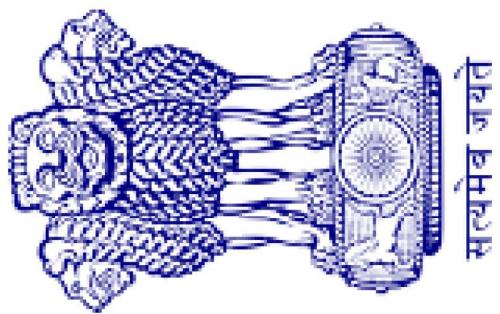


# IR-ATP : KAVACH



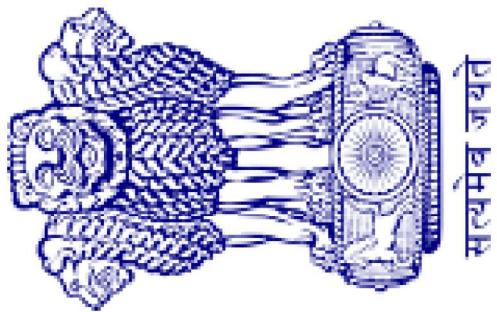
**KAVACH**  
Train Protection System



वश्येव कुदुम्बकम्

ONE EARTH • ONE FAMILY • ONE FUTURE

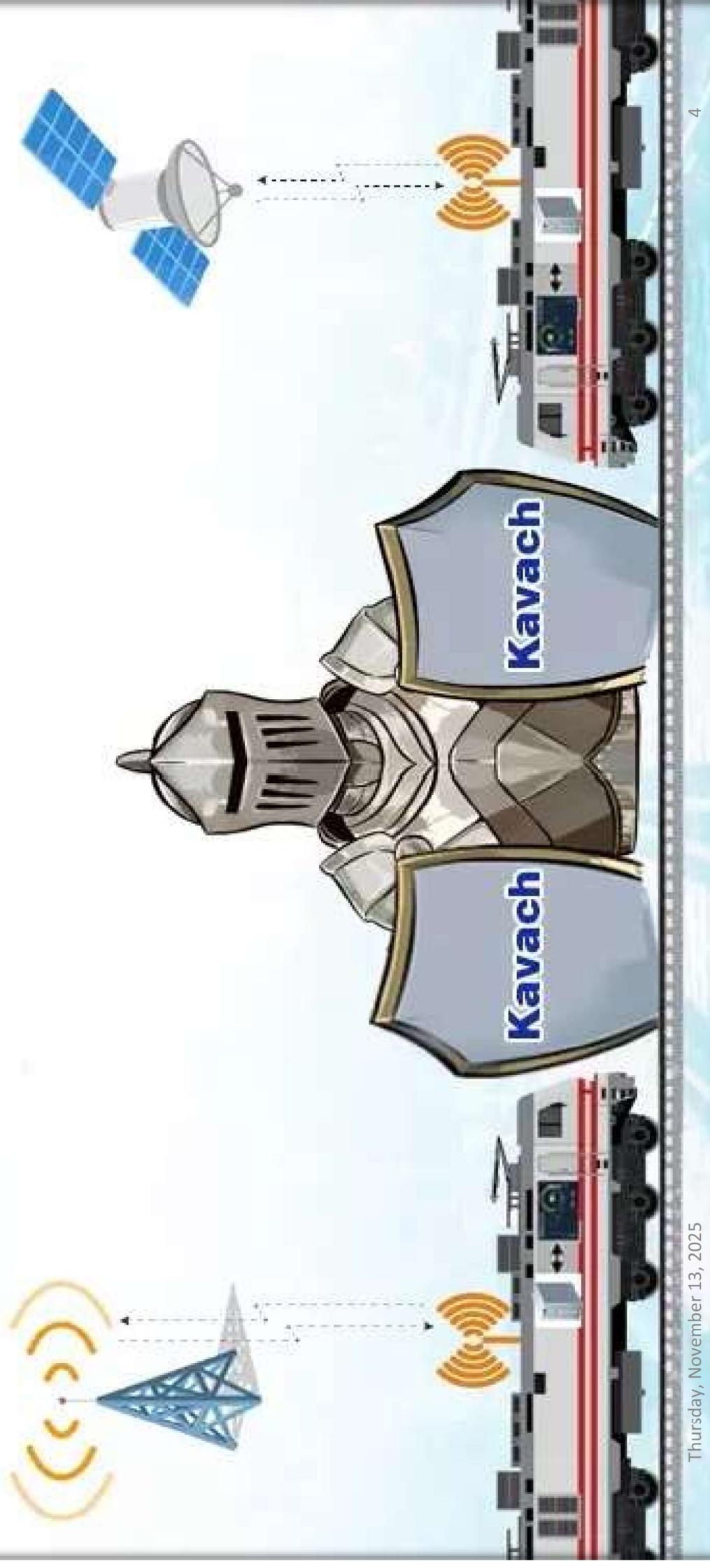
# KAWACH 4.0

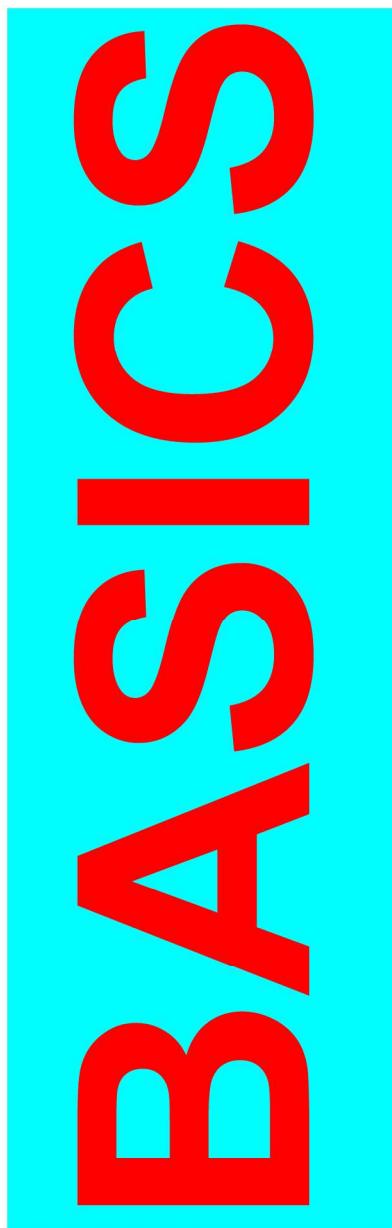


# IR-ATP KAVACH



# Indian Railways Kavach to Make Train Journey Safer





## Introduction of Kavach

- For train speeds beyond 140 KMPH,  
Automatic Train Protection (ATP) Systems  
is compulsory in IR as per Para 7.8.9,  
table-3 of IRSEM
- Indian Railways has developed its own  
indigenous ATP Systems for enhancing  
safety in train operations as per RDSO  
spec RDSO/SPN/196/2012.

## Introduction of Kavach

- The system is formerly known as Train Collision Avoidance System (TCAS) which is now named as ‘KAVACH’.  
(RB LETTER NO. 2021/SIG/tcas-PART(1), DT: 06.09.2021)
- KAVACH has been adopted as **our National Automatic Train Protection (ATP) System** across Indian Railways in line with the strategy of Atma Nirbhar Bharat. (Dt: 04.07.2020)

**Para No: 7.8.9 of IRSEM (Issue - July 2021): Table-3: Important Minimum Signalling Features**

S.No	DETAILS	STD I	STD II	STD III	STD IV
1	Maximum permissible speed	Up to 50 Kmph	Up to 110 Kmph	Up to 140 Kmph	Up to 160 Kmph
2	Isolation	See Notes below	Required	Required	Required
3	Point Operation, Locking & Detection	Point Machine	Point Machine	Point Machine	Point Machine & Direct Clamp type with Thick web switches
4	Train Detection (Track circuit/Axle Counters)	On all Run through Lines	On all Running Lines	On all Running Lines	On all Running Lines
5	MACLS Signalling, Movement authority	MACLS	MACLS	MACLS	MACLS, Movement Authority
6	Block Working (Absolute/Automatic Signaling)	Permitted (Including Token Working)	Permitted (Excluding Token)	Permitted (Excluding Token) or 4A Automatic Signalling	Permitted (Excluding Token) or 4A Automatic Signalling
7	Double Distant/Automatic Signalling	Not Compulsory	Required (On sections where Trains have a Emergency Braking Distance of more than 1 Km)	Required or 4A Automatic Signalling	Required or 4A Automatic Signalling
8	Last Vehicle verification	Not Compulsory	Required at stations with centralized operation or in high density routes	Required	Required
9	Relay/Electronic Interlocking (RI/EI)	RI/EI	RI/EI	RI/EI	RI/EI
10	Mobile Train radio communication (MTRC) or LTE or any other Technology	Not Compulsory	Desirable	Desirable	Required
11	ATP (ETCS/TCAS/TPWS) with Cab Signalling for SPAD mitigation	Not Compulsory	Desirable	Desirable	Required
12	Centralised Traffic Control (CTC)	Not Compulsory	Desirable	Desirable	Desirable (Contd..)

Thursday, November 13, 2025

# **CONTENT**

---

- Introduction to Kavach and its Sub Systems
- Salient features of Kavach
- Components of Kavach
- Kavach arrangements in station at a glance
- Loco Kavach at a glance
- Radio Frequency Identification (RFID) Tags
- Working Principle

# **CONTENT**

---

- Operational Modes of Onboard Kavach for Version 4.0
- Driver Machine Interface (DMI) at a glance
- Different Types of Operational Modes of Onboard Kavach for Version 4.0
- Mode Transitions in Kavach Ver 4.0
- Features available at different Operational Modes in Kavach.

- ✓ What is KAVACH?
- ✓ When it is required?
- ✓ Why it is required?
- ✓ Is there any changes in working for LP/SM/TMR ?

# **WHAT IS KAVACH?**

---

- ✓ A radio communication-based control system provided as an **additional aid** to Loco Pilots of functional Kavach fitted locomotives in Kavach territory, **the use of which shall in no way infringe or override the provisions (codes and manuals) of regular train operation required to be followed by Loco Pilot**

## Definition of Kavach

**General Rule 2024 :- Rule 1.02(28 A)**

“IR-ATP (Kavach),  
Communication based control system, provided  
as an aid to Loco Pilots of functional Kavach  
fitted Locos, in Kavach territory, the use of which  
shall in no way infringe or override the provisions  
(codes and manuals) of regular train operation  
required to be followed by Loco Pilot.”

**Gazette Notification dated 31st Dec, 2024.**

# Unified Subsidiary Rules for KAVACH

**Limit of Speed Generally:**

**New Subsidiary Rule under GR 4.08(1)(a) :**

In case Loco is not equipped with Kavach or LOCO Kavach become defective, **the maximum speed of train shall not exceed 140 kmph,** subject to other speed restrictions.

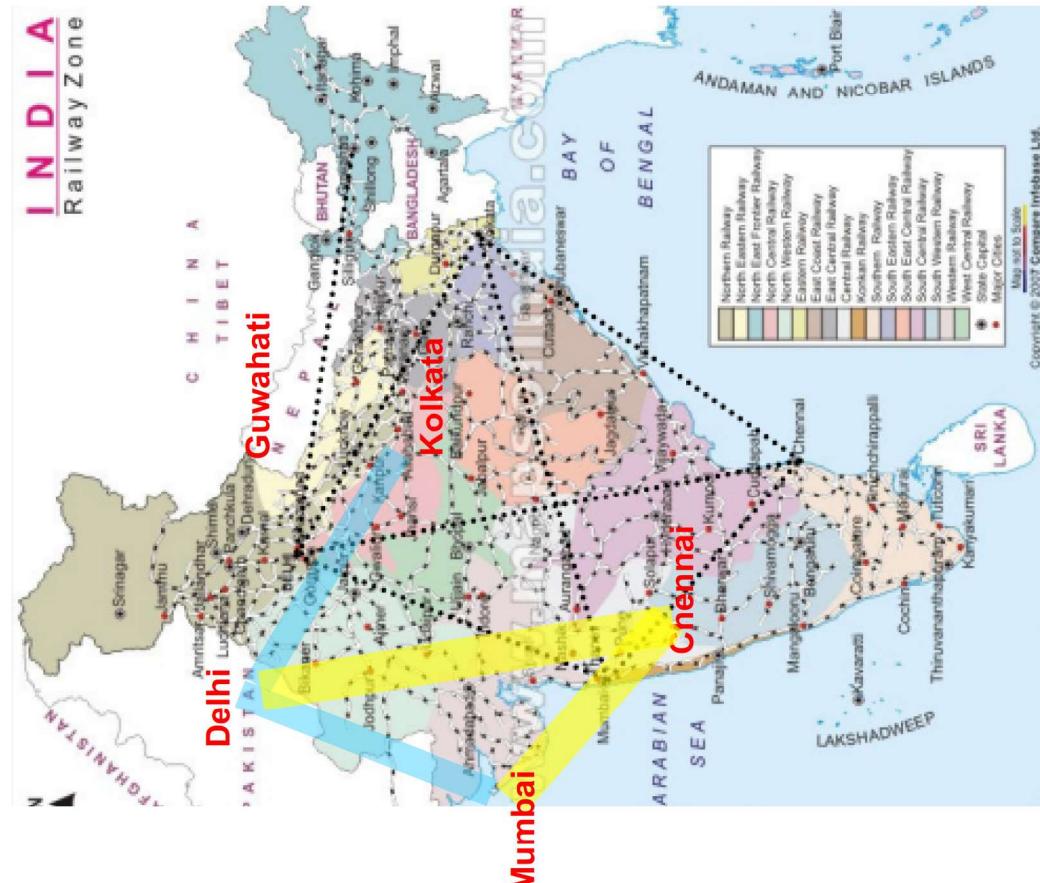
## When & Why it is required?

- ✓ As per IRSEM 2020, when the speed of a train exceeds 140 KMPH -Std IV (R), ATP with Cab Signalling for SPAD mitigation is required

# ROAD MAP of Kavach implementation in IR

Priorities for KAVACH  
implementation:

- HDN routes
- HUN routes
- Other Passenger HDN routes
- Other routes



## ROAD MAP of Kavach implementation in IR

### Present progress:

- SCR – 1465 Rkm deployed in LDN
- NCR – 80 Rkm - Mathura – Palwal Section completed.
- Mumbai – Delhi – Howrah sections (WR, WCR, NR, NCR, ECR & ER) – 3000 Rkm appr.

Kavach works of appr. 37,000 (HDN: 12,000 + LDN: 25,000) Rkm have been sanctioned in Indian Railways.  
**Kavach fitment in 10,000 Locos by CLW order placed on 18/11/2024 on five OEMs – completion period 01 year.**

# **Is there any changes in working for LP/SM/GUARD?**

- Kavach is **only an additional safety aid** to the Loco Pilot to avoid unsafe situations arising out of non-adherence to signalling indications or speed restrictions by the Loco Pilot.
- The provision of Kavach shall, in no way absolve the railway staff of their responsibilities in respect of observance and compliance of Speed restrictions and aspects of signals.

## **Basic functions of KAVACH**

---

- An additional aid to the loco pilot for mitigation of risks arising out of SPAD.
- It automatically applies brakes if the loco pilot violates speed restrictions or fails to act in time to prevent Signal Passed at Danger.

# **Basic functions of KAVACH**

---

- Continuous Speed Supervision:  
Controlling over-speeding beyond  
Sectional speed, PSRs, Loop Line Speed  
Control – at present.  
(TSRs will be included once TSRMS  
becomes operational).
- Kavach uses continuous supervision of  
Movement Authority to maintain train  
speed within specified limits.

## Basic functions of KAVACH

- Kavach also provides protection from ***head-on, rear-end and side collisions*** by estimating track occupancy and identifying the track.
- This feature works only between trains with locomotives having functional on board Kavach.
- Capable of displaying Signal Aspect of approaching signal in loco pilot's cab along with the movement authority aiding Loco Pilot.
- Displays the section speed, permitted speed and current speed on a single dial.
- Auto whistling at Level Crossing Gate in certain conditions.

- **SPAD Mitigation:** Automatically applies brakes if the LP fails to stop at a ‘danger’ signal.
- **Over-speed Protection:** Enforces speed limits (sectional, permanent, turnout, and, in future, temporary restrictions via TSRMS).
- **Collision Avoidance:** Prevents head-on, rear-end, and side collisions (when both trains are Kavach-equipped).
- **Roll-back/Reverse Movement Protection:** Prevents unintended movements.
- **Cab Signalling:** Displays real-time signal aspect, speed profiles, and movement authority to the LP.
- **Auto-whistling at Level Crossings:** Enhances safety at unmanned crossings.
- **SOS Functionality:** Station Master can initiate a system-wide emergency stop within a 3 km radius.

## Components of Kavach

The Kavach System comprises of :

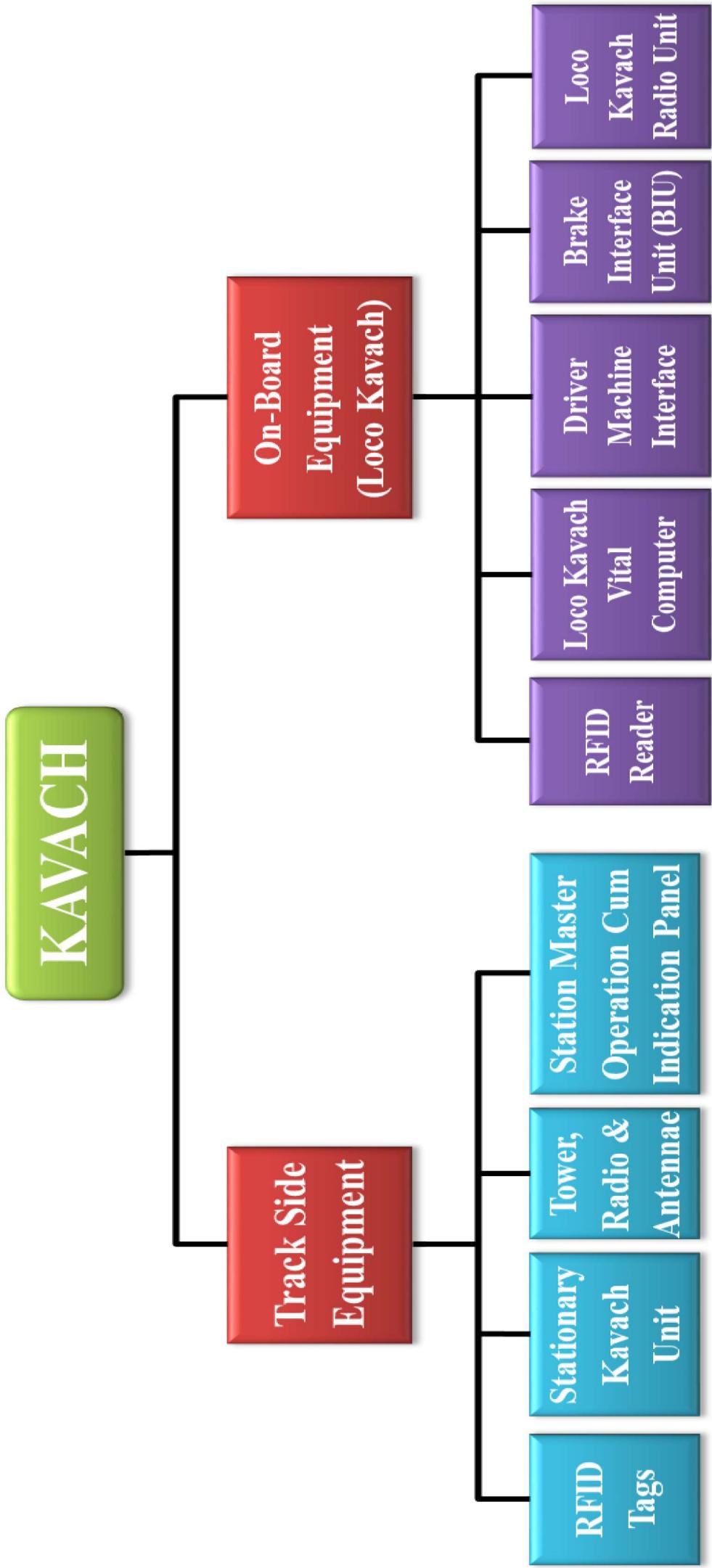
### **1. Track side equipment (Track & Station)**

- RFID tag, Stationary Kavach Unit
- Tower, Radio & Antenna
- SM Operation cum Indication panel

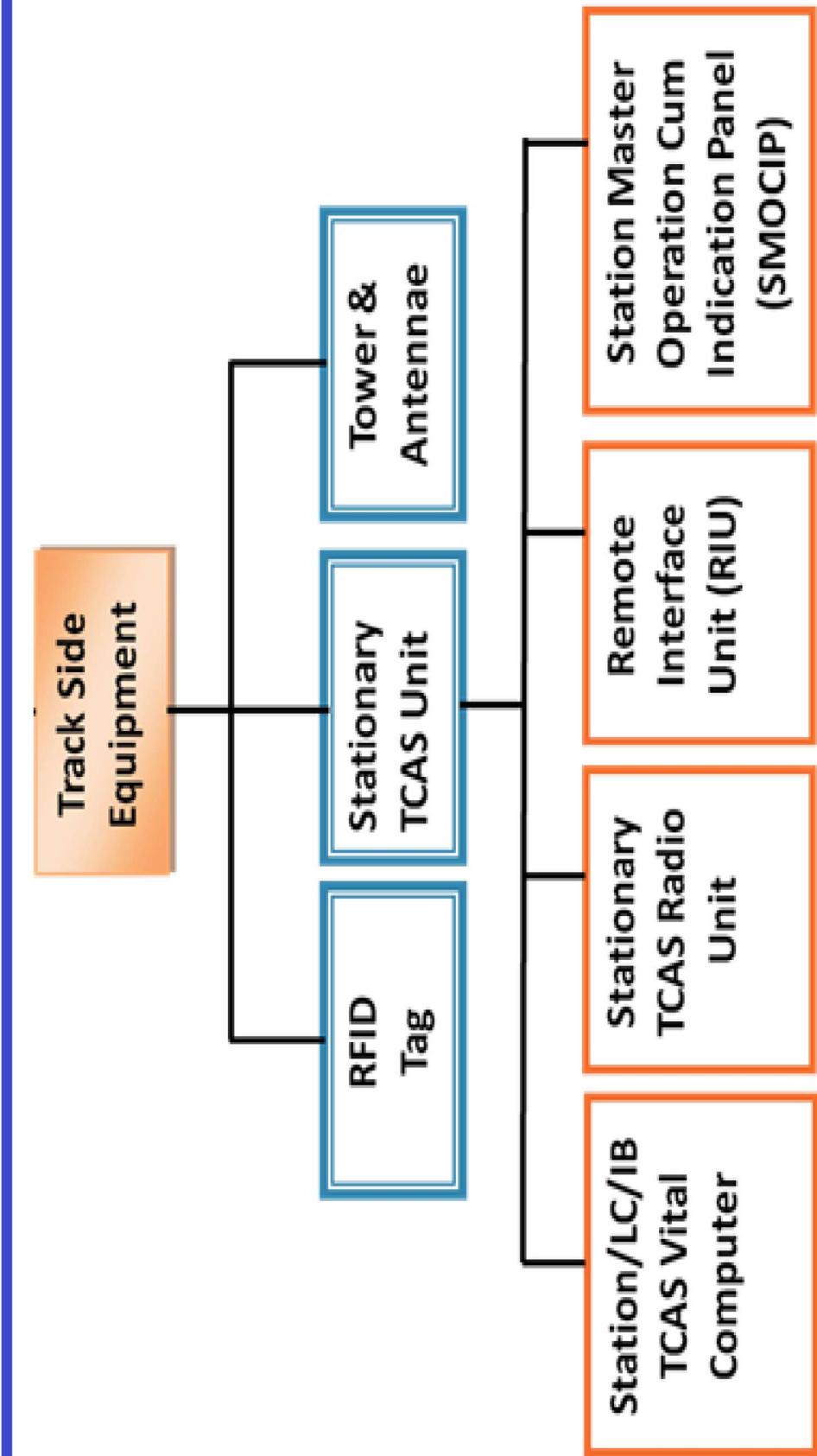
### **2. On-board equipment (Loco Kavach)**

- RFID reader
- Loco Kavach Vital computer
- LP-OCIP (Driver Machine Interface)
- BIU (Brake Interface Unit)
- Loco Kavach Radio Unit.

# Components of Kavach



# Stationary Kawach Block Diagram



# Trackside Components

- **RFID Tags:** Placed on sleepers at regular intervals (1 km in block sections, at every signal, turnout, and level crossing in stations). Tags are passive, weatherproof, and provide location, track ID, and operational data.
- **Stationary Kawach Unit:** Located in relay/electronic interlocking rooms, it interfaces with signalling systems and transmits movement authority to trains.
- **Radio Towers/Antennas:** Enable wireless communication between stations and trains.
- **Station Master Operation Cum Indication Panel (SM-OCIP):** Allows SM to monitor system health, generate/cancel SOS, and log events.

## RFID Technology

- ~~RFID is Technology which works on Radio frequency and used for the auto-identification for the different object.~~
- The RFID system mainly consists of two parts.
  - ❖ RFID Tags
  - ❖ RFID Reader
- RFID TAG consists chip for data storage and an antenna.
- RFID Reader Consists of RF Signal Generator and antenna.

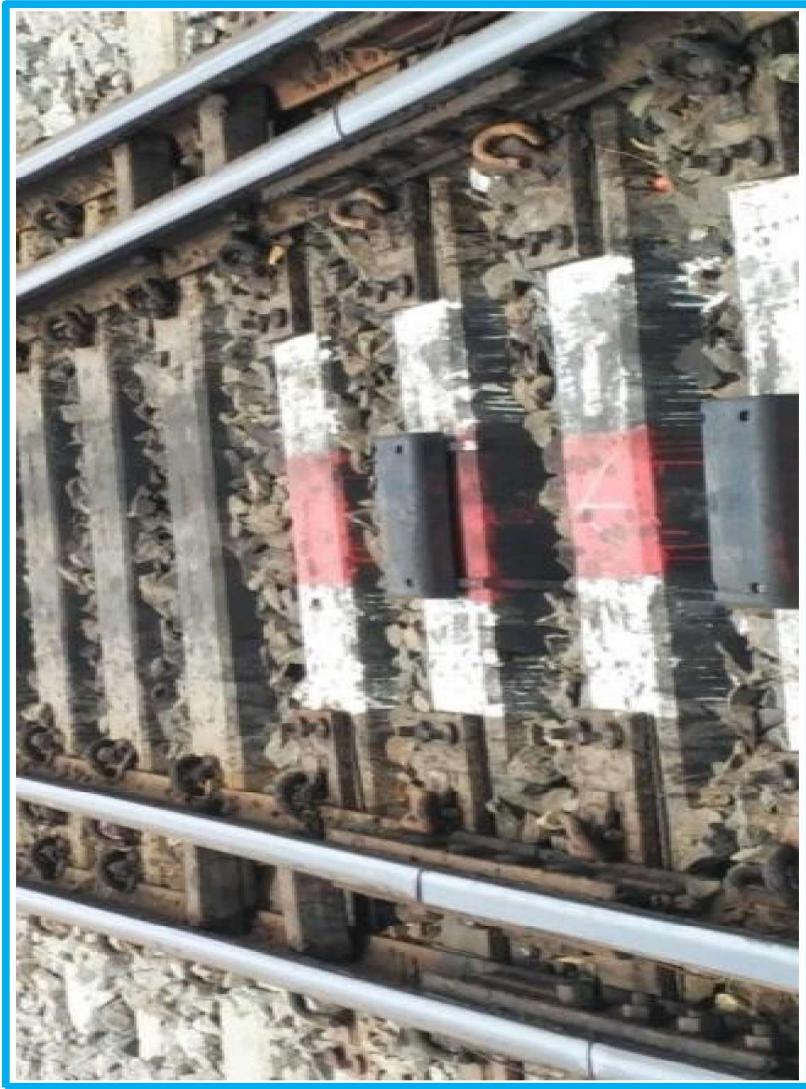
# **RFID Introduction**

---

- RFID Tags fitted on track in station section and in block section for giving Trackside information to Loco TCAS unit.
- RFID Tags at all the places duplicated (Redundant) with identical information related to operations except for Unique ID.
- Each Loco KAVACH unit have two RFID Readers.
- When Loco KAVACH unit RFID reader passes over RFID tag, RFID tag transmits the programmed data to RFID reader.
- Loco unit Acts as per the information received from the RFID tags.

