सत्यमेव जयते

GOVERNMENT OF INDIA

(भारत सरकार)

MINISTRY OF RAILWAYS

(रेल मंत्रालय)

Annexure – P

S-KAVACH- S-KAVACH Interface Requirements

Amdt-4

Issued by

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Revison History:

Amdt No.	Date of issue	Amendment
4.0 d3	06.11.2021	First issue
Amdt-1	29.04.2023	• **Cl. No 1.2.3**: Diagram for communication between two Stationary KAVACH systems is modified. • **Handing Over Stationary KAVACH-** Clause 2.2.1 modified and Cl. 2.2.2 to 2.2.12 are new clause added. • **Accepting Stationary KAVACH-** Clause 2.3.1, 2.3.2, 2.3.3 is modified. • **Clause 2.4.1 & 2.4.2** is shifted to overview and clause no shifted. • **Onboard KAVACH-** Clause 2.4.1, 2.4.2 are modified. • **Stationary KAVACH – Stationary KAVACH Interface definition**- Clause 2.5.7 is modified. • **Application Layer Requirements: Clause** 3.1.2 is modified and clause 3.2 for variant 1 of UDP is new clause added. • **Cl. 3.4.5:-** clause added with heart beat message. • **Clause 3.5-Telegram structure- Message:** length byte 43...44 added. • **Clause 3.7-Messages exchanged with adjacent Stationary KAVACH-** Packet structure modified. • **Clause 3.8-Command "PDI-Version check" (Primary Stationary KAVACH --> Secondary Stationary KAVACH-** Message length byte 43..44 added along with sample data. • **Clause 3.9- Message "PDI-Version check" (Secondary Stationary KAVACH --> Primary Stationary KAVACH-** Message length byte 43..44 added along with sample data. • **Clause 3.10-Message "Heart Beat**"- New packet added. • ~~**Message "Field Elements status"**~~ clause 3.8 deleted~~.~~ • ~~**Message "TSR Information message"**~~ clause deleted. • ~~**Message "Train Length Information Message"**~~ clause deleted.

		• ~~**Message "Train Acceptance Message"**~~ - clause deleted~~.~~ • ~~**Message "Acknowledge Message"**~~ Clause deleted. • **Clause 3.11-Message "Train Handover Request** " packet structure added. • **Clause 3.12-Message "Train RRI Message"**- New packet added. • **Clause 3.13-Message "Train Taken Over"**- New packet structure added. • **Clause 3.14-Message "Train Hand Over Cancellation" New** packet structure added. • **Clause 3.15-Message "Train Length Information "-** New packet added. • **Clause 3.16-Message "Train Length Acknowledgement"-** New packet added. • **Clause 3.17-Message "TSL Request "** New packet added. • **Clause 3.18-Message "TSL Authority"** New packet added.
Amdt-2	14.06.2023	• Cl. 2.2.1 is modified based on field trial. • Cl.2.3.1 – MA packet corrected. • Cl. 2.3.2 is modified for conformity. • Cl. 2.3.4 - Exception 8 – new clause added. • Cl. 2.4.1 is modified. • Cl. 2.4.3- clause deleted. • Cl. 3.7- Messages exchanged with adjacent Stationary KAVACH is modified with Field Elements Status Request message & Relays status message. • Cl. 3.11- Message "Train Handover Request" is modified. • Cl. 3.19- Message "Field Elements Status Request"- New packet added. • Cl.3.20 Message "Field Elements Status"- New packet added.
Amdt-3	14.11.2023	• **Cl. 2.3.5** The handling of Train Length Information with respect to communication mandatory area beyond train length measuring track circuits is defined. • The sender and receiver ID are corrected in clause 3.5, 3.9, 3.15, 3.17 and 3.18 from 2 bytes to 20 bytes. • **Cl 3.7** Corrected for ~~Relays~~ Field Elements Status message. • **Cl 3.8** Corrected for byte No 01, 02..03, 23...42 & 46...47 for confirmity. • **Cl. 3.9**- Result PDI check is defined as 0X01-

		Not Ok, 0x02- Ok. • **ClL. 3.15** In byte 55, 0x10 is corrected to 0x02 for determining the Train Length end frame. • **Cl. 3.16** New byte 55 conveying the Train Length information is added. Further MAC bytes are corrected accordingly. • **Cl. 3.17** corrected for message type byte no 01…02 from 0x0110 to 0x010A. • **Cl. 3.18** corrected for message type byte no 01…02 & 23…42 from 0x0111 to 0x010B.
Amdt-4	18.05.2024	• **CL. 1.3.1 –**Sample of IP Address scheme for communication between SKAVACH to SKA-VACH modified. • **CL 2**.3.6 – Exception (10) added to fetch MA and Track Profile from Stationary KAVACH be-yong Accepting Stationary KAVACH. • **CL 3.19–** Message "Field Elements Status Re-quest" modified with deletion ~~of byte 50..51 for border RFID~~ • CL 3.20–Message "Field Elements Status" modified with deletion ~~of byte 50..51 for bor-der RFID~~ • CL 2.2.6, 3.21- Message "Train Hand Over Cancellation Acknowledgement added".

1. INTRODUCTION

1.1 Scope and Purpose

1.1.1 This document specifies the functional interface for the neighbouring Stationary KAVACH communication to perform the Stationary KAVACH to Stationary KAVACH handover according to the principles and procedures given below.

1.1.2 The purpose of this annexure is to enable any pair of neighbouring Stationary KAVACH systems compliant with it to be interconnected so that SKAVACH-SKAVACH handovers can be performed, independently of the functional characteristics, service performance and safety of the concerned Stationary KAVACH Systems, which are outside the scope of this annexure.

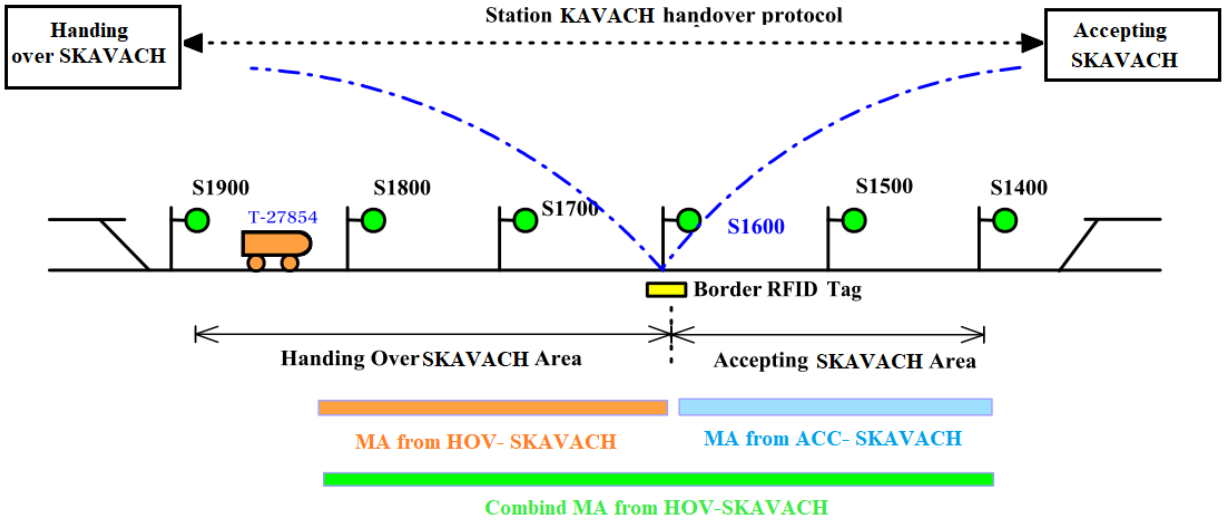
1.1.3 The information is required to be exchanged between stationary KAVACH and adjacent stationary KAVACH i.e both stationary KAVACH and adjacent stationary KAVACH contain information about TSR, PSR, track layout and track elements etc.

