सत्यमेव जयते

GOVERNMENT OF INDIA

(भारत सरकार)

MINISTRY OF RAILWAYS

(रेल मंत्रालय)

Annexure – C

KAVACH
Multiple Access Scheme & Radio Communication Protocol
Amendment-10

Issued by

S&T DIRECTORATE
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Amdt	Date of issue	Amendment
1	10.10.2022	• C3.1.4 f_0 is named as center frequency. • C3.1.6 & C3.1.7 –deleted. The limitation of maximum packet size of 1024 bits is no more applicable. • Correction in Figure 1- 25 millisec is corrected to 15 millisec for minimum before commencement of transmission Over –The-Air. • C 3.2 Multiple Access scheme- The time slots are changed from 78 to 68 each of width 432 bits (22.5 ms). Accordingly, the timeslot allocations are modified in C3.2.1, C3.2.2, C3.2.3, C3.2.4, C3.2.5 and C3.2.10 • C5.2 Regular radio packet from station to onboard – (i) Stationary KAVACH unit shall send separate packet for each loco. MA Sub packet is updated every cycle. SSP and other packets are to be sent when MA is extended or modified. Header correction done accordingly. (ii) REF_PROFILE_ID is mentioned as Onboard Specific. (iii) No track profile packets to be sent when route is not known. (iv) Invalid RFID sequence SoS is removed as onboard knows RFID sequence. (v) Fouling mark clearance validation by Station is added. (vi) Only Single location reset is permitted in a given MA. (vii) Definitions for adj line count are clarified. Line TINs retained for 9 bits. (viii) Provisions for missing padding bits are added at the end of each subpacket. • C5.3 Onboard to station regular packet (i) Separate look up table for EMUs to be maintained. (ii) Parting SoS is added. (iii) Last_Ref_Profile_ID changed to Last_Ref_Prof_Num (iv) Packet CRC is made as 32 bit for C5.4 Access Authority Packet Version 2.0, C5.5 Additional Emergency Packet, • C5.5 Access Request Packet. (i) Train speed corrected to 9 bits from 10 bits (ii) Parting SoS added. (iii) TIN Programmed in Last RFID Tag is sent instead

		of six TINs. (iv) CRC changed to 32 bits. The timing diagram is deleted.
2	06.12.2022	• ClauseC.5.2 – **Regular Radio Packet from Station/ Interlocked LC Gate / IBS toOnboard Kavach** 12) Frame Offset as per version 3.2 added. Frame offset = (Stationary Kavach frame number – last received Onboard Kavach frame number)/2 Cyclic substraction to be ensured at 00:00 hours. ii) Fouling_Mark_STS modified: - 12) 0: No Fouling Tag Mark ~~cleared by Train rear~~ ~~end~~ *b)* 1: Fouling Mark Tag Read (Information shall be sent for 3 cycle) ii) DIST_NXT_RFID: - Distance of next RFID from previous RFID (first tag will be from last reference RFID) in meters i.e. 2047 meter. iii) ADJ_LINE_CNT – Modified as- 0: No adjacent lines, Self block section TIN will follow. 1-5: Number of Adjacent lines including occupied self block section TIN. iii) LINE _TIN- Modified- Self and Adjacent Line TIN Only If ADJ_LINE_CNT = 0 to 5, LINE_TIN variable will follow. • ClauseC.5.4- Access Authority Packet verion 2.0 i) Allotted_UpLink_Freq – 7 bit–New clause added ii) Allotted_DownLink_Freq- 7 Bit - New clause added. iii) Allotted_FDMA_FREQ – Clause deleted
3	20.03.2023	▪ Clause C.3.2 is modified to accommodate only single frequency switching in a cycle to accommodate more slots. The no of slots are increased to 70 from 68. ▪ Clause C.3.2.1 is modified to accommodate 44 slots for stationary KAVACH and Onboard KAVACH communication. ▪ Clause C.3.2.2, C.3.2.3, C.3.2.4, C.3.2.5 and C.3.2.10 modified to incorporate new slot numbers. ▪ Clause 3.2.11: Position marker start time in millsecond is newly added ▪ Clause 3.2.12: frame structure for FDMA/TDMA time frame cycle with position marker is modified. ▪ **Clause C.5.2**: o CUR_SIG_INFO – '00000' – to be sent when line number information is not applicable. o Permissive signals controlled by ON RUN Override permitted stop signals shall also be made

		ON RUN as 1. ○ Authorized speed 62 is to be coded as "8 Kmph for auto signal override during night". ○ DUP_TAG_DIR and DIST_DUP_TAG are added in TLI subpacket. ○ ABS_LOC_RESET is reduced from 2 bits to 1 bit ○ Abs locotion reset field values '01' and '10' are modified as invalid from location correction +ve/-ve. ○ FOULING_MARK_STS is removed and Track Condition type "Fouling Mark location" is added in Station to Onboard regular packet. Sound Horn & Reversing Area track condition type BIT is corrected. ○ LM_Static_Speed_ Type is deleted and LM_Static_Speed_Class & LM_Static_Speed_Value added. ▪ **Clause C 5.3:** ○ Invalid SRC_Loco_ ID, Invalid Abs_location ID are defined. ○ Location accuracy of RFID Tag is changed to 5m from 1m and Reader Offset is added in assessment of L_Doubtover and L_Doubtunder. ○ Side Collision word is removed. ○ TAG_DUP new field added. ○ TAG_LINK_INFO new field added. ○ "Brake_Applied" Normal Service Brake by Kavach (not to be sent when hardwire interface is not done. For ex: in EMUs and Trainsets) ○ "Specific_SoS_Ack" with field width of 1 bits changed to "INFO_ACK" with field width of 4 bits by LP ○ Loco_Health_Status (Only for NMS Logging and re-port generation) shall be as per prescribed in Clause 6.1.24 of Annexure- G) ▪ **Clause C 5.4:** ○ Allotted_UpLink_Freq & Allotted_DownLink_Freq is modified to suit frequency range of 406 to 470 MHz.
4	27.04.2023	• **Clause C 5.2:** ○ Movement Authority packet- Authority _type newly added as "11: SR Authority (When adjacent S-KAVACH communication failed, Authorised speed shall be Section Speed)". • **Clause C 5.3:** ○ In Info Ack field "Not Ack" is replaced by "No Ack"

		○ Spare field – 3 bits corrected to 2 bits
04.05.2023	Amdt-5	• **Clause C 3.2.8- deleted as** per CoE letter No IRISET/CoE/ KAVACH /MISC dtd 30.04.2023. • **Clause 3.2.9 –** is modified with addition of desirable/preferably word. • **New Clause added 3.2.13-** Start of Frame is indicated. • **New Clause added 3.2.14-** Transmission when no loco is registred with Stationary KAVACH is clarified. • **Clause 5.2-** ○ LAST_REF_RFID- The following correction is carried out "Stationary and Onboard KAVACH shall not consider ~~Adjustment tags,~~ Foreign tags~~, Adjacent line tags~~ and wrong line tags as LAST_REF_RFID". ○ Authority type- when SR Authority is provided, Authorized speed shall be unknown (63) and other details are specified.
16.08.2023	Amdt-6	• **Clause 5.2** ○ **SUB_PKT_LENGTH** field is uniquely define for each type of sub packet. ○ New, Revised, spec. 3.2 are added in remarks coloum for confirmity. ○ **CUR_SIG_INFO** ▪ a8 to a5 bits are define as **line name**. ▪ The following are newly added in a14 to a9 bit – (Type of Signal)- • 101110- Gate cum IB Distant Signal. • 101111- Gate cum IB Inner Distant Signal ○ In CUR_SIG_ASPECT- AG marker off- Newly added. ○ In AUTHRISED_SPEED- LM_STATIC_SPEED_VALUE and TSR_UNIVERSAL SPEED, the following correction carried out for uniformity. ▪ 51-61 is modified to reserved for future. ▪ 62- as 8 Kmph ▪ 63 as Unknown. ○ Train integrity, MA shortening field are proposed for future use. ○ LM_GRADIENT_VALUE- is modified to confirm with Annexure-I. ○ TRACK_COND_TYPE-1001: KAVACH Territory Exit. (Not to validate RFID linking beyond this location).
26.10.2023	Amdt-7	**CL. C.3.2.2 –** modified with addition of "The time slot

