

ISO 9001: 2015	Effective from 13.06.2023	RDSO/SPN/196/2020	Version 4.0 d3- Amdt-1
Document Title : Specification of Kavach (The Indian Railway ATP)-Mode Transitions, SOS & MA handling			–
Annexure-A1			

Annexure – A

Modes Transitions, SOS & MA Handling

Issued by

SIGNAL & TELECOM DIRECTORATE
RESEARCH, DESIGNS & STANDARDS ORGANISATION
MINISTRY OF RAILWAYS
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Amdt	Date of issue	Amendment
Amdt-1	13-06-2023	<ul style="list-style-type: none"> Introduction, Scope and essential requirement of mode transition is added. Annexure A is separated with Annexure A1, A2 and A3 with their requirement of configuration parameter. Condition-89- Timing is modified from 120S to 240 Second. Rear End and Head On Collision handling scenario has been re-vised for conformity.

FOR FIELD TRIALS

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A1.1 Introduction

A1.1.1 This annexure describes the Mode Transitions and Conditions, mode based onboard function, Stationary KAVACH function w.r.t. Onboard modes. The complete list of transition to and from each mode is defined in transition table.

A1.1.2 This document describes how the received information is filtered, respect to several criteria such as the level, the mode, etc.

A1.2 Scope

A1.2.1 This document defines the mode transition condition of Onboard KAVACH system with their priority, transition condition, and stationary KAVACH functions with respects to onboard modes. The SOS and MA handling by stationary KAVACH is also defined.

A1.2.2 This document describes how the stored information is handled, respect to several criteria such as the level, the mode, etc.

A1.2.3 All the tables that are included in this document shall be considered as mandatory requirements.

A1.2.4 Each transition from a given mode receives a priority order (indicated by “-px-”, x is the priority order) to avoid a conflict between the different transitions when they occur at the same time (i.e. in the same clock cycle). P1 has a higher priority than P2.

A1.3 Essential Requirement

When evaluating trackside information received by radio or when re-evaluating a set of information released from the transition buffer, linking information, if any, shall be evaluated prior to any other location related information.

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A1.4 Mode Transitions condition

Modes Transitions & Function		Note: The indication “ n ” means: The condition n must be fulfilled to trigger the transition. To the mode that is indicated by the arrow “>” or “<”. Each transition from a given mode receives a priority order (indicated by “- px ”, x is the priority order) to avoid a conflict between the different transitions when they occur at the same time											
1. Standby	SB	<7 -p4-	<7 -p4-	<7 -p5-	<7 -p4-	<7 -p5-		<7 -p3-	<7 & 35 -p4-	<7,56 -p4-	<82 -p3-	<79 -p3-	<80 -p3-
2. Staff Responsible	77,60> -p4-	SR	<17, 23, 30, 85, - p5-	<17, 23, 30,85, - p6-	<17, 23, 30, 34, 85, -p5-	<17, 23, 30, 85, 89 -p6-,		<17, 30 -p4-					
3. Limited Supervision	61> -p3-		LS	<76 -p7-									
4. Full Supervision	62> -p4-			FS	<74 -p7-	<81 -p8-							
5. Override	63> -p4-			71> -p7-	OV	<71 -P7-		<86 -p5-					
6. On-Sight	64> -p4-	87> -p6-	90> -P6-	90> -p9-	91> -p6-	OS							
7. Trip				69> -p4-		69> -P4-	TR						
8. Post Trip	66> -p4-						59> -p3-	PT					
9. Reverse	67> -p4-	58> -p5-	58> -p5-	58> -p8-		58> -p7-		58> -p5-	RV				
10 .Shunt	68,57> -p4-	56> -p5-	56> -p5-	56> -p8-		56> -p7-				SH			
11. Non Leading	53> -p3-	53> -p3-	53> -p3-	53> -p3-	53> -p3-	53> -p3-			53> -p3-	53> -p3-	NL	<54 -p2-	<55 -p2-
12. System Failure	5> -p2-	5> -p2-	5> -p2-	5> -p2-	5> -p2-	5> -p2-	5> -p2-	5> -p2-	5> -p2-	5> -p2-	51> -p2-	SF	<52 -p1-
13. Isolation	2> -p1-	2> -p1-	2> -p1-	2> -p1-	2> -p1-	2> -p1-	2> -p1-	2> -p1-	2> -p1-	2> -p1-	2> -p1-	2> -p1-	IS

A1.5 Mode Transitions condition Table

Condition No.	Transition Conditions
1	KAVACH is Not Isolated
2	KAVACH is Isolated manually
3	Non Leading input is Active
4	Non Leading input is Not Active
5	System Faulty (Interfaces required for KAVACH function failed)
6	System Healthy
7	No CAB is Occupied or EM cock is closed.
8	Any one CAB is occupied
9	CAB is changed
10	Train is at standstill
11	Train is Moving
12	New Train Formation
13	No New Train Formation
14	Train configuration Available
15	Train configuration Not Available
16	In KAVACH Area
17	Not In KAVACH Area (KAVACH Territory Exit)
18	In Station Section
19	Not Station section
20	In Communication Mandatory Area
21	Not in Communication Mandatory Area
22	Track Profile Available (Including Traffic Direction) upto 3000m (Configurable) or Movement Authority, whichever is less
23	Track Profile NOT Available upto 3000m (Configurable) or Movement Authority, whichever is less
24	Valid Radio Packets are receiving (Loco Id match & Frame number valid (Rx Frame no is Present cycle Frame number Or Previous cycle Frame no)
25	Valid Radio packets miss for 15 consecutive cycles
26	Frame Offset cycle is more than 14 in Radio Rx packet
27	Frame Offset cycle is less than 5 in Radio Rx packet
28	Train Brakes health test is success (Test triggers when New train is formed)
29	Train Traffic Direction Known
30	Train Traffic Direction is Unknown
31	Loco pilot Presses SR Button & [10]
32	Loco pilot Presses Shunt Button
33	Radio Communication is good – ([24] & [27]) & (Valid MA)
34	Radio Communication is Bad – ([25] or [26]) & [20]
35	{500mtrs(configurable) travelled in reverse direction} or {10min (configurable) timeout in Reverse mode} or (Reverser moved out of Reverse Position)
36	Loco pilot Presses SR Button
37	TSR Info available.
38	TSR info not available.
39-49	Spare

50	[12]&[14]&[32]&[10]&[28]&[8]
51	[4]&[5]&[10]
52	[1]&[5]&[10]
53	[3]&[10]
54	[3]&[6]&[10]
55	[1]&[3]&[10]
56	[10]&[32]
57	[12]&[14]&[32]&[10]&[28]&[8]
58	[10] & Loco pilots request Reverse Mode
59	[10] & Loco pilot Presses PT button (Train Trip)
60	[8] & [13] & Previous mode is SR mode
61	[8] & [13] & Previous mode is LS mode
62	[8] & [13] & Previous mode is FS mode
63	[8] & [13] & Previous mode is OV mode
64	[8] & [13] & Previous mode is OS mode
65	[8] & [13] & Previous mode is TR mode
66	[8] & [13] & Previous mode is PT mode
67	[8] & [13] & Previous mode is RV mode
68	[8] & [13] & Previous mode is SH mode
69	Train Crosses EOA Location {MA+30m(Configurable)} or Crossed Signal foot with MA < 50 (Configurable)
70	Train Crosses EOA Location Or Signal Foot tag and &[25]
71	[10] & Loco pilots request Override & MA < 200m (Configurable)
72	[22]&[33]&(MA Valid)&(if SR mode entry is because of Loco pilot request in LS or FS mode then {Target Distance > 300m(Configurable)& No SOS Condition})
73	[22]&[33]&(MA Valid) & [37]
74	[22]&[33]&(MA extended or On Override Timeout)
75	([22]or[33])& {if SR mode entry is because of Loco pilot request in LS or FS mode then (Target Distance > 300 (Configurable) & No SOS Condition)}
76	Track Profile Available (Including Traffic Direction) upto 3000m (Configurable) AND [34] AND[20]
77	[12]&[14]&[31]&[28]&[8]
78	[23]&[34]
79	[4]&[6]
80	[1]&[4]&[6]&[10]
81	[22]&[33]&FS MA recived
82	[4]&[6]&[10]
83	(Spare)
84	(Spare)
85	Three consecutive Normal tags missed
86	[10] & Loco pilots select Override
87	OS MA received & [22]
88	Invalid RFID Tag or Wrong RFID Sequence.
89	Expiry of OSMA holding Time (120 240 Seconds) & [20]
90	OSMA received
91	OSMA extended and [22]

A1.6 Onboard KAVACH Unit Functions

	KAVACH MODES												
On-Board Functions	SB	SR	LS	FS	OV	OS	TR	PT	RV	SH	NL	SF	IS
Train Interface Related functions													
Train Direction computation(Based on CAB & Wheel rotation)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X
Traffic direction computation(Based on Absolute Kilometer Mark where available from RFID reader)	WA	WA	✓	✓	✓	✓	✓	WA	WA	✓	X	X	X
CAB Occupation & CAB number	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	WA	WA	WA
Speed Measurement	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	WA	WA	WA
Distance measurement	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	WA	WA	WA
GPS & Time Related Functions													
GPS Date & Time data	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	WA	WA	WA
PPS Synchronization	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	WA	WA	WA
Track Data Processing													
RFID Linking & data processing	WA	WA	✓	✓	WA	WA	WA	WA	X	X	X	X	X
LC Gate Warning & Horn	X	✓	✓	✓	✓	✓	✓	✓	X	WA	X	X	X
Absolute Kilometer Computation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	WA	WA	WA
Tag missing Indication on LP-OCIP (DMI)	WA	WA	✓	✓	WA	WA	WA	WA	X	X	X	X	X
Radio Communication & Signaling Data Processing													
Onboard Packet Transmission (only In KAVACH Area)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X
Onboard to Onboard communication	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X
Packet Reception from Linked Station	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X
Next Stationary KAVACH Linking	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X
Communication Failure in Comm Mandatory Zone	X	X	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X
MA display on LP-OCIP (DMI)	X	X	X	✓	✓	✓	✓	✓	X	X	X	X	X
Signal display on LP-OCIP (DMI)	X	X	X	✓	WA	WA	X	X	X	X	X	X	X
Emergency Functions													
Manual SoS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X
Unusual Block Stoppage SoS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X