1.2 Overview

1.2.1 The amount of information to be sent between the Stationary KAVACH systems is depending on the implementation trackside.

1.2.2 The Stationary KAVACH shall able to handle upto 06 (Six) neighbouring stationary KAVACH systems communication simultaneously.

1.2.3 For an efficient handover, communication between two Stationary KAVACH systems is required when a train is about to move from one Stationary KAVACH supervision area to the adjacent one.



1.3 Configuration

1.3.1 The following table lists configuration data related to the exchange of messages for the SKAVACH-SKAVACH interface, which should be considered for offline agreement.

SNo	Configuration items	Description
1	System version applicable for the interface.	The applicable system version for the interface is the lowest operated by the neighbouring Stationary KAVACH (SOURCE_STN_ILC_IBS_VERSION)
2	Identity of the adjacent Stationary KAVACH	SOURCE_STN_ILC_IBS_ID
3	Identity of the border location	Overlap starting location and movement direction
4	Cycle time – health message	1s (configurable upto 2s in resolution of 50ms)
5	Primary or Secondary communication partner	To establish the communication session
6	Primary station IP address	xxx.yyy.aaa.bbb/ppppp aaa:bbb – Station ID (0xAABB)
7	Secondary station IP address	xxx.yyy.aaa.bbb/ppppp aaa:bbb – Station ID (0xAABB)
8	Communication transmission System	Open / Closed

*Since **Communication Transmission System is Open Transmission System, IP addresses shall be provided by concerned Railways. RDSO will issue TAN based on the field experiences**. Sample IP address allocation for IPv4 with inclusion of Stationary KAVACH Id in IP addresses is given in below table. It shall be ensured that same port number shall not be allotted to two different functions.*

Stationary KAVACH ID	Stationary KAVACH IP Address	Adjacent Stationary KAVACH – ID	Adjacent Stationary KAVACH – IP Address
503 in Hex format = 0x01F7. Host part of station IP address derived from station ID = 01.247 [0x01 .0xF7]	192.254.1.247/60001	500 (01.244)	192.254.01.244/60001
	192.255.1.247/60002	500 (01.245)	192.255.01.244/60002

2. Stationary KAVACH – Stationary KAVACH Handover

2.1.1 The SKAVACH-SKAVACH handover principles are such that trains are able to pass from one Stationary KAVACH area to another seamlessly. The communication session changes over of train during SKAVACH-SKAVACH handover shall not result in performance in penalities.

2.1.2 The Stationary KAVACH shall be able to handle SKAVACH-SKAVACH handover transactions which,

a) Multiple KAVACH equipped loco (Train) will follow each other (i.e. the first approaching train taken over before the following second train.

b) In special cases, some signal /track status are required to be sent from accepting Stationary KAVACH to handing over Stationary KAVACH.

c) Route and direction wise SKAVACH-SKAVACH handing over transaction is handled simultaneously.

d) If the signal is put back by handing over station, the accepting station shall not stop the handing over process.

2.2 Handing Over Stationary KAVACH

2.2.1 The Handing over Stationary KAVACH shall send train handover request message to accepting Stationary KAVACH when MA is required to extend beyond border Tag locationevery one second (Configurable) which shall include the following information:

a) The details of Border RFID Tag indicating the start of SKAVACH-SKAVACH boundary that will be passed by the train when entering the accepting Stationary KAVACH area.

b) Movement Authority and track profile to be sent from Border RFID Tag (in Sections).

c) DIST _TO_ Border Tag location

d) Loco to station regular packet

2.2.2 The Handing over Stationary KAVACH shall append the MA and track profile to the Onboard KAVACH received from Accepting Stationary KAVACH through the “Train RRI” message.

2.2.3 When the Handing Over Stationary KAVACH receives an onboard position report and detects that the Onboard KAVACH has Movement Authority upto the Border RIFD tag (border location) or beyond, it shall send next station ID to Onboard KAVACH to establish communication with next station after passing the Border RFID tag (border location).

2.2.4 After the receipt of "Train Taken Over" message from the Accepting Stationary KAVACH, the Handing over Stationary KAVACH shall deregister the Onboard KAVACH without the application de-registration time out.

2.2.5 When Handing Over Stationary KAVACH is unable to transmit Train Length Information to Onboard KAVACH before handing over, it shall send "Train Length Information" message which shall include the following information to the Accepting Stationary KAVACH.

a) Border RFID Tag

b) Onboard KAVACH Identity

c) Train length Information status

i) When the Handing Over Stationary KAVACH cannot detect train length, it shall send "No Train Length Info" in this field.

ii) When the Handing Over Stationary KAVACH did not receive acknowledgement for train length start frame from Onboard KAVACH, it shall send "Train Length Start frame" in this field.

iii) When the Handing Over Stationary KAVACH received acknowledgement for train length start frame, it shall send "Train Length end frame" in this field.

iv) When the Handing Over Stationary KAVACH did not receive acknowledgement for both train lengths start frame and train length end frame, it shall send "Train Length start frame" in this field. Subsequent to acknowledgement from the Accepting Stationary KAVACH, the Handing Over Stationary KAVACH shall send "Train Length End frame" till acknowledgement.

d) Train length measurement frame

e) Train length measurement frame offset

2.2.6 **Exception Condition (1)**: When the train handover is no longer required due to route cancellation or train diversion, the Handing Over Stationary KAVACH shall send "Train Hand Over Cancellation" message which shall include the following information to Accepting Stationary KAVACH.

a) The details of border RFID tag which indicates the beginning of Accepting Stationary KAVACH territory.

b) Onboard KAVACH ID whose handover request is being cancelled.

Accepting Stationary Kavach shall send "Acknowledgement" after reception "Train Hand Over Cancellation" message.

2.2.7 **Exception Condition (2)**: When there is a time out in communication between SKAVACH to SKAVACH, the Handing over Stationary KAVACH shall send SR Authority type to Onboard KAVACH, when it is required to extend MA and track profile beyond border tag.

2.2.8 **Exception Condition (3):** When Onboard KAVACH reads the Border Tag and SKAVACH-SKAVACH health is good, but "*Train taken over*" message is not received, the Handing Over Stationary KAVACH shall continue communication session till passing of entire train beyond the border Tag or MA hold time equaivalent to Communication timeout.

2.2.9 **Exception Condition (4):** When Onboard KAVACH does not read the Border Tag and SKAVACH-SKAVACH health is good, the Handing Over Stationary KAVACH shall continue communication session till passing of entire train beyond the border Tag or MA hold time equaivalent to Communication timeout.

2.2.10 **Exception Condition (5):** When there are multiple Onboard KAVACH on the route approaching the Border Tag in the same direction and SKAVACH-SKAVACH health is good, the Handing Over Stationary KAVACH shall request "*Train Handover Request*" message communicating the Onboard KAVACH ID of the first train only, till the first train crosses the Border Tag. The preceding train will get MA and Track Profile beyond Border Tag only after receipt of "*Train Taken Over*" message in favor of the first train from the Accepting Stationary KAVACH.

2.2.11 **Exception Condition (6):** When there are multiple Onboard KAVACH on the route approaching the Border Tag in the Opposite direction and SKAVACH-SKAVACH health is good, the Accepting Stationary KAVACH shall send MA as 0 and generate "Head on Collision" SoS.

2.2.12 **Exception Condition (7):** When there are multiple Onboard KAVACH on the route approaching the Border Tag and one train in the section beyond Border Tag moving in the Same direction and SKAVACH-SKAVACH health is good, the Accepting Stationary KAVACH shall send OS MA considering Rear End Collision and generate “Rear End Collision” SoS, when there is no signal in between the trains.

