limit the amount of route related information to be received.

4.2.2.3 The handing over RBC is responsible to use route related information received from the accepting RBC according to the rules applicable in its own area (these rules may include situation when the route related information is discarded).

4.2.2.4 The handing over RBC is responsible to forward route related information received from accepting RBC to the relevant ETCS on-board equipment. In case the accepting RBC requests confirmation, the handing over RBC must return a confirmation to the accepting RBC indicating the response from the onboard.

4.2.2.5 The handing over RBC is responsible to take safe measures (according to its own rules), if the communication with the accepting RBC is lost.

4.2.2.6 The handing over RBC is responsible to cancel a transition to the accepting RBC when necessary.

4.2.3 Accepting RBC

4.2.3.1 After the reception of pre-announcement from the handing over RBC, the accepting RBC is allowed to send route related information to the handing over RBC.

4.2.3.2 The accepting RBC is responsible to send route related information as often as necessary, according to its own rules. The route related information has to be limited according to the last received route related information request if one has been received. The accepting RBC is allowed to send route related information with request for confirmation.

4.2.3.3 Note: The accepting RBC assumes that any route related information sent to the handing over RBC will be forwarded to the relevant ETCS on-board equipment, according to the rules of the handing over RBC.

4.2.3.4 The accepting RBC is responsible to send a “Taking over responsibility” message after the condition “border passed” is fulfilled.

4.2.3.5 The accepting RBC is allowed to cancel a RBC-RBC handover transaction when necessary.

4.2.3.6 The accepting RBC is responsible to send a “life sign” if required.

5. RBC/RBC HANDOVER PROTOCOL

5.1 General requirements

5.1.1 RBC/RBC Handover Communication

5.1.1.1 The RBC/RBC communication shall be established according to the rules of the underlying RBC-RBC Safe Communication Interface [Subset-098]. Further information about RBC/RBC Communication can be found in Annex A.

5.1.1.2 Only one RBC/RBC communication between a pair of RBCs shall be active at one time.

5.1.1.3 Note: One RBC/RBC communication is able to handle all necessary transactions between a pair of RBCs.

5.1.1.4 The RBC/RBC communication shall provide for an exchange of NRBC messages (as specified in chapter 6) in both directions simultaneously, i.e. the RBC/RBC HOV transaction(s).

5.1.1.5 The RBC/RBC communication entities of handing over RBC and accepting RBC are identified by their ETCS ID.

5.1.2 RBC/RBC Handover transaction

5.1.2.1 The RBC/RBC HOV transaction is identified by the ETCS ID of the engine and the ETCS ID of the border balise group. Note: In case of more than one communicating engine in a train set each engine has its own RBC/RBC handover transaction.

5.1.2.2 An attempt to establish a new transaction is invalid if it uses the ETCS ID of either an engine or a border balise that is already in use in another transaction, except

- where this is to establish a transaction for an engine in Non Leading mode at a border balise which is being used for another engine, or
- a Pre-Announcement message is repeated in case the acknowledgement was not received by the handing over RBC.

5.1.2.3 It shall be possible for an RBC to act as the accepting and as the handing over RBC for different engines at different RBC border locations simultaneously.

5.1.2.4 The RBC shall be able to handle RBC/RBC Handover transactions which,

a) follow each other (i.e. the first RBC/RBC HOV transaction is finished before the second starts),

b) overlap (i.e. RBC/RBC HOV transactions are handled simultaneously),

c) overlap with inverted roles of RBCs,

d) are cancelled without a train being handed over.

5.1.3 RBC/RBC Handover supervision

5.1.3.1 If the safe connection between the RBCs is lost (e.g. by an error in the lower layers):

a) Ongoing handover transaction shall not be aborted.

b) Re-establishment of the safe connection shall be requested by the RBC responsible for this task (see Table 9, list item 2)

c) If the re-establishment of the safe connection fails, the RBC/RBC handover transaction shall be aborted by the RBCs.

Note: The conditions for determining that the re-establishment has failed are implementation matter for both RBCs.

5.1.3.2 The ability to communicate during an ongoing RBC/RBC Handover transaction shall be supervised to detect the loss of a safe connection, which otherwise could result in a possible loss of a restrictive RRI. In case a loss of safe connection is detected, the handing over RBC shall take any necessary action according to its own rules.

5.1.3.3 The accepting RBC shall send an appropriate NRBC message when a handover transaction is ongoing and a specified time has passed since any NRBC message was sent.

5.1.3.4 The handing over RBC shall supervise the RBC/RBC communication from the reception of the first RRI NRBC message until reception of Taking Over Responsibility NRBC message or until the transaction has been cancelled.

5.1.3.5 The parameters for communication supervision are configuration items to be agreed off-line.

5.2 State Tables

5.2.1 General

5.2.1.1 Without restriction to the implementation of the internal RBC behaviour this section 5.2 formally describes the RBC/RBC handover transaction. The RBC shall conform to the external behaviour at the RBC/RBC interface.

5.2.1.2 The description of the data exchange at the RBC/RBC interface is given by state transition tables, which show the states of a RBC/RBC communication entity, the incoming events, the actions taken and the resultant states.

5.2.1.3 At each intersection of state and incoming event a state transition table specifies a transition which may include actions, consisting of a list of outgoing events (none, one, or more), followed by the resulting state.

5.2.1.4 If the intersection of state and incoming event is left blank then the incoming event is invalid in the respective state. In this case an error notification may be given (implementation matter) and the state remains unchanged.

5.2.1.5 Note:

a) The actions to build a NRBC message before sending are not shown in the state transition table.

b) The consistency checks of a received NRBC message and - in case of an error - the resulting actions are not shown in the state transition table.

c) At any time the lower layers may close the safe connection for any reason; this is not shown in state transition table.

5.2.1.6 All events, which indicate the reception of a NRBC message implicitly, include checking that the message is consistent.

5.2.2 State table of Handing over RBC

5.2.2.1 The following states are defined for one transaction.

Table 1 States of Handing over RBC

State	Description
IDLE	No RBC/RBC handover is in progress
HOV	An RBC/RBC handover is on-going. The RBC has the role of Handing over RBC.

5.2.2.2 The following table specifies the incoming events.

Table 2 Incoming events of Handing over RBC

Event	Description
HOV condition detected	Handover condition detected
RRI request necessary	Handing over RBC detects that route related information is required from the accepting RBC
RRI received	NRBC message “Route Related Information” received
Condition “Border passed by safe front end” detected	Position report received and condition “Border passed by maximum safe front end” detected
TOR received	NRBC message “Taking Over Responsibility” received
Condition “Border passed by safe rear end” detected	Position report received and condition “Border passed by minimum safe rear end” detected
Cancellation condition detected	Condition for cancellation of the RBC/RBC handover transaction is detected in the handing over RBC
ACK received	NRBC message “Acknowledgement” has been received
Cancellation received	NRBC message “Cancellation” received
Life Sign received	NRBC message “Life Sign” received
Request for RRI Confirmation received	NRBC message “Request for RRI Confirmation” received
RRI Confirmation condition detected	RRI Confirmation condition detected

5.2.2.3 The following table specifies the outgoing events.

Table 3 Outgoing events of Handing over RBC

Event	Description
Pre-Announcement	Send NRBC message “Pre-Announcement”
RRI request	Send NRBC message “Route Related Information Request”
ACK	Send NRBC message “Acknowledgement”
Announcement	Send NRBC message “Announcement”
Cancellation	Send NRBC message “Cancellation”
RRI Confirmation	Send NRBC message “RRI Confirmation”

5.2.2.4 The following figure shows the state diagram of the Handing over RBC:

a) The states (refer to Table 1)

b) The incoming events (refer to Table 2)

c) The state transitions.