On-Board Functions	SB	SR	LS	FS	OV	OS	TR	PT	RV	SH	NL	SF	IS
Train Parting SoS(if Train Integrity Device such as EOTT is available)-KAVACH shall be capable of reading potential free contact.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X
Loco specific SoS from Linked Station	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X
General SoS from Station(within 3km Radius)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X
Train Data Capturing													
Train Length Measurement	X	X	X	✓	X	✓	X	X	X	X	X	X	X
Manual Brake Test	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X
Train Movement Protections													
Stand still supervision	✓	X	X	X	X	X	✓	✓	X	X	X	X	X
Standstill Supervisionwhen the train speed is zero and reverser is detected at Neutral	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X
Reverse Movement Protection	✓	✓	✓	✓	✓	✓	✓	✓	X	✓	X	X	X
Roll back Protection	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X
Train Movements Supervision													
Movement authority supervision	X	X	X	✓	✓	✓	X	X	X	X	X	X	X
Track Profile	WA	X	✓	✓	✓	✓	✓	✓	X	X	X	X	X
Temporary Speed Restriction	WA	X	✓	✓	✓	✓	✓	✓	X	X	X	X	X
Loop line speed control	X	X	WA	✓	X	WA	X	X	X	X	X	X	X
Collision Avoidance	WA	WA	✓	✓	✓	✓	✓	✓	X	X	X	X	X
Locomotive related speed restriction	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X
Mode related speed restriction	✓	✓	NA	NA	NA	✓	✓	✓	✓	✓	X	X	X
Event Logging													
Radio TX data	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	WA	WA	WA
Radio Rx Data	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	WA	X
RFID data	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	WA	WA	WA
Events data	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	WA	WA	WA
Critical Faults Data	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	WA	WA	WA

‘WA’ means Where available.

A1.7 Stationary KAVACH Functions With Respect to Onboard Modes

Stationary KAVACH Functions	SB	SR	LS	FS	OV	OS	TR	PT	RV	SH	NL	SF	IS
SPAD Prevention After crossing EoA, SoS and Zero MA	X	X	X	✓	X	✓	X	X	X	X	X	X	X
RFID Tag Sequence Validation	✓	✓	X	✓	✓	✓	✓	X	X	X	X	X	X
TIN Validation for collision detection	✓	✓	X	✓	✓	X	✓	X	X	X	X	X	X
Shunt Limit Validation	X	X	X	X	X	X	X	X	X	✓	X	X	X
Extending MA	✓	✓	✓	✓	✓	✓	X	X	X	X	X	X	X
Registration of Onboard KAVACH	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X
Timeout based Deregistration of Onboard KA- VACH	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X
Direction based De-registration of Onboard - KAVACH at Standstill	✓	✓	X	X	X	X	X	X	X	X	X	X	X
SoS Generation due to direction unknown and OS MA Invalid	X	✓	X	✓	✓	✓	✓	✓	X	X	X	X	X
Recovery of SoS occurred due to direction un- known, Foreign tag, wrong sequence RFID, In- valid train location: Onboard transits to SR Mode at standstill.	X	✓	X	✓	✓	✓	✓	✓	X	X	X	X	X
Next Signal Linking	✓	✓	X	✓	✓	✓	X	✓	X	X	X	X	X
Reset of Signal Linking	X	✓	X	X	X	✓	X	X	X	X	X	X	X
Validation of Stationary Limits Radio commu- nication	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X

FOR

A1.8 SoS and MA handling by Stationary KAVACH

A1.8.1 These clauses provide uniform Head on and Rear-end collision scenario monitoring, when Onboard KAVACH is supervised by Stationary KAVACH.

A1.8.2 Two functional Onboard KAVACH equipped trains cannot come in FS mode in the approach of Stop Signal.

A1.8.3 Onboard **KAVACH** in the rear will always be in “On Sight” mode.

A1.8.3A1.8.4 The states of MA upon reception of SoS can be as follows

M1	No Change
M2	Rear End Collision SoS and Reduce MA up-to Rear End Collision Margin
M3	Zero(0) for L2
M4	Head On Collision SoS and MA Zero(0) for both locos
M5	Rear End Collision SoS when MA not available
M6	Head On Collision SoS for both locos when MA not available.

A1.8.4A1.8.5 The States of Status of signal display can be as follows

S1	As at Site
S2	Blank
S3	Red

A1.8.5A1.8.6 The States of brakes can be

B1	No Brake
B2	Brake

A1.8.6A1.8.7 The various conditions that an Onboard KAVACH can based on Communication zone and availability are as follows

C1	Zone-Mandatory and Available with station
C2	Zone-Mandatory and Unavailable with station
C3	Zone-non Mandatory

A1.8.7A1.8.8 The various conditions that an Onboard KAVACH can based on Signal Foot Tag read can be as follows

R1	Read
R2	Missed and passed 30m

A1.8.8A1.8.9 The various conditions that an Onboard KAVACH can based on Position Report can be as follows

P1	Available
P2	Not Available

A1.8.9**A1.8.10** The type of section occupied by Onboard KAVACH can be as follows

A1	Station Section
A2	Absolute Block Section
A3	Automatic Block Section
A4	Virtual Block

A1.8.10**A1.8.11** The result of IXL validations to be done by Stationary KAVACH can result in two states

I1	Ok
I2	Not Ok

A1.8.11**A1.8.12** The result of TIN validations to be done by Stationary KAVACH can result following states

T1	Same TIN, Onboard KAVACH separated by Signal at ON
T2	Same TIN, Onboard KAVACH separated by Signal at OFF & state I2
T3	Different in the Route, Onboard KAVACH separated by Signal at ON, Route not known & state I1
T4	Different in the Route, Onboard KAVACH separated by Signal at ON, Route Ascertained due to enroute Tags & state I1
T5	Different in the Route, Onboard KAVACH separated by Signal at OFF, Route not known & State I2
T6	Different in the Route, Onboard KAVACH separated by Signal at OFF, Route Ascertained due to enroute Tags & state I2
T7	Same TIN, No signal in between two trains

A1.8.12 ~~A1.8.13~~ Handling of SoS and MA during various scenarios is detailed below: Scenarios and expected protection

A1.8.12.1 ~~A1.8.13.1~~ Absolute Block Station (Home to Adv.Starter)

(a) Stop Signal at ON is between two trains with valid position report:

(i) Rear End Collision

Rear End Collision as at Figure 1		Section: Station (A1)		Communication: Zone-Mandatory and Available with station (C1)						
		Tin Validation: Different in the Route, Onboard KAVACH separated by Signal at ON, Route not known & state I1 (T3)								
L2↓	L1→	SR (P1)	LS (C2)	OS	FS	OS+OV	FS+OV	TR	PT	PT+OV
SR(P1)		☒	☒	☒	☒	☒	☒	☒	☒	☒
LS(C2)		☒	☒	☒	☒	☒	☒	☒	☒	☒
OS		☒	☒	M2 @T4	M2 @T4	M2 @T4	M2 @T4	M2 @T4	M2 @T4	M2@T4
FS		NA	NA	NA	NA	NA	NA	NA	NA	NA
OS+OV		☒	☒	M2 @T4	M2 @T4	M2 @T4	M2 @T4	M2 @T4	M2 @T4	M2@T4
FS+OV		☒	☒	M2 @T4	M2 @T4	M2 @T4	M2 @T4	M2 @T4	M2 @T4	M2@T4
TR		NA	NA	NA	NA	NA	NA	NA	NA	NA
PT		NA	NA	NA	NA	NA	NA	NA	NA	NA
PT+OV		☒	☒	M2 @T4	M2 @T4	M2 @T4	M2 @T4	M2 @T4	M2 @T4	M2@T4

(a)

(i) ~~SOS: Not generated.~~

(ii) ~~Rear End Collision: FS MA for L 2 Onboard is generated up to stopsignal and for L 1 Onboard up to next stop signal at ON. When override mode is selected in L 2, OS MA is generated up to an EoA location which is at rear end of the L 1 Onboard with additional rear end collision margin distance (Configurable). MA for L 1 will be as per stationary KAVACH table of control.~~

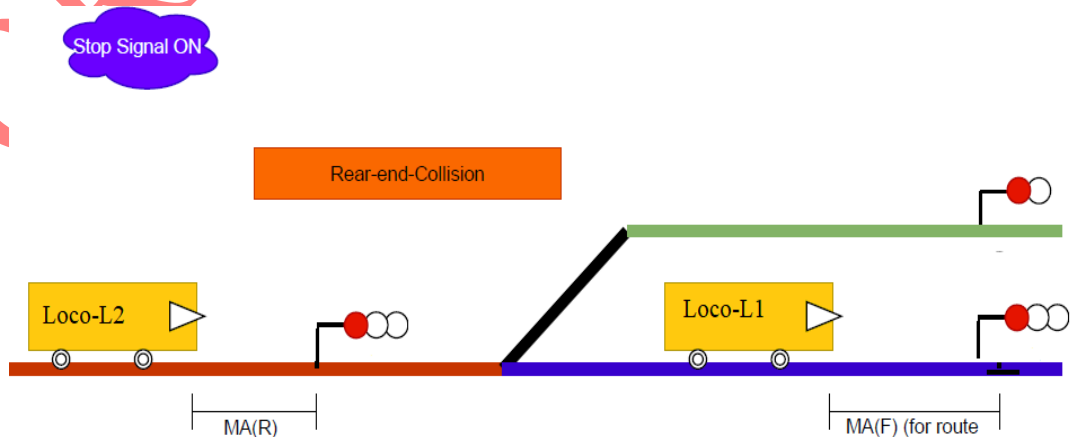


Figure 1

- (b) Stop Signal at OFF (IxL fail) is between two trains with valid position report.
TIN Occupation: TIN occupied by L-1 and L-2 Onboard are different.