2.3 Accepting Stationary KAVACH

2.3.1 When the "Train Handover Request" Message is received, the Accepting Stationary KAVACH shall send the "Train RRI" message which shall include the following information to Handing Over Stationary KAVACH system.

a) The details of Border RFID tag indicating the start of the profile.

b) Reference Profile ID- Which shall be modified with every update of MA.

c) Onboard KAVACH Identity to which the MA and track profile is to be made applicable. The MA and track profile shall not be more than the number of sections requested by Handing Over Stationary KAVACH.

d) MA packet –

(i) If Onboard KAVACH is in SR Mode, OS MA is to be extended.

(ii) If Onboard KAVACH is in FS/OS/PT Mode and SIG_OV is '1', OS MA is to be extended.

(iii) If Onboard KAVACH is in FS/OS Mode and SIG_OV is '0', FS MA is to be extended.

e) The following information shall be sent with reference RFID as Border Tag

(i) Static Speed profile packet

(ii) Gradient profile packet

(iii) LC gate profile packet

(iv) Turn out Speed profile packet

(v) Tag linking packet

(vi) Track Condition packet

(vii) Temporary Speed Restrictions profile

2.3.2 When the train crosses the border tag location, Onboard KAVACH establishes communication with Accepting Stationary KAVACH. The Accepting Stationary KAVACH shall not process the packet till the Onboard KAVACH sends position report after Border RFID tag location. The Access Authority Packet shall not be sent to Onboard Kavach. The Accepting Stationary KAVACH shall establish the communication after receiving the train position report after Border Tag location. Subsequently, Accepting Stationary KAVACH shall send "*Train Taken Over*" message which shall include the following information to Handing Over Stationary KAVACH.

a) The details of border RFID tag where Handing Over Station KAVACH territory ends.

b) Onboard KAVACH ID whose responsibility is taken over.

2.3.3 When "**Train Handover Cancel**" message is received or "**Train Handover request**" message is not received for more than 10 seconds (Configurable), the Accepting Stationary KAVACH shall withdraw the extended MA and Track Profile for the corresponding Onboard KAVACH. Subsequently, on new "Train Handover request" for the same Onboard KAVACH ID or different Onboard KAVACH ID, the Accepting Stationary KAVACH shall extend the MA and track profile.

2.3.4 **Exception 8:** When the train is required to override stop signal at border tag location, the Accepting Stationary KAVACH shall check for the standstill/on run, day/night time, based on the speed of the Onboard KAVACH being taken over and type of signal being overridden respectively.

2.3.5 **Exception (9):** The Handing Over Stationary KAVACH shall send Message "Train Length Information" to Accepting Stationary KAVACH when the communication mandatory area is not available at least 1.5 km beyond the train length measuring track circuits. The Accepting Stationary KAVACH shall acknowledge the reciept of the same. These messages are not applicable to stationary KAVACH where train length measurement is not planned.

2.3.6 **Exception (10):** When Handing over Stationary KAVACH requests for MA and Track profile, the Accepting Stationary KAVACH shall fetch the data from the next Stationary KAVACH, if required. In such cases, when the handing over is cancelled, the Accepting Stationary KAVACH Shall inform the next Stationary KAVACH accordingly.

2.4 Onboard KAVACH

2.4.1 Once the border tag location is crossed, the Onboard KAVACH shall start communication session with the Accepting Stationary KAVACH. Simultaneously, it shall continue the communication session with Handing over Stationary KAVACH, till passing of entire train beyond the border Tag location or MA hold time equaivalent to Communication timeout. The accepting stationary KAVACH shall update MA subpacket (current signal aspect, approaching signal aspect etc.,) and track profile subpackets accordingly to Handing Over Stationary KAVACH in this period.

2.4.2 As soon as the Onboard KAVACH sends an onboard position report directly to the Accepting Stationary KAVACH with its front end having passed the border RFID tag (border location), it shall use information received from the Accepting Stationary KAVACH.

2.5 Stationary KAVACH – Stationary KAVACH Interface definition

2.5.1 The protocol stack is shown in the below figure.

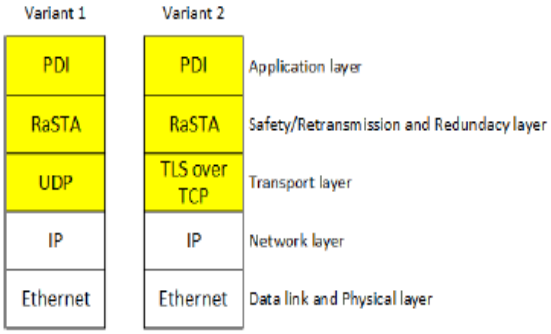
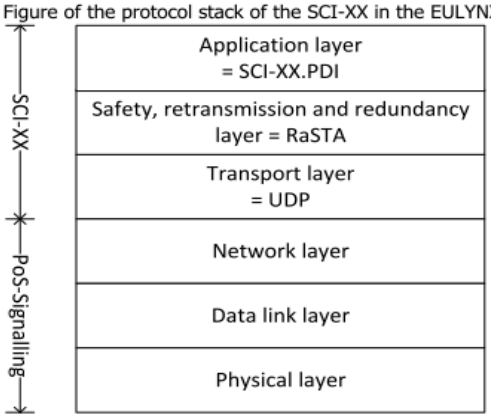


Figure of the protocol stack of the SCI-XX in the EULYNX System



2.5.2 The safety, retransmission and redundancy layers (safe communication according to EN 50159) shall be realised with the RaSTA protocol [RaSTA]. CRC of 32 BIT is to be followed for SIL-4 functionality.

2.5.3 The transport layer in SCI-XX shall be realised as two variants. Both variants shall be supported.

2.5.4 In variant 1, The transport layer in SCI-XX shall be realised with UDP and in variant 2, the transport layer shall be realised with TLS over TCP. Which of the two variants is used in a concrete application is defined by configuration.

2.5.5 The transport layer shall be realised with UDP.

2.5.6 The lower layers (network layer, data link layer and physical layer) are defined by the PoS-Signalling.

2.5.7 Communication Partner/Sub-system should support either two M-12 ethernet interfaces or two fiber interfaces for redundancy.

2.5.8 Communication Partner/Sub-system should support both IPv4 (M) and IPv6 (F).

3. Application Layer Requirements:

3.1 General

3.1.1 The communication connection between two communication partners at the application layer shall be designated as a PDI connection.

3.1.2 After a disconnection (in the lower layers of the protocol stack), Subsystem - SKAVACH and adjacent SKAVACH system shall attempt to re-establish communication within the time Tmax ≤ X ≤ Tmax + 20 %.

3.1.3 Simultaneous establishment of PDI connection has to be achieved by both the communication partners, before any other message can be transmitted on the interface. As long as the PDI connection is established, the following functions shall be available:

(a) both communication partners shall issue commands and/or messages according to the respective interface specifications.
(b) both communication partners shall receive and process commands and/or messages according to the respective interface specifications.
(c) both communication partners may only send telegrams which have been defined as valid for the aligned PDI version of the PDI connection**.**

3.2 For variant 1 of UDP, there is 1 RaSTA configuration. (F)

3.2.1 **RaSTA configuration for UDP**

(i) It is assumed that RaSTA parameters are related to Tmax according to the following formula: $T_{max} > 3*T_h + 2*(T_a + T_b) + T_{seq}$ plus sufficient margin. (T_a and T_b are transmission times)

(ii) T_{max}
A message shall be received within T_{max} after sending (Max acceptage of message).
T_{max} =1800 ms

(iii) T_h
Th is the heartbeat interval. T_h = 300 ms.