		shall be changed by the onboard KAVACH at every cycle randomly. **CL. C.5.2 –** Current_Sig_info- a15 to 16 – is shifted after a14 to a9. **CL. C5.3** modified as ~~**Total TINs occupied by Train in entire train length section from front end. Max upto 6 TINs.**~~ Track identification number occupied by front end of onboard KAVACH and total bit is corrected.
12.12.2023	Amdt-8	• CL 5.3 Onboard to Station Regular Packet: **MOVEMENT _DIR** is modified with deletion of ~~(Normally Traffic Direction as UP & Normally Traffic Direction as DOWN).~~
15.02.2024	Amdt-9	• CL. 5.2-**Stationary KAVACH to Onboard Regular Packet:** ➢ **REF_PROF_ID**- Clause modified with addition of "Stationary KAVACH shall send REF_PROF_ID as "0000" when route is not known." ➢ **MOVEMENT AUTHORITY- AUTHORIZED SPEED**: clause modified as Only If AUTHORITY_TYPE = '01 &11' & "i.e 3: 15 kmph to be sent for unknown route. ~~when ROUTE_RFID_CNT is 63 (unknown route).~~ ➢ **TAG LINKING INFORMATION- ROUTE_RFID_CNT-** 63- Clause modidied :63- ~~unknown route~~ (~~15 Kmph speed restriction in OS mode).~~ Reserved for future. • **CL. 5.3- Onboard to Station Regular Packet:** Clause modified- ➢ **L_DOUBTOVER**- This is the over-reading amount plus the 5 m location accuracy of RFID Tag + 5% odometery error+Reader Offset in ~~front~~ rear end (ROR). This information shall be used for distance supervision of targets on safe-side (eg. PSR, TSR, ~~Linking~~, Rear End Collision etc.). ➢ **L_DOUBTUNDER**-This is the under-reading amount plus the 5 m location accuracy of RFID Tag + 5% odometery error+Reader Offset from ~~Rear~~ Front end (RO~~R~~F). This information shall be used for ~~distance~~ supervision of ~~targets on safe-side~~ location for discarding the Tag identified beyond this length (eg. ~~PSR, TSR,~~ Linking, Head on Collision etc.) ➢ **TRAIN_LENGTH**-1 to 2047: Train length in mtrs (It shall include both L_doubt Over and L_doubt

		under).
07.05.2024	Amdt-10	• CL. 4.0- Radio Communication Protocol for Version 3.2 Version 1.0 are deleted as these protocol not used verion 4.0 and numbering is modified for clause 5 as 4 subsequently • CL. 4.2-**Stationary KAVACH to Onboard Regular Packet-** Modified for confirmity. ➢ **CUR_SIG_INFO -**1110-UP BI-Direction, 1111-DN BI-Direction, 0100 to 0111-Future Use- ➢ 100100- Semi Automatic Signal without A marker lit ➢ 110000- Advance Starter-cum-Gate Dis-tant Signal • **CL. 4.3- Onboard to Station Regular Packet:** Clause modified- ➢ ABS_LOCO_LOC modified "Absolute Location in meters shall compensate for Reader Offset in rear end and reader offset in front" ➢ **L_DOUBTOVER**-This is the over-reading amount plus the 5 m location accuracy of RFID Tag + 5% odometery error ~~+Reader Offset in rear end (ROR).~~ This information shall be used for distance supervision of targets on safe-side (eg. PSR, TSR, Rear End Collision etc.) **L_DOUBTUNDER-**This is the under-reading amount plus the 5 m location accuracy of RFID Tag + 5% odometery error ~~+Reader Offset from Rear Front end (ROF).~~ This information shall be used for supervision of location for discarding the Tag identified beyond this length (eg. Linking, Head on Colli-sion etc.)

C.1 Introduction

This document describes the requirements for data transmission over the air (through radio), Multiple Access scheme and Radio communication protocol for Onboard and Stationary KAVACH sub-systems.

C.2 Scope

This document defines the Radio communication transmission time slots and frequencies required for Stationary KAVACH and Onboard KAVACH system in UHF radio transmission.
Wherever KAVACH Sub-system is referred, it shall mean Onboard KAVACH and Stationary KAVACH.

C.3 Over the Air Requirements

C.3.1 Radio Modem Requirements

C.3.1.1 Communication between the Stationary KAVACH and Onboard KAVACH shall be Over-The-Air using Multiple Access.

C.3.1.2 Each Multiple Access frame cycle shall be of 2000 milli seconds.

C.3.1.3 It shall be suitable for communication in frequency range of 406 MHz to 470 MHz.

C.3.1.4 Onboard KAVACH shall use centre frequency (f0) in block section and at the times of emergency situations (SoS, head-on, rear-end collisions).

C.3.1.5 Stationary KAVACH and Onboard KAVACH shall use their respective timeslot(s) in the Multiple Access with in their channel for the transmission of communication packet(s).

C.3.1.6 The transmission Over-The-Air from Radio shall be controlled by KAVACH Sub-systems using request to Send signal in the RS232/RS 485/Ethernet.

C.3.1.7 KAVACH sub-system may transmit multiple Communication packets in a single transmission burst.

C.3.1.8 KAVACH sub-system shall transfer all the data for a single transmission burst to the Radio modem at least 20 milli second before commencement Over-The-Air.

C.3.1.9 KAVACH sub-system shall calculate the timings from commencement and completion of transmission by Radio Modem Over-The-Air

by considering the preamble, communication packet, postamble and extra stuffed bits.

C.3.1.10 KAVACH sub-system shall disable the RTS signal after completion of transmission of information data over-The-Air.

C.3.1.11 Change of frequency or switch between the frequencies shall be completed well in advance i.e., 15 milliseconds before commencement of Data Transmission Over-The-Air.

C.3.1.12 In the bit-stream Over-The-Air, LSB shall be transmitted first.

C.3.1.13 Refer the below timing diagram, for data transfer between KAVACH sub-system and radio modem.

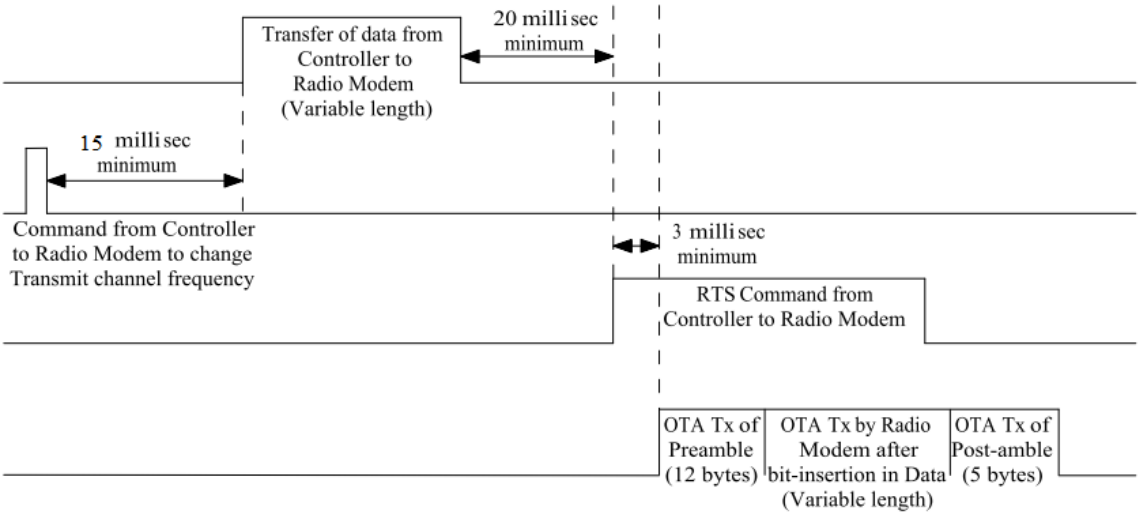


Figure 1: Timing Diagram to transfer the data between KAVACH and Radio modem

C.3.2 **Multiple Access Scheme**

The optimized frame cycle structure for the TDMA/FDMA/SDMA scheme is shown in figure-2. As shown frame cycle is divided into basic 70-time slot position markers (position nos. 1 to 70) each of width 432 bits (22.5 m-sec) except position nos 1 and 46. These are spaced 96 bits (5 m-sec) apart except for the four wider time slots to ensure proper frequency stabilization on change.

C.3.2.1 Time slots from P2 to P45 shall be used for stationary KAVACH and Onboard KAVACH communication. These timeslots have been marked as M-1 to M-44.

C.3.2.2 Time slots P47, P48, P49, P50, P51, P52, P59, P60, P61, P62, P63

and P64 shall be used by the Onboard KAVACH for broadcasting communication packets in the block section. Onboard KAVACH System shall switch its Tx frequency to f0 in the block section and shall transmit the radio packet with reference to markers Mobile System MBS-1 to MBS-12. The time slot shall be changed by the onboard KAVACH at every cycle randomly.

