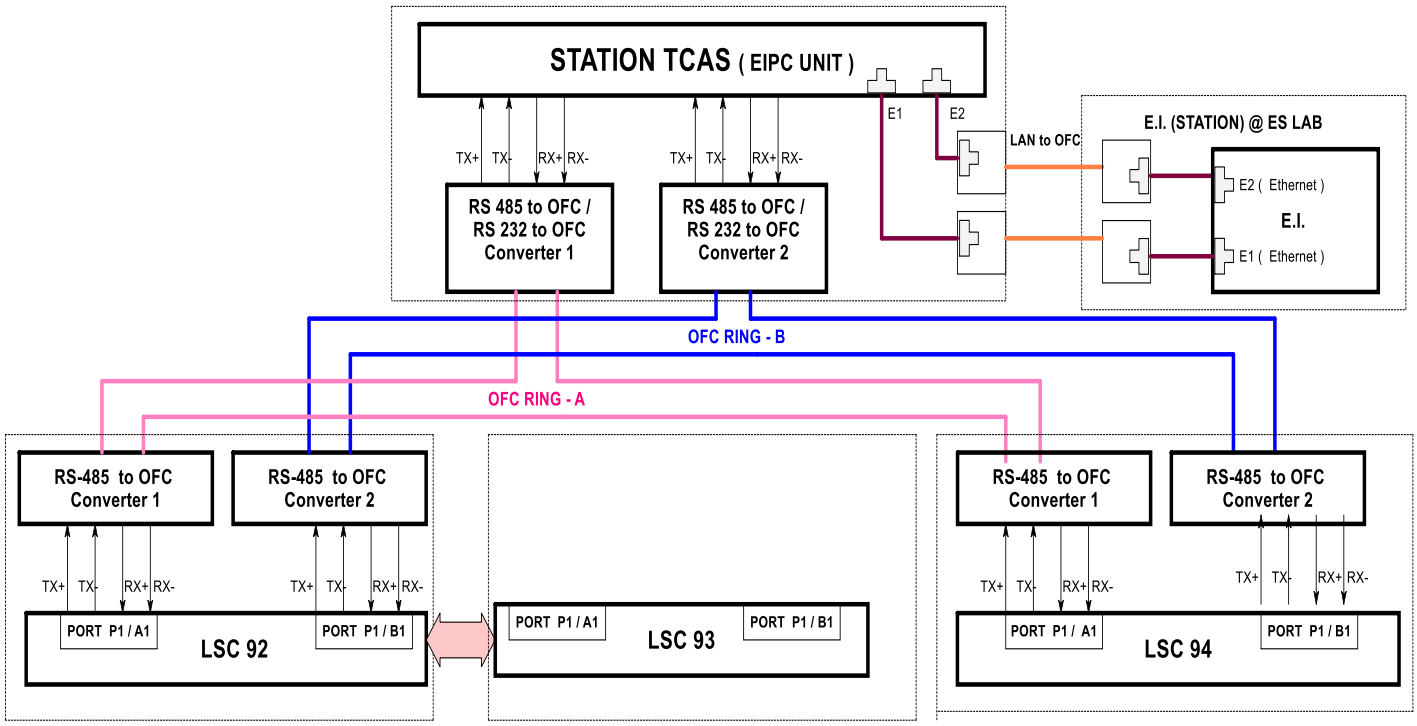
1. The part list interfacing is as under

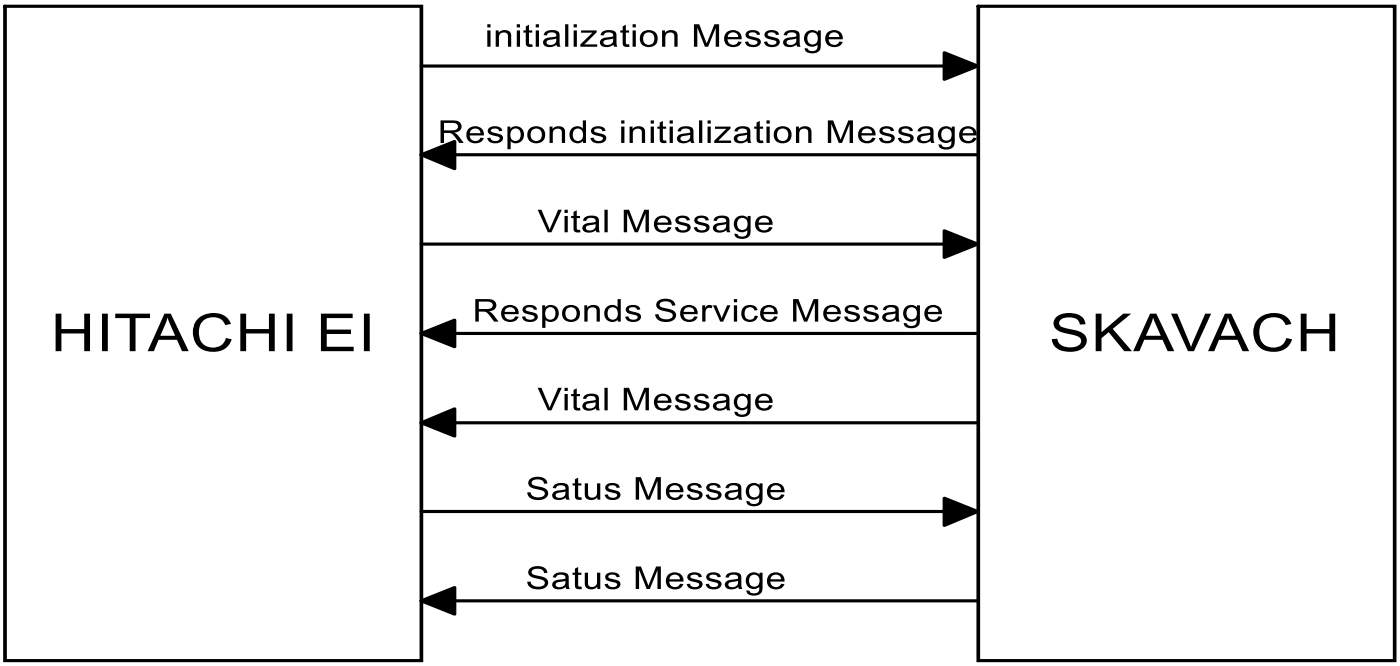
#	Electronic Interlocking	KAVACH
Make	HITACHI	KERNEX
Model no		
Interface type	Ethernet & serial	Ethernet &serial
Power Supply		5V
Other modules		

2. Connection diagram :



a) Is the power supply duplicated? **YES**
b) Is the communication duplicated? **YES**
c) Whether the communication is point to point? **YES**
d) Whether the communication is Peer to Peer OR Master - Slave? **PEER-PEER**

3. <u>Protocol Sequencing</u>:



a) Is periodic health check available? **YES**
b) Is time synchronization available? **YES**
c) Entire Request – Response procedure is to be written down below:-

1. **Hitachi-EI sends Initialization Message.**

2. **S-KAVACH responds with Initialization Message.**

3. **Hitachi-EI sends Vital Message.**

4. **S-KAVACH responds with Service Message.**

5. **S-KAVACH sends Vital Message.**

6. **Hitachi-EI responds with STATUS Message.**

7. **S-KAVACH responds with STATUS Message.**

8. **After exchanging configured STATUS messages, VITAL message will be received and STATUS message will be received.**

4. Periodicity and Timeout:

(i) Whether the communication is periodic? : **YES**

(ii) What is the maximum rate of transfer of data? : **Ethernet:100Mbps**

Serial: 19200 Baud rate

(iii) How many maximum number of data bits can be exchanged between EI and KAVACH? : **128 Bits**

(iv) The maximum round trip delay after which communication is said to be lost is : **As per Stale Data Timeout (Configuration)**

(v) The KAVACH (Receiver) cycle time is : _____

(vi) The Electronic Interlocking (Transmitter) cycle time is: **Event Based**

(vii) The boot up time of Electronic Interlocking is :**2 Minutes**

(Is it Station – specific?) :**NO**

(viii) The boot up time of Stationary KAVACH is : **20 Seconds**

(Is it Station – specific?) :**NO**

5. Handling of duplicate messages:

a) How duplicate messages are detected?By EI: **Using TX and RX sequence numbers**

By SKAVACH: **Using TX and RX sequence numbers**

b) How duplicate messages are not processed?By EI :

By SKAVACH: **By checking last received Sequence number, the latest sequence number should be greater than previous valid message sequence number and shall be within the range of configured value expect for Service Message.**

c) Are duplicate messages stored in event logger?

By EI: NO

By SKAVACH: NO

6. Handling of out of sequences messages :

a) How out of sequence messages are detected?By EI :

By SKAVACH: **By checking last received Sequence number, the latest sequence number should be greater than previous valid message sequence number and shall be within the range of configured value expect for Service Message.**

b) How out of sequence messages are not handled?By EI :

By SKAVACH:

By checking last received Sequence number, the latest sequence number should be greater than previous valid message sequence number and shall be within the range of configured value expect for Service Message.

c) Are out-of-sequence messages stored in event logger?

By EI: **NO**

By SKAVACH: **NO**

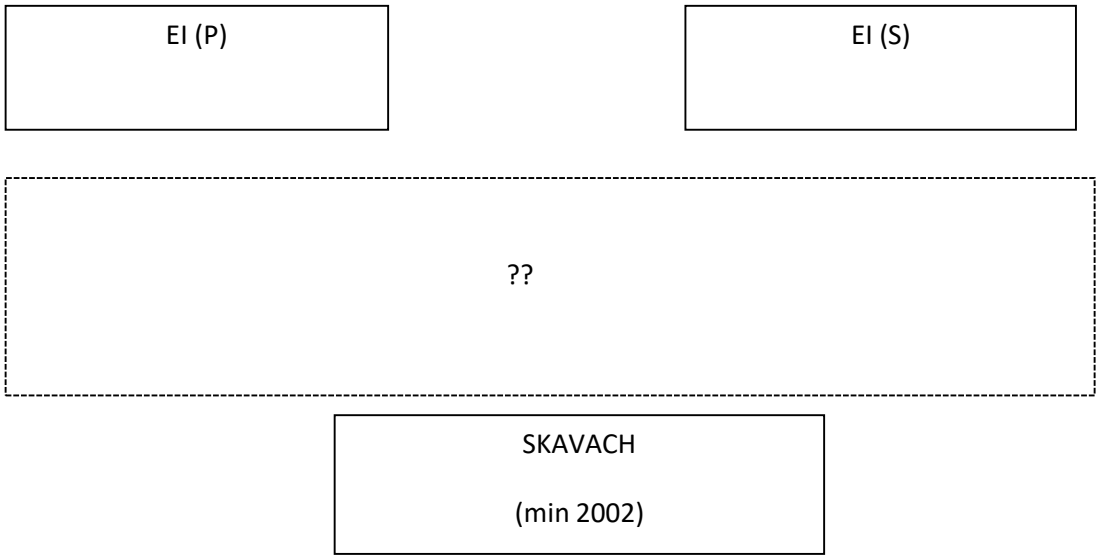
7. Communication Redundancy:

Test Format for EI – KAVACH Interface based on OEM proprietary protocols.

a) KAVACH is standalone system with 2oo2: **2oo2**

b) Is the Electronic Interlocking System Hot Standby or Warm Standby: **Hot Standby with 2oo2**

c) Schematic showing the communication arrangements without having impact originalarchitecture of EI and SKAVACH is shown below:-



d) The entire message flow explaining communication redundancy is as under :-

i) SKAVACH request to both EIs in hot/warm standby: **Hot standby.**

ii) Both EIs respond and reply: **Only Active System will respond and reply.**

iii) SKAVACH Validates : **SKAVACH validates the messages received to EI(P) and EI(S) will be validated with 2oo2.**

e) Is the connection between EI and KAVACH direct? **YES**

f) If it is not direct, i.e., through a channel which is connected to other devices then theprecautions taken to mitigate vulnerability and Interference shall be listed below:-

#	Mitigation Measures	Phase of mitigation	Responsibility (EI/Kavach/Railways)

Test Format for EI – KAVACH Interface based on OEM proprietary protocols.