(iv) Safety Code
Safety Code = 'option 2' in RaSTA (Lower half of MD4)
The initialisation value for MD4 is project specific.

(v) Nsendmax

A communication partner shall not send more than N sendmax messages without an acknowledgement received (receivebuffersize).

This value is exchanged among communication partners during initialisation and can be interpreted as receive buffer minimum size.

N SENDMAX = 20

(vi) MWA

A communication partner shall send an acknowledgement after receiving MWA messages (AcknowledgeWindow).

MWA < N sendmax

MWA = 10

(vii) NmaxPaket

N maxPaket determines how many user messages may be combined to a single Safety/Retransmission layer packet.

Nmaxpaket=1

(viii)NdiagWindow

N diagWindow defines the channel quality measurement window.

NOTE: The value of NdiagWindow shall be defined by national Specifications. The recommended default value is ***N diagWindow = 5000***

3.2.2 Redundancy layer configuration

(i) **Number of physical channels** Two Number of channels used for communication in transport layer. One channel means no redundancy.

(ii) Check code CHECK CODE = 'OPTION A' IN RaSTA(NO CHECK CODE)

(iii) **TSEQ**

T SEQ defines the amount of time a message, received off the channels sequence, is stored (DeferTime).

(iv) **NDIAGNOSE**

N Diagnose defines the Redundancy layers diagnostic message window.

NDIANOSE =200

(v) **NDEFERQUEUESIZE**

N deferQueueSize defines the maximum number of entries in the deferQueue.

NdeferQueueSize = 4

3.3 Communication partner requirements

The PDI connection is a connection between two communication partners. Any one Station KAVACH shall act as primary communication partner and the other Station KAVACH shall act as secondary communication partner. This is required to be specified in stationary KAVACH configuration.

The primary communication partner shall have the role to:

i. Initiate the establishment of the PDI connection

ii. Supervise the PDI connection for connection losses (by means of RaSTA)

iii. Re-establish the PDI connection after a connection loss

3.4 Establishing the PDI connection:

3.4.1 The PDI connection is a connection between Stationary KAVACH (Primary Communication partner) and Neighbour Stationary KAVACH (Secondary Communication partner). As soon as the primary communication partner has achieved safe operation (according to the assigned SIL level), the safe communication shall be established in accordance with the specifications in [RaSTA].

3.4.2 The primary communication partner shall send a command PDI-Version check, including the configured version of the Process Data Interface protocol (PDIVer), to the secondary communication partner as soon as the safe communication is available.

3.4.3 When the secondary communication partner receives the command PDI-Version check, it shall

i. Compare the reported PDI-Version sent by the primary communication partner to its own version, and

ii. Send to the primary communication partner a message PDI-Version check, containing the result of the PDI-Version comparison, the version of the Process Data Interface protocol (PDIVer) it has configured and checksum data.

3.4.4 When the primary communication partner receives the message PDI-Version check, it shall:

i. Check the PDI-Version comparison result, and

ii. Compare the reported checksum data sent by the secondary communication partner with its own stored checksum data.

3.4.5 If the PDI-Version comparison is a match and the checksum data are identical or not applicable, the primary communication partner shall send heart beat message to the secondary communication partner.

3.4.6 If the safe communication to the secondary communication partner terminates, the primary communication partner shall re-establish the connection in accordance with [RaSTA] unless specified otherwise for individual cases.

3.4.7 The PDI connection is established if the following conditions are satisfied:

i. the safe communication to the communication partner is available

ii. the PDIVer shall be identical for both communication partners

iii. the checksum data shall be identical or not applicable for both communication partners

3.4.8 As long as the PDI connection is established, the following functions shall be available:

i. both communication partners shall issue commands and/or messages

ii. both communication partners shall receive and process commands and/or messages

iii. both communication partners may only send telegrams which have been defined as valid for the aligned PDI version of the PDI connection.

3.4.9 If the PDI Version comparison gives a negative result, the primary communication partner shall terminate the safe communication. If the checksum data are not identical, the primary communication partner shall terminate the safe communication.

3.4.10 If the establishment of the PDI connection, measured from the sending of the command PDI-Version check the receipt of the message Initialisation Completed is not completed within a configurable time, the safe communication shall be terminated. A diagnostic message shall be issued. The safe communication is re-established in accordance with [RaSTA]. The default value for the configurable time is 20s.

3.5 Telegram structure

Byte No	Element Name	Size (in bytes)
00	Specific protocol	1 byte binary
01..02	Message type	2 bytes binary
03..22	Sender identifier	20 bytes binary (ISO/IEC 8859-1:1998)
23..42	Receiver identifier	20 bytes binary (ISO/IEC 8859-1:1998)
43..44	Message Length	2 bytes binary
45..1023	Payload	Max 979 bytes

The value of byte “00” shall be:

Value	Meaning
0xF0	Stationary KAVACH – Stationary KAVACH
0xF1	Stationay KAVACH to Remote Interface Unit (Future Use)

3.6 Sender/Receiver Identifier (F):

3.6.1 The technical identifier shall be unique. The following scheme shall be implemented

i. [country code] [area designator] [system type] [code][tag][sequence no]

Country code: 2 characters ISO IEC 8859-1:1998 (ISO 3166 Alpha-2), left justified IN (India)

Area designator: 5 characters ISO IEC 8859-1:1998, left justified, empty space to be filled with underscore (0X5F)

ii. First five characters of the division name (Ex: SECUN)

System type: 5 characters ISO IEC 8859-1:1998, left justified, empty space to be filled with underscore (0X5F), as per list below for KAVACH: KAVACH

For CTC: TCS__

Code: 2 characters:

iii. Station ID (in Hexa decimal format 0-255) (in EULYNX it's a 2 character ASCII code with 99 decimal values) Tag: 2 characters ISO IEC 8859-1:1998, fixed "##"

Sequence no.: 4 characters ISO IEC 8859-1:1998 decimal, empty spaces filled with "0"

It is the unique system ID in this location (16 bit) for each equipment.

If there are multiple EIs or axle counters (Train Detection system) in one station each system of the type shall be given a unique number.

Example:

A Subsystem - Generic IO 5 in Germany in area HG2_X in operating location 37 has the identifier:

[country code][area designator][system type][code][tag][sequence no] DEHG2_XIO___37##0005.

Note: The applied byte order shall be Little-Endian

3.7 Messages exchanged with adjacent Stationary KAVACH

Message Type	Value	Purpose
Command PDI version check	0x0101	Request to check PDI version
Message PDI version check	0x0102	Answer to check PDI version request.
Heart Beat message	0x0103	Stationary KAVACH shall transmit heart beat message periodically to adjacent stationary KAVACH
Train Handover Request Message	0x0104	Stationary KAVACH shall transmit Train handover message to Adjacent Stationary KAVACH system when a Onboard KAVACH handover is required
Train RRI Message	0x0105	Stationary KAVACH shall transmit Train Route Related Information (RRI) message to Adjacent Stationary KAVACH system when handover request

		message is received
Train Taken Over Message	0x0106	Accepting stationary KAVACH shall send this message to Handing over stationary KAVACH as a response to Train Handover Request Message when Accepting Stationary KAVACH detects that border tag is passed by the Train and responsibility is taken over.
Train Handover Cancellation message	0x0107	Handing over stationary KAVACH shall send this message to Accepting stationary KAVACH when Handing over Stationary KAVACH detects that train handover is no longer required.
Train Length Information message	0x0108	Handing over stationary KAVACH shall send this message to Accepting stationary KAVACH when Stationary KAVACH is unable to transmit Train Length Information to Onboard KAVACH before handing over.
Train Length Acknowledgement	0x0109	It is an acknowledge message to Train Length information received from neighbouring stationary KAVACH
TSL Route Request message	0x010A	Handing over stationary KAVACH shall send this message to Accepting stationary KAVACH when TSL request is made by SM for traffic diversion.
TSL Information message	0x010B	It is TSL reply message from Accepting Stationary KAVACH as a response to TSL Route Request message
Field Elements Status Request message	0x010C	Handing over / Accepting stationary KAVACH can request the field inputs from Accepting / Handing over Stationary KAVACH only when enabled in configuration.
Field Elements Status message	0x010D	On reception of Field Elements Status Request message either by Handing over or Accepting

		stationary KAVACH, it shall send the required relays status information as a response. The required relays shall be configurable in stationary KAVACH database.
Train Handover Cancellation Acknowledgement message	0x010E	Accepting stationary KAVACH shall send this message to Handing over stationary KAVACH requests for cancellation when Handing over Stationary KAVACH sends train handover cancellation message.