C.3.2.3 Time slots P53, P54, P65 and P66 in f0 shall be used by the Onboard KAVACH for broadcasting messages Access Request Packet (additionally EMERGENCY_STATUS). These timeslots have been marked as Mobile Emergency ME-1 to ME-4.

C.3.2.4 Time slots P55, P56, P67 and P68 in f0 shall be used by the Stationary KAVACH for broadcasting additional emergency (SoS) messages. These timeslots have been marked as Stationary System Emergency SE-1 to SE-4.

C.3.2.5 Time slots P57, P58, P69 and P70 in f0 shall be used by the Stationary KAVACH for broadcasting Access Authority messages. These timeslots have been marked as Stationary System slot STS-1 to STS-4.

C.3.2.6 Stationary KAVACH System shall transmit the Radio packet in its designated time slot.

C.3.2.7 Onboard KAVACH System shall transmit the radio packet in its designated time slot and designated frequency channel received from stationary KAVACH Unit.

C.3.2.8 It is desirable not to have Onboard time slots adjacent to each other for the same station (Preferably minimum one-time slot gap may be kept).

C.3.2.9 The time slot P1 and P46 shall be kept as reserve.

C.3.2.10 P2 slot shall start exactly at 45 mill-second from cycle start. Subsequently every slot shall start at an interval of 27.5 ms till P-45. P-47 shall start at 1320 millsecond and subsequently every slot shall start at an interval of 27.5 millisecond till P-70.

C.3.2.11 The frame structure for FDMA/TDMA time frame cycle with position marker is attached as Annexure-1.

C.3.2.12 When Radio1 is transmitting, the prefix "0xF1 0xA5 0xC3" must be

added as Start of frame. When Radio2 is transmitting, the prefix "0xF2 0xA5 0xC3" must be added as Start of frame.

C.3.2.13 When no Onboard KAVACH is registered, Stationary KAVACH shall be keep transmitting, Stationary KAVACH to Onboard KAVACH regular packet header with information upto SOURCE_STN_ILC_IBS_VERSION and pad other bits as zero. No MAC to be made applicable for this packet CRC is to be calculated for this packet.

The sample Data is shown below:

Packet Type:	STATION TO ONBOARD REGULAR PACKET
The Packet length in bytes is	16
Frame Number	86399
Source Station ID: (Range: 1 to 65535)	514
Station Version	Kavach Spec 4.0
Destination Loco ID: (Range: 1 to 999999)	0
Reference Profile ID: (Range: 0 to 15)	0
Last Reference RFID: (Range: 0 to 1024)	0
Distance Packet To Start: (Range: -16384 to 16383)	0
Packet Direction	Unidentified

The data transmitted through Radio1 shall be 0xF1, 0xA5, 0xC3, 0x90, 0x42, 0xA2, 0xFE, 0x04, 0x04, 0x88, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x0D, 0xFE, 0xEE, 0X62

C.4 Version 2.0 Protocol

C.4.1 Onboard KAVACH equipped with Version 2.0 Radio Protocol shall be able to travel seamlessly in the territory of Stationary KAVACH with Version 1.0 Protocol without any problem. The vice-versa is not applicable.

C.4.2 Regular Radio Packet from Station/ Interlocked LC Gate / IBS to Onboard Kavach units

Note:

(i) Stationary KAVACH shall send separate packet for each Loco.

(ii) Only MA sub packet shall be sent at every cycle. SSP and other sub packet shall be sent when MA is extended or modified.

Field	Size (bits)	VALUE	Description	Re-marks
PKT_TYPE	4	1001(9)	0000- 0111: Radio packets for KAVACH V3.2	Revised
			Radio packets for KAVACH V4.0:	
			1000: Reserved for future use	
			1001: Station to Onboard Regular Packet	
			1010: Onboard to Station Regular Packet	
			1011: Access Authority Packet	
			1100: Additional Emergency Packet	
			1101: Onboard Access Request	
			1110 to 1111: Reserved for future use	
PKT_LENGTH	10		Packet Length is in terms of bytes	For LTE and to accom-modate more in-fo.
			00 0000 0000 - 1 byte	
			00 000 0001 – 2 bytes	
			.....	
			11 1111 1111 – 1024 bytes	
FRAME_NUM	17		1 to 86400 ((hr * 3600 + mm * 60 + ss)+ 1)	
			eg: 00:00:00 - Frame No 1	
			00:00:02 - Frame No. 3	
			.....	

			23:59:58 - Frame No 86399	
SOURCE_STN_ILC_IBS_ID	16		Unique Code, Valid values from 1 to 65535 (Purchaser Railway to Decide) (It will be unique for one KMS)	Spec 3.2
SOURCE_STN_ILC_IBS_VERSION	3		0: Not used 1 to 7: Kavach Version 1 : Kavach Specification 3.2 2 : Kavach Specification 4.0	Spec 3.2
DEST_LOCO_ID	20		1 to 999999	Modified
REF_PROF_ID	4		This is the Profile number of the below packets transmitted to Onboard KAVACH and is specific to it. On every update of MA, these packets are to be retrans-mitted. 0000: No profile information. On receipt of Access Authority Pack-et, the onboard KAVACH shall send '0000' retaining the profile already available for speed super-vision. Stationary KAVACH shall send REF_PROF_ID as "0000" when route is not known. 0001 to 1111: Valid profile infor-mation This is associated with Turn-Out_INFO, TSR_INFO, TAG_LINKING, NEUTRAL _INFO, etc., Onboard KAVACH is ex-pected to acknowledge the receipt of this profile ID. Stationary KA-VACH will stop transmission of this profile after the receipt of acknowledgement.	New

LAST_REF_RFID	10		Below track profile data is given from last RFID as a reference position. This RFID shall be one of the last ten tags read by Onboard KAVACH. Onboard KAVACH shall retain last 11 RFID Tags along with their location. From the last 10 RFID Tags reported by Onboard KAVACH, Stationary KAVACH shall send the profile with respect to the most recently received tag. Stationary KAVACH shall send the actual distances of start and end locations of each element in the profile with respect to LAST_REF_RFID. Stationary and Onboard KAVACH shall not consider Foreign tags and wrong line tags as LAST_REF_RFID.	New
DIST_PKT_START	15		Signed Value. -16384m to +16383m. Distance in meters from LAST_REF_RFID from where below sub packets data starts. For this distance there is no profile or already profile might be given. When the value is negative, the onboard KAVACH shall supervise the profile from the REAR end of the train. When the value is positive, the onboard KAVACH shall merge with the existing profile, if available and supervise MRSP. Positive correction shall be sent by Stationary KAVACH in exceptional cases. When current Onboard route is unknown, this value to be from shifted position reference (eg. from approaching signal foot).	New
PKT_DIR	2		00-unidentified 01- Nominal 10- Reverse	New

			11- Spare	
Padding Bits	3		If required to make header length as multiple of bytes	
MOVEMENT AUTHORITY PACKET				
SUB_PKT_TYPE	4	0000(0)	0000: Movement Authority	New
			0001: Static Speed Profile	
			0010: Gradient Profile	
			0011: LC gate profile	
			0100: Turnout Speed Profile	
			0101: Tag Linking Information	
			0110: Track Condition data	
			0111: Temporary speed Restrictions Profile	
			1000 to 1111: Reserved for future use	
SUB_PKT_LENGTH_MA	7		Length in bytes. Max 128 bytes (1024 bits).	New
FRAME_OFFSET	4	0001 to 1110	Frame offset = (Stationary Kavach frame number - last received Onboard Kavach frame number)/2 Cyclic substraction to be ensured at 00:00 hours.	New
DEST_LOCO_SOS	4		SoS/ Emergency Condition to Specific Onboard	Revised
			under following conditions	
			0000: No SoS /Emergency	
			0001: Foreign RFID	
			0010: Reserved.	
			0011: Onboard Odo error is >= 120m	
			0100: Detection of SPAD	
			0101: Rear-end collision	
			0110: Head-On collision	
			0111: Violation of Shunting limits in shunt mode	
			1000: Station General SoS	
			1001 to 1111: Reserved	
TRAIN_SECTION_TYPE	*2*		00: Station Section	
			01: Absolute Block	
			10: Autoblock	
			11: Reserved	

