सत्यमेव जयते

GOVERNMENT OF INDIA
(भारत सरकार)
MINISTRY OF RAILWAYS
(रेल मंत्रालय)

Annexure – A1

Modes Transitions, SOS & MA Handling (Amdt-6)

Issued by

SIGNAL & TELECOM DIRECTORATE
RESEARCH, DESIGNS & STANDARDS ORGANISATION
MINISTRY OF RAILWAYS
MANAK NAGAR
LUCKNOW – 226 011

Amendment History

Amdt	Date of issue	Amendment
Amdt-1	13-06-2023	• 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.
Amdt-2	08.04.2024	• The following in CL. 1.4 is modified for confirmity ➢ RV to standby condition modified as <7 , ~~&~~ 35. ➢ LS to SR condition modified with adding condition <40, 44. ➢ FS to SR condition modified with adding condition <39, 40, 44. ➢ OV to SR condition modified with adding condition <39, 40, 44. ➢ OS to SR condition modified with adding condition <34, 39, 40, 44. • The following in CL. 1.5 is modified for confirmity ➢ Condition 22 modified with addition of Condition 43. ➢ Condition 39, 40, 41, 42,43 & 44 – New conditions added for conformity with FRS. ➢ Condition 58 is modified as "[10] & [42] & Onboard KA-VACH pilots request Reverse Mode". ➢ Condition 71 is modified as "{[10] & Onboard KAVACH pilots request Override & MA < 200m (Configurable)} or {Onboard KAVACH pilot request override while running for signal not requiring standstill override}. ➢ Condition 72 &75- Deleted. ➢ Condition 90 is modified with addition of condition {[22] or [41]}. ➢ Condition 91 is modified with addition of condition [41]. • CL A1.9 – Onboard KAVACH specific SoS- New clause added. • CL.A1.10- SR authorisation – New clause added.
Amdt-3	19.04.2024	• CL.A1. 1.4 is modified for conformity- LS to SR condition modi-fied with adding condition <39. • CL A1.9.3 is modified for action in onboard KAVACH i.e. "Onboard KAVACH shall apply ~~EB~~ brakes in SL No 1, 2, 6 &7". • CL A1.10.3 is corrected for confimity as "After override of the en-try Signal, which leads to multiple routes, Stationary KAVACH de-termines the route based on the reported Tags and extends the MA accordingly. When Onboard KAVACH does not report the Tags, OSMA cannot be extended because the route is unknown. In such a scenario, if override input is received, Stationary KAVACH shall extend SR authorization".

Amdt-4	06.05.2024	• The following in CL. 1.4 is modified for confirmity ➢ LS to SB priority is modified with correction of p4 to p5. ➢ OV to SB priority is modified with correction of p4 to p5. ➢ LS to SR priority is modified with correction of p5 to p6. ➢ OV to SR priority is modified with correction of p5 to p6. ➢ OV to FS & OS priority is modified with correction of p7 to p8. ➢ LS to Reverse & Shunt priority is modified with correction of p5 to p6. ➢ LS to TR condition modified with adding condition 44>-p4-. ➢ OV to TR condition modified with adding condition 44> -p4-. ➢ OS to SR condition modified with deletion of ~~<44~~ ➢ OV to SR condition modified with deletion of condition ~~<44.~~ ➢ FS to SR condition modified with deletion of condition ~~<44.~~ ➢ LS to SR condition modified with deletion of condition < ~~44.~~ ➢ FS to TR condition modified with adding condition <44. ➢ OS to TR condition modified with adding condition <44
Amdt-5	20.06.2024	• CL.A1.9.3- Modified for addition of specific SOS for Unlinked Tag and for foreign tag.
Amdt-6	15.07.2024	• Onreading unlinked tag within location accuracy window, condition 44 is modified from trip to SR in FS/OS/OV and LS modes. • Reverse mode to SR transition without reversing area condition 45 added. • CL.A1.9.3- Modified for specific SOS for Unlinked Tag and SPAD prevention

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.

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, 39 40, 44, 85, p5-**	**<17, 23, 30, 39, 40, 44, 85, -p6-**	**<17, 23, 30, 34, 39, 40, 44, 85, -p5-**	**<17, 23, 30, 34, 39, 40, 44 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> -p5-**	**90> -p9-**	**91> -p6-**	**OS**							
7. Trip				**69> -p4-**		**69 >-P4-**	**TR**						
8. Post Trip	**66> -p4-**						**59> -p3-**	**PT**					
9. Reverse	**67> -p4-**	**45> -p5-**	**58> -p7-**	**58> -p8-**		**58> -p7-**		**58> -p5-**	**RV**				
10. Shunt	**68,57> -p4-**	**56> -p5-**	**56> -p7-**	**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 [43] or Movement Authority, whichever is less
23	Track Profile NOT Available upto 3000m (Configuarable) or up to Movement Authority, whichever is less
24	Valid Radio Packets are receiving (Onboard KAVACH 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 (Configurable) consecutive cycles
26	Frame Offset cycle is more than 14 (configurable) in Radio Rx packet
27	Frame Offset cycle is less than 5(Configurable) 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	Onboard KAVACH pilot Presses SR Button & [10]
32	Onboard KAVACH 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	Onboard KAVACH pilot Presses SR Button
37	TSR Info available.

38	TSR info not available.
39	Received SR authorization from Stationary KAVACH.
40	Slip or Skid detected for more than their time out.
41	Received Radio Profile ID “0000”.
42	Received Reversing Area track condition.
43	Received Track profile upto Exit tag (Track condition).
44	Unlinked RFID tag received within the location accuracy window of Onboard KA-VACH.
45	[10] & [42]
46-49	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] & [42] & Onboard KAVACH pilots request Reverse Mode.
59	[10] & Onboard KAVACH 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] & Onboard KAVACH pilots request Override & MA < 200m (Configurable)} or {Onboard KAVACH pilot request override while running for signal not requiring standstill override}.
72	Spare
73	[22]&[33]&(MA Valid) & [37]
74	[22]&[33]&(MA extended or On Override Timeout)
75	Spare
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] & Onboard KAVACH pilots select Override.
87	OS MA received & [22].
88	Invalid RFID Tag or Wrong RFID Sequence.
89	Expiry of OSMA holding Time (240 Seconds -Configurable)) & [20].
90	OSMA received and {[22] or [41]}.
91	OSMA extended and {[22] or [41]}.

