Essential Details of Items/Services Required

1. **Schedule of Requirements:** List of items / services required are as follows –

Name/Description of Item(s)/Service(s)	Unit of Measure	Qty required
Work package for OTS	Job	01

2. **Technical Details:**

Contents

2.1. Statement of Work for Work package for OTS

2.1.1 Introduction

Centre for Air Borne Systems (CABS) is one of the major DRDO Labs entrusted with the development, integration, and testing and flight evaluation of Airborne Surveillance Systems. The OTS Facility is the Nerve Centre for all OTS and OBT Related activities of many ongoing and futuristic Projects/ Progammes under perview of CABS. The OTS facility will be operated by Fighter Controllers and Mission Operators for Training Purpose. The OBT will be used for providing On-Board Training. This will be an integrated training center where the instructors shall create detailed simulated scenarios, or the actual mission scenarios will be recreated in order to train the operators. The trainee's actions and response to the simulated scenario as displayed on the Trainee Operator Station (TOS) shall be monitored by the instructors.

OTS facility is envisaged to have following simulators:

i. War Gamming simulator (War Gaming Controller)
ii. Instructor Operator Station (IOS Application)
iii. Software-in-loop simulation controller
iv. SOS simulator
v. Frontal and Dorsal Radar Simulator (PRSIM)
vi. Identification Friend or Foe Simulator (IFF SIM)
vii. Electronic Support Measure Simulator (ESM SIM)
viii. Communication Support Measure (CSM SIM)
ix. Data Link Simulator (CBDL & KBDL)
x. ADS-B Simulator
xi. SDR Simulator
xii. IACCS Simulator
xiii. AIS Simulator
xiv. GES Simulator
xv. Network time services
xvi. 3D Map content creation and management

In addition to the above simulators, there will be On Board Training (OBT) mode provided in the airborne segment of Airborne Systems.

The OBT shall not only simulate the arena but shall also simulate sensor simulator systems and their interfaces to project a simulated arena similar to the real arena. OBT system involves following simulators:

a. OBT Controller application
b. PR, IFF, ESM, CSM
c. Navigation simulator
d. Scenario Generator Instructor Application
e. OBT IRS

This document describes the detailed Statement of Work (SOW) to be carried out by the industry partner selected through the tendering process.

2.2 Scope of Work

Broad scope of work involves documentation, development and delivery of software along with certification of software. The software/codes developed for the above packages shall be modular in such a way that they can be re-used for the future programmes of CABS. The software shall be developed in the same frame work that is already defined by CABS. The software developed shall be accompanied by design diagrams like the class diagrams/ sequence diagrams and relevant documentation. Broad scope of works is listed in Table below.

Sr. No.	Work objectives	Details
1.	**Documentation for all simulators software** (as per section 1 using DOORS or equivalent SW**)**	• Plan for Software Aspects of Certification (PSAC) • Software Development Plan (SDP) • Software Verification Plan (SVP) • Software Configuration Management Plan (SCMP) • Software Requirement Specification (SRS) • Software Design Document (SDD) • Interface Requirement Specification (IRS)

		• Software Test Plan (STP) • Software Test Description (STD) • Software Test Report (STR) • Version Description Document (VDD) • User Manual • Operator Manual for IOS of OTS • Operator Manual for IOS of OBT • Maintenance Manual for OBT • HMI Document (IOS of OTS and OBT) • Installation Manual • Acceptance document • Human Machine Interface (HMI) Document for OTS and OBT ✓ Instructor (IOS) Software application ✓ OBT Controller application (OBT) ✓ War Gaming Controller (OTS) • Software Architecture Document: ✓ IOS of OTS and OBT (Instructor application software) ✓ All Sensor Simulator software ✓ War Gaming Controller (for OTS) ✓ OBT Controller (for OBT)
2.	**Development of simulator software for OTS and OBT (with Qt framework)**	• SIL controller • Frontal and Dorsal Radar Simulator (**PR SIM**) • IFF simulator (IFF SIM) • Navigation (Nav) Sensor Simulator (NAV SIM) • Systems Operator Station (SOS SIM) • ESM simulator (ESM SIM) • CSM simulator (CSM SIM) • Data Link simulator (KBDL & CBDL SIM) • Instructor Operator Station Application Software (OTS and OBT VS.Net) (IOS Application) • War Gaming Simulation Controller (OTS) (WGS Application) • OBT Controller (OBT: QT) (OBT Controller Application) • MCS simulators – SDR (MCS SIM) • IACCS simulator (IACCS SIM) • GES simulator (GES SIM) • AIS and ADS-B simulator (AIS & ADS-B SIM) • 3D Map content creation (3-D Map)

3.	**Development of Simulation control application software for OTS and OBT**	• NTP Time synchronization • Health & Hardware BIT • Data Logger • Troubleshooting • Database management (MySQL/MS Access) • Command Listener application for IOS stations
4.	**Software Version Control, bug reporting, fixing, milestone tracking**	• Git client/server repositories & Version control • Suitable s/w for milestone tracking and reporting • Bug fixing
5.	**Integration & testing of subsystem simulators for OTS and OBT**	• Software in Loop (SIL) & Hardware in Loop (HIL) • Lab setup • Rig Setup • Standalone
6.	**Software Certification for OTS and OBT**	• The standard for software certification is as per DO-178C Level C as specified by CEMILAC. • The industry partner shall prepare documents as per IEEE 12207 templates provided by CABS. • The industry partner shall write code as per MISRA-C/MISRA-C++ or equivalent coding standard.