(i) ~~SOS: Not generated.~~

(i) Rear End Collision:

Rear End Collision as at Figure 3		Section: Station (A1)	Communication: Zone-Mandatory and Available with station (C1)							
		Tin Validation: Different in the Route, Onboard KAVACH separated by Signal at ON, Route not known & state I2 (T5)								
L2 ↓	L1 →	SR (P1)	LS (C2)	OS	FS	OS+OV	FS+OV	TR	PT	PT+OV
SR(P1)		☒	☒	☒	☒	☒	☒	☒	☒	☒
LS(C2)		☒	☒	☒	☒	☒	☒	☒	☒	☒
OS		☒	☒	S3@T5, S2@R1/ R2, M2@T6	S3@T5,S2 @R1/R2, M2@T6	S3@T5,S2 @R1/R2, M2@T6	S3@T5,S2 @R1/R2, M2@T6	S3@T5,S2 @R1/R2, M2@T6	S3@T5,S2 @R1/R2, M2@T6	S3@T5,S2 @R1/R2, M2@T6
FS		S3	S3	S3	S3	S3	S3	S3	S3	S3
OS+OV		☒	☒	S3@T5, S2@R1/ R2, M2@T6	S3@T5,S2 @R1/R2, M2@T6	S3@T5,S2 @R1/R2, M2@T6	S3@T5,S2 @R1/R2, M2@T6	S3@T5,S2 @R1/R2, M2@T6	S3@T5,S2 @R1/R2, M2@T6	S3@T5,S2 @R1/R2, M2@T6
FS+OV		☒	☒	S3@T5, S2@R1/ R2, M2@T6	S3@T5,S2 @R1/R2, M2@T6	S3@T5,S2 @R1/R2, M2@T6	S3@T5,S2 @R1/R2, M2@T6	S3@T5,S2 @R1/R2, M2@T6	S3@T5,S2 @R1/R2, M2@T6	S3@T5,S2 @R1/R2, M2@T6
TR		S3	S3	S3	S3	S3	S3	S3	S3	S3
PT		S3	S3	S3	S3	S3	S3	S3	S3	S3
PT+OV		☒	☒	S3@T5, S2@R1/ R2, M2@T6	S3@T5,S2 @R1/R2, M2@T6	S3@T5,S2 @R1/R2, M2@T6	S3@T5,S2 @R1/R2, M2@T6	S3@T5,S2 @R1/R2, M2@T6	S3@T5,S2 @R1/R2, M2@T6	S3@T5,S2 @R1/R2, M2@T6

Signal Aspect is shown as danger on DMI of L-2. FS/OSMA for L-2 Onboard is not extended beyond approaching stop signal. SoS is generated, if Onboard passes S-Tag. MA for L-1 will be as per stationary KAVACH table of control.

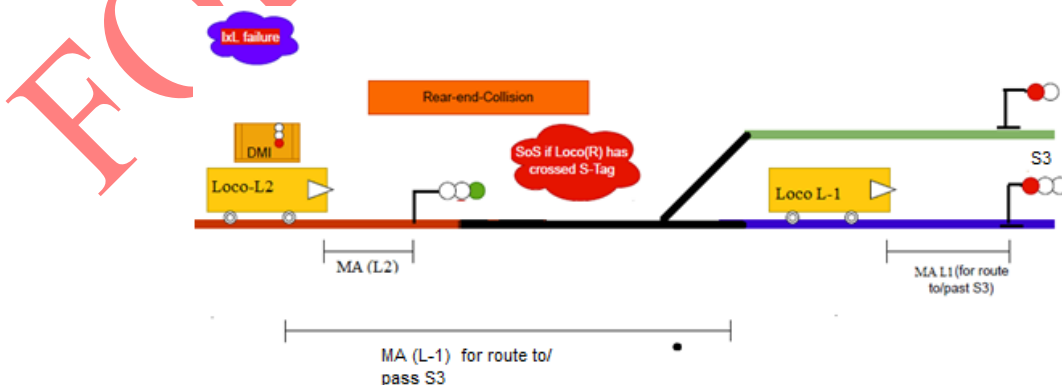


Figure 3

(ii) Head On Collision:

Head On Collision as at Figure 4		Section: Station (A1)		Communication: Zone-Mandatory and Available with station (C1)							
		Tin Validation: Different in the Route, Onboard KAVACH separated by Signal at ON, Route not known & state I2 (T5)									
L2 ↓	L1 →	SR (P1) ↓	LS (C2) ↓	OS	FS	OS+OV	FS+OV	TR	PT	PT+OV	
SR(P1)		☒	☒	☒	☒	☒	☒	☒	☒	☒	
LS(C2)		☒	☒	☒	☒	☒	☒	☒	☒	☒	
OS		☒	☒	S3@T5 S2@R1/R 2 M4@T6	S3@T5 S2@R1/R 2 M4@T6	S3@T5 S2@R1/R 2 M4@T6	S3@T5 S2@R1/R 2 M4@T6	S3@T5 S2@R1/R 2 M4@T6	S3@T5 S2@R1/R 2 M4@T6	S3@T5 S2@R1/R 2 M4@T6	
FS		S3	S3	S3	S3	S3	S3	S3	S3	S3	
OS+OV		☒	☒	S3@T5 S2@R1/R 2 M4@T6	S3@T5 S2@R1/R 2 M4@T6	S3@T5 S2@R1/R 2 M4@T6	S3@T5 S2@R1/R 2 M4@T6	S3@T5 S2@R1/R 2 M4@T6	S3@T5 S2@R1/R 2 M4@T6	S3@T5 S2@R1/R 2 M4@T6	
FS+OV		☒	☒	S3@T5 S2@R1/R 2 M4@T6	S3@T5 S2@R1/R 2 M4@T6	S3@T5 S2@R1/R 2 M4@T6	S3@T5 S2@R1/R 2 M4@T6	S3@T5 S2@R1/R 2 M4@T6	S3@T5 S2@R1/R 2 M4@T6	S3@T5 S2@R1/R 2 M4@T6	
TR		S3	S3	S3	S3	S3	S3	S3	S3	S3	
PT		S3	S3	S3	S3	S3	S3	S3	S3	S3	
PT+OV		☒	☒	S3@T5 S2@R1/R 2 M4@T6	S3@T5 S2@R1/R 2 M4@T6	S3@T5 S2@R1/R 2 M4@T6	S3@T5 S2@R1/R 2 M4@T6	S3@T5 S2@R1/R 2 M4@T6	S3@T5 S2@R1/R 2 M4@T6	S3@T5 S2@R1/R 2 M4@T6	

(ii) Both Onboards receive FS/OS MA = 0 and SoS when Stationary KAVACH detects that any of the Occupied TIN falls in the path of the two trains.

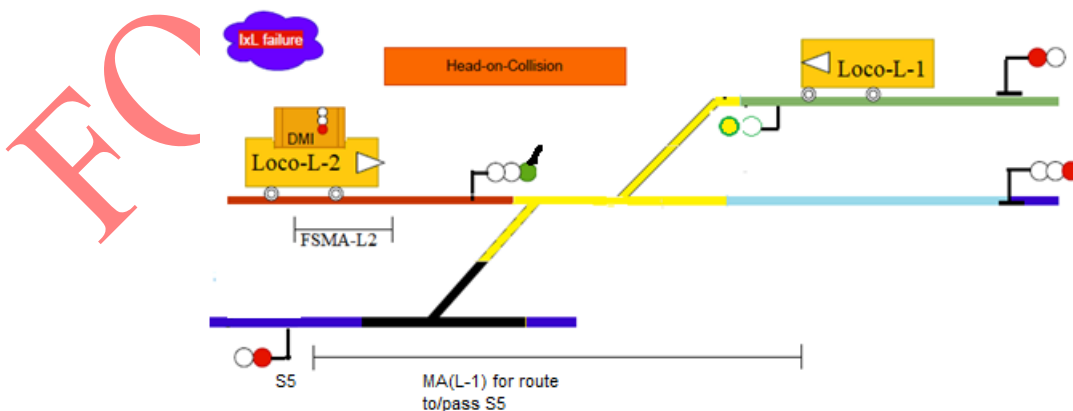


Figure 4

- (c) Stop signal is at OFF (IxL fail) is between two trains with valid position report
TIN Occupation: TIN occupied by L-1 Onboard is same as L-2.

(i) ~~SOS: Generated.~~

(i) Rear End Collision:

Rear End Collision as at Figure 5		Section: Station (A1)		Communication: Zone-Mandatory and Available with station (C1)							
		Tin Validation: Same TIN, Onboard KAVACH separated by Signal at OFF & state I2 (T2)									
L2↓	L1→	SR (P1)	LS (C2)	OS	FS	OS+OV	FS+OV	TR	PT	PT+OV	
SR(P1)		M5	M5	M5	M5	M5	M5	M5	M5	M5	
LS(C2)		M5	M5	M5	M5	M5	M5	M5	M5	M5	
OS		M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	
FS		M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	
OS+OV		M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	
FS+OV		M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	
TR		M3, S2	M3, S2	M3, S2	M3, S2	M3, S2	M3, S2	M3, S2	M3, S2	M3, S2	
PT		M3, S2	M3, S2	M3, S2	M3, S2	M3, S2	M3, S2	M3, S2	M3, S2	M3, S2	
PT+OV		M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	M2, S2	

- (ii) SoS is generated for L-2 Onboard only. OS MA for L-2 Onboard is generated up to an EoA location which is at rear end of the L-1 Onboard with additional safety margin of 300m (Configurable) distance. MA for L-1 Onboard will be as per Stationary KAVACH Table of Control.