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)	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✗	✗	✗
Traffic direction computation (Based on Absolute Kilometer Mark where available from RFID reader)	WA	WA	✔	✔	✔	✔	✔	WA	WA	✔	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	✗	✗	✗	✗	✗
LC Gate Warning & Horn	✗	✔	✔	✔	✔	✔	✔	✔	X	WA	✗	✗	✗
Absolute Kilometer Computation	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	WA	WA	WA
Tag missing Indication on LP-OCIP (DMI)	WA	WA	✔	✔	WA	WA	WA	WA	✗	✗	✗	✗	✗
Radio Communication &Signaling Data Processing													
Onboard Packet Transmission (only In KAVACH Area)	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✗	✗	✗
Onboard to **Onboard** communication	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✗	✗	✗
Packet Reception from Linked Station	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✗	✗	✗
Next Stationary KAVACH Linking	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✗	✗	✗
Communication Failure in Comm Mandatory Zone	✗	✗	✔	✔	✔	✔	✔	✔	✔	✔	✗	✗	✗
MA display on LP-OCIP (DMI)	✗	✗	✗	✔	✔	✔	✔	✔	✗	✗	✗	✗	✗
Signal display on LP-OCIP (DMI)	✗	✗	✗	✔	WA	WA	✗	✗	✗	✗	✗	✗	✗
Emergency Functions													
Manual SoS	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✗	✗	✗
Unusual Block Stoppage SoS	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✗	✗	✗

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.	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✗	✗	✗
Onboard KAVACH specific SoS from Linked Station	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✗	✗	✗
General SoS from Station (within 3km Radius)	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✗	✗	✗
Train Data Capturing													
Train Length Measurement	✗	✗	✗	✔	X	✔	✗	✗	✗	✗	✗	✗	✗
Manual Brake Test	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✗	✗	✗
Train Movement Protections													
Stand still supervision	✔	✗	✗	✗	✗	✗	✔	✔	✗	X	✗	✗	✗
Standstill Supervisionwhen the train speed is zero and reverser is detected at Neutral	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✗	✗	✗
Reverse Movement Protection	✔	✔	✔	✔	✔	✔	✔	✔	X	✔	✗	✗	✗
Roll back Protection	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✗	✗	✗
Train Movements Supervision													
Movement authority supervision	✗	✗	✗	✔	✔	✔	✗	✗	✗	✗	✗	✗	✗
Track Profile	WA	✗	✔	✔	✔	✔	✔	✔	✗	✗	✗	✗	✗
Temporary Speed Restriction	WA	✗	✔	✔	✔	✔	✔	✔	✗	✗	✗	✗	✗
Loop line speed control	✗	✗	WA	✔	✗	WA	✗	✗	✗	✗	✗	✗	✗
Collision Avoidance	WA	WA	✔	✔	✔	✔	✔	✔	✗	✗	✗	✗	✗
Onboard KAVACHmotive related speed restriction	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✗	✗	✗
Mode related speed restriction	✔	✔	NA	NA	NA	✔	✔	✔	✔	✔	✗	✗	✗
Event Logging													
Radio TX data	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	WA	WA	WA
Radio Rx Data	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✗	WA	✗
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 OnboardKA-VACH 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

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 same Stop Signal.

A1.8.3 Onboard KAVACH in the rear will always be in "On Sight" mode.

A1.8.4 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 Onboard KAVACHs
M5	Rear End Collision SoS when MA not avail-able
M6	Head On Collision SoS for both Onboard KAVACHs when MA not available.

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

S1	As at Site
S2	Blank
S3	Red

A1.8.6 The States of brakes can be

B1	No Brake
B2	Brake

A1.8.7 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 sta-tion
C3	Zone non-mandatory

A1.8.8 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

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

P1	Available
P2	Not Available

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

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

I1	Ok
I2	Not Ok

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

A1.8.13 Scenarios and expected protection

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

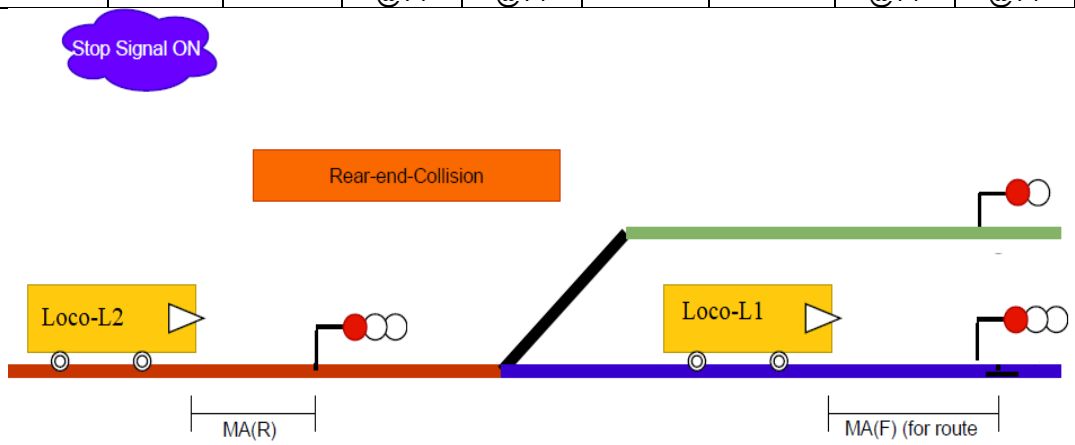


Figure 1

(ii) **Head On Collision**:

Head On 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		☒	☒	M4@T4	M4@T4	M4@T4	M4@T4	M4@T4	M4@T4	M4@T4
FS		NA	NA	NA	NA	NA	NA	NA	NA	NA
OS+OV		☒	☒	M4@T4	M4@T4	M4@T4	M4@T4	M4@T4	M4@T4	M4@T4
FS+OV		☒	☒	M4@T4	M4@T4	M4@T4	M4@T4	M4@T4	M4@T4	M4@T4
TR		NA	NA	NA	NA	NA	NA	NA	NA	NA
PT		NA	NA	NA	NA	NA	NA	NA	NA	NA
PT+OV		☒	☒	M4@T4	M4@T4	M4@T4	M4@T4	M4@T4	M4@T4	M4@T4