2.2.1 Software Development Environment

The typical software development environment for the project will include the following software tools:

i. Windows / RHEL / Ubuntu (latest version)

ii. C/C++, Python

iii. Qt and Visual studio 2019 and above

iv. STAGE software

v. IBM Software Engineering Tools (DOORS, Workflow Management, Test Management, Quality Management, Rhapsody) or equivalent

The software tools for the development listed above shall be provided by CABS. The software needs to be developed with cross platform support.

2.2.2 Work packages

Work Package – I: Design & development of Instructor Scenario Generation Software

Work Package – II: Design and development of sensor and communication simulators

Work Package –III: Integration & Testing of all subsystem simulators

Work Package –IV: Documentation, Certification, Setup, installation, deliverables and Knowledge transfer (KT)

2.2.3 Details of Work packages

Sl.NO	Work package	Work Description	Brief Work activities
1	**Work Package-I**	Design & development of Instructor Scenario Generation Software	**A. WGS Controller Application** i. Configuration settings ii. BIT Statuses **(Team1: 6 IOS + 6 TOS & Team2: 4 IOS + 4 TOS)** iii. Simulation Control: • SIL simulation controller application • War Gaming controller Station iv. NTP time synchronization • Query based • Broadcast mode v. IRS Implementation vi. Controlling execution of SG-IOS and SIM in automation (for team1 & team2 of war simulation)
			B. OBT Controller Application i. Configuration settings for OBT ii. BIT Statuses (BIT messages) & Health management iii. Mode switch commands iv. Simulation Control: Master/slave SG-IOS configuration setup v. Sim engine & sensor application invocation in automation vi. Handling of OBT Controller systems: SBC Board1, Board2 and Board3 vii. Porting applications on SBC Board1, Board2 and Board3 Automation of IOS: Instructor, Simulated Pilot and Sensor Simulators
			C. Scenario Simulation IOS Application A. Ground segment: IOS for OTS system (Configuration 1:Team1:6 Instructors+6 Trainees & Team2: 4 Instructors +4 Trainees) & Configuration 2 :Team:10 Instructors+10Trainees) **B.** Airborne segment: IOS for OBT system (1Insructor+1Simulated Pilot) ***IOS Application for OTS and OBT (.Net Visual Studio 2019 and above)*** i. Customization & enhancement of third-party simulation tool to cater for new sensors like ADS-B, AIS, SOS, KBDL, CBDL etc. ii. Scenario Tactical Database Management & centralized repository management for forces/teams iii. Scenario Planning, DB management (arena DB and config. management), and running a simulation module

Sl.NO	Work package	Work Description	Brief Work activities
			iv. Import scenario module (from external sources like kinematic data, INS/GPS) data etc. v. Simulated pilot & Simulated Entity Maneuvering functionalities vi. Various Simulated pilot and Instructor functionalities vii. Master-slave & DIS/HLA environment setup using third party simulation tools. viii. Ammunition/weapon management functionalities like Chaff, Missile etc. ix. Communication channel and entity ownership management x. ESM Sensor attributes dynamic data implementation xi. Incorporating MPD data in SG-IOS (implementation) for OTS & OBT
			D. Scenario Generation through MRD Data **A. Scenario Import** Optimizing the Route data using AI/ML algorithm B. **Scenario generation automation** Scenario creation using positional coordinate-based training dataset
			E. SIM Engine and DIS/HLA Interfacing i. Setting up DIS/HLA for communication through Protocol Data Units. ii. Customization of Sim Engine module to incorporate various sensor attributes iii. Defining and setting up general PDUs for communication using DIS/HLA iv. Encoding and decoding of PDUs for communicating with sensor simulators over Ethernet v. Working with customized PDUs to cater for specific sensor attributes vi. Truth data vii. Communication channel and entity ownership management with DIS
			F. 3D Map features i. 3D Map rendering/loading/content creation ii. IOS application with OpenGL APIs implementation iii. 3D Map with layers like cities, rivers, shore lines etc. Map Layer Management
			G. IOS – Training Management Homepage i. Homepage application to cater for 6 IOS (team1) + 4 IOS (team2) stations (Workstation m/c.) ii. Scenario scheduling iii. Configuration & Resource allocation iv. Centralized DB management v. Communication with War Gaming Simulation Controller and Listener application
			H. Listener application