CUR_SIG_INFO	17		a16a15a14a13a12a11a10a9a8a7 a6a5a4a3a2a1a0	modified
			a4 to a0 : (to be defined and displayed only for applicable Home / Routing Home / Starter / Intermediate Starter)	
			00000: To be sent when line number information is not applicable.	
			11111: Line Number in excess of 30 Decimal, in this case, no line number to be displayed on DMI.	
			11110: Goods Lines (in case of any Goods Line > 30 Decimal, no need to display Line Number on DMI, however, the information to be displayed on DMI that the Train is going to Goods Line). It is clarified that even for multiple Goods Lines, Line Number shall not be communicated to Onboard KAVACH Unit and distinction among Goods Line would not be available through DMI to Onboard Pilot.	
			a8 to a5: **Line Name** 0000-Up Signal 0001-Down Signal 0010-Up Fast Signal 0011-Down Fast Signal 1000-Up Slow Signal 1001-Down Slow Signal 1010-Up Main Signal 1011-Down Main Signal 1100-Up Sub Signal 1101-Down Sub Signal 1110-UP BI-Direction 1111-DN BI-Direction 0100 to 0111-Future Use. This field is not to be used for any purpose other than display associated with signal.	
		a14 to a9	**Type of Signal**	

		0	Undefined - nothing to be displayed on DMI	
		010xxx	Various Distant Signals & Auto Signals	
			Undefined- Nothing to be displayed in DMI	
			010000 – Distant Signal	
			010001 - Inner Distant Signal	
			010010 - Gate Distant Signal	
			010011 - Gate Inner Distant Signal	
			010100 - IB Distant Signal	
			010101 - IB Inner Distant Signal	
			010110 - Auto Signal (Excludes Gate Stop Signal in Auto Territory)	
			010111 - Semi-Automatic Signal with A-marker lit	
			100100- Semi Automatic Signal without A marker lit	
		0110xx	Various Home Signals	
			011000 - Main Home without Junction Route Indicator	
			011001 - Main Home with Junction Route Indicator	
			011010 - Routing Home without Junction Type Route Indicator	
			011011 - Routing Home with Junction Type Route Indicator	
		0111xx	Various types of Starter Signals	
			011100 - Mainline Starter	
			011101 - Loopline Starter	
			011110 - Intermediate Starter	
		x0xxxx	Other Misc Signals	
			000001 - Advanced Starter Signal	
			000010 - IB Stop Signal	
			000011 - Gate Stop Signal	
			000100 - Calling-on Signal	
			000101 - Advanced Starter-cum-Gate Signal	
			000110 - Gate-cum-Distant Signal	

			000111 - Advanced Starter-cum-Distant Signal	
			100011 - Gate Stop Signal in Auto Territory	
			100100 - Semi Automatic Signal without A marker lit	
			100101- Advance Starter-cum-Gate Inner Distant Signal	
			100110- Gate-cum-Inner Distant Signal	
			100111- Gate Inner Distant-cum-Distant Signal	
			101000- IB Signal-cum-Gate Distant Signal	
			101001- IB Signal-cum-Gate Inner Distant Signal	
			101010- IB Signal-cum-Distant Signal	
			101011- Advanced Starter-cum-IB Distant	
			101100- Starter-cum- IB Distant Signal	
			101101- Stop Board/Buffer Stop	
			101110- Gate cum IB Distant Signal	
			101111- Gate cum IB Inner Distant Signal	
			110000- Advance Starter-cum-Gate Distant Signal	
			001000 - Only in RFID Tag, not in Radio Packet.	
			OnboardKavach shall apply Brake when it crosses signal with this code (dead stop locations - such as end of berthing tracks with Shunt Signals) in normal mode.	
			The full list of signals along with corresponding binary codes will be issued through a Technical Advisory Note (TAN). Modification of nomenclature shall not result in change of Executive Software.	
CUR_SIG_ASP	6	**Value**	**Description**	6 bit uni-

ECT		0	Unidentified	formity required.
		000001	Red	
		000010	Yellow without Display of Route Indication	
		000011	Yellow with Pos1 Junction Type Route Indication (left)	
		000100	Yellow with Pos2 Junction Type Route Indication (left)	
		000101	Yellow with Pos3 Junction Type Route Indication (left)	
		000110	Yellow with Pos4 Junction Type Route Indication (right)	
		000111	Yellow with Pos5 Junction Type Route Indication (right)	
		001000	Yellow with Pos6 Junction Type Route Indication (right)	
		001001	Spare	
		001010	Double Yellow	
		001011	Green	
		001100	Double Yellow with Pos1 Junction Type Route Indication (left)	
		001101	Double Yellow with Pos4 Junction Type Route Indication (right)	
		001110	AG Marker OFF	
		001111	Red with Calling-on at OFF	
		'010000 to 010111	Spare	
		'011000	Stop Board / Buffer Stop	
		011001 to 011111	Spare	
		100000 to 111111	Yellow with Stencil route 1 to 32	
		a15:	Signal override permission when danger (0: at standstill, 1: while running- permissive signals controlled by such stop signals shall also be considered)	

		a16	Stop Signal (0: No, 1: Yes)	
NEXT_SIG_ASPECT	6	0	In case current Signal Aspect is RED (Undefined)	
		-	Codes as given in CUR_SIG_ASPECT above	
APPR_SIG_DIST	*15*		Approaching signal distance in meter from the last reference RFID Tag (valid up to 32767m)	Spec 3.2
AUTHORITY_TYPE	*2*		00: Not to be used	New
			01: OS Authority (Distance allowed in OS mode with speed restriction)	
			10: FS Authority (Distance allowed in FS mode)	
			11: SR Authority. When MA is required to be extended beyond border signal and adjacent S-KAVACH communication failed, Authorised speed shall be unknown (63). Onboard KAVACH shall ignore APPR_SIG_DIST and MA_W_R_T_SIG.	
AUTHORIZED_SPEED	*6*		Only If AUTHORITY_TYPE = ’01, AUTHORIZED_SPEED variables follows.	New
			0-50: 0 to 250 kmph, (in revolution of 5Kmph)	
			i.e 3: 15 kmph to be sent for unknown route. No Track profile packets to be sent.	
			51-61: Reserved for future use,	
			62: 8 Kmph (Configuarble) for auto signal override during night	
			63: Unknown.	
MA_W_R_T_SIG	16		0 to 65534 in meters.	Spec 3.2
			65535: Unknown (Onboard Kavach continues in SR Mode).	

			The Movement Authority transmitted shall be the distance of End of Authority from reference RFID position. In order to cater the delays and failure in acquiring information due to missing radio frames, the Movement Authority in Onboard shall be deduced as the Movement authority corresponding to particular frame received from Stationary Kavach Unit minus the actual distance traveled by the Onboard from that reference RFID position.	
REQ_SHORTEN_MA	1		*0: No request from trackside for shortening MA* *1: New request from trackside for shortening MA*	*New* (Future Use)
NEW_MA	16		*Only If REQ_SHORTEN_MA = 1, NEW_MA variables follow.* *New MA due to signal cancellation request from EI*	*New* (Future Use)
TRN_LEN_INFO_STS	1		0 – No Train Length Info, 1 – Train Length Info follows Only If TRN_LEN_INFO_STS = 1, TRN_LEN_INFO_TYPE and remaining variables follow.	Spec 3.2
TRN_LEN_INFO_TYPE	*1*		0 – means. REF_FRAME_NUM_TL and REF_OFFSET_INT_TL pertain to “Start” frame and offset. 1 - means REF_FRAME_NUM_TL and REF_OFFSET_INT_TL pertain to “END” frame and offset.	Spec 3.2
REF_FRAME_NUM_TLM	*17*		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	Spec 3.2

REF_OFFSET_INT_TLM	*8*		0 to 200 (10ms resolution)	Spec 3.2
NEXT_STN_COMM	1		0 – No next station handover 1 – Requires next station handover Only If NEXT_STN_COMM = 1, APPR_STN_ILC_IBS_ID variables follow.	Spec 3.2
APPR_STN_ILC_IBS_ID	*16*	*1 to 65535*	Approaching next stationary Kavach ID	Spec 3.2
Padding Bits	x		If required to make sub packet length as multiple of bytes	
STATIC SPEED PROFILE				
SUB_PKT_TYPE	4	0001(1)	0000: Movement Authority 0001: Static Speed Profile 0010: Gradient Profile 0011: LC gate profile 0100: Turnout Speed Profile 0101: Tag Linking Information 0110: Track Condition data 0111: Temporary speed Restrictions Profile 1000 to 1111: Reserved for future use	New
SUB_PKT_LENGTH_SSP	7		Length in bytes. Max 128 bytes (1024 bits).	New
LM_Speed_Info_CNT	5		1 to 31	Spec 3.2
LM_Static_Speed_Distance	15		Value in meters i.e. ranging from 0 – 32.76 km	Revised
LM_Static_Speed_Class	1		0 – Universal Speed will follow 1 – Classified Speeds A,B,C will follow	
LM_Static_Speed_Value		Class Value	Description	Revised