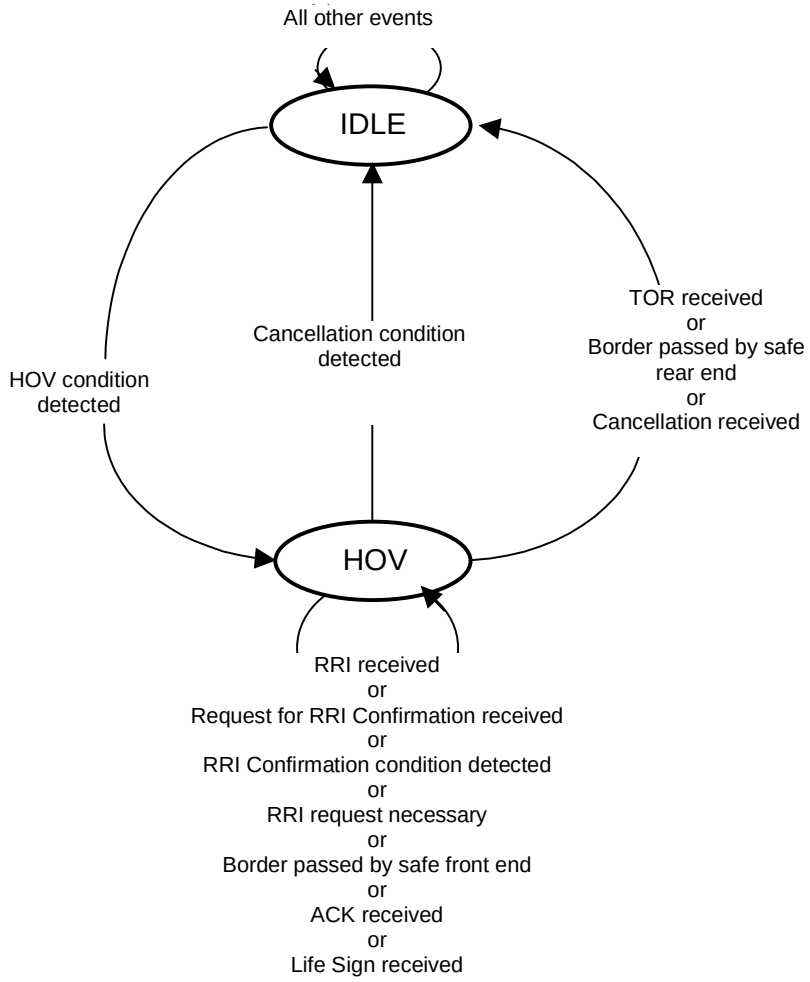


Figure 2 Handing over RBC state diagram

5.2.2.5 For each state (see Figure 2) the following table defines for each incoming event what has to happen and which is the next state.

Table 4 Handing over RBC state transition table

Event	IDLE	HOV
HOV condition detected	Send “Pre-Announcement” → HOV	
RRI request necessary		Send “RRI request” → HOV
RRI received	→ IDLE	Send “Acknowledgement” → HOV
Condition “Border passed by safe front end”	→ IDLE	Send “Announcement”

Event	IDLE	HOV
		→ HOV
TOR received	→ IDLE	→ IDLE
Condition “Border passed by safe rear end”	→ IDLE	→ IDLE
Cancellation condition detected	see Note below this table	Send “Cancellation” → IDLE
ACK received	→ IDLE	→ HOV
Cancellation received	If M_ACK=1: Send “Acknowl-edgement” → IDLE If M_ACK=0 → IDLE	If M_ACK=1: Send “Acknowl-edgement” → IDLE If M_ACK=0 → IDLE
Life Sign received	→ IDLE	→ HOV
Request for RRI Confirma-tion received	→ IDLE	Send “Acknowledgement” → HOV
RRI Confirmation condition detected		Send “RRI Confirmation” → HOV

Note: Cancellation may be repeated, e.g. if acknowledgement was not received.

5.2.3 State table of Accepting RBC

5.2.3.1 The following states are defined for one transaction.

Table 5 States of Accepting RBC

State	Description
IDLE	No RBC/RBC handover is in progress
ACC	An RBC/RBC handover is ongoing. The RBC has the role of accepting RBC.

5.2.3.2 The following table specifies the incoming events.

Table 6 Incoming events of Accepting RBC

Event	Description

Event	Description
Pre-Announcement received	NRBC message “Pre-Announcement” received
RBC decided to send RRI	Accepting RBC has decided (e.g. Signalling environment has changed) to send NRBC message “Route Related Information”
RRI request received	NRBC message “Route Related Information Request” received
ACK received	NRBC message “Acknowledgement” received
Announcement received	NRBC message “Announcement” received
Condition “Border passed by safe front end” detected	Position report received and condition “Border passed by maximum safe front end” detected
Cancellation received	NRBC message “Cancellation” received
Missing ACK for RRI	Acknowledgement for RRI not received, e.g. a timer expires
Cancellation condition detected	Condition for cancellation of the RBC/RBC handover transaction is detected in the accepting RBC
RBC decided to send Life Sign	Accepting RBC has decided to send NRBC message “Life Sign”
RBC decided to send Request for RRI Confirmation	Accepting RBC has decided to send NRBC message “Request for RRI Confirmation”
RRI Confirmation received	NRBC message “RRI Confirmation” received

5.2.3.3 The following table specifies the outgoing events.

Table 7 Outgoing events of Accepting RBC

Event	Description
RRI	Send NRBC message “Route Related information”
TOR	Send NRBC message “Taking over Responsibility”
ACK	Send NRBC message “Acknowledgement”
Cancellation	Send NRBC message “Cancellation”
Life Sign	Send NRBC message “Life Sign”
Request for RRI Confirmation	Send NRBC message “Request for RRI Confirmation”

