

## C620 – Signalling

### IRS ATS-008-TRU C620/NR TRUST (CRL)

**CRL Document Number: C620-SIC-R2-RSP-CR001-50028**

Supplier Document Number: A6Z00035220929, F

Contract MDL Reference A09.025

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YES ☐ NO ☒

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DLR ☐ Other: \_\_\_\_\_

This document has been reviewed by the following individual for coordination, compliance, integration and acceptance and is acceptable for transmission to the above stakeholder for the above stated purpose.


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#### 2b. Review by Stakeholder (if required):

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### Signature from Interface Partners

Agreed		Network Rail*		
Agreed				
Agreed				
Agreed				
	Chapter	Name	Company	Date
				Signature

\* As agreed by CRL during the ROGS meeting on 11-02-2020, this document will be submitted without NR signature.

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## Document History

Rev. CRL	Date	Rev. SAP	Chapter	Reason for Issue:
1.0	2015-05-22	A	all	First version
2.0	2015-06-24	B	all	Revised according to C620-PMC-00784
3.0	2015-09-15	C	1.1,7	Revised according to C620-PMC-50784
4.0	2016-12-09	D	all	Revised traced requirements
-	-	-	Figure 2	Revised figure
-	-	-	6	Revised design input
-	-	-	all	Added attachment with description for Moving Block Berth Principle and referred to where applicable.
5.0	2018-03-21	E	List of References, 6	Updated references and added reference 17 to the table and chapter 6.
-	-	-	all	Reformatted the document based on the actual template.
6.0	2020-03-13	F	4.1	Considered review comment from NR: Waterloo has been replaced by Basingstoke
-	-	-	4.2	Added configuration details

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## List of References

Ref.	Document Code	SAG Number	SRA Number	Document Title
[E01]	C620-SIC-R2-DWG-CR001-50047, Rev. 9.0	A6Z00037389060, M	n/a	Crossrail Scheme Plans: Area 1 and 2
	C620-SIC-R2-DWG-CR001-50048, Rev. 10.0	A6Z00038251930, L		Area 3
	C620-SIC-R2-DWG-CR001-50049, Rev. 11.0	A6Z00037585953, P		Area 4
	C620-SIC-R2-DWG-CR001-50050, Rev. 9.0	A6Z00037727635, L		Area 5
	C620-SIC-R2-DWG-CR001-50051, Rev. 11.0	A6Z00037586032, N		Area 6
	C620-SIC-R2-DDE-CR001-00006, Rev. 6	A6Z00040614185, H		Area 7
[E02]	N/A	A6Z00045941228, -	N/A	Network Rail RT/E/PS/00009, Issue 2, May 2004
[E03]	N/A	A6Z00044480889, A	N/A	Network Rail NR/L3/SIG/nnnnnn Issue: 2009/01/01
[E04]	C620-SIC-R2-STP-CR001-50028, Rev. 6.0	N/A	N/A	S&CS Test and Commissioning Plan
	C620-SIC-R2-STP-CR001-50202	N/A	N/A	Test Book: TRUST Tests
[E05]	C620-SIC-R2-RSP-CR001-50146	A6Z00038803246	N/A	ATS Detailed Configuration Data Specification, - Part A Berth Maps
[E06]	C620-SIC-R2-RSP-CR001-50219, Rev. 5.0	A6Z00041759097, E	N/A	ATS Moving Block Berth Principle

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[E07]	CRL1-XRL-R2-RSP-CR001_1-50001	A6Z00045941244, -	N/A	TIPLOC: Timing Point Locations for Crossrail Route
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Table 1 List of References

*Note: If no version is itemised, the latest version of the referred documents is always the valid one.*

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## 1 Introduction

### 1.1 Purpose and Scope

This interface requirements specification describes the interface between the CRL C620 S&CS ATS system and the NR TRUST system. The S&CS ATS transmits Train Descriptor data via the SMART interface to the NR TRUST. The Train Descriptor data contains Train Descriptor Stepping messages and Signalling Status messages.