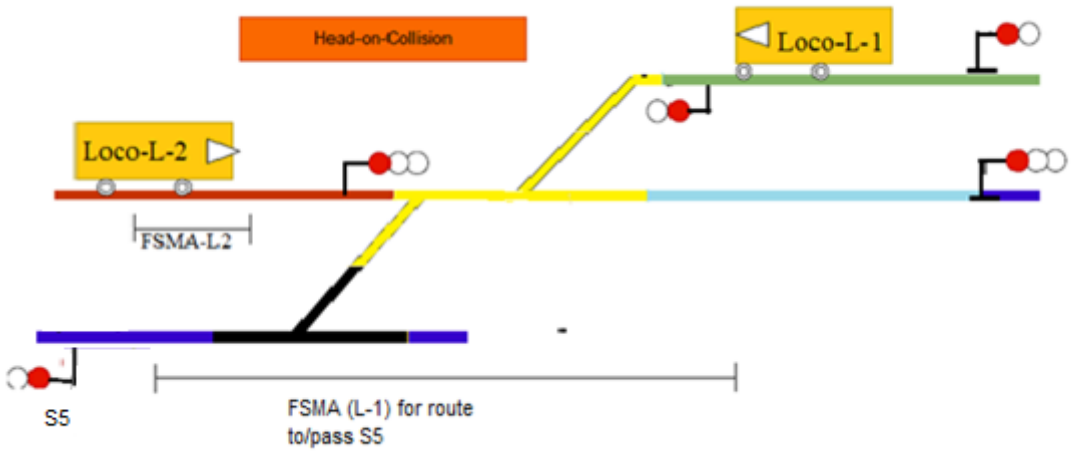


Figure 2

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

(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,S 2@R1/R2, M2@T6	S3@T5,S 2@R1/R2, M2@T6	S3@T5,S 2@R1/R2, M2@T6	S3@T5,S 2@R1/R2, M2@T6	S3@T5,S 2@R1/R2, M2@T6	S3@T5,S 2@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,S 2@R1/R2, M2@T6	S3@T5,S 2@R1/R2, M2@T6	S3@T5,S 2@R1/R2, M2@T6	S3@T5,S 2@R1/R2, M2@T6	S3@T5,S 2@R1/R2, M2@T6	S3@T5,S 2@R1/R2, M2@T6
FS+OV	☒	☒	S3@T5, S2@R1 /R2, M2@T6	S3@T5,S 2@R1/R2, M2@T6	S3@T5,S 2@R1/R2, M2@T6	S3@T5,S 2@R1/R2, M2@T6	S3@T5,S 2@R1/R2, M2@T6	S3@T5,S 2@R1/R2, M2@T6	S3@T5,S 2@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,S 2@R1/R2, M2@T6	S3@T5,S 2@R1/R2, M2@T6	S3@T5,S 2@R1/R2, M2@T6	S3@T5,S 2@R1/R2, M2@T6	S3@T5,S 2@R1/R2, M2@T6	S3@T5,S 2@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 stationay KAVACH table of control.

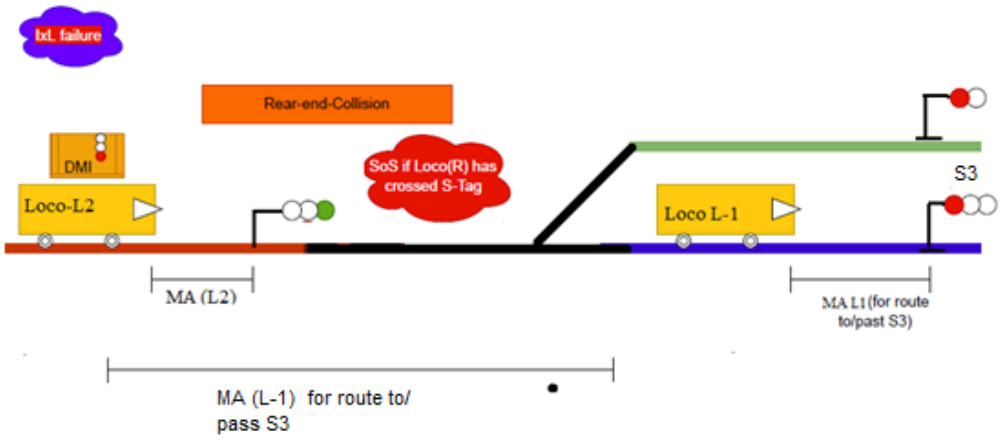


Figure 3

(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/R2 M4@T6	S3@T5 S2@R1/R2 M4@T6	S3@T5 S2@R1/R2 M4@T6	S3@T5 S2@R1/R2 M4@T6	S3@T5 S2@R1/R2 M4@T6	S3@T5 S2@R1/R2 M4@T6	S3@T5 S2@R1/R2 M4@T6
FS		S3	S3	S3	S3	S3	S3	S3	S3	S3
OS+OV		☒	☒	S3@T5 S2@R1/R2 M4@T6	S3@T5 S2@R1/R2 M4@T6	S3@T5 S2@R1/R2 M4@T6	S3@T5 S2@R1/R2 M4@T6	S3@T5 S2@R1/R2 M4@T6	S3@T5 S2@R1/R2 M4@T6	S3@T5 S2@R1/R2 M4@T6
FS+OV		☒	☒	S3@T5 S2@R1/R2 M4@T6	S3@T5 S2@R1/R2 M4@T6	S3@T5 S2@R1/R2 M4@T6	S3@T5 S2@R1/R2 M4@T6	S3@T5 S2@R1/R2 M4@T6	S3@T5 S2@R1/R2 M4@T6	S3@T5 S2@R1/R2 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/R2 M4@T6	S3@T5 S2@R1/R2 M4@T6	S3@T5 S2@R1/R2 M4@T6	S3@T5 S2@R1/R2 M4@T6	S3@T5 S2@R1/R2 M4@T6	S3@T5 S2@R1/R2 M4@T6	S3@T5 S2@R1/R2 M4@T6

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

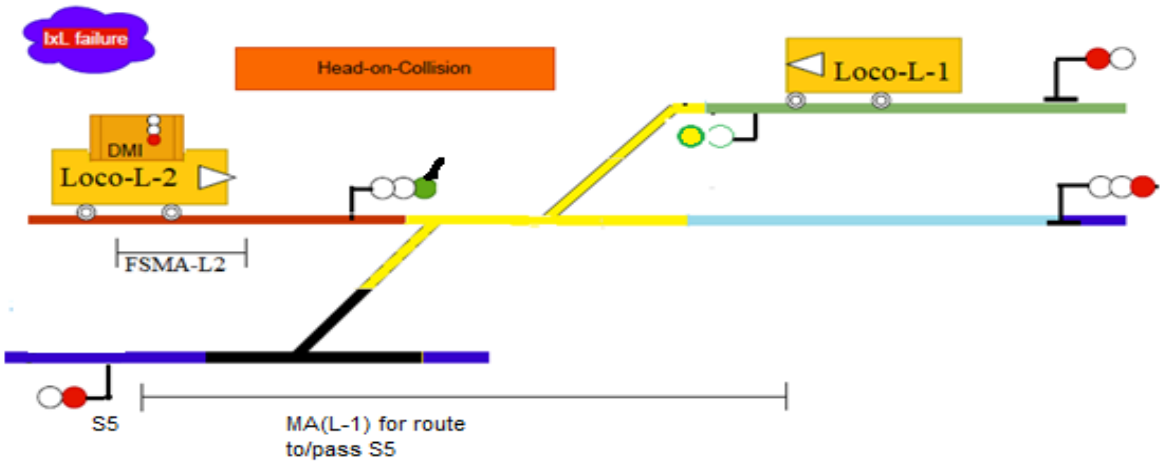


Figure 4

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

(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

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.