## RFID TAGS

- ❖ Placed to Track Sleepers at regular intervals



# RFID Tag Fixing & Placement Arrangement

- RFID Tags provided in block section **at ~1 km** and in station yard for each signal, signal approach and turnouts.
- Used for track identification, correction of location of train and train movement direction identification
- Fixed at the center of PSC Sleepers
- No holes are drilled in the Sleepers. Fixing through clamps only
- Suitable for reliable working at train speed upto 250 KMPH
- Able to work even when submerged in water up to rail level



# RFID Reader



Thursday, November 13, 2025

# **RFID TAG**

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❖ TRACK INFORMATION

❖ LOCATION DATA TO ON-

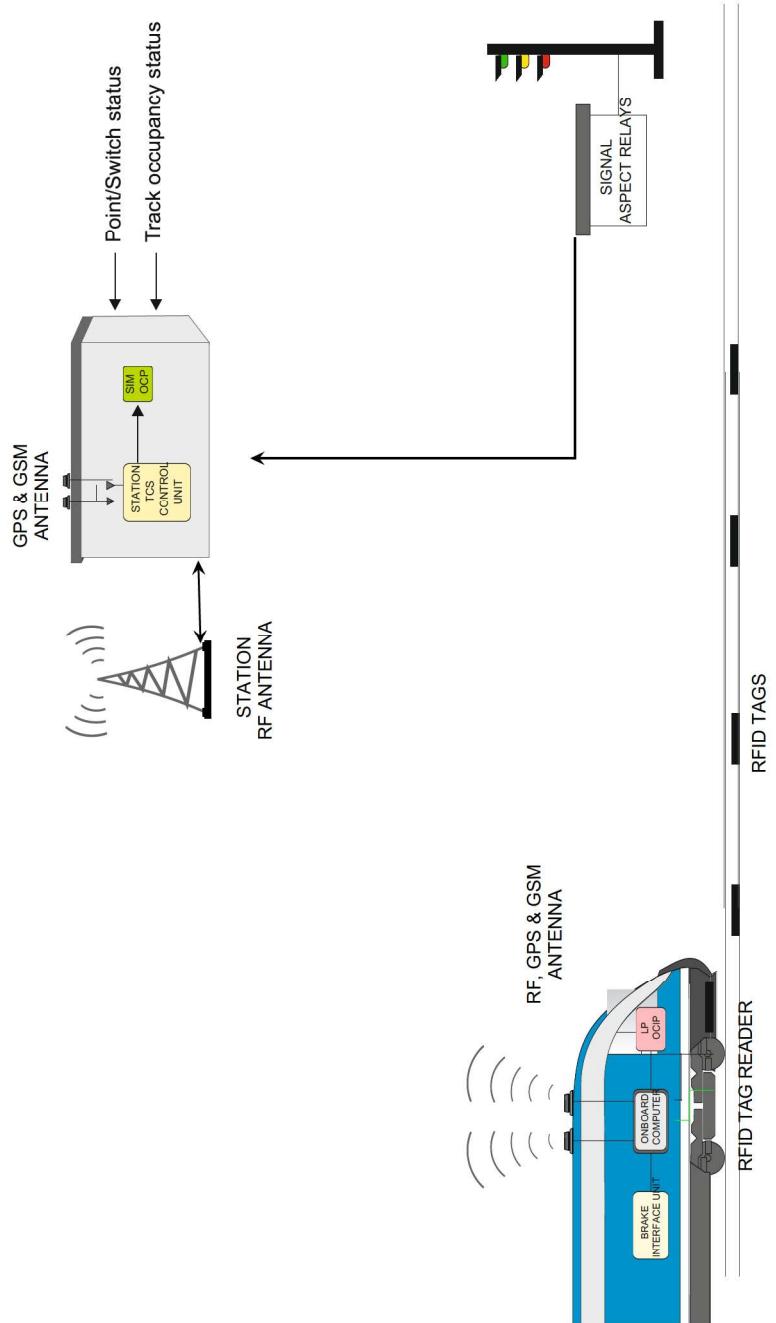
BOARD KAVACH

## **RFID READER**

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◆ IT IS PLACED UNDERNEATH  
THE LOCOMOTIVE TO READ  
THE RFID tags

# RFID Introduction



- RFID Tag is the Trackside subsystem of KAVACH System.

# RFD tags Summary of

- **Normal Tag (N/S/T)** :- Used in station yard and block section.
- **LC Tag (G)** :- Used for LC Gates.
- **Adjacent Line Tag (L)** :- Used in block section to give information about adjacent line(s).
- **Adjustment/Junction Tag (A)** :- Used in block section to adjust the absolute location (KM) and/or Direction Reset.
- **Exit Tag (X)** :- Used for exiting from Kavach fitted area to unfitted area. Min 2 Tags are installed at 10 m apart. Transit to SR mode. Stop the communication after the complete train passed over.
- **Border ID Tag (N)** :- Used in block section to identify boundary between two Stationary Kavach communication zone.

S.No	Type of Tag	Function
1	Normal Tag	The maximum distance between the two normal tags shall not be more than 100m. Each Normal tag shall be linked to next two normal tags in both the directions
2	Signal Foot Tag	To indicate the Signal Foot to the Approaching train If loco crosses this without MA, loco enters into Trip mode
3	Signal Approach	At Signal approach, N tags shall be provided before the approach of (typically 150 ~ 250m) every signal post to correct the odometry error
4	TIN Discrimination Tag	shall be used to indicate change in the TIN of track section. Normally it will be placed at turnouts.
5	LC Gate Tag	shall be provided at both sides of LC gate at around 600 to 850 Mts
6	Adjustment junction Tag	Shall be used to adjust the absolute location in the block section. Junction tag shall be provided, at the junction stations to correct the absolute location. Junction tag data shall not be used to determine the train direction movement such as Nominal or Reverse
7	Exit Tags	shall be provided at KAVACH territory exit point

## RFID TAG Numbering

### **In Double line:**

- Even numbers used for DN direction and Odd numbers used in UP direction
- Station section, in Up direction RFIDs are ODD numbered from home signal to Advance Starter in Nominal direction and after that Loop Lines RFIDs are numbered.
- Station section, in DN direction RFIDs are Even numbered from home signal to Advance Starter in Reverse direction and after that Loop Lines RFIDs are numbered.
- Block section, in Up direction RFIDs are Odd numbered in Nominal Direction
- Block section, in DN direction RFIDs are Even numbered in Reverse Direction

# **Track Identification Number (TIN)**

---

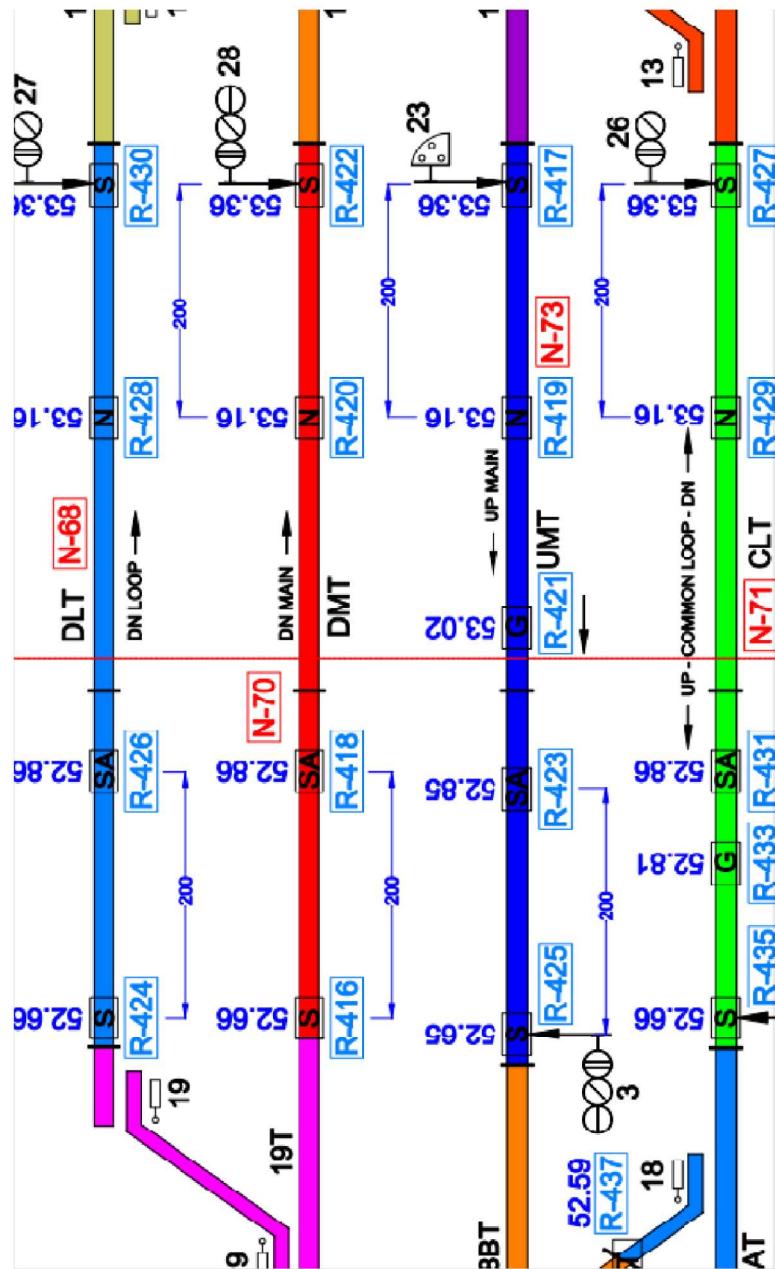
- Each track designated with Track Identification Number (TIN).
- A single TIN section represented using a single color.
- Non-TCAS territory represented through white color.
- TIN layouts thus prepared, permit all the train movements allowed in a section as per Table of TOC
- Each Block section have single unique designated TIN.
- TINs allotted in such a manner not to inhibit permissible simultaneous movements.

# **Track Identification Number (TIN)**

- Each berthing track in the station shall have an unique TIN
- TIN demarcation to be done at points joining the two Main lines
- Zonal Railways Allots Each and Every station and Block sections with Different TIN Numbers.
- Even TIN numbers used for Up direction and Odd numbers used in down direction

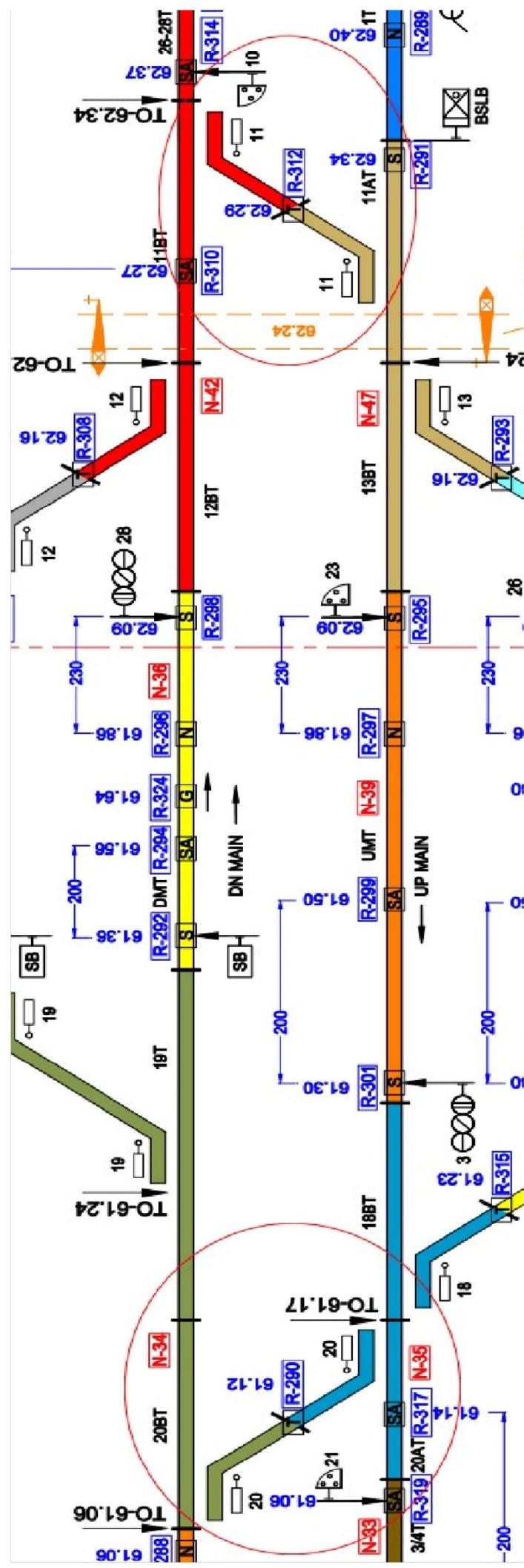
# Track Identification Number (TIN)

- Each berthing track in the station shall have an unique TIN.



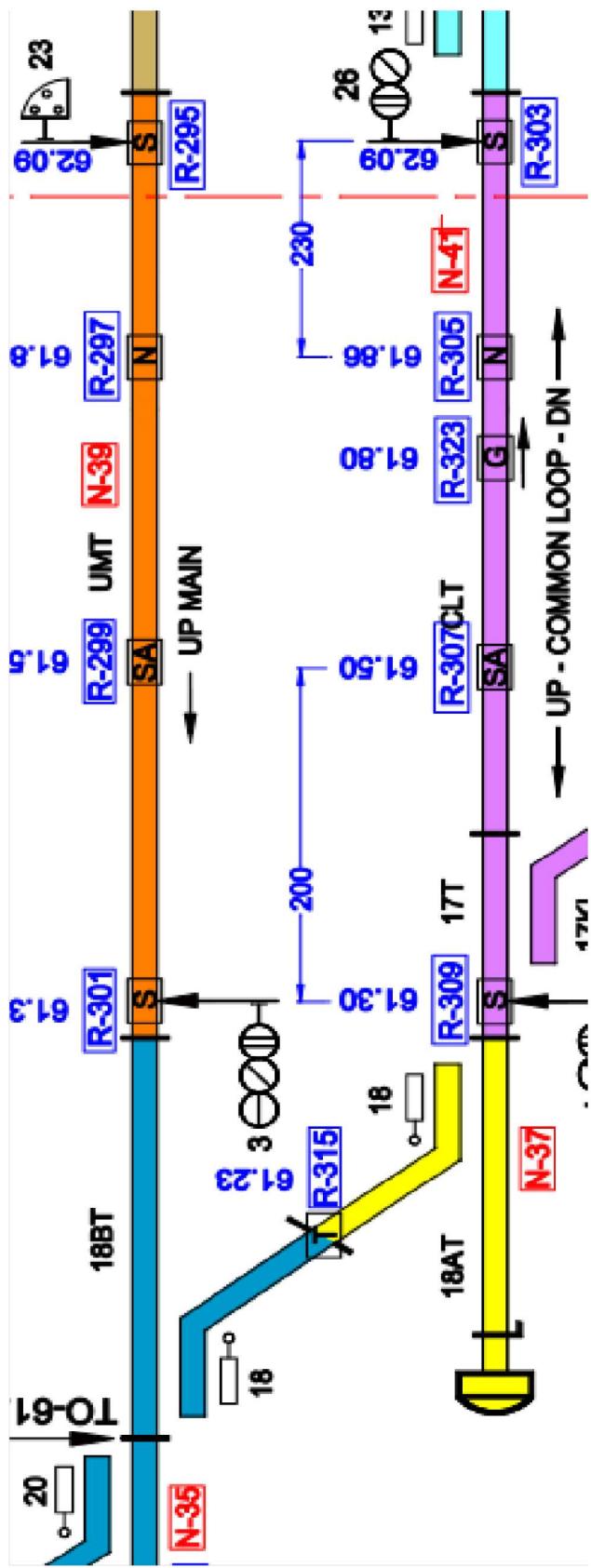
## Track Identification Number (TIN)

- TINs should be allocated in such a way that they do not inhibit permissible simultaneous movements
  - TIN demarcation to be done at points joining the two Main lines.



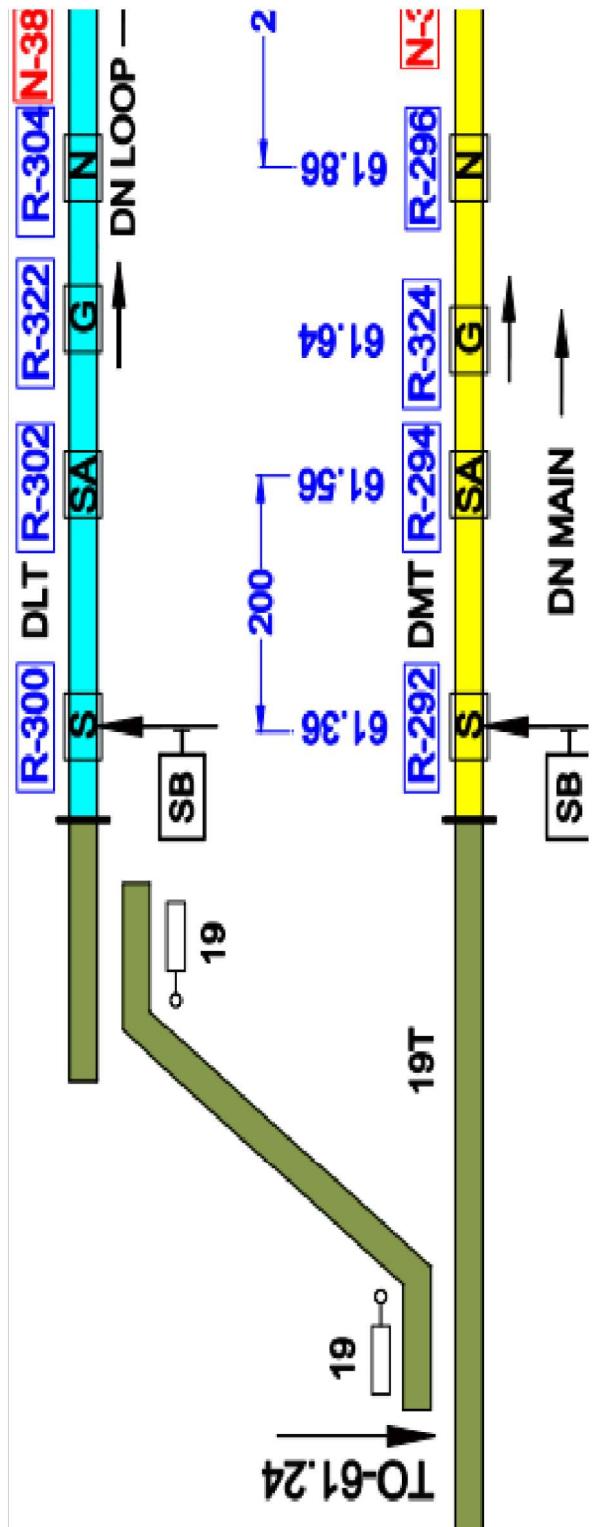
## Track Identification Number (TIN)

- TIN demarcation to be done at points joining the Lines with Isolation



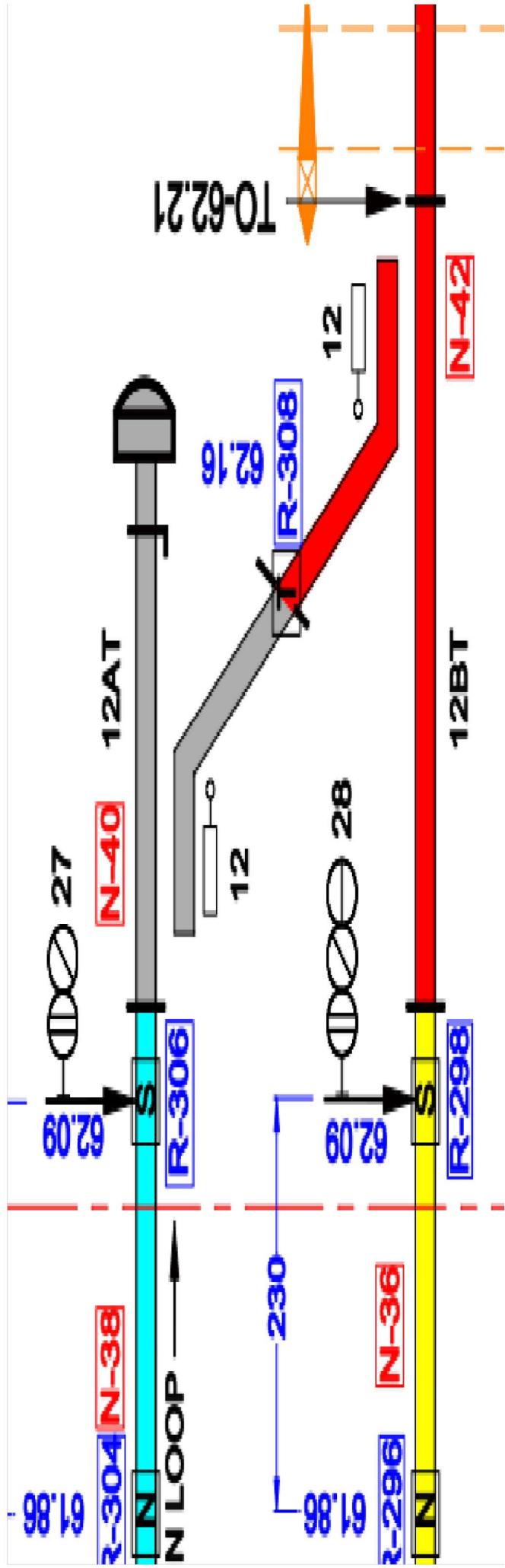
# Track Identification Number (TIN)

No TIN demarcation to be done at points joining the Main Line and the corresponding Loop line without isolation



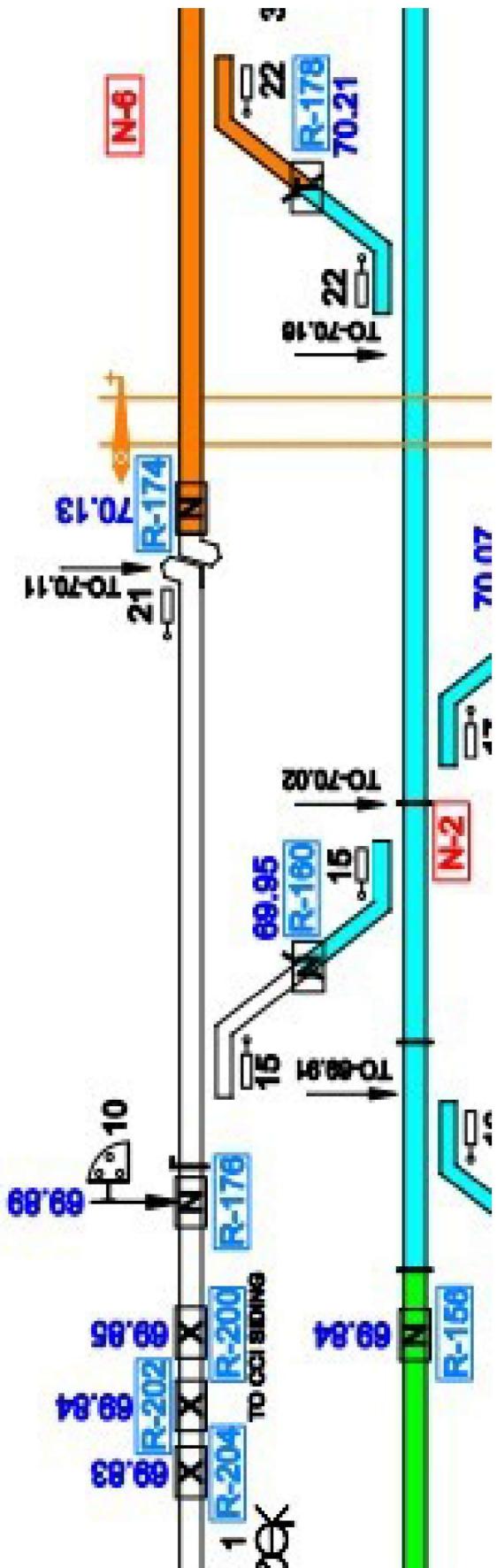
# Track Identification Number (TIN)

The portion of the track leading to a dead end(sand hump) shall have different TIN



Track Identification Number (TIN)

In cases where Exit tags are provided with two sets of Normal tags, TIN shall not be assigned up to the second Normal tag which marks the entry into TCAS territory.



# STATION EQUIPMENT



Station Antenna  
 $2 \times 2 = 4$

Radio-  
communication  
Locos



Radio Unit



SM-OCIP



Station KAVACH—  
Gathers  
signalling inputs & loco inputs  
and transmits signalling inputs to  
Loco KAVACH.



47 Relay Rack

## Kavach Towers

Station Kavach and Loco Kavach communicates with each other through Radio for every 2 seconds.

Frequency band : 427 - 430 MHz (UHF).

Two Adjacent

Stations communicate with Loco Kavach units without any interference.



**Mounting of  
Antennae on top of  
the tower**



**40m Kavach tower**

# Onboard (Loco) Components

- **Vital Computer:** Processes data and issues brake commands.
- **RFID Readers:** Detect trackside tags for location and track identification.
- **Driver Machine Interface (DMI/OCIP):** Displays speed, signal aspect, movement authority, and accepts LP inputs.
- **Brake Interface Unit (BIU):** Executes automatic brake applications.
- **Radio Unit:** Facilitates communication with trackside and other locomotives (direct loco-to-loco in emergencies).