			0: Reserved 1- 50: 5-250 Kmph, Speed in steps of 5kmph. Max Speed = 250 kmph 51--61: Reserved for future use 62 – 8 Kmph 63 : Unknown	
	6	0	Universal Static Speed	
	6	1	Static Speed for Category A Trains (LE / Passenger Trains)	
	6		Static Speed for Category B Trains (Loaded Goods Trains)	
	6		Static Speed for Category C Trains (Empty Goods Trains)	
Padding Bit	x		If required to make sub packet length as multiple of bytes	
GRADIENT PROFILE				
SUB_PKT_TYPE	4	0010 (2)	0000: Movement Authority 0001: Static Speed Profile 0010: Gradient Profile 0011: LC gate profile 0100: Turnout Speed Profile 0101: Tag Linking Information 0110: Track Condition data 0111: Temporary speed Re-strictions Profile 1000 to 1111: Reserved for future use	New
SUB_PKT_LENGTH_GRAD	7		Length in bytes. Max 128 bytes (1024 bits).	New
LM_Grad_Info_CNT	5		1 to 31	Spec 3.2
LM_Gradient_Distance	15		Value in meters i.e. ranging from 0 – 32.76 km	Revised
LM_GDIR	1		0 = downhill 1 = uphill	Spec 3.2

LM_GRADIENT_VALUE	5		This is the absolute value of the average gradient between two defined position as described in Annexure-I. Values lie between 0 to 30. Value 31: reserved. 0: Gradient not steeper than "1 in 1000". Includes Level Gradient 1: Gradient from "1 in 1000" to not steeper than "1 in 500" 2: Gradient from "1 in 500" to not steeper than "1 in 333" 3: Gradient from "1 in 333" to not steeper than "1 in 250" 4: Gradient from "1 in 250" to not steeper than "1 in 200" .... n: Gradient from "1 in (1000/n)" to not steeper than "1 in {1000/(n+1)}" .... 30: Gradient steeper than "1 in 33" 31: Reserved	
Padding	X		If required to make sub packet length as multiple of bytes	
LC Gate profile				
SUB_PKT_TYPE	4	0011(3)	0000: Movement Authority 0001: Static Speed Profile 0010: Gradient Profile 0011: LC gate profile 0100: Turnout Speed Profile 0101: Tag Linking Information 0110: Track Condition data 0111: Temporary speed Restrictions Profile 1000 to 1111: Reserved for future use	New
SUB_PKT_LENGTH_LC	7		Length in bytes. Max 128 bytes (1024 bits).	New
LM_LC_Info_CNT	5		0 to 31	Spec 3.2

LM_LC_Distance	15		Value in meters i.e. ranging from 0 – 32.76 km This is the start distance of the LC gate from reference position.	Revised
LM_LC_ID_Numeric	10		0: Invalid 1 – 1021: LC Gate Number 1022: LC Gate Number other than 1 to 1022 - out of range (Display xx on DMI) 1023: Spare	Spec 3.2
LM_LC_ID_Alpha_Suffix	3	**Value** 000 001 010 011 100 101 110 111	**Suffix of Gate** No suffix a b c d e Out of Range (Display xx on DMI) Spare	Spec 3.2
LM_LC_Manning_Type	1		0 : Manned, 1 : Unmanned	Spec 3.2
LM_LC_Class	3	**Value** 000 001 000 011 100 101 110 111	**Suffix of Gate** Spl A B1 B2 B (where not specified in terms of B1/B2) C D Spare	Spec 3.2
LM_LC_Auto_Whis-tling_Enabled	1		0 : No, 1 : Yes	Spec 3.2
LM_LC_Auto_Whistling_Type	2	**Value**	**Auto Whistling Type** 00 Distance Based 01 Time Based (Not Used) 10 Configured Pattern Based (Not Used) 11 Spare	Spec 3.2
Padding Bit	X		If required to make sub packet length as multiple of bytes	

TURNOUT SPEED PROFILE				
SUB_PKT_TYPE	4	0100 (4)	0000: Movement Authority 0001: Static Speed Profile 0010: Gradient Profile 0011: LC gate profile 0100: Turnout Speed Profile 0101: Tag Linking Information 0110: Track Condition data 0111: Temporary speed Re-strictions Profile 1000 to 1111: Reserved for future use	New
SUB_PKT_LENGTH_TSP	7		Length in bytes. Max 128 bytes (1024 bits).	New
TO_CNT	2		Number of turnouts from refer-ence position 0: No turnouts 1-3: No.of turnouts follow	New
TO_SPEED	5	**Value** 00000 00001 00010 00011 -- -- 10010 10011-11110 11111	**Description** Not Used Upto 5 kmph Upto 10 kmph Upto 15 kmph Upto 90 Kmph Reserved for future use Unrestricted	Revised
DIFF_DIST_TO	*15*		Only If TO_SPEED = restricted, DIFF_DIST_TO variable follow. Starting Distance of the turnout from last reference RFID. Value in meters i.e. ranging from 0 – 32.76 km	Revised
TO_SPEED_RE	*12*		Only If TO_SPEED = restricted,	Revised

L_DIST			DIFF_DIST_TO variable follow. Turnout release distance. Value in meters i.e. ranging from 0 - 4095 m. Value to be given upto end of turnout or upto other location will be defined by railways.	
Padding Bits	x		If required to make sub packet length as multiple of bytes	
TAG LINKING INFORMATION				
SUB_PKT_TYPE	4	0101 (5)	0000: Movement Authority 0001: Static Speed Profile 0010: Gradient Profile 0011: LC gate profile 0100: Turnout Speed Profile 0101: Tag Linking Information 0110: Track Condition data 0111: Temporary speed Restrictions Profile 1000 to 1111: Reserved for future use	New
SUB_PKT_LENGTH_TLI	7		Length in bytes. Max 128 bytes (1024 bits).	New
DIST_DUP_TAG	4		Distance between Main and duplicate tag. 0000 shall be sent when the tags are placed closer than 1 meter. 1111 is invalid In a yard, the distance between main and duplicate tag is mentioned in the RFID Tag data format. This distance shall be kept common for a yard and shall be sent by a stationary KAVACH in TLI subpacket.	New
ROUTE_RFID_CNT	6		List of expected approaching RFID tags from reference position up to the End of Authority. Station updates the new list only when required. 0: No tag shall be crossed by Onboard KAVACH. eg: In approach of danger signal.	New

			1-62: expected route RFID count. 63- Reserved for future Only If RFID_CNT = 1 to 62, RFID_TAG and LINK_REACTION variables follow.	
DIST_NXT_RFID	11		Distance of next RFID from previous RFID (first tag will be from last reference RFID) in meters i.e. 2047 meter.	New
NXT_RFID_TAG_ID	10		Next RFID Tag ID	New
DUP_TAG_DIR	1		Linking Direction of Duplicate Tag w.r.t Main Tag 0: Duplicate Tag in Nominal Direction (+)/No Linking distance correction is required for T-Tag and A-Tag 1: Duplicate Tag in Reverse Direction (-)	New
ABS_LOC_RESET	1		0–No Locational Error (The following bits will not be padded) 1–Location Correction (New Section) Location shall get corrected in block section after 100m from Advance Starter. Onboard shall not apply brakes due to any of these reasons. When this information is not available, linking distance given in N-tag shall be used to avoid abnormal train trip due to location correction. Station shall able to transmit MA, SSP, TSR and maintain radio communication even after location reset. Only If ABS_LOC_RESET>0, below variables follow. In Given MA, single location reset is considered.	