Sl.NO	Work package	Work Description	Brief Work activities
			i. Socket Listener for managing communication messages with War Gaming controller & IOS-HMI ii. SG-IOS automation to invoke IOS application in all 6 IOS (team1) + 4 IOS (team2) stations.
2	**Work Package-II**	Design and development of sensor and communication simulators	**A. SIL Controller Application** The SIL Simulation Controller does the following function in broad term. • Time Synchronization • Selection of Scenario generator (SG) • Configuration of Sensor Simulators • Receiving Target Information from SG • Sending target information to sensor simulators • Health Monitoring and Error Injection • Sending Health info to War gamming controller and SOS simulator • Logging of target information • Report Generation • Interface with Higher Rig Controller • Help Features
			B. PR SIM application The Primary Radar Simulator will simulate the detection of airborne, sea surface and Ground targets by the AEW&C Radar System. PR simulator simulate both radar (frontal and dorsal) functionality. The PR Simulator will consist of the following CSCIs. i. Receive NAV Data ii. Reception of Target Data iii. Simulation of POST Results iv. Loading of PFM v. State Management vi. Sector Management vii. Sector Scanning viii. Detection of Targets The Radar Simulator will declare targets detected according to the following: • The radar modes of operation. • Position and radial speed of the target relative to the Radar. • LOS (Line of Sight) from Radar to target • Type of Target a. Air b. Sea / Surface c. Ground (GMTI)

Sl.NO	Work package	Work Description	Brief Work activities
			ix. Simulate Scan Pattern and Timing x. Measurement Errors xi. Target Resolution xii. Simulation of Radar Plots/ Tracks xiii. Terrain Masking The Primary Radar Simulator shall behave according to the a. Mode definition b. Sector definition c. Noise model d. Clutter model e. Scan pattern f. Jammer model g. Weather model h. Target RCS definition i. Beam definition j. Detection model k. Tracking model l. Graceful degradation effects m. LOS Model n. Aircraft blockage model
			C. IFF SIM application i. Interrogator Simulation: - (Simulation of different mode of Interrogations, interlacing of modes and interlacing ratio etc.) ii. Transponder Simulation (Transponder capability, Reply Criteria etc.) iii. Phased Array Antenna simulation. iv. Radiation Pattern for Sum and Difference beam. v. Target Detection vi. Scanning vii. Target Report Generation viii. Configurable Range & Azimuth Coverage ix. Multiple antenna Simulation for Scanning. x. Error Modelling xi. Data Logging xii. Interface with Navigation Simulator, STAGE, NTP Server, Mission Controller & Operator Console as per Interface Requirement Specifications xiii. Reply Garbling Simulation xiv. POST & various BIT Simulation e.g., CBIT, IBIT etc.

Sl.NO	Work package	Work Description	Brief Work activities
			xv. Command & Control and corresponding response to Mission Controller and Operator Console
			D. ESM SIM application i. Scanning & detection of emitters. ii. Identification & classification iii. Direction Finding of emitters iv. Location fixing for static emitters using geo-location methods v. Desired frequency coverage & angular Coverage vi. Simulation of different type of signals e.g., Pulse, CW, frequency & PRI agile etc. and its characteristics vii. Identification of Signals viii. Signal characteristics Simulation ix. Post & various BIT Simulation e.g., CBIT, IBIT etc. x. Simulation of environment effects xi. Estimated Range simulation for Emitters xii. Error modeling for desired signal Parameters. xiii. Scanning as per multiple dwells containing multiple frequency bands in the search strategies. xiv. Detection criteria simulation using scanning frequency bands, angular coverage, Amplitude threshold, Probability of detection, Rx sensitivity etc. xv. Simulation of frequency type, PGRI type, MOP type, number of pulses etc. for emitter signal xvi. Simulation of Antenna Parameters (Tx & Rx both) & its characteristics xvii. Simulation of Rx and channel characteristics e.g., SNR, path loss etc. xviii. Interface with Navigation simulator, STAGE, NTP server, Mission Controller and Operator Console as per Interface Requirement Specifications xix. Emitter database management xx. Command & Control and corresponding response to Mission Controller and Operator Console xxi. Emitter Report Generation

Sl.NO	Work package	Work Description	Brief Work activities
			E. CSM SIM application i. Spectral Search, Interception & detection of radio/communication signals ii. Direction Finding iii. Location Fixing for Static emitters iv. Configurable frequency & angular coverage v. Simulation of signal parameters/characteristics vi. Simulation of different type of radios/signals e.g., Fixed frequency, Burst, Hopper etc. vii. Scan rate simulation viii. Estimation of center frequency of intercepted signals ix. Post & various BIT Simulations: CBIT, IBIT etc. x. Simulation of antenna parameters (Tx and Rx both) and its characteristics xi. Simulation of SNR, path loss, Rx Sensitivity etc. (Channel & Rx Characteristics) xii. Voice and Data Simulation if desired xiii. Simulation to support Monitor net & Protected Net xiv. Different radio report generation & simulation of signal parameters in report e.g., Hop start and stop, hop rate, signal level, modulation etc. xv. Interface with Navigation simulator, STAGE, NTP server, Mission Controller and Operator Console as per Interface Requirement Specifications xvi. Simulation of Environment effects on simulator performance. xvii. Error modeling for desired parameters xviii. Command & Control and corresponding response to Mission Controller and Operator Console xix. Radio Report Generation for different types of radios (FF, FH and Burst).
			F. DL SIM application i. GES Simulation ii. LOS & BLOS Simulation iii. Satellite simulation for beyond line of sight