3.8 Command "PDI-Version check" (Primary Stationary KAVACH --> Secondary Stationary KAVACH)

Byte No	Element Name	Size (in Bytes)	Description
00	Specific protocol	1 byte binary	F0
01..02	Message type (0x0101)	2 bytes binary	Bytes 01 and 02 shall be set to 0x0101
03..22	Sender identifier	(20 Byte)	Stationary KAVACH ID
23..42	Receiver identifier	(20 Byte)	Neighbour Stationary KAVACH ID
43..44	Message Length	2 bytes binary	The message length shall be of 2 bytes binary
45	PDI version of primary Stationary KAVACH	1 byte binary	(SOURCE_STN_ILC_IBS_VERSION)
46..47	Primary Stationary KAVACH Random Number (Rp)	(2 Byte)	When Communication transmission system is open transmission system, this random number shall be used for session key derivation. Otherwise, this shall be filled with zeros.

Sample Data for the above:

0xF0,0x01,0x01,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x0
0,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x11,0x00,0x00,0x00,0x00,0
x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00
,0x02,0x10,0x00,0x30,0x02,0xrr,0xrr

-> for initial session key derivation.

0xF0,0x01,0x01,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x0
0,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x11,0x00,0x00,0x00,0x00,0
x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00
,0x02,0x10,0x00,0x30,0x02,0x00,0x00 -> for regular transmission.

3.9 Message "PDI-Version check" (Secondary Stationary KA-VACH --> Primary Stationary KAVACH)

Byte No	Element Name	Size (in Bytes)	Description
00	Specific protocol	1 byte binary	F0
01..02	Message type (0x0102)	2 bytes binary	Bytes 01 and 02 shall be set to 0x0102
03..22	Sender identifier	20 Byte	Stationary KAVACH ID
23..42	Receiver identifier	20 Byte	Neighbour Stationary KAVACH ID
43..44	Message Length	2 bytes binary	The message length shall be of 2 bytes binary
45	Result PDI version check	1 byte binary	0x01 –PDI version -Not OK 0x02- PDI version - OK
46	PDI version of Secondary Stationary KAVACH	1 byte binary	(SOURCE_STN_ILC_IBS_VERSION)
47..48	Secondary Stationary KAVACH Random Number (Rs)	2 Byte	When Communication transmission system is open transmission system, this random number shall be used for session key derivation. Otherwise, this field shall be filled with zeros.
49..52	MAC-CODE	4 bytes binary	MAC-Code based on AES-128 encryption.

Sample Data for the above:

0xF0,0x01,0x02,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x10,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x11,0x00,0x35,0x02,0x02,0xrr,0xrr,0xMACMSByte,0xMAC, 0xMAC, 0xMACLSByte

-> for initial session key derivation.

3.10 Message "Heart Beat"

The Stationary KAVACH shall send this message to adjacent Stationary KAVACH systems periodically (configurable value from 0.1s to 2s).

Byte Number	Data Structure Element Name	Size (in Bytes)	Description
00	Specific Protocol	1 byte binary	F0
01..02	Message Type: 0x0103	(2 Bytes binary)	Bytes 01 and 02 shall be set to 0x0103.
03..22	Sender: Primary/ Secondary S-KAVACH	(20 Bytes binary)	The message bytes shall contain the primary or secondary station KAVACH ID which is transmitting this message
23..42	Receiver: Secondary/ Primary S-KAVACH	(20 Bytes binary)	The message bytes shall contain the secondary station KAVACH ID which is receiving this message
43..44	Message Length	2 bytes binary	The message length shall be of 2 bytes binary

Byte Number	Data Structure Element Name	Size (in Bytes)	Description
45..47	Frame Number	(3 Bytes binary)	The message bytes shall contain the time stamp in the below format. 1 to 86400 ((hr * 3600 + mm * 60 + ss)+ 1) Example: 00:00:00 - Frame No 1 00:00:02 - Frame No. 3 ..... 23:59:58 - Frame No 86399
48..49	Message sequence number	(2 Bytes binary)	This is the message sequence number to be incremented for every message transmitted to receiver.
50..53	MAC-CODE	(4 bytes binary)	4 bytes binary. MAC-Code based on AES-128 encryption.

Sample Data for the above

0xF0,0x01,0x03,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x11,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x10,0x00,0x36,0x00 (frame number),0xA8 (frame number),0xB8 (frame number), 0x52(sequence number),0xE6(sequence number), 0xMACMSByte,0xMAC, 0xMAC, 0xMACLSByte.

3.11 Message "Train Handover Request"

Any partner shall send this message when a train is required to be handed over to the neighbouring stationary KAVACH.

Byte Number	Data Structure element name	Size (in Bytes)	Description
00	Specific protocol	1 byte binary	F0
01..02	Message Type: 0x0104	(2 Bytes binary)	Bytes 01 and 02 shall be set to 0x0104.
03..22	Sender: Primary/	(20 Bytes bi-	The message bytes

Byte Number	Data Structure element name	Size (in Bytes)	Description
	Secondary SKAVACH	nary)	shall contain the primary or secondary station KAVACH ID which is transmitting this message
23..42	Receiver: Secondary/ Primary SKAVACH	(20 Bytes binary)	The message bytes shall contain the secondary station KAVACH ID which is receiving this message
43..44	Message length	(2 Bytes binary)	
45..47	Frame Number	(3 Bytes binary)	The message bytes shall contain the time stamp in the below format. 1 to 86400 ((hr * 3600 + mm * 60 + ss)+ 1) Example: 00:00:00 - Frame No 1 00:00:02 - Frame No. 3 …… 23:59:58 - Frame No 86399
48..49	Message sequence number	(2 Bytes binary)	This is the message sequence number to be incremented for every message transmitted to receiver.
50..51	Border RFID Tag	(2 Bytes binary)	Reference RFID from where adjacent station boundary starts.
52	Movement Authority From Border RFID Tag (in Sections)	(1 Byte binary)	0x01-1 section 0x02-2 sections 0x03-3 sections. ….
53..54	DIST _TO_ Border Tag location	(2 Byte Binary)	This is the distance from last read tag by onboard KAVACH to Border RFID tag location .

Byte Number	Data Structure element name	Size (in Bytes)	Description
55..75	Loco to station regular packet	(21 Bytes binary)	The packet shall be same as that available in C 5.3 i.e., Onboard to Station Regular Packet except MAC_CODE and PKT_CRC
76..79	MAC-CODE	(4 bytes binary)	4 bytes binary. MAC-Code based on AES-128 encryption.