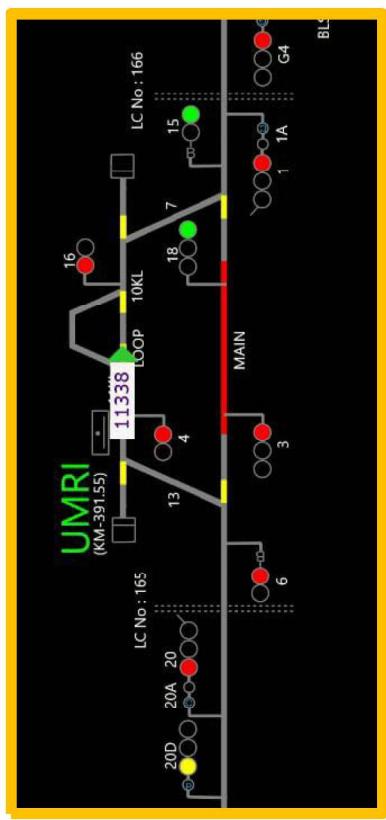
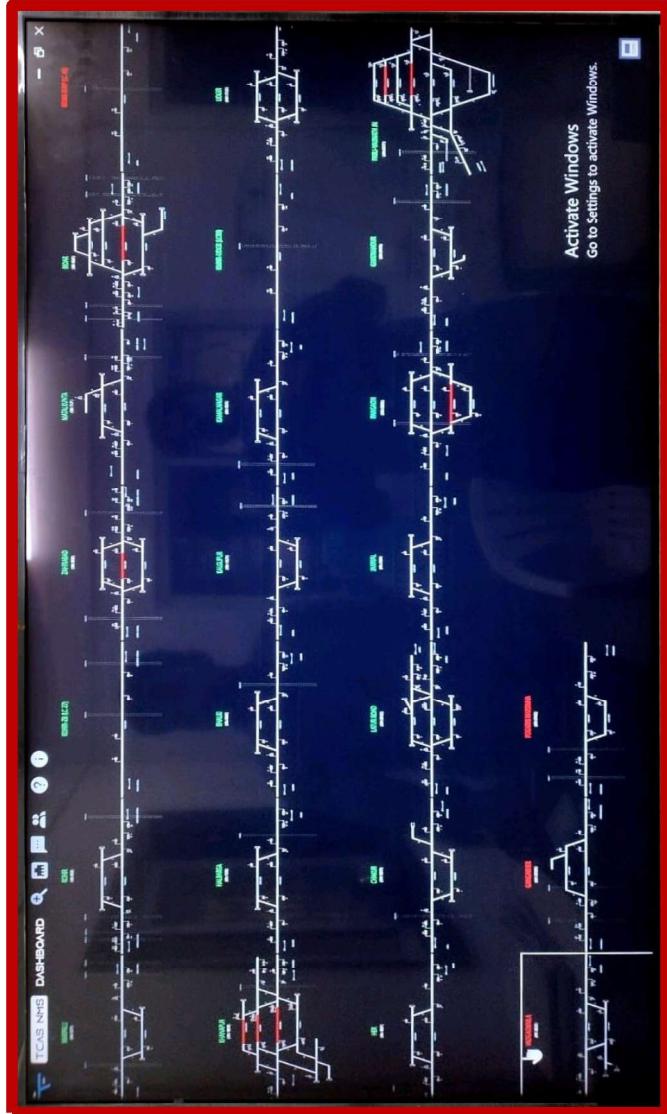
# Network and Monitoring

- **Network Monitoring System (NMS):** Logs train movements, faults, and alerts teams.

- **Key Management System (KMS):** Secures communication channels.

# Network Monitoring System (NMS)

- All stations are networked to NMS
  - Real time display of Kavach train movements
  - Offline Simulation of Train Movements
  - Helps in Analysing trouble shooting of events



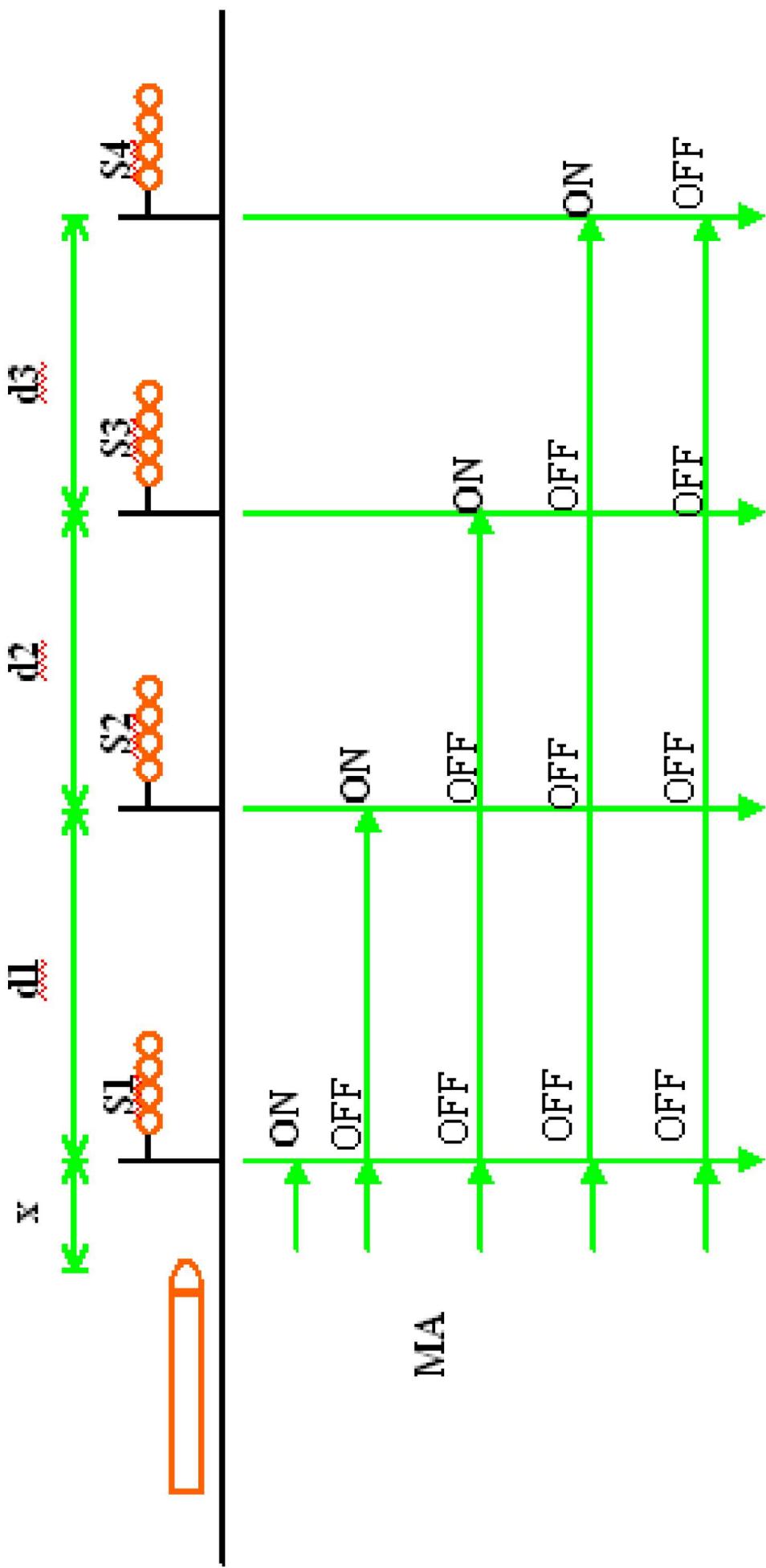
# Key Management System (KMS)

- Communication is established with an authorized Loco Kavach unit to authorized Station Kavach unit.
  - Authenticity and Integrity of any information exchanged between Loco Kavach and Stationary Kavach unit
    - Only legitimate units should be allowed to participate
      - A random number  $R_1$  generated by Onboard Unit afresh for every session
      - A random number  $R_2$  generated by Trackside Unit afresh for every session
    - Authentication Keys  $K_a$  with limited validity period by KMS to all legitimate units
- 
- The diagram illustrates the KMS architecture. It features a central cloud labeled "INTERNET" connected to four nodes: "NMS", "Station TCAS", "Loco TCAS", and "KMS". Arrows indicate data flow from NMS to Station TCAS, Station TCAS to Loco TCAS, and KMS to Station TCAS. Labels "Fault Data" and "Auc Keys" are shown above the arrows. To the right, a large key icon is shown with a red section labeled "Session Key  $K_s$ " and a yellow section labeled " $R_1 || R_2$ ". Below the key, a smaller key icon is labeled " $K_s = K_a || R_1 || R_2$ ".

# Working Principle

- Movement Authority (MA)**: The distance up to which the train is permitted to travel safely.
- End of Authority(EOA)** : Location up to which the train is permitted to proceed and where target speed is zero

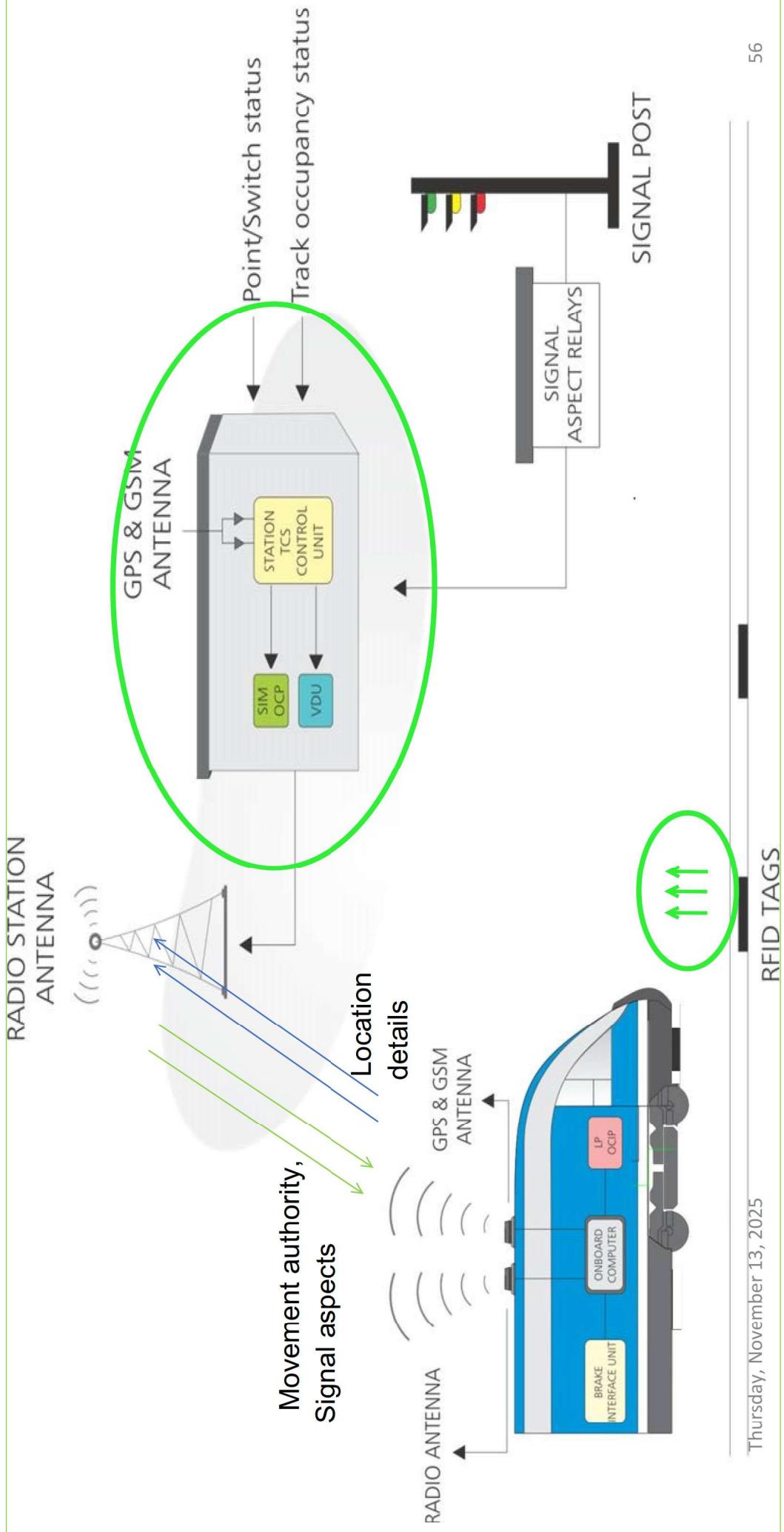
# Movement Authority (MA)



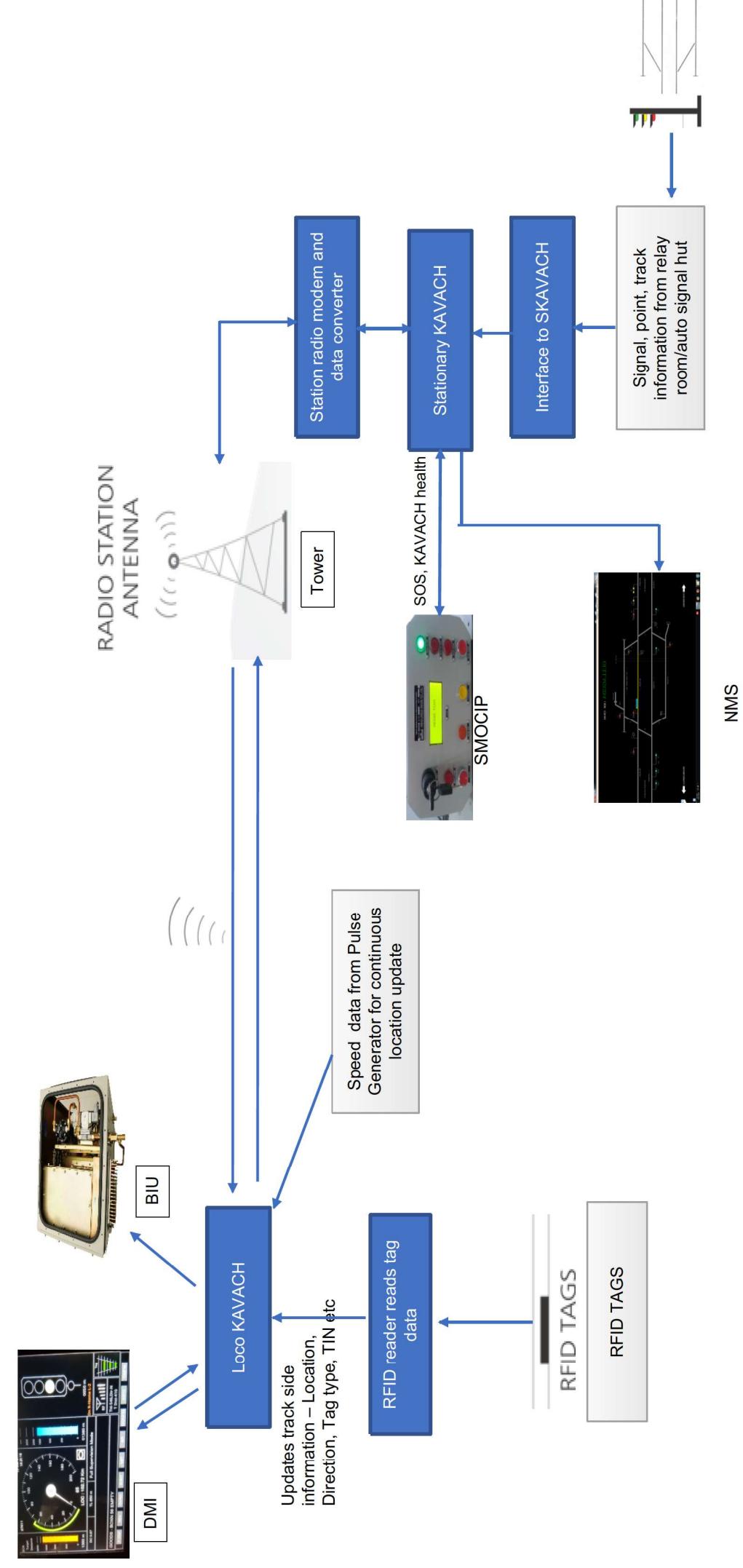
## Working Principle

- **Speed Supervision:** Kawach enforces a **dynamic speed profile** (based on train characteristics) and a **static profile** (fixed track restrictions).
- **Communication:** Bi-directional UHF radio links (upgrading to LTE in future) ensure real-time data exchange. Direct loco-to-loco communication is possible.
- **Tag Logic:** RFID tags are numbered and typed (normal, signal, level crossing, junction, exit, etc.) for precise location and track identification. Even/Odd numbering distinguishes directions.

# KAVACH functionality

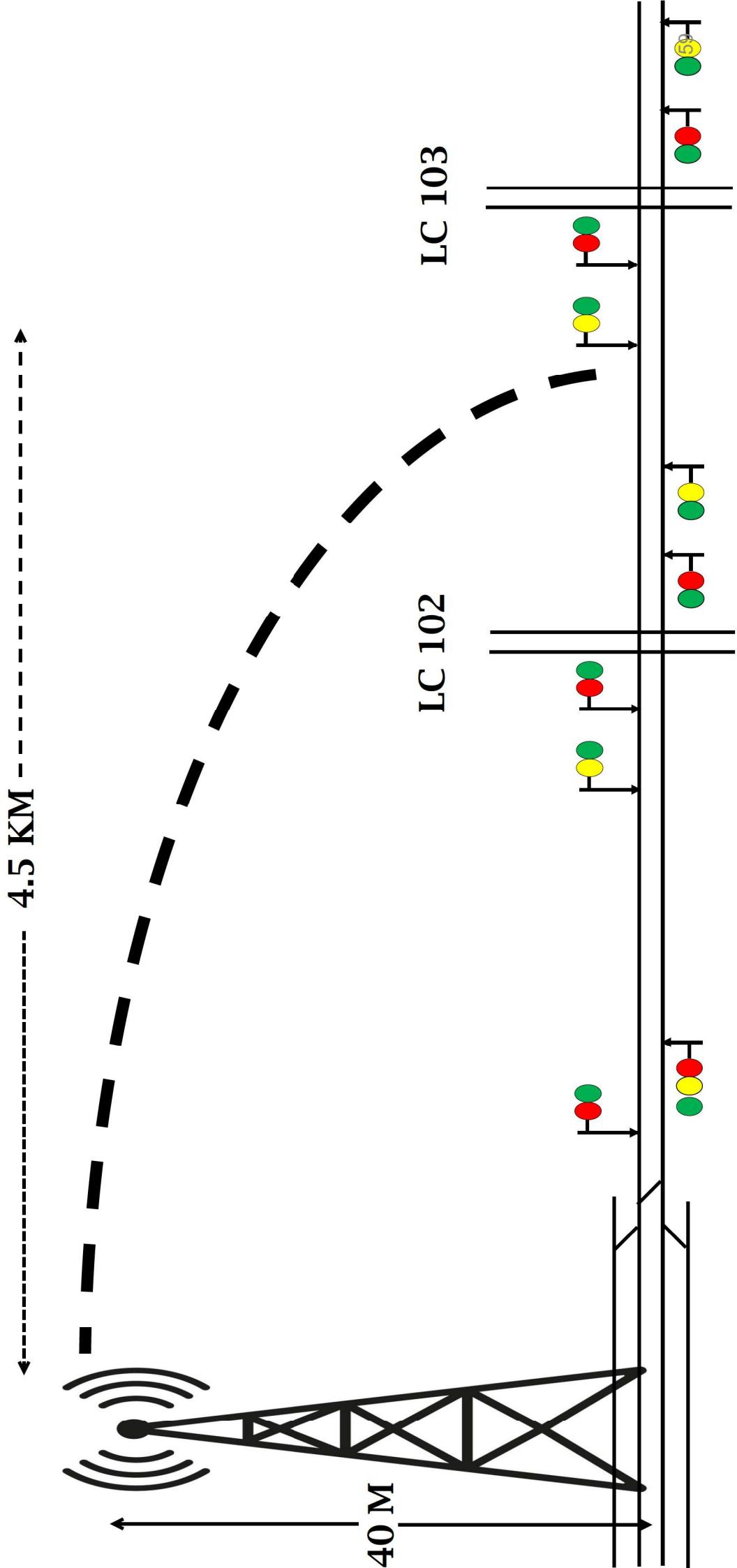


# KAVACH – The Data Flow

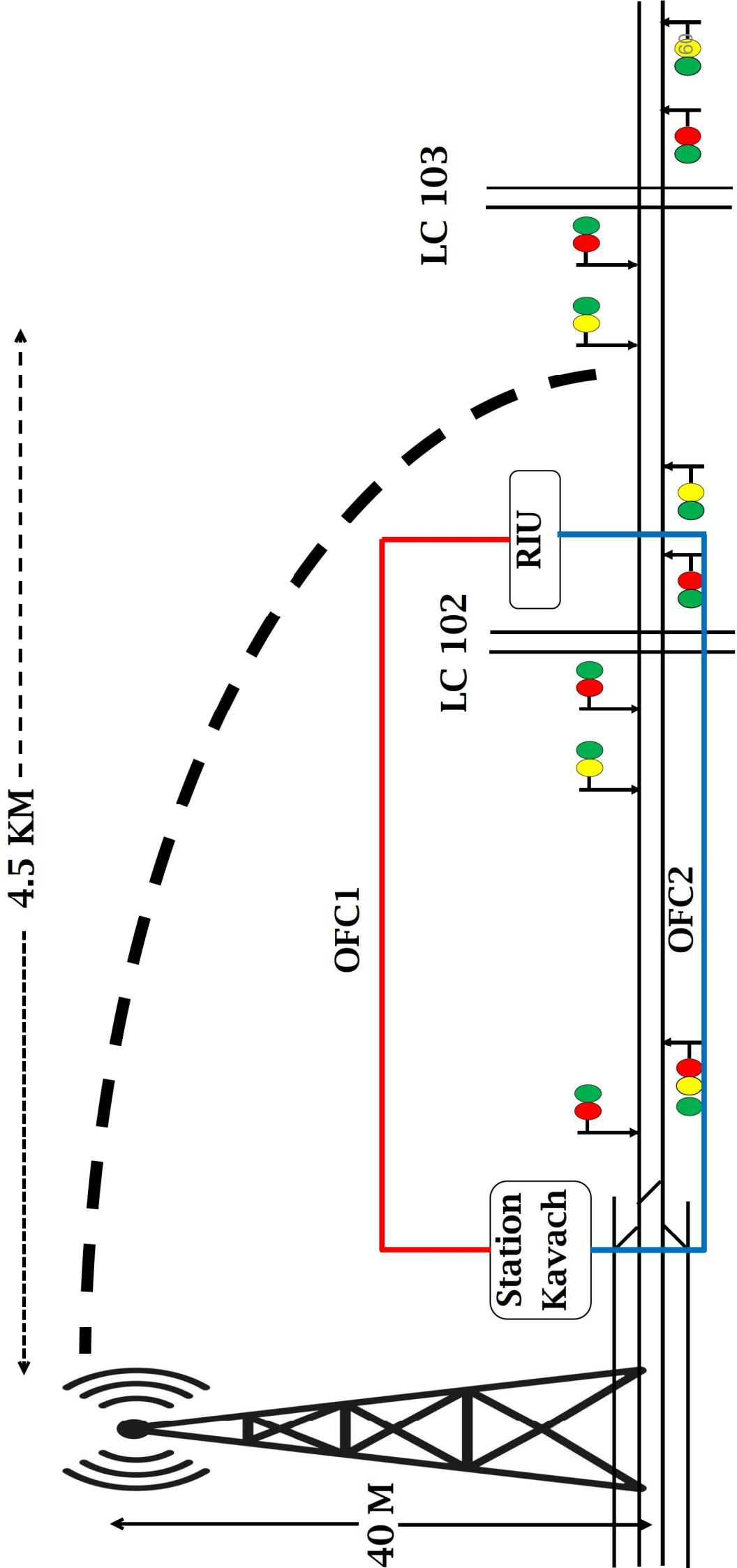


# SKAVVACH, LC KAVVACH & RIU selection criteria

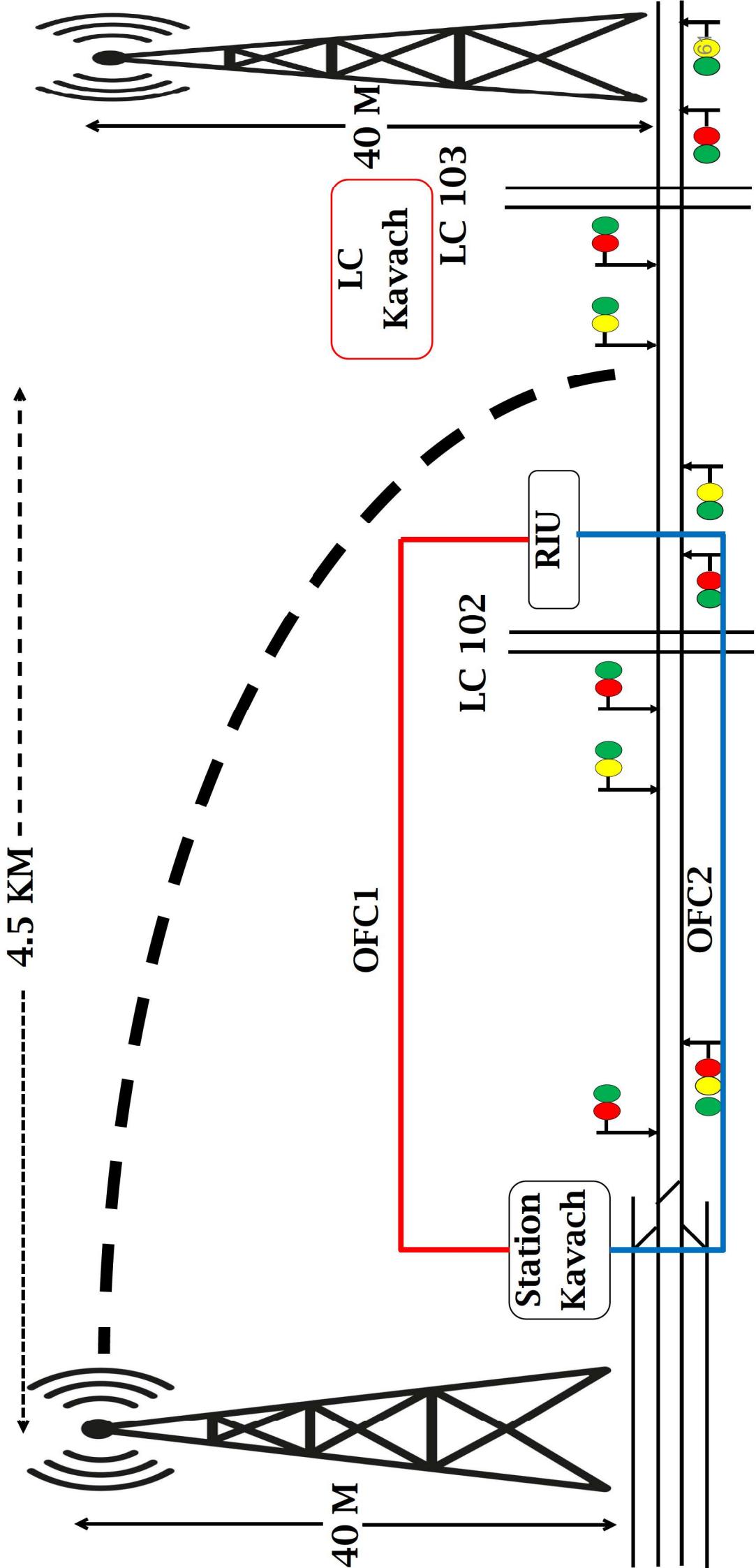
## Requirement of Towers



## Requirement of Towers



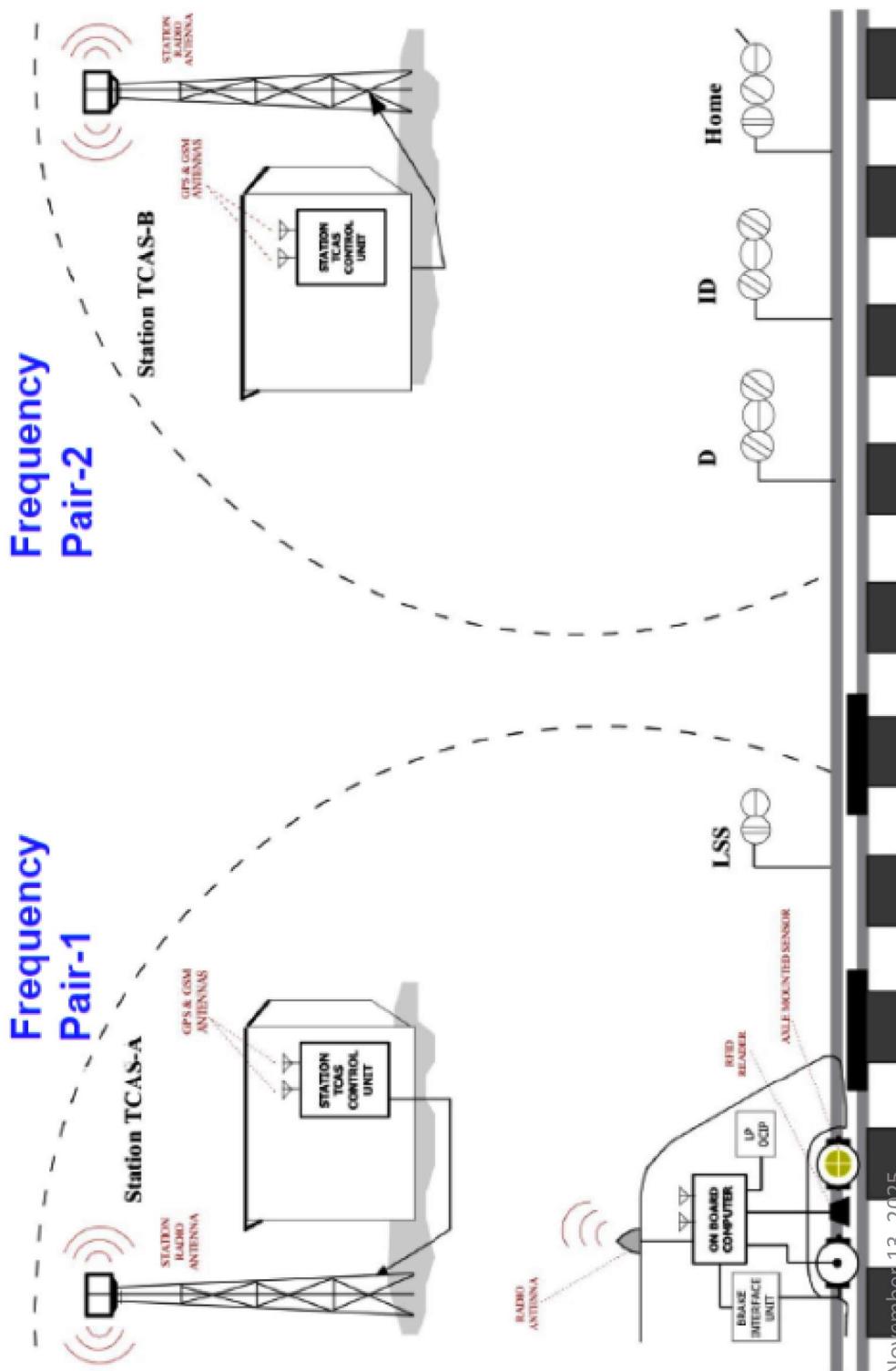
## Requirement of Towers



# Criteria for SKAVACH / LC KAVACH / RIU and Tower Selection

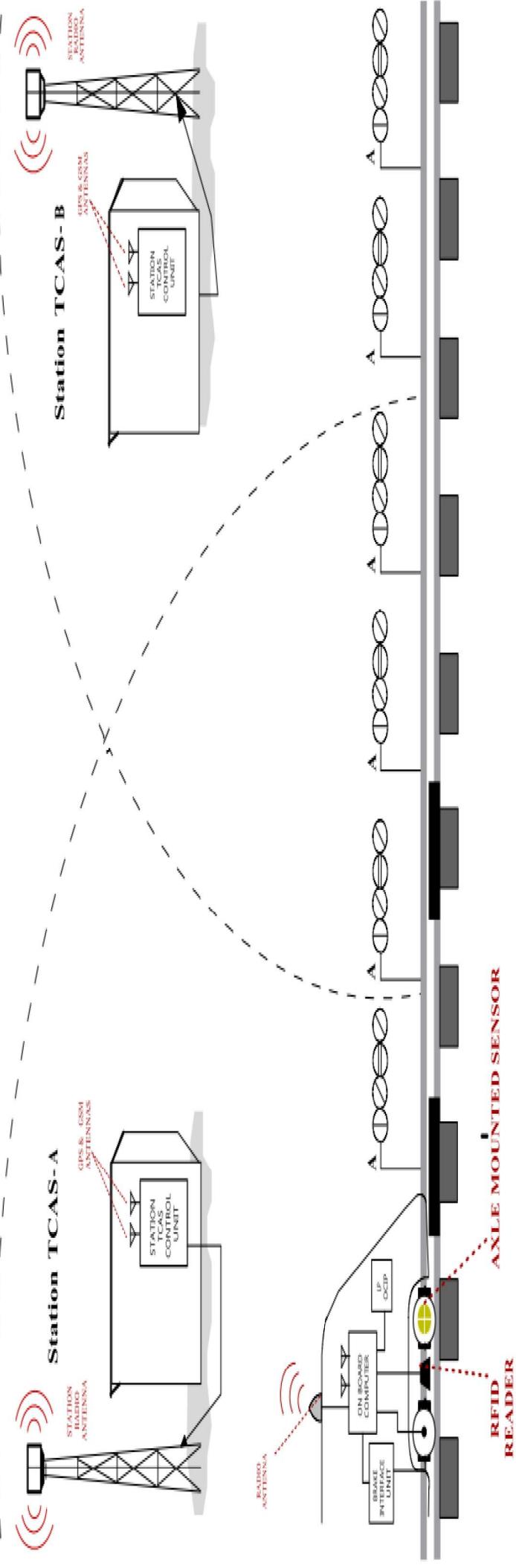
S.N o	Location & Type of Interlocking	Communication Coverage	Requirement		Remarks
			RF	SKAVACH/ LC KAVACH/ RIU	
1	Station with Centralized EI /RRI/PI	-	SKAVACH	Yes	Nil. ECRs are available at Relay Room
2	Interlocked LCs in Station Section (Traffic gate)	Yes	Nil	No	Nil. ECRs are available at Relay Room or can be exchanged through signalling cables.
3	Interlocked LCs in Station Limits / Close to Station with combined signals (Engg. Gates)	Yes	RIU	No	Signalling/OFC cable needed to transfer signalling functions to adjacent SKAVACH
4	Mid section Interlocked LC Gates (Engg. Gates) / IBS	No	LC KAVACH	Yes	Tower of 15 m / 20 m height clear of SOD infringements OFC connectivity for NMS or GSM/eSIM cards with proper signal coverage.
5	Station with Distributed EI with OCs at End cabins	-	SKAVACH & RIUs	Yes	Dark fibre availability between RIU and SKAVACH
6	Distributed Els at Major yards (With multiple Els) Thursday, November 13, 2025	-	SKAVACH at each EI and RIUs at cabins	Yes	Single Tower to cover entire yard SKAVACH at main EI with RIUs at other Els (or) SKAVACH at each EI with dark fibre connectivity between SKAVACHs.

# Absolute Section KAVACH Scheme – No Communication Overlap zone



Thursday, November 13, 2025

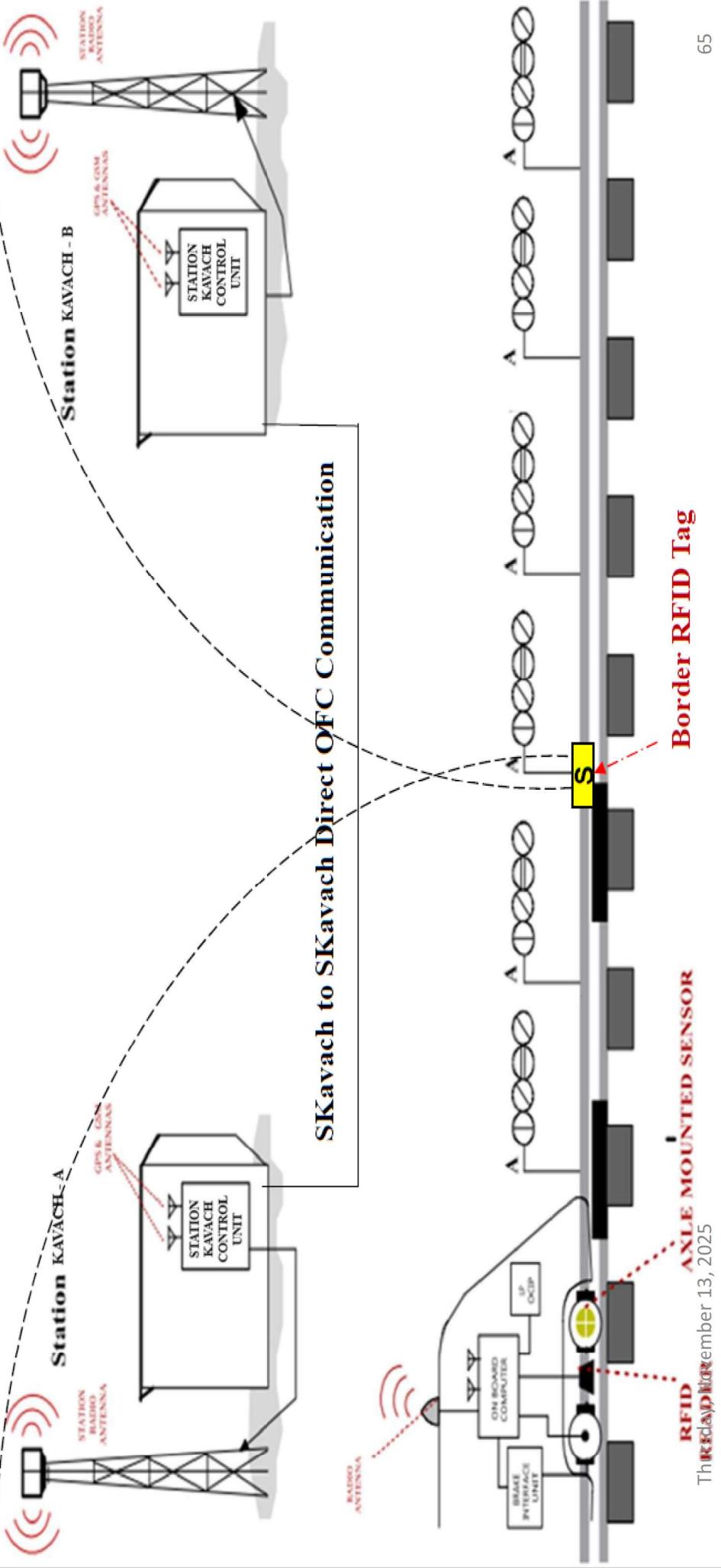
# Auto Section KAVACH Scheme – Communication Overlap zone



Overlap of 2 km to 3 km depending on design speed, EBD and communication handing over time  
Requirement of towers if inter-distance between stations is greater than 7 km  
Continuous availability of MA to avoid abrupt braking by loco KAVACH  
Requirement of redundant RIUs in the overlap zone  
With SKAVACH to SKAVACH communication, signalling data can be exchanged without additional RIUs in overlap zone

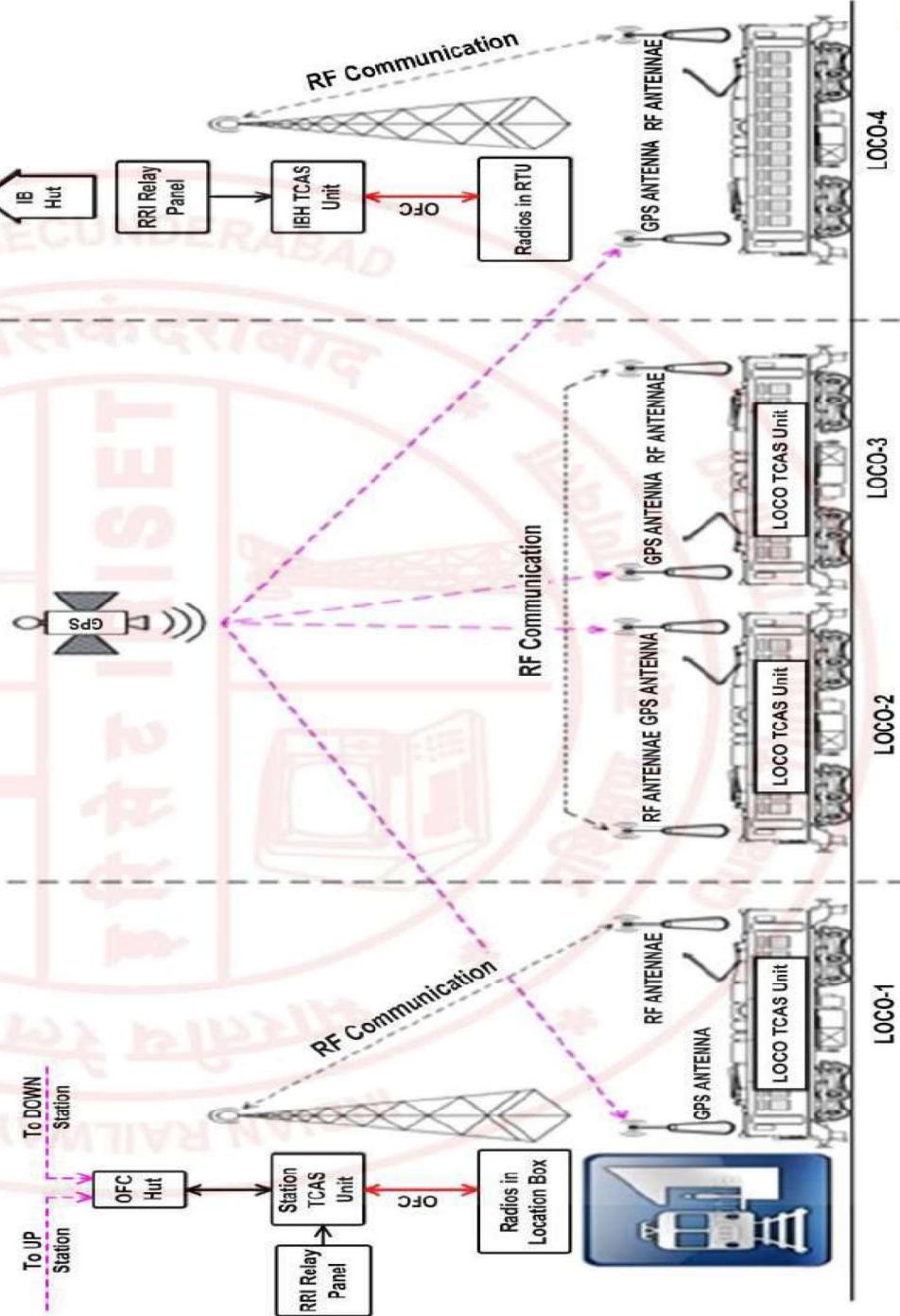
## Auto Section TCAS Scheme in Ver 4.0

- Continuous Coverage Requirement is met through slight overlapping of Jurisdictions and Station-to-Station Communication on OFC



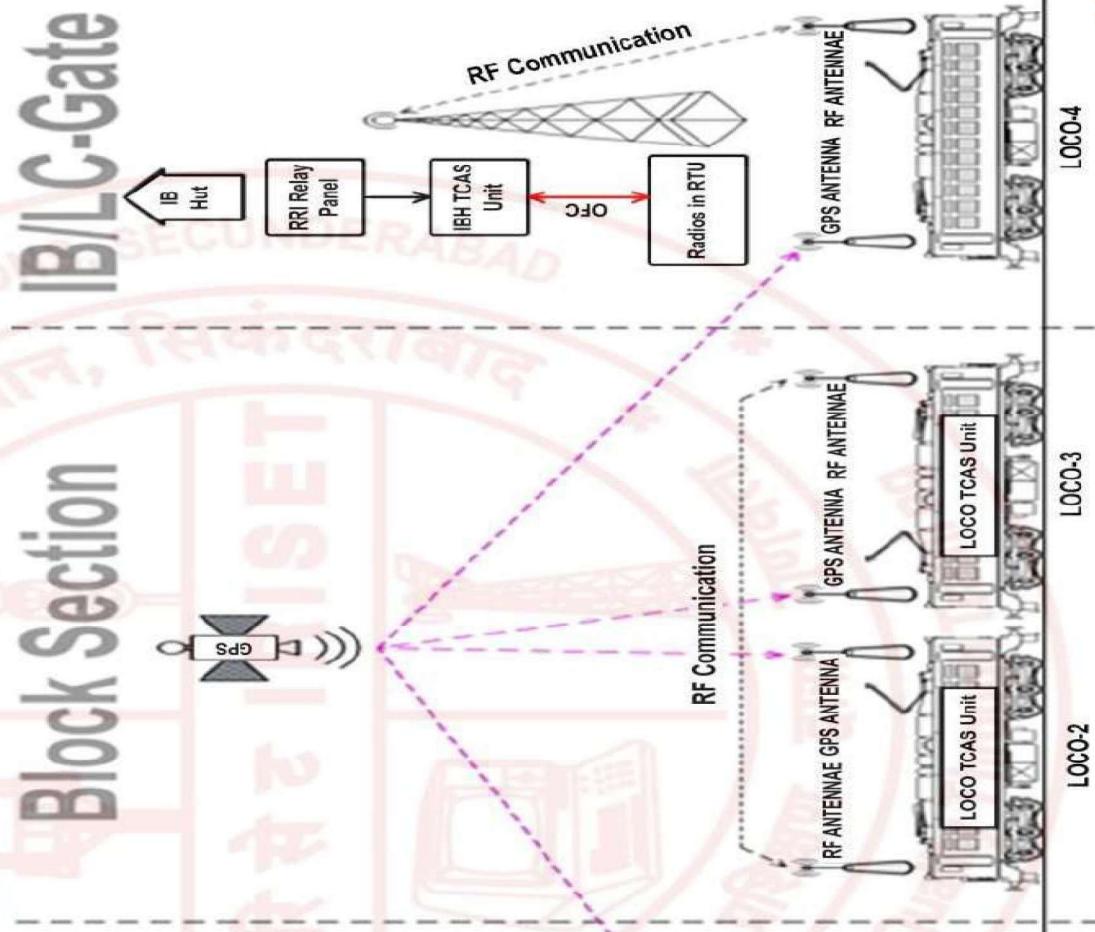
# Station Section

To UP  
Station  
To DOWN



# Block Section

To UP  
Station  
To DOWN

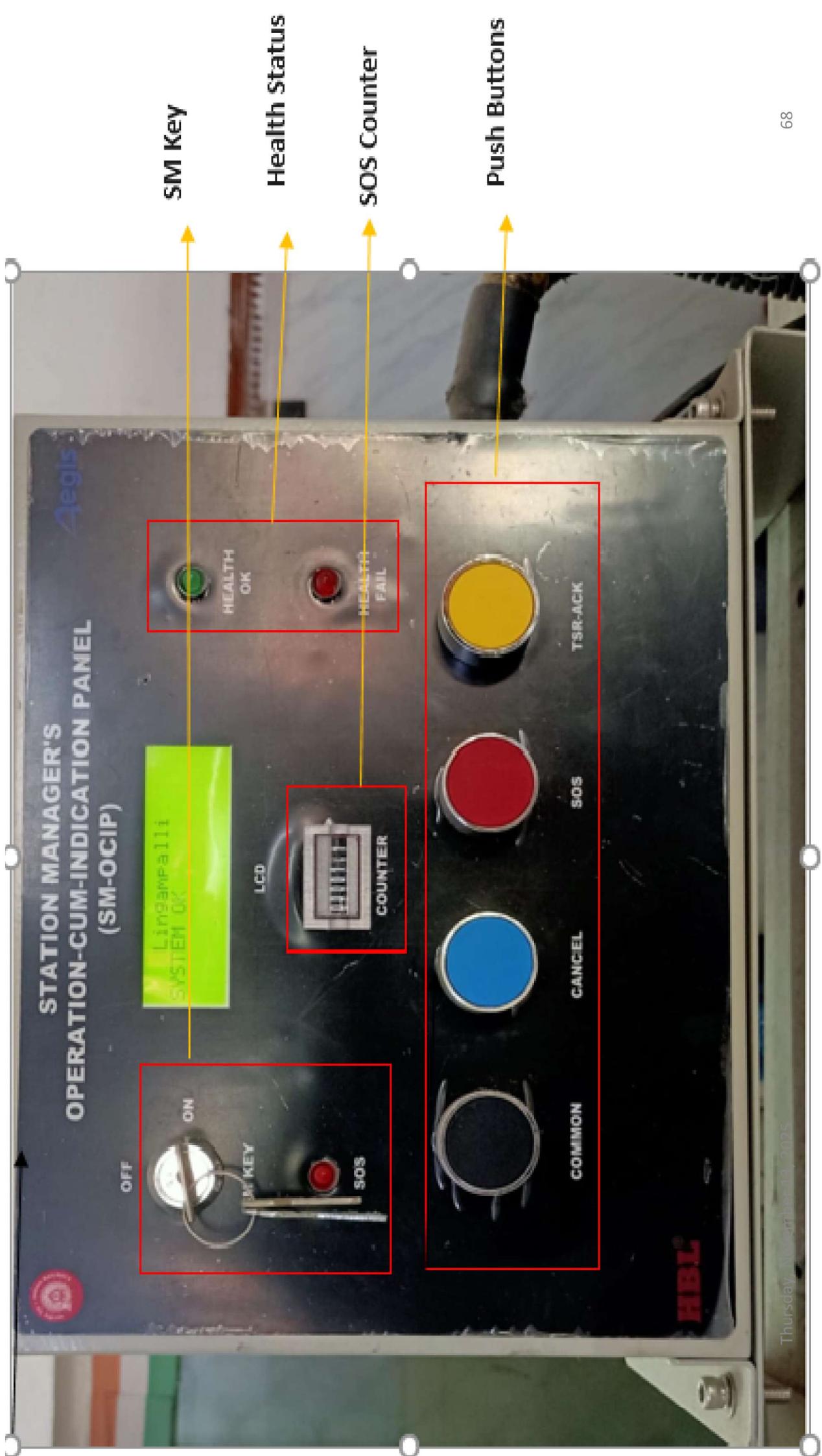


# Communication

## Radio

## **Stationary Kavach Architecture**

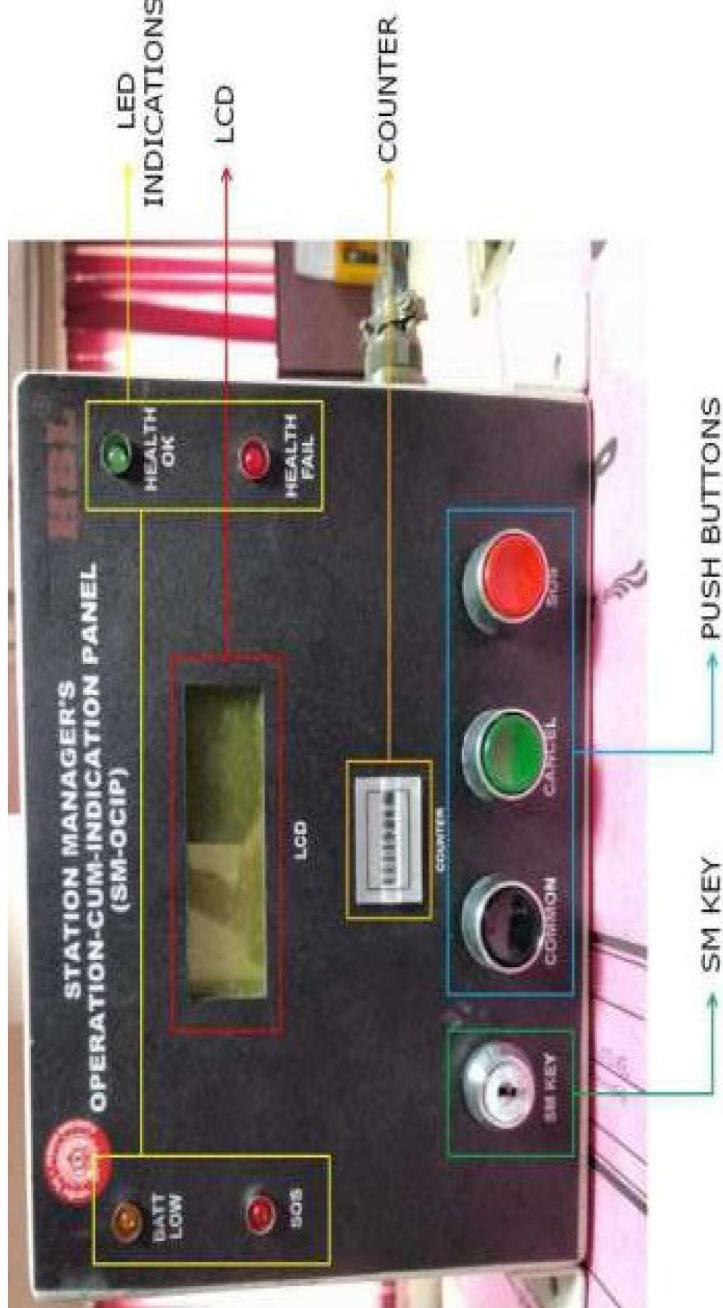
- ✓ It uses radio communication for exchanging information between Loco to Station
- ✓ **Station Kavach and Loco Kavach units communicates with each other for every 2 seconds.**
- ✓ GPS is the time reference for Loco and Station Kavach systems to perform Radio Communication.



# Station Master cum Indication Panel (SMOCIP)

The SM-OCIP communicates with the Stationary TCAS to receive information that has to be displayed on the LCD.

- Also, the Station Master can visualize the statuses of **SOS reception, SOS generation and System health** through LED indications mounted on the SM-OCIP module.



## **Station Master Interface (SM-OCIP)**

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- **Functions:** Manual SOS generation/cancellation, system health monitoring, event logging.
- **Indications:** LED/LCD displays for SOS, health status, and faults. A non-resettable counter logs SOS operations.
- **Procedure:** Insert key, press **SOS + COMMON** to generate emergency stop; **CANCEL + COMMON** to reset. All actions are logged.
- **Variations:** SM-OCIP panels differ slightly by manufacturer (Medha, Kernex, HBL) but core functions remain consistent.
- **Failures:** Must be logged and reported to S&T for rectification.

# **Kavach Features – Manual SOS**

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- A UNIQUE feature even when a train is not protected by a signal.
- Loco as well as Stationary Kavach unit have the provision of generating and Cancellation of SoS message by **pressing SOS and Common buttons together.**
- The Loco Kavach units of all the trains/Locos **within 3000m of Location of SoS originating source** (as well as self-train) apply brakes to bring the train/locomotive to standstill.
- After train speed to be supervised for 30kmph (configurable) till the train passes the originating Location of “SoS” message.

# **Station Master Interface (SM-OCIP)**

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❖ SOS GENERATION BY SM:

**SOS+COMMON**

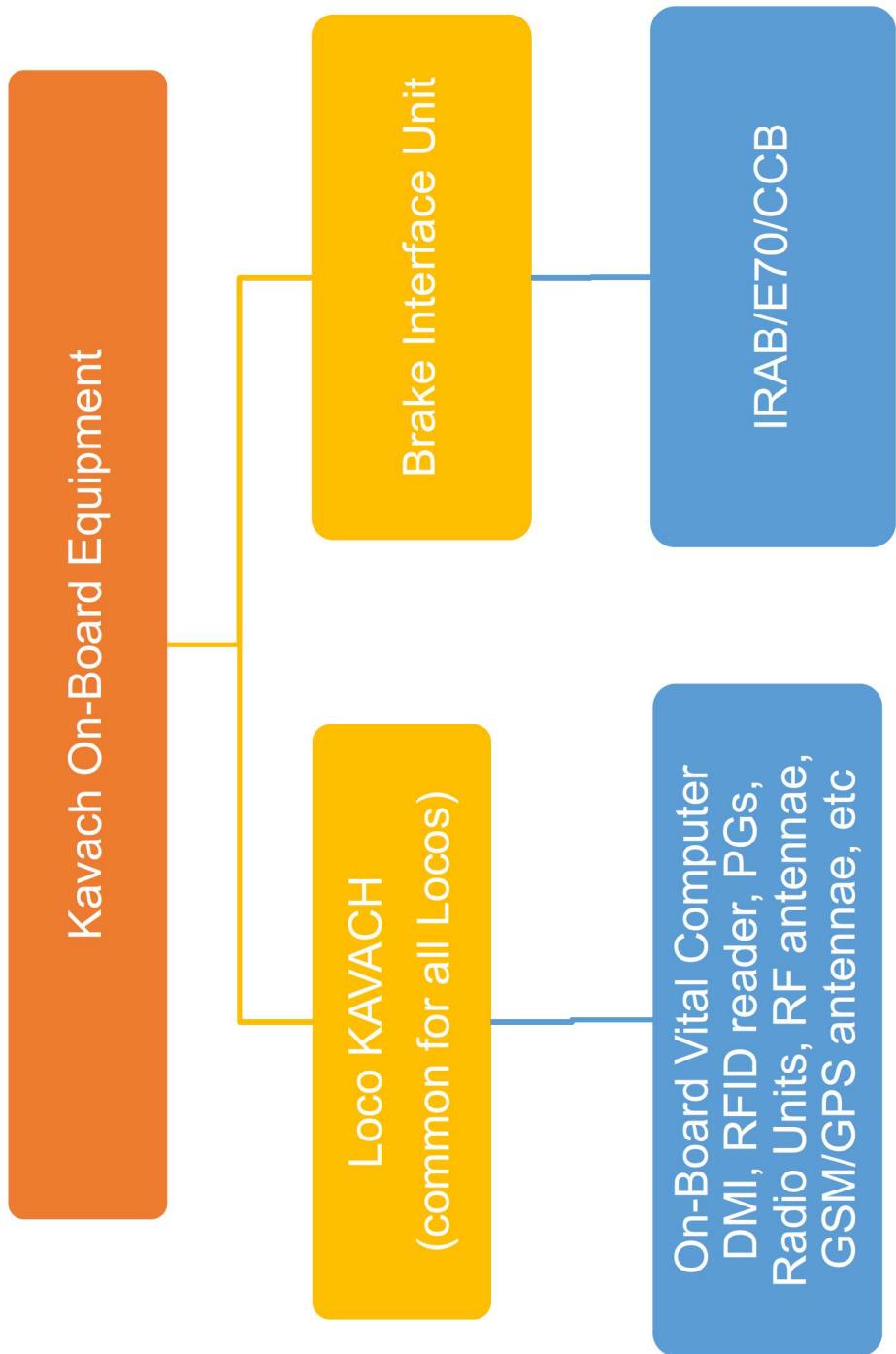
❖ SOS CANCELLATION BY SM:

**CANCEL+COMMON**

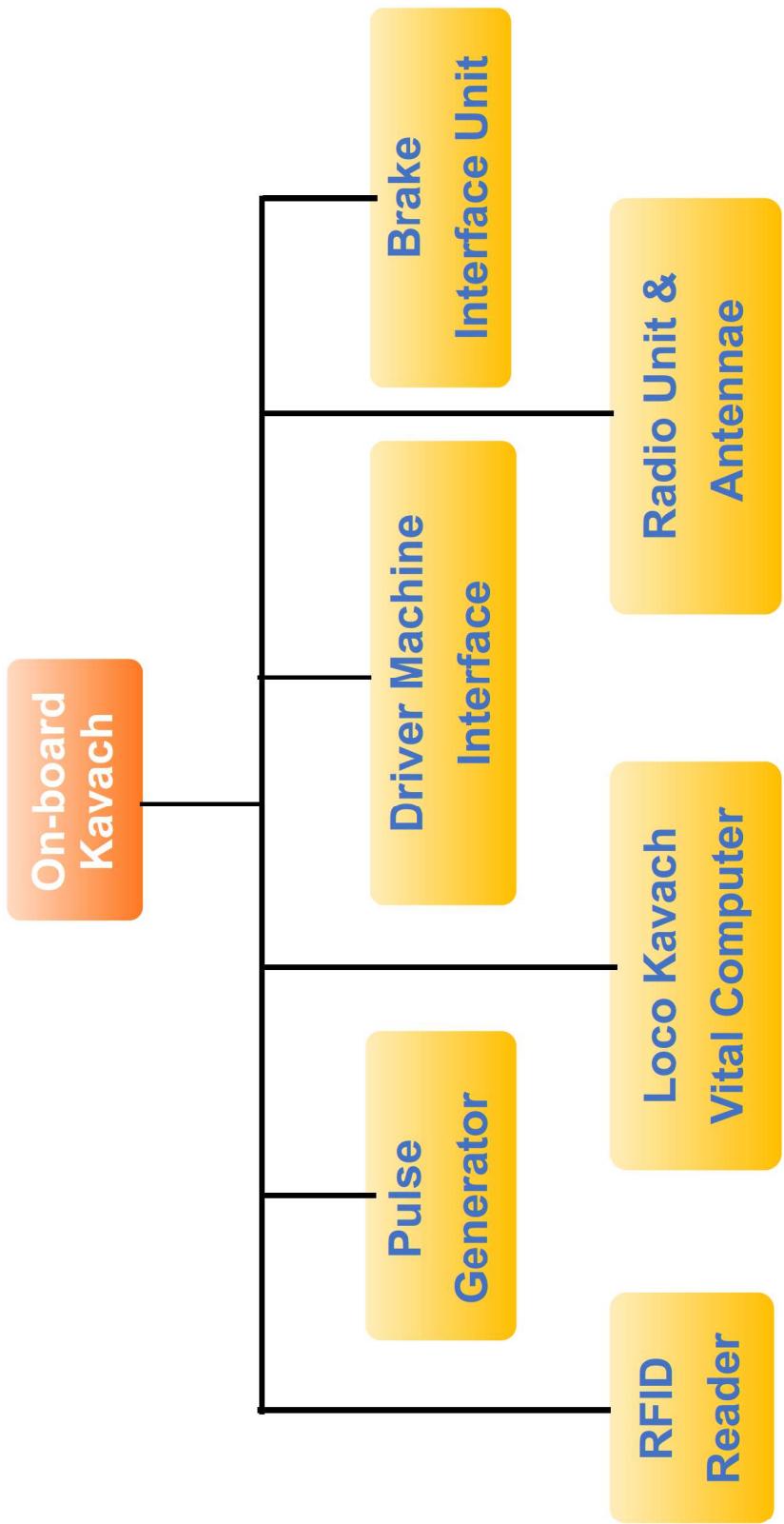
- ❖ SM press **TSR-ACK** to acknowledge the display screen and buzzer when LP generates SOS
- ❖ Loco Pilot acknowledges the SOS then **Kavach supervises for 30 KMPH**

- Stationary Kavach generates loco specific SoS, if the train crosses the shunting limits.
- Stationary Kavach generates loco specific SoS, if the train shunting speed exceeds the configured value.
- The normal speed shall be restored only when
  - SoS message is cancelled by the source.
  - Train is moved away to more than 1500m from the source.
  - No SoS message for more than 3 minutes

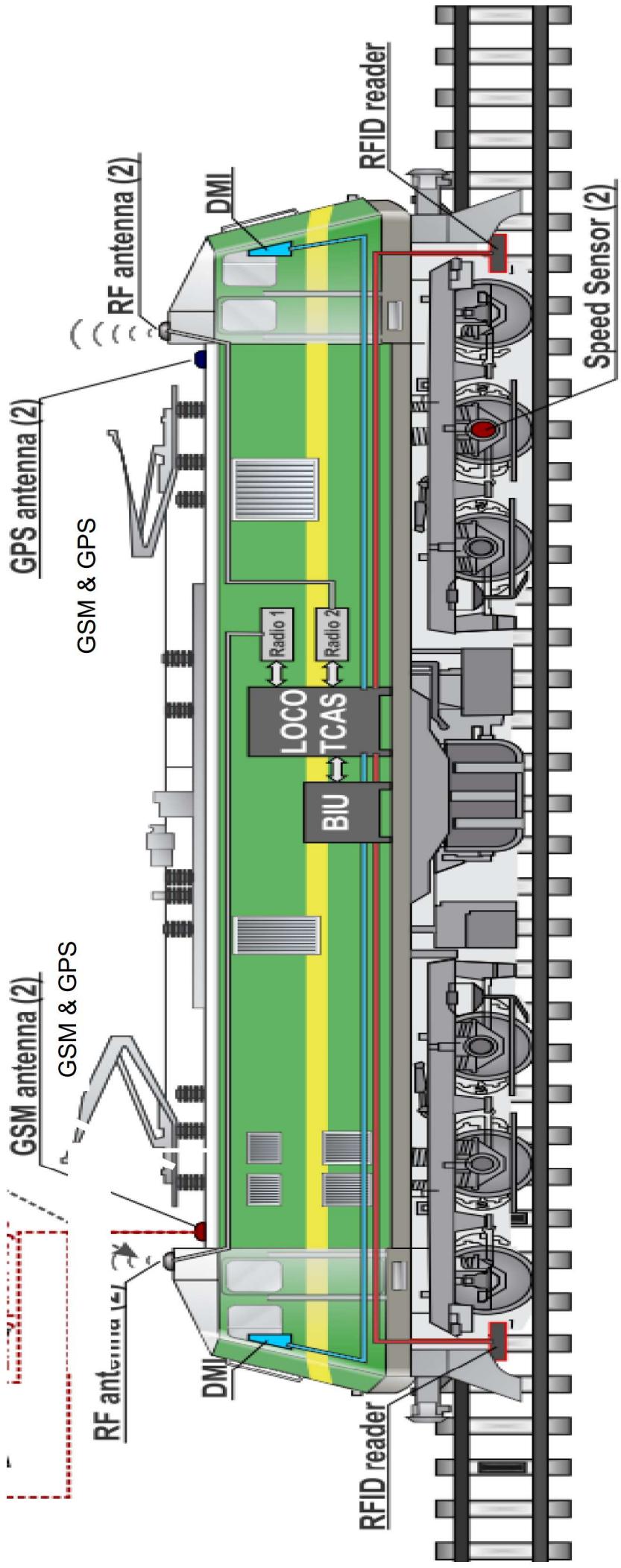
# Basic Sub systems for Loco fitment



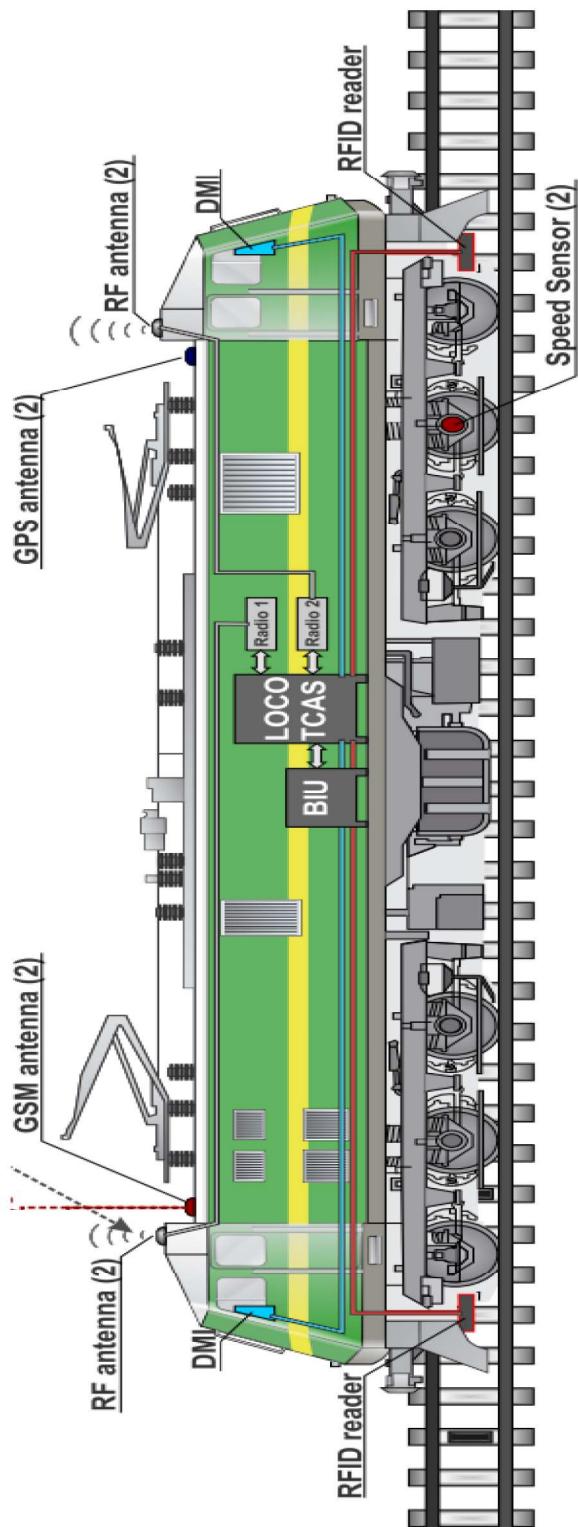
# LOCO Kavach EQUIPMENT Sub-Systems



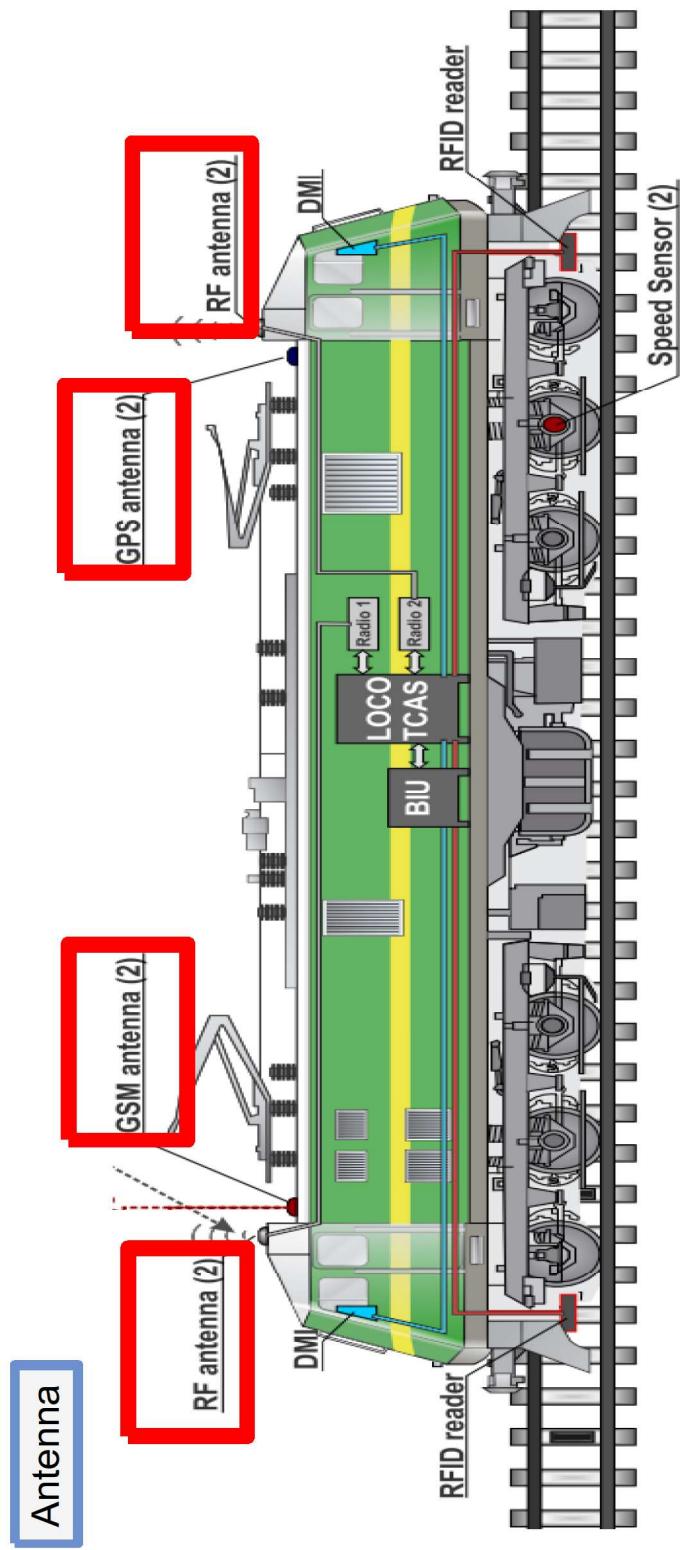
# LOCO Kavach EQUIPMENT LAYOUT LOCOMOTIVE



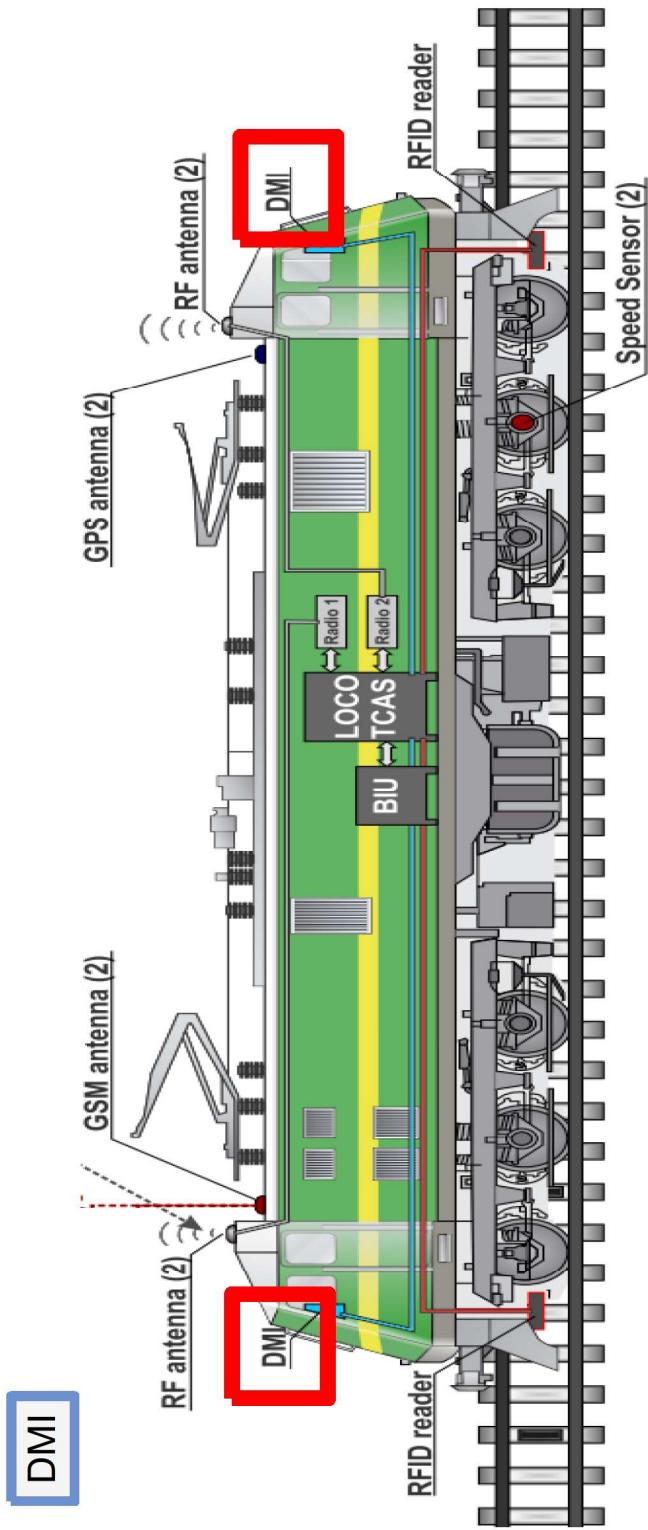
# LOCO Kavach



# LOCO Kavach

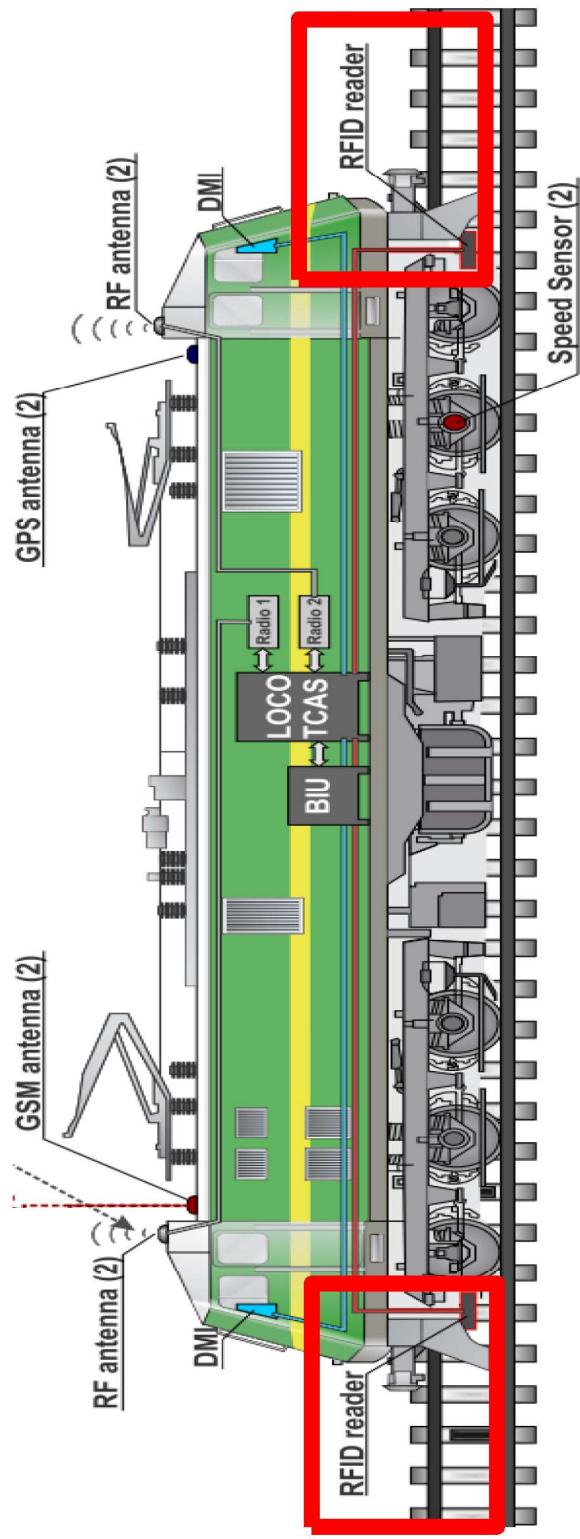


# LOCO Kavach



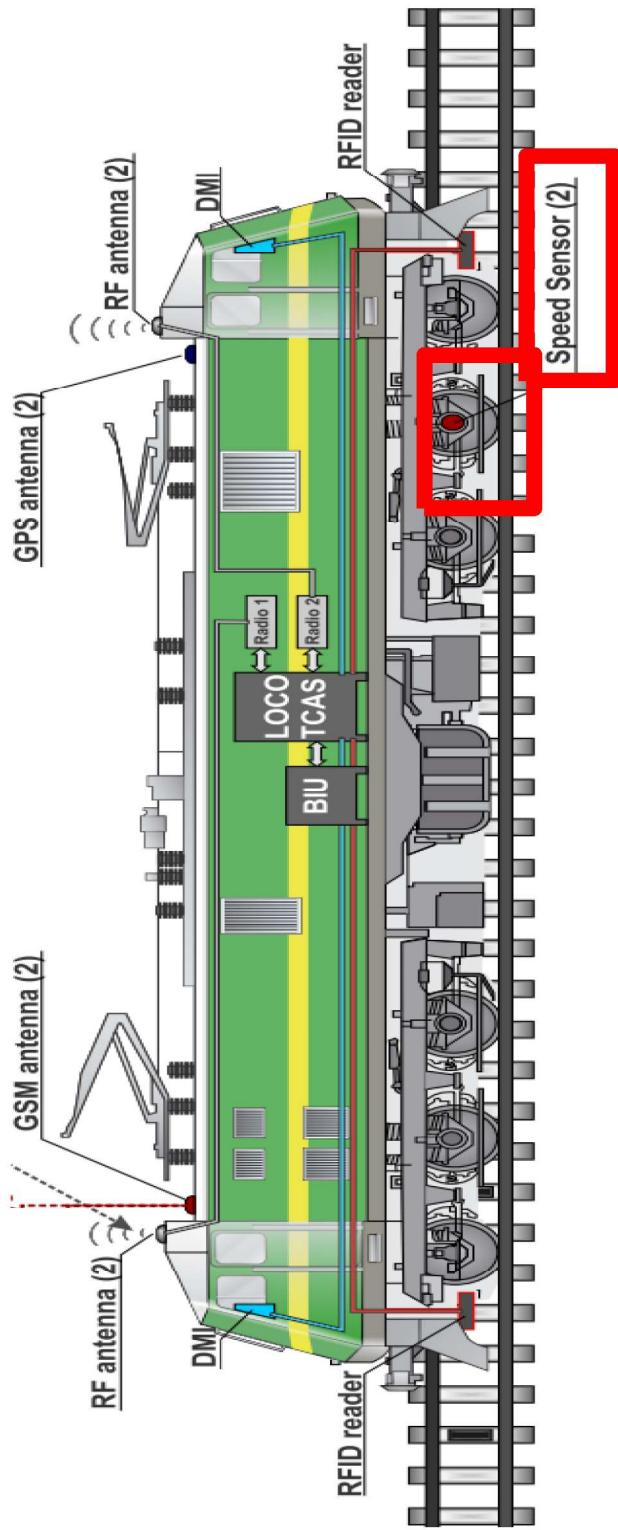
# LOCO Kavach

RFID Reader

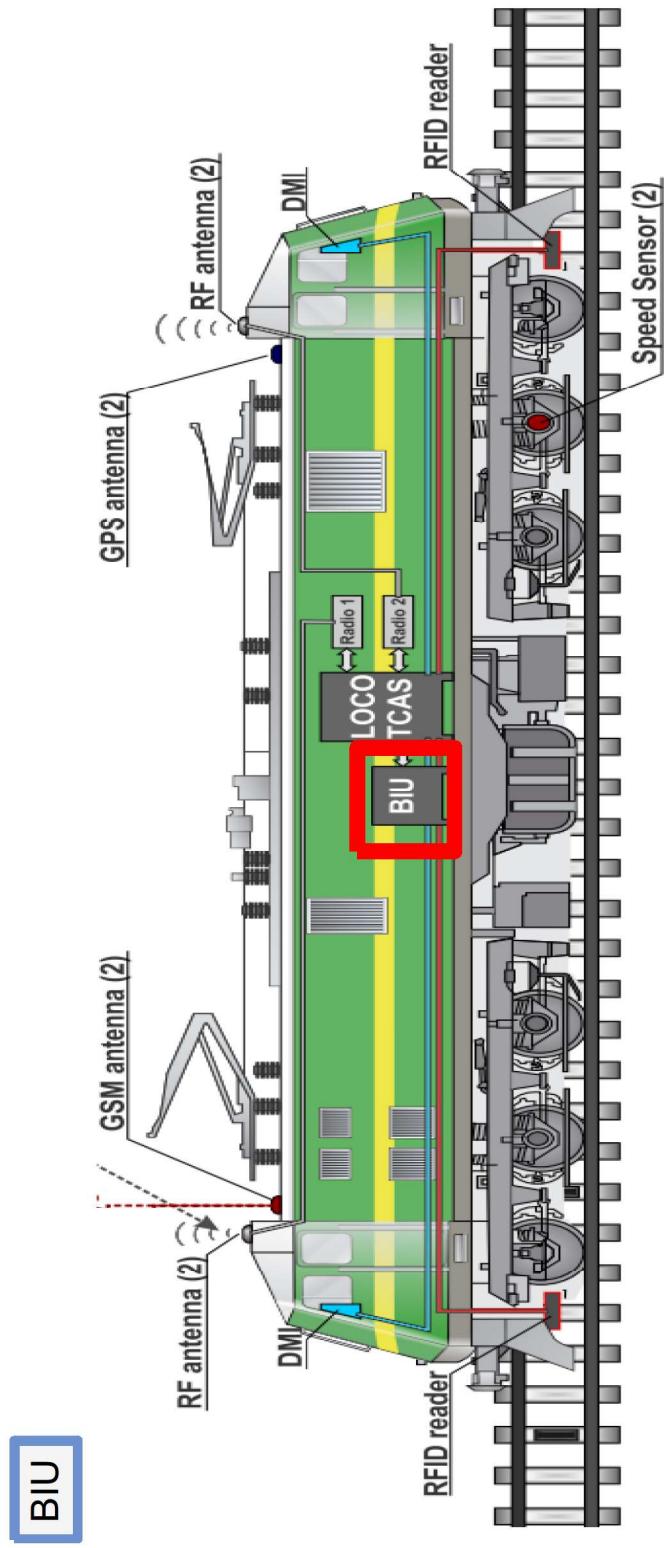


# LOCO Kavach

Speed Sensors

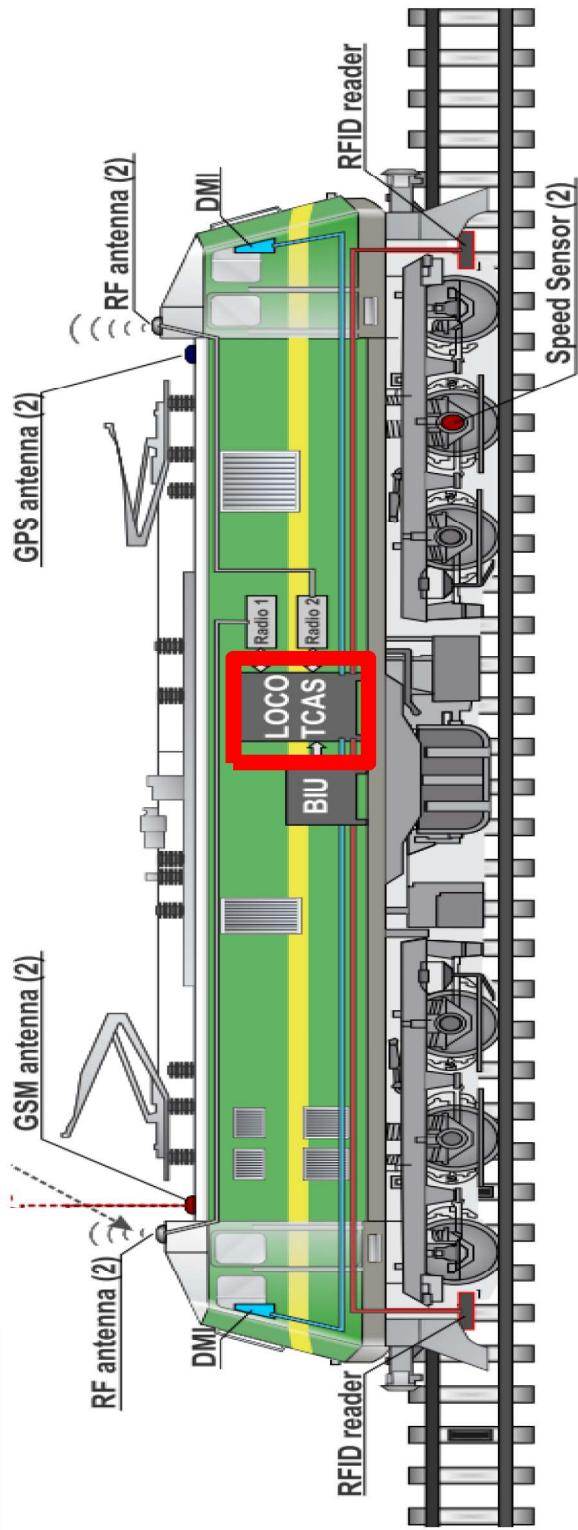


# LOCO Kavach



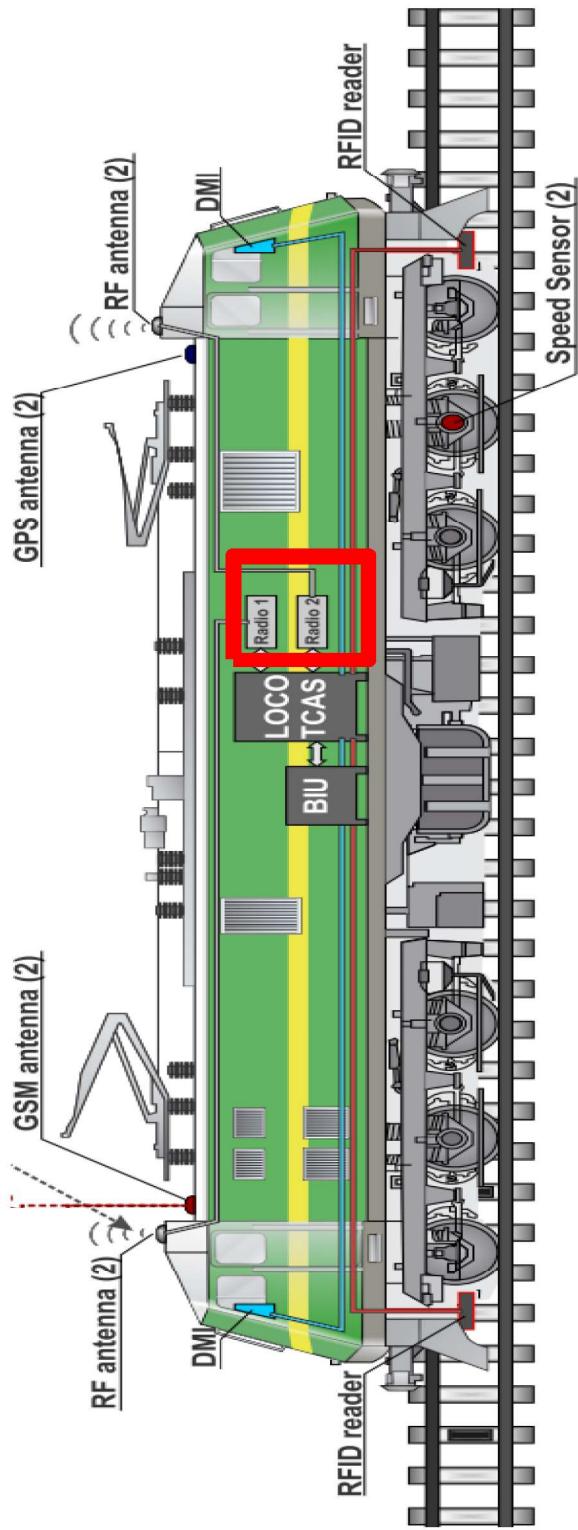
# LOCO Kavach

Kavach Unit



# LOCO Kavach

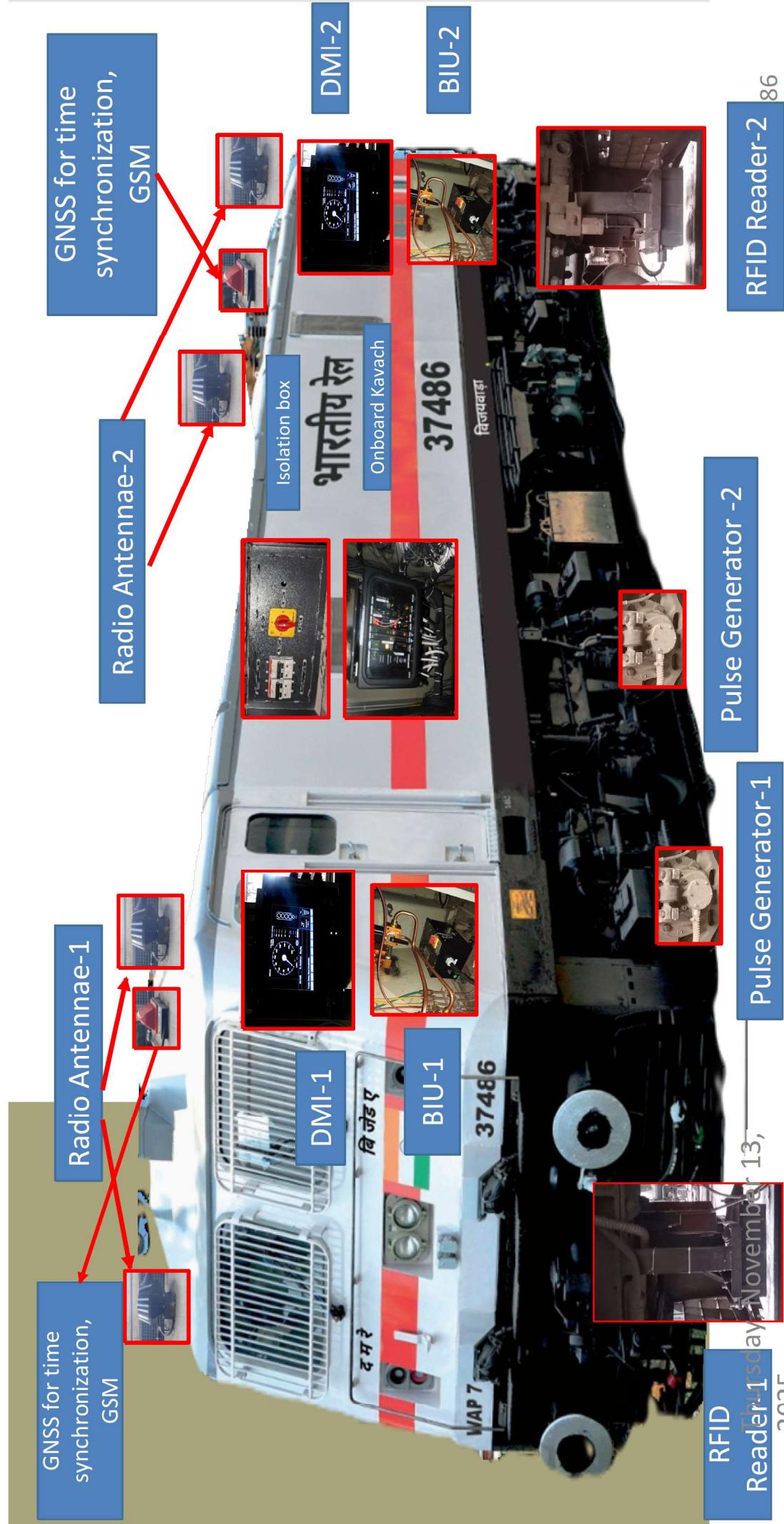
Radio



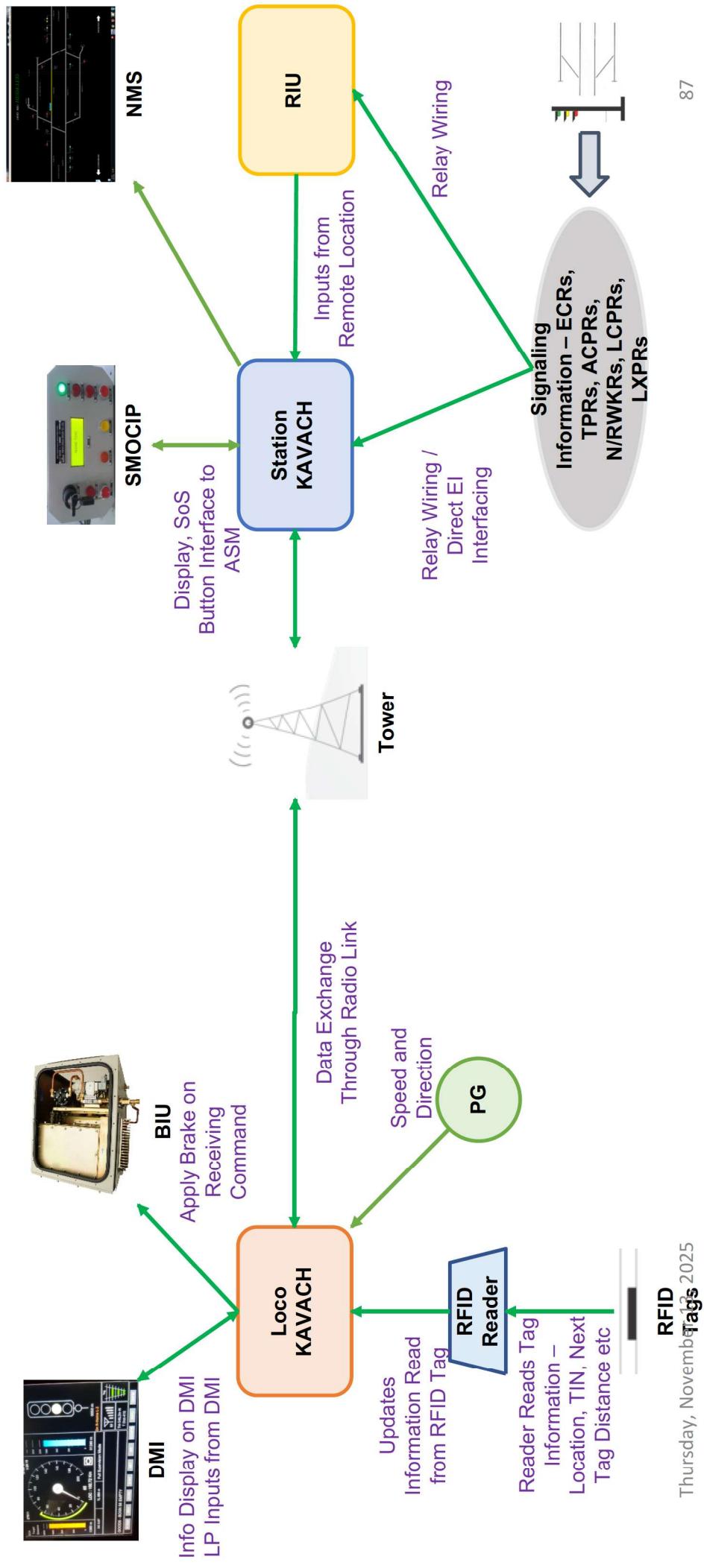
# LOCO Kavach

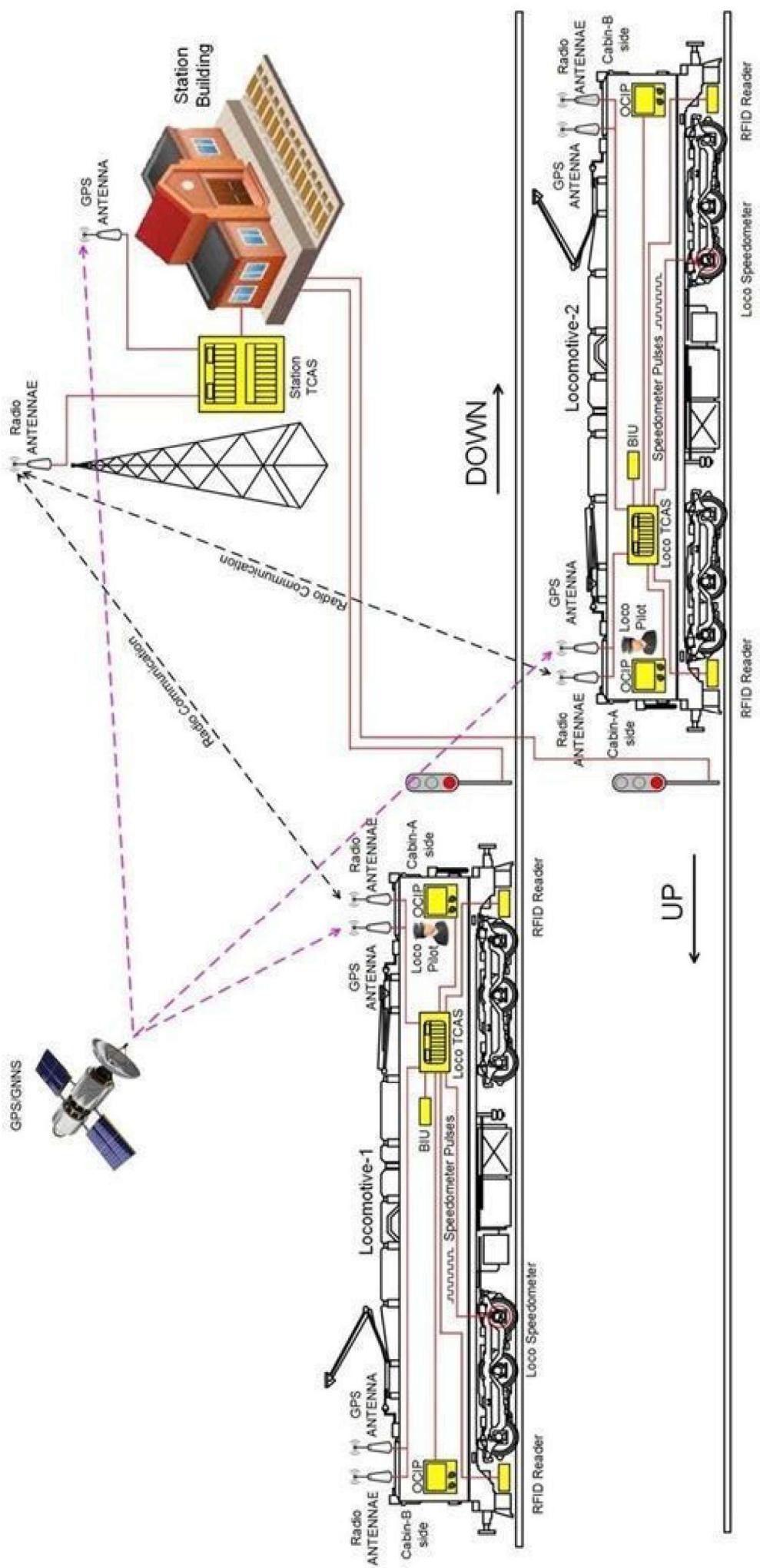
- Loco Kavach Equipment
- Radio modems Interface
- GSM / GPRS interface
- LP DMIs
- Brake Interface Unit
- Power supply and its interface

# ONBOARD KAVACH – EQUIPMENT & LOCATIONS



# KAVACH – The Basic Flow





**DMI**

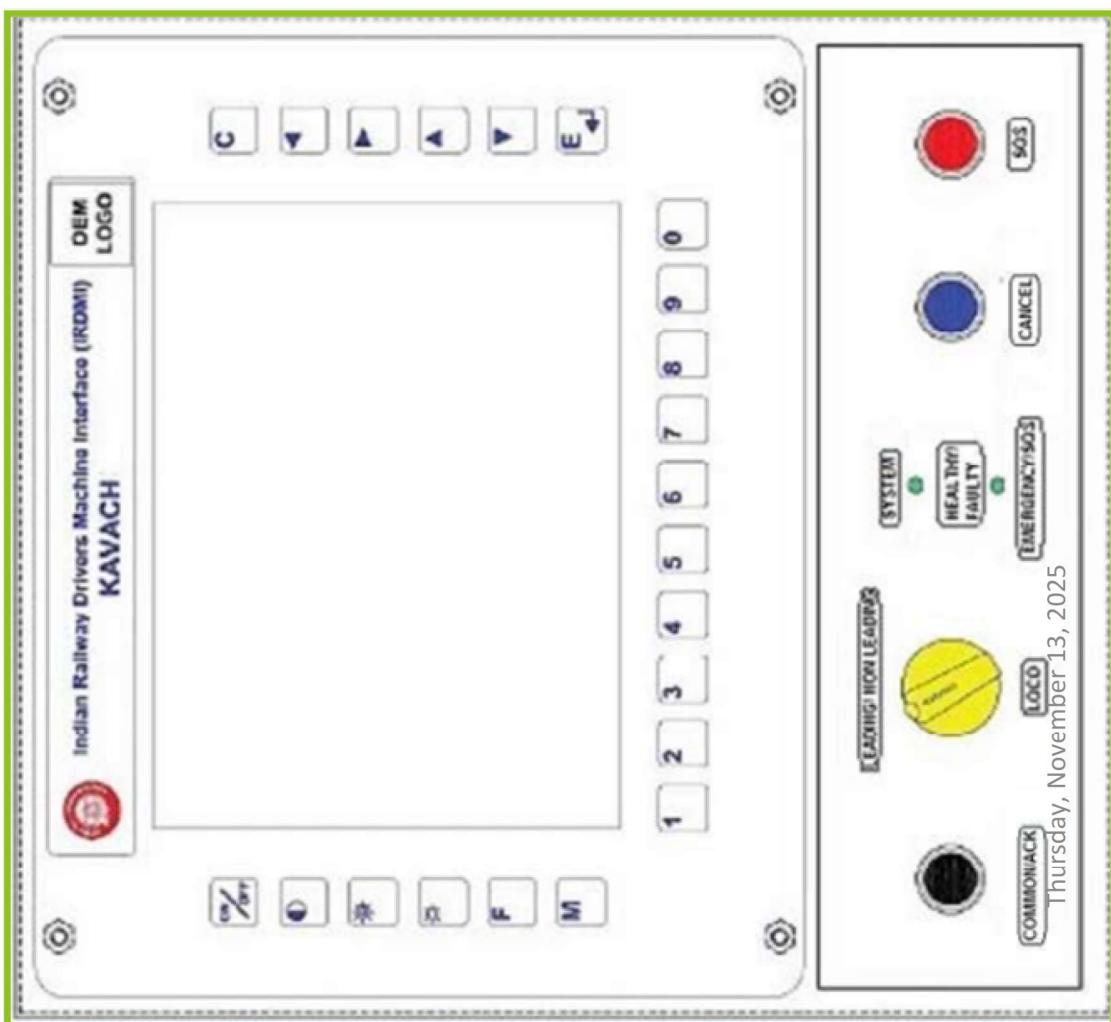
**(DRIVER MACHINE INTERFACE)**

**LP-OCIP**

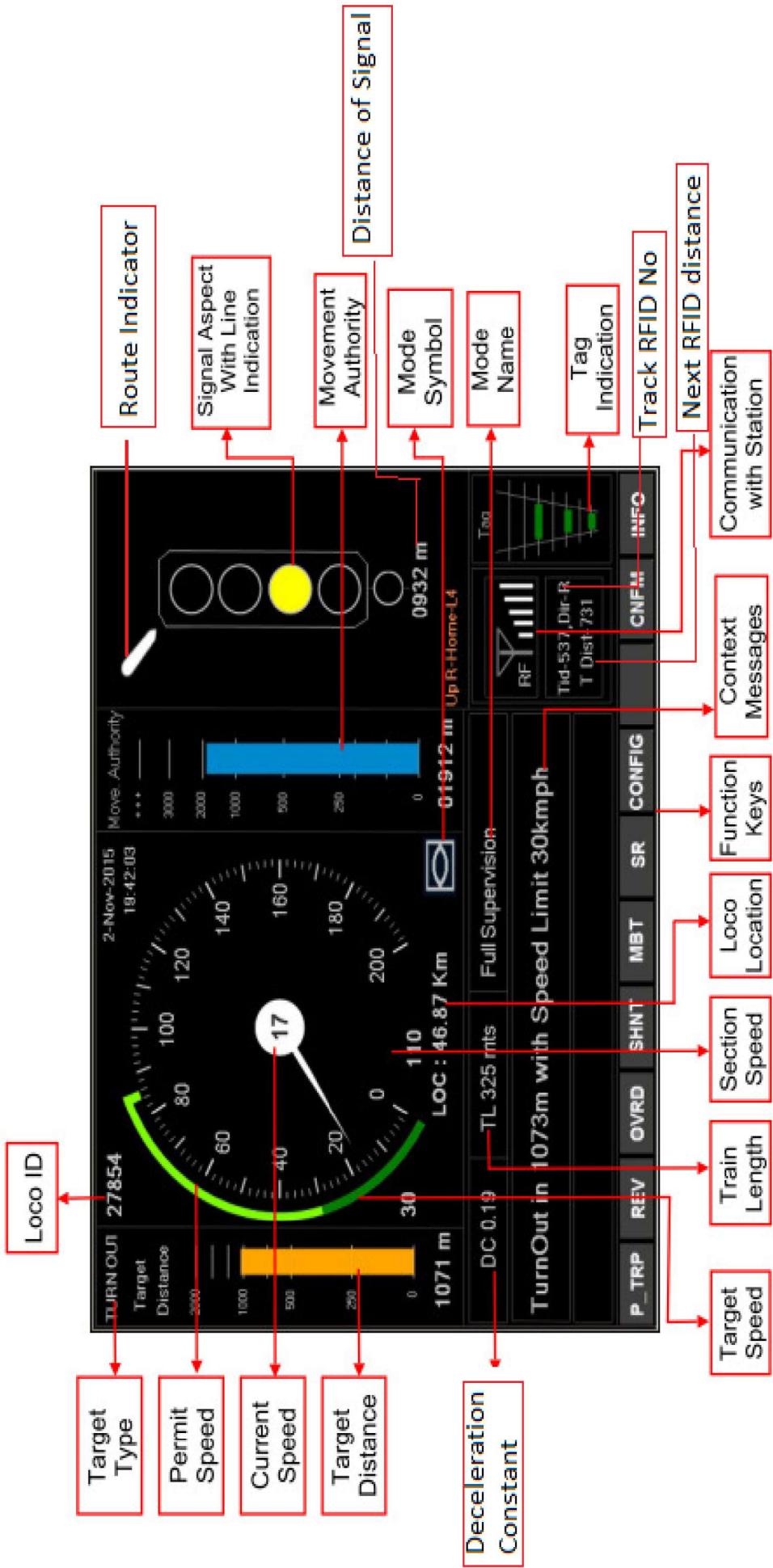
**(LOCO PILOT -OPERATION  
cum INDICATION PANEL)**

# KAVACH- DMI

- LEDs Bi-color
  - SYSTEM: Green/Red
  - EMERGENCY/SOS: Green/Red
- Pushbuttons for SOS
  - Common/ Ack (black)
  - Cancel (Blue)
  - SOS (Red)
- Audio buzzer
- Knob
- Leading/Non Leading



# Loco Pilot Operating cum Indication Panel (LP-OPIP) or Driver Machine Interface (DMI)



# Display Parameters on LPOCIP DMII



Loco ID      Date and Time

Current speed of the Loco      Loco Mode

Movement Authority

Target Distance/ Permitted speed

Aspect of the approaching signal along with route indicator.