Sl.NO	Work package	Work Description	Brief Work activities
			iv. Establishment of link with ground station for LOS and BLOS v. Simulation of antenna parameters and its effect vi. Link quality for uplink & down link vii. Link load simulation viii. Voice & data simulation if desired ix. Data rate, BER and Error modeling x. Transmit and Receive data from Air to Ground & Ground to Air in simulation mode xi. Primary & Secondary GES Simulation xii. Simulation of Environment effects xiii. Simulation of Tx, Channel & Rx characteristics and its effect xiv. Post & Various BIT simulation xv. Interface with Navigation simulator, STAGE, NTP server, Mission Controller and Operator Console as per Interface Requirement Specifications xvi. Command & Control and corresponding response to Mission Controller and Operator Console
			G. NAV SIM application The navigation simulator shall simulate the own ship positions as per WGS84 co-ordinate system and the output data from the simulator shall be send to MMS in following interface formats. i. Ethernet ii. NMEA (NMEA packet Decoding and encoding) iii. 1553-B iv. ARINC
			H. SOS SIM application **TBD**
			I. IACCS SIM application **TBD**
			J. AIS SIM application AIS sensor is a co-operative sensor which receives information from ships about its location, type, MMSI etc. i. AIS simulator provides plots for detected targets which have transponders installed on it. ii. The following models shall be used a. Detection model b. Tracking model c. Parameter extraction model

Sl.NO	Work package	Work Description	Brief Work activities
			d. Error model LOS model
			K. MSC Stub application i. Development of MSC and OWS stub simulator for implementing the limited functionalities of Mission System Controller and Operator Work Station. ii. It shall have interface with all the relevant simulators as per the interface definition between simulators and actual MSC & OWS. iii. Development of MSC and OWS stub simulator shall be based on interface document and HMI provided by CABS.
			L. SDR data level simulation TBD
			M. ADS-B simulation TBD
			N. GES Simulator
			Note: i. Simulators shall have dedicated interfaces with other subsystem and simulators as per the requirement. ii. All the simulators shall be developed using modular architecture such that the codes can be modified or changed easily to cater for requirement changes or implementing new requirements. iii. Core performance parameters simulated by the simulators, governing the specification of the actual system shall be configurable. iv. The simulators shall be developed in Qt 6.4 or latest version of Qt. v. Simulators shall be stable and consistence in performance in the maximum required load conditions. vi. Simulators shall be developed for the following segments as per the requirements. • Ground Segment • Airborne Segment
3	**Work Package-III**	Integration & Testing of all subsystem simulators	**A. Integration with MSC & OWS Stub** • Integration of following subsystem simulators to be done • Scenario Simulation Application Software (HMI) • Navigation Simulator (Nav Sim) • Primary Radar Simulator (PR Sim) • Identification of Friend and Foe (IFF Sim)

Sl.NO	Work package	Work Description	Brief Work activities
			• Electronic Support Measures (ESM Sim) • Communication Support Measures (CSM Sim) • Sensor and communication software • Data Link Simulator (CBDL & KBDL Sim) • Systems Operator Station (SOS) • Automatic Identification System (AIS) Simulator • Automatic Dependent Surveillance - Broadcast (ADS-B) Simulator • Integrated Air Command & Control System (IACCS) Simulator • GES Simulator (GES SIM) • Mission Communication System (MCS) simulator (MCS Sim) • SIL Controller Simulator • War Gaming Simulator (for OTS) • OBT Controller • Simulation Control and monitoring Application (SIL Simulation) **B. Integration with Actual MSC & OWS in MSyIR Rig** Testing of all subsystem simulators shall be carried out by vendor in following modes: • Software in loop • Hardware in loop Installer setup shall be made by the vendor as part of deliverable in such a way that it can be used for installation of all subsystems to be setup for AEW&C MK II in: • Lab setup, • Rig setup • Aircraft (applicable for OBT) • Standalone
4	**Work Package-IV**	Documentation, Certification, Setup installation, deliverables and Knowledge transfer (KT)	• **Software Certification Documents** The following Documents for OBT controller, IOS and each Sensor simulator to be prepared for all the above simulators as a part of DO178C Level C Certification: • **Software Planning Stage** • Planning for Software Aspect of Certification (PSAC) • Software Development Plan (SDP) • Software Verification Plan (SVP)

Sl.NO	Work package	Work Description	Brief Work activities

			• Software Configuration Management Plan (SCMP)
			• Software Quality Assurance Plan (SQAP)
			• **Software Development Stage**
			• Software Requirement specification (SRS)
			  o Interface Requirement Specifications (IRS)
			  o Software Design Document (SDD)
			• Software Test Description (STD)
			• Software Test Plan (STP)
			• Software Test Report (STR)
			• Version Description Document (VDD)
			• User Manual
			• Operator Manual for IOS of OTS
			• Operator Manual for IOS of OBT
			• Maintenance Manual for OBT
			• HMI Document (IOS of OTS and OBT)
			• Installation Manual
			• Acceptance document
			• Human Machine Interface (HMI) Document for OTS and OBT
			• Instructor (IOS) Software application
			• OBT Controller application (OBT)
			• War Gaming Controller (OTS)
			• Software Architecture Document:
			• IOS of OTS and OBT (Instructor application software)
			• All Sensor Simulator software
			• War Gaming Controller (for OTS) and OBT Controller (for OBT)
			• **Software Integration and testing Stage**
			• 100 % statement coverage Report
			• Requirement based test report
			• Unit Test Report
			• MISRA C 2012/ MISRA C++ 2008 and higher/ preferably latest guidelines coding standard compliance report
			• Memory Analysis Report
			• Data and control coupling analysis report
			
			PDIF (Parameter Data Item Files), verification of Parameter data item report
			
			OBT system and certification
			Build procedure document, User manual, Operator Manual, Maintenance Manual Submission of complete set of deliverables.

