

# सामर्थ्य मार्गदर्शिका CAPABILITY ROADMAP



IAF COMPENDIUM OF

CHALLENGES &

OPPORTUNITIES FOR

INDIAN INDUSTRY

\*\*\* नवाचार उत्कर्षतम् भविष्यम् \*\*\*



# DIRECTORATE OF AEROSPACE DESIGN

## AIR HQ



राजनाथ सिंह  
RAJNATH SINGH



रक्षा मंत्री  
भारत  
DEFENCE MINISTER  
INDIA

## MESSAGE

Our great nation relies on the capability of the defence forces to safeguard our interests. These capabilities flow from the bravery of personnel armed with modern equipment. As a technologically advanced country, our endeavour would be to cover the technological gaps in the journey towards Atmanirbharta in Aerospace. While we have highly capable and motivated air warriors, Atmanirbharta in technologies is a work in progress marked by some major achievements. Besides the contribution made by DRDO and DPSUs, the journey towards innovative and indigenous product realisation is also being propelled by Govt schemes like Make in India, iDEX and TDF. Concurrently, there is a requirement for industry, academia and R&D institutes to invest in core technology and product development and reduce our import dependence.

This compendium by Indian Air Force highlights the progress of IAF as well as the opportunities created for our industry towards creating self reliance in Aerospace domain. It specifies the gaps in key technologies and forms the bedrock of concepts towards realising futuristic capabilities such as the Next Gen Fighter Aircraft, Space technologies, Advanced Materials and manufacturing, Directed Energy Weapons, AI/ML based computing, Quantum Technologies, advanced sensors and navigation systems, Robotics/Autonomous systems and Electronic Warfare systems. With the advances in these fields for usage in defence, I am confident that complete self reliance in defence sector will become a reality.

I compliment the IAF for coming out with this compendium towards realising new technologies in collaboration with the private sector and wish them continued success in this path towards Atmanirbharta.

**'Jai Hind'**

**(Rajnath Singh)**

New Delhi  
06 Feb, 2025



**MESSAGE FROM CHIEF OF THE AIR STAFF**  
**AIR CHIEF MARSHAL AP SINGH PVSM AVSM**

1. IAF is going through a transformation in this era of Indian industrial awakening. This year of IAF is being themed as **‘Saksham, Sashakt, Atmanirbhar’** which signifies the impetus given by IAF towards self-reliance and Make in India. In the past few years, there has been a continuous push towards making IAF more self-reliant by engaging MSMEs, start-ups, individual innovators, professionals, R&D institutes and academia.
2. With impetus on **‘Atmanirbharata’** and National vision of **‘Viksit Bharat’**, IAF is more determined than ever towards building a strong partnership with Indian industries and strengthening the foundation of our technological superiority to induct effective systems. This compendium shares the capability requirements of the IAF to be an effective deterrent and ensure air supremacy in any conflict. The requirements shared through this compendium are a reflection of IAF’s push towards operational preparedness in light of the geo-political situation in various theatres of the world.
3. The release of this compendium to the industry emphasises our belief in Indian industry’s capabilities to develop technologically modern systems. I am sure that these Problem Statements will find their suitable place in the future roadmap of Indian industries and contribute towards continued operational capability of IAF while making it more self-reliant.



## **MESSAGE FROM DEPUTY CHIEF OF THE AIR STAFF**

### **AIR MARSHAL TEJINDER SINGH AVSM VM**

IAF has always been at the forefront of efforts towards indigenous capability building. All domain experts of the defence ecosystem including policy makers, users and developers, have been focused towards achieving Atmanirbharta and are aligned towards making progressive policies like DAP 2020.

The IAF centres of excellence like ASTE and SDI have integrated with this effort for facilitating the industry partners more than ever. Formation of Dte of Aerospace Design (DAD) at Air HQ, with focused aim of facilitating innovations in IAF and increased interaction with the private industries has been a major step towards partnering innovative and indigenous developments in the field of Air Force domain. Regional Aerospace Innovation Divisions (RAIDs) at Bangalore and Gandhinagar have been established under DAD as dedicated industry outreach teams for IAF. Industry outreach events have been conducted at IAF stations, resulting into valuable partnerships between industries and IAF in form of formal contracts.

The compendium aims to bring problem statements on the table for the industry partners to pick their challenges as per their capabilities. Handholding for product realisation through the route to certification for airborne equipment and other issues which are new to the private industry partners is being carried out by DAD.

This compendium, though being the first, will definitely form a medium of exchanging ideas between the IAF and its industry partners for improvement in our capabilities to further and achieve the goals of Atmanirbharta in Aerospace sector.