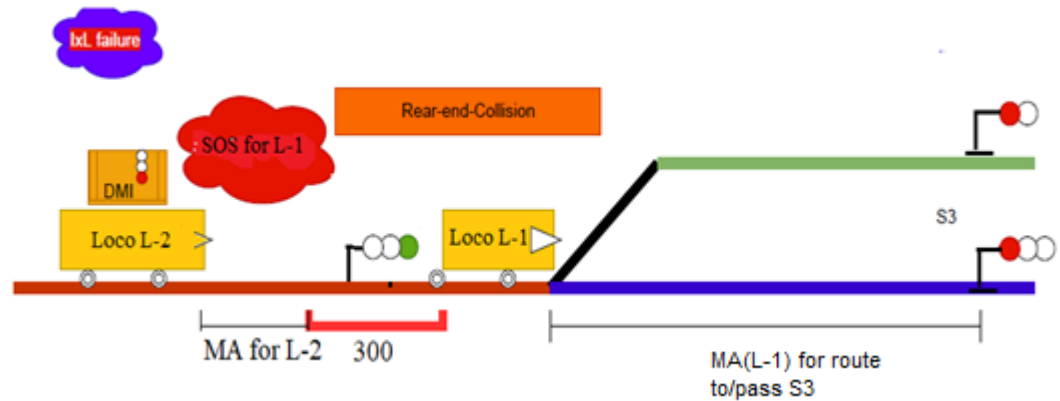


Figure 5

(ii) Head On Collision:

Head On Collision as at Figure 6		Section: Station (A1)			Communication: Zone-Mandatory and Available with station (C1)						
		Tin Validation: Same TIN, Onboard KAVACH separated by Signal at OFF & state I2 (T2)									
L2↓	L1→	SR (P1)	LS (C2)	OS	FS	OS+OV	FS+OV	TR	PT	PT+OV	
SR(P1)		M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	
LS(C2)		M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	
OS		M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	
FS		M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	
OS+OV		M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	
FS+OV		M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	
TR		M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	
PT		M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	
PT+OV		M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	M6, S2	

(iii) Both Onboards receive FS MA = 0 and So when Stationary KA-VACH detects that any of the Occupied TIN falls in the path of the two trains.

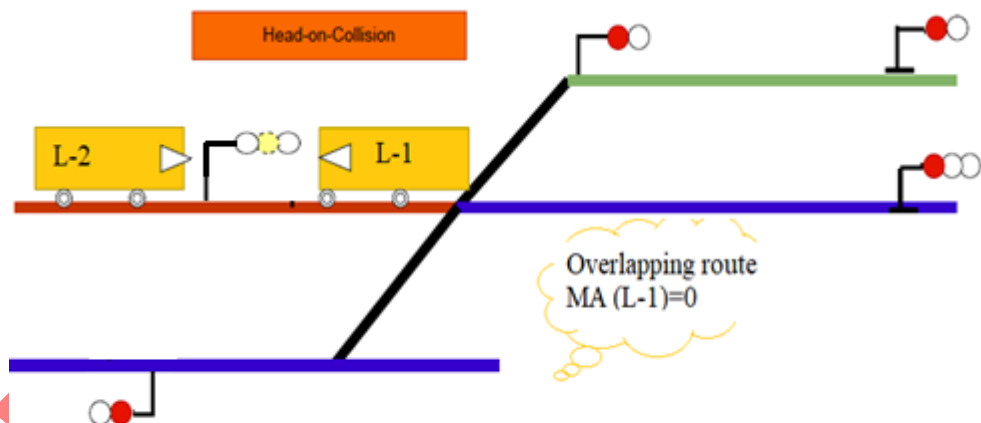


Figure 6

- (d) No Stop Signal between two trains with valid position report. TIN Occupation: Two trains are on different TIN but in the same route (or) on the same TIN.

(i) ~~SOS: Generated.~~

(ii) ~~Rear End Collision: SoS is generated for L 2 Onboard only. MA for L 2 Onboard is generated up to an EoA location which is at rear end of the L 1 Onboard with additional safety margin of 300m (Configurable) distance. MA for L 1 Onboard will be as per Stationary KAVACH Table of Control inputs.~~

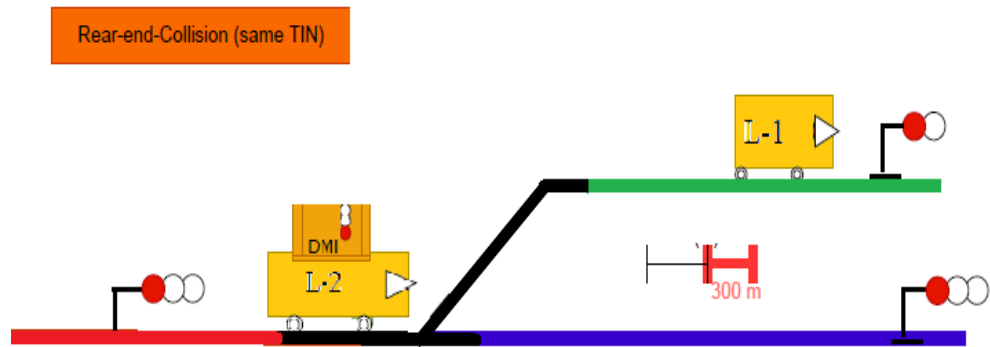


Figure 7 Route Ascertained in Rear End Collision Scenario

(iii) ~~Head On Collision: Both Onboards receive FS MA = 0 and SoS when Stationary KAVACH detects that any of the Occupied TIN falls in the path of the two trains.~~

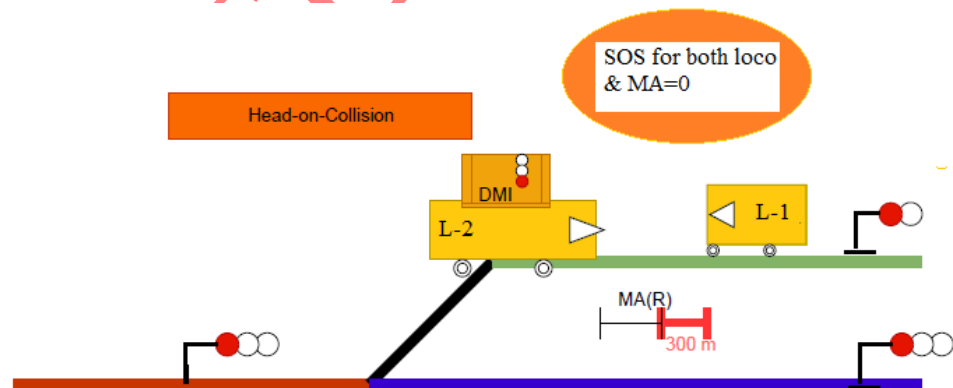


Figure 8 Route Ascertained in Head On Collision Scenario

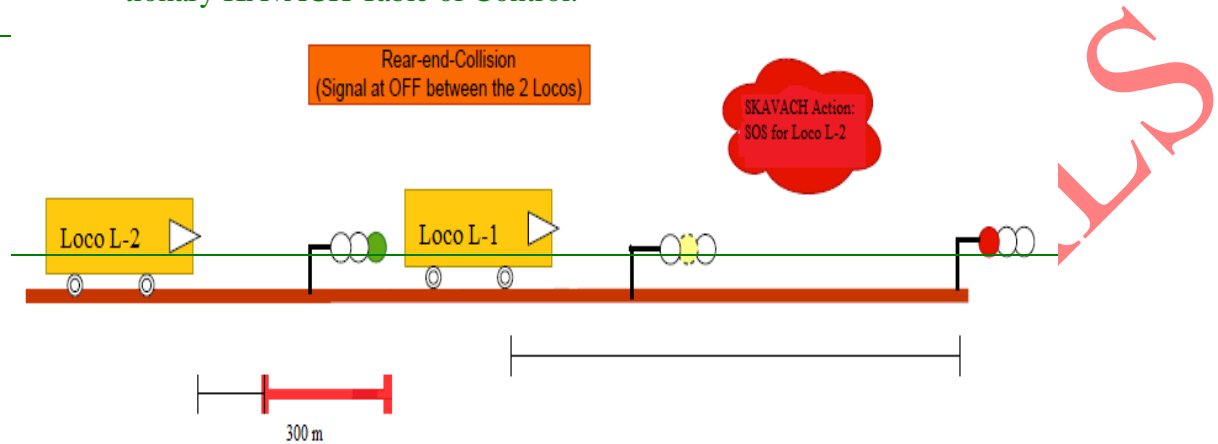
A1.8.13 Automatic Block Station (Home to Adv.Starter)

(a) Stop Signal at ON is between two trains with valid position report

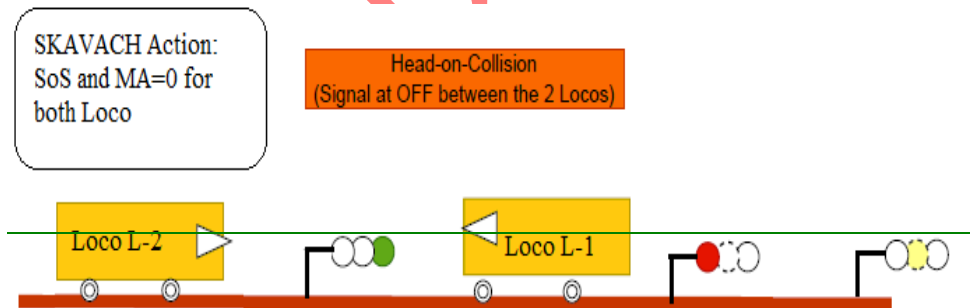
(i) ~~SOS: Not Generated.~~

(ii) ~~Rear End Collision: MA for L 2 Onboard is generated up to stop signal and for L 1 Onboard up to next stop signal at ON.~~

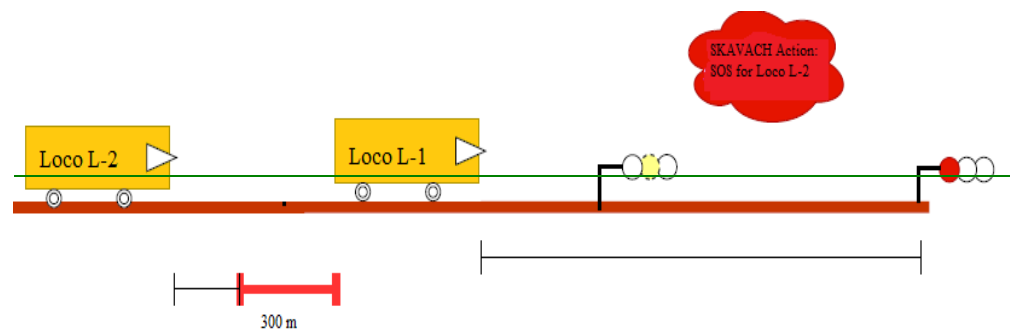
- (e) Stop signal is at OFF (IxL fail) is between two trains with valid position report. TIN Occupation: TIN occupied by front Onboard is same as rear Onboard TIN in the signal route.
- (i) **SOS:** Generated.
- (ii) **Rear End Collision:** SoS is generated for L 2 Onboard only. FS MA for L 2 Onboard is generated up to foot of approaching signal. MA for L 1 Onboard will be as per Stationary KAVACH Table of Control.



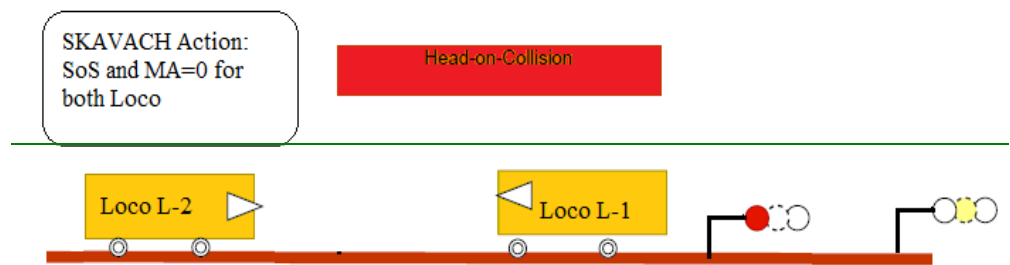
- (iii) **Head On Collision:** Both Onboards receive FS MA = 0 and So when Stationary KAVACH detects that any of the Occupied TIN falls in the path of the two trains.



- (d) Stop Signal between two trains with valid position report. TIN Occupation: Two trains are on different TIN but in the same route (or) on the same TIN.
- (i) **SOS:** Generated.
- (ii) **Rear End Collision:** SoS is generated for rear end Onboard only. MA for L 2 Onboard is generated up to an EoA location which is at rear end of the L 1 Onboard with additional safety margin of 300m (Configurable) distance. MA for front Onboard will be as per Stationary KAVACH Table of Control inputs.



(iii) **Head On Collision:** Both **Onboards** receive FS MA = 0 and So when Stationary KAVACH detects that any of the Occupied TIN falls in the path of the two trains.



(a) Mainline signals in Automatic mode: Same as point A1.8.13.1A-8.4.2 for the presence of a Stop Signal between two trains and No Stop Signal between two trains.

(e)

A1.8.14 Absolute Block Section

- (a) No Stop Signal between trains with valid position report (Communication-mandatory zone).

(i) ~~SOS: Generated. (Stationary KAVACH supervision)~~

(i) Rear End Collision:

Rear End Collision as at Figure 9		Section: Absolute Block (A2)			Communication: Zone-Mandatory and Available with station (C1)						
		Tin Validation: Same TIN and no Stop signal in between two trains (T2)									
L2↓	L1→	SR (P1)	LS (C2)	OS	FS	OS+OV	FS+OV	TR	PT	PT+OV	
SR(P1)		M5	M5	M5	M5	M5	M5	M5	M5	M5	
LS(C2)		M5	M5	M5	M5	M5	M5	M5	M5	M5	
OS		S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	
FS		NA	NA	NA	NA	NA	NA	NA	NA	NA	
OS+OV		S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	
FS+OV		S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	
TR		NA	NA	NA	NA	NA	NA	NA	NA	NA	
PT		NA	NA	NA	NA	NA	NA	NA	NA	NA	
PT+OV		S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	

- (ii) SoS is generated for L-2 Onboard only. OS MA for L-2 Onboard is generated up to an EoA location which is at rear end of the L-1 Onboard with additional safety margin of 300m (Configurable) distance. MA for L-1 Onboard will be as per Stationary KAVACH Table of Control inputs.

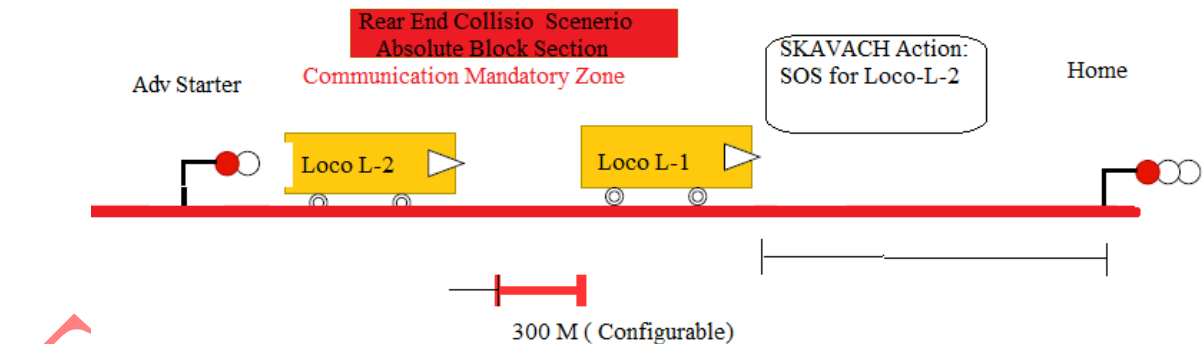


Figure 9

(ii) Head On Collision:

Head On Collision as at Figure 10		Section: Absolute Block (A2)	Communication: Zone-Mandatory and Available with station (C1)							
		Tin Validation: Same TIN and no Stop signal in between two trains (T2)								
L2↓	L1→	SR (P1)	LS (C2)	OS	FS	OS+OV	FS+OV	TR	PT	PT+OV
SR(P1)		M6	M6	M6	M6	M6	M6	M6	M6	M6
LS(C2)		M6	M6	M6	M6	M6	M6	M6	M6	M6
OS		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4
FS		NA	NA	NA	NA	NA	NA	NA	NA	NA
OS+OV		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4
FS+OV		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4
TR		NA	NA	NA	NA	NA	NA	NA	NA	NA
PT		NA	NA	NA	NA	NA	NA	NA	NA	NA
PT+OV		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4

- (iii) Both Onboards receive FS/OS MA = 0 and SoS when Stationary KAVACH detects that any of the Occupied TIN falls in the path of the two trains.

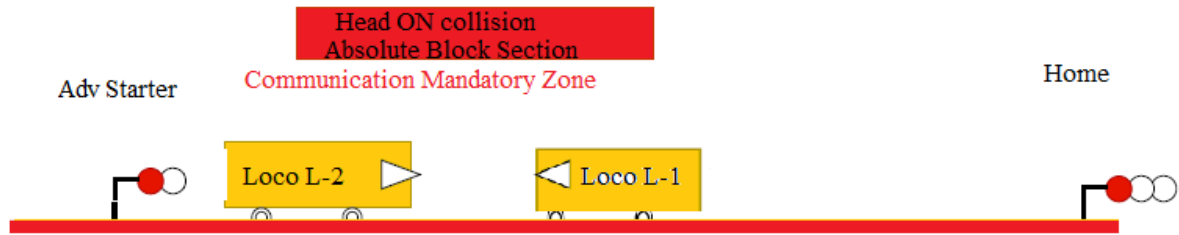


Figure 10

- (b) No Stop Signal between trains with valid position report and communication is ~~failed~~ ~~not available~~ ~~(in~~ Communication_mandatory ~~/not mandatory~~ zone.
~~(i) — SOS: Not generated.~~

(i) Rear End Collision:

Rear End Collision as at Figure 11		Section: Absolute Block (A2)		Communication: Zone-Mandatory and Available with station (C2)							
		Tin Validation: Same TIN and no Stop signal in between two trains (T7)									
L2↓	L1→	SR (P1)	LS (C2)	OS	FS	OS+OV	FS+OV	TR	PT	PT+OV	
SR(P1)		M5	M5	M5	M5	M5	M5	M5	M5	M5	
LS(C2)		M5	M5	M5	M5	M5	M5	M5	M5	M5	
OS		S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	
FS		NA	NA	NA	NA	NA	NA	NA	NA	NA	
OS+OV		S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	
FS+OV		S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	
TR		NA	NA	NA	NA	NA	NA	NA	NA	NA	
PT		NA	NA	NA	NA	NA	NA	NA	NA	NA	
PT+OV		S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	

- ~~(ii)~~ L-2 Onboard KAVACH on detection of rear end collision shall apply brakes and ensure stopping before 300m in rear of front Onboard KAVACH under any of the following conditions.

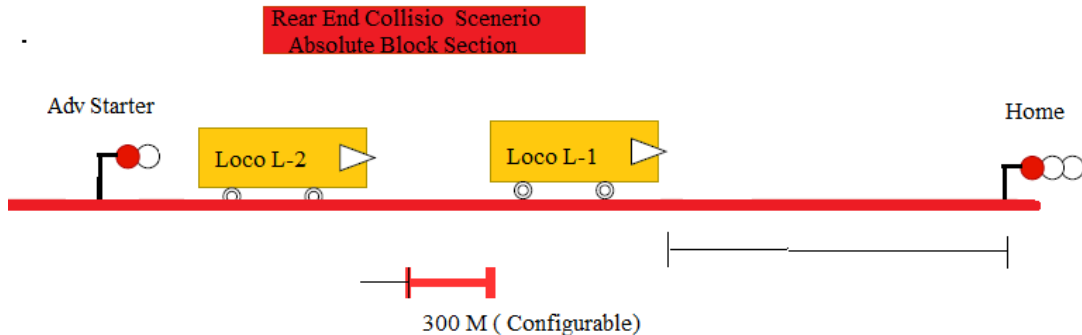


Figure 11

(ii) **Head On Collision:** Both Onboards on detection of head on collision shall apply EB and shall stop the train unconditionally.