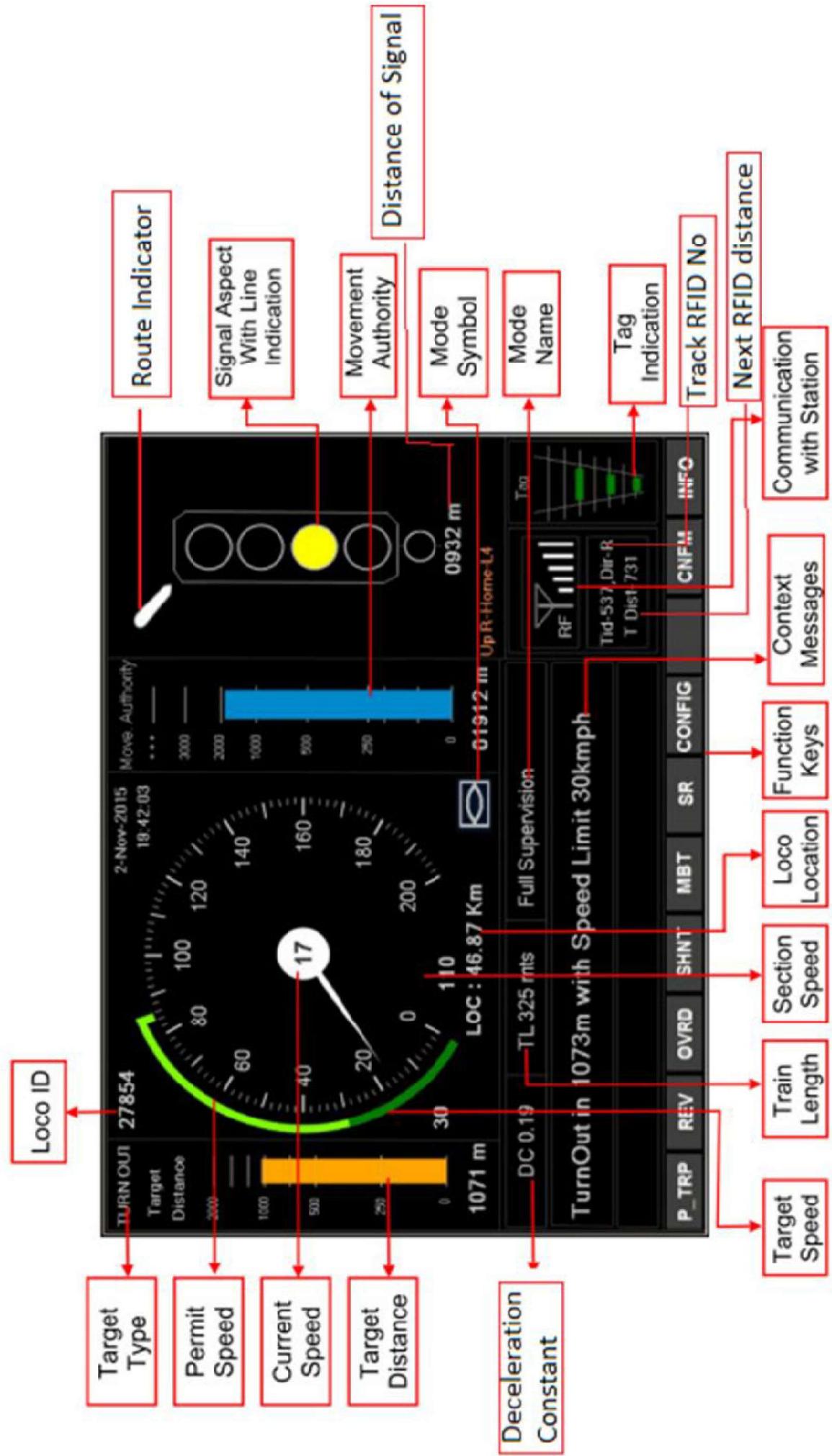
Distance to the approaching signal and Type of signal

Turn out Distance and Turn out speed, when loco is approaching to the Point

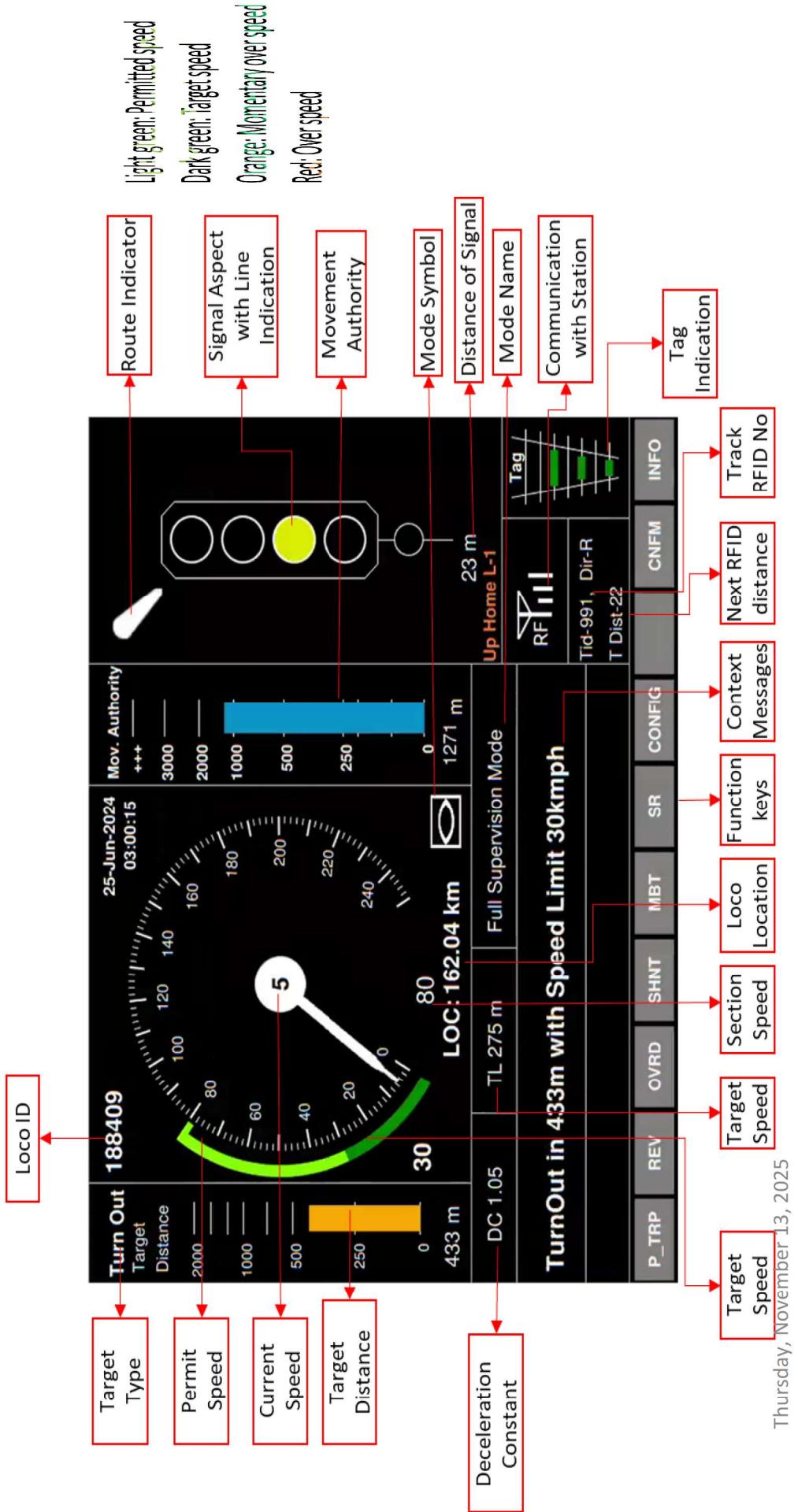
Emergency/ Contextual messages

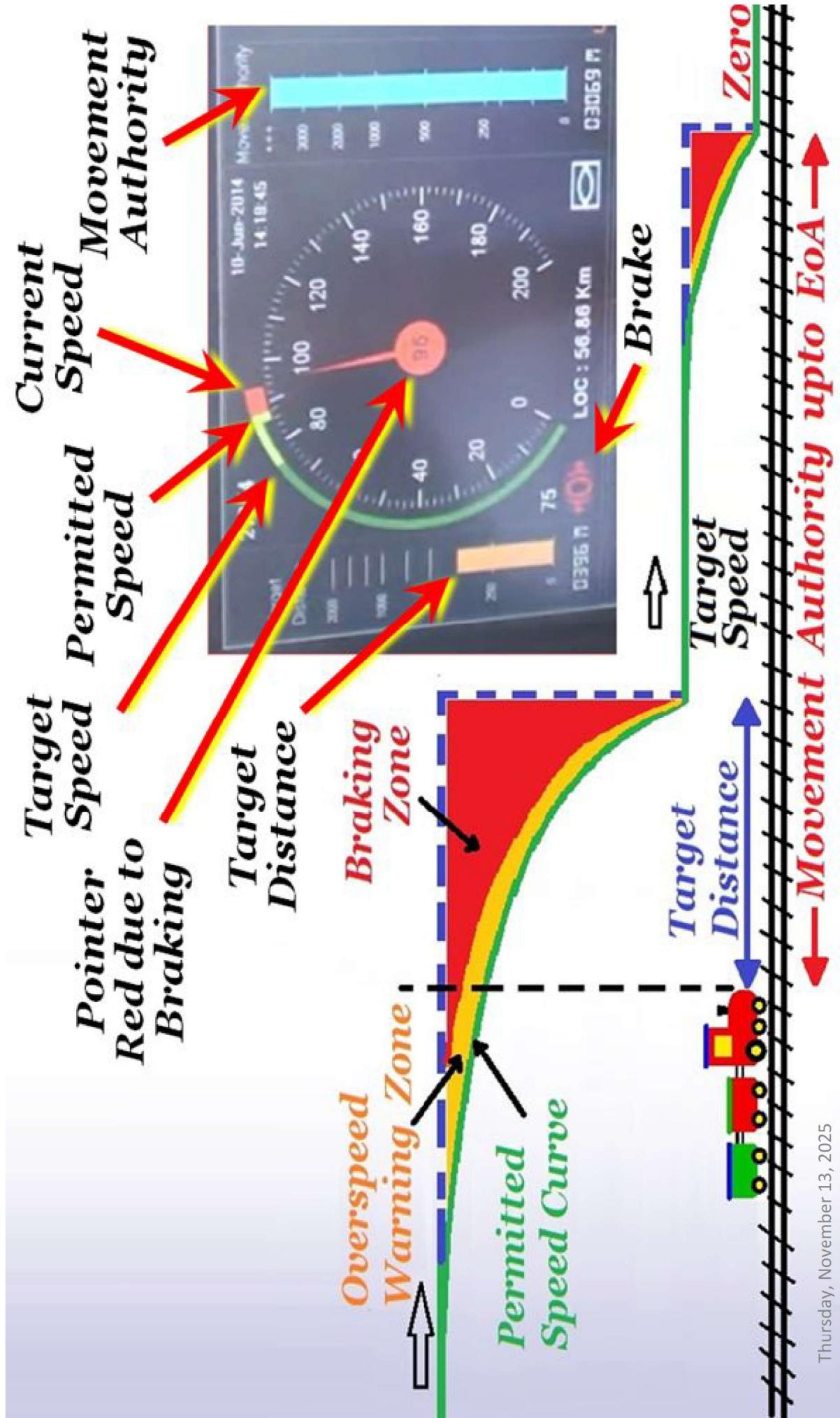
RF Signal Status/ strength

RFID tag read status



# LOCO PILOT OPERATION CUM INDICATION PANEL (OCIP) / DRIVER MACHINE INTERFACE (DMI)





# **DIFFERENT TYPES of OPERATIONAL MODES OF ONBOARD KAVACH FOR VERSION 4.0**

## **OPERATIONAL MODES**

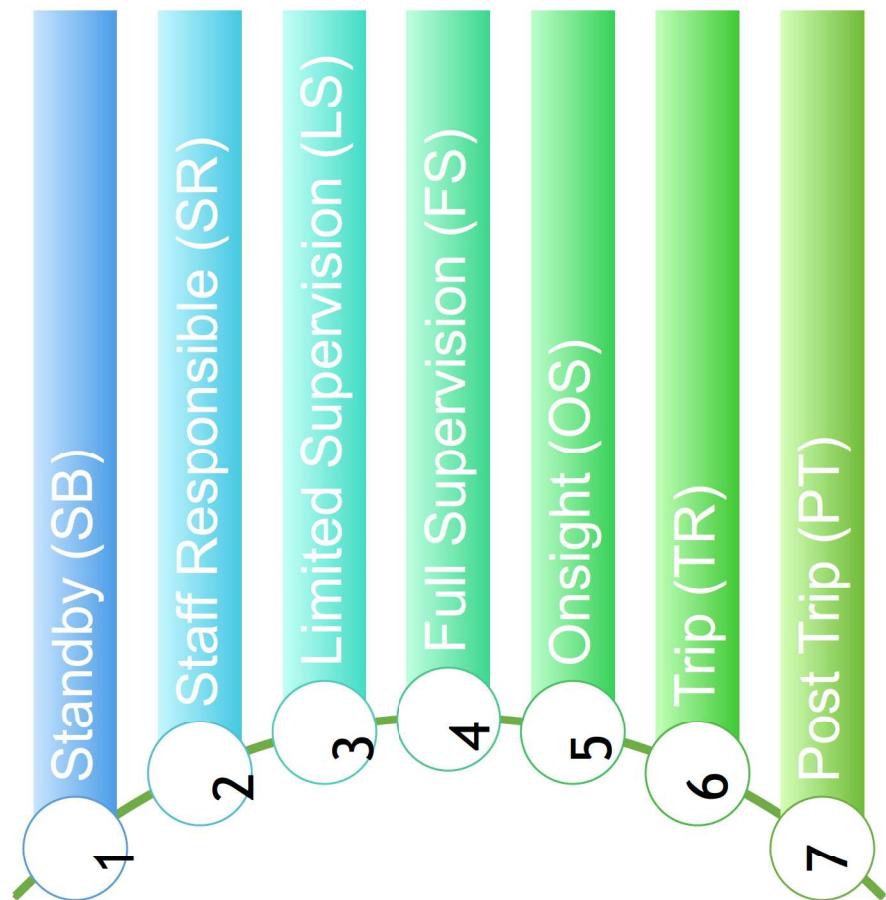
- 1) STANDBY MODE (SB)
- 2) STAFF RESPONSIBLE MODE (SR)
- 3) ONSIGHT MODE (OS)
- 4) FULL SUPERVISION MODE (FS)
- 5) LIMITED SUPERVISION MODE (LS)
- 6) TRIP MODE (TR)

## **OPERATIONAL MODES**

- 7) POST TRIP MODE (PT)
- 8) REVERSE MODE (RV)
- 9) NON-LEADING MODE
- 10) SHUNT MODE (SH)
- 11) SYSTEM FAILURE MODE (SF)
- 12) ISOLATION MODE (IS)

# **OPERATIONAL MODES IN Version 4.0**

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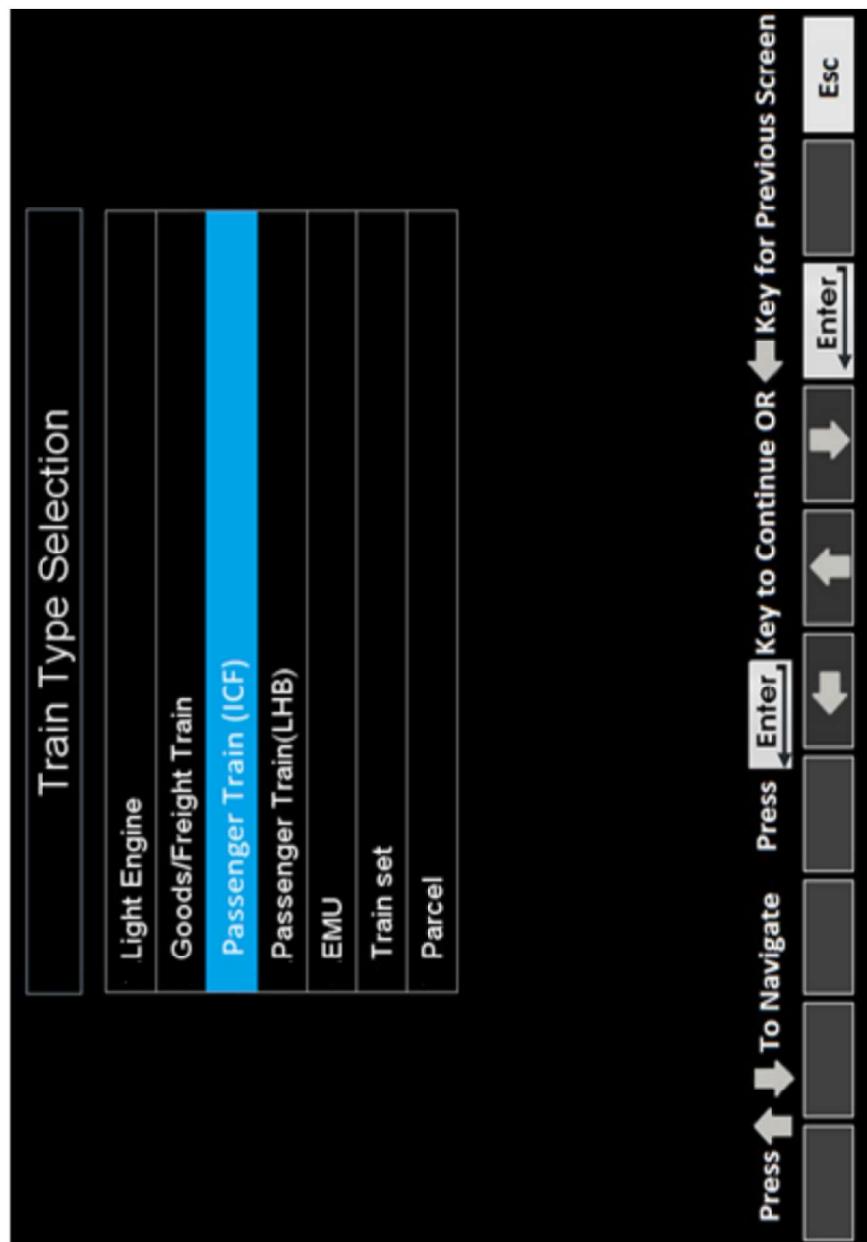


# STANDBY MODE

- When Loco is energized and Kavach unit is switched on, the Kavach unit comes into Standby (SB) mode
- The SB mode is the default mode.
- In this mode, train is supervised for STOP DEAD (STANDSTILL) only.
- If any movement is detected, it applies Emergency Brake.

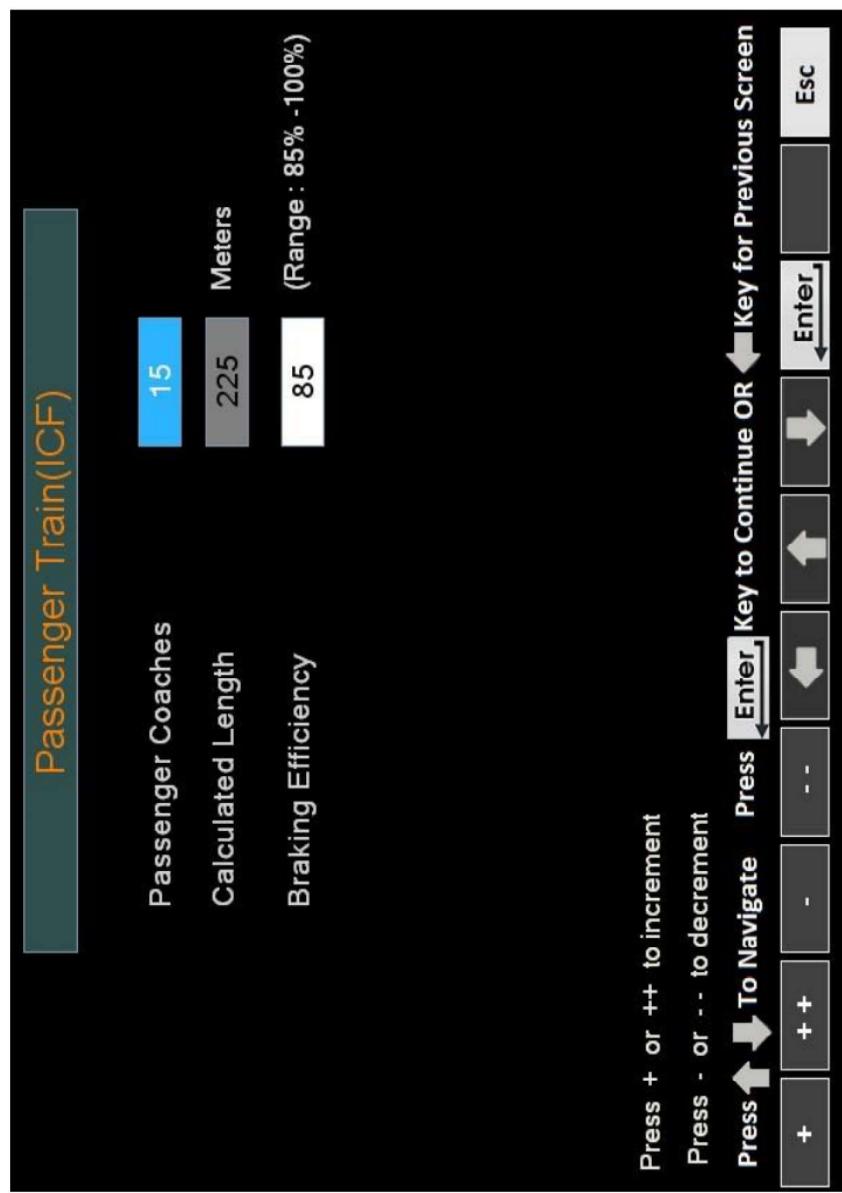


# Train Type Selection



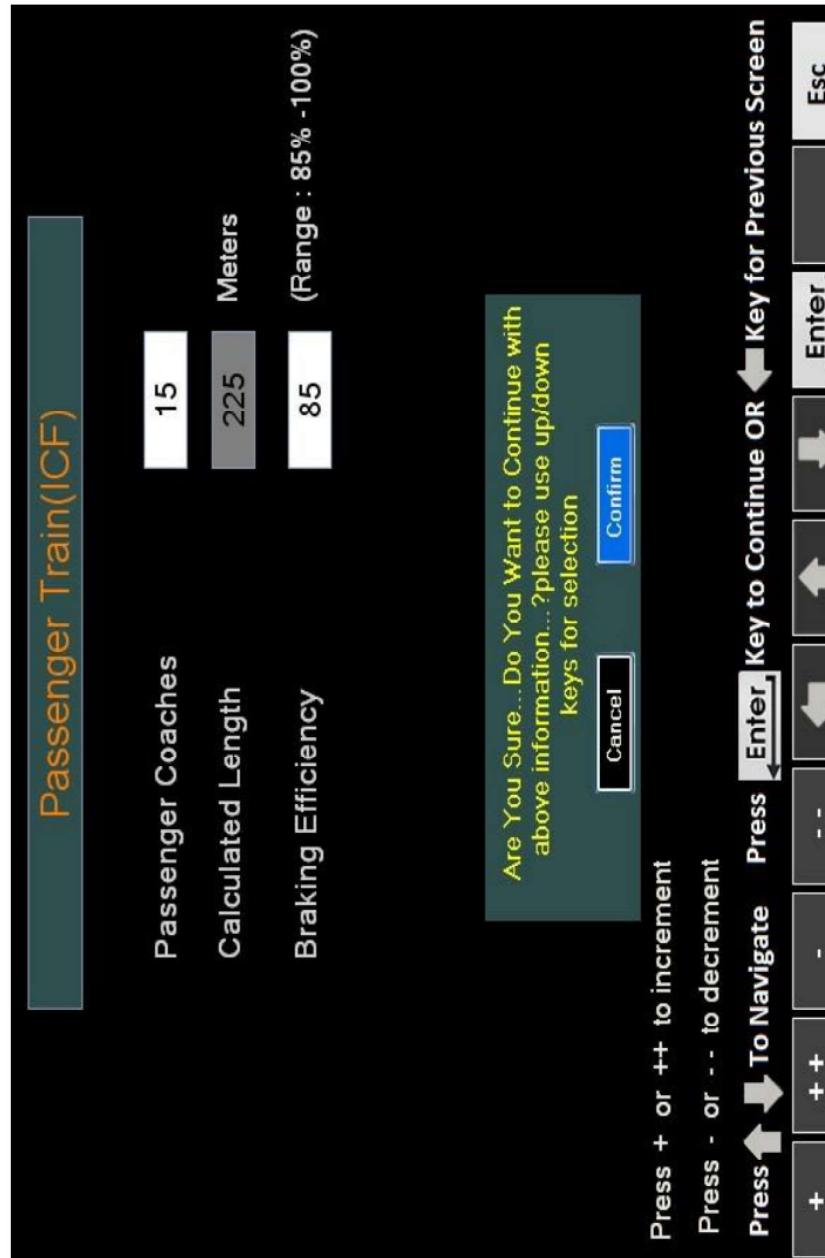
Thursday, November 13, 2025

# Train Type Selection



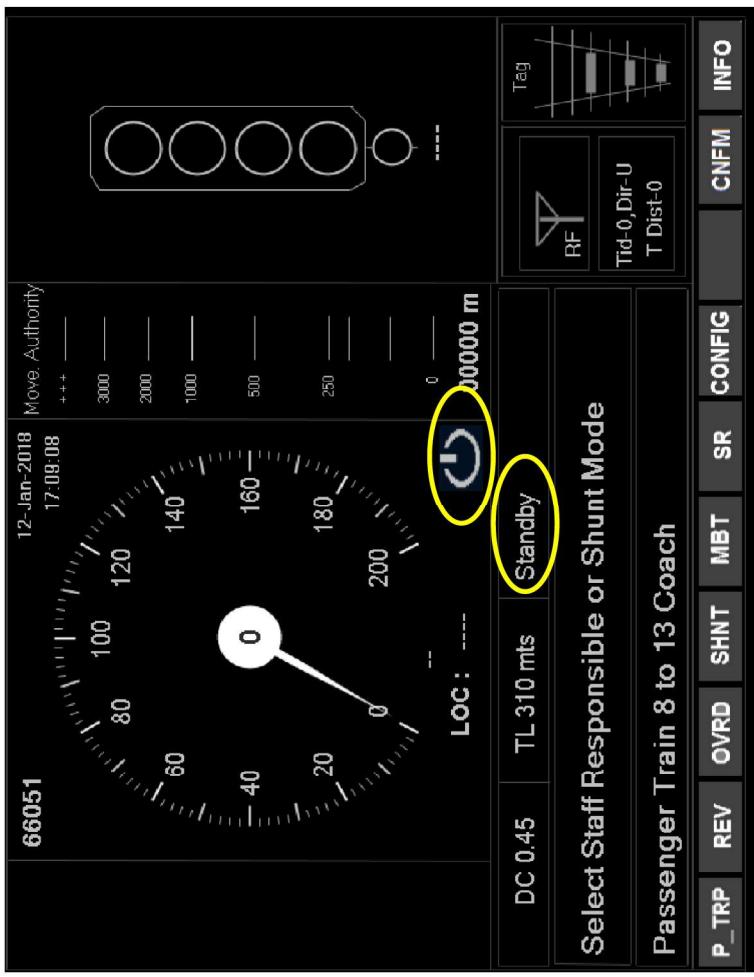
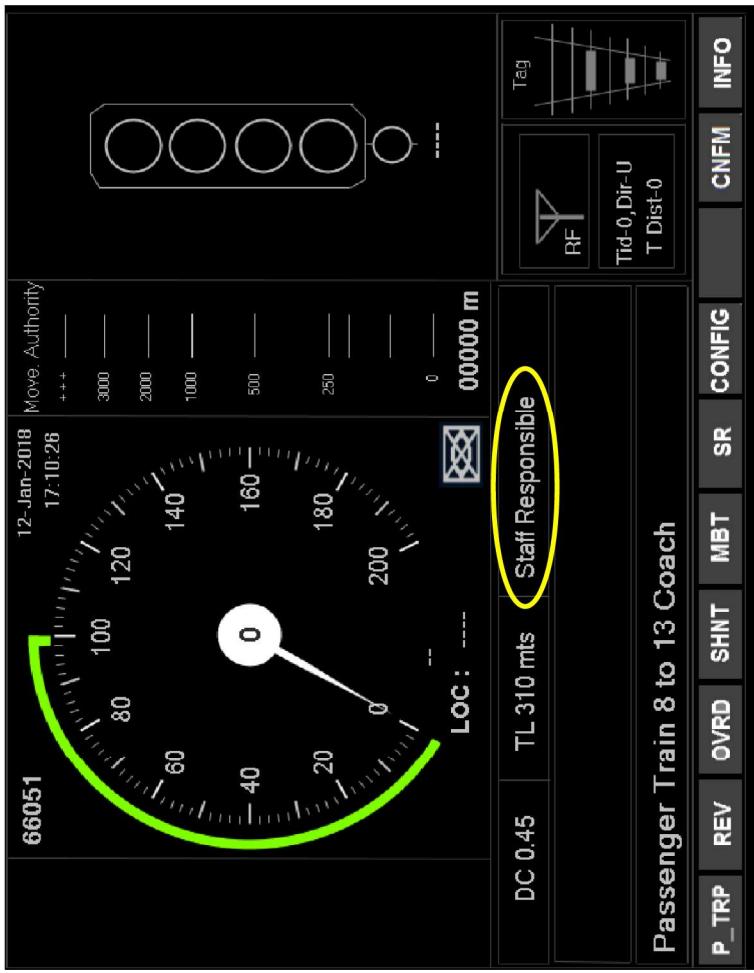
Press + or ++ to increment  
Press - or -- to decrement  
Press **Enter** Key to Continue OR **Esc** Key for Previous Screen  
Press **↑ ↓** To Navigate

# Train Type Selection



- ❖ The loco pilot cannot move the train in this mode.
- ❖ Kavach performs brake system health test when Onboard Kavach is energized and DMI activated.
- ❖ Once Train configuration is completed, Loco pilot can opt for changing the mode from ‘Standby’ to ‘Staff Responsible’ or ‘Shunt’ Mode by pressing **SR** or **SHNT** respectively followed by **CNFM** soft keys on DMI.