(i)			
(ii)			
(iii)			

g) (i) Is Tx sequence number available from EI side? **YES**

(ii) Is Tx sequence number generated by EI unique? **YES**

(iii) How is it unique? **Generates a Random number in Initialization message and it is incremented in the next following messages.**

(iv) How S- KAVACH validated this? **Stores the random number received from the EI in Initialization message, when there is a communication break HITACHI EI will send the random number in Initialization message that shall not be matched with previously stored Random number.**

h) i) Is Tx sequence number available from SKAVACH side? **YES**

ii) Is Tx Sequence number generated by SKAVACH unique? **YES**

iii) How is it Unique? **Generates the random each time Initialization message received from the EI.**

iv) How S-KAVACH validated this? **The Random number sent by the SKAVACH will be stored the Next messages received from the EI shall contain an incremented one.**

8. Time Stamp :-

a) Time stamping process of EI: **Through railway data logger (station specific), however S-KAVACH is able send the TIME STAMP to the EI.**

b) Time stamping process of S-KAVACH: **Through GPS**

c) Is time stamping process of EI and S-KAVACH same? **NO**

d) If time stamping is not same, the following are the steps taken to resolve the issue:

In some stations EI is taking time from DATALOGGER, otherwise SKAVACH is able to send time stamp if there is time difference between SKAVACH and EI.

e) How leap year is handled? **Leap year is not having impact in the communication.**

f) It time Zone having impact on design? IST/GMT: **NO**

9. IP address:

a) KAVACH system must ensure that the IP address provided by EI is only used for it'ssystem/PC which is connected to EI.

b) KAVACH system shall inform EI OEM about IP address which they use at theirsystems (This is to avoid any network conflict between both systems):
IP Address needs to be provided by EI for SKAVACH.

10. CRC :

a) What is the length of CRC of the Interface Protocol? **32-Bit**

b) If it is less than 27 – bit, what techniques the OEM is following to meet the required level of THR for SIL-4? **Not Applicable**

11. Version Control:

a) How version control of executive logic is managed in EI?
Executive CRC is exchanged in initialization message.

b) How version control of executive logic is managed in S-KAVACH?
Executive CRC is exchanged in initialization message.

c) How version control of application logic is managed when bits required to be sent aremodified in EI?

i) Does the CRC of application logic changes? **YES**

ii) If yes, how safety validation of application logic is ensured?

Application CRC of EI is received to the SKAVACH during Initialization message,

This CRC is checked in the SKAVACH which is configured, if it is mismatches SKAVACH will not process the message received.

iii) What measures the Firm is planning to make it independent of Application logic CRC? **Application CRC will be configured in SKAVACH, if there is modification at EI side the latest Application CRC is need to be re-configured then only EI packets will be processed.**

iv) How version control of data being sent through the EI-KAVACH Interface is ensured? **Using the Application Logic CRC.**

v) If version control of data sent is not ensured what validation measures are taken byEI OEM to ensure safety? **If the Application CRC mismatches, EI packets will not be processed.**

d) How version control of application logic is managed when bits required to be received are modified is S-KAVACH?

i) Does the CRC of KAVACH TOC application logic change? **YES**

ii) If yes, how safety Validation of KAVACH TOC application logic is ensured?

Application Logic shall be re-verified by a FAT with the independent V&V team.

iii) What measures the firm is planning to make it independent of KAVACH TOCapplication logic CRC?
SKAVACH application logic depends on the relays statuses, presently no plans to make it independent.

iv) How version control of data being received through the Kavach – EI interface isensured?
Application CRC's of EI and SKAVACH shall be maintained.

v) If version control of data sent is not ensured, what validation measures are takenby KAVACH OEM to ensure safety?
Application CRC's of EI and SKAVACH shall be maintained.

12. Grouping of Relays / Acquiring relay information: -

a) EI shall indicate the total number of axle counters/ track circuits, points, lampproviding relays, other relays in a message. The message bytes shall be standardized and submitted to RDSO by KAVACH OEMs: **Presently the Bit list is submitted to respective railway board.**

b) EI shall keep on sending all the relays status every cycle on the KAVACH Interfaceport.

Not sending vital message (Relays statuses) every cycle (The vital message is send by EI, if there is any event/configured number of status messages are exchanged).

c) This shall be a default activity in all new EI installations.
d) The existing installations are also to be gradually migrated.
e) The bit chart shall be provided to Railways by EI OEM.
f) KAVACH OEM shall use this bit-chart and fetch the required relay information.

The test details shall be as under: -

_____

_____

_____

_____

g) The logs showing the status of relays between the Data logger output and port ofKAVACH shall be compared for 30 days and SD shall be less than 10^{-8} in an hour. Report to be enclosed.