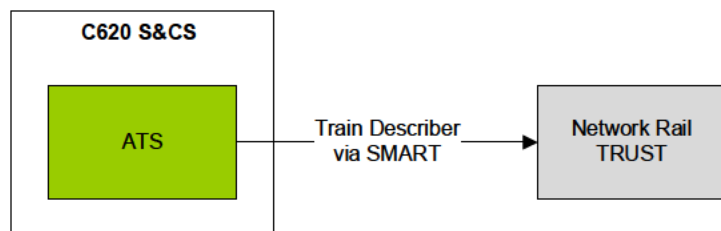


Figure 1 Overview of Interface

Within this document the following parts will be described:

- General information:
  - Description of the interface (Overview)
  - Boundary
- Functional:
  - Function of the Interface
- Performance:
  - Performance of the interface
- Design input:
  - Plans and Documents required
  - Data to be provided
- Design constraint requirements
  - Requirements and Constraints derived from the contract
  - Requirements and Constraints due to other contractors
  - Assumptions



## 1.2 Terms and Abbreviations

The following terms and abbreviations are used in this document:

Term / Abbreviation	Explanation
ATS	Automatic Train Supervision
BCC	Block Check Character
BUCF	Back Up Control Centre Facility
CDN	Crossrail Data Network
CIF	Common Interface File format
COS	Central Operating Section
CRL	Crossrail
DCC	Document classification code
FTN	Fixed Telecom Network
IRS	Interface Requirement Specification
IXL	Interlocking
NR	Network Rail
RCC	Rail Control Centre
S&CS	Signalling and Control System
SAG	Now refers to Siemens Mobility GmbH Note: As of August 1, 2018, the Mobility Division of Siemens AG has been transferred into Siemens Mobility GmbH.
SER	Signalling Equipment Room
SMART	Signal Monitoring and Reporting to TRUST
SMTI	SMART Interface
SRA	Now refers to Siemens Mobility Limited Note: As of June 1, 2018, Siemens Rail Automation Holdings Ltd has been renamed to Siemens Mobility Limited.
TD	Train Descriptor
TD.net	Train Descriptor and train running information via internet
TOPS	Total Operations Processing System
TRUST	Train Running System on TOPS

Table 2 Terms and Abbreviations

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### 1.3 Standards used

The following standards are used in this document:

Standard	Description
EIA232(RS232)	Serial data communication between Data Terminal Equipment (DTE) and Data Communication Equipment (DCE)
RT/E/PS/00009	Message Handling and Data Transmission Requirements between Processor Based Systems
NR/L3/SIG/nnnnnn	Interface requirements between Train Descriptor and Information Management systems via SMART

Table 3 List of Standards

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## 2 General Information:

### 2.1 Description of the Interface (Overview on System Level)

TRUST is a Network Rail computer system, which records details of train operational data as compared with schedule, supporting the logging of delays and associated attribution process.

The S&CS ATS located in the Route Control Centre (RCC) in Romford provides the required data via the SMART interface to TRUST. This data comprises Train running information related to TD Stepping data and Signalling status data.

### 2.2 Boundary

The ATS interfaces with the TRUST system through a redundant SMART interface.

The boundary of the S&CS system is a RS232 interface (based on the EIA 232 specification) within the SER in the RCC building at Romford.

### 3 Design Constraint Requirements

#### 3.1 Requirements and Constraints derived from the Contract

Ref.	Requirement	Comment
SRS_1188	The S&CS shall send describer function (included train description and routing data) to the national TRUST system through the SMART interface.	
SRS_1594	The S&CS shall provide redundancy for the interfaces to the NR control centres, the Communications Systems, the TRUST System, the TSDB/ITPS and the System Reference time.	
SRS_620	The S&CS shall be able to provide the data exchange to the national Trust system via the SMART interface.	
SRS_1425	The S&CS shall provide data to the Network Rail TRUST systems in accordance with the applicable standards	
SRS_2101	The S&CS shall provide that the transmission between RCC and adjacent train describers and SMART is within the parameters specified in RT/E/PS/00009 Message Handling and Data Transmission Requirements between Processor Based Systems.	
SDS_6428	The ATS will send describer function (included train description and routing data) to the national TRUST system through the SMART interface.	
SSRS_ATS_1172	The ATS shall send describer function (included train description and routing data) to the national TRUST system through the SMART interface.	
PIHA_58	(IHA-161) The ATS will send describer function (included train description and routing data) to the national TRUST system through the SMART interface. This is assigned to "No SIL"	

Table 4 List of Interface Requirements

#### 3.2 Requirements and Constraints due to other Contractors

The necessary FTN infrastructure will be provided by others (Network Rail). This equipment must provide the necessary performance for the data exchange generated by the train run within the COS.