# Standby Mode to SR/ Shunt Mode



# STAFF RESPONSIBLE MODE

- This mode needs to be selected by LP in order to start the train.
- In this mode, Kavach will only supervise a ceiling speed (MPS of Loco).
- In this mode, LP moves the train under his/her direct responsibility.
- LP to respect line side information (signals, speed boards).
- After passing two RFID tags (for getting direction) and communication from stationary Kavach, the on board Kavach will automatically enter in to ‘On sight’ mode.



## ON SIGHT MODE:

- Once the Onboard Kavach is SR mode and it passes two RFID tags (on establishment of direction) and on reception of information from SKavach, the Onboard Kavach transits from SR mode to OS mode with a speed permitted up to the Maximum Sectional Speed.

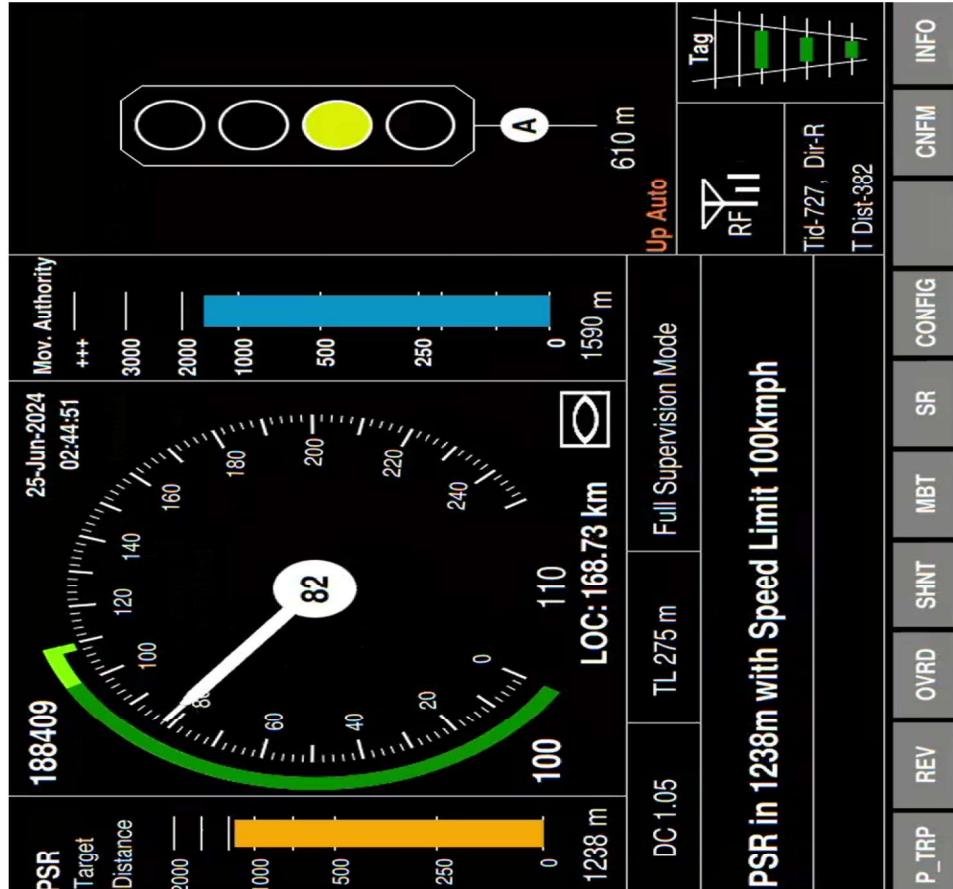


- When there is a failure of communication from Skavach which is subsequently restored, the Onboard transits from LS/SR to OS mode, allowing speeds up to the MRSP (Most Restrictive Speed Profile).
  - When the loco pilot presses the OVRD and CNFM buttons to pass a signal at ON, the locomotive enters Onsight mode with a speed restriction of 15 km/h (except for LSS/IBS) and MPS for LSS/IBS respectively.
  - In P-Trip mode, Onboard Kavach enters into OS mode on pressing the OVRD and CNFM buttons

- When a Calling-on signal taken OFF, the system enters into OS mode and prompts the LP for acknowledgement for OS mode.
- When the train crosses at least one stop signal in OFF position then OS mode automatically shifts to FS mode.
- This Mode is under review and the features / conditions are subject to change.

# FULL SUPERVISION MODE:

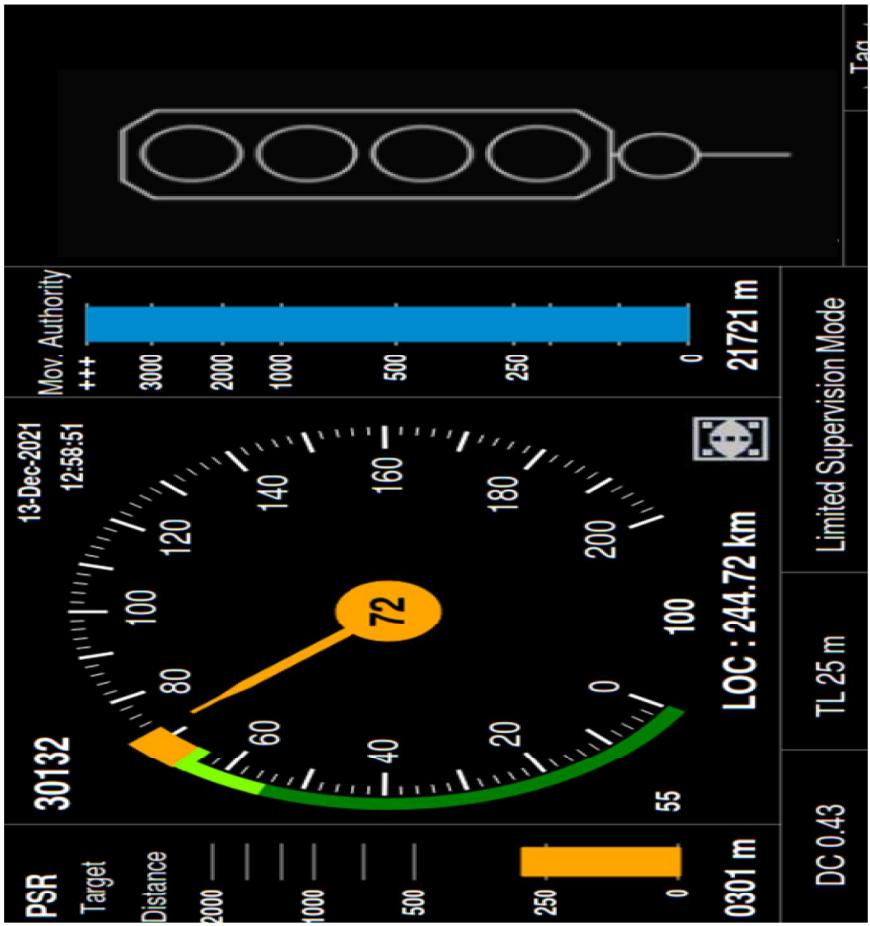
- Full Supervision mode shall be entered automatically when all the following necessary conditions are fulfilled:
- Track profile Available (Including Traffic Direction) upto 3000m or Movement Authority, whichever is less.
  - Valid Radio Packets are receiving in communication mandatory area.
  - Movement Authority is valid.
  - After coming to On Sight mode, train has crossed at least one stop signal in OFF condition



- The loco Kavach unit shall supervise train movements against a dynamic speed profile.
- Onboard Kavach will revert to Staff Responsible (SR) mode if any of the following conditions occur:
  - (i) Valid Radio packets are not available in communication mandatory area and track profile is not available upto 3000m or Movement Authority, whichever is less.
  - (ii) When three consecutive tags are missed.
  - (iii) Kavach Territory Exit tag is read.
  - (iv) Train traffic direction is unknown.

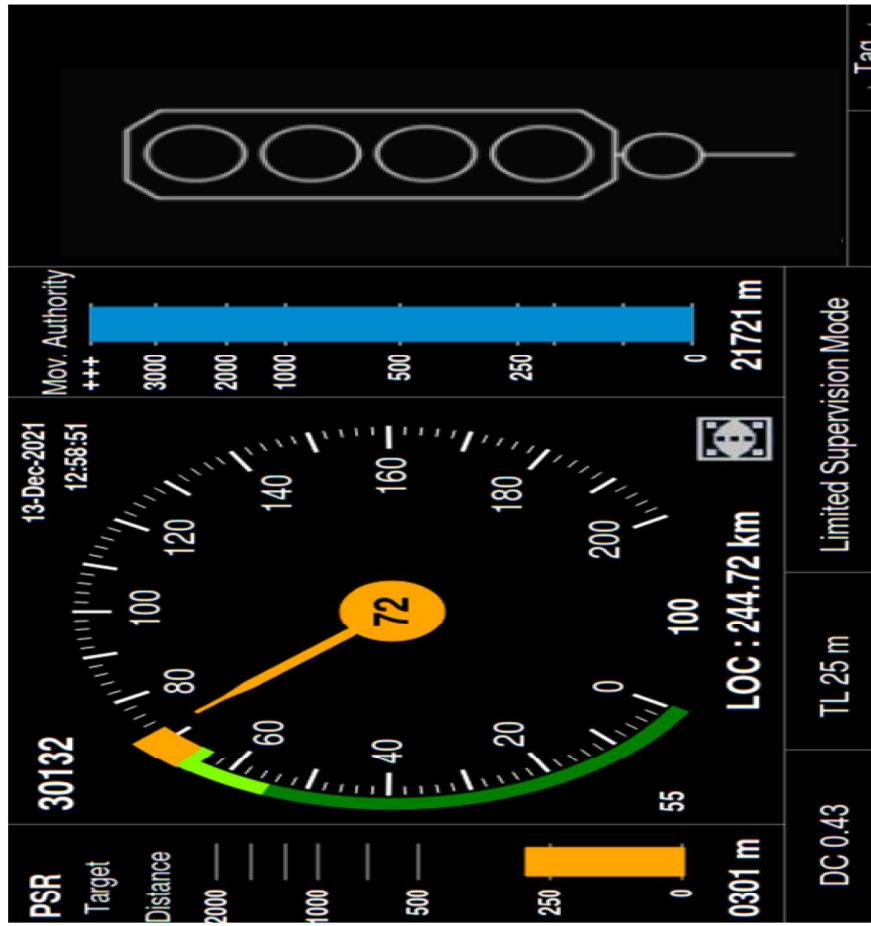
# LIMITED SUPERVISION MODE:

- The Kavach will automatically enter LS mode from FS mode when Radio packets are not available/received for 30 seconds (configurable) for Absolute Block System and 10 seconds (configurable) for Automatic Block System from SKavach in Communication Mandatory Area but track profile is available up to 3000m.
- Limited supervision mode enables Onboard Kavach to supervise track profile in case of communication failure.



# LIMITED SUPERVISION MODE:

- It supervises train movement against a dynamic speed profile.
- It obeys general SOS from station if loco is within 3000m.
- It also supervises roll away and reverse movement protection.
- Kavach will transit from LS to SR in case track profile is not available upto 3000m (configurable) or when three consecutive tags are missed or Kavach territory exit tag is read or traffic direction is unknown.



# ON SIGHT MODE:

- The on sight mode allows the train to enter into a track that could be already occupied by another train.
- In this mode, the loco Kavach unit shall supervise train movements against a dynamic speed profile.
- Loco Kavach enters into on sight mode from SR when OS MA is received , Override Main stop signals, Override of LSS/IBS and Auto signals.
- Loco exits from OS mode when it crosses passing signal at OFF Aspect.



# TRIP MODE:

- When Loco Kawach is in FS/OS mode and the train passes a stop signal at ON or end of authority, Kawach will automatically enter into trip mode
- Loco applies EB continuously.
- Loco pilot has to acknowledge by pressing P\_Trip followed by CNFM, then it releases EB.



# POST TRIP MODE:

- LP shall manually select Post Trip Mode in order to come out of Trip Mode

LP can do this only when the train is at STOP DEAD (STANDSTILL).  
The post trip mode shall be entered by pressing P\_Trip followed by CNFM then Kavach releases EB.

As the train has passed signal at ON, necessary rules as in G&SR shall be followed.

Required authorities shall be made and obtained before starting the train.

After obtaining the above authorities, for the train to start, LP is required to press OVRD button followed by CNFM button in order to enter to OS mode from PT mode.



# REVERSE MODE:

- This mode shall be used by LP only when reverse movement without cab change is permitted in rules. Else cab change must be done.
- This mode allows the LP to change the direction of movement of the train and drive from the same cab, i.e., the train orientation remains unchanged.
- LP shall enter manually when the train is at STOP DEAD (STANDSTILL) by pressing REV button, followed by CNFM soft keys on DMI.
- The loco Kavach unit shall supervise train movements against a ceiling speed (Default 25 kmph), distance (Default 500 mts) and time out (Default 300 sec) for which reverse movement is allowed.



# NON LEADING MODE:

The non-leading mode is defined to manage the loco Kavach unit of a slave engine that is either electrically coupled to the leading engine or not electrically coupled to the leading engine.

- LP shall enter manually when the train is at STOP DEAD (STANDSTILL).
- The loco Kavach shall not perform any train movement supervision in this mode.



# SHUNT MODE:

- Shunt mode shall be selected by loco pilot for shunting movements.
- It shall only be accepted by Kavach when the train is at STOP DEAD (STANDSTILL).
- It shall be possible to manually select shunting mode from SB, SR, LS, FS mode by pressing SHNT followed by CNFM soft key on DMI.
- Supervises Shunt mode speed (default: 15 kmph) within station section.
- SKavach generates SOS if the train crosses the shunting limits.



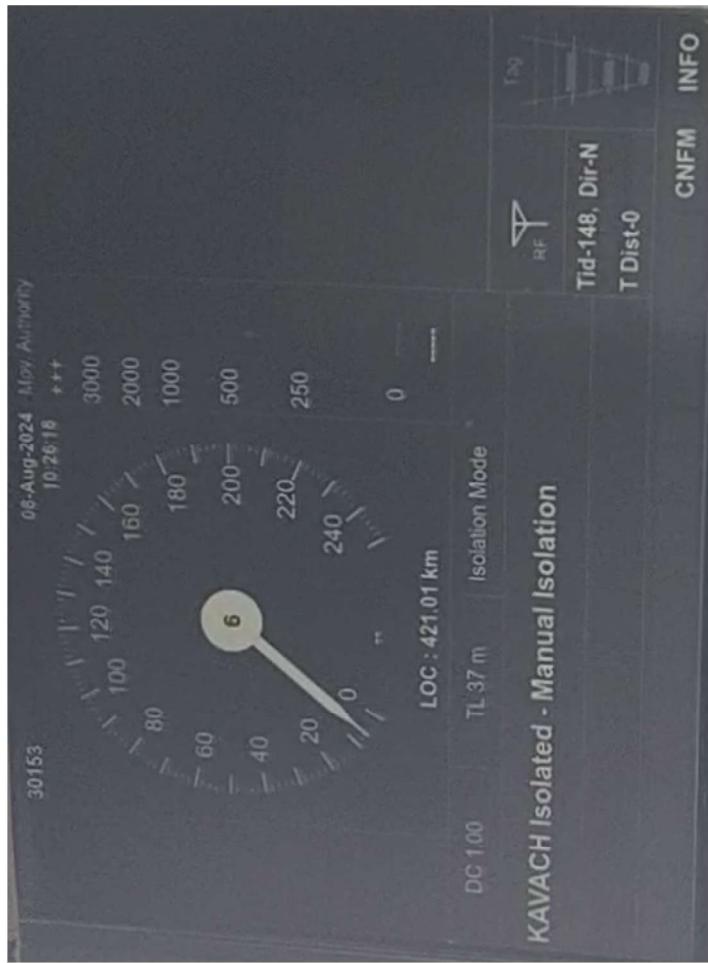
# SYSTEM FAILURE MODE:

- The loco Kavach unit shall switch automatically to this mode in case of a fault which affects the functioning of loco Kavach.
- The Loco Pilot shall isolate Kavach, which means that Loco shall be no more under the control of Loco Kavach unit.



## **ISOLATION MODE:**

- This mode is manually selected by LP during malfunctioning of Kavach.
- In this mode, the loco Kavach unit shall be physically isolated from the brakes and shall not perform any train supervision.
- There shall be a clear indication on DMI that the loco Kavach is isolated (Manual isolation)



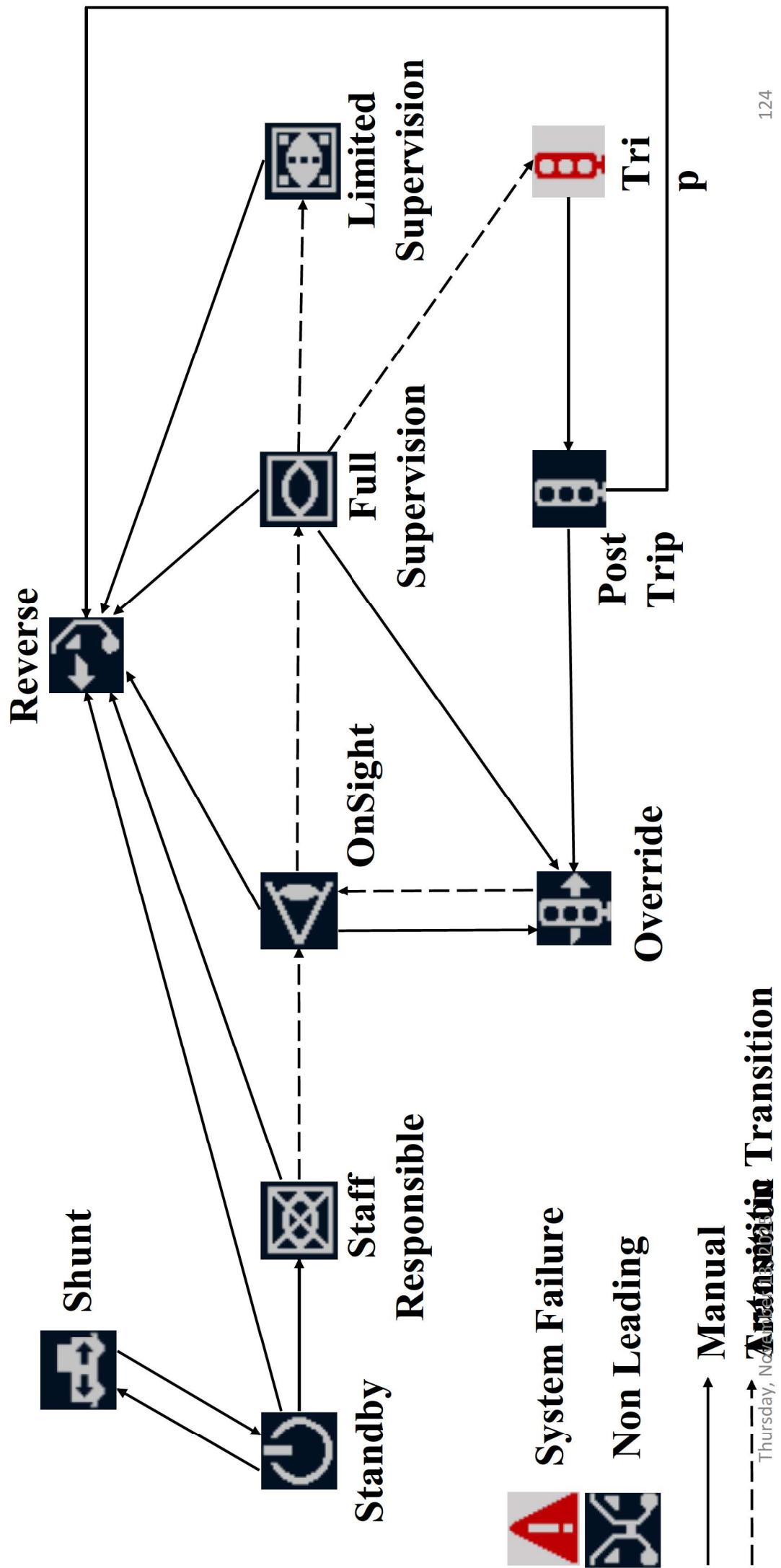
## **Modes Transition in Version 4.0**

- In case of transition, When Responsibility of Loco Pilot increases due to result of automatic transition, the Kavach shall seek an acknowledgement from the loco pilot, whether the train is stationary or not.
- In case the transition has to be acknowledged and the loco pilot fails to acknowledge as required, the Kavach shall initiate a brake application. When the train is standstill condition, in such case no brake shall be applied.

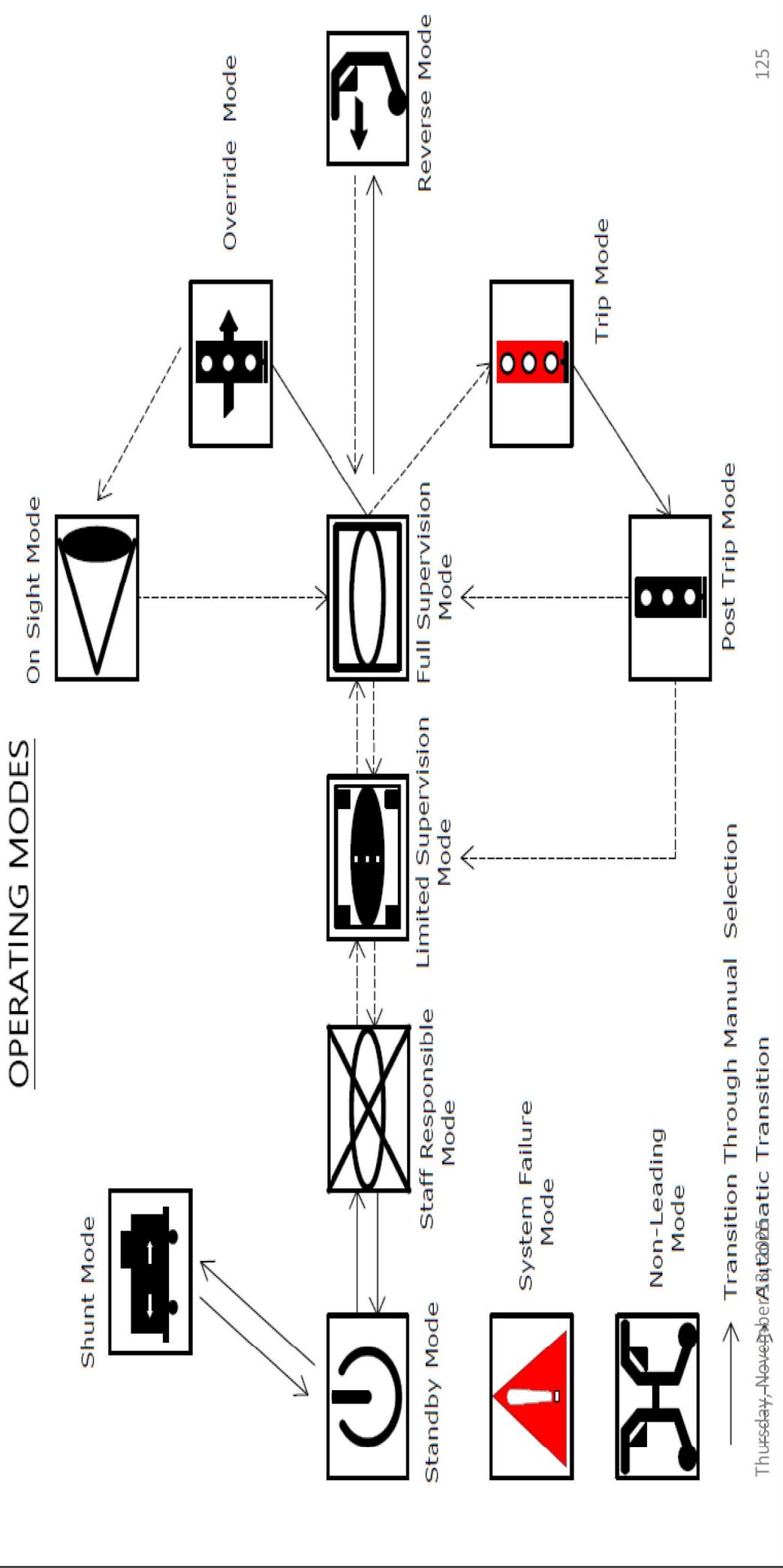
## **Modes Transition in Version 4.0**

- During the transition period between two operational states the supervision provided shall at least ensure the same protection provided by the least restrictive state
- The current mode shall be indicated to the loco pilot on the LP-OCIP (DMI)

# Mode Transitions in Ver. 4.0



## MODES TRANSITIONS – Version 3.2





# Any Questions?

Who

When

Why

Where

How

What



# Thank You!