START_DIST_TO_LOC_RESET	15		This is the start distance of the Normal tag (from the Onboard current location) in which location correction is done. Value in meters.	
ADJ_LOCO_DIR	2		This is expected Onboard direction after passing location correction N-tag 00 – Not Known 01 – Nominal 10 – Reverse 11 – Deduce from Tags	
ABS_LOC_CORRECTION	23		This is the new absolute location from Adjustment/Junction Tag location correction	
ADJ_LINE_CNT	3		Adjacent line TINs along the MA for unusual stoppage detection. 0: No adjacent lines, Self block section TIN will follow. 1-5: Number of Adjacent lines including occupied self block section TIN. 6: Reserved 7: unknown	New
LINE_TIN	9		Self and Adjacent Line TIN Only If ADJ_LINE_CNT = 0 to 5, LINE_TIN variable will follow.	New
Padding Bits	x		If required to make sub packet length as multiple of bytes	
TRACK CONDITION DATA				
SUB_PKT_TYPE	4	0110 (6)	0000: Movement Authority 0001: Static Speed Profile 0010: Gradient Profile 0011: LC gate profile 0100: Turnout Speed Profile 0101: Tag Linking Information 0110: Track Condition data 0111: Temporary speed Restrictions Profile 1000 to 1111: Reserved for future use	New

SUB_PKT_LENGTH_TC	7		Length in bytes. Max 128 bytes (1024 bits).	New
TRACK-COND_CNT	4		Track condition in MA region from reference RFID	New
TRACK-COND_TYPE	4		0000: Not used 0001: Dead Stop 0010: Radio hole (MA is valid up-to Comm. fail time out) 0011: Non stopping area 0100: Tunnel stopping area 0101: Powerless section (Neutral section) 0110: Sound horn 0111: Reversing area 1000: Fouling Mark location 1001: KAVACH Territory Exit. (Not to validate RFID linking beyond this location). 1010 to 1111: Reserved for future use	New
*START_DIST*_TRACKCOND	15		Start distance to Track condition from reference RFID. Value in meters i.e. ranging from 0 – 32.76 km	New
*LENGTH*_TRACKCOND	15		Length of the Track condition. Value in meters i.e. ranging from 0 – 32.76 km	New
Padding Bit	X		If required to make sub packet length as multiple of bytes	
TEMPORARY SPEED RESTRICTIONS PROFILE				
SUB_PKT_TYPE	4	0111 (7)	0000: Movement Authority 0001: Static Speed Profile 0010: Gradient Profile 0011: LC gate profile 0100: Turnout Speed Profile 0101: Tag Linking Information 0110: Track Condition data 0111: Temporary speed Restrictions Profile 1000 to 1111: Reserved for future use	New
SUB_PKT_LENGTH_TSR	7		Length in bytes. Max 128 bytes (1024 bits).	New

TSR_STATUS	2		00 – No applicable TSR for the current MA 01 – No Latest TSR Information (Onboard KAVACH shall transit to SR Mode, No MA to be extended by Stationary KAVACH). 10 – Latest TSR Information 11 – Reserved	New
TSR_Info_CNT	5		0 to 31	
TSR_ID	8		This is the ID of TSR received from TSR management system.	Revised
TSR_Distance	15		This is the distance to TSR start-ing point from reference RFID. Value in meters i.e. ranging from 0 – 32.76 km	Revised
TSR_Length	15		Length of TSR. Value in meters i.e. ranging from 0 – 32.76km	Revised
TSR_Class	1		0 – Universal Speed 1 – Classified Speed	
TSR_Universal_Speed	6		only if Q_TSR_CLASS = 0, LM_TSR_Universal_Speed variable follow	
		Value	**Speed in kmph**	
		0	Dead stop	
		N = 1 to 40	= 5*N (5,10,15, ...,200 kmph)	
		41 to 61	Reserved for future use	
		62	8 kmph	
		63	Unknown	
TSR_ClassA_Speed	6		only if LM_TSR_Class = 1, LM_TSR_ClassA_Speed variable follow. Values are Same as LM_TSR_Universal_Speed.	
TSR_ClassB_Speed	6		only if LM_TSR_Class = 1, LM_TSR_ClassB_Speed variable follow. Values are Same as LM_TSR_Universal_Speed.	

TSR_ClassC_ Speed	6		only if LM_TSR_Class = 1, LM_TSR_ClassC_Speed variable follow. Values are Same as LM_TSR_Universal_Speed.	
TSR_Whistle	2		00: No Whistle 01: Whistle blow 10-11: Spare	
Padding Bits	x		If required to make sub packet length as multiple of bytes	
End of the sub packets				
LO-CO_Specific_ MAC_CODE	32		Calculated from starting field PACKET_TYPE to last Sub-Packet padding bits	Modified
End of the packet				
PKT_CRC	32		Packet CRC	

C.4.3 **Onboard to Station Regular Packet:**

Field	Size (bits)	VALUE	Description	Re-marks
PKT_TYPE	4	1010(10)	0000: Undefined 0000- 0111: Radio packets for KAVACH V3.2 Radio packets KAVACH V4.0: 1000: Reserved for future use 1001: Station to Onboard Regular Packet 1010: Onboard to Station Regular Packet 1011: Access Authority Packet 1100: Additional Emergency Packet Example: 1110 to 1111: Reserved for future use	Revised
PKT_LENGTH	7		- Packet Length is in terms of bytes 000 0000 - 1 byte 000 0001 – 2 bytes	Spec 3.2

Field	Size (bits)	VALUE	Description	Re-marks
			…….	
			111 1111 – 128 bytes	
FRAME_NUM	17		1 to 86400 ((hr * 3600 + mm * 60 + ss)+ 1)	Spec 3.2
			Example:	
			00:00:00 - Frame No 1	
			00:00:02 - Frame No. 3	
			……	
			23:59:58 - Frame No 86399	
SOURCE_LOCO_ID	20		1 to 999999 (Separate Look up table for EMU/DEMU) 0 is an invalid Loco ID.	
SOURCE_LOCO_VERSION	3		0: Not used	New
			1 to 7: Kavach Version	
			1: Kavach Specification 3.2	
			2: Kavach Specification 4.0	
ABS_LOCO_LOC	23		Absolute Location in meters shall comensate for Reader Offset in rear end and reader offset in front 8388607 is invalid Location.	
L_DOUBTOVER	9		This is the over-reading amount plus the 5 m location accuracy of RFID Tag + 5% odometery error. This information shall be used for distance supervision of targets on safe-side (eg. PSR, TSR, Rear End Collision etc.)	New
L_DOUBTUNDER	9		This is the under-reading amount plus the 5 m location accuracy of RFID Tag + 5% odometery error. This information shall be used for supervision of location for dis-carding the Tag identified beyond this length (eg. Linking, Head on Collision etc.)	New

Field	Size (bits)	VALUE	Description	Re-marks
TRAIN_INT	2		Train Integrity status of the train 00: No Train Integrity information available 01: Train integrity confirmed by integrity monitoring device 10: Train integrity confirmed by Loco Pilot 11: Reserved	New (Future Use)
TRAIN_LENGTH	11		0: Unidentified/ Invalid	Modified
			1 to 2047: Train length in mtrs (It shall include both L_doubt Over and L_doubt under).	
TRAIN_SPEED	9	**Value**	**Description**	New
		0 to 400	Train Speed in kmph	
		401 to 510	Reserved for future use	
		511	Train Speed unidentified	
MOVE-MENT_DIR	2	**Value**	**Description**	Spec 3.2
		00	Traffic Direction not established / unidentified	
		01	Nominal	
		10	Reverse	
		11	Reserved for future use	
EMERGEN-CY_STATUS	3	**Value**	**Description**	
		000	No Emergency - Regular Packet	
		001	Unusual Stoppage in block sec-tion	
		010	SoS	
		011	Roll Back Detected	
		100	Head On Collision	
		101	Rear End Collision	
		110	Parting SoS	
		111	Spare	
LOCO_MODE	4	**Value**	**Description**	
		0001	Stand_By	
		0010	Staff_Responsible_Mode	
		0011	Limited_Supervision	
		0100	Full_Supervision	

Field	Size (bits)	VALUE	Description	Re-marks
		0101	Override	
		0110	On_Sight	
		0111	Trip	
		1000	Post_Trip	
		1001	Reverse	
		1010	Shunting	
		1011	Non_Leading	
		1100	System_Failure	
		1101	Isolation	
LAST_RFID_TAG	10		Tag ID of Last RFID Tag Read	
TAG_DUP	1		0: Main Tag 1: Duplicate Tag	
TAG_LINK_INFO	3	000	No Tag missing	New
		001	Duplicate Tag missing	
		010	Main Tag missing	
		011	Both Tag missing	
		100	Tag position interchanged	
		101	Both Tags have same location info	
		110	Intertag distance less than DIST_DUP_TAG	
		111	Intertag distance greater than DIST_DUP_TAG	
TIN	9	**Each TIN is 9 bits.** Track identification number occupied by front end of onboard KAVACH.		
		Value	**Description**	
		0	Ignore / Don"t Care	
		1 to 250	Track Identity Number as per Track Section Occupied	
		251	Onboard shed TIN	
		252-511	Reserved for future use	
Brake_Applied	3	**Value**	**Description**	
		0	No over speed, No brakes by Ka-vach	
		1	Over speed but no brakes by Ka-vach	