5.2.3.4 The following figure shows the state diagram of the Accepting RBC.

a) The states (refer to Table 5)

b) The incoming events (refer to Table 6)

c) The state transitions

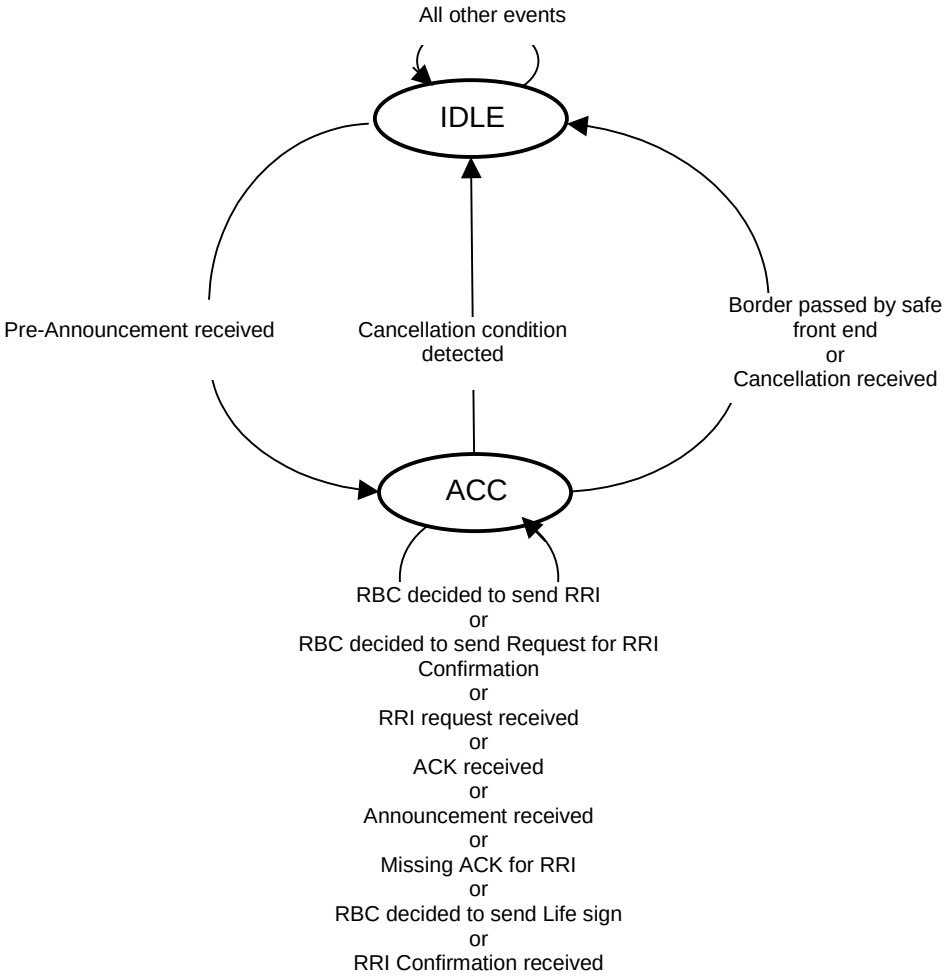


Figure 3 Accepting RBC state diagram

5.2.3.5 For each state (see Figure 3) the following table defines for each incoming event, what has to happen and which is the next state.

Table 8 Accepting RBC state transition table

Event	IDLE	ACC

Pre-Announcement received	If M_ACK=1: Send “Acknowledgement” → ACC If M_ACK=0: → ACC	If M_ACK=1& it is repetition: Send “Acknowledgement” → ACC
RBC decided to send a RRI		Send “RRI” → ACC
RRI request received		If M_ACK=1: Send “Acknowledgement”→ ACC If M_ACK=0: → ACC
ACK received	→ IDLE	→ ACC
Announcement received	→ IDLE	If M_ACK=1: Send “Acknowledgement” → ACC If M_ACK=0: → ACC
Condition “Border passed by safe front end”	→ IDLE	Send “TOR” → IDLE
Cancellation received	If M_ACK=1: Send “Acknowledgement” → IDLE If M_ACK=0: → IDLE	If M_ACK=1: Send “Acknowledgement” → IDLE If M_ACK=0: → IDLE
Missing ACK for RRI		Send RRI → ACC
Cancellation condition detected	see Note below this table	Send “Cancellation” → IDLE
RBC decided to send Life Sign		Send “Life Sign” → ACC
RBC decided to send Request for RRI Confirmation		Send “Request for RRI Confirmation” → ACC

RRI Confirmation received	→ IDLE	If M_ACK=1: Send “Acknowl-edgement” → ACC If M_ACK=0: → ACC

Note: Cancellation may be repeated, e.g. if acknowledgement was not received.

5.3 Configuration management

5.3.1.1 The following Table lists configuration data related to the exchange of messages for the RBC-RBC interface, which should be considered for offline agreement.

Table 9 Configuration items

Nr.	Configuration items	Comments, justification, examples
1.	Version of the Subset-039	Project specific.
2.	Parameters of the underlying RBC-RBC Safe Communication Interface	Details see Subset-098
3.	Identity of the adjacent RBC	NID_C, NID_RBC
4.	Identity of the border BG	NID_C, NID_BG
5.	Location and orientation of border BG	Project specific
6.	Handling of life sign messages	Cycle times for transmission/reception
7.	TSR ID assignment	Project specific
8.	Use of variables from Subset 054	Project specific, Might require multilateral agreement e.g. for - M_TRACTION, - NC_DIFF
9.	RRI Confirmation	As the implementation of this function is not mandatory, its use has to be agreed between the parties involved. It is forbidden to use this function without an agreement.
10.	TSR Revocation	As the implementation of this function is not mandatory, its use has to be agreed between the parties involved. It is forbidden to use this function without an agreement.

5.3.1.2 The implementation of the following functions on the RBC/RBC interface is not mandatory:

- RRI Confirmation
- TSR Revocation

6. MESSAGES

6.1 General

6.1.1.1 The RBC/RBC Handover ERTMS/ETCS language is based on variables, packets and messages. This chapter re-uses some of the variables and packets specified for transmission over other interfaces by [Subset-026 chapter 7].

6.1.1.2 New variables, which are required for NRBC messages, are specified in this document.

6.1.1.3 A NRBC message contains a header and an identified and coherent set of variables and packets (if needed).

6.1.1.4 The behaviour of the receiver shall not depend on the sequence of the optional packets given by the message.

6.1.1.5 The RBC shall reject a message transmitted from the NRBC if the message is not consistent.

6.1.1.6 An NRBC message is consistent when all checks have been completed successfully:

a) Checks performed by RBC/RBC protocol have been passed (see Subset-098)

b) Variables in the message do not have invalid values.

6.1.1.7 It shall be forbidden to send more instances of the same packet type in the same message, except for Packet 65 (TSR) and Packet 66 (TSR Revocation).

6.1.1.8 The message identifier is unique (variable NID_NRBCMESSAGE).

Table 10 List of NRBC messages

Message identifier	Message Name	Direction
201	Pre-Announcement	RBC_{HOV} => RBC_{ACC}
202	Route Related Information request	RBC_{HOV} => RBC_{ACC}
203	Announcement	RBC_{HOV} => RBC_{ACC}
204	Cancellation	RBC_{HOV} <=> RBC_{ACC}
205	Acknowledgement	RBC_{HOV} <=> RBC_{ACC}
206	RRI Confirmation	RBC_{HOV} => RBC_{ACC}
221	Route Related Information	RBC_{ACC} => RBC_{HOV}
222	Taking Over Responsibility	RBC_{ACC} => RBC_{HOV}
223	Life Sign	RBC_{ACC} => RBC_{HOV}

Message identifier	Message Name	Direction
224	Request for RRI Confirmation	RBC_{ACC} => RBC_{HOV}

6.1.1.9 Each message includes the message length in bytes (variable L_MESSAGE).

6.1.1.10 If the computed length of the message is not equal to the length given by L_MESSAGE, the entire message shall be rejected.