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### 3.3 Testing and Commissioning Requirements

The interface is based on a proven standard [E02]. The test and commissioning of the interface will be done in accordance with the S&CS Test and Commissioning Plan [E04].

The test and commissioning schedule shall consider [E03] Appendix A.2.

### 3.4 Assumptions

Not used.

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## 4 Interface Description (Overview)

### 4.1 Physical Connection between the Interface Partners

[Trace “SRS\_620,SRS\_1594”]

The physical connection between the S&CS ATS and the TRUST system will be realised by redundant serial connections in accordance to the definition in [E02] chapter 5 “Interface”, in [E03] chapter 6 “General Requirements” and the EIA232 specification.

For the S&CS ATS data exchange to the TRUST system, S&CS will provide RS232 interfaces. The serial interfaces are the border of the S&CS effort. The RS232 interfaces are located in the S&CS SER within the Romford RCC. The delivery and installation of components is assigned to S&CS and to NR as shown in the following figure.

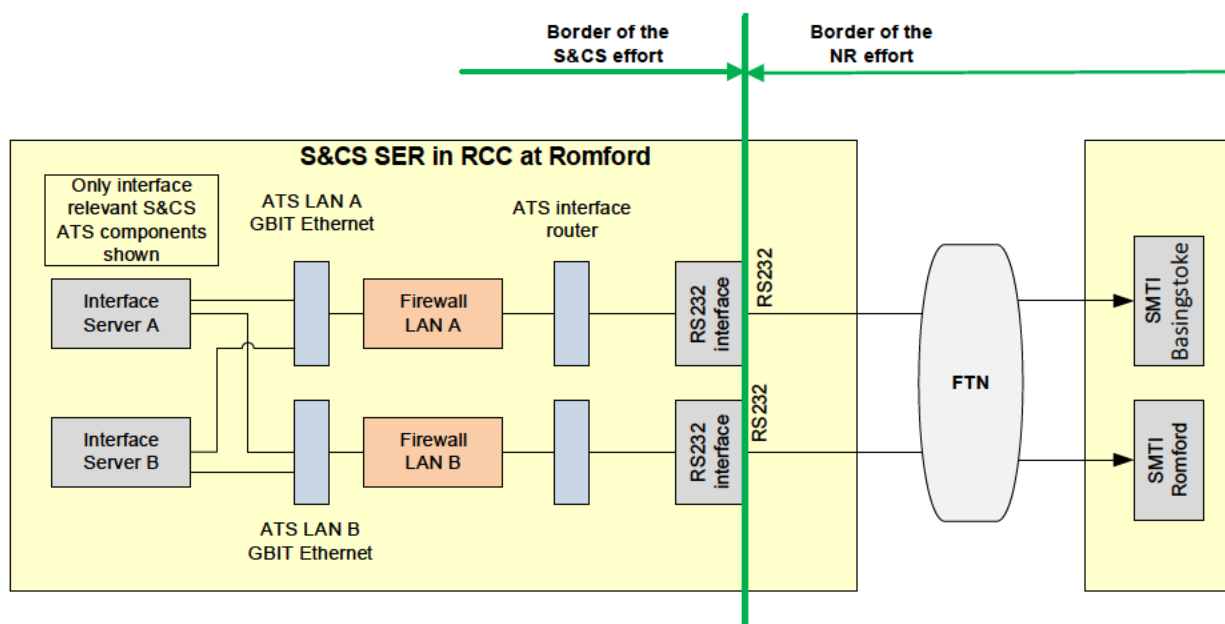


Figure 2 Structure of the S&CS ATS and TRUST/SMART Interface

[/Trace].

## 4.2 Logical Connections and Data Transmission Rules between the Interface Partners

[Trace “SRS\_1425,SRS\_2101”]

The protocol and the data transmission procedure are described in [E02] chapter 6 and [E03] chapter 6. The calculation of the BCC is described in [E02] chapter 11. The timing of the protocol and the behaviour of the interface in case of connection failures is described in [E02] Appendix A. In case of a faulty channel, the S&SC will send “CQ” messages to the communication link until a response is received.

The S&CS will use communication links with redundant channels to the TRUST system according to [E02] chapter 7.