Field	Size (bits)	VALUE	Description	Re-marks
		10	Normal Service Brake by Kavach (not to be sent when hardwire interface is not done. For ex: in EMUs and Trainsets)	New
		11	Full Service Brake by Kavach	
		100	Emergency Brake by Kavach	
		101 to 111	Spare	
NEW_MA_REPLY	2		0: No request for Shorten MA from Station KAVACH 1: Request to Shorten MA granted 2: Request to Shorten MA rejected 3: reserved	New (Future Use)
LAST_REF_PROFILE_NUM	4	-	Indicates the last track profile number received. To ensure RFID linking and TSR data received and taken into cognizance by Onboard.	
			0: Indicates no track profile data with Onboard KAVACH in given MA. On receipt of Access Authority Packet, the onboard KAVACH shall send '0000' retaining the profile already available for speed supervision.	
SIG_OV	1		Request for OS MA to pass the approaching signal at danger when Authority to Proceed is available with LP.	New
			0: Signal Override Inactive	
			1: Signal Override Active	
Info_Ack	4	-	0: No Ack 1: Loco Specific SoS Ack by LP 2: FS to LS Ack by LP 3: LS to SR Ack by LP 4: FS to SR Ack by LP 5: OS to SR Ack by LP 6: OV to SR Ack by LP 7: Trip Ack by LP 8: PTRIP to SR Ack by LP 9: Auto horn Ack by LP	

Field	Size (bits)	VALUE	Description		Re-marks
			10: Train Length Measurement (TLM) Start packet received Ack from Onboard KAVACH 11: TLM End packet received Ack from Onboard KAVACH 12: Unusual Stoppage Ack by LP 13: Manual SoS Ack by LP 14: Spare 15: Spare When event is started, flag is to set and when event ends flag is to be reset. The Ack shall be sent for minimum 5 (five) cycle or as long as flag is set high. The expected functionality in the Stationary KAVACH (SVK), is to log the event in case of mode transitions. In cases of SoS acknowledgement, it would be released by SVK. In case of TLM Start/End acknowledge-ment, STCAS would act on transmission of TLM. Acknowl-edgement by LP for onboard spe-cific sos and TLM Start/End can occur simultaneously.		
Spare	2		Future use		
Loco_Health _Status (Only for NMS Log-ging and re-port genera-tion)	6		Onboard Kavach health shall be prepared for length of 24bits and same to be included in each radio packet as per below procedure. Each bit indicates status of each sub system in the OnboardKa-vach unit		
			Frame Number in Binary	**Onboard Kavach Health (as prescribed in Clause 6.1.24 of Annexure- G)**	
			xxxx xxxx xxxx x001	First 6 bits of Onboard Health	

Field	Size (bits)	VALUE	Description		Re-marks
			xxxx xxxx xxxx x011	Second 6 bits of Onboard Health	
			xxxx xxxx xxxx x101	Third 6 bits of Onboard Health	
			xxxx xxxx xxxx x111	Fourth 6 bits of Onboard Health	
MAC_CODE	32		Calculated from PKT_TYPE to Onboard_Health_Status fields		
PKT_CRC	32		Packet CRC		
Total	230				

C.4.4 Access Authority Packet Version 2.0

Field	Size (bits)	VALUE	Description	Re-marks
PKT_TYPE	4	1011 (11)	- 0000- 0111: Radio packets for KAVACH V3.2	Revised
			Radio packets for KAVACH V4.0:	
			1000: Reserved for future use	
			1001: Station to Onboard Regular Packet	
			1010: Onboard to Station Regular Packet	
			1011: Access Authority Packet	
			1100: Additional Emergency Packet	
			1101: Onboard Access Request	
			1110 to 1111: Reserved for future use	
PKT_LENGTH	7		Packet Length is in terms of bytes	
			000 0000 - 1 byte	
			000 0001 – 2 bytes	
			.....	
			111 1111 – 128 bytes	
FRAME_NUM	17		1 to 86400 ((hr * 3600 + mm * 60 + ss)+ 1)	
			eg: 00:00:00 - Frame No 1	
			00:00:02 - Frame No. 3	
			.....	

Field	Size (bits)	VALUE	Description	Re-marks
			23:59:58 - Frame No 86399	
SOURCE_STN_ILC_IBS_ID	16		Unique Code, Valid values from 1 to 65535 (Purchaser Railway to Decide)	Spec 3.2
			(It will be unique for one KMS)	
SOURCE_STN_ILC_IBS_VERSION	3		0: Not used	Spec 3.2
			1 to 7: Kavach Version	
			1 : Kavach Specification 3.2	
			2 : Kavach Specification 4.0	
STN_ILC_IBS_LOC	23		Absolute Location in meters	
DEST_LOCO_ID	20		1 to 999999 (Separate Look up table for EMU/DEMU	
Allotted_UpLink_Freq	12	**Value**	**Allotted Frequency Channel for UpLink (L-Kavach to S-Kavach frequency)**	New
		0	FDMA Not Used	
		1 to 2560	Base Frequency: 406 MHz (Configurable) Allotted Channel Frequencies at 25kHz space is Channel-1: 406 + 1*0.025 = 406.025 MHz Channel-2:406 + 2*0.025 =406.050 MHz -- -- Channel2560: 406 + 2560*0.025 = 470.000 MHz	
		2561 to 4093	Reserved for future use	
		4094	Other Radio Communication systems used like WiFi/LTE/4G/5G Networks	
		4095	Not to be used	
Allotted_DownLink_Freq	12	**Value**	**Allotted Frequency Channel for DownLink (S-Kavach to L-Kavach frequency)**	New
		0	FDMA Not Used	

Field	Size (bits)	VALUE	Description	Re-marks
		1 to 2560	Base Frequency: 406 MHz Allotted Channel Frequencies at 25kHz space is Channel-1: 406 + 1*0.025 = 406.025 MHz Channel-2: 406 + 2*0.025 =406.050 MHz -- Channel-2560: 406 + 2560*0.025 = 470.000 MHz	
		2561 to 4093	Reserved for future use	
		4094	Other Radio Communication systems used like WiFi/LTE/4G/5G Networks	
		4095	Not to be used	
Allotted_TDMA_Timeslot	7	**Value**	**Description**	
		0	Not nominated	
		1 to 68	Exact Time slot shall be sent by stationary KAVACH excluding reserved slot in Frame	
STN_RND_NUM_RS	16		On reception of Access Request Packet from Onboard KAVACH Unit, Stationary KAVACH unit generates its own Random Number (RS).	
STN_TDMA	7	**Value**	**Description**	
		0 to 68	Station TDMA slot time in p-markers to capture RSSI.	
		100 to 125	Reserved for future use	
		126	Other Radio Communication systems used like WiFi/LTE/4G/5G Networks	
		127	Not to be used	
MAC_CODE	32		Calculated for PKT_TYPE to station TDMA	
PKT_CRC	32		Packet CRC	
Total	208			

C.4.5 Additional Emergency Packet

Field	Size (bits)	VALUE	Description	Re-marks
PKT_TYPE	4	1100 (12)	0000- 0111: Radio packets for KA-VACH V3.2	Re-vised
			Radio packets for KAVACH V4.0:	
			1000: Reserved for future use	
			1001: Station to Onboard Regular Packet	
			1010: Onboard to Station Regular Packet	
			1011: Access Authority Packet	
			1100: Additional Emergency Packet	
			1101: Onboard Access Request	
			1110 to 1111: Reserved for future use	
PKT_LENGTH	7		Packet Length is in terms of bytes	
			000 0000 - 1 byte	
			000 0001 – 2 bytes	
			.....	
			111 1111 – 128 bytes	
FRAME_NUM	17		1 to 86400 ((hr * 3600 + mm * 60 + ss)+ 1)	
			eg: 00:00:00 - Frame No 1	
			00:00:02 - Frame No. 3	
			.....	
			23:59:58 - Frame No 86399	
SOURCE_STN_ILC_IBS_ID	16		Unique Code, Valid values from 1 to 65535 (Purchaser Railway to Decide)	Spec 3.2
			(It will be unique for one KMS)	
SOURCE_STN_ILC_IBS_VERSION	3		0: Not used	Spec 3.2
			1 to 7: Kavach Version	
			1 : Kavach Specification 3.2	
			2 : Kavach Specification 4.0	
STN_ILC_IBS_LOC	23		Absolute Location in meters	
GEN_SOS_CALL	1	**Value**	**Description**	Spec 3.2
		0	No Station Manual SoS	