Sample Data for the above

0xF0,0x01,0x04,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x11,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x10, 0x00 (message length), 0x4F (message length), 0x00(frame number),0xA8 (frame number),0xB8 (frame number), 0x52(sequence number),0xE6(sequence number), 0x02 (Border Tag),0xC7 (Border Tag), 0x03(MA in sections), ,0xd3d2, 0xd1d0 (distance to border Tag), -21 bytes LSRP, 0xMACMSByte,0xMAC, 0xMAC, 0xMACLSByte

3.12 Message "Train RRI Information"

Byte Number	Data Structure Element Name	Size (in Bytes)	Description
00	Specific protocol	1 byte binary	F0
01..02	Message Type: 0x0105	(2 Bytes binary)	Bytes 01 and 02 shall be set to 0x0105.
03..22	Sender: Primary/ Secondary SKAVACH	(20 Bytes binary)	The message bytes shall contain the primary or secondary station KAVACH ID which is transmitting this message
23..42	Receiver: Secondary/ Primary SKAVACH	(20 Bytes binary)	The message bytes shall contain the secondary station KAVACH ID which is receiving this message
43..44	Message Length	(2 Bytes binary)	
45..47	Frame Number	(3 Bytes bina-	The message bytes shall con-

Byte Number	**Data Structure Element Name**	**Size (in Bytes)**	**Description**
		ry)	tain the time stamp in the below format. 1 to 86400 ((hr * 3600 + mm * 60 + ss)+ 1) Example: 00:00:00 - Frame No 1 00:00:02 - Frame No. 3 …… 23:59:58 - Frame No 86399
48..49	Message sequence number	(2 Bytes binary)	This is the message sequence number to be incremented for every message transmitted to receiver.
50..51	Border RFID	(2 Bytes binary)	Reference RFID from where adjacent station boundary starts.
52	REF_PROFILE_ID	(1 Byte binary)	0x01 .. 0xFF On every update of MA, the reference profile ID shall be changed.
53..55	Onboard KAVACH Identity	(3 Bytes binary)	The message bytes shall contain the Onboard KAVACH ID which is required to be handed over.
56..a	MA packet Static Speed profile packet Gradient profile packet LC Gate profile packet Turn out Speed profile packet Tag linking packet Track Condition packet TSR packet	(m Bytes binary)	The packets shall be same as that available in C 5.2 i.e., Stationary KAVACH to Onboard KAVACH regular packet.
a+1..a+	MAC-CODE	(4 bytes bina-	4 bytes binary. MAC-Code

Byte Number	Data Structure Element Name	Size (in Bytes)	Description
4		ry)	based on AES-128 encryption.

Sample Data for the above

0xF0,0x01,0x05,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x11,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x10, 0xml (message length dynamic),0xml (message length dynamic), 0x00(frame number),0xA8(frame number),0xB8 (frame number), 0x52(sequence number),0xE6(sequence number), 0x02 (Border Tag),0xC7 (Border Tag), 0x02 (Ref Profile ID), 0x00(Onboard Kavach ID), 0x6D (Onboard Kavach ID),0x70 (Onboard Kavach ID),--m Bytes binary SORP---,0xMACMSByte,0xMAC, 0xMAC, 0xMACLSByte.

3.13 Message "Train Taken Over"

The Accepting Stationary KAVACH shall send this message when responsibility is taken over after passing border Tag.

Byte Number	Data Structure element name	Size (in Bytes)	Description
00	Specific protocol	1 byte binary	F0
01..02	Message Type: 0x0106	(2 Bytes binary)	Bytes 01 and 02 shall be set to 0x0106
03..22	Sender: Primary/ Secondary SKAVACH	(20 Bytes binary)	The message bytes shall contain the primary or secondary station KAVACH ID which is transmitting this message
23..42	Receiver: Secondary/ Primary SKAVACH	(20 Bytes binary)	The message bytes shall contain the secondary station KAVACH ID which is receiving this message
43..44	Message Length	(2 Bytes binary)	
45..47	Frame Number	(3 Bytes binary)	The message bytes shall contain the time stamp in the below format. 1 to 86400 ((hr * 3600 + mm * 60 + ss)+ 1) Example:

Byte Number	Data Structure element name	Size (in Bytes)	Description
			00:00:00 - Frame No 1 00:00:02 - Frame No. 3 …… 23:59:58 - Frame No 86399
48..49	Message sequence number	(2 Bytes binary)	This is the message sequence number to be incremented for every message transmitted to receiver.
50..51	Border RFID Tag	(2 Bytes binary)	Reference RFID from where adjacent station boundary starts.
52..54	Onboard KAVACH Identity	(3 Bytes binary)	These bytes shall contain the Onboard KAVACH ID whose responsibility is taken over.
55..58	MAC-CODE	(4 bytes binary)	4 bytes binary. MAC-Code based on AES-128 encryption.

Sample Data for the above

0xF0,0x01,0x06,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x11,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x10, 0x00 (message length),0x3A (message length), 0x00(frame number),0xA8(frame number),0xB8 (frame number), 0x52(sequence number),0xE6(sequence number), 0x02 (Border Tag),0xC7 (Border Tag),0x00(Onboard Kavach ID), 0x6D (Onboard Kavach ID),0x70 (Onboard Kavach ID),0xMACMSByte,0xMAC, 0xMAC, 0xMACLSByte.

3.14 Message "Train Hand Over Cancellation"

The Handing Over stationary KAVACH shall send this message when train handover is no longer required due to route cancellation or train diversion.

Byte Number	Data Structure element name	Size (in Bytes)	Description
00	Specific protocol	1 byte binary	F0
01..02	Message Type: 0x0107	(2 Bytes binary)	Bytes 01 and 02 shall be set to 0x0107
03..22	Sender: Primary/ Secondary SKAVACH	(20 Bytes binary)	The message bytes shall contain the primary or secondary station KAVACH ID

Byte Number	Data Structure element name	Size (in Bytes)	Description
			which is transmitting this message
23..42	Receiver: Secondary/ Primary SKAVACH	(20 Bytes binary)	The message bytes shall contain the secondary station KAVACH ID which is receiving this message
43..44	Message Length	(2 Bytes binary)	
45..47	Frame Number	(3 Bytes binary)	The message bytes shall contain the time stamp in the below format. 1 to 86400 ((hr * 3600 + mm * 60 + ss) + 1) Example: 00:00:00 - Frame No 1 00:00:02 - Frame No. 3 …… 23:59:58 - Frame No 86399
48..49	Message sequence number	(2 Bytes binary)	This is the message sequence number to be incremented for every message transmitted to receiver.
50..51	Border RFID Tag	(2 Bytes binary)	Reference RFID from where adjacent station boundary starts.
52..54	Onboard KAVACH Identity	(3 Bytes binary)	These bytes shall contain the Onboard KAVACH ID for which handover is cancelled.
55..58	MAC-CODE	(4 bytes binary)	4 bytes binary. MAC-Code based on AES-128 encryption.

Sample Data for the above

0xF0,0x01,0x07,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x11,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x10, 0x00 (message length),0x3A (message length), 0x00(frame number),0xA8(frame number),0xB8 (frame number), 0x52(sequence number),0xE6(sequence number), 0x02 (Border Tag),0xC7 (Border Tag),0x00(Onboard Kavach ID), 0x6D (Onboard Kavach ID),0x70 (Onboard Kavach ID),0xMACMSByte,0xMAC, 0xMAC, 0xMACLSByte.