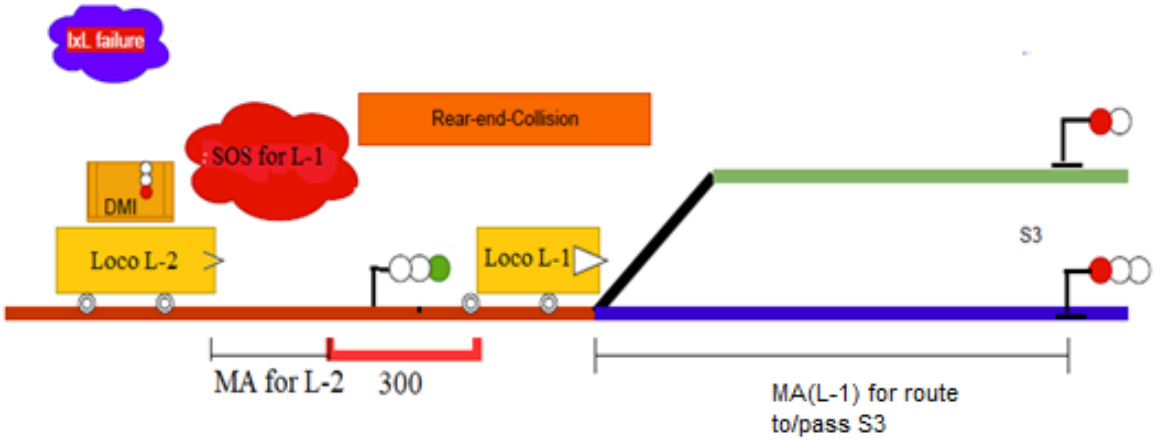


Figure 5

(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

Both Onboards receive FS MA = 0 and So whenStationary KAVACH detects that any of the Occupied TIN falls in the path of the two trains.

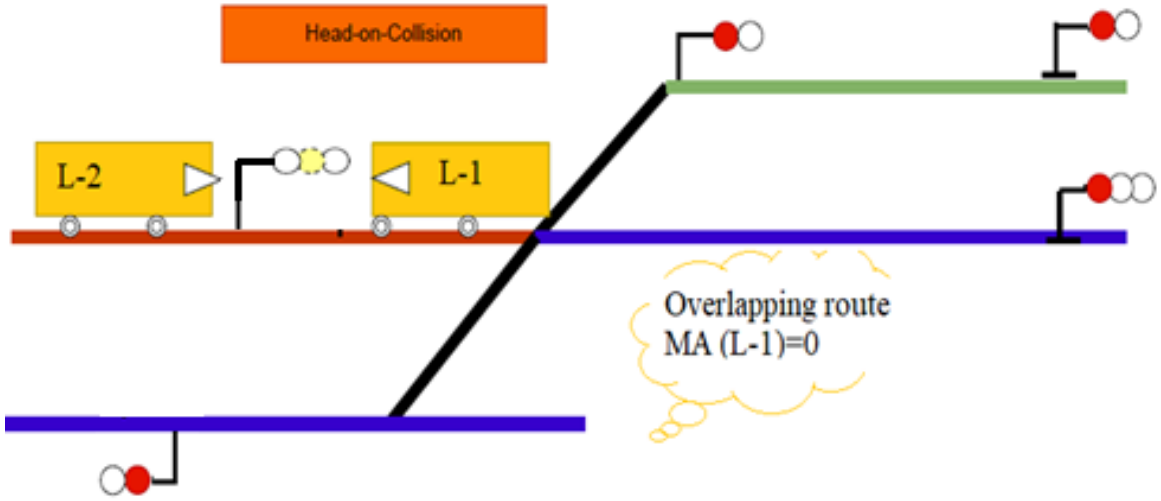


Figure 6

(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.

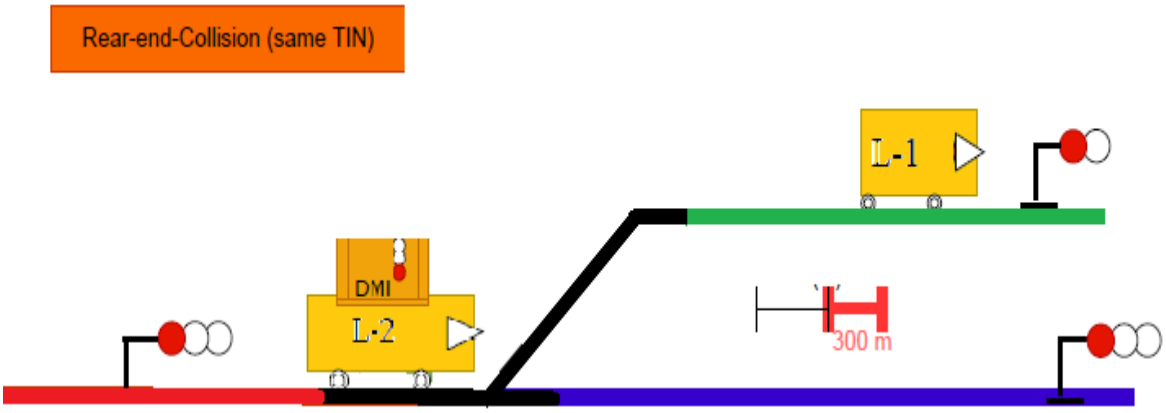


Figure 7 Route Ascertained in Rear End Collision Scenario

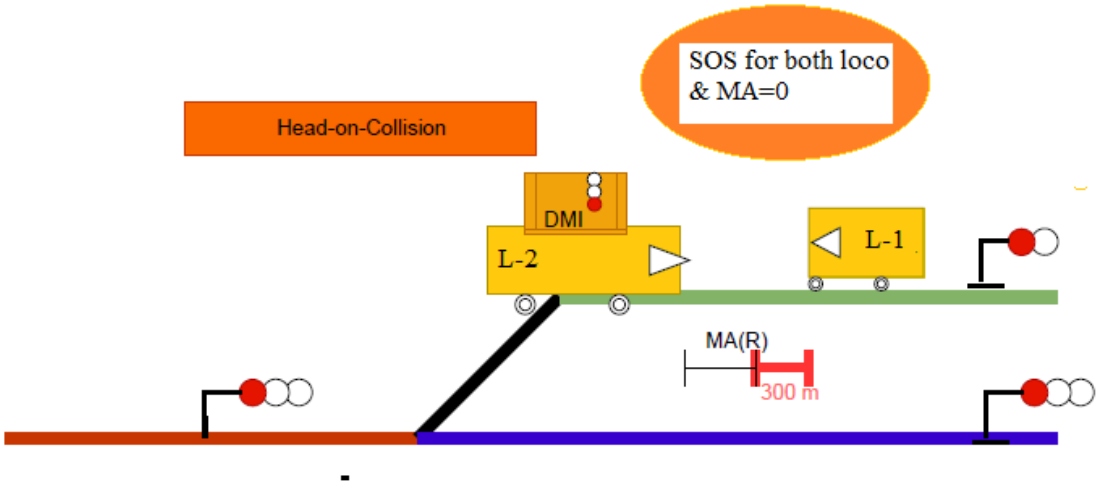


Figure 8 Route Ascertained in Head On Collision Scenario

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

A1.8.14 Absolute Block Section

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

(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

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.

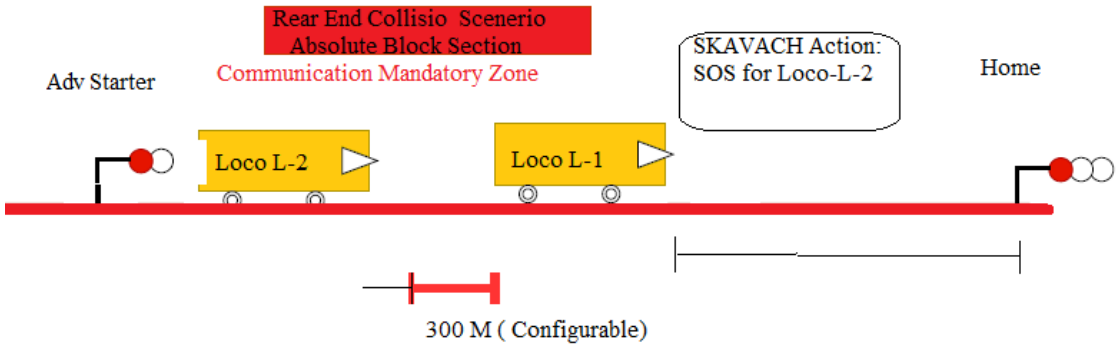


Figure 9

(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

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.

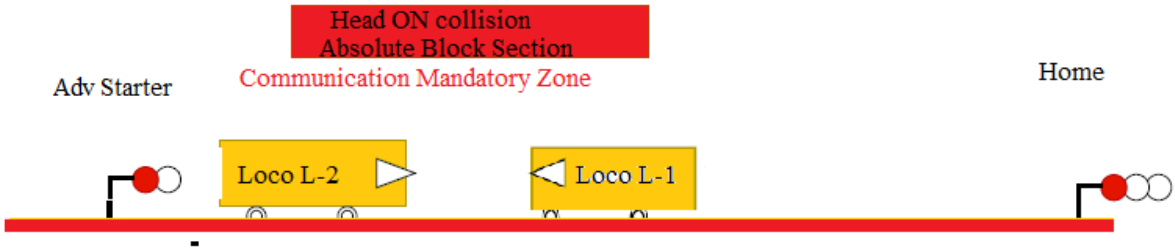


Figure 10

(b) No Stop Signal between trains with valid position report and communication is not available in Communication mandatory zone.

(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

L-2 Onboard KAVACH on detection ofrear end collision shall apply brakes and ensure stopping before 300m inrear of front Onboard KAVACH under any of the following conditions.

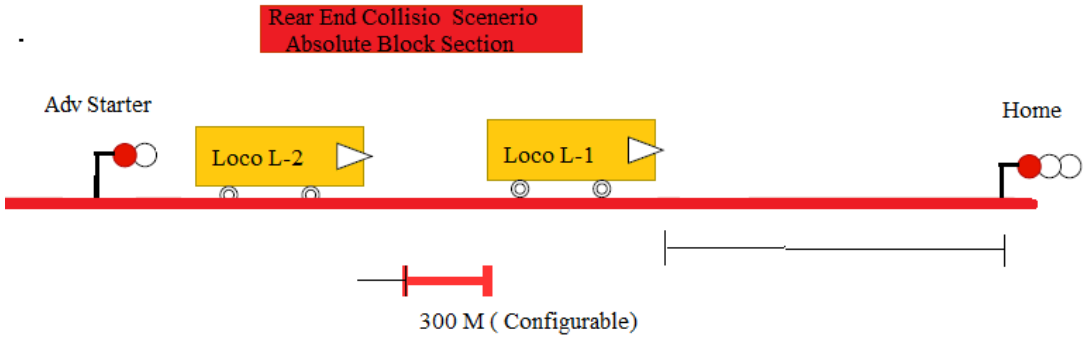


Figure 11

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

Head On 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	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	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
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

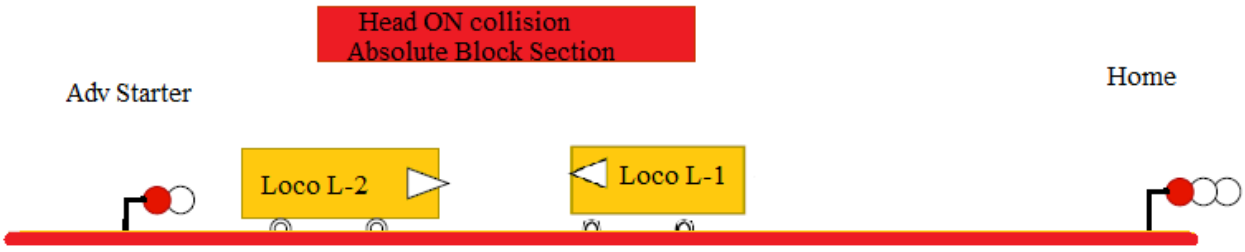


Figure 12

A1.8.15 Absolute Block Section with IBS

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

(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

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

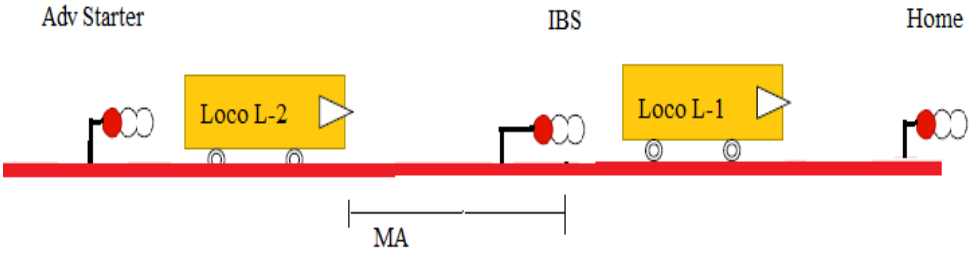


Figure 13

(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

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.

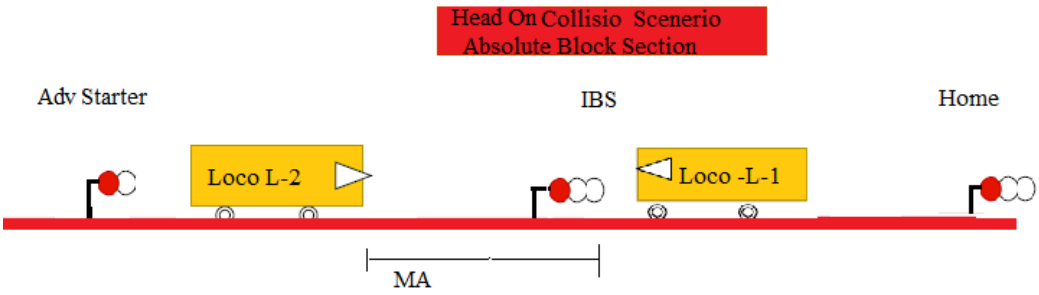


Figure 14

(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) **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	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	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	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	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2	S2, M2

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

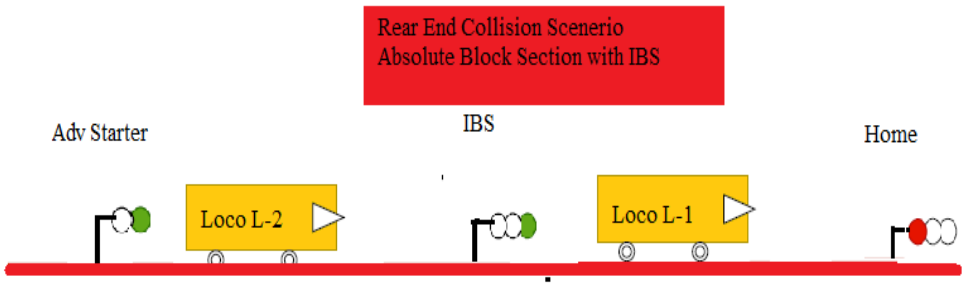


Figure 15

(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

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.

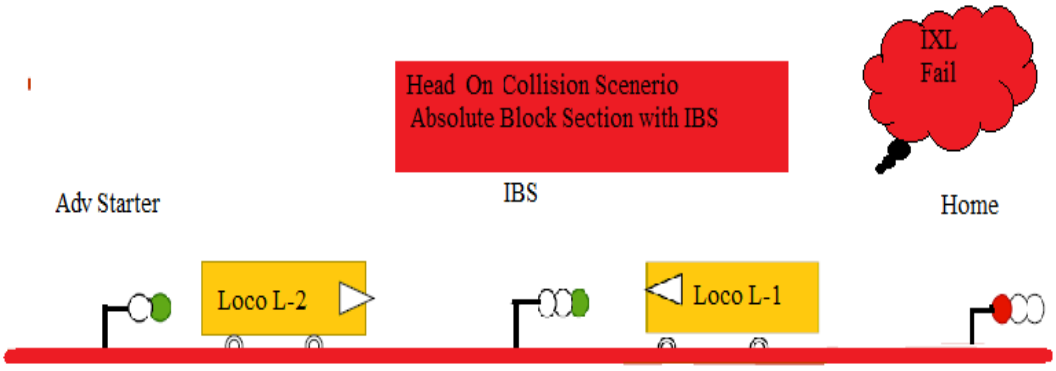
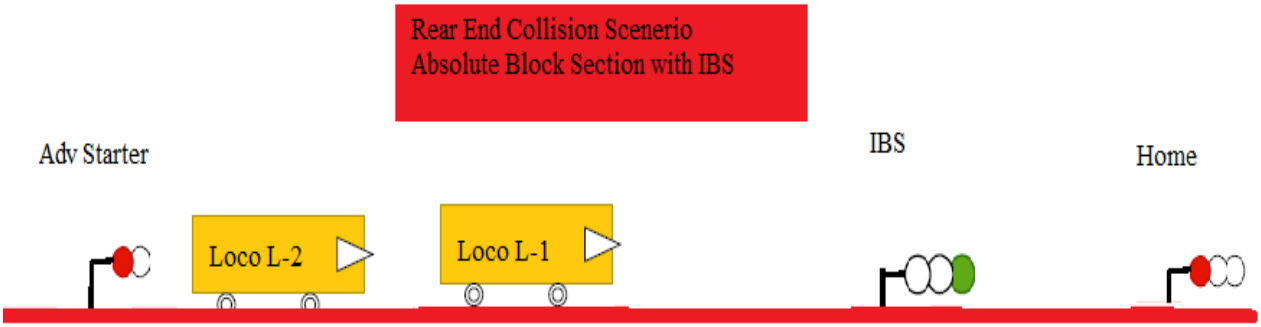


Figure 16

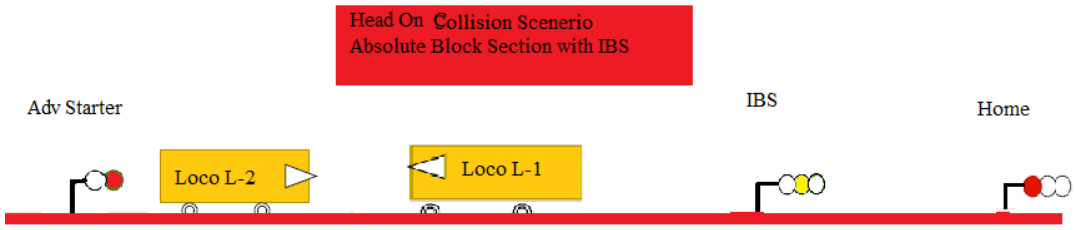
(c) No Stop Signal between two trains with valid position report.TIN Occupation: Two trains are on the same TIN.

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



(ii) **Head On Collision:**

Refer the case for absolute block section case above



A1.8.16 Automatic Block Section

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

(i) **Rear End Collision**:

Rear End Collision as at Figure 17		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)		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

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.

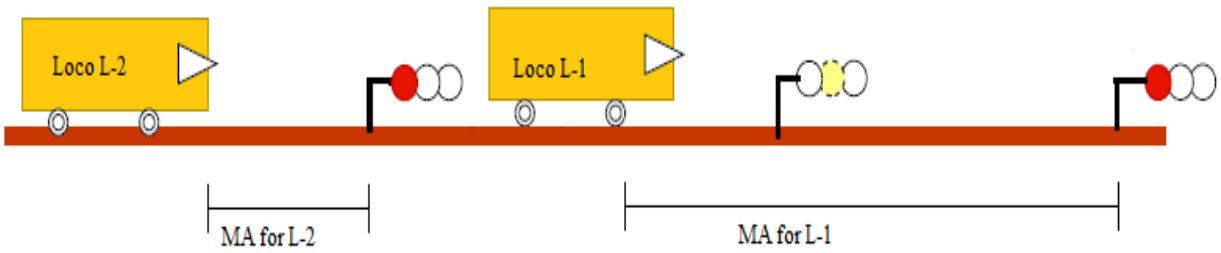


Figure 17

(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

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.

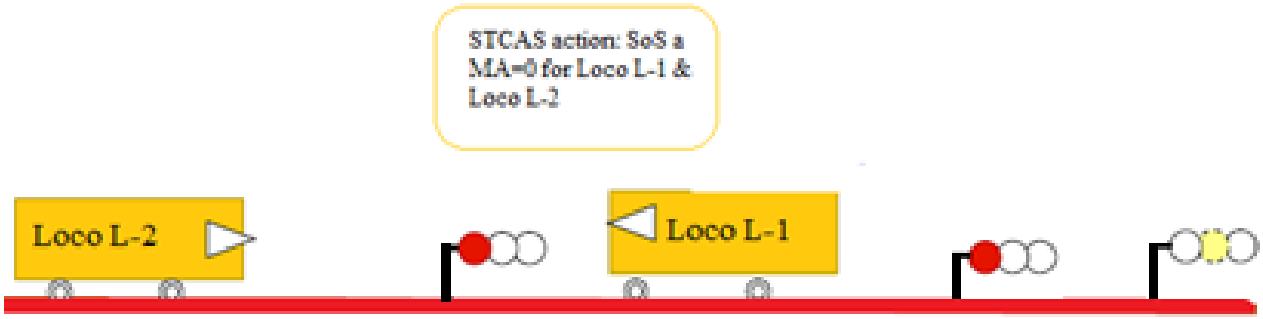


Figure 18

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

(i) **Rear End Collision**:

Rear End Collision as at Figure 19	Section: Automat-ic 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

SoS is generated for L-2 Onboard only. On request by LP OS MA for L-2Onboard is generated up to an EoA location which is atrear 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.

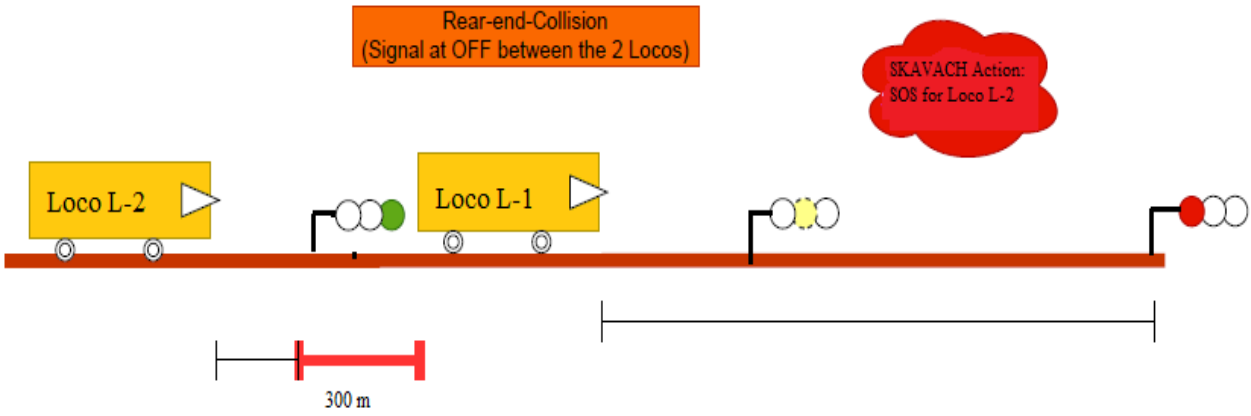


Figure 19

(ii) **Head On Collision**:

Head On Collision as at Figure 20		Section: Automat-ic 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

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.

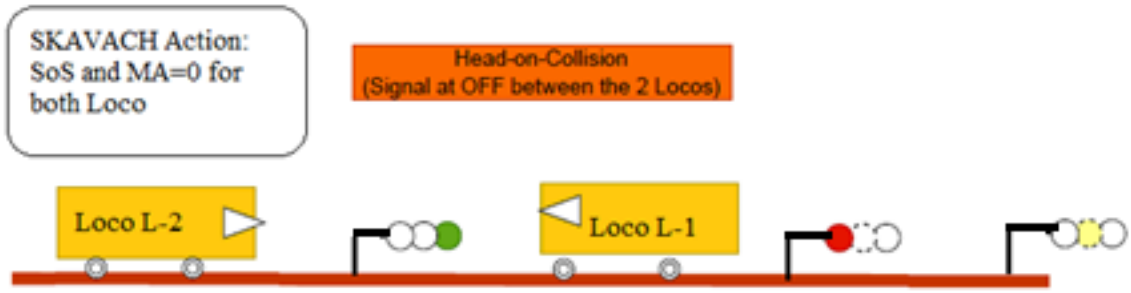
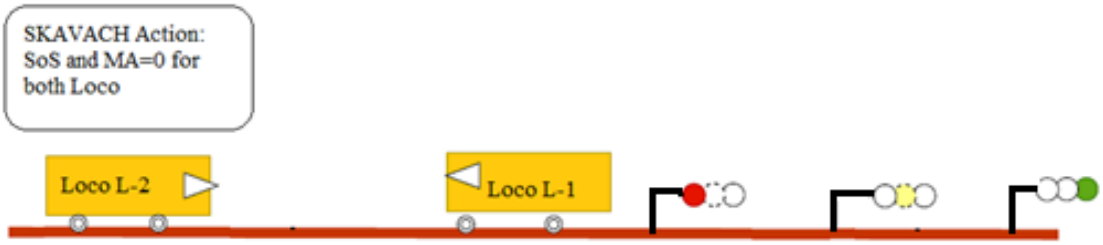


Figure 20

(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)



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

(a) Calling On signal

(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

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.

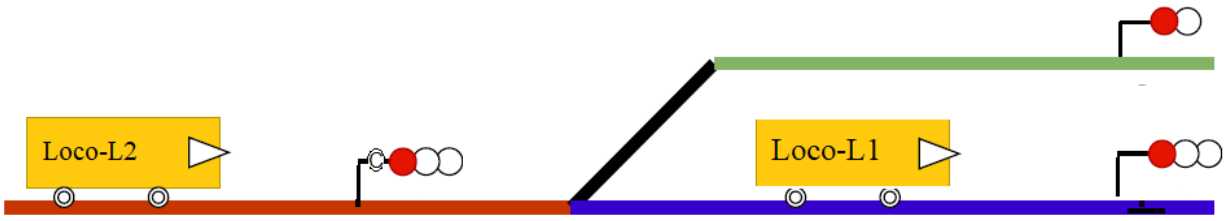


Figure 21

(ii) **Head On Collision**:

Head On Collision 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)		☒	☒	☒	☒	☒	☒	☒	☒	☒
LS(C2)		☒	☒	☒	☒	☒	☒	☒	☒	☒
OS		☒	☒	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
FS+OV		☒	☒	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

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.