Rear End Collision as at Figure 12		Section: Absolute Block (A2)		Communication: Zone-Mandatory and Available with station (C2)							
		Tin Validation: Same TIN and no Stop signal in between two trains (T7)									
		L2↓	L1→	SR (P1)	LS (C2)	OS	FS	OS+OV	FS+OV	TR	PT
SR(P1)		M6	M6	M6	M6	M6	M6	M6	M6	M6	M6
LS(C2)		M6	M6	M6	M6	M6	M6	M6	M6	M6	M6
OS		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4
FS		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4
OS+OV		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4
FS+OV		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4
TR		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4
PT		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4
PT+OV		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4

(iii)

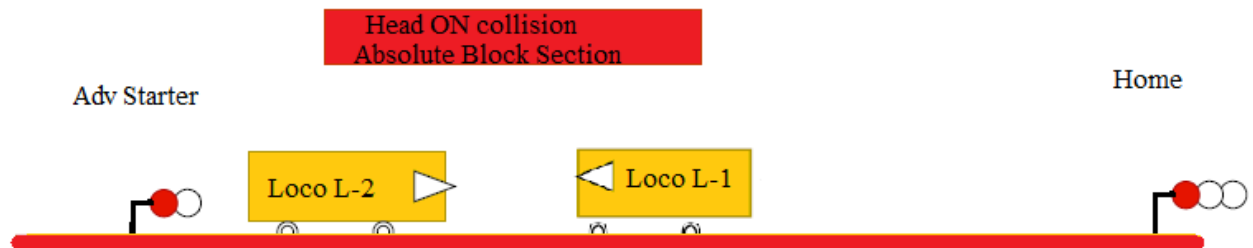


Figure 12

A1.8.15 Absolute Block Section with IBS

(a) Stop Signal at ON is between two trains with valid position report.

(i) ~~SOS: Not generated.~~

(i) Rear End Collision:

Rear End Collision as at Figure 13		Section: Absolute Block (A2)		Communication: Zone-Mandatory and Available with station (C2)							
		Tin Validation: Same TIN and Stop signal at ON in between two trains (T1)									
L2↓	L1→	SR (P1)	LS (C2)	OS	FS	OS+OV	FS+OV	TR	PT	PT+OV	
SR(P1)		M5	M5	M5	M5	M5	M5	M5	M5	M5	
LS(C2)		M5	M5	M5	M5	M5	M5	M5	M5	M5	
OS		M2	M2	M2	M2	M2	M2	M2	M2	M2	
FS		M2	M2	M2	M2	M2	M2	M2	M2	M2	
OS+OV		M2	M2	M2	M2	M2	M2	M2	M2	M2	
FS+OV		M2	M2	M2	M2	M2	M2	M2	M2	M2	
TR		S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	
PT		S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	
PT+OV		M2	M2	M2	M2	M2	M2	M2	M2	M2	

(ii) MA for rear Onboard is generated up to stopsignal and for Front Onboard up to next stop signal at ON.

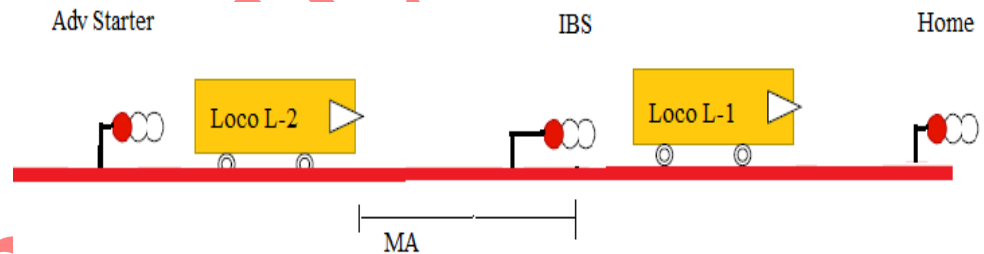


Figure 13

(ii) Head On Collision:

Head On Collision as at Figure 14		Section: Absolute Block (A2)		Communication: Zone-Mandatory and Available with station (C2)							
		Tin Validation: Same TIN and Stop signal at ON in between two trains (T1)									
L2↓	L1→	SR (P1)	LS (C2)	OS	FS	OS+OV	FS+OV	TR	PT	PT+OV	
SR(P1)		M6	M6	M6	M6	M6	M6	M6	M6	M6	
LS(C2)		M6	M6	M6	M6	M6	M6	M6	M6	M6	
OS		M4	M4	M4	M4	M4	M4	M4	M4	M4	
FS		M4	M4	M4	M4	M4	M4	M4	M4	M4	
OS+OV		M4	M4	M4	M4	M4	M4	M4	M4	M4	
FS+OV		M4	M4	M4	M4	M4	M4	M4	M4	M4	
TR		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	
PT		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	
PT+OV		M4	M4	M4	M4	M4	M4	M4	M4	M4	

(iii)

Both Onboards receive FS/OS MA = 0 and SoS when Stationary KAVACH detects that any of the Occupied TIN falls in the path of the two trains.

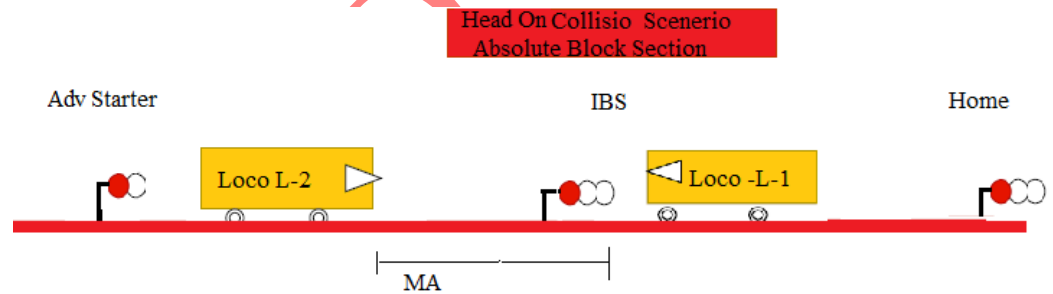


Figure 14

- (b) Stop signal is at OFF (IxL fail) is between two trains with valid position report. TIN Occupation: TIN occupied by L1 & L2 Onboard is same TIN in the signal route.

(i) ~~SOS: Generated.~~

(i) **Rear End Collision:**

Rear End Collision as at Figure 15		Section: Absolute Block (A2)		Communication: Zone-Mandatory and Available with station (C2)							
		Tin Validation: Same TIN and Stop signal at OFF in between two trains & State I2 (T2)									
		L2↓	L1→	SR (P1)	LS (C2)	OS	FS	OS+OV	FS+OV	TR	PT
SR(P1)		M5	M5	M5	M5	M5	M5	M5	M5	M5	M5
LS(C2)		M5	M5	M5	M5	M5	M5	M5	M5	M5	M5
OS		S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2
FS		S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2
OS+OV		S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2
FS+OV		S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2
TR		S2, M3	S2, M3	S2, M3	S2, M3	S2, M3	S2, M3	S2, M3	S2, M3	S2, M3	S2, M3
PT		S2, M3	S2, M3	S2, M3	S2, M3	S2, M3	S2, M3	S2, M3	S2, M3	S2, M3	S2, M3
PT+OV		S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2

- (ii) SoS is generated for L-2 Onboard only. FS/OS MA for L-2 Onboard is generated up to an EoA location which is at rear end of the L-1 Onboard with additional safety margin of 300m (Configurable) distance. FS/OS MA for L-1 Onboard will be as per Stationary KAVACH Table of Control.

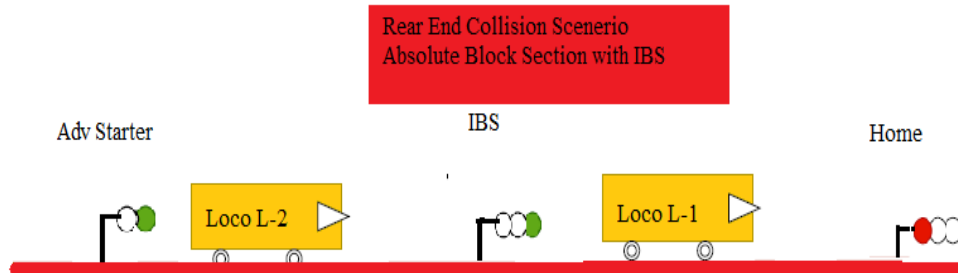


Figure 15

(ii) Head On Collision:

Head On Collision as at Figure 16		Section: Absolute Block (A2)		Communication: Zone-Mandatory and Available with station (C2)							
		Tin Validation: Same TIN and Stop signal at OFF in between two trains & State I2 (T2)									
L2↓	L1→	SR (P1)	LS (C2)	OS	FS	OS+OV	FS+OV	TR	PT	PT+OV	
SR(P1)		M6	M6	M6	M6	M6	M6	M6	M6	M6	
LS(C2)		M6	M6	M6	M6	M6	M6	M6	M6	M6	
OS		S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	
FS		S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	
OS+OV		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	
FS+OV		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	
TR		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	
PT		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	
PT+OV		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	

(iii) Both Onboards receive FS/OS MA = 0 and So when Stationary KAVACH detects that any of the Occupied TIN falls in the path of the two trains.