6.1.1.11 An NRBC message is identified for acknowledgement by

a) Identity of the sending RBC (variables NID_C and NID_RBC) **and**

b) Identity of the handed over engine (variable NID_ENGINE) **and**

c) Identity of the border BG (variables NID_C and NID_BG) **and**

d) Timestamp of the sending RBC (variable T_RBC).

6.1.1.12 Note: Non-unique identifiers for outstanding acknowledgements may have an impact on system behaviour.

6.1.1.13 There shall always be a time stamp increment between consecutive messages. Wrap around of the RBC time stamp value can occur during an RBC/RBC session and shall have no impact on system behaviour.

6.1.1.14 Note: This time stamp does not have to be based on real time.

6.1.1.15 The structure of a NRBC message is shown by Figure 4. Fields 1-9 builds the header.

Field No.	VARIABLE	Remarks
1	NID_NRBCMESSAGE	Message Identifier
2	L_MESSAGE	Message length including everything (field 1 to padding)
3	NID_C	Identity of the country or region (of the sending RBC)
4	NID_RBC	Identity of the sending RBC
5	NID_ENGINE	Identity of the handed over engine
6	NID_C	Identity of the country or region (of the border balise group)
7	NID_BG	Identity of border balise group
8	T_RBC	Time stamp of sending RBC
9	M_ACK	Qualifier for acknowledgement request
10	Variables as required by NID_NRBCMESSAGE	If needed for this message. Used when sending variables, which are not included in a packet.
11	Packets as required by NID_NRBCMESSAGE	
	Padding	Bit padding to octet borders, if required.

Figure 4 Structure of NRBC messages

6.2 Messages from the handing over RBC to the accepting RBC

6.2.1 Pre-Announcement

Description	The handing over RBC informs the accepting RBC that a given train is approaching its area at a specific border location.		
Content	**Variable**	**Length**	**Comment**
	NID_NRBCMESSAGE	8	201 (Pre-Announcement)
	L_MESSAGE	10	
	NID_C	10	
	NID_RBC	14	
	NID_ENGINE	24	
	NID_C	10	
	NID_BG	14	
	T_RBC	32	
	M_ACK	1	
	M_MODE	4	Only 0,1,2,7,8 or 11
	Q_ MASTERENGINE	1	If M_MODE = 11 (i.e. NL)

	NID_ENGINE	24	If M_MODE = 11 and Q_MASTERENGINE = 1 identity of the leading engine
	Packet 11 (Train data)		If M_MODE = 0, 1, 2, 7, or 8 (i.e. FS, OS, SR, TR or PT)

6.2.1.1 Note: Pre-announcement is only supported for onboards in modes FS, OS, SR, TR, PT or NL, because the Accepting RBC cannot forward any information to the on-board in other modes.

6.2.2 Route Related Information Request

Description	The handing over RBC requests route related information from the accepting RBC.		
Content	**Variable**	**Length**	**Comment**
	NID_NRBCMESSAGE	8	202 (Route related information request)
	L_MESSAGE	10	
	NID_C	10	
	NID_RBC	14	
	NID_ENGINE	24	
	NID_C	10	
	NID_BG	14	
	T_RBC	32	
	M_ACK	1	
	D_REMAINDISTANCE	15	Remaining distance for RRI
	N_REMAINEOAINTERVALS	5	Number of remaining EoA intervals
	N_REMAINTSR	5	Total number of remaining TSR related packets 65 and 66
	Q_ADDRESTRICTIONS	1	Flag for additional restrictions
	N_REMAINLINKEDBG	5	Number of remaining linked balise groups
	N_REMAINGRADIENTCHANGE	5	Number of remaining changes of gradients
	N_REMAINMASECTION	5	Number of remaining MA sections
	N_REMAINSPEEDCHANGE	5	Number of remaining changes of SSP

N_REMAINTRACKCONDITION	5	Number of remaining track conditions
N_REMAINASP	6	Number of remaining axle load speed profiles
N_REMAINMODEPROFILE	5	Number of remaining mode profile sections
Q_REMAINAXLELOAD	1	Flag, if axle load route suitability data still possible or not (only one allowed)
Q_REMAINLOADINGGAUGE	1	Flag, if loading gauge route suitability data still possible or not (only one allowed)
Q_REMAINTRACTION	1	Flag, if traction route suitability data still possible or not (only one allowed)
Q_REMAINLEVELTRANSITION	1	Flag, if level transition still possible or not
Q_REMAINTRACTIONPOWERCHANGE	1	Flag, if traction power change still possible or not

6.2.2.1 Note: Parameters D_REMAINDISTANCE and N_REMAINEOAINTERVALS may be used in combination.

6.2.3 Announcement

Description	The handing over RBC informs the accepting RBC that the maximum safe front end of the train has passed the location corresponding to the border		
Content	**Variable**	**Length**	**Comment**
	NID_NRBCMESSAGE	8	203 (Announcement)
	L_MESSAGE	10	
	NID_C	10	
	NID_RBC	14	
	NID_ENGINE	24	
	NID_C	10	
	NID_BG	14	
	T_RBC	32	
	M_ACK	1	

6.2.4 RRI Confirmation

Description	The handing over RBC confirms that the RRI has been processed according to the information in this RRI Confirmation message.		
Content	**Variable**	**Length**	**Comment**
	NID_NRBCMESSAGE	8	206 (RRI Confirmation)
	L_MESSAGE	10	
	NID_C	10	
	NID_RBC	14	
	NID_ENGINE	24	
	NID_C	10	
	NID_BG	14	
	T_RBC	32	
	M_ACK	1	
	T_RBCCONF	32	The timestamp of the Request for RRI Confirmation message being confirmed
	Q_RRICONFSTATUS	2	Positive or negative confirmation

6.2.4.1 The handing over RBC shall send a positive confirmation when the train is able to stop before the new end of movement authority.

6.2.4.2 Note: The negative confirmation means that the train is not able to stop before the new end of movement authority.

6.3 Messages from the accepting RBC to the handing over RBC

6.3.1 Route related information

Description	Route information from the accepting RBC to the handing over RBC		
Content	**Variable**	**Length**	**Comment**
	NID_NRBCMESSAGE	8	221 (Route Related Information)
	L_MESSAGE	10	
	NID_C	10	
	NID_RBC	14	
	NID_ENGINE	24	
	NID_C	10	
	NID_BG	14	

T_RBC	32	
M_ACK	1	=1 (i.e. acknowledgement is always requested)
Q_RRIMACHANGE	2	
Q_TDCHANGE	1	If Q_RRIMACHANGE=0
Q_MATIMER	1	
Packet 15		Level 2/3 Movement Authority
Packet 21		Gradient Profile
Packet 27		International Static Speed Profile
optional packets		

6.3.1.1 The optional packets of NRBC message “Route related information” are

Optional packets
3, 5, 39, 41, 51, 65, 66, 68, 70, 71, 80

6.3.1.2 Each RRI message shall provide complete information (see [Subset-026] chapter 3.7) for the area starting at the border balise group and shall use the border balise group as the LRBG. The RRI shall not include any information with a start or end location in the area beyond the remaining distance which was given by the last received NRBC message RRI Request.