Sl.NO	Work package	Work Description	Brief Work activities
			Note: All the OBT simulators and documents shall satisfy the certification aspect given/suggested by IV&V, CEMILAC and DGAQA

2.2.4 Deliverables

a) Plan for Software Aspects of Certification (PSAC)

b) Software Development Plan (SDP)

c) Software Verification Plan (SVP)

d) Software Configuration Management Plan (SCMP)

e) Software Requirement Specification (SRS)

f) Software Design Document (SDD)

g) Interface Requirement Specification (IRS)

h) Software Test Plan (STP)

i) Software Test Description (STD)

j) Software Test Report (STR)

k) Version Description Document (VDD)

l) Operator Manual for IOS of OTS

m) Operator Manual for IOS of OBT

n) Maintenance Manual for OBT

o) HMI Document (IOS of OTS and OBT)

p) Human Machine Interface (HMI) Document for OTS and OBT

   i. Instructor (IOS) Software application for OTS
   ii. Instructor (IOS) Software application for OBT
   iii. OBT Controller application (OBT)
   iv. War Gaming Controller (OTS)

q) Software Architecture Document:

   i. IOS of OTS and OBT (Instructor application software)
   ii. All Sensor Simulator software
   iii. War Gaming Controller (for OTS)
   iv. OBT Controller (for OBT)

r) User Manual

s) Installation Manual

t) Acceptance document

u) Implementation of the modules - Source Code (running in integrated mode) along with dependent libraries having appropriate comments, logical grouping of modules and traceability to design.

v) Simulation/ Computations/ Analysis for algorithms/requirement

w) Any other Software Development Life Cycle Document

y) Any Other document for Knowledge transfer to CABS

2.3 Standards & Certification requirements

a) The standard for software certification is as per DO-178C Level C as specified by CEMILAC.

b) The industry partner shall prepare documents as per IEEE 12207 templates providedby CABS.

c) The industry partner shall follow iterative model of software development process.

d) Industry partner shall maintain the process and configuration management for the subsystems using tools specified by CABS.

e) The industry partner shall have the knowledge of IBM SE tools (DOORS, Workflow Management, Test Management, Quality Management, Rhapsody) or similar tools to create artifacts at different stages of the software development process.

f) The industry partner shall follow SE processes as per ISO/IEC 15288 standard using IBM SE tools or similar.

g) The industry partner shall write code as per MISRA-C/MISRA-C++ or equivalent coding standard.

h) The industry partner should assist in all the activities towards the software certification.

2.4 Resources for the Development

To meet the objective in the stipulated timelines, industry partner shall deploy required number of resources in software development team. Following roles and responsibilities with educational qualification and experience have to be deployed for the smooth execution of the work package.

Sl.No	Designation/ Role	Work Page Name/ Description	Man Power Required if any (No.)	Duration of Man Power for the work package (Months)	Academic Qualification, Experience & Skill Set	Work Overview
	Project coordinator / Team Lead + Software Architect	All Work Packages	1	24	**Qualification:** ME/BE/B.Tech. (Electronics/ Computer Engg /CS/IT) with 4+ years' experience in software design & development **Skills:** - UML / Microsoft Visio - Software Architecture MVC Patterns - Software development using VC/C++ Visual Studio.Net - QT Framework - OpenGL/ OpenCV - DIS/HLA Comm. - Modelling and	- Project Mgmt. including Software design, development and documentation. - Software Architect, - - High and low Level - Design and Analysis - Milestone settings - Task assignment - Team Mgmt. - Milestone Tracking - Change Mgmt.

Sl.No	Designation/ Role	Work Page Name/ Description	Man Power Required if any (No.)	Duration of Man Power for the work package (Months)	Academic Qualification, Experience & Skill Set	Work Overview
					Simulation - Windows/Linux OS - Database Mgmt. - GIT, Redmine Tools - SCM	- Reviews
	Software Developer + Software Test Engineer + Software Support Engineer		4	**Qualification:** ME/BE/B.Tech. (Electronics/ Computer Engg /CS/IT) with 2+ years' experience in software development **Skills:** - Software development using VC/C++ Visual Studio.Net - QT Framework - OpenGL/ OpenCV - GUI Development with GIS - DIS/HLA Comm. - Modelling and Simulation - Windows/Linux OS - MySQL Database Mgmt.	**Qualification:** ME/BE/B.Tech. (Electronics/ Computer Engg /CS/IT) with 2+ years' experience in software development **Skills:** - Software development using VC/C++ Visual Studio.Net - QT Framework - OpenGL/ OpenCV - GUI Development with GIS - DIS/HLA Comm. - Modelling and Simulation - Windows/Linux OS - MySQL Database Mgmt. - GIT, Redmine Tools - Linux/Windows OS **Testing Skills:** - RTRT, LDRA/ Equivalent testing	Coding and unit testing (as per DO178C and DO332) of data simulator software applications **Testing:** Integration testing subsystem testing, porting to hardware Hardware-in-loop & Software-in-loop testing **Integration & Testing:** Integration and testing in Integration Rig setup **Documentation** Preparation of documents as per DO178C standard e.g., IRS, SRS,