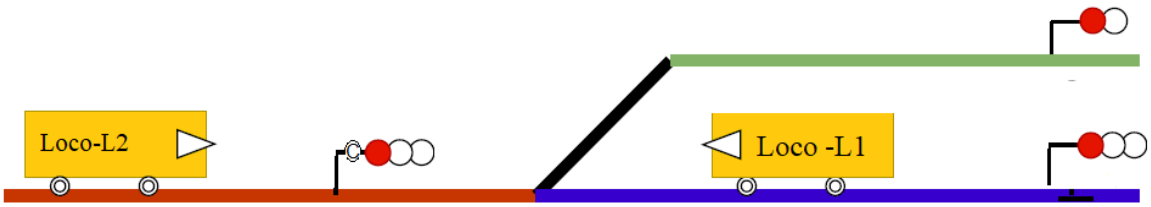


Figure 22

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

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 highas got analysed by ISA.

A1.9 Onboard KAVACH Specific SoS

A1.9.1 The Onboard KAVACH Specific SoS function is used to stop the train when an emergency condition is detected by Stationary KAVACH subsystem.

A1.9.2 The Onboard KAVACH Specific SoS is generated by Stationary KAVACH to particular onboard KAVACH which is in its supervision.

A1.9.3 Stationary KAVACH subsystem shall generate the following types of specific SoS to any given onboard KAVACH.

S.No.	Onboard KAVACH Specific SoS	Condition for SoS Generation in Stationary KAVACH	Action in Onboard KAVACH	Condition for SoS Cancellation/Removal by KAVACH
1	Unlinked Tag (Normal Tag which are in stationary KAVACH application data but not in route)	Unlinked RFID tag within the location accuracy window by Onboard Kavach in FS/OS/LS modes.	Tag shall be reported to Stationary KAVACH. Onboard KAVACH shall apply brakes till standstill-Position Report shall be erased. Next tag read by onboard Kavach before standstill or before acknowledgement shall not be considered for position establishment.	If loco pilot acknowledges, brakes and SoS shall be released. If the train comes to standstill, the SoS shall be released. The position report shall be established subsequently after reading two tags.
2	Onboard Odo error is >= 120m	On detection of Odo error in a frame cycle is more than 120m. This shall be	Onboard KAVACH shall apply brakes. On LP Acknowledge at standstill, shall	On entering into SR mode after LP acknowledge.

		calculated based on travelled distance ≥ 2xV + E (Configuration value) against travelled distance. Where V is current train speed in m/s and E is tolerable error.	remove Position Report and enter into SR mode.	
3	Detection of SPAD	On detection of passing Signal foot Tag at danger without MA. MA shall be Zero. On receiving Override request from Onboard KAVACH, OS MA shall be extended to the nearest stop signal.	Onboard KAVACH shall enter into TRIP mode. On LP Selecting PT mode and signal Override procedure shall be followed. Position report shall not be erased based on tags read during TRIP mode.	After signal Override from LP
4	Rear-end collision	On detection of another KAVACH equipped train within the extended MA with 300m safe margin i.e MA+300m. MA shall be truncated till the safe rear end of the train with 300m safe margin	Onboard KAVACH shall display SoS message on DMI and shall supervise the train movement as per truncated MA. In case of approaching red sigal aspect, overlap distance shall be reduced to zero.	After detection of 300m (Configured) safe margin from rear end of front train beyond EoA.
5	Head-On collision	On detection of another KAVACH equipped train in opposite direction within the extended MA or on Same TIN within the station territory. MA shall be withdrawn, if extended.	Onboard KAVACH shall display SoS message on DMI and shall enter into TRIP mode. On LP Selecting PT mode and then Override procedure shall be followed after removal of head on collision incident.	After receiving OS MA when Override initiated from LP.
6	Violation of Shunting limits	On detection of train position in SH mode in out of shunting limits configured in the station territory.	Onboard KAVACH shall apply brakes and allow the movement in opposite direction until train is brought within the shunting limits	After bringing the train into within shunt limits of the station.

			boundaries.	
7	Station Manual SoS	On detection of SoS generation command from SM.	Onboard KAVACH shall apply brakes and allow the movement at configured speed until train is moved out of station boundaries.	After cancellation of SoS by SM or moving the train out of station boundaries.

A1.9.4 The above conditions are guaranteed only when Radio communication is healthy with on-board KAVACH.

A1.10 SR Authorization:

A1.10.1 The SR authorization function is used to allow the train movements in station territory in case of station fail to extend the movement authority due to uncertainty in available signalling data.

A1.10.2 The SR authorization is generated by Stationary KAVACH to particular onboard KAVACH which is in its supervision.

A1.10.3 Stationary KAVACH subsystem shall allow the train to move in SR mode by extending SR authorization in the following cases.

S.No.	**Condition for extension of SR authorization**	**Condition for removal of SR authorization and extending to OSMA.**
1	On detection of train in uncertain signalling route at Start of Mission. **Eg:** In point zone with multiple exit signals, movements from siding.	On detection of train in known signalling route.
2	On detection of train movement in undefined signalling route at Start of Mission. **Eg:** Detection of Train Movement in opposite direction in uni-direction lines.	On detection of train in defined signalling route.
3	On detection of communication link fail with EI system.	On recovery of communication link fail with EI system.
4	On detection of communication link fail with TSRMS Server.	On recovery of communication link fail with TSRMS Server.
5	Fails to handing over the trains before application of brakes at station boundaries when no communication with Adjacent stationary KAVACH. SR authorization shall be given by stationary KAVACH on approach of station boundary based on train speed. SR authorization distance from	On recovery of communication link fail with Adjacent Stationary KAVACH.

S.No.	Condition for extension of SR authorization	Condition for removal of SR authorization and extending to OSMA.
	boundary = V^2 + D. Where V is current train speed in m/s and D is configured additional distance.	
6	After override of the entry Signal, which leads to multiple routes, Stationary KAVACH determines the route based on the reported Tags and extends the MA accordingly. When Onboard KAVACH does not report the Tags, OSMA cannot be extended because the route is unknown. In such a scenario, if override input is received, Stationary KAVACH shall extend SR authorization.	On detection of train in known signalling route.