5327699/2026/O/o ED/Tele-II/RDSO

GOVERNMENT OF INDIA: MINISTRY OF RAILWAYS

RESEARCH DESIGNS & STANDARDS ORGANISATION

MANAK NAGAR, LUCKNOW – 226 011.

(S&T DIRECTORATE)

EXPRESSION OF INTEREST

(RDSO website: https://www.rdso.indianrailways.gov.in**)**

No. RDSO-SIG0KVCH(GEN)/6/2026/TB Date: 31/07/2026

RDSO is the sole Research Design and Standards Organization of Indian Railways, dedicated to create & adopt technology solutions for Indian Railways. Signal & Telecom Directorate of RDSO is engaged in design, development and introduction of appropriate technology for equipment related to S&T System. The Directorate is involved in evolving designs & standards to improve the reliability & availability of Signaling and Telecommunication system of Indian Railways

RDSO is seeking to develop **SYSTEM REQUIREMENT SPECIFICATION** and **GENERIC TEST BENCH FOR AUTOMATED SYSTEM LEVEL FUNCTION TESTING OF KAVACH SYSTEM** to expedite the system level functional testing of KAVCAH system. The functional requirements of the desired specifications along with other documents and the proforma for response are enclosed.

Firms/Organizations who have enough experience and capability in this field and are interested in developing the system requirement specification and development of above system are requested to see the details on the RDSO's website http://www.rdso.indianrailways.gov.in/ or contact Executive Director/Tele-III, RDSO, Secunderabad on edtele3rdso@gmail.com /directorsntcoe@gmail.com on any working day for further details. The firms are requested to submit the details in the prescribed format attached herewith a period of 30 days from the date of publication of EOI, to the address mentioned below.

Contact Address

Principal Executive Director,

S&T Directorate, Annexe-II Building,

Research Designs & Standards Organization (RDSO),

Ministry of Railways, Manak Nagar

Lucknow – 226 011, Uttar Pradesh, India

Phone : 9794863312, 9794863017

Email: edtele3rdso@gmail.com

5327699/2026/O/o ED/Tele-II/RDSO

LETTER OF INVITATION

(EOI Reference No. RDSO-SIG0KVCH(GEN)/6/2026/TB)

S&T Directorate of RDSO working under Ministry of Railways seeks response from Prospective associate(s), meeting the requirements of this EOI and who are willing to be associated with RDSO for “Development of system requirement specification and further development of generic test bench for automated system level function testing of Kavach system” through joint development program route to pursue existing need of functional testing of Kavach system (during development/software change) Prospective Associate(s) can be a company/Joint Venture /Sole Proprietor/Partnership firm/Consortium.

The proposed EOI is to associate with the technological companies and innovators, who have capability of “Development of Generic Test Bench for Automated System Level Function Testing of Kavach System” shall participate & submit the response as specified in this EOI document.

Only one response shall be entertained from one company.

PRIYA AGRAWAL

Digitally signed by PRIYA AGRAWAL
Date: 2026.07.31 12:08:42 +05'30'

(Priya Agrawal)
ED/Tele III/RDSO

INDEX

SECTION-1

DISCLAIMER

1. The purpose of this EOI document is to provide the prospective associate(s) with information to assist the formulation of their response.
2. RDSO, its employees make no representation or warranty and shall incur no liability under any law, statute, rules or regulations as to the accuracy, reliability or completeness of the EOI document.
3. RDSO may, in its absolute discretion, but without being under any obligation to do so, modify, amend or supplement the information in this EOI document.
4. The issue of this EOI does not imply that RDSO is bound to shortlist any or all the prospective associate(s). Even after short-listing of suitable prospective associate(s), RDSO is not bound to proceed ahead with the prospective associate(s) and in no case be responsible or liable for any commercial and consequential liabilities in any manner whatsoever.
5. The prospective associate(s) shall bear all costs associated with the preparation, technical discussion/presentation and submission of response to EOI. RDSO shall in no case be responsible or liable for these costs regardless of the conduct or outcome of the EOI process.
6. Canvassing in any form by the prospective associate(s) or by any other agency on their behalf shall lead to disqualification of their response to EOI.
7. RDSO reserves the right to accept or reject any or all the EOI responses received against this notice without assigning any reasons and without prejudice.

SECTION-2

DETAILS OF EOI

2.1. KAVACH is an indigenous Automatic Train Protection System developed by RDSO under Ministry of Railways, Government of India. The primary objective of Kavach is to avoid cases of Signal Passing at Danger of train running on Indian Railways. It further provides additional features of Speed supervision against Permanent Speed Restriction, Head-On Collision Prevention and Rear end Collision prevention.

2.2. While some vendors have been approved by RDSO for Kavach product against specification RDSO/SPN/196/2020 Version 4.0, development with other vendors is also in process. KAVACH system is designed to be interoperable from operation point of view. The system integration is developed in such a way that on board Kavach equipment of one supplier should work seamlessly with the way side Kavach system of different Kavach supplier.

2.3. Once the prototype hardware testing of the Kavach system from any particular Kavach developer is completed successfully, the next phase in the development is system level functional testing which checks whether the Kavach system designed and developed meets its intended functionalities and is developed in compliance with the RDSO specifications.

2.4. Software change management is a part of Kavach version upgrades. In case, the Kavach system undergoes any software upgrades/refinements due to changes in specification, addition of new features, address field issues, function testing on the updated software is performed to ensure that the software is still in compliance with the specification. New function test cases also get added with time to ensure that the updated requirements are adequately verified and validated.

2.5. Function testing is like a black box testing in which, for each test case, a starting condition is set, required test scenarios are executed and the end condition actual output of the Kavach system is compared with the expected output to determine the results of the test case.

2.6. Repeated manual functional testing consume significant engineering time, create bottlenecks for OEM approvals, and do not yet provide a unified platform to certify interoperability across different KAVACH OEMs.

2.7. Indian Railways intend to automate the function testing process and engage with the technology developers and innovators to finalize the Functional requirement specification, develop System Requirement Technical Specification and subsequently develop such Generic Test bench which automates the execution of pre-defined test cases by executing test scripts and sequences, and automatically evaluate test results of system level function testing for Kavach system of different suppliers. Creation of test sequences for test cases, development of Kavach test scenario database and test scripts is also under the scope of such Generic test bench.

2.8. The system shall be able to work in coherence with the Kavach system of approved and developing vendors of KAVACH to check interoperability among different KAVACH suppliers. The system shall be designed to be possible to be interfaced with the existing Indian Railway Automatic Train Protection system according to latest Railway specifications.

2.9. Process of EOI shall be in following stages

Respondents to the EOI shall be selected based on shortlisting criteria mentioned in section 3, for deliberations for development of specifications. The RDSO team in consultation with the selected panel shall finalize the specifications and schedule of technical requirement before proceeding with development of test bench. Following stages are involved:

Stage 1:

Initial Draft Functional Requirement Specification (FRS) of the generic test bench is uploaded with this EOI. The shortlisted eligible prospective associate(s) shall work with RDSO and Kavach OEMs to finalize this FRS. Subsequently, the shortlisted eligible Prospective Associate(s) shall be involved in definition of System level technical specification requirement (SRS) which defines the external I/Os, adapter interfaces, data formats, etc. to be used for various simulators and adapters between the test bench and the KAVACH equipment under test. This will be based on FRS finalized.

The shortlisted eligible Prospective Associate(s) should demonstrate a prototype of test database using at least 50 test cases as prescribed by RDSO from approved Kavach test specification and corresponding test sequences using international test standard-based notions and test script languages. Automatic test scenario execution, automatic pass/fail evaluation shall be demonstrated for these test cases with evidence. The test case demonstrated should be traceable to the Kavach test

specification SIF-0533 clause/test id, it covers. Prototype of Loco simulator or Radio Message simulator and connected adapter used in Functional test bench shall be demonstrated to assess the capability for development of generic test bench. The prototypes developed will be evaluated based on the extent to which it meets the Kavach functional testing requirement. The successful demonstration of prototype will qualify as a technical eligibility to participate in Stage 2.

Stage 2:

Based on the cost estimates for the development process, a detailed estimate shall be drafted and sanctioned for taking up the work of development as per the established process of vetting and sanction of estimates.

Tender (open/special limited tender) shall be called for development of the generic test bench. This tender shall be evaluated and orders will be placed for manufacture of generic test bench as per the FRS and SRS finalized in Stage 1. The conversion of complete high level Kavach test suite into formal test requirements and corresponding test scripts is also included in this stage.

The developed test bench shall have capability to perform function testing on Kavach system of different suppliers as per the test cases defined in Function Test Cases for Kavach, RDSO/SPN/196/2020- version 4.0 Part I and Part II SIF 0533 version 4.22 or latest, DMI functional test campaign in SIF-0522 v1.5 or latest, event logger tests in SIF-0595 v1.0 or latest or any other functional test document circulated by RDSO.

In case, improvements are required in the design of generic test bench developed, further changes may be done to improve the same. This process should be iterated as required for finalization of the design and verification / validation of the generic test bench.

The selected tenderers in stage 2 shall engage Independent Safety Assessor from RDSO approved panel of Independent Safety Assessors (ISAs) for mainline signaling projects/systems for generic safety assessment of the test bench.

The specification (FRS& SRS) shall be finalized in accordance with RDSO ISO document QO-D-8.1-1 ver 2.4 or latest incorporating changes that are required over the period of the development exercise.

Stage 3

The generic test bench developed shall complete generic safety assessment by an Independent Safety Assessor. After verification of the test results/design calculations,

validation of actual performance and review of generic safety case, the generic test bench of the selected Associate(s) will be approved by RDSO. Such approved automated function testing generic test bench will be accepted as RDSO approved set up/facility for function testing. All Kavach OEMs shall have to undergo function testing (during product development/software change) with the Generic test bench approved by RDSO, and submit the test evaluation results along with logs to RDSO for verification.

2.10 Indicative processes and tentative timelines are shown in Annexure A.

2.11 The following compliance are mandatory for development of Generic Test bench.

i. Should have valid ISO 9001:2015: General quality management system required for the manufacturing and design processes of the test bench.

ii. Compliance to ISO/IEC standards for quality management and cyber security

iii. Compliance to Kavach Spec Version 4.0 RDSO/SPN/196/2020.

iv. Compliance to Function Test Cases at System Level for KAVACH as per RDSO/SPN/196/2020- version 4.0 Part I and Part II SIF 0533 version 4.22 or latest , DMI functional test campaign in SIF-0522 v1.5 or latest, event logger tests in SIF-0595 v1.0 or latest or any other functional test document circulated by RDSO.

v. Compliance to specific RAMS and CENELEC safety standards (such as EN 50126, EN 50128, EN 50129. EN 50159 etc.) for hardware, software and simulators for functional testing in railways.

vi. The safety integrity requirement/level for all vital components for the hardware and software of the KAVACH functional test bench and its automated test environment should be in compliance with the defined CENELEC standards. This is required to ensure that the test equipment is reliable and accurate.

2.12. Eligibility

i. Firms must have proven experience in designing, developing, and supplying real-time functional test benches and automated test environment used to validate functionality of safety-critical embedded control systems in compliance with CENELEC standards in passenger rail transit sector.

ii. Firm shall have ISO 9001:2015 accreditation from a government recognized certifying body.

iii. Provisions of Make in India Policy 2017 issued by Govt. of India, as amended from time to time, shall be followed for consideration of EOI. Class I Local supplier(s) and Class II local supplier(s) as defined under the Order No P-45021/2/2017-PP (BE II) dated 16.09.2020 or latest, issued by Department for Promotion of Industry and Internal Trade, Ministry of Commerce and Industry, Government of India, are eligible to participate in the EOI.

iv. **Non-local supplier(s):**

Non-local supplier(s)/Foreign firms shall be eligible to participate in the EOI either as a single entity or by executing a Partnership Deed/Joint Venture (JV), or Consortium agreement with a legally registered Indian Company. A copy of such partnership deed, JV/Consortium agreement shall be submitted along with response to EOI. In response to the EOI, such prospective associate(s) shall initially submit the technology collaboration agreement/transfer of technology agreement for indigenous manufacture of product developed abroad with clear phasing of increase in local content as mandated in Government of India Order No P-45021/2/2017-PP (BE-II)-Part 4 Vol II dated 16th July 2024 or latest.

The composition of Partnership deed/JV/Consortium at the time of bidding in works tender in Stage 2 shall remain same as submitted in response to the EOI.