6.3.1.3 The same rules for packets as in [Subset-026] and [Subset-040] apply.

6.3.1.4 Additional rule: packet 68 and packet 70 with Q_TRACKINIT = 1 shall not be sent in the RRI message.

6.3.1.5 Note: In packet 68 and 70 the value Q_TRACKINIT = 1 is used to reset the track conditions or route suitability. With this value, it is not possible to use such packets to send new restrictions; moreover only one instance of them is allowed in a message.

6.3.1.6 The total number of TSR related packets 65 and 66 in the RRI shall not exceed the limit set by N_REMAINTSR in the last received RRI Request.

6.3.1.7 Note: It is a configuration issue to ensure that TSR identities are not duplicated. The agreed value range for a specific RBC is applicable to both packet 65 and 66.

6.3.1.8 Note: Q_RRIMACHANGE and Q_TDCHANGE together with Q_MATIMER could help the Handing Over RBC to determine the use of the received RRI information without analysing the content of the individual packets.

6.3.1.9 The track description may also be changed if Q_RRIMACHANGE ≠ 0.

6.3.1.10 When sending RRI the Accepting RBC shall respect any limits set by the parameters in the last received RRI Request.

6.3.2 Taking Over Responsibility

Description	The accepting RBC informs the handing over RBC that it has taken over the responsibility		
Content	**Variable**	**Length**	**Comment**
	NID_NRBCMESSAGE	8	222 (Taking Over Responsibility)
	L_MESSAGE	10	
	NID_C	10	
	NID_RBC	14	
	NID_ENGINE	24	
	NID_C	10	
	NID_BG	14	
	T_RBC	32	
	M_ACK	1	=0 (i.e. no acknowledgement is required)

6.3.3 Life Sign

Description	The accepting RBC sends a Life Sign message, if a HOV transaction is ongoing and a specified time has passed since any message was sent.		
Content	**Variable**	**Length**	**Comment**
	NID_NRBCMESSAGE	8	223 (Life Sign)
	L_MESSAGE	10	
	NID_C	10	
	NID_RBC	14	
	NID_ENGINE	24	
	NID_C	10	
	NID_BG	14	
	T_RBC	32	
	M_ACK	1	=0 (i.e. no acknowledgement is required)

6.3.4 Request for RRI Confirmation

Description	Request for confirmation including request for shortening of MA, from the accepting RBC to the handing over RBC.		
Content	**Variable**	**Length**	**Comment**

NID_NRBCMESSAGE	8	224 (Request for RRI Confirmation)
L_MESSAGE	10	
NID_C	10	
NID_RBC	14	
NID_ENGINE	24	
NID_C	10	
NID_BG	14	
T_RBC	32	
M_ACK	1	=1 (i.e. acknowledgement is always requested)
Packet 15		Level 2/3 Movement Authority
optional packet		packet 80 only

6.3.4.1 The Accepting RBC shall only send this message after at least one RRI was sent to the HOV RBC and this has been acknowledged.

6.3.4.2 The content of packet 15 in the Request for RRI Confirmation shall not exceed the MA distance of packet 15 sent in the previous RRI.

6.3.4.3 Note: It is the responsibility of the HOV RBC how to handle the contained shortened MA towards the onboard.

6.4 Messages from both accepting RBC or handing over RBC

6.4.1 Acknowledgement

Description	The RBC acknowledges a received message according to M_ACK. The meaning of the acknowledgement from its sender point of view is: the acknowledged message is consistent. For the generator of the original information, the missing of the acknowledgement message means, that this is one of the causes to generate and send this information again, according to its own rules.		
Content	**Variable**	**Length**	**Comment**
	NID_NRBCMESSAGE	8	205 (Acknowledgement)
	L_MESSAGE	10	
	NID_C	10	
	NID_RBC	14	
	NID_ENGINE	24	

	NID_C	10	
	NID_BG	14	
	T_RBC	32	
	M_ACK	1	=0 (i.e. no acknowledgement is required)
	T_RBCACK	32	The timestamp of the message being acknowledged

6.4.2 Cancellation

Description	When an RBC detects that the transition to a neighbour RBC is to be cancelled, it sends this information.		
Content	**Variable**	**Length**	**Comment**
	NID_NRBCMESSAGE	8	204 (Cancellation)
	L_MESSAGE	10	
	NID_C	10	
	NID_RBC	14	
	NID_ENGINE	24	
	NID_C	10	
	NID_BG	14	
	T_RBC	32	
	M_ACK	1	

6.5 Packets

6.5.1.1 The following packets defined in [Subset-026] are also used by NRBC messages:

Packet number	Packet Name
3	National values
5	Linking
11	Train data
15	Level 2/3 Movement Authority
21	Gradient Profile
27	International Static Speed Profile
39	Track Condition Change of traction power
41	Level Transition Order
51	Axle Load Speed Profile

Packet number	Packet Name
65	Temporary Speed Restriction
66	Temporary Speed Restriction Revocation
68	Track Condition
70	Route Suitability Data
71	Adhesion factor
80	Mode profile

6.6 Variables

6.6.1.1 The following variables defined in [Subset-026] are also used by NRBC messages:

Variable	Name
L_MESSAGE	Message length
M_ACK	Qualifier for acknowledgement request
M_MODE	Onboard operating mode
NID_BG	Identity number of the balise group
NID_C	Identity number of the country or region
NID_ENGINE	Onboard ETCS identity
NID_RBC	RBC ETCS identity number

6.6.1.2 Note the dimensioning rules of [Subset-040].

6.6.1.3 D_REMAINDISTANCE

Name	The remaining distance beyond the border BG for which data (including the danger point and overlap of the MA) can be transmitted in NRBC message “Route Related Information”.		
Description	The RRI must not include any information outside the remaining distance.		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
15 bits	0	32766	1m
Special/Reserved Values	32767	No restriction given	

6.6.1.4 N_REMAINASP

Name	The remaining number of axle load speed profile changes for a NRBC message “Route Related Information”		
Description			
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
6 bits	0	15	Integers

6.6.1.5 N_REMAINEOAINTERVALS

Name	The remaining number of EoA intervals for a NRBC message “Route Related Information”		
Description			
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
5 bits	0	30	Integers
Special/Reserved Values	31	No restriction given	

6.6.1.6 N_REMAINGRADIENTCHANGES

Name	The remaining number of gradient profile changes for a NRBC message “Route Related Information”		
Description			
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
5 bits	0	31	Integers

6.6.1.7 N_REMAINLINKEDBG

Name	The remaining number of linked balise groups for a NRBC message “Route Related Information”		
Description			
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
5 bits	0	29	Integers

6.6.1.8 N_REMAINMASECTION

Name	The remaining number of MA sections for a NRBC message “Route Related Information”		
Description	The end section is included in this number.		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
5 bits	0	6	Integers

6.6.1.9 N_REMAINMODEPROFILE

Name	The remaining number of mode profile changes for a NRBC message “Route Related Information”		
Description	This is the first element plus up to 2 iterations.		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
5 bits	0	3	Integers