[/Trace]

The following configuration parameters from [E03] apply for this interface:

- Baud rate: 9600 bits/second
- Data bits: 7
- Stop bits: 1
- Parity: Even
- Interface: RS-232C

The configuration deviates from the standard [E02] for the acknowledge response time (CFX00418308):

- Specification chapter 6.9: *From the time of transmission of the BCC of a message, an acknowledgement shall have been received within 2 seconds, otherwise a No Response (N/R) shall be assumed.*
- Configuration of this interface: *From the time of transmission of the BCC of a message, an acknowledgement shall have been received within 3 seconds, otherwise a No Response (N/R) shall be assumed*

## 5 Functional Data Transmission at Application Layer

[Trace "SRS\_1188,SDS\_6428,SSRS\_ATS\_1172"]

The ATS will send train description data via C-Class messages and routing data via S-Class messages to the TRUST system via the SMART interface. The details are described in the following sections.

The general types of available S-Class messages and C-Class messages are described in [E02] Appendix B and [E03] chapter 6. The S&CS ATS will provide a selection of these message types in accordance with the functional requirements of the data provision to the TRUST system.

[/Trace]

[Trace "PIHA\_58"]

This function is assigned to "No SIL".

[/Trace]

### 5.1 Provision of Train Descriptor Information via C- Class Messages

[Trace "SRS\_1188,SDS\_6428,SSRS\_ATS\_1172"]

The S&CS ATS will provide Train descriptor messages related to train runs within the COS to the TRUST system. The interface will use the message types defined in Table 5.

Class "C" Messages	
CA, CB, CC	Step, Cancel/Clear Out, Interpose
CT, CQ	Test Messages
CI	Initialise
CL	Buffer Overload (receive only, transmit buffer cannot overload)
CX	Area Recall message
CY, CF	Berth Contents Request/Reply

Table 5 General Classification "C" Messages

[/Trace]

The following diagram shows exemplarily the message sequence based on the description in [E02].