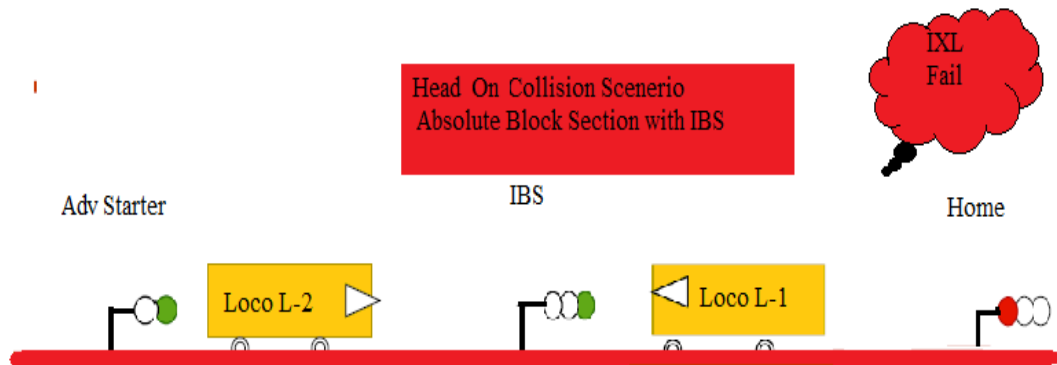


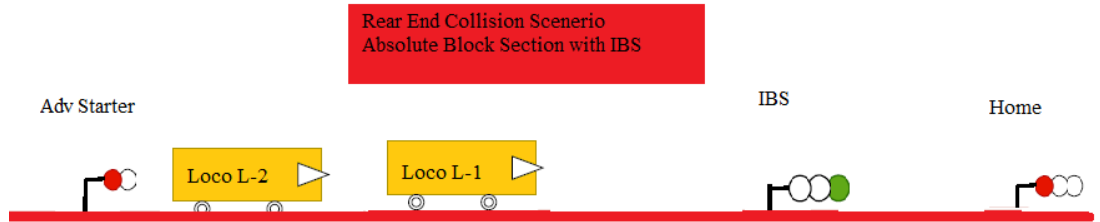
Figure 16

(c) No Stop Signal between two trains with valid position report.TIN Occupation: Two trains are on the same TIN.

(i) SOS: Generated.

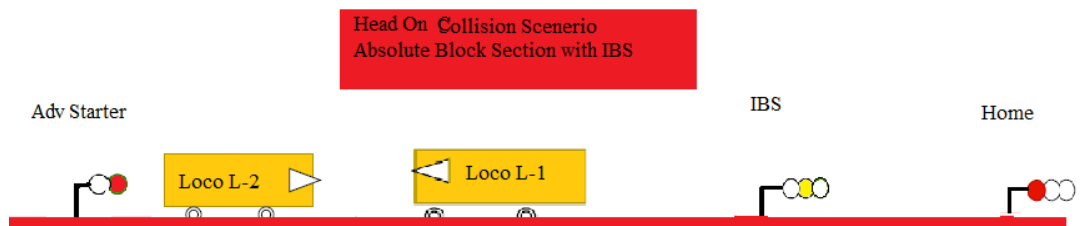
(i) : SoS is generated for L-2 Onboard only.MA for L-2 Onboard is generated up to an EoA location which isat rear end of the L-1 Onboard with additional safety margin of 300m(Configurable) distance. MA for L-1Onboard will be as per StationaryKAVACH Table of Control inputs.

(ii)(i) Rear End Collision : Refer the case for absolute block section case above.



(ii) Head On Collision:

(iii) Refer the case for absolute block section case above: Both Onboards receive OS/FS MA = 0 and SoS when Stationary KAVACH detects that any of the Occupied TIN falls in the path of the two trains.



A1.8.16 Automatic Block Section

(a) Stop Signal at ON is between two trains with valid position report

~~(i) SOS: Not generated.~~

(i) Rear End Collision:

<u>Rear End Collision as at Figure 17</u>		<u>Section: Automatic Block (A3)</u>		<u>Communication: Zone-Mandatory and Available with station (C2)</u>							
		<u>Tin Validation: Same TIN and Stop signal at ON in between two trains (T1)</u>									
<u>L2↓</u>	<u>L1→</u>	<u>SR (P1)</u>	<u>LS (C2)</u>	<u>OS</u>	<u>FS</u>	<u>OS+OV</u>	<u>FS+OV</u>	<u>TR</u>	<u>PT</u>	<u>PT+OV</u>	
<u>SR(P1)</u>		<u>M5</u>	<u>M5</u>	<u>M5</u>	<u>M5</u>	<u>M5</u>	<u>M5</u>	<u>M5</u>	<u>M5</u>	<u>M5</u>	
<u>LS(C2)</u>		<u>M5</u>	<u>M5</u>	<u>M5</u>	<u>M5</u>	<u>M5</u>	<u>M5</u>	<u>M5</u>	<u>M5</u>	<u>M5</u>	
<u>OS</u>		<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	
<u>FS</u>		<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	
<u>OS+OV</u>		<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	
<u>FS+OV</u>		<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	
<u>TR</u>		<u>S2, M2</u>	<u>S2, M2</u>	<u>S2, M2</u>	<u>S2, M2</u>	<u>S2, M2</u>	<u>S2, M2</u>	<u>S2, M2</u>	<u>S2, M2</u>	<u>S2, M2</u>	
<u>PT</u>		<u>S2, M2</u>	<u>S2, M2</u>	<u>S2, M2</u>	<u>S2, M2</u>	<u>S2, M2</u>	<u>S2, M2</u>	<u>S2, M2</u>	<u>S2, M2</u>	<u>S2, M2</u>	
<u>PT+OV</u>		<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	<u>M2</u>	

(ii) FS/OS MA for L-2 Onboard is generated up to stop signal and for L-1 Onboard up to next stop signal at ON.

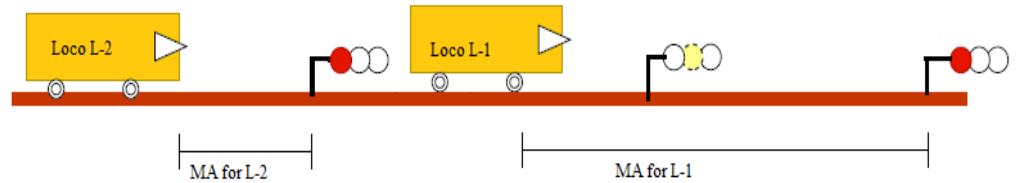


Figure 17

(ii) Head On Collision:

Head On Collision as at Figure 14		Section: Automatic Block (A3)		Communication: Zone-Mandatory and Available with station (C2)						
		Tin Validation: Same TIN and Stop signal at ON in between two trains (T1)								
L2↓	L1→	SR (P1)	LS (C2)	OS	FS	OS+OV	FS+OV	TR	PT	PT+OV
SR(P1)		M6	M6	M6	M6	M6	M6	M6	M6	M6
LS(C2)		M6	M6	M6	M6	M6	M6	M6	M6	M6
OS		M4	M4	M4	M4	M4	M4	M4	M4	M4
FS		M4	M4	M4	M4	M4	M4	M4	M4	M4
OS+OV		M4	M4	M4	M4	M4	M4	M4	M4	M4
FS+OV		M4	M4	M4	M4	M4	M4	M4	M4	M4
TR		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4
PT		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4
PT+OV		M4	M4	M4	M4	M4	M4	M4	M4	M4

(iii) Both Onboards receive FS/OS MA = 0 and SoS when Stationary KAVACH detects that any of the Occupied TIN falls in the path of the two trains.

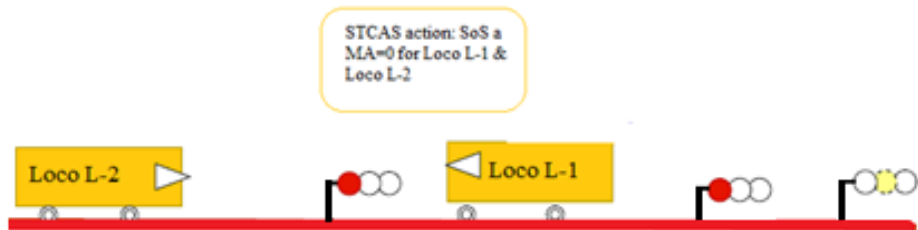


Figure 18

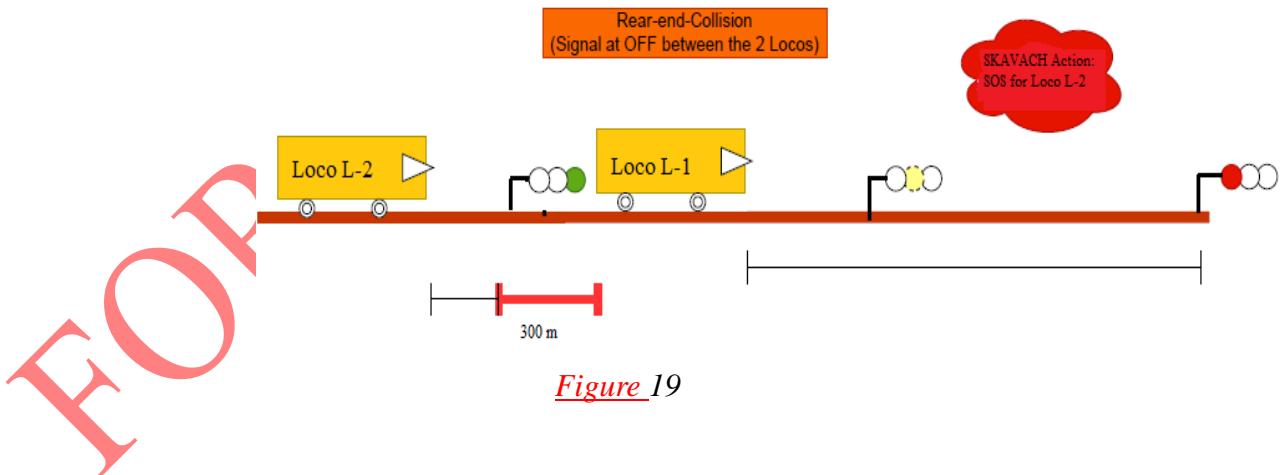
- (b) Stop signal is at OFF (IxL fail) is between two trains with valid position-report: TIN Occupation: TIN occupied by L-2 Onboard is same as L-1 Onboard TIN in the signal route.