6.6.1.10 N_REMAINSPEEDCHANGE

Name	The remaining number of static speed profile changes for a NRBC message “Route Related Information”		
Description			
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
5 bits	0	31	Integers

6.6.1.11 N_REMAINTRACKCOND

Name	The remaining number of track condition for a NRBC message “Route Related Information”		
Description	This is the first element plus up to 19 iterations.		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
5 bits	0	20	Integers

6.6.1.12 N_REMAINTSR

Name	The remaining total number of temporary speed restriction and revocation packets for a NRBC message “Route Related Information”		
Description			
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
5 bits	0	10	Integers

6.6.1.13 NID_NRBCMESSAGE

Name	Message identifier		
Description	Identifier of a NRBC message		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
8 bits	0	255	Numbers
Special/Reserved Values	201	Pre-Announcement	
	202	Route related information request	
	203	Announcement	
	204	Cancellation Information	
	205	Acknowledgement	
	206	RRI Confirmation	
	221	Route related information	
	222	Taking Over Responsibility	
	223	Life Sign	
	224	Request for RRI Confirmation	

6.6.1.14 Q_ADDRESTRICTIONS

Name	Flag additional restrictions		
Description			
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
1 bit			
Special/Reserved Values	0	No further restrictions following	
	1	Further restrictions following	

6.6.1.15 Q_MASTERENGINE

Name	Flag indication if the NID of the master engine is known		
Description			
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
1 bit			
Special/Reserved Values	0	No	
	1	Yes	

6.6.1.16 Q_MATIMER

Name	Flag indication if MA contains timers		
Description			
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
1 bit			
Special/Reserved Values	0	No	
	1	Yes	

6.6.1.17 Q_REMAINAXLELOAD

Name	Flag, if one route suitability data for axle load is possible or not		
Description			
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
1 bit			
Special/Reserved Values	0	No	
	1	Yes	

6.6.1.18 Q_REMAINLEVELTRANSITION

Name	Flag, if level transition still possible or not		
Description			
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
1 bit			
Special/Reserved Values	0	No	
	1	Yes	

6.6.1.19 Q_REMAINLOADINGGAUGE

Name	Flag, if one route suitability data for loading gauge is possible or not		
Description			
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
1 bit			

Special/Reserved Values	0	No
	1	Yes

6.6.1.20 Q_REMAINTRACTION

Name	Flag, if one route suitability data for traction is possible or not		
Description			
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
1 bit			
Special/Reserved Values	0	No	
	1	Yes	

6.6.1.21 Q_REMAINTRACTIONPOWERCHANGE

Name	Flag, if traction power change still possible or not		
Description			
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
1 bit			
Special/Reserved Values	0	No	
	1	Yes	

6.6.1.22 Q_RRICONFSTATUS

Name	Status of RRI Confirmation		
Description	Indication whether the confirmation is negative or positive		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bit			
Special/Reserved Values	0	No response from train, no further confirmation will be sent from HOV RBC	
	1	Not confirmed (negative)	
	2	Confirmed (positive)	
	3	Spare	

6.6.1.23 Q_RRIMACHANGE

Name	Type of MA change		
Description	Relation of MA in the current RRI message to the MA in the last acknowledged RRI message.		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits			
Special/Reserved Values	0	Unchanged	
	1	Created	
	2	Extended	
	3	Shortened	

6.6.1.24 Q_TDCHANGE

Name	Change of track data		
Description	Indication whether the track data has changed in respect to the last acknowledged RRI message. Track data applies to any packets in the RRI message except packet 15.		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
1 bit			
Special/Reserved Values	0	Not changed	
	1	Changed	

6.6.1.25 T_RBC

Name	Time stamp of sending RBC		
Description	Time stamp. It is used as unique identification for any message. The unit is count of 10ms, i.e. 4294967295 corresponds to 42949672.95s		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
32 bits	0	4294967295	10 ms
Special/Reserved Values			

6.6.1.26 T_RBCACK

Name	The timestamp of the message being acknowledged.		
Description	The timestamp of the received message is used (together with Identification fields of the header) as unique identification of the message being acknowledged.		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
32 bits	0	4294967295	10 ms

6.6.1.27 T_RBCCONF

Name	The timestamp of the message being confirmed.		
Description	The timestamp of the received message is used (together with Identification fields of the header) as unique identification of the message being confirmed.		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
32 bits	0	4294967295	10 ms

A. Annex (informative) RBC/RBC communication

A.1 The RBC/RBC communication model

A.1.1.1 An application entity responsible for RBC/RBC Handover (RBC/RBC communication entity) communicates with its peer entity by means of the RBC/RBC Handover protocol.

A.1.1.2 The exchange of application messages (NRBC messages) is a logical view only. For real data exchange the services of the RBC-RBC Safe Communication Interface [Subset-098] will be used. Access to these services is possible by means of the service primitives at service access points (SAP). These service primitives are dependent on the implementation and outside the scope of this document.

A.1.1.3 The RBC/RBC Handover protocol is independent of the RBC safe communication protocol.

A.1.1.4 Figure 5 shows a model of the RBC/RBC communication. This model does not restrict any implementations.

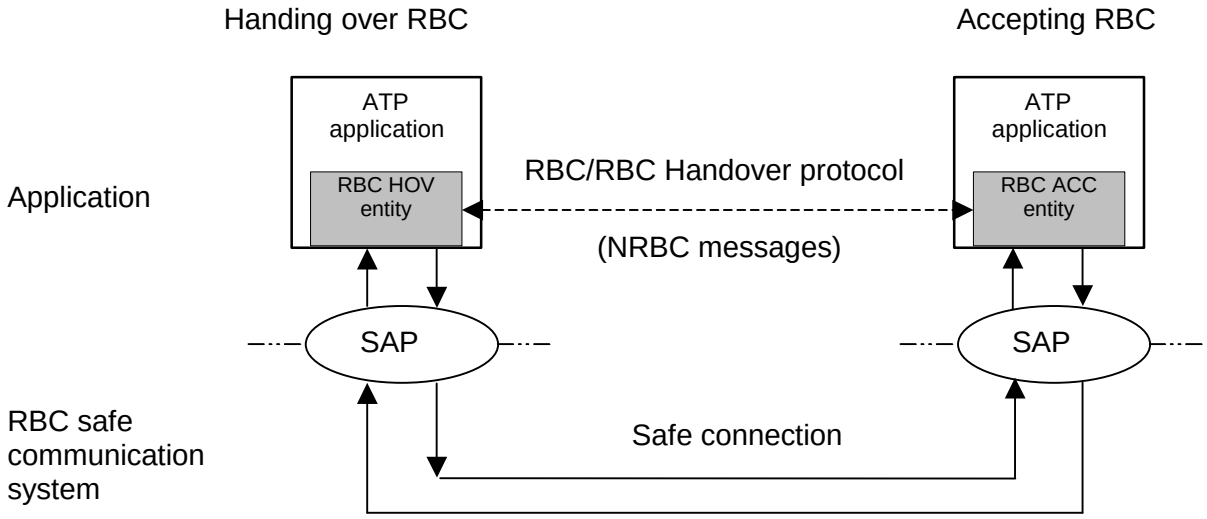


Figure 5 Model of the RBC/RBC communication

A.1.1.5 The RBC/RBC communication entities of handing over RBC and accepting RBC (RBC_{HOV} / RBC_{ACC} entities) are related to each RBC/RBC communication. Different RBC/RBC communications have simultaneously to be handled for the neighbour RBCs.