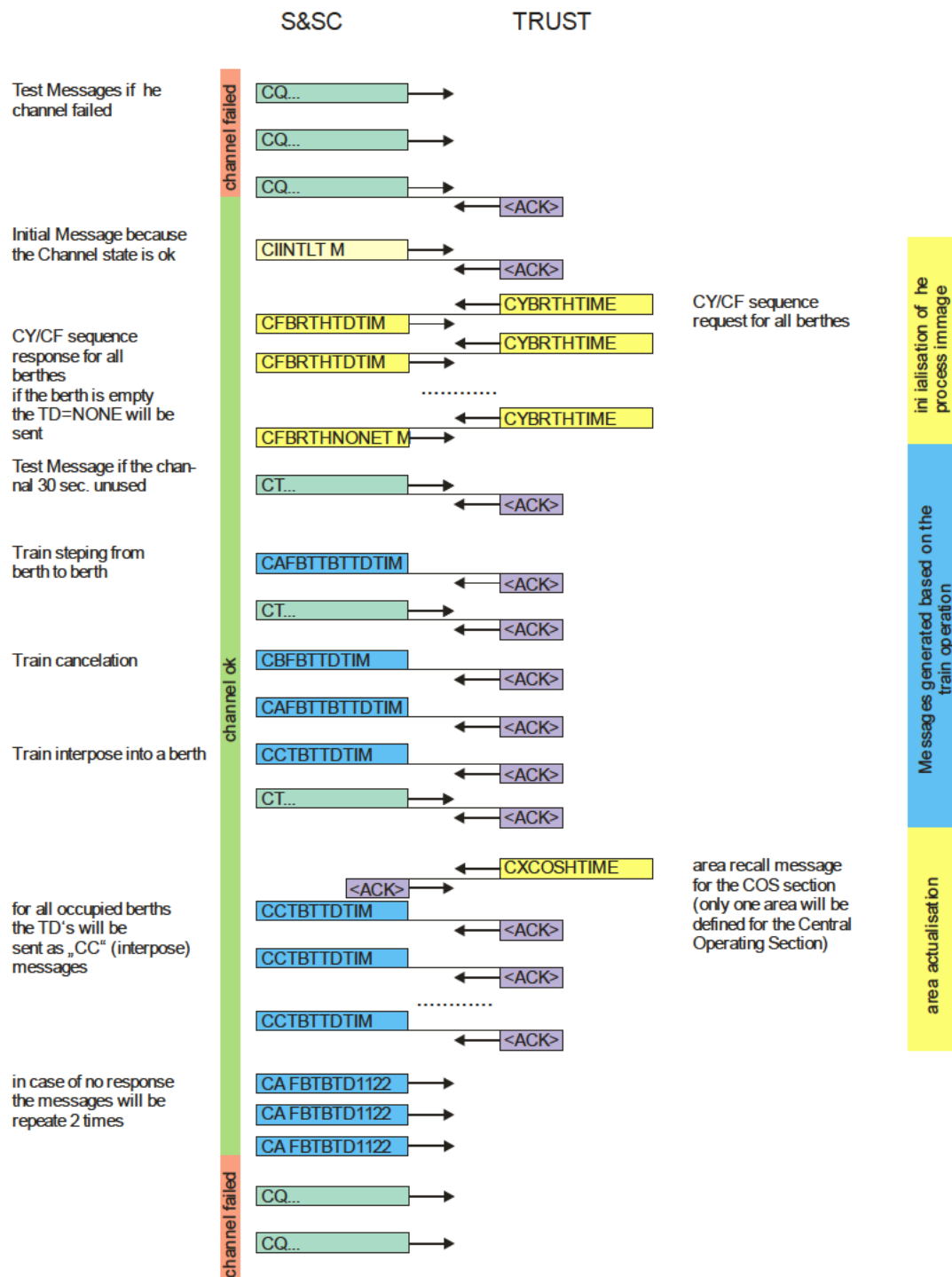


Figure 3 Example for the Dynamic Message Timing via the Train Describer Interface

## 5.2 Provision of Signalling Information via S- Class Messages

[Trace “SRS\_1188,SDS\_6428,SSRS\_ATS\_1172”]

The S&CS will provide selected signalling states from the Crossrail COS to the Network Rail TRUST system. The interface will use the message types defined in Table 6.

Class “S” Messages	
SF	Change of state
SR	Request Base Scan Message
SG	Initial State block any except last (Reply to SS Message)
SH	Last in list of initial state (Reply to SS Message)

Table 6 General Classification “S” Messages

[/Trace]

The S- Class messages will be sent as part of the TD- interface. The following diagram shows exemplarily the sequence of the S- class messages based on [E02].