Sl.No	Designation/ Role	Work Page Name/ Description	Man Power Required if any (No.)	Duration of Man Power for the work package (Months)	Academic Qualification, Experience & Skill Set	Work Overview
				- GIT, Redmine Tools - Linux/Windows OS **Testing Skills:** - RTRT, LDRA/ Equivalent testing tools - Software Integration & Testing **S/W Documentation** - DOORS Tele logic Tools - UML / Microsoft Visio	tools - Software Integration & Testing **S/W Documentation** - DOORS Tele logic Tools - UML / Microsoft Visio	SDD, HMI, STP etc. Data Analysis & Report preparation, Resolving the issues Maintenance activities

2.5 Procedure for Execution of Work

a) The industry partner shall sign the Non-Disclosure Agreement before commencing with the work package activities of the project. The IPR of the software and libraries which are developed as part of this contract including their concepts, architecture, and their designs shall solely belong to CABS.

b) The industry partner should be able to place the required team at CABS within 01month from the placement of SO.

c) After the SO is placed, initially CABS will provide required user manual/ documents/ presentations/ training demos to the industry partner. CABS shall explain the requirements in detail to the team through documents/verbally. After the training period the industry partner will submit the software development plan with work breakdown structure and GANTT Chart. Industry partner shall make necessary process/procedure document/template to ensure smooth execution of activities.

d) Industry Partner is responsible for design, development, integration, and testing of the modules of the milestone-wise activity as detailed.

e) The industry partner shall perform development of all the work packages in parallel.

f) Industry partner shall develop test plans, test design specification, test case specification for the modules developed.

g) Industry partner shall do integration with simulators/sub systems and shall submit the test results meeting the requirements.

h) CABS project coordinator shall review the progress made by the industry partner on the work assigned in the presence of project coordinator from the industry partner side for every milestone.

i) For each defined milestone the completion report shall be generated by the industry partner duly approved by the project coordinator of CABS.

j) The approved milestone shall be submitted along with milestone deliverables.

k) The efficacy of work carried out by the industry partner will be reviewed by the CABS project team on regular basis. In case, the work carried out is unsatisfactory the CABS project team will instruct the onsite team to rework on the same. Hence, reviewing timelines are to be catered for by the industry partner to ensure that the timelines are met as per the defined milestones.

l) If the work carried out by the industry partner is not meeting the milestone based on

m) the evaluation done by the CABS project team, the payment for the milestone will be held.

n) Computers, infrastructure to execute the work will be provided by CABS.

2.6 Industry Partner Qualification Criteria/Industry partner Evaluation criteria

1. Industry partner shall have executed successfully at least two software development projects having Qt application and AI/ML application. Proof shall be enclosed along with the bid.

2. Industry partner shall hold CMMI Level-3 accreditation / AS 9001/ISO/IEC 20000-1: 2018 or equivalent. The certificates must be valid at the time of submitting the bid. Copy of the certificate shall be submitted by the industry partner along with the bid.

3. Industry partner must have executed projects related to Hardware-in-the loop (HIL) or Software-in-the Loop (SIL) systems for Radar /EW for Radar /EW systems. The documentary proof for the same must be submitted along with the bid.

4. Industry partner,their subsidiary companies, or sister concerrns must have work experience for RF/Mission/Virtual Environment modelling software tools such as Presagis STAGE or Ansys STK. The documentary proof for the same must be submitted along with the bid.

5. Industry partner must have software development experience as per DO 178C guideline.

6. Each of the engineers given for the task will be interviewed by CABS scientists and only if found satisfactory will be accepted by CABS else a suitable replacement has to be arranged by the industry partner.

7. Industry partner's expertise in each category as mentioned in the work package description would be evaluated by the CABS during technical evaluation if required.If asked, Industry partner shall submit documentary proof/self-attested undertaking along with the bid.

8. The average annual turnover of the industry partner for the last three consecutive years ending with 31 March 2023 must not be less than 175 Lakhs. CABS shall verify the credentials of certificates submitted with user, if found wrong, the bid shall summarily be rejected and appropriate action shall be initiated by CABS.

9. ITR of the last three years, duly certified by a chartered accountant/ITR acknowledgement has to be submitted along with the bid.

10. The industry partner should provide warranty/support for the developed software (maintenance/bug fixing) for a period of 1 year after development contract. The industry partner shall be willing to provide the extended warranty/support after 01-year warranty/support period on payment basis. The rate for extended warranty for one year shall be based on the manpower required at that point of time and the rates shall be applicable as per the payment term derived for the present engagement.

11. The industry partner should develop application indigenously with the capabilities as mentioned in Statement of Work.

12. Industry partner would be responsible for delivery of the software as per defined specification within timelines and is required to quote the total fix cost for both work packages.

13. Work for each milestone is defined in RFP. This will provide time for the industry partner to evaluate the time, budget and manpower required to bid correctly.

14. **Terms and Conditions**

In order to ensure that the industry partners interested in bidding for this tender has understood the RFP, a Pre-Bid meeting will be planned.

14.1. At Pre-Bid stage

a. During the Pre-bid meetings, the potential industry partners shall be exposed to relevant information of the project inside the CABS premises to assess the quantum of effort required to execute the contract.
b. Industry partner should give a presentation showing their capabilities and proposed approach to the RFP.
c. The bids submitted by the industry partners who have attended the Pre-Bid meeting only will be considered for further processing.
d. The potential industry partners can pose their queries on the tender for obtaining clarifications. Clarifications provided to one potential industry partner shall be sent to all the potential industry partners who have attended the Pre-Bid meeting.
e. The industry partner shall sign Non-Disclosure Agreement (NDA) with CABS, if asked to, during the Pre-bid stage.
f. The authorized representatives, after submitting duly signed NDA, shall be given access to relevant information/documents for viewing and return and to obtain clarification on any points to aid in submitting the bid.

14.2. TCEC Evaluation stage

a. Industry partner shall be ready to give a detailed presentation to Techno- Commercial evaluation committee (TCEC) about their proposed approach to RFP, estimated man months and team structure with roles & experience to be deployed along with additional documents, proofs if asked. If the approach is found unsatisfactory, it will lead to disqualification in TCEC. The TCEC may visit the industry partner premises to assess the claims, if required.

14.3. After Placement of Purchase order

a. The industry partner shall start the work immediately within 01 month of placement of work order. Only Indian nationals are allowed to work onsite and hence all resources deputed should be Indian nationals. The deputed persons will be subjected to security checks and restrictions as applicable within the CABS premises. They shall strictly adhere to the security norms of CABS and will be legally liable to adhere to official secrets act 1923.
b. CABS or its work center shall not be responsible for any liability arising out of any accident injury caused while carrying out the work package in our campus or at its work center. CABS shall be indemnified, in the event of injury to any third party person caused during the execution of work by the industry partner. The industry partner shall himself bear such liabilities in case of such unforeseen contingencies. Any protective gears and safety measures wherever required shall be provided by the industry partner at his own cost.
c. Administrative arrangements including any administrative/statutory charges, transportation and accommodation etc., shall be at industry partner's cost and responsibility.
d. The industry partner shall comply with all the applicable statutory provisions of Contract Labor Act, Employees State Insurance Act, Workmen Compensation Act, Provisions of Employees Provident Fund Act, Payment of Minimum Wages Act etc.
e. The industry partner shall make good of any loss caused to CABS due to wrong doing /negligence on the part of the deputed personnel.
f. The industry partner shall deploy resources at CABS with valid police verification. Any cost incurred for police verification shall be borne by the industry partner. Police verification letter to be submitted by the industry partner for the deployed resources before deployment for execution of work.
g. The industry partner shall maintain strict and complete confidentiality of work/information during the tenure of the contract and also thereafter.
h. Industry partner shall submit the execution plan and task distribution plan for the personnel to be deputed for the development.
i. Industry partner shall submit the timeline for development, testing, integration, documentation and certification for the work packages.

j. The duration of the development activity is for 24 months.

k. Any new requirement for change in process reported by CABS shall be taken up as priority task by the industry partner. The impact on timeline and resources due to the change in requirement will be decided by CABS based on the logical explanation by the industry partner.

l. In case development agency completes the delivery in line with expected deliverable before 18 months of contract duration, agency would still be required to deploy sufficient team members for support and handholding for remaining period of contract.

m. The industry partner shall depute the team only with adequate skills/experience to assist the CABS team to follow the best practices for software development. In case non-performance or skill levels below acceptable limits of the software developer/tester/team lead/project coordinators as assessed by CABS coordinator, the industry partner shall replace the resource persons with adequate skills to the satisfaction of the CABS coordinator without any delay. The period of non-availability of resources will be adequately compensated by the industry partner.

n. In case of non-performance, CABS has the right to terminate the contract at a suitable stage of the product and/or by giving one-month notice to the industry partner.

o. In case of resignation/ long leave/ non-satisfactory performance of the deployed personnel, the industry partner shall compensate the period/effort lost with necessary action.

p. The industry partner shall maintain continuity with respect to the work package. No disruption shall be allowed for more than three days, except with specific approval of CABS in writing.

q. An undertaking shall be submitted that, the industry partner has not been blacklisted by any central/state government department and is not under any illegal expression by Govt of India.

14.4. Other Items

a. The contract resulting from this Tender Enquiry Document will commence upon the execution of the contract and will end upon the completion of the activities within 18 months as stated in the statement of work.

b. All the software modules developed by industry partner specifically under this project are IPR of CABS, DRDO and shall not be disclosed. Industry partner does not have any rights on the software/artifacts developed. All artifacts developed specifically for this project during the project life cycle shall be submitted to CABS with source code and documentations at appropriate stages.

c. CABS shall retain the absolute rights on the nature of work carried out during the course of work/tenure of the development.

d. Industry partner shall not subcontract parts of the project without written consent from CABS.

e. Industry Partners are required to submit all necessary documents in support of the above-mentioned criteria. Failure to submit documents will result in rejection of the bid.

2.7 Schedule and Milestones

The industry partner shall meet the schedule and milestone for the project. A broad project schedule for the work packages with proposed milestone is shown in table below.

Schedule/Time	**Milestone**	**Milestone Activities**	**Milestone Deliverable /Acceptance Criteria**
T0			Placement of SO
T0 + 01Month		● Deployment of required team resource persons in CABS. ● Familiarization on the Work Packages and OTs & OBT architecture	Required resource person deployed in CABS.
T0 + 06Month	**Milestone 1**	Preparation of plan documents ● Requirement finalization ● Completion of Work Package 1(A, B ,E) 75 % ● Completion of Work Package 2 (A, B ,C ,D, E k, G)- 30 % ● Completion of Work Package 4 (Aa)-100%	PSAC, SDP, SVP, SCMP, SQAP, SRS, WBS, GANTT, HMI document, acceptance document, demonstration,
T0 + 12Month	**Milestone 2**	● Completion of Work Package 1(A, B ,E)-100% and (C ,D ,F,G,H) -75% ● Completion of Work Package 2 (A, B ,C ,D, E, K, G)- 90 %	STP, SDD, IRS, and Demonstration to each sensor simulator with IOS application

		● Completion of Work Package 3 (A)-30% ● Completion of Work Package 4 (Ab)-90%	
T0 + 18Month	**Milestone 3**	● Completion of Work Package 1(A, B , C ,D ,E ,F, G ,H) – 90% ● Completion of Work Package 2 (A, B ,C ,D, E F, G)- 90 % and (H,I,J, K,L)-70% ● Completion of Work Package 3 (A, B)-75% ● Completion of Work Package 4 (Ab)-100% and 4(c) -80%	STD, demonstration in integrated setup. All sensor simulators with MSC and OWS stub functionality test in integrated environment.
T0 + 24Month	**Milestone 4**	● Completion of Work Package 1– 100% ● Completion of Work Package 2 -100 % ● Completion of Work Package 3 - 100% ● Completion of Work Package 4 -100%	Build procedure document, User manual, Submission of complete set of deliverables. All sensor simulators with actual MSC and OWS functionality test in integrated environment at Rig.

2.8 Payment Terms

Payment schedule is on milestone basis after achieving each milestone of work packages

Sl No	Description	% of Total Cost	Cumulative % of Total cost
1	**Milestone 1**	**25**	**25**
2	**Milestone 2**	**25**	**50**
3	**Milestone 3**	**25**	**75**
4	**Milestone 4**	**25**	**100**

2.9 Terms and conditions:

2.9.1 Development Environment

(a) All architecture and block diagrams shall be in Visio, or equivalent sW

(b) The development environments for software are on, Windows 10 or higher or Linux Operating Systems. The software shall be developed in QT as per the frame work defined by CABS.

(c) The debugging tool should be compatible with OS selected.

2.9.2 Standards:

(a) The documents to be prepared should be as per IEEE 12207.

(b) The Software developed has to be written as per Misra-C Coding Standard.

2.9.3 Intellectual Property Rights

The intellectual property right of the developed S/W, documents, designs, and knowledge under this contract shall remain as exclusive property of CABS. The above shall apply to all processes, products developed under this contract.

2.9.4 General

(a) All the tasks mentioned can be carried out in CABS premises.

(b) The vendor should adhere to CABS security rules and timings

(c) One Project Co-coordinator is responsible for the activities stated in SOW. One project manager should work under the project coordinator. The different work package teams should work under the project manager.

(d) The vendor engineers shall adhere to the working hours of CABS from Monday to Friday from 8.30 am to 1700 Hours.

(e) However, to meet the deadlines, CABS will permit the vendor engineers to work on holidays and extra hours on week days.

(f) CABS shall not be responsible for any injury or loss of life that may take place while on the said job

(g) The engineers engaged by the vendor shall strictly confine to the indicated place of work and shall not enter any other restricted areas within CABS premises without prior permission and suitable escort.

(h) No material to be carried out of CABS without CABS permission

(i) The vendor should not copy or reprint any of the CABS software or documents. The vendor is not permitted to bring or carry any electronic or optical media such as CD ROMs, DVDs, External Hard Disks, and Pen Drives etc.

(j) The vendor shall be responsible for the employees conduct in the premises. The vendor and his employees shall strictly follow all the rules, regulations and security procedures within CABS premises.

(k) Vendor shall be responsible for breach of any of the above within CABS premises by him or his employees and shall be sued accordingly.

2.9.5 Supplier to confirm & provide details about:

2.9.5.1 Registration with ministry of labour

a. The vendor should follow or comply with all the latest Labor rules if any and also certify this.

2.9.5.2 Experience

a. The team members assigned for tasks shall be well qualified and have relevant experience.

2.10 Warranty:

Vendor shall provide a warranty of one year for bug fixing and Technical support.