A.2 Initialisation of RBC/RBC communication

A.2.1.1 Note: The exchange of NRBC messages during the initialisation phase is not necessary.

A.3 Data transfer

A.3.1.1 The time sequence of Figure 6 shows in which way data are exchanged between RBCs.

A.3.1.2 A NRBC message is included in the user data of data transmission service request.

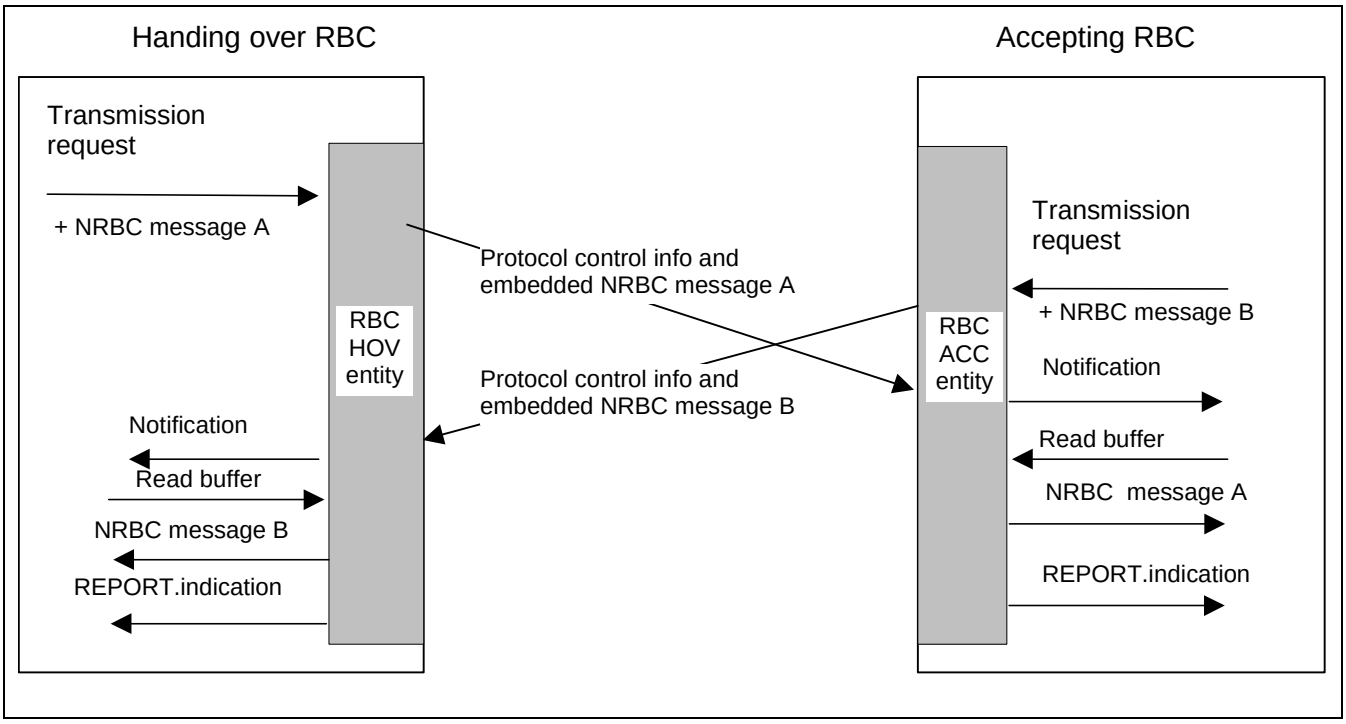
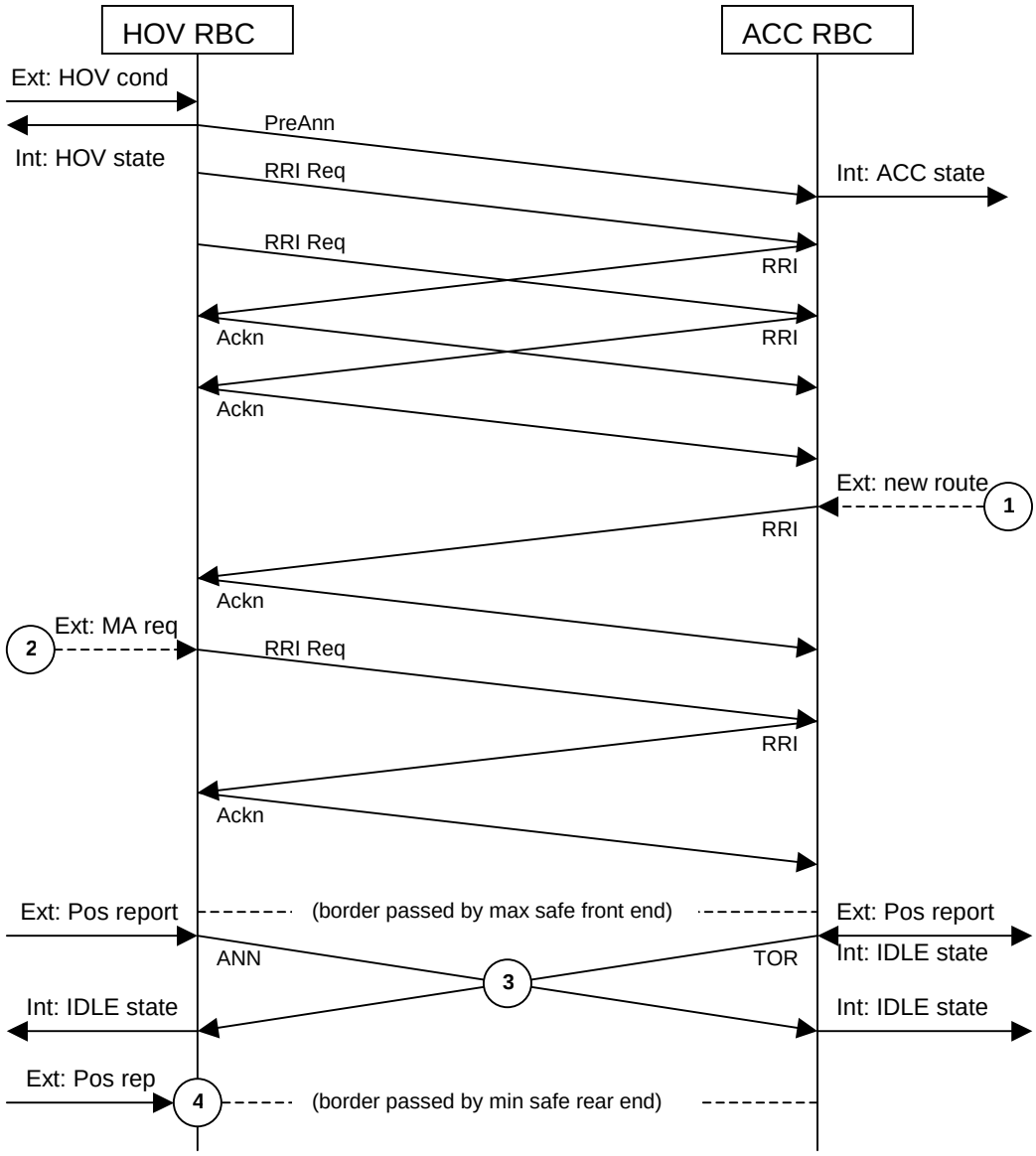


Figure 6 General time sequences during data transfer

A.3.1.3 The safe data transfer according to EN50159 (like authenticity, integrity and boundaries of NRBC messages) is provided by the RBC-RBC Safe Communication Interface (see [Subset-098]).