(i) ~~SOS: Generated.~~

(i) **Rear End Collision:**

Rear End Collision as at Figure 19		Section: Automatic Block (A3)		Communication: Zone-Mandatory and Available with station (C2)							
		Tin Validation: Same TIN and Stop signal at OFF in between two trains & State I2 (T2)									
L2↓	L1→	SR (P1)	LS (C2)	OS	FS	OS+OV	FS+OV	TR	PT	PT+OV	
SR(P1)		M5	M5	M5	M5	M5	M5	M5	M5	M5	
LS(C2)		M5	M5	M5	M5	M5	M5	M5	M5	M5	
OS		S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	
FS		S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	
OS+OV		S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	
FS+OV		S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	
TR		S2, M3	S2, M3	S2, M3	S2, M3	S2, M3	S2, M3	S2, M3	S2, M3	S2, M3	
PT		S2, M3	S2, M3	S2, M3	S2, M3	S2, M3	S2, M3	S2, M3	S2, M3	S2, M3	
PT+OV		S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	S3, M2	

- (ii) SoS is generated for L-2 Onboard only. On request by LP OS MA for L-2 Onboard is generated up to an EoA location which is at rear end of the L-1 Onboard with additional safety margin of 300m (Configurable) distance. MA for L-1 Onboard will be as per Stationary KAVACH Table of Control.



(ii) Head On Collision:

Head On Collision as at Figure 20		Section: Automatic Block (A3)		Communication: Zone-Mandatory and Available with station (C2)							
		Tin Validation: Same TIN and Stop signal at OFF in between two trains & State I2 (T2)									
L2↓	L1→	SR (P1)	LS (C2)	OS	FS	OS+OV	FS+OV	TR	PT	PT+OV	
SR(P1)		M6	M6	M6	M6	M6	M6	M6	M6	M6	
LS(C2)		M6	M6	M6	M6	M6	M6	M6	M6	M6	
OS		S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	
FS		S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	
OS+OV		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	
FS+OV		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	
TR		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	
PT		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	
PT+OV		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	

(iii) Both Onboards receive FS/OS MA = 0 and SoS when Stationary KAVACH detects that any of the Occupied TIN falls in the path of the two trains.

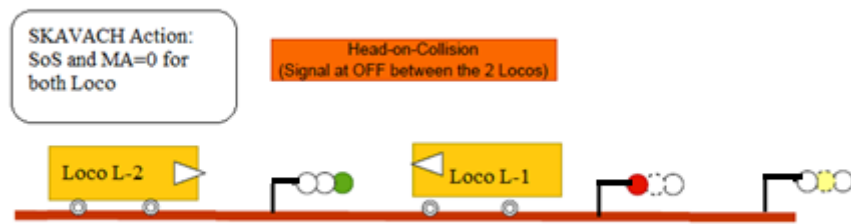


Figure 20

(c) No Stop Signal between two trains with valid position report: TIN Occupation: Two trains are on the same TIN (Same as Abs block cases)

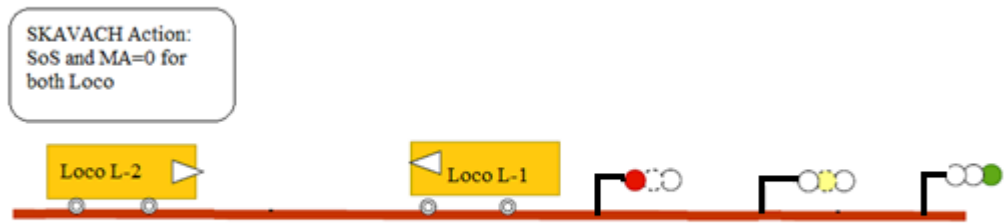
(i) **SOS: Generated.**

(ii) **Rear End Collision:** SoS is generated for L-2 Onboard only. MA for L-2 Onboard is generated up to an EoA location which is at rear end of the L-1 Onboard with additional safety margin of 300m (Configurable) distance. MA for L-1 Onboard will be as per Stationary KAVACH Table of Control inputs.



(iii) **Head On Collision:** Both Onboards receive OS/FS MA = 0 and SoS

when Stationary KAVACH detects that any of the Occupied TIN falls in the path of the two trains.



A1.8.17 Automatic/Absolute block station (Home to Adv.Starter)

(a) Calling On signal

(i) ~~SOS: No~~

(i) Rear End Collision:

Rear End Collision as at Figure 21		Section: Station (A1)		Communication: Zone-Mandatory and Available with station (C1)						
		Tin Validation: Different in the Route, Onboard KAVACH separated by Signal at ON, Route known & state I1 (T4)								
L2↓	L1→	SR (P1)	LS (C2)	OS	FS	OS+OV	FS+OV	TR	PT	PT+OV
SR(P1)		⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗
LS(C2)		⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗
OS		⊗	⊗	M2	M2	M2	M2	M2	M2	M2
FS		NA	NA	NA	NA	NA	NA	NA	NA	NA
OS+OV		⊗	⊗	M2	M2	M2	M2	M2	M2	M2
FS+OV		⊗	⊗	M2	M2	M2	M2	M2	M2	M2
TR		NA	NA	NA	NA	NA	NA	NA	NA	NA
PT		NA	NA	NA	NA	NA	NA	NA	NA	NA
PT+OV		⊗	⊗	M2	M2	M2	M2	M2	M2	M2

(ii) No SoS is generated for L-2 Onboard. OS MA for L-2 Onboard is generated up to an EoA location which is at rear end of the front Onboard with additional safety margin of 300m (Configurable) distance. MA for L-1 Onboard will be as per stationary KAVACH Table of control inputs.

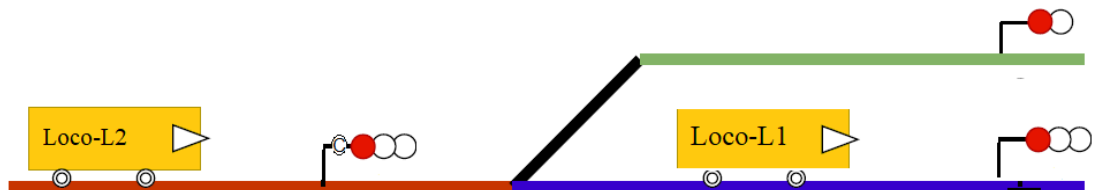


Figure 21

(ii) Head On Collision: Head-On Collision:

Head On Collision as at Figure 22		Section: Station (A1)		Communication: Zone-Mandatory and Available with station (C1)						
		Tin Validation: Different in the Route, Onboard KAVACH separated by Signal at ON, Route known & state I1 (T4)								
L2↓	L1→	SR (P1)	LS (C2)	OS	FS	OS+OV	FS+OV	TR	PT	PT+OV
SR(P1)		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
LS(C2)		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
OS		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	S3, M4
FS		S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	S3, M4	S3, M4
OS+OV		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4
FS+OV		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4
TR		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4
PT		S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4
PT+OV		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4	S2, M4

(iii) Both Onboards receive FS/OS MA = 0 and So when Stationary KAVACH detects that any of the Occupied TIN falls in the path of the two trains.

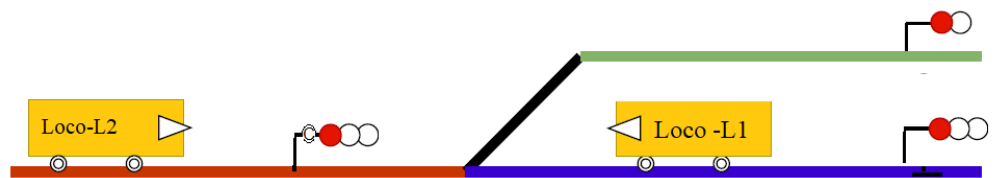


Figure 22

A1.8.18 Automatic/Absolute block station (Home to Adv.Starter):TIN Occupation: Two trains on different TIN at mission startup in the same route

- (a) No stop signal between two trains with valid position Report.
- (i) SOS: Not generated
- (ii) Rear End Collision: Not supervised. MA is provided as per Table of Control and train direction.

A1.8.19 The above conditions are applicable only both Onboard KAVACH has valid position report and the operational modes are other than SR, FS and OS modes.

A1.8.20 Primary safety shall be met by Stationary KAVACH with existing ToC through up-date of safe MA.

A1.8.21 The secondary level of Safety from stationary KAVACH is through generation of SoS

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Document Title : Specification of Kavach (The Indian Railway ATP)- Mode Transitions, SOS & MA handling – Annexure-A1			

in emergency packet which is a non SIL function. This is primarily due to automatic clearing of TINs in case of communication failure and non consideration of all TINs occupied by entire train length, acceptance of missing RFID Tags. This is always not guaranteed due to inherent limitations of TIN definition in stationary KAVACH.

A1.8.22 SoS generation would result in Onboard KAVACH applying brakes and Onboard can further be moved at 30kmph (Configurable cautious speed) after coming to stop.

A1.8.23 Stationary KAVACH can only detect the collision in its territory only when route is known for all trains.

A1.8.24 The collision through Onboard to Onboard communication with the availability of limited slots is not guaranteed especially in case of tunnels, at curvatures, in hilly areas, in junction stations. The probability of selection of same slots by onboard of same make shall be as high as got analysed by ISA.

FOR FIELD TRIALS

MANISH KUMAR GUPTA <small>Digitally signed by MANISH KUMAR GUPTA, Date: 2023.06.13 12:17:40 +05'30'</small>	RAVINDRA NATH SINGH <small>Digitally signed by RAVINDRA NATH SINGH, Date: 2023.06.13 12:20:04 +05'30'</small>		Printed :
Manish Kumar Gupta SSE/S&T/SC	R. N. Singh AIE/INSP/S&T/SC	G. Pavan Kumar ED/Tele-II	Page 36 of 36