The shortlisted non local supplier(s)/foreign firm(s) however shall be eligible to participate in works tender in Stage 2 either as a single entity or as a partner in partnership deed/JV/Consortium, only if they have already opened a project office in India and have got registered with the Registrar of the Companies under "The Companies Act-2013" in India and other applicable statutory requirements. The entity will have to submit proof of the same along with the bid, failing which the bid shall be rejected.

The credentials of the foreign firm(s) shall be verified and certified by the Indian Embassy/High Commission/ Consulate located in the country of origin of the bidder or in the country where works have been done. (Ref: Railway Board Letter No 2026/CE-I/CT/1 (Global Tender Enquiry)(3523970) dated 08.04.2026)

v. Any Prospective Associate from a country which shares a land border with India will be eligible to participate only if the Prospective Associate is registered

with the Competent Authority. The Competent Authority for registration will be the Registration Committee constituted by the Department for Promotion of Industry and Internal Trade (DPIIT), Government of India. For interpretation of this para, Department of Expenditure, Ministry of Finance, Government of India, Order (Public Procurement No. 4) issued vide OM No. F.7/10/2021-PPD (1) dated 23/02/2023 shall be referred.

vi. Prospective Associate(s) shall clearly specify whether the response to EOI is submitted on his own (Proprietary Firm) or on behalf of a Partnership Firm / Company / Joint Venture (JV) / Consortium/ Registered Society / Registered Trust / Hindu Undivided Family (HUF) / Limited Liability Partnership (LLP) etc. The respondent(s) shall enclose the attested copies of the constitution of their concern, and copy of PAN Card along with their response. The response to EOI in such cases are to be signed by such persons as may be legally competent to sign them on behalf of the firm, company, association, trust or society, as the case may be.

vii. Any firm, consortium member, or associate thereof shall **not be eligible** to participate in this Expression of Interest (EOI) if they, their Original Equipment Manufacturer (OEM), sister concerns[#], subsidiaries, or authorized representatives:

a. Are actively engaged in Kavach product development or currently hold status as an approved Kavach vendor.

OR

b. Have participated in Kavach field trials, or have been awarded technical clearance for Kavach field trials/Trial order

OR

c. Have been granted Capacity Cum Capability Assessment (CCA) approval against their application for development of Kavach

viii. The prospective associate participating in this Expression of Interest (EOI) shall submit a legally binding, solemn Undertaking executed on non-judicial stamp paper of appropriate value and duly notarized. This Undertaking must explicitly declare that the prospective associate is an independent entity and **does not** constitute a sister concern, affiliate, subsidiary, joint venture partner,

or holding company of any approved or developmental KAVACH vendor or Original Equipment Manufacturer (OEM).

ix. The respondent should submit a copy of Authorization/Power of Attorney[$] issued by the Company (backed by the resolution of Board of Directors) in favour of the individual to sign the documents and respond to EOI on behalf of the company and create liability against the company.(Performa in Appendix II)

#For the purpose of this EOI, a 'Sister Concern' or 'Affiliate' shall mean any business entity that directly or indirectly controls, is controlled by, or is under common control by same directors, promotors partners associated with OEM.

[$]A Power of Attorney executed and issued overseas, the document will also have to be legalized by the Indian Embassy and notarized in the jurisdiction where the Power of Attorney is being issued. However, the Power of Attorney provided by Bidders from countries that have signed the Hague Legislation Convention 1961 are not required to be legalized by the Indian Embassy if it carries a conforming Appostille certificate.

SECTION-3

SHORTLISTING CRITERIA

3.1 The model criteria for shortlisting is indicated below

S. No	Item	Marks	Remarks
1.	Average annual turnover of the firm during last 3 years*	10	Firm having maximum be given 10 marks and others as their percentile of maximum marks.
2.	Turnover of similar supplies made in the field of item under EOI*	30	This is the turnover of similar supplies (designing, developing, and supplying real-time functional test benches and automated test environment used to validate functionality of safety-critical CENELEC compliant embedded control systems in passenger rail transit sector) made by the prospective firm. The firm having maximum be given full marks & other as their percentile of maximum marks. If the item supplied is NIL, the firm will be given Zero mark. Documentary proof (Invoices or payment receipts for similar supplies) may be submitted.
3.	Customer(s) and supplies made in the field of EOI	10	Number of similar supplies (designing, developing, and supplying real-time functional test benches and automated test environment used to validate functionality of CENELEC compliant safety-critical embedded control systems in passenger rail transit sector) made by the prospective firm. The firm having 5 or more similar supplies will be given full marks. The firm having less than 5 similar supplies will be given 2 marks for each similar supply. If the item supplied is NIL, the firm will be given Zero mark. Documentary proof (work completion certificate/purchase orders/client testimonials/client certificate) may be submitted.

4.	Experience & expertise for item proposed under EOI	20	It is based on years of experience in such products (designing, developing, and supplying real-time functional test benches and automated test environment used to validate functionality of safety-critical CENELEC compliant embedded control systems in passenger rail transit sector). The firm having relevant experience of 5 years or more will be given full marks & those having experience of less than 5 years will be given 4 marks for each completed year of experience. The firm having less than one year experience will be given Zero mark.
5.	Manpower & their qualification Graduate qualified engineers (Hardware/ Software) employed for more than one year continuously with the firm and proposed to work in the field of EOI. (To ensure firm's commitment to build a competent team)	10	Details of such persons with professional qualification on firm's direct roll proposed to work in field of EOI. Firm having 10 or more hardware/software (graduate qualified) engineers will get maximum marks. For others, each graduate qualified engineer will fetch one mark. (CV of all such employees to be enclosed)
6.	Details of ISO certifications as mentioned in Mandatory and desired compliance in para 2.11	10	Number of ISO certifications held specifically ISO 9001:2015, ISO/IEC 17025, etc. by the prospective associate(s). Firm having maximum be given 10 marks and others as percentile of maximum marks.
7	Commitment to use Open test specifications or open source test scripting language or commitment of sharing the necessary software tools which allow for extension/changes to the test suite/test scenarios as per future requirement	10	The firm that commits to use of open test standards or allow for later modifications in test suite under a perpetual license will be given 10 marks and others as percentile of maximum marks.
Minimum Marks for eligibility = 50 out of 100 marks			

**Note: Credentials if submitted in foreign currency shall be converted into Indian currency i.e., Indian Rupee as under:*

The conversion rate of US Dollars into Rupees shall be the daily representative exchange rates published by the Reserve Bank of India or entity authorized by RBI to do so for the relevant date or immediately previous date for which rates have been published. Where, relevant date shall be as on the last day of month previous to the one in which EOI is invited. In case of any other currency, the same shall first be converted to US Dollars as on the last day of month previous to the one in which EOI is invited, and the amount so derived in US Dollars shall be converted into Rupees at the aforesaid rate. The conversion rate of such currencies shall be the daily representative exchange rates published by the International Monetary Fund for the relevant date or immediately previous date for which rates have been published

3.2 Responsibilities of the shortlisted Firms:

i. The shortlisted firm shall respond to each request for Bid/quotation raised by RDSO for the developmental work within stipulated time.

ii. The shortlisted firms shall provide training of 100 man days to the RDSO personnel at Head Design and Development HQ during the development work of the project (if required by Indian Railways on payment basis).

iii. Shortlisted firm must ensure fulfillment of regulatory compliances and licenses for the services being offered for. In this regard Shortlisted Firm shall indemnify RDSO against any non-compliance and submit a declaration as per Annexure 1 on the company letter head duly signed by authorized signatory.

iv. The Data Log generated in this development exercise may be used by all stakeholders involved - Shortlisted Firms, KAVACH OEMs, and RDSO.

v. **Participation of JV:** Please refer Annexure E

SECTION-4

Details to be submitted by the respondents

The respondents to the EOI shall submit the following details:

1. Details of items manufactured or services provided in area of similar work **(Mandatory)**
2. Turn-over of the firm during the last three financial years with the copies of CA- certified annual report. **(Mandatory)**
3. Turnover of similar supplies made in the field of item under EOI. **(Mandatory)**
    a. Invoices or payment receipts for similar supplies
4. Details of customer(s) and supplies made in the field of similar work (**Mandatory)**
    a. Work orders or purchase orders from customers.
    b. Client testimonials or references.
5. Experience and expertise for the items proposed in EOI to assess years of experience- Any of the below **(Mandatory)**
    a. Any Recognized Government Organizations/Institutions.
    b. Government organizations/institutions using services of the respondent in similar work.
    c. Organization with Past Work Experience:
        - The firm must have successfully executed at least one project area of similar work defined above
        - Documentary proof such as completion certificates, or client testimonials must be submitted.
6. Certifications & Technical Qualifications **(Mandatory)**
    The firm must hold following certifications:
        - ISO 9001:2015 accreditation for General quality management system required for the manufacturing and design processes of the test bench.
        - Details of ISO certifications, particularly in function testing accreditation such as ISO 17025, data protection and other relevant ISO certifications.
        - Any other recognized international/national ISO certification relevant to the scope of work as mentioned in Mandatory Compliance in para 2.11
7. Partnership deed/JV/Consortium agreement with an Indian firm(s) in case the prospective associate is a non-Local supplier(s)/foreign entity. In case, the respondent

involves a foreign entity, such Partnership deed/JV/Consortium agreement should have an Indian firm/company as the Lead Member with a minimum share of 51%. Please refer para 11 under Annexure E for list of documents to be enclosed. **(Mandatory)**

8. Details of man-power with their qualification and experience. A separate sheet of manpower proposed in the field of item under EOI with their qualification and experience shall also be attached. **(Mandatory)**

    a. List of key personnel with their name and qualifications and experience.

9. Detailed proposal for items proposed in EOI including alternative proposal, if any. (**Optional**)

10. An undertaking stating firm's commitment to use open test standards or willingness to allow for later modifications in test bench under perpetual license. Performa enclosed as Appendix III (**Mandatory**)

Note:

1. All information must be clearly mentioned and supported with authentic and verifiable documents.
2. Submissions must be made in the prescribed format within the stipulated timeline.
3. Incomplete or non-compliant submissions will not be considered.

Annexure A

Indicative processes & Tentative Timelines

After finalization of EOI		
1	Finalization of Draft FRS and Development of System Requirement specification	2 months
2	Definition of interfaces with KAVACH and test bench	2 Weeks
After award of tender		
3	Mapping of all test cases to executable scenarios; test sequencing; traceability matrix; additional test cases, if required	2 months
4	Development of various simulators and testing integration of these simulators with KAVACH system and Test bench Demonstration of 30% of test cases with at least 2 approved/developmental KAVACH OEMs	4 months
5	Comparison of test results and analysis of test evaluation results for sample test cases across different OEMs	1 month
6	Integration of complete Generic test bench, full hardware assembly and compliance of interoperability of KAVACH test bench with wayside and onboard KAVACH of different OEMs	2 months
7	100% function testing with KAVACH system Acceptance testing	2 month
8	Comparison of test results and analysis of test results for sample test cases across different OEMs	1.5 month
9	ISA assessment of Generic test bench	1 month
	Total Time	**16 months**

Annexure B

FORMAT FOR LETTER OF RESPONSE

Respondents Ref No.:
Date:

Principal Executive Director (S&T)
Room No: 203, Building: Manak Bhavan Research Designs & Standards Organization Ministry of Railways
Manak Nagar
Lucknow, 226011
INDIA

Dear Sir,

Subject: Response To EOI for Participation

1. We, the undersigned, offer the following information in response to the Expression of Interest sought by you vide your Notification No.___, dated _____.
2. We are duly authorized to represent and act on behalf of _____ (hereinafter the "respondent")
3. We have examined and have no reservations to the EOI Document including Addenda No(s)

   _____.
4. We are attaching with this letter, the copies of original documents defining: -
   a) the Respondent's legal status;
   b) its principal place of business;
   c) its place of incorporation (if respondents are corporations); or its place of registration (if respondents are cooperative institutions, partnerships or individually owned firms);
   d) Self-certified financial statements of Last three years, clearly indicating the financial turn over and net worth.
   e) Copies of any market research, business studies, feasibility reports and the like sponsored by the respondent, relevant to the project under consideration
5. We shall assist MoR and/or its authorized representatives to obtain further clarification from us, if needed.
   a) RDSO and/or its authorized representatives may contact the following nodal persons for further information on any aspects of the Response:

S. No.	Contact Name	Address	Telephone	E Mail
1				
2				

6. This application is made in the full understanding that:
   a) Information furnished in response to EOI shall be used confidentially by RDSO for the purpose of development of the project.
   b) RDSO reserves the right to reject or accept any or all applications, cancel the EOI and subsequent bidding process without any obligation to inform the respondent about the grounds of same
   c) We confirm that we are interested in participating in development of the project
7. In response to the EOI we hereby submit the following additional details annexed to this application.
   7.1. Details of turnover during last 3 financial years
   7.2. Details of various items being manufactured/consultancy undertaken
   7.3. Details of customer(s) and supplies made in the field of item under EOI.
   7.4. Experience and expertise for the items proposed in EOI.
   7.5. Details of man-power with their qualification and experience.
   7.6. Detailed proposal for items proposed in EOI including alternative proposal, if any.
   7.7. Details of ISO certification
   7.8. Undertaking as per Para 2.11 clause viii
   7.9. Undertaking as per Annexure- C
   7.10. Checklist as per Annexure-D
   7.11. Undertaking as per Appendix III
   7.12. Power of Attorney
8. The undersigned declare that the statements made and the information provided in the duly completed application are complete, true, and correct in every detail. We also understand that in the event of any information furnished by us being found later on to be incorrect or any material information having been suppressed, RDSO may delete our name from the list of qualified Respondents. We further understand that RDSO will give first preference to the applicants considered relevant for the purpose10. Our response is valid till (date in figures and words):_____

Yours sincerely,

(Sign)
NAME
In the Capacity of
Duly authorized to sign the response for and on behalf of
Date

Annexure-C

(To be taken on non-judicial stamp paper of appropriate value as applicable in the respective state and dully notarized & witnessed)

UNDERTAKING

I, son of …… aged about …..... Years resident of…….do hereby solemnly affirm as under –

1. That the deponent is the Authorized signatory of *(Name of the Sole Proprietorship Concern/ Partnership Firm/ Registered Company/ Joint Venture).*

2. That the deponent declares on behalf of *(Name of the Sole Proprietorship Concern/ Partnership Firm/ Registered Company/Joint Venture)* that:

   a) In regard to matters relating to the security and integrity of the country, no charge sheet has been filed by an agency of the Government / conviction by a Court of Law for an offence committed by the ----------(name of the entity)or by any sister concern of the-(name of the entity) would result in disqualification.

   b) In regard to matters other than the security and integrity of the country,----------(name of the entity) has not been convicted by a Court of Law or indicted / passed any adverse order by a regulatory authority against it or it's any sister concern which relates to a grave offence, or would constitute disqualification. Grave offence is defined to be of such a nature that it outrages the moral sense of the community.

DEPONENT VERIFICATION

I declare that the contents of para 1 to 2 above are true as per my knowledge and nothing has been hidden.

DEPONENT

Annexure-D

CHECKLIST

SN.	Item	Category	Details	Submitted (Yes/No)
1.	Details of items manufactured or services provided, particularly in the fields of system level function testing.	Mandatory		
2.	Turnover of the firm during last 3 years	Mandatory	2025-26:	
			2024-25:	
			2023-24:	
3.	Turnover of similar supplies made in the field of item under EOI.	Mandatory	2025-26:	
			2024-25:	
			2023-24:	
			..	
			20xx-xx+1	
4.	Customer(s) and supplies made in the field of EOI	Mandatory		
5.	Experience & expertise for item proposed under EOI to arrive at **years** of experience of the firm	Mandatory		
6.	Manpower & their qualification	Mandatory		
7.	Detailed proposal for items proposed in EOI including alternative proposal, if any	Optional		
8.	Details of ISO certifications or equivalent	Mandatory		
9.	Undertaking as per Annexure C	Mandatory		
10.	Undertaking as per Appendix III	Mandatory		
11.	Undertaking as per Para 2.11 clause viii	Mandatory		
12.	Power of Attorney	Mandatory		

Note:

- All information may be clearly mentioned and supported with authentic and verifiable documents.

(Sign)
NAME
In the Capacity of
Duly authorized to sign the response for and on behalf of
Date

Annexure E

Instructions for Joint Ventures (JV)

1. Separate identity/name shall be given to the Joint Venture.
2. Number of members in a JV shall not be more than five. One of the members of the JV shall be its Lead Member, who shall have a majority (at least 51%) share of interest in the JV. The other members shall have a share of not less than 20% each in case of JV upto 3 members and not less than 10% each in case of JV with more than three members. In case of JV with foreign member(s), the Lead Member has to be an Indian firm/company with a minimum share of 51%.
3. A member of JV shall not be permitted to participate either in individual capacity or as a member of another JV in the same Bid.
4. The response to the EOI shall be submitted only in the name of the JV and not in the name of any constituent member. The response can however be submitted by JV or any of its constituent member or any person authorized by JV through Power of Attorney to submit response. (Performa in Appendix II)
5. A copy of JV agreement (Performa enclosed in Appendix I) duly executed by the JV members on a stamp paper, shall be submitted by the JV along with the response. The complete details of the members of the JV, their share and responsibility in the JV etc. shall be furnished in the MoU.
6. Approval for change of constitution of JV shall be at the sole discretion of the Railway. The constitution of the JV shall not normally be allowed to be modified after submission of the response by the JV, except when modification becomes inevitable due to succession laws etc., provided further that there is no change in shortlisting criteria by JV after change of composition. However, the Lead Member shall continue to be the Lead Member of the JV. Failure to observe this requirement would render the response to EOI invalid.
7. On shortlisting in Stage 1, the JV entity to whom the approval of POC has been awarded in Stage 1, with the same shareholding pattern as was declared in the JV Agreement submitted along-with the response, shall be got registered before the Registrar of the Companies under 'The Companies Act -2013' (in case JV entity is to be registered as Company) or before the Registrar/Sub-Registrar under the 'The Indian Partnership Act, 1932' (in case JV entity is to be registered as Partnership Firm) or under 'The LLP Act 2008' (in case JV entity is to be registered as LLP). A

separate PAN shall be obtained for this entity.

8. Governing Laws - The Registered Entity shall in all respect be governed by and interpreted in accordance with Indian Laws.
9. Authorized Member - Joint Venture members in the JV agreement/MoU shall authorize Lead member on behalf of the Joint Venture to deal with the EOI. All Notices/correspondences with respect to the EOI would be sent only to this authorized member of the JV.
10. No member of the Joint Venture shall have the right to assign or transfer the interest right or liability in the EOI without the written consent of the other members and that of the Indian Railway in respect of the said EOI.

11. Documents to be enclosed by the JV along with the EOI response:

11.1 *In case one or more of the members of the JV is/are partnership firm(s), following documents shall be submitted:*

a. A notarized copy of the Partnership Deed or a copy of the Partnership deed registered with the Registrar.
b. A copy of consent of all the partners or individual authorized by partnership firm, to enter into the Joint Venture Agreement on a stamp paper,
c. A notarized or registered copy of Power of Attorney in favour of the individual to sign the MOU/JV Agreement on behalf of the partnership firm and create liability against the firm.
d. An undertaking by all partners of the partnership firm that they are not blacklisted or debarred by Railways or any other Ministry / Department of the Govt. of India from participation in tenders / contracts as on the date of submission of bids, either in their individual capacity or in any firm/LLP in which they were / are partners/members.

11.2 In case one or more members is/are Proprietary Firm or HUF, the following documents shall be enclosed:

a. A copy of notarized affidavit on Stamp Paper declaring that his Concern is a proprietary Concern and he is sole proprietor of the Concern OR he who is signing the affidavit on behalf of HUF is in the position of ‘Karta’ of Hindu Undivided Family (HUF) and he has the authority, power and consent given by other members to act on behalf of HUF.

11.3 In case one or more members of the JV is/are companies, the following documents shall be submitted:

a. A copy of resolutions of the Directors of the Company, permitting the company to enter into a JV agreement,

b. The copies of MOA (Memorandum of Association) / AOA (Articles of Association) of the company

c. A copy of Certificate of Incorporation

d. A copy of Authorization/copy of Power of Attorney issued by the Company (backed by the resolution of Board of Directors) in favour of the individual, to sign the EOI, sign MOU/JV Agreement on behalf of the company and create liability against the company

11.4 In case one or more members of the JV is/are LLP firm/s, the following documents shall be submitted:

a. A copy of LLP Agreement

b. A copy of Certificate of Incorporation of LLP

c. A copy of resolution passed by partners of LLP firm, permitting the Firm to enter into a JV agreement

d. A copy of Authorization /copy of Power of Attorney issued by the LLP firm (backed by resolution passed by the Partners) in favour of the individual, to sign the EOI response and/or sign the MOU/ JV agreement on behalf of the LLP and create liability against the LLP.

e. An undertaking by all partners of the LLP that they are not blacklisted or debarred by Railways or any other Ministry / Department of the Govt. of India from participation in tenders / contracts as on the date of submission of bids, either in their individual capacity or in any firm/LLP or JV in which they were / are partners/members.

11.4 In case one or more members of the JV is/are Society/s or Trust/s the following documents shall be submitted:

a. A copy of Certificate of Registration

b. A copy of Memorandum of Association of Society/Trust Deed

c. A copy of Rules & Regulations of the Society

d. A copy of Power of Attorney, in favour of the individual to sign the EOI documents and create liability against the Society/Trust.

12. **Eligibility Criteria for JV/Consortium**: The following evaluation will be used for JV/Consortium.

S. No	Item	Remarks
1.	Average annual turnover of the firm during last 3 years*	The arithmetic sum of individual "Average annual turnover during last 3 years" of all the members of JV/Consortium shall be taken as JV/ Consortium's "Average annual turnover" to satisfy this requirement.
2.	Turnover of similar supplies made in the field of item under EOI*	The arithmetic sum of individual "Turnover of similar supplies made in the field of item under EOI "of all the members of JV/ Consortium shall be taken as JV/ Consortium's "Turnover of similar supplies made in the field of item under EOI" to satisfy this requirement
3.	Customer(s) and supplies made in the field of EOI	The arithmetic sum of individual "Customer(s) and number of similar supplies made in the field of EOI" of all the members of JV/Consortium shall be taken as JV/Consortium's "Number of similar supplies" to satisfy this requirement.
4.	Experience & expertise for item proposed under EOI	Years of experience for item proposed under EOI shall be mentioned for either the 'JV/ Consortium in its own name & style' or 'any member of the JV/ Consortium
5.	Manpower & their qualification	No. of persons with professional qualification proposed to work in the field of EOI on direct roll of either the 'JV/ Consortium in its own name & style' or 'any member of the JV/ Consortium's or both shall be mentioned to satisfy this requirement.
7	Commitment to use Open test specifications or open source test scripting language or commitment of sharing the necessary software tools which allow for	The JV in its own name & style or the lead member of the JV/ Consortium shall submit this undertaking to satisfy this requirement.

	extension/changes to the test suite/test scenarios as per future requirement	

APPENDIX I

Format for Joint Bidding Agreement for { Consortium /Joint Venture}

(To be executed on Stamp paper of appropriate value)

THIS JOINT BIDDING AGREEMENT is entered into on this the …… day of ……20…

AMONGST

1. {…… Limited, and having its registered office at …… } (hereinafter referred to as the “First Part” which expression shall, unless repugnant to the context include its successors and permitted assigns)

AND

2. {…… Limited, having its registered office at …… }and (hereinafter referred to as the “Second Part” which expression shall, unless repugnant to the context include its successors and permitted assigns)

AND

3. {…… Limited, and having its registered office at ……} (hereinafter referred to as the “Third Part” which expression shall, unless repugnant to the context include itssuccessors and permitted assigns)

4. {…… Limited, and having its registered office at ……} (hereinafter referred to as the “Fourth Part” which expression shall, unless repugnant to the context include its successors and permitted assigns)

The above mentioned parties of the FIRST, {SECOND, THIRD and FOURTH} PART are collectively referred to as the “Parties” and each is individually referred to as a “Party”

WHEREAS,

The President of India represented by the Ministry of Railways, Principal Executive Director/RDSO, having its principal office at S&T Directorate, Annexe-II Building, Research Designs & Standards Organization (RDSO), Ministry of Railways, Manak Nagar, Lucknow – 226 011, Uttar Pradesh, India is engaged in the development of railways and related infrastructure, and as part of this endeavour, has invited reponses by its EOI for development of System Requirement Specification And Generic Test Bench For Automated System Level Function Testing Of Kavach System through a response to the EOI no No. RDSO-SIG0KVCH(GEN)/6/2026/TB.

The Parties are interested in jointly submitting bid response for the Project as members of a {Consortium /Joint Venture } and in accordance with the terms and conditions of the EOI/ RFP document and other Bid documents in respect of the Project, and

A. It is a necessary condition under the EOI/RFP document that the members of the {Consortium /Joint Venture} shall enter into a Joint Bidding Agreement and furnish a copy thereof with the Application.

NOW IT IS HEREBY AGREED as follows:

1. **Definitions and Interpretations**

In this Agreement, the capitalized terms shall, unless the context otherwise requires, have the meaning ascribed thereto under the RFP/EOI

2. { Consortium /Joint Venture}

2.1 The Parties do hereby irrevocably constitute a Consortium /Joint Venture (the "{Consortium /Joint Venture}") for the purposes of jointly participating in the Bidding Process for the Project.

2.2 The Parties hereby undertake to participate in the Bidding Process only through this {Consortium /Joint Venture} and not individually and/ or through any other {Consortium /Joint Venture} constituted for this Project, either directly or indirectly.

3. Covenants

The Parties hereby undertake that in the event the { Consortium /Joint Venture} is declared the Selected Bidder and awarded the Project, it shall enter into a Contract with the Authority for performing all its obligations as the Contractor in terms of the EOI/RFP for the Project.

4. Role of the Parties

The Parties hereby undertake to perform the roles and responsibilities as described

below:

(a) Party of the First Part shall be the Lead member of the { Consortium /Joint Venture} and shall have the power of attorney from all Parties for conducting all business for and on behalf of the { Consortium /Joint Venture} during the Bidding Process/EOI process and for performing all its obligations as the Contractor in terms of the Contract for the Project;

(b) Party of the Second Part shall be {the member of the Consortium /Joint Venture}; and

(c) Party of the Third Part shall be {the member of the Consortium /Joint Venture.}

(d) Party of the 4th Part shall be {the member of the Consortium /Joint Venture.}

5. Joint and Several Liability

The Parties do hereby undertake to be jointly and severally responsible for all obligations and liabilities relating to the Project and in accordance with the terms of the EOI/RFP and the Contract, till such time as the completion of the Project is achieved under and in accordance with the Contract.

6. Share of work in the Project

The Parties agree that the proportion of construction in the Contract to be allocated among the members shall be as follows:

First Party:

{Second Party:}

{Third Party:}

{Fourth Party:}

Further, the Lead Member shall itself undertake and perform at least 30 (thirty) per cent of the total length of the project highway if the Contract is allocated to the {Consortium /Joint Venture}

7. Representation of the Parties

Each Party represents to the other Parties as of the date of this Agreement that:

(a) Such Party is duly organized, validly existing and in good standing under the laws of its incorporation and has all requisite power and authority to enter into this Agreement;

(b) The execution, delivery and performance by such Party of this Agreement has been authorized by all necessary and appropriate corporate or governmental action and a copy of the extract of the charter documents and board resolution/ power of attorney in favour of the person executing this Agreement for the delegation of power and authority to execute this Agreement on behalf of the {Consortium /Joint Venture} Member is annexed to this Agreement, and will not, to the best of its knowledge:

i. require any consent or approval not already obtained;
ii. violate any Applicable Law presently in effect and having applicability to it;
iii. violate the memorandum and articles of association, by-laws or other applicable organizational documents thereof;
iv. violate any clearance, permit, concession, grant, license or other governmental authorization, approval, judgment, order or decree or any mortgage agreement, indenture or any other instrument to which such Party is a party or by which such Party or any of its properties or assets are bound or that is otherwise applicable to such Party; or
v. create or impose any liens, mortgages, pledges, claims, security interests, charges or Encumbrances or obligations to create a lien, charge, pledge, security interest, encumbrances or mortgage in or on the property of such Party, except for encumbrances that would not, individually or in the aggregate, have a material adverse effect on the financial condition or prospects or business of such Party so as to prevent such Party from fulfilling its obligations under this Agreement;

(c) this Agreement is the legal and binding obligation of such Party, enforceable in accordance with its terms against it; and

(d) there is no litigation pending or, to the best of such Party's knowledge, threatened to which it or any of its Affiliates is a party that presently affects or which would have a

material adverse effect on the financial condition or prospects or business of such Party in the fulfillment of its obligations under this Agreement.

8. Termination

This Agreement shall be effective from the date hereof and shall continue in full force and effect until Project completion (the “Defects Liability Period”) is achieved under and in accordance with the contract, in case the Project is awarded to the {Consortium /Joint Venture} However, in case the { Consortium /Joint Venture} is either not pre-qualified for the Project or does not get selected for award of the Project, the Agreement will stand terminated in case the Applicant is not pre-qualified or upon return of the Bid Security by the Authority to the Bidder, as the case may be.

9. Miscellaneous

9.1 This Joint Bidding Agreement shall be governed by laws of {India}.

9.2 The Parties acknowledge and accept that this Agreement shall not be amended by the Parties without the prior written consent of the Authority.

IN WITNESS WHEREOF THE PARTIES ABOVE NAMED HAVE EXECUTED AND DELIVERED THIS AGREEMENT AS OF THE DATE FIRST ABOVE WRITTEN.SIGNED, SEALED AND DELIVERED

For and on behalf of

LEAD MEMBER by:	SECOND PART	THIRD PART	FOURTH PART
(Signature)	(Signature)	(Signature)	(Signature)
(Name)	(Name)	(Name)	(Name)
(Designation)	(Designation)	(Designation)	(Designation)
(Address)	(Address)	(Address)	(Address)

In the presence of:

Notes:

1. The mode of the execution of the Joint Bidding Agreement should be in accordance with the procedure, if any, laid down by the Applicable Law and the charter documents of the executants(s) and when it is so required, the same should be under common seal affixed in accordance with the required procedure.
2. Each Joint Bidding Agreement should attach a copy of the extract of the charter documents and documents such as resolution / power of attorney in favour of the person executing this Agreement for the delegation of power and authority to execute this Agreement on behalf of the { Consortium /Joint Venture} Member.

3. For a Joint Bidding Agreement executed and issued overseas, the document shall be legalized by the Indian Embassy and notarized in the jurisdiction where the Power of Attorney has been executed.

APPENDIX II

Format for Power of Attorney for Lead Member of
{ Consortium /Joint Venture}

Whereas the [Railways] (the "Authority") has invited Bids for the ***** Project (the "Project").

Whereas, ……..., ……..., and …….. (collectively the "{Consortium /Joint Venture }") being Members of the { Consortium /Joint Venture } are interested in Bidding for the Project/submitting response to EOI in accordance with the terms and conditions of the EOI and other Bid documents including agreement in respect of the Project, and

Whereas, it is necessary for the Members of the { Consortium /Joint Venture} to designate one of them as the Lead Member with all necessary power and authority to do for and on behalf of the { Consortium /Joint Venture}, all acts, deeds and things as may be necessary in connection with the { Consortium's/ Joint Venture} Bid/response for the Project and its execution.

NOW THEREFORE KNOW ALL MEN BY THESE PRESENTS

We, …… having our registered office at ……., M/s. ….. having our registered office at …,

M/s. … having our registered office at ….., and ….. having our registered office at ……,

(hereinafter collectively referred to as the "Principals") do hereby irrevocably designate, nominate, constitute, appoint and authorize M/s ……. having its registered office at ……., being one of the Members of the {Consortium /Joint Venture}, as the Lead Member and true and lawful attorney of the Consortium /Joint Venture (hereinafter referred to as the "Attorney"). We hereby irrevocably authorize the Attorney (with power to sub-delegate) to conduct all business for and on behalf of the { Consortium /Joint Venture } and any one of us during the Bidding/EOI response process and, in the event the { Consortium /Joint Venture} is awarded the contract/shorlisted, during the execution of the Project and in this regard, to do on our behalf and on behalf of the { Consortium /Joint Venture }, all or any of such acts, deeds or things as are necessary or required or incidental to the pre-qualification of the { Consortium /Joint Venture } and submission of its Bid for the Project, including but not limited to signing and submission of all

applications, response/Bids and other documents, signing bank Guarantee for Bid security and writings, participate in EOI discussion/ pre Bid and other conferences, respond to queries, submit information/ documents, sign and execute contracts and undertakings consequent to acceptance of the Bid of

the { Consortium /Joint Venture } and generally to represent the { Consortium /Joint Venture } in all its dealings with the Authority, and/ or any other Government Agency or any person, in all matters in connection with or relating to or arising out of the { Consortium /Joint Venture } Bid/EOI response in all respect Project and/ or upon award thereof till the contract is entered into with

the Authority & Compelled.

AND hereby agree to ratify and confirm and do hereby ratify and confirm all acts, deeds and things done or caused to be done by our said Attorney pursuant to and in exercise of the powers conferred by this Power of Attorney and that all acts, deeds and things done by our said Attorney in exercise of the powers hereby conferred shall and shall always be deemed to have been done by us/ { Consortium /Joint Venture}.

IN WITNESS WHEREOF WE THE PRINCIPALS ABOVE NAMED HAVE EXECUTED THIS POWER OF ATTORNEY ON THIS …….. DAY OF ……. 2..…

For …… ….. (Signature) ……. . (Name & Title)	For …… ….. (Signature) ……. . (Name & Title)	For …… ….. (Signature) ……. . (Name & Title)	For …… ….. (Signature) ……. . (Name & Title)

(Executants)

(To be executed by all the Members of the { Consortium /Joint Venture})

Witnesses:

1.

2.

Notes:

- The mode of execution of the Power of Attorney should be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the executant(s) and when it is so required, the same should be under common seal affixed in accordance with the required procedure.
- Also, wherever required, the Bidder should submit for verification the extract of the charter documents and documents such as a board or shareholders' resolution/ power of attorney in favour of the person executing this Power of Attorney for the delegation of power hereunder on behalf of the Bidder.
- For a Power of Attorney executed and issued overseas, the document will also have to be legalized by the Indian Embassy and notarized in the jurisdiction where the Power of Attorney is being issued. However, the Power of Attorney provided by Bidders from countries that have signed Legislation Convention 1961 are not required to be legalized by the Indian Embassy if it carries a conforming Appostille certificate.

Note: Paragraphs in curly parenthesis may be omitted by the Bidder, if not applicable to it, and 'Deleted' may be indicated there

APPENDIX III

(PROFORMA FOR)

AFFIDAVIT OF UNDERTAKING

In favour of,

Principal Executive Director (S&T)

Room No: 203, Building: Manak Bhavan Research Designs & Standards Organization

Ministry of Railways

Manak Nagar Lucknow, 226011 INDIA

Name of the Project: Development, Supply, Commissioning of Generic Functional Test Bench for Kavach

Expression of Interest (EOI) Reference No : .....

Name of the Respondent in response to EOI:……..

WHEREAS the Purchaser has stipulated in EOI that the Kavach Generic Test Bench must remain adaptable to evolving test suites, operational requirements, and functional specifications;

AND WHEREAS the Respondent desires to submit its Expression of Interest (EOI) and in view of the Purchaser's stipulation in EOI is required to undertake to comply with the Purchaser's requirements for open architecture, perpetual licensing, and warranty preservation;

NOW THEREFORE, in consideration of the Purchaser's evaluation of the Respondent's EOI, I (Name of the respondent's representative) son of ……aged about…….years and resident of ……..…… ……. holding the position of …… in (name of respondent Entity) solemnly affirms that he is competent and authorized on behalf of (name of the respondent entity) and as such hereby covenants and undertakes as follows:

1. RIGHT OF MODIFICATION

1.1 We explicitly agree that the Purchaser, or any technical agency/third-party authorized by the Purchaser, possess the absolute right to modify existing test cases, rewrite test logic, add new automated test scenarios, and re-map test execution scripts to match evolving Kavach specifications.

1.2 To make these later changes legally, technically, and operationally viable without requiring proprietary tools, licensing renewals, or vendor interventions, we commit to delivering the software environment under an Open Source framework /Perpetual Unrestricted License, as detailed in Sections 2 and 3 below.

2. DELIVERY OF EDITABLE SOURCE CODE & SCRIPTS

2.1 To facilitate independent test case modification, the respondent shall supply the complete, unencrypted, and fully editable Source Code of all Test Scripts, compilation environments, testing libraries, and framework configuration files at the time of commissioning.

2.2 The Respondent warrants that no proprietary obfuscation, encryption, or digital rights management (DRM) restrictions shall be employed that would impede the Purchaser’s ability to modify test case files.

3. PROVISION OF A PERPETUAL, UNRESTRICTED MODIFICATION LICENSE

3.1 The respondent hereby grants the Purchaser a perpetual, irrevocable, worldwide, and royalty-free license to deploy any modified test cases or updated test suites onto the test bench without paying any modification fees, seat license premiums, runtime subscription fees, or vendor certification penalties.

4. PRESERVATION OF HARDWARE WARRANTY post-MODIFICATION

4.1 The respondent undertake that any later modifications, rewrites, or executions of new test cases/scripts performed independently by the Purchaser or its authorized representatives shall not invalidate, reduce, or nullify the hardware warranty or core equipment maintenance obligations of the test bench supplied under the contract.

5. ENFORCEMENT AND REMEDIES

5.1 Failure of the respondent to provide the open source files, unencrypted scripts, or the perpetual license required for modifying test cases shall result in immediate rejection of the EOI response, or constitute a Material Breach of Contract if discovered during execution of contract.

Deponent

VERIFICATION

I, the above-named deponent, do hereby verify that the contents of the aforesaid paragraphs (insert paragraph numbers, 1 to 5 above are true and correct to the best of my knowledge and belief, and nothing material has been concealed therefrom.

Verified at [City/Location,…….] this [Day, ……..] day of [Month, …….] [Year, 2026].

Deponent

Company Seal / Stamp:

Date: / / 202_

Place:

सत्यमेव जयते

GOVERNMENT OF INDIA

(भारत सरकार)

MINISTRY OF RAILWAYS

(रेल मंत्रालय)

DRAFT

FUNCTIONAL REQUIREMENT SPECIFICATION FOR KAVACH GENERIC TEST FACILITY

Document No: RDSO/GTB Kavach/FRS/2026
Version 1.0

July-2026

Issued by

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

अअमासं RDSO
रेल अग्रदूत Transforming Railways
www.rdso.gov.in

1. DOCUMENT DATA SHEET

Document No RDSO/GTB Kavach/FRS/2026		Version 1.0
Title of the Document Functional Requirements Specification of KAVACH Generic Test Bench		
Authors: Name: Shri Satish Kr Chilamkurti Designation: Director/S&T/CoE/RDSO		
Reviewed By: Name: Smt. Priya Agrawal Designation: Executive Director Tele-III		
Approved By Name: Sri Prashant Varma Designation: Executive Director Tele-III		
Abstract This document covers the draft Functional requirement Specification for KAVACH Generic Facility for functional testing at System level		

2. DOCUMENT CONTROL SHEET

Name	Designation	Organization	Level
Sri Ravi Prakash	SSE/S&T/RDSO	RDSO	Prepare
Sri R N Singh	ADE/Signal/VII	RDSO	Check
Sri Satish Kr Chilamkurti	Dir/S&T/CoE/RDSO	RDSO	Review
Smt. Priya Agrawal	ED/Tele III/RDSO	RDSO	Issued

3. DOCUMENT AMENDMENT RECORD

Version	Date	Section number	Modification/description
1.0		All	First Draft

4. TABLE OF CONTENTS

5. REFERENCES, TERMS AND ABBREVIATIONS

5.1. Reference documents

Table 1 : Reference documents

Ref. N°	Document Reference	Title
[1]	RDSO/SPN/196/2020	Functional Requirements Specification of KAVACH (The Indian Railway Automatic Train Protection System) SPECIFICATION No. RDSO/SPN/196/2020 Version 4.0
[2]	RDSO/SPN/196/2020	System Requirements Specification of KAVACH (The Indian Railway Automatic Train Protection System) Version 4.0 Amendment 3
[3]	SIF: -0533 Version- 4.2	Function Test Cases at System Level for KAVACH as per RDSO/SPN/196/2020- version 4.0 Part I and Part II SIF 0533 ver 4.22

5.2. Terms and abbreviations

Table 2 : Abbreviations

Abbreviation	**Definition**
RDSO	Research Design and Standards Organization
FRS	Functional requirement Specification
SRS	System Requirement Specification
SVK	Stationary KAVACH
OVK	On board KAVACH
SOP	Standard Operating Procedure
RIU	Remote Interface Unit
BIU	Brake Interface Unit
LS	Loco Simulator
RFID	Radio Frequency Identification
RFID-S	Radio Frequency Identification-Simulator
KMS	Key Management System
ODO	Odometry function
DMI	Driver Machine Interface
EVL	Event Logger
BS	Block Section
RCU	Radio Control Unit
DMI	Driver Machine Interface
DIS	DMI Interface Simulator
SMOCIP	Station Master Operation cum Indication Panel
LS	Loco Simulator
SS	Speed Simulator

RFID	Radio Frequency Identification
TBC	Test Bench Controller
TSE	Test Scenario Editor
TSL	Test Scenario Logger
SIM -A	Simulation Adaptor
TPS	Track Profile Simulator
TET	Test Evaluation Tool
TSR	Temporary speed Restriction
PSR	Permanent Speed Restriction

6. OBJECTIVES

5.1.1.1 This document defines the functional requirements for KAVACH reference test facility to perform functional tests on the Stationary KAVACH unit, LOCO Kavach Unit, SKAVACH Remote Interface unit and associated subsystems.

5.1.1.2 The reference generic test facility provides an environment for the execution of the tests specified in RDSO document “Function Test Cases at System Level for KAVACH as per RDSO/SPN/196/2020- version 4.0 Part I and Part II SIF 0533 ver 4.22”

5.1.1.3 It is strongly recommended to perform the tests as specified in document vide 5.1.1.2 above to check the KAVACH system designed and developed meets its required functionality and satisfy functional and system level requirements.

5.1.1.4 Function testing should start only after successful completion of type testing of way side KAVACH and onboard KAVACH equipment in line with Standard Operating Procedure (SOP) for Generic Product Approval of KAVACH.

5.1.1.5 The objective of generic test bench is to test the software of KAVACH equipment for its intended functionality. Card level hardware testing in not covered in the scope of the generic test facility.

7. INTRODUCTION

6.1.1.1 The test architecture described in this document is focused on performing the tests defined in Function Test Cases at System Level for KAVACH as per RDSO/SPN/196/2020-version 4.0 Part I and Part II SIF 0533 ver 4.22

6.1.1.2 The test cases are designed to check the functional behavior of the Wayside and Onboard KAVACH equipment.

6.1.1.3 The KAVACH equipment, is considered as a Black Box with defined interfaces and their determined range of values. The test facility shall therefore interact with the KAVACH equipment through these interfaces.

6.1.1.4 For proper testing, the test facility shall provide the appropriate inputs to the on- board and way side KAVACH equipment internal functions such as brake interface unit, odometry, RFID Tag reading, signaling conditions in that yard etc. The test facility shall provide interfaces to access event logger packets of stationary KAVACH and loco KAVACH system to analyze test results and compare the actual output with expected output.

6.1.1.5 The analysis of the tests shall be done using the data extracted from the standard interfaces.

6.1.1.6 The current test case document discussed in 5.1.1.2 describes only the test cases to check functional requirements of the KAVACH system. Combination of test cases to generate test sequences is in the scope of development of generic test facility.

8. KAVACH EQUIPMENT TEST ARCHITECTURE

8.1. Pre set up

8.1.1.1. The KAVACH equipment under test should be loaded with required software under test.

8.1.1.2. Various configuration file comprising of station configuration file and application logic, track profile, train configuration parameters, Kavach specific parameters, brake parameters etc. should be preloaded

8.1.1.3. The stationary KAVACH equipment under test should be loaded with required software under test and the application logic of the yard (track side parameters such as track profile, gradient profile shall be configured.

8.1.1.4. Connectivity to any other Remote Interface Unit/Stationary KAVACH equipment is configured and known to generic test bench

8.2. Test basics

8.2.1. Scenario definition

8.2.1.1. The test basic unit shall be the scenario.

8.2.1.2. A scenario shall be composed by the following data:

a. Test sequence information: station signaling information to be sent to the equipment under test, basic configuration parameters, timing and location of the simulation.

b. Track description (track conditions and gradient profiles).

c. Train description, comprising train formation with rolling stock type, loco type etc. for the dynamic simulation of train movement the on-board KAVACH equipment (OVK).

d. Simulations details (e.g. list of modules to be used during the simulation and their configuration options).

NOTE: The current test case document discussed in 5.1.1.2 describes only the test cases to check functional requirements of the KAVACH system. Combination of test cases to generate test sequences is in the scope of development of generic test facility.

8.2.2. Simulation phases

8.2.2.1. The entire test process shall go through several phases, which are explained below.

8.2.2.2. Preparation of the adequate internal states of the on-board KAVACH equipment and wayside KAVACH equipment, according to the specific Scenario to be tested. Yard Scenario should be set up for particular track and signal conditions.

8.2.2.3. Simulation start. Initialization and synchronization of the lab modules and the Test Adaptor: within this phase the lab modules shall prepare for the simulation and the different communication links with the Test Adaptor shall be established.

8.2.2.4. Initial communication with the Test Adaptor. Within this phase, the current yard signaling scenario data shall be provided to the adaptor.

8.2.2.5. Scenario run. The scenario starts with the power up of the OVK equipment under test (or opening the desk, depending on the Test Sequence) and finishes when the equipment under test is switched off.

8.2.2.6. Simulation stop. Within this phase, the lab modules and the Test Adaptor shall be stopped. The SVK and OVK Event logger data shall be downloaded and state of OVK and SVK should be recorded by Test bench.

8.2.3. General overview

8.2.3.1. KAVACH used single test bench to check the functionalities of both LOCO Kavach and Stationary KAVACH equipment as shown in Figure 1. For ease of understanding, the core functionalities of OVK and SVK are explained separately

8.2.3.2. The boxes shown in Figure 2 and 3, grouped within the Onboard KAVACH Equipment and Stationary KAVACH under test, are just functional modules. The internal implementation details depend exclusively on the OEM.

8.2.3.3. The boxes shown in Figure 2, grouped within the OVK Functional test bench and boxes shown in Figure 3, grouped within SVK Functional test bench are just functional modules. The internal implementation details are out of the scope of this document.

8.2.3.4. Table 1 below provides meaning of every acronym in Figure 1 and 2.

Acronym	Full form
GPS	Global Positioning System
GPS-A	Global Positioning System Adapter
GPSS	Global Positioning System Simulator
DMI	Driver Machine Interface
DMI-A	Driver Machine Interface Adapter
DIS	Driver Interface Simulator
BIU	Brake Interface Unit
BIU-A	Brake Interface Unit Adapter
BIU -S	Brake Interface Unit Simulator
RCU	Radio Communication Unit
RCU -A	Radio Communication Unit Adapter
RMS	Radio Messaging simulator
ODO	Odometry
ODO-A	Odometry Adapter
SS	Speed Simulator
RFID Reader	Radio Frequency Identification Reader
RFID -A	Radio Frequency Identification Reader Adapter
RFID-S	Radio Frequency Identification Reader Simulator
Power Unit	Power Supply Unit
Power Adapter	Power Adapter
PA	Power Analyzer
EVL	Event Logger
EVL-A	Event Logger Adapter
SIM-A	Simulator Adapter
FIM	Field Input Module
SMOCIP	Station Master Operation cum Interface Panel
SMOCIP-S	Station Master Operation cum Interface Panel Simulator
ALM	Application Logic module
TPS-A	Track Profile Simulator Adapter
TPS	Track Profile Simulator
TSE	Test Scenario Editor
TSL	Test Scenario Logger

Table 1: Acronyms in Figure 1 & 2

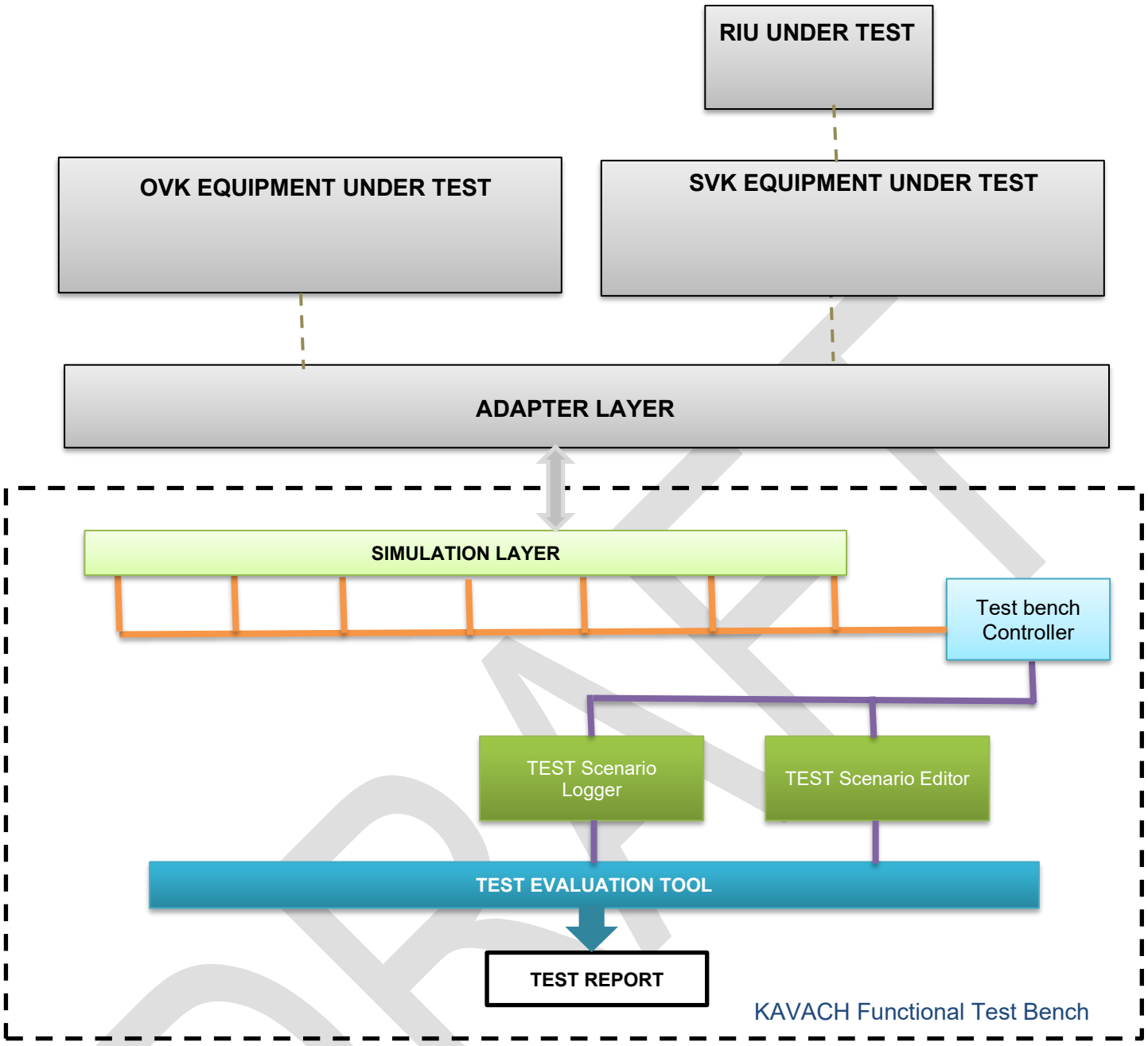

Figure 1: Reference test architecture for KAVACH equipment

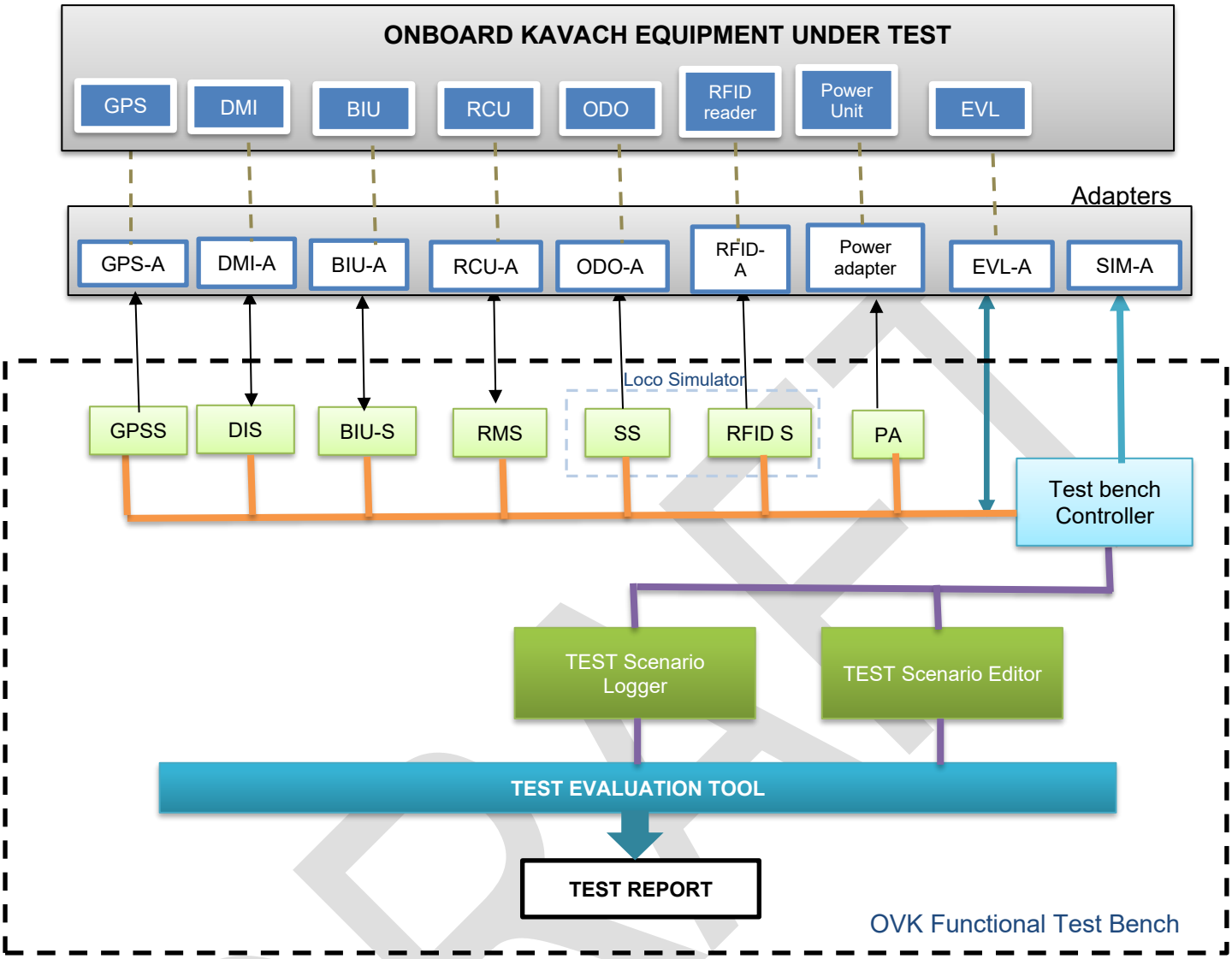

Figure 2: Reference test architecture for KAVACH on-board equipment

7.3 ONBOARD KAVACH Equipment under test

7.3.1. General

7.3.1.1. An overview of the On board KAVACH test architecture is shown in Figure 2

7.3.1.2. As described in figure 1, the equipment under test shall be composed by the On board KAVACH equipment with associated sub systems.

7.3.1.3. The functional requirements of On Board KAVACH equipment are defined in Functional Requirements Specification of KAVACH (The Indian Railway Automatic Train Protection System) SPECIFICATION No. RDSO/SPN/196/2020 Version 4.0 and System Requirements Specification of KAVACH (The Indian Railway Automatic Train Protection System) Version 4.0 Amendment 3. The interoperability requirements are also defined in the same documents.

7.3.1.4. The on board KAVACH equipment will be treated as a black box with various functional modules (simulators) of the test bench connected to the respective functional modules of the OVK equipment through adapters.

7.3.1.5. Different modules of ON board KAVACH equipment which interface with functional test bench are as follows:

7.3.2. Global Positions System (GPS)

7.3.2.1. The Onboard KAVACH equipment uses actual GPS to synchronize time with Way side KAVACH unit. The GPS module interfaces with GPS simulator through an adapter/interface.

7.3.3. Driver Machine Interface

7.3.3.1. The OVK Driver Machine Interface shall be implemented as defined in specification and managed by the corresponding reference test architecture module.

7.3.4. Brake Interface Unit

7.3.4.1. The Brake Interface Unit to the ON Board KAVACH is only defined at functional level. The BIU-A shall be used with the on-board equipment to complete the functionality provided by the Reference Test Facility.

7.3.4.2. The BIU -A shall exchange brake command with BIU simulator and simulate braking in OVK.

7.3.4.3. The status of execution of brae commands shall be read back by OVK through BIU

7.3.5. Radio Communication Unit

7.3.5.1. The test bench should interface with radio communication unit of OVK through an adapter. The simulated radio packets will be transmitted to the OVK units through RMS of the generic test bench.

7.3.5.2. This prevents usage of actual radio and antenna and help simulate radio packets as per different scenarios in field. The OVK will process the Radio message as received by its radio communication unit.

7.3.6. Odometry

7.3.6.1 The Odometry of the locomotive shall process the location data and connect with speed simulator through an interface/adapter to give an update of absolute location/speed to the On board KAVACH equipment.

7.3.6.2 The odometry sensors providing computable data to the ON board KAVACH internal odometry function shall not be included. In its place an ODO-A shall be used.

7.3.6.3 The OVK calculates its current position using this input and actuates necessary command. The raw data for the Odometry shall be provided by the Speed Simulator.

7.3.7. RFID reader

7.3.7.1 The RFID reader reads the RFID tag and passes this information to OVK Vital computer. Actual hardware of RFID reader may not be fully implemented and functionality to be interfaced through an adapter.

7.3.7.2 The raw data for RFID reader shall be provided by RFID tag simulator.

7.3.8. Power Unit

7.3.8.1 The Power unit controls the supply to different cards of the OVK equipment. The unit can switch ON/OFF the OVK as requited based on command received from test bench. The test bench interfaces with power unit through a power adapter.

7.3.9. Event Logger

7.3.9.1 For the interface to the On-board event recording device, included in the Rolling Stock Subsystem, only the functional description of the information is included. The test bench shall use an adapter to access logs of OVK and check different states of OVK during functional testing process.

7.3.10 **The Key Management system interface** shall be managed internally by the on-board KAVACH equipment through SIM card installed and is not intended to be connected to the reference test architecture module.

7.4. STATIONARY KAVACH Equipment under test

7.4.1. General

7.4.1.1. An overview of the On board KAVACH test architecture is shown in Figure 3

7.4.1.2. As described in figure 3, the equipment under test shall be composed by the Stationary KAVACH equipment (SVK) with associated sub systems.

7.4.1.3. The functional requirements of Stationary KAVACH equipment and RIU are defined in Functional Requirements Specification of KAVACH (The Indian Railway Automatic Train Protection System) SPECIFICATION No. RDSO/SPN/196/2020 Version 4.0 and System Requirements Specification of KAVACH (The Indian Railway Automatic Train Protection System) Version 4.0 Amendment 3. The interoperability requirements are also defined in the same documents.

7.4.1.4. The Stationary KAVACH equipment and connected RIU will be treated as a black box with various functional modules (simulators) of the test bench connected to the respective functional modules of the SVK equipment through adapters.

7.4.1.5. Different modules of SVK equipment which interface with functional test bench are as follows:

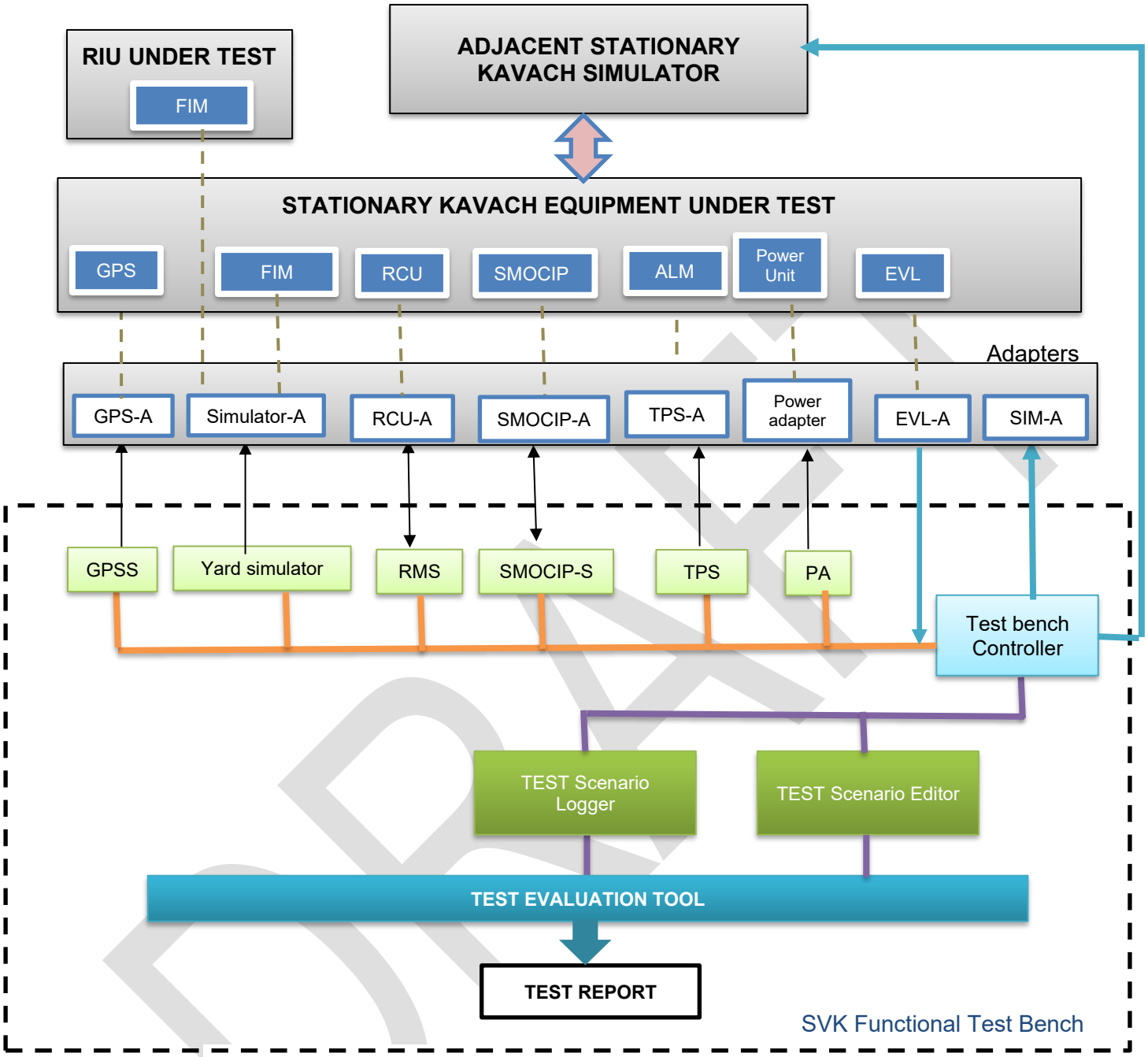

Figure 3: Reference test architecture for KAVACH way side equipment

7.4.2. Global Positions System (GPS)

7.4.2.1. The way side KAVACH equipment uses actual GPS to synchronize time with On-board KAVACH unit. The GPS module interfaces with GPS simulator through an adapter/interface.

7.4.3. Field Input Module

7.4.3.1. The track side signaling information shall be given to SVK equipment through various field input interfaced with field input modules.

7.4.3.2. The simulated yard field inputs (signal ECR, Point WKR, Track TPS, LCPR etc.) are given to FIM card of SVK through suitable relay adapters.

7.4.4. Radio Communication Unit

7.4.4.1. The test bench should interface with radio communication unit of SVK through an adapter. The simulated radio packets will be transmitted to the SVK units through RMS of the generic test bench.

7.4.4.2. This prevents usage of actual radio and antenna and help simulate radio packets as per different scenarios in field. The SVK will process the Radio message as received by its radio communication unit.

7.4.5. SMOCIP

7.4.5.1. The Station Master Operation Cum Indication Panel is connected to SVK and provided SOS related inputs to SVK.

7.4.5.2. The SMOCIP functionality and Interface shall be implemented as defined in specification and managed by the corresponding reference test architecture module

7.4.6. ALM

7.4.6.1. The application logic module has the yard specific static signaling information, track profile, gradient profile, and other vital information that SVK uses to calculate Movement authority.

7.4.6.2. The test bench shall be able to access this module to load the missing track profile information. The KAVACH OEM can also suggest an alternative way to alter track profile to carry out track profile related functional test cases through generic test bench**.**

7.4.7. Power Unit

7.4.7.1. The Power unit controls the supply to different cards of the SVK equipment. The unit can switch ON/OFF the SVK as requited based on command received from test bench. The test bench interfaces with power unit through a power adapter.

7.4.8. Event Logger

7.4.8.1. For the interface to the Stationary Kavach event recording device, only the functional description of the information is included. The test bench shall use an adapter to access logs of SVK and check different states of SVK during functional testing process.

7.4.9. Adjacent Stationary KAVACH Simulator

7.4.9.1. The SVK equipment under test has to communicate with adjacent SVK equipment for ensuring seamless transfer of information, track profile, TSR, PSR and MA related packets in areas where OVK has to maintain continuous communication with SVK.

7.4.9.2. The requirements for SVK to SVK communication are defined in Annexure P of SRS of KAVACH under reference [2] above.

7.4.9.3. The SVK shall be able to handle up to 6 instances of such simulator.

7.4.9.4. This simulator should interface with RFID tag simulator also to exchange border tag related information and pass it to SVK equipment under test when requested.

7.4.9.5. It should simulate the adjacent station KAVACH communication protocol to exchange various packets as defined in specification with SVK equipment under test

7.4.9.6. Implementation should be in real-time.

7.4.10 **The Key Management system** interface shall be managed internally by the stationary KAVACH equipment through SIM card installed and is not intended to be connected to the reference test architecture module.

7.5 The Test Adaptor

7.5.1 General

7.5.1.1 The Test Adaptor is a module (no matter the implementation details) provided by the KAVACH equipment supplier.

Note: if agreed by both KAVCAH equipment supplier and the Test Bench Provider, it is allowed to use a combined solution for the test adaptor. In any case, the performance requirements for the Test Adaptor shall be proven.

7.5.1.2 Its main functions shall be to interact with the reference test bench modules and provide function related inputs to different subsystems of the OVK KAVACH equipment and SVK KAVACH equipment

7.5.1.3 The function outputs of the OVK equipment and SVK equipment are also given to the reference test bench through these adapters.

7.5.1.4 The interfaces to be managed by the Test Adaptor shall be related to yard signaling scenario generation, loco odometry, brake interface, driver machine interface, odometry, radio communication protocol, SMOCIP, GPS, RFID tag reading, access to OVK and SVK data loggers, station application logic, (if required to access track profile) etc.

7.5.2 Functional description

7.5.2.1 For the GPS interface, the GPS-A shall manage the unidirectional communication with the GPS module. It shall get the time information from the GPS simulator as raw data, and shall transfer this information to the GPS module of the on-board KAVACH and stationary KAVACH equipment as computable data. The adapter should interface the GPS simulator with the KAVACH GPS modules using same protocol and physical interface as used by KAVACH equipment.

7.5.2.2 The DMI interface adapter shall manage the bi-directional communication with the On board KAVACH DMI module. The DMI module is directly connected to OVK Vital computer using physical connectors. The DMI adapter shall get the LP inputs information from the

DMI simulator as raw data, and shall transfer this information to the OVK vital computer. Also, the information which OVK displays on DMI screen, should be interfaced through this adapter and displayed on DMI simulator to analyze the test results/test inputs by the test bench.

7.5.2.3 For the BIU interface, the BIU-A shall manage the bidirectional communication with the BIU module. It shall read the status of the BIU implemented inputs from the OVK and shall redirect and write this information in the appropriate format to the Speed simulator. The communication shall not be periodic, but produced upon a change on the BIU signal status. The status feedback from BIU of OVK to BIU-A shall include Brake pipe Pressure and Brake cylinder pressure.

7.5.2.4 For the ODO interface, the ODO-A shall manage the unidirectional communication with the Speed simulator module. It shall get the location, speed and acceleration information from this module as raw data, and shall transfer this information to the on-board KAVACH equipment as computable data in the appropriate internal conditions.

7.5.2.5 For the radio communication interface, the RCU-A shall manage the bi-directional communication with the On board and way side KAVACH equipment. The radio message generated by SVK shall be transmitted to the communication module of OVK through this interface via radio message simulator. The radio message generated by OVK shall be transmitted to the communication module of SVK through this interface via radio message simulator in compliance with KAVACH radio protocol.

7.5.2.6 For RFID interface, the RFID-A shall manage the unidirectional communication with the OVK. It shall get the RFID tag read information from loco simulator and shall transfer this information to the OVK in the appropriate data format as defined in specification.

7.5.2.7 The SMOCIP interface adapter shall manage the bi-directional communication with the Stationary KAVACH. The SMOCIP module is directly connected to SVK Vital computer using physical connectors. The SMOCIP adapter shall get the SOS inputs information from the SMOCIP simulator as raw data, and shall transfer this information to the SVK vital computer. Also, the information which SVK displays on 7 segment LED screen, should be interfaced through this adapter and displayed on SMOCIP simulator to analyze the test results/test inputs by the test bench

7.5.2.8. For the Track profile simulator adapter, TPS-A shall manage the unidirectional communication with the SVK. It shall get the track profile parameters from the simulator and shall transfer this information to the vital computer of SVK. The KAVACH OEM can also suggest an alternative way to alter track profile to carry out track profile related functional test cases through generic test bench**.**

7.5.2.9. For yard simulator interface, Simulator-A shall manage the unidirectional communication with the SVK. Yard dynamic conditions (signal, track, point status) shall be simulated and given to the field input module of the SVK unit. Some OEMs are feeding the inputs directly to vital computer of SVK through this interface.

7.5.1.10 For the EVL interface, the EVL-A shall manage the unidirectional communication with the SVK module. The EVL-A shall manage the bi-directional communication with the OVK module. It shall deliver all the logged data from SVK event logger to the test bench logger to analyze test results. It shall deliver all the logged data from OVK event logger to the test bench logger to analyze test results. Additionally, test bench shall be able to access KMS keys related information stored in EVL to run some KME relates test cases.

7.5.1.11 The Power Adaptor shall manage the unidirectional communication with the OVK and SVK. It shall be able to switch OFF/ON the Kavach system on start and stop of test scenario. The Power Adaptor shall be capable to create a System Failure condition to the On-board and stationary KAVACH equipment.

7.5.1.12 The simulation adaptor sends and receives simulation management commands from the Reference Test Bench. The commands shall include the possibility to start and stop the test and power up and down the on-board/wayside equipment.

7.5.3 Performance requirements

7.5.3.1 The performance requirements to be fulfilled by the SVK and OVK are already mentioned in System Requirement specification.

7.5.3.2 The performance requirements for interoperability related to BIU (i.e. brake orders) shall be made extensive to the BIU-A and to every BIU output. The simulated BIU shall simulate and interface with all kinds of brake interface systems.

7.5.3.3 For the RCU inputs, the RCU Adaptor and RMS shall not introduce delays such that the cycle time of radio message exchange between OVK and SVK exceeds 2 seconds.

7.5.3.4 For Event logger function in Test Adaptor, no performance requirements are necessary since the data flow from EVL of SVK and OVK does not need to be synchronized.

7.5.3.5 The accuracy requirements related to ODO interface (i.e. position and speed accuracy) described in KAVACH SRS shall be respected, taking as reference the position and speed generated by the corresponding laboratory module.

7.6 Generic KAVACH Test Bench

7.6.1 General issues

7.6.1.1 The test to be performed is described in the Test Scenario Editor (TSE).

7.6.1.2 *Development of TSE is very much in the scope of this document. A database of all test cases is to be created and connected test cases to be combined to create test scenarios.*

7.6.1.3 The test bench Controller (TBC) permits the selection of the Scenario to execute and configures the remaining modules before the simulation starts. The TBC module also performs monitoring tasks during the simulation.

7.6.1.4 The simulation start/stop shall be reported not only to the Test bench, but also to the Test Adaptor.

7.6.1.5 The modules in charge of simulating the train movement are Speed simulator and RFID simulator. Together they are called as LOCO Simulator.

7.6.1.6 The Speed simulator calculates the travelled distance and provides this datum to the relevant modules and the odometry information to the OVK equipment. The Loco simulator calculates the speed and acceleration of the train taking into account the interventions read from the BIU and the predefined speed profile

7.6.1.7 The BIU-S manages the BIU signals, including the on-board commands affecting the train dynamics.

7.6.1.8 The modules in charge of simulating the yard conditions of signals, points and tracks is Yard simulator.

7.6.1.9 During the simulation, according to the information included in the Scenario, different inputs shall be sent to the stationary and loco KAVACH equipment to perform the test, while the outputs shall be managed and recorded in TSL

7.6.1.10 The RMS manages the radio messages exchange between OVK and SVK according to the travelled distance, time constraints and conditions about having received or sent other messages previously.

7.6.1.11 The GPSS connected to SVK and OVK GPS module conveys the current time information to KAVACH system.

7.6.1.12 The DIS module record the information displayed on DMI. It also sends the DMI inputs to the DMI internal interface as required to be given in the test scenario. This includes Post Trip mode selection, Override mode selection, Train configuration inputs, Acknowledgement to various prompts on DMI (such as unusual stoppage in BS etc.)

7.6.1.13 The TSL collects data from the laboratory modules while the simulation takes place.

7.6.1.14 Once the simulation has finished and all the information from the OVK and SVK has been retrieved by the test facility modules, they can be accessed by the AET, which shall compare the logged data with the Test Sequence description and produce a report with the estimated results.

7.6.1.15 Many of the previous modules require interacting with the test operator (user). GUI interface is preferred.

7.6.1.16 In the following sections, every module of the Generic KAVACH Test Bench is described in detail, from a functional point of view. Performance requirements have been added where considered critical for the simulation. For any other case, the only request is the integrity of the information to be transferred from one module to other.

7.6.1.17 AT physical layer, Most of the interfaces defined in Test bench will be serial (RS 232 and RS 485) interfaces. The interface of Yard simulator and some other modules with KAVACH equipment may be over Ethernet.

7.6.1.18 Currently all KAVACH OEMs are not having similar interfaces for simulators and adapters. A further study is required in this area.

7.6.2 Test Scenario Editor (TSE)

7.6.2.1 This module shall allow managing the scenarios to be used in the simulation. It shall implement as basic functions to create, edit, delete and save a scenario.

7.6.2.2 This module shall allow accessing all the information included in Function Test Cases at System Level for KAVACH as per RDSO/SPN/196/2020- version 4.0 Part I and Part II SIF 0533 ver 4.22.

7.6.2.3 Test case data base and sequences created (which is also in the scope of this FRS) are the input to the TSE.

7.6.2.4 This module shall also permit to define simulation details (e.g. list of modules to be used during the simulation and their configuration options) for every scenario.

7.6.2.5 Once all the information is completed and the scenario is saved, it shall be stored into data sets that shall be available for the other modules for a proper testing.

7.6.2.6 Optionally, this module can provide some correctness checks in order to avoid undesired mismatches among all the data to be used for a proper simulation.

7.6.3 Test Bench Controller (TBC)

7.6.3.1 This module shall manage the synchronization with the modules interfacing the OVK and SVK under test and with the Test Adaptors.

7.6.3.2 During the simulation, this module shall perform surveillance tasks to control the right behavior of the laboratory modules involved.

7.6.3.3 The mandatory user interface functions for this module are related to the simulation management. At least, it shall be possible to select the scenario, start, /stop the simulation and power up/down the OVK and SVK equipment as required.

7.6.3.4 Optionally, it will be possible to send a signal to the Test Adaptor in order to generate a System Failure condition to the OVK and SVK equipment.

7.6.3.5 The optional user interface functions for this module are related to the display of general information during the simulation run, retrieved by the modules interfacing the KAVACH equipment under test. This general information comprises, at least, yard condition, train speed and location, RFID tag read, DMI status, SMOCIP status and messages exchanged through radio.

7.6.3.6 As this module is in charge of controlling and monitoring the simulation, it must handle several communication links. Although the information exchanged is not time critical for the simulation, it is recommended a real time implementation in order to guarantee a predictable and faulty-free behavior.

7.6.4 Brake Interface Unit Simulator (BIU-S)

7.6.4.1 The BIU-S will account for the communication with the Test Adaptor related to brake interface data. This communication shall be bidirectional and shall cover all the train interface information.

7.6.4.2 The BIU-S should be able to simulate interfaces for different kind of brake systems used in KAVACH equipped locomotives.

7.6.4.3 The BIU inputs status (i.e. generated by BIU) shall be transferred to the BIU-A once, before the on-board KAVACH equipment is powered up. Later on, when the scenario is running, BIU shall only update this information to BIU-S upon change.

7.6.4.4 The set of BIU input data which are exchanged with OVK are as follows :

a) Brake pipe pressure

b) Brake cylinder pressure

7.6.4.5 The BIS module, when detecting a change on this set of BIU inputs, shall report this information to the loco simulator module.

7.6.4.6 The following BIU outputs affects the speed simulation and shall be managed accordingly:

a) Normal Service Brake

b) Full Service Brake

c) Emergency Brake.

d) Traction Cut-off.

7.6.4.7 All the information exchanged between the BIU-S and the BIU-A shall be reported to the TSL with the corresponding timestamp and location. The module status information shall be reported as well.

7.6.5 Speed Simulator (SS)

7.6.5.1 The sped simulator will account for the communication with the Test Adaptor related to Odometry data. This communication shall be unidirectional and shall be performed either on a cyclic basis, or in a continuous way.

7.6.5.2 This module shall provide speed and acceleration to the ODO-A. All this information shall be updated periodically by the Loco Simulator.

7.6.5.3 This module shall calculate the train absolute location from the dynamic data provided by the loco simulator. This absolute location data shall be available for the remaining modules included in the reference test bench for decision making.

7.6.5.4 This module shall report to the event logger the location information with timestamp on a cyclic basis. The module status information shall be reported as well.

7.6.5.5 In case the odometry data is transmitted cyclically to the ODO-A, this communication cycle shall be identical to the time cycle used for the location calculation. In case the odometry data is transmitted continuously to the ODO-A, the generated speed shall not deviate more than 1% from the theoretical speed.

7.6.5.6 The module should be implemented in real time.

7.6.5.7 This module should take following data from BIU-S:

a. Service brake (Normal and Full service)

b. Emergency brake

c. Traction cut off

7.6.6 RFID simulator (RFID S)

7.6.6.1 The RFID simulator reads the RFID tags en-route based on the route defined by yard simulator. The RFID tag simulator will have the tag data of all the tags intended to be read for given train route and share this information with OVK.

7.6.6.2 It can generate Tag MISS situation, if a particular tag is required not to be read by the OVK RFID reader.

7.6.6.3 The communication between RFID -S and RFID reader shall be unidirectional and shall be performed at regular interval as defined in the actual hardware. The cycle time should be such that there should be no unintentional TAG MISS even when OVK is simulated to run at speeds up to 200kmph.

7.6.6.4 It is desired that since the tag read is based on absolution location of the speed simulator, the information should be communicated on real time basis.

7.6.6.5 All the information exchanged between the RFID-S and the RFID-A shall be reported to the TSL with the corresponding timestamp, location and RFID tag information. The module status information shall be reported as well.

7.6.6.6 Speed simulator and RFID simulator can be implemented as one unit. Same has been implemented by some KAVACH OEM and called as Loco simulator.

7.6.7 Radio Message Simulator (RMS)

7.6.7.1 This module shall simulate the radio messages for communication between OVK and SVK

7.6.7.2 This module shall interface with the Radio control unit of SVK and OVK and should pass on the messages to KAVACH through RCU-A.

7.6.7.3 The RMS should implement the same radio protocol as implemented in actual KAVACH environment where actual transmitter, radio modem and receiver antenna are used.

7.6.7.4 It shall be possible to create delays through this simulator in radio message reception at either OVK or SVK end to test field like conditions.

7.6.7.5 It shall be possible to create radio packet loss through this simulator in radio message reception at either OVK or SVK end to test field like conditions.

7.6.7.6 It shall manage the OVK and SVK radio messages timestamp in real time, according to the test sequences description and restrictions

7.6.7.7 The module status information shall be reported to TSL.

7.6.7.8 Radio packets are exchanged between OVK and SVK at a cycle of every 2 sec. The simulator should be able to meet that condition.

7.6.7.9 If required, it shall emulate at least two UHF radio terminals, at logical level. The behavior at logical level shall be programmable and shall include the registration in radio networks etc.

7.6.7.10 This module shall allow generating connection losses at predefined locations and distances. It shall manage predefined radio hole sections.

7.6.8 Driver Machine Interface Simulator (DIS)

7.6.8.1 In addition to the simulator features, the DMI simulator should mimic the button inputs and screen outputs of the Driver Machine interface used in KAVACH

7.6.8.2 It shall record every input and output on the DMI device in digital format

7.6.8.3 It shall be possible to give inputs (which the loco pilot gives through DMI to OVK) through this simulator to the OVK equipment under test.

7.6.8.4 At start of mission, train configuration is selected through DMI by loco pilot in actual field situation. This simulator should allow to select that particular train configuration from set of options available and pass this configuration to OVK for further selection of KAVACH parameters and brake parameters from already stored configuration files in OVK.

7.6.8.5 Optionally, it shall manage in an autonomous way the DMI inputs described in the Test Sequence, permitting in this way an automatic simulation with no operator.

7.6.8.6 It should also communicate to Test bench controller and TSL various DMI events appearing on the DMI screen. This is related to display of Movement authority, signal aspect ahead, special message, mode of operation etc.

7.6.8.7 The DMI screen is divided into different regions showing specific information. The OVK DMI event packet as received by the simulator should be logged in TSL and displayed on the DMI simulator as done on the actual hardware.

7.6.8.8 Real time implementation is requested.

7.6.9 Global Positioning System Simulator

7.6.9.1 The GPS simulator should simulate GPS timing information and give as an input to the GPS module of OVK and SVK

7.6.9.2 This is required to run GPS diagnostic related test cases. These test cases are related to GPS failure, GPS timing mismatch of OVK and SVK etc.

7.6.9.3 Since the test cases are limited, currently actual GPS is being used in OVK and SVK as part of test set up. Development of GPSS can be taken up subsequently.

7.6.9.4 Implementation should be in real GPS time.

7.6.10 Power Analyzer (PA)

7.6.10.1 This module simulates voltage pulses to be given to different modules of OVK and SVK

7.6.10.2 Through this simulator, it shall be possible to switch OFF/ON any modules of OVK and SVK and inject power supply related faults.

7.6.11 Test Scenario Logger (TSL)

7.6.11.1 This is the heart of test bench where all the test cases are logged.

7.6.11.2 It interfaces with the event logger card of OVK and SVK to record logs to various states of the KAVACH equipment under different test scenario.

7.6.11.3 All test sequence logs are also stored in this module along with detailed logged data packets of different simulators used in Generic Test bench.

7.6.11.4 The communication shall be unidirectional, from OVK and SVK equipment to the TSL.

7.6.11.5 In order to avoid undesired drifts in this time cycle, for this module a real time implementation is requested.

7.6.12 SMOCIP Simulator (SMOCIP-S)

7.6.12.1 Similar to DMI simulator, this module simulates the SMOCIP available in Station Master room.

7.6.12.2 The SMOCIP simulator should mimic the SOS button inputs and 7 segment LED screen outputs of the Station Master Operation cum Indication Panel (SMOCIP)

7.6.12.3 It shall record every input and output on the SMOCIP device in digital format

7.6.12.4 It shall be possible to give inputs (which the Station Master gives through SMOCIP to SVK) through this simulator to the SVK equipment under test.

7.6.12.5 Heath of various modules of SVK is displayed on the SMOCIP. In case of any hardware fault, the fault code is also displayed on the SMOCIP. This simulator should allow to access the SVK health information and provision of SOS button inputs to SVK.

7.6.12.6 Optionally, it shall manage in an autonomous way the SMOCIP inputs described in the Test Sequence, permitting in this way an automatic simulation with no operator.

7.6.12.7 Real time implementation is requested.

7.6.13 Yard Simulator

7.6.13.1 Yard Simulator is a track simulator. It simulates field condition of points, route and signals and give these inputs to field input modules of the SVK.

7.6.13.2 For a particular position of the loco, movement authority packets are created by SVK based on the status of field signaling gears which are simulated using this simulator.

7.6.13.3 Implementation is required in real time.

7.6.14 Track Profile Simulator

7.6.14.1 The Track profile simulator is required to alter the track profile data in SVK as part of test case requirement.

7.6.14.2 The track profile is currently part of application logic of SVK and different OEMs use their proprietary compilers to generic this application logic.

7.6.14.3 *Specific requirements of track profile simulator are yet to be explored*.

7.6.15 Test Evaluation Tool (TET)

7.6.15.1 This is an off line module used to compare the data logged during the simulation with the expected behavior of the Onboard and Stationary KAVACH equipment described in the Test cases.

7.6.15.2 The data logged shall comprise the data recorded by TSL and the data recorded by OVK and SVK Event logger.

7.6.15.3 The observables shall be directly traced to a specific record within the whole set recorded by the different test bench modules.

7.6.15.4 The comparison mechanism shall be in fact a search of the defined observable within the Test Sequence description in the correct time and location window.

7.6.15.5 The test evaluation shall provide additional algorithms in order to avoid duplicated matches and solve the dependencies among consecutive steps.

8 SYSTEM INTEGRITY AND VALIDATION

8.1.1.1 The implementation of the KAVCAH Generic test bench shall be used to test Stationary and On -board KAVACH equipment which shall be SIL 4, although it can include components with a lower SIL.

8.1.1.2 The test bench shall be calibrated before and after testing KAVACH equipment. The calibration shall be done according to the procedures defined by Railways.