A.4 Example of message sequence

The figure below is an example of a sequence of messages during RBC/RBC handover.



Comments to the numbered events:

1: The ACC RBC can send RRI without a RRI Request when there is new info.

2: The HOV RBC can send RRI Request initiated by MA request from the train.

3: These messages are sent depending on when the position report is received, e.g. if train with only one mobile the ACC RBC receives this report much later.

4: This event will cause the HOV RBC to go to IDLE state, if not already in IDLE.

Figure 7 Sequence of messages during RBC/RBC handover

A.5 Example of Life Sign

A.5.1.1 The following figure shows an example of timers for safe connection supervision.

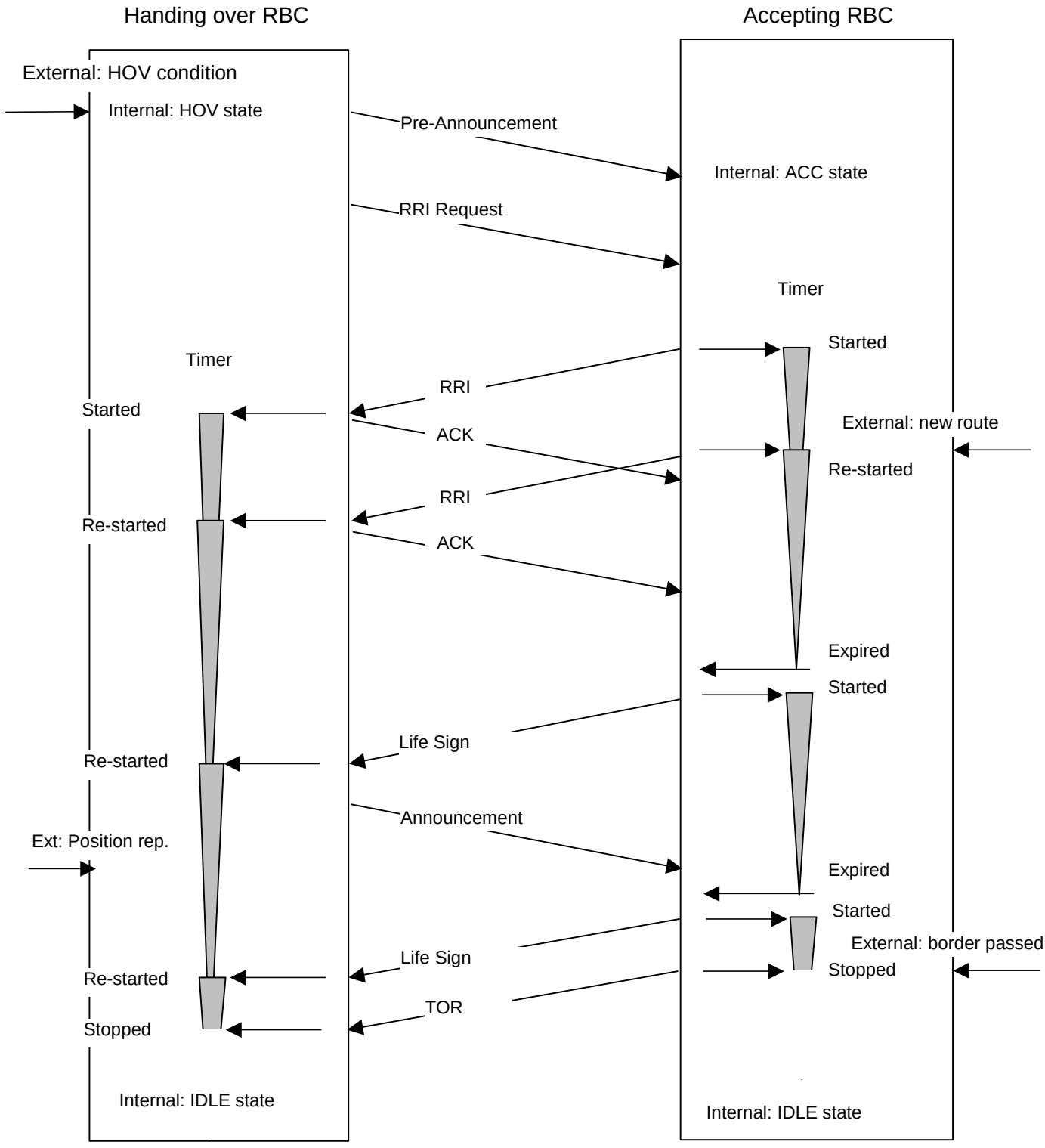


Figure 8 Life Sign

Notes:

1. The message receiving timer of the handing over RBC will not be started until receiving the first RRI: its task is supervision because of a possible **restrictive** RRI. This could not be the first one.
2. The Life Sign transmitting timer will be started after sending an NRBC message (RRI, ACK or Life Sign): supervision is only necessary during an ongoing transaction.

A.6 Error handling

A.6.1.1 The RBC Safe Communication entity can provide local error reports towards the application.

B. Annex List of Requests for Change

B.1.1.1 The following **Table 11** contains a summary of all Change Requests (CR) to resolve inconsistencies between this FIS and the SRS [Subset-026]. These are only relevant if a project needs RBC/RBC handover. Clause 3.3.1.7 of SUBSET-108 applies to these CR's.

Table 11 List of CRs

CR	Headline	Justification
491	Acknowledgement of the Route Related Information	Addition of requirements in [Subset-026] for the acknowledgement of RBC-RBC messages by an RBC.
492	Missing information in the pre-announcement message	Clarification of the information transmitted at pre-announcement by changing [Subset-026] requirement 3.15.1.2.1
493	Removal of Emergency Stop data from Route Related Information	Modification in [Subset-026] to the information that can be transmitted across an RBC-RBC interface to remove the transmission of emergency messages.
494	Communication of SR balise list on the RBC/RBC interface	Modification in [Subset-026] to the information that can be transmitted across an RBC-RBC interface to remove the transmission of a list of balises in SR authority.
495	Restriction of capacity within the Route Related Information Request	Clarification that the route related information sent by the Accepting RBC may be limited by the Handing Over RBC as defined in this document and by the introduction of an RBC requirement in [Subset-026].
522	Misleading sentences for RBC/RBC announcement.	Clarification in [Subset-026] that the Announcement message from the Handing Over RBC does not include a position report of the train.
564	Missing Parameter in the Route Related Information message	Modification in [Subset-026] to the information that can be transmitted across an RBC-RBC interface to include adhesion factor.