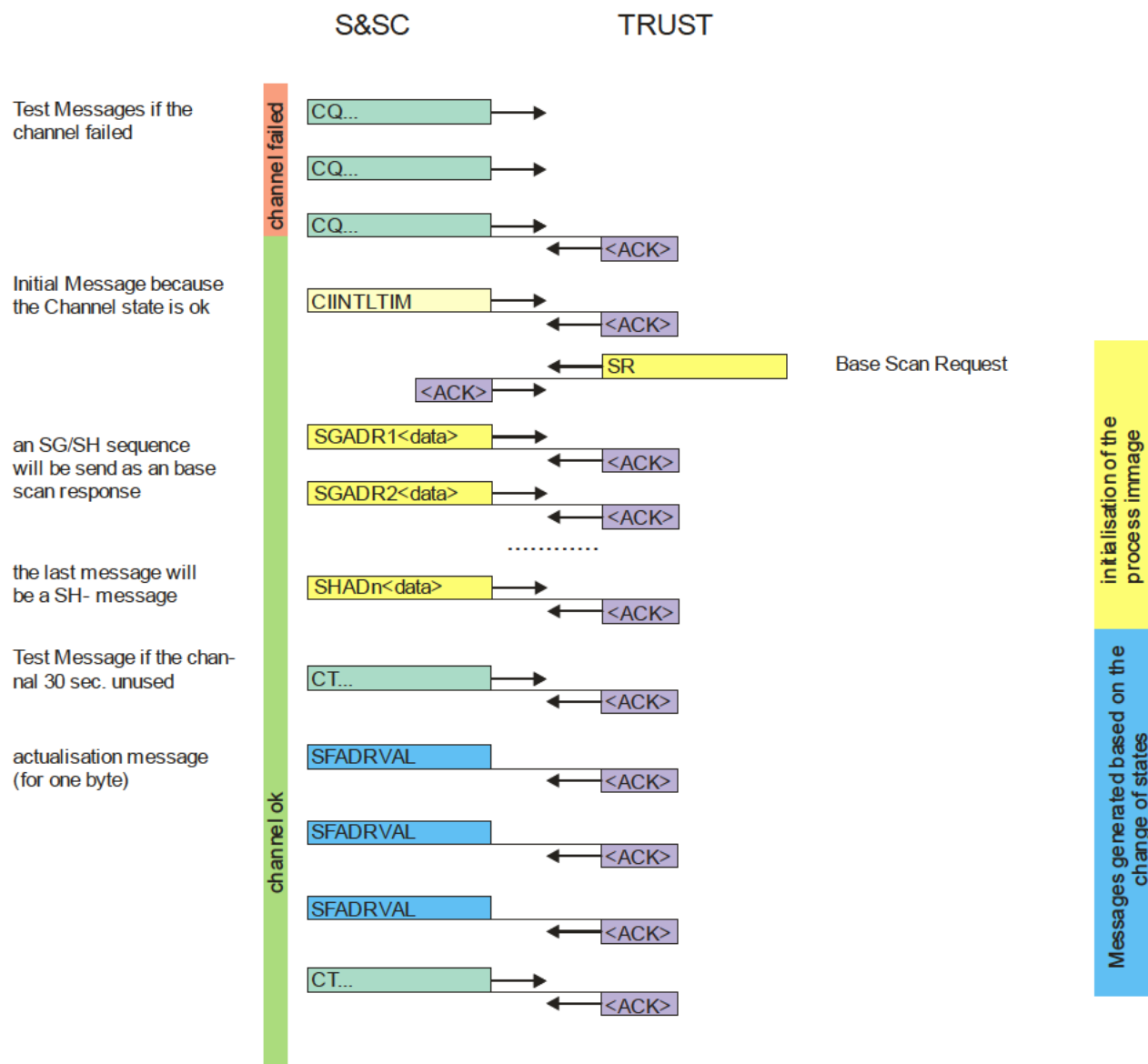


Figure 4 Example for the Dynamic Message Timing of the S- Class Messages Performance

## **5.3 Performance of the Interface**

### **5.3.1 Performance of the Data Transmission**

The Performance requirements for the data transmission (necessary bit rate) are defined in [E02] chapter 5.3. The involved components shall maintain these requirements at minimum.

### **5.3.2 Buffering**

The requirements for the involved buffers are described in [E02] chapter 8. Generally, the buffers at the involved components must be able to store the received messages until the next processing step.

## 6 Design Input

The S&CS will provide the Crossrail COS Scheme Plan [E01] to TRUST. This plan includes the information related to locations for LTES (Logical Track Elements), Axle Counter Sections and other signalling items.

The document “ATS Detailed Configuration Data Specification, - Part A Berth Maps”, refer to [E05] contains:

- the Berth maps for the COS. This contains also the engineering data as transmitted via the C class messages via this interface and
- the detailed definition for the Signalling data. This defines the bit and byte positions together with the associated signalling conditions as shown in the example below.

The C-class messages from the COS are sent according to the Moving Block Berth Principle, refer to [E06].

### Scheme Plan Excerpt Example:

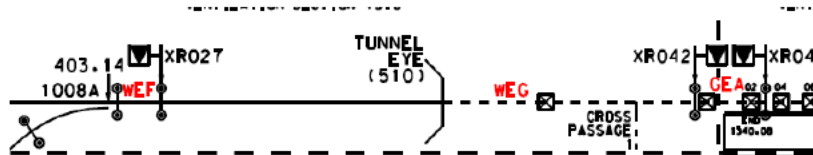


Figure 5 Example Excerpt Scheme Plan

The figure above shows for example the names and locations of the

- Axle Counter Sections: WEF, WEG and GEA
- Signals: XR027, XR042
- Points: 1008A

Signalling Conditions provided to TRUST ([E05]) as defined in [E03] chapter 7.5:

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
00h								
01h				R062063	XR027			
02h		P1008A					WEF	
03h								

(Byte/Bit position within the S- Class message and short name of the Signalling Condition)

Table 7 List of Signalling Conditions provided to TRUST

The following Signalling Conditions will be transferred via this interface:

Routes:

- Route Status: Route locked (<Route-name>, hint the route name is derived from the start and destination signal, e.g. route from XR0062 to XR063 is named as R062063)

Signals:

- Signal aspect: NOT Aspect failed AND NOT Stop (<signal-name>)

Points:

- Point position: Point Reverse (<point-name>)

Axle Counter Section:

- Clear indications: Occupied (<axle counter section name>)

Others (not supported):

- E.g. Train ready to start (TRTS)

In addition to that, the Timing Point Locations for Crossrail Route from [E07] are considered.