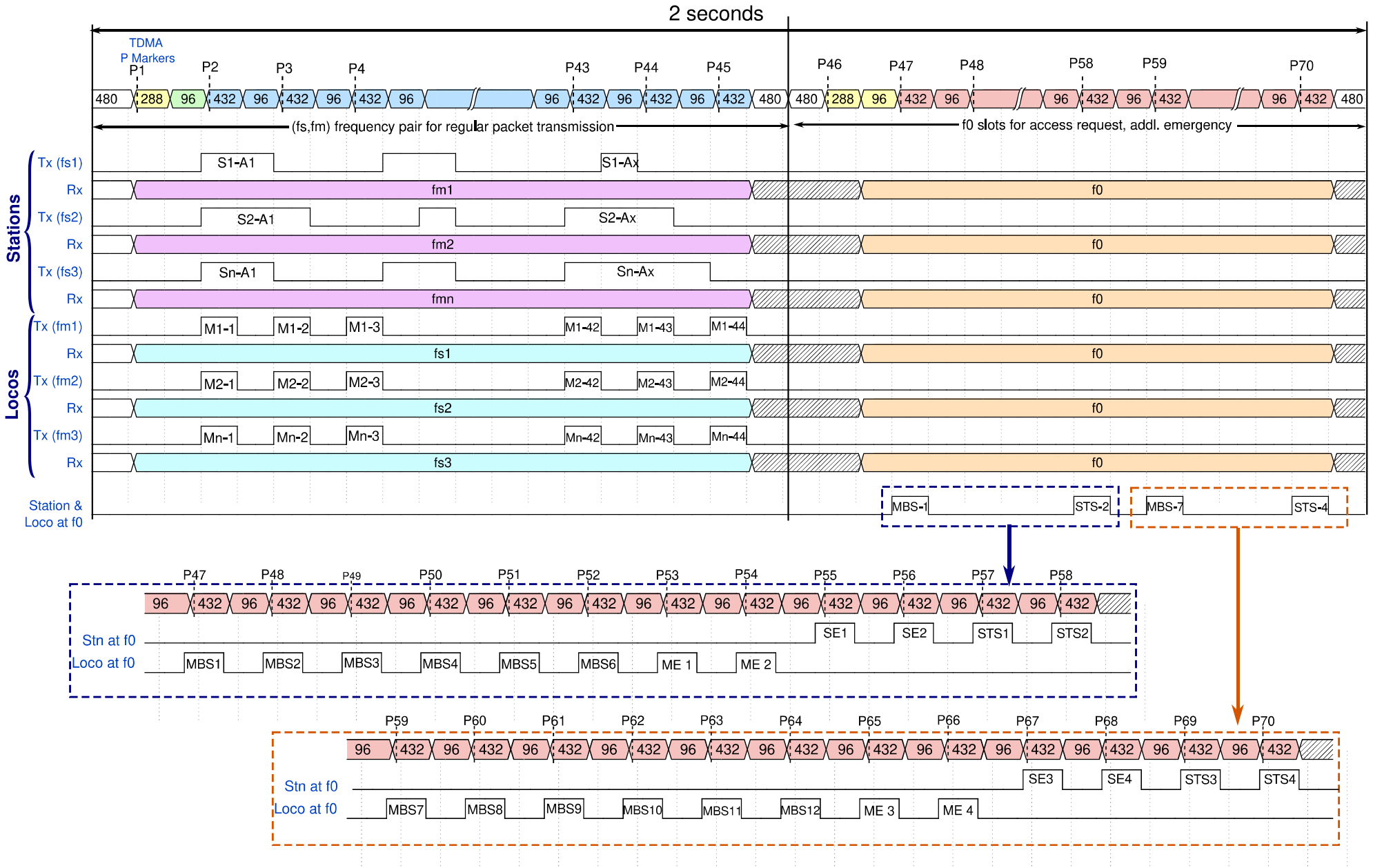
Field	Size (bits)	VALUE	Description	Re-marks
		1	General SoS Call generated by Stationary Unit Conditions: Manual operation of SOS buttons provided on SOIP.	
Padding bits	1		If required to make sub packet length as multiple of bytes	
PKT_CRC	32		Packet CRC	
Total	**104**			

C.4.6 Access Request Packet:

Field	Size (bits)	VALUE	Description	Re-marks
PKT_TYPE	4	- 1101(13)	0000: Undefined	Revised
			0000- 0111: Radio packets for KAVACH V3.2	
			Radio packets KAVACH V4.0:	
			1000: Reserved for future use	
			1001: Station to Onboard Regular Packet	
			1010: Onboard to Station Regular Packet	
			1011: Access Authority Packet	
			1100: Additional Emergency Packet	
			1101: Onboard Access Request	
			1110 to 1111: Reserved for future use	
PKT_LENGTH	7		Packet Length is in terms of bytes	Spec 3.2
			000 0000 - 1 byte	
			000 0001 – 2 bytes	
			.....	
			111 1111 – 128 bytes	
FRAME_NUM	17		1 to 86400 ((hr * 3600 + mm * 60 + ss)+ 1)	Spec 3.2
			Example :	
			00:00:00 - Frame No 1	
			00:00:02 - Frame No. 3	
			.....	
			23:59:58 - Frame No 86399	
SOURCE_L	20		1 to 999999	

OCO_ID				
SOURCE_LOCO_VERSION	3		0: Not used 1 to 7: Kavach Version 1: Kavach Specification 3.2 2: Kavach Specification 4.0	New
ABS_LOCO_LOC	23		Absolute Location in meters	Width changed
TRAIN_LENGTH	11		0: Unidentified/ Invalid 1 to 2047: Train length in mtrs	Spec 3.2
TRAIN_SPEED	9	**Value** 0 to 400 401 to 510 511	**Description** Train Speed in kmph Reserved for future use Train Speed unidentified	Width changed from 8 to 10 bits
MOVE-MENT_DIR	2	**Value** 00 01 10 11	**Description** *Traffic Direction not established / unidentified* *Nominal (Normally Traffic Direction as UP)* *Reverse (Normally Traffic Direction as DOWN)* *Reserved for future use*	Spec 3.2
EMERGEN-CY_STATUS	3	**Value** 000 001 010 011 100 101 110 111	**Description** *No Emergency - Regular Packet* *Side Collision (Unusual Stoppage)* *SoS* *Roll Back Detected* *Head On Collision* *Rear End Collision* *Parting SoS* *Spare*	New Added for part-ing SoS
LO-CO_MODE	4	**Value** 0001 0010 0011 0100 0101 0110 0111	**Description** Stand_By Staff_Responsible_Mode Limited_Supervision Full_Supervision Override On_Sight Trip	

		1000	Post_Trip	
		1001	Reverse	
		1010	Shunting	
		1011	Non_Leading	
		1100	System_Failure	
		1101	Isolation	
Approaching Station ID	16		Approaching Station ID as received from Tag	
LAST_RFID_TAG	10		Tag ID of Last RFID Tag Read – The combination of Approaching Station ID and LAST_RFID_TAG shall be used for detecting Head on Collision or Rear End Collision. For this purpose, LAST_Station_ID shall be also be used by the Onboard KAVACH as read from the Tag.	
TIN	9	TIN programmed in last RFID tag		
		Value	**Description**	
		0	*Ignore / Don"t Care*	
		1 to 250	*Track Identity Number as per Track Section Occupied*	
		251	*Onboard shed TIN*	
		252-511	*Reserved for future use*	
Longitude	21	-180 to +180	Signed.	
			Degrees: First nine bits.	
			Minutes: six bits.	
			Seconds: six bits.	
Latitude	20	-90 to +90	Signed.	
			Degrees: First eight bits.	
			Minutes: six bits.	
			Seconds: six bits.	
LO-CO_RND_NUM_RL	16		Onboard Random number for session request. Change of this value by Onboard KAVACH indicates that requesting a fresh session from onboard KAVACH.	
Padding bits	5		If required to make sub packet length as multiple of bytes	
PKT_CRC	32		Packet CRC	
Total	232			



RAVINDRA NATH SINGH Digitally signed by RAVINDRA NATH SINGH Date: 2024.07.01 10:31:19 +05'30'

Pavan Kumar Digitally signed by Pavan Kumar Date: 2024.07.10 15:51:53 +05'30'