3.15 Message "Train Length Information"

Byte Number	Data Structure element name	Size (in Bytes)	Description
00	Specific protocol	1 byte binary	F0
01..02	Message Type: 0x0108	(2 Bytes binary)	Bytes 01 and 02 shall be set to 0x0108
03..22	Sender: Primary/ Secondary SKAVACH	(20 Bytes binary)	The message bytes shall contain the primary or secondary station KAVACH ID which is transmitting this message
23..42	Receiver: Secondary/ Primary SKAVACH	(20 Bytes binary)	The message bytes shall contain the secondary station KAVACH ID which is receiving this message
43..44	Message Length	(2 Bytes binary)	
45..47	Frame Number	(3 Bytes binary)	The message bytes shall contain the time stamp in the below format. 1 to 86400 ((hr * 3600 + mm * 60 + ss)+ 1) Example: 00:00:00 - Frame No 1 00:00:02 - Frame No. 3 …… 23:59:58 - Frame No 86399
48..49	Message sequence number	(2 Bytes binary)	This is the message sequence number to be incremented for every message transmitted to receiver.
50..51	Border RFID Tag	(2 Bytes binary)	Reference RFID from where overlap section starts.
52..54	Onboard KAVACH Identity	(3 Bytes binary)	The message bytes shall contain the Onboard KAVACH ID which is required to be handed over.
55	Train length Information status	(1 Byte binary)	0x00 – No Train Length Info, 0x01 – Train Length start frame, 0x02– Train Length end frame.
56..58	Train length	(3 Bytes binary)	1 to 86400

Byte Number	Data Structure element name	Size (in Bytes)	Description
	measurement frame		Frame no.1 –0x 00 00 01 Frame no.3- … Frame no. 4095-0x 00 0F FF … Frame no. 86399-0x 01 51 7F
59	Train length measurement frame offset	(1 Byte binary)	0 to 200 (10 ms) resolution 0x00-0 0x01-1 …. 0xC8-200 0xC9 to 0x FF – reserved.
60..63	MAC-CODE	(4 bytes binary)	4 bytes binary. MAC-Code based on AES-128 encryp-tion.

Sample Data for the above

0xF0,0x01,0x08,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x11,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x10, 0x00 (message length),0x3F (message length), 0x00(frame number),0xA8(frame number),0xB8 (frame number), 0x52(sequence number),0xE6(sequence number), 0x02 (Border Tag),0xC7 (Border Tag),0x00(Onboard Kavach ID), 0x6D (Onboard Kavach ID),0x70 (Onboard Kavach ID),0xTL (TL Status),0x00(TL measurement frame),0xA8(TL measurement frame),0xB8 (TL measurement frame),0x8F (TL measurement offset), 0xMACMSByte,0xMAC, 0xMAC, 0xMACLSByte..

3.16 Message "Train Length Acknowledgement"

The Stationary KAVACH shall send this message as an acknowledge to Train length information message received from adjacent stationary KAVACH.

Byte Number	Data Structure Element Name	Size (in Bytes)	Description
00	Specific protocol	1 byte binary	F0
01..02	Message Type: 0x0109	(2 Bytes bina-ry)	Bytes 01 and 02 shall be set to 0x0109
03..22	Sender: Primary/ Secondary SKA-VACH	(20 Bytes bina-ry)	The message bytes shall contain the primary or sec-ondary station KAVACH ID

Byte Number	Data Structure Element Name	Size (in Bytes)	Description
			which is transmitting this message
23..42	Receiver: Secondary/ Primary SKAVACH	(20 Bytes binary)	The message bytes shall contain the secondary station KAVACH ID which is receiving this message
43..44	Message Length	(2 Bytes binary)	
45..47	Frame Number	(3 Bytes binary)	The message bytes shall contain the time stamp in the below format. 1 to 86400 ((hr * 3600 + mm * 60 + ss)+ 1) Example: 00:00:00 - Frame No 1 00:00:02 - Frame No. 3 …… 23:59:58 - Frame No 86399
48..49	Message sequence number	(2 Bytes binary)	This is the message sequence number to be incremented for every message transmitted to receiver.
50..51	Border RFID Tag	(2 Bytes binary)	Reference RFID from where overlap section starts.
52..54	Onboard KAVACH Identity	(3 Bytes binary)	The bytes shall contain the Onboard KAVACH ID which TLM information is received
55	Train Length information	(1 Byte Binary)	0x00- No Train length info. 0x01- Train length start frame. 0x02-Train length end frame
56..59	MAC-CODE	(4 bytes binary)	4 bytes binary. MAC-Code based on AES-128 encryption.

Sample Data for the above:

0xF0,0x01,0x09,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x11,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x10, 0x00 (message length),0x3A (message length), 0x00(frame

number),0xA8(frame number),0xB8 (frame number), 0x52(sequence number),0xE6(sequence number), 0x02 (Border Tag),0xC7 (Border Tag),0x00(Onboard Kavach ID), 0x6D (Onboard Kavach ID),0x70 (Onboard Kavach ID), 0x01, 0xMACMSByte,0xMAC, 0xMAC, 0xMACLSByte.

3.17 Message "TSL Request"

Handing over stationary KAVACH shall send this message to Accepting stationary KAVACH when the requirement of temporary single line (TSL) working on double line (in between the stations having crossover facility) arises. This request is initiated by Station Master through suitable interface with Stationary KAVACH.

Byte Number	Data Structure element name	Size (in Bytes)	Description
00	Specific protocol	1 byte binary	F0
01..02	Message Type: 0x010A	(2 Bytes binary)	Bytes 01 and 02 shall be set to 0x010A
03..22	Sender: Primary/ Secondary SKAVACH	(20 Bytes binary)	The message bytes shall contain the primary or secondary station KAVACH ID which is transmitting this message
23..42	Receiver: Secondary/ Primary SKAVACH	(20 Bytes binary)	The message bytes shall contain the secondary station KAVACH ID which is receiving this message
43..44	Message Length	(2 Bytes binary)	
45..47	Frame Number	(3 Bytes binary)	The message bytes 43..45 shall contain the time stamp in the below format. 1 to 86400 ((hr * 3600 + mm * 60 + ss)+ 1) Example: 00:00:00 - Frame No 1 00:00:02 - Frame No. 3 …… 23:59:58 - Frame No 86399
48..49	Message sequence number	(2 Bytes binary)	This is the message sequence number to be incremented for every message

Byte Number	Data Structure element name	Size (in Bytes)	Description
			transmitted to receiver.
50..51	Border RFID Tag	(2 Bytes binary)	Reference RFID where border between two stations exists
52..54	Onboard KAVACH Identity	(3 Bytes binary)	The message bytes shall contain the Onboard KAVACH ID which is required to be handed over.
55	TSL Route Id	(2 Byte binary)	Signalling Route for which TSL working is requested with next station
56..58	MAC-CODE	(4 bytes binary)	4 bytes binary. MAC-Code based on AES-128 encryption.

Sample Data for the above:

0xF0,0x01,0x0A,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x11,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x10, 0x00 (message length),0x3A (message length), 0x00(frame number),0xA8(frame number),0xB8 (frame number), 0x52(sequence number),0xE6(sequence number), 0x02 (Border Tag),0xC7 (Border Tag),0x00(Onboard Kavach ID), 0x6D (Onboard Kavach ID),0x70 (Onboard Kavach ID),0xAA (TSL Route ID), 0xMACMSByte,0xMAC, 0xMAC, 0xMACLSByte

3.18 Message "TSL Authority"

The Accepting Stationary KAVACH shall send this message as a reply to TSL Request message received from Handing over stationary KAVACH.