## PREFACE

5 In the rapidly evolving landscape of aerospace technology and defence, collaboration between the Indian Air Force and industry partners has never been more crucial. This **IAF Compendium of Challenges & Opportunities for Indian Industry** is an invaluable resource that encapsulates the strategic challenges and technological opportunities that lie at the forefront of National defence and Air superiority.

Indian Air Force stands as a beacon of innovation and strategic prowess, continually striving to maintain its edge through the adoption and integration of cutting-edge technologies. In this pursuit, the engagement with industry partners becomes essential, fostering a synergistic relationship that accelerates technological advancements and operational efficiencies. This compendium is designed to bridge the gap between the Indian Air Force's needs and the industry's capabilities, providing a comprehensive overview of the key problem statements that require innovative solutions and expert insights.

The problem statements included in this compendium are not merely challenges; they are calls to action for pioneering minds and dedicated organisations to contribute their expertise and creativity. Each statement is a reflection of the complex and multifaceted nature of operations in the aerospace domain, addressing areas ranging from advanced technologies and propulsion systems to cyber security and autonomous systems. Some of these challenges are already being met through existing collaborations, however their spiral development into better or new products is deemed to be an opportunity for the Indian industry.

The Indian Air Force's commitment to partner with industry is grounded in a shared vision of excellence and innovation. By aligning with the strategic goals outlined in this document, industry leaders have the opportunity to not only contribute to vital national security objectives but also to position themselves at the cutting edge of technological development.



## **PREFACE**

6 This compendium is more than a catalogue of problem statements; it is an invitation to engage in a collaborative process that drives forward the capabilities of the Indian Air Force and enhances national security.

As you explore the problem statements contained within, Indian Air Force encourages you to view them through the lens of opportunity each represents. The Indian Air Force values the insights and solutions that industry partners bring to the table and is eager to engage with those who are ready to tackle these challenges head-on.

**Note**:- The images in this compendium are placed for representative purposes and are intended only to introduce the challenge.



## CONTENTS

7 The compendium has been arranged into three sections for the ease of the readers.

**Section-I** (Page 22-109): This section comprises of ongoing projects under Make, iDEX and TDF categories for which the Industry partners for design and development have been shortlisted by IAF.

**Section-II** (Page 111-163): This section comprises of projects under Make, iDEX and TDF categories which are open for participation by Start-Ups / MSMEs / large Industries.

**Section-III** (Page 165-212): This section comprises of future opportunities for industries.

Furthermore, Sections I and II have been arranged capability/ domain wise for the readers to quickly glance though the projects pertaining to any specific capability/ domain of reader's interest. All the projects have been classified into

Weapon System	DefSpace/ Satellite
Air Defence	Early Warning
UAS/ CUAS	Communication
Training/ Simulators	Sensors
Sustenance	Op Capability
Sub Systems	Software
Bio-Medical	Aero-Engine



## INDEX

<u>Ser No</u>	<u>Challenges</u>	<u>Page No</u>
	<b><u>Section-I: Ongoing Projects Under Development</u></b>	
	<b><u>Weapon System</u></b>	
1.	Aerial Fuse for Bomb	22
2.	125 Kg Bomb	23
3.	Helicopter Launched Weaponised Drone	24
4.	Booster Assisted REK with EO-IR Terminal Guidance	25
5.	Air Launched Flexible Assets –Swarm (ALFA-S)	26
6.	Multi Domain Launch Capable Loitering Aerial Interceptor	27
	<b><u>DefSpace/ Satellite</u></b>	
7.	Space Domain Awareness	28
8.	Autonomous Docking Operation On Orbit Maintenance and Refuelling (OOMR)	29
9.	Intelligent On-board System for Satellite Mission Planning	30
10.	Ground Controlled Satellite Antenna Frequency Switching System	31
11.	Multiband RF Sensor Data Processing and Analysis System	32
12.	L/P Band Continuous Wave SAR Payload for LEO Small Satellites	33
13.	Miniaturised Multi-Payload Satellite Upto 150 Kgs	34
14.	Miniaturisation of Payloads (EO And SAR) for a Small Satellite Upto 150 Kgs	35
15.	Miniaturisation of Payloads (IR & Hyper Spectral) for a Small Satellite Upto 150 Kgs	36
16.	Miniaturisation of On-Board Antenna Sys Using Additive Manufacturing Techniques	37