Byte Number	Data Structure Element Name	Size (in Bytes)	Description
00	Specific protocol	1 byte binary	F0
01..02	Message Type: 0x010B	(2 Bytes binary)	Bytes 01 and 02 shall be set to 0x01-0B.
03..22	Sender: Primary/ Secondary SKAVACH	(20 Bytes binary)	The message bytes shall contain the primary or secondary station KAVACH ID which is transmitting this message

Byte Number	Data Structure Element Name	Size (in Bytes)	Description
23..42	Receiver: Secondary/ Primary SKAVACH	(20 Bytes binary)	The message bytes shall contain the secondary station KAVACH ID which is receiving this message
43..44	Message Length	(2 Bytes binary)	
45..47	Frame Number	(3 Bytes binary)	The message bytes 43..45 shall contain the time stamp in the below format. 1 to 86400 ((hr * 3600 + mm * 60 + ss)+ 1) Example: 00:00:00 - Frame No 1 00:00:02 - Frame No. 3 …… 23:59:58 - Frame No 86399
48..49	Message sequence number	(2 Bytes binary)	This is the message sequence number to be incremented for every message transmitted to receiver.
50..51	Border RFID Tag	(2 Bytes binary)	Reference RFID where border between two stations exists
52..54	Onboard KAVACH Identity	(3 Bytes binary)	The message bytes shall contain the Onboard KAVACH ID which is required to be handed over.
55	TSL Route Request Reply	(1 Bytes binary)	0x00: TSL working not authorised for requested route 0x01: TSL working authorised for requested route
56..59	MAC-CODE	(4 bytes binary)	4 bytes binary. MAC-Code based on AES-128 encryption.

Sample Data for the above:

0xF0,0x01,0x0B,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x11,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x10, 0x00 (message length),0x3B (message length), 0x00(frame number),0xA8(frame number),0xB8 (frame number), 0x52(sequence number),0xE6(sequence number), 0x02 (Border Tag),0xC7 (Border Tag),0x00(Onboard Kavach ID), 0x6D (Onboard Kavach ID),0x70

(Onboard Kavach ID),0x01 (TSL Route Request Reply), 0xMACMSByte,0xMAC, 0xMAC, 0xMACLSByte.

3.19 Message "Field Elements Status Request"

The Stationary KAVACH shall send this message to required adjacent Stationary KAVACH systems periodically for every 1 second (configurable). When disabled in the station configuration, this request shall not be transmitted.

Byte Number	Data Structure element name	Size (in Bytes)	Description
00	Specific protocol	1 byte binary	0xF0
01..02	Message Type: 0x010C	(2 Bytes binary)	Bytes 01 and 02 shall be set to 0x010C.
03..22	Sender: Primary/ Secondary SKAVACH	(20 Bytes binary)	The message bytes shall contain the primary or secondary station KAVACH ID which is transmitting this message
23..42	Receiver: Secondary/ Primary SKAVACH	(20 Bytes binary)	The message bytes shall contain the secondary station KAVACH ID which is receiving this message
43..44	Message length	(2 Bytes binary)	
45..47	Frame Number	(3 Bytes binary)	The message bytes shall contain the time stamp in the below format. 1 to 86400 ((hr * 3600 + mm * 60 + ss)+ 1) Example: 00:00:00 - Frame No 1 00:00:02 - Frame No. 3 …… 23:59:58 - Frame No 86399
48..49	Message sequence number	(2 Bytes binary)	This is the message sequence number to be

Byte Number	Data Structure element name	Size (in Bytes)	Description
			incremented for every message transmitted to receiver.
50..53	MAC-CODE	(4 bytes binary)	4 bytes binary. MAC-Code based on AES-128 encryption.

Sample Data for the above:

0xF0,0x01,0x0C,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00, 0x00, 0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x10,0x00,0x00,0x00,0x00,0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,0x00,0x00,0x00,0x02,0x11, 0x00 (message length), 0x37(message length), 0x00(frame number), 0xA8(frame number),0xB8 (frame number), 0x52(sequence number),0xE6(sequence number), 0x02 (Border Tag),0xC7 (Border Tag),0xMACMSByte,0xMAC, 0xMAC, 0xMACLSByte

3.20 Message "Field Elements Status"

The Stationary KAVACH shall send this message to adjacent Stationary KAVACH systems periodically for every 1 second (configurable).

Byte Number	Data Structure Element Name	Size (in Bytes)	Description
00	Specific protocol	1 byte binary	0xF0
01..02	Message Type: 0x010D	(2 Bytes binary)	Bytes 01 and 02 shall be set to 0x010D.
03..22	Sender: Primary/ Secondary SKAVACH	(20 Bytes binary)	The message bytes shall contain the primary or secondary station KAVACH ID which is transmitting this message
23..42	Receiver: Secondary/ Primary SKAVACH	(20 Bytes binary)	The message bytes shall contain the secondary station KAVACH ID which is receiving this message
43..44	Message length	(2 Bytes binary)	
45..47	Frame Number	(3 Bytes bi-	The message bytes shall con-

Byte Number	Data Structure Element Name	Size (in Bytes)	Description
		nary)	tain the time stamp in the below format. 1 to 86400 ((hr * 3600 + mm * 60 + ss)+ 1) Example: 00:00:00 - Frame No 1 00:00:02 - Frame No. 3 ..... 23:59:58 - Frame No 86399
48..49	Message sequence number	(2 Bytes binary)	This is the message sequence number to be incremented for every message transmitted to receiver.
50..51	Total field elements (f)	(2 Bytes binary)	The message bytes shall contain the number of elements configured in the database
52..m	All Field Elements Data	(m = roundoff (f/8) bytes binary)	The message bytes shall contain the image of all elements status as per element address. Bit position indicates address and bit value indicates the element status (0-picked up, 1- dropped)
m+1.. m+4	MAC-CODE	(4 bytes binary)	4 bytes binary. MAC-Code based on AES-128 encryption.

Sample Data for the above

0xF0,0x01,0x0D,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x11,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x10, 0xml (message length dynamic),0xml (message length dynamic), 0x00(frame number),0xA8(frame number),0xB8 (frame number), 0x52(sequence number),0xE6(sequence number), 0x02 (Border Tag),0xC7 (Border Tag), 0x00 (No of field elements),0x30 (No of field elements),--m Bytes binary Field elements data---,0xMACMSByte,0xMAC, 0xMAC, 0xMACLSByte.

3.21 Message "Train Hand Over Cancellation Acknowledgement"

The Handing Over stationary KAVACH shall send this message when train handover is no longer required due to route cancellation or train diversion.

Byte Number	Data Structure element name	Size (in Bytes)	Description
00	Specific protocol	1 byte binary	F0
01..02	Message Type: 0x010E	(2 Bytes binary)	Bytes 01 and 02 shall be set to 0x010E
03..22	Sender: Primary/ Secondary SKAVACH	(20 Bytes binary)	The message bytes shall contain the primary or secondary station KAVACH ID which is transmitting this message
23..42	Receiver: Secondary/ Primary SKAVACH	(20 Bytes binary)	The message bytes shall contain the secondary station KAVACH ID which is receiving this message
43..44	Message Length	(2 Bytes binary)	
45..47	Frame Number	(3 Bytes binary)	The message bytes shall contain the time stamp in the below format. 1 to 86400 ((hr * 3600 + mm * 60 + ss) + 1) Example: 00:00:00 - Frame No 1 00:00:02 - Frame No. 3 …… 23:59:58 - Frame No 86399
48..49	Message sequence number	(2 Bytes binary)	This is the message sequence number to be incremented for every message transmitted to receiver.
50..51	Border RFID Tag	(2 Bytes binary)	Reference RFID from where adjacent station boundary starts.
52..54	Onboard KAVACH Identity	(3 Bytes binary)	These bytes shall contain the Onboard KAVACH ID for which handover is cancelled.
55..58	MAC-CODE	(4 bytes binary)	4 bytes binary. MAC-Code based on AES-128 encryption.

Sample Data for the above

0xF0,0x01,0x0E,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x11,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x10, 0x00 (message length),0x3A (message length), 0x00(frame number),0xA8(frame number),0xB8 (frame number), 0x52(sequence number),0xE6(sequence number), 0x02 (Border Tag),0xC7 (Border Tag),0x00(Onboard Kavach ID), 0x6D (Onboard Kavach ID),0x70 (Onboard Kavach ID),0xMACMSByte,0xMAC, 0xMAC, 0xMACLSByte.