## INDEX

<u>Ser No</u>	<u>Challenges</u>	<u>Page No</u>
	<b><u>DefSpace/ Satellite</u></b>	
17.	High Speed On-Board Data Processing Technology for LEO Imaging Satellites	38
18.	AI/ ML Based Change Detection for Multi Payload Fused Imagery Data in Satellite	39
19.	Motion Controller (Hardware And Software) for LEO Antenna Stations	40
	<b><u>Air Defence</u></b>	
20.	Infrared Identifier Patches	41
21.	Vehicle Mounted Transportable Aerostat with Multiple Payloads	42
	<b><u>Electronic Warfare</u></b>	
22.	Chaffs & Flares	43
23.	Inflatable Decoy	44
24.	Portable Spoof Emitter for Radiation (POSERAD)	45
25.	Expendable Active Decoy (EAD) for Defeating RF- Guided Missiles and Fire Control Radars	46
26.	SIGINT System for Hilly Terrain and High Altitude Areas	47
27.	Drone/ Unmanned Aircraft Emulator	48
28.	Anti-Radar Decoy Swarm With Chaff Dispensation and EW Payloads	49
29.	SAR Image Disruptor	50
	<b><u>UAS/ CUAS</u></b>	
30.	Tethered Drone	51
31.	Air-Mine – Measuring and Sensing of Air Disturbance for Drone Detection	52
32.	Swarm Anti Drone System	53



## INDEX

<u>Ser No</u>	<u>Challenges</u>	<u>Page No</u>
	<b><u>UAS/ CUAS</u></b>	
33.	Multirole Autonomous UAV for Air Defence Units & Bases of IAF	54
34.	Non-Rotating Active Electronic Scanned Array (AESA) Radar of Counter Drone Applications	55
35.	Hand Held Hard Kill Counter UAS System	56
	<b><u>Communication</u></b>	
36.	Communication Equipment with Indian Security Protocols	57
37.	Wide Band HF Modem	58
38.	Wireless Headset for Flight Gunner	59
39.	Internet Protocol (IP) Based Gateway Interface for Bridging Inter-Communication between two different SDR Networks	60
	<b><u>Training/ Simulators</u></b>	
40.	Part Task Trainer for Mirage 2000 Aircraft	61
41.	Infusion of AR/ VR in Technical Type Training	62
42.	Hawk Twin Dome Flight Simulators	63
43.	Simulator System for Force-On-Force Training of IAF Garud Commandos	64
	<b><u>Sensors</u></b>	
44.	Infrared Imaging Search & Track System (IRST)	65
45.	Lightening Detection System	66
46.	Wind Profiler	67
47.	Multi Band Navigation Receiver	68



## INDEX

<u>Ser No</u>	<u>Challenges</u>	<u>Page No</u>
	<b><u>Sensors</u></b>	
48.	Remote Real-time In-Flight Health Monitoring of Aircrew	69
49.	Portable Automatic Weather Station	70
	<b><u>Sustenance</u></b>	
50.	Foldable Fibreglass Mat (FFM) for Rapid Runway Repair	71
51.	Smoke Generators for Sarang Display Team	72
52.	Pressurized Radome for Different Radars	73
53.	Green and Saffron Dye for Sanders SCSG-5R Pods of Suryakiran (Hawk Mk132) Aircraft	74
54.	Tool Tracking Using Modern Technologies Like BLE	75
55.	Flight Data Recorder (FDR) Using On-board Camera	76
	<b><u>Operational Capability</u></b>	
56.	Air Transportable Starting Aggregate for Starting Apache Helicopter at Altitudes Upto 16000 Feet	77
57.	Inflatable/ Modular Sun Shelters	78
58.	Bullet Proof Jackets for Aircrew	79
59.	Humanitarian Assistance and Disaster Relief Platform for Chinook Helicopter	80
60.	Drone Based/ Innovative Range Scoring System for Air to Ground Weapons	81
61.	Helicopter Electronic Glide Path Based Landing System	82
62.	Battery Operated Taxi Bots for Aircraft Movement	83
63.	Body Mounted Personal Oxygen Delivery System for Extended Aerial Operation	84



## INDEX

<u>Ser No</u>	<u>Challenges</u>	<u>Page No</u>
	<b><u>Operational Capability</u></b>	
64.	Air Transportable Rubberised Fuel Storage and Bridging System	85
	<b><u>Sub Systems</u></b>	
65.	Pulse HVPS for Elta ASPJ	86
66.	Fuel Flow Metering Unit (BRZA-7) for Fighter Aircraft	87
67.	Three Concentric Rings for Aero Engine for Aero Engine	88
68.	CW HVPS for Elta ASPJ	89
69.	GMI-32B (P-19 Modulator Valve)	90
70.	Cold Flaps (Four Types) for M53-P2 Aero-Engine	91
	<b><u>Software</u></b>	
71.	Artificial Intelligence Based Forecasting Tools for Prediction of Atmospheric Visibility	92
72.	Creation of a Browser Plug-In for Chrome and Firefox to Detect Phishing Mails and Initiate Appropriate Action	93
73.	Intelligent (AI Based) Document Management System	94
74.	Multi-Engine AV Solution Capable of Handling and Identifying Present Day Complex Malware	95
75.	AI/ ML Based Prediction of Thunderstorm And Gale Force Wind Over an Airfield	96
76.	AI/ML Assisted Pilot Debrief and Assessment System	97
77.	AI Based Compiler for Verifying Optimizing Software	98
78.	AI-Based Natural Language Processing	99
79.	Innovative Decision Support System (DSS) for Analysis of Unstructured Database	100
80.	Artificial Intelligence (AI) for Human Resource Management (HRM) for IAF	101



## INDEX

<u>Ser No</u>	<u>Challenges</u>	<u>Page No</u>
	<b><u>Software</u></b>	
81.	Artificial Intelligence (AI) Based Prediction Model for Bird Hazard Management System	102
	<b><u>Bio-Medical</u></b>	
82.	Indigenized Hypoxicator to provide Normobaric Hypoxia Indoctrination to the Aircrew	103
83.	Full Coverage Anti-G Suit (AGS)	104
84.	Integrated Patient Transportation Unit (PTU)	105
85.	Accelerated Complete Acclimatization System, Prior to Induction at High Altitude, using Nitrogen Enriched Atmosphere	106
86.	Skin Spray Gun	107
87.	Spatial Disorientation and Upset Recovery Simulator	108
88.	Universal Anti-G Suit Testing Rig (Portable)	109



## INDEX

<u>Ser No</u>	<u>Challenges</u>	<u>Page No</u>
	<b><u>Section-II: Proposals Open for Industry Participation</u></b>	
	<b><u>Weapon System</u></b>	
89.	Long Range Land Attack Cruise Missile	111
90.	Indigenous Precision Range Extension Kit	112
91.	Aerial Bomb 1000 Kgs	113
92.	Common Air to Air Launcher for Su-30 MKI Aircraft	114
93.	Common Air to Ground Launcher for Su-30 MKI Aircraft	115
94.	Air to Air Missile	116
95.	Air to Ground Missile	117
	<b><u>DefSpace/ Satellites</u></b>	
96.	Multiband Programmable RF Sensor Satellite	118
97.	Innovative Space Applications of Fourth/ Final Stage of Launch Vehicles	119
98.	High Throughput Communication Satellite in LEO	120
99.	On Orbit Maintenance And Refuelling (OOMR) Technology in LEO	121
100.	On Orbit Propellant Storage and Transfer System	122
101.	On Orbit Space Infra Maintenance and Upgrade Operations	123
102.	Modular, Multi Payload Configurable Very Low Earth Orbit (VLEO) Vehicle/ Bus	124
103.	CBRN Threat Detection And Monitoring Sensors for VLEO Bus	125
104.	Advanced Extremely High Frequency (AEHF) GEO Satellite for Secure Communications	126
105.	L/P Band Synthetic Aperture Radar (SAR) Small Satellite	127
106.	Ultra-Light Weight, Sub-Meter Resolution Monolithic SiC Telescope as Optical Payload	128



## INDEX

<u>Ser No</u>	<u>Challenges</u>	<u>Page No</u>
	<b><u>DefSpace/ Satellites</u></b>	
107.	Network Management Port (NMP) for Efficient SATCOM Bandwidth Management Using Multiple Satellite	129
108.	Computer Defence System for Cyber Situational Awareness to Secure Own Satellites from Cyber Attacks	130
109.	Cyber Hardening Suite for Satellite Communication Links/ Hubs	131
110.	Ultra High Resolution Optical Payloads with Edge Computing for VLEO Bus	132
111.	HySIS (Hyper Spectral Imaging Spectrometer) Payload for VLEO (Very Low Earth Orbit) Bus	133
	<b><u>Air Defence</u></b>	
112.	Rapidly Deployable Blast Protection System: An Alternative to Sandbags	134
	<b><u>Aero-Engine</u></b>	
113.	Aero-Engine for Mi-17 V5 Helicopter	135
	<b><u>Electronic Warfare</u></b>	
114.	Airborne Stand-Off Jammer	136
115.	Mobile Ground Based Multi-Purpose Jammer System	137
116.	High Altitude Pseudo Satellite (Fixed Wing And	138
117.	Indigenous Repair/ Refurbishment of Elta Jammer System	139
118.	Active Countermeasures to Degrade the Performance of Terminal EO/ IR Seekers	140
119.	Replacement of Existing EO Payloads in IAF RPA Fleet	141



## INDEX

<u>Ser No</u>	<u>Challenges</u>	<u>Page No</u>
	<b><u>Electronic Warfare</u></b>	
120.	Low Cost Transmitter as an Active Decoy and Aerial Imitator for Target Practice in EW Environment	142
	<b><u>Airborne Systems</u></b>	
121.	Air to Air Refuelling Pod System	143
	<b><u>UAS/ CUAS</u></b>	
122.	Collaborative Long Range Target Saturation/ Destruction System	144
	<b><u>Training/ Simulators</u></b>	
123.	Full Mission Simulator for Apache Helicopter	145
124.	Simulator for Training and Testing of SAGW Crew	146
	<b><u>Sensors</u></b>	
125.	Airborne Electro-Optical Pod with Ground Based System	147
126.	Airborne Multi-Constellation GNSS (Global Navigation Satellite System) Receiver and Converter	148
	<b><u>Sustenance</u></b>	
127.	Containers for Russian Air Launched Missiles	149
	<b><u>Operational Capability</u></b>	
128.	Automatic Take-Off and Landing Recording System	150
129.	Aircraft Recovery Dollies	151
130.	Transition Platform with Trailer	152
131.	Aircraft Lifting Slings	153



## INDEX

<u>Ser No</u>	<u>Challenges</u>	<u>Page No</u>
	<u>Sub Systems</u>	
132.	Airborne Ruggedized Flight Instrumentation System	154
133.	Tail Rotor Blade for Mi-17 Helicopter	155
134.	Tail Rotor Chain for Mi-17 Helicopter	156
135.	Main Rotor Blade for Mi-17 Helicopter	157
136.	Breakable Plug Valve of HPU for Air to Air Missile Launcher	158
137.	Continuous Wave TWT for Elta, ASPJ	159
138.	Pulse TWT for Elta ASPJ	160
139.	Smart Multifunctional Display for Jaguar Aircraft	161
	<u>Software</u>	
140.	Universal FDR Data Mining Suite for IAF	162
141.	Quick Flight Data Recorder (FDR) Analysis Software/ Tool for Rafale Aircraft	163



## INDEX

<b>Ser No</b>	<b>Challenges</b>	<b>Page No</b>
	<b><u>Section-III: Future Opportunities</u></b>	
142.	Indigenous Low Level Transportable Radar (LLTR) Receiver Tile	165
143.	Underground Optical Fibre Cable Detector	166
144.	Visual Check of Undercarriage by High Intensity Vertically Focused Beam Light	167
145.	Universal Rescue Ladder	168
146.	Telescopic Television in Visible and Infrared Spectrum	169
147.	Heat Exchanger (Primary)	170
148.	Heat Exchanger (Secondary)	171
149.	Fuel Cooled Hydraulic Oil Cooler (FCHOC)	172
150.	Ejection Seat for Jaguar Aircraft	173
151.	Platinum Rhodium Catalytic Igniters for Jaguar Aircraft	174
152.	Wireless Headsets for Tarmac Operations Between Pilots and Tarmac Crew	175
153.	Indigenous Joint Waveform for Software Defined Radios	176
154.	Future Portable Mobile Communication Solution for Ground Based Weapon System	177
155.	Indigenous Secure ADS-B In and Out	178
156.	Data Link Capability in Cockpit Using Software Defined Radio and Digital Aviation Solutions	179
157.	Airborne GPS Jammer	180
158.	Low Band Jammer for Existing Fighter Aircraft	181



## INDEX

<b>Ser No</b>	<b>Challenges</b>	<b>Page No</b>
159.	Next Generation Radar Warning Receiver (NG RWR) for Transport Aircraft	182
160.	Multi GNSS Jammer and Spoofer	183
161.	Next Gen RWR and ASPJ for Existing Fighter Aircraft	184
162.	Missile Approach Warning System (MAWS) and Directed Infra-Red Counter Measures (DIRCM) for Transport and Helicopters	185
163.	Drone/ UAV Based High Band Jammer	186
164.	UAV Based Electronic Intelligence System With AI Enabled Analysis	187
165.	High Altitude Electronic Intelligence Sensors	188
166.	Surveillance, Detection and Tracking System for Targets Moving at Hypersonic Speed	189
167.	Medium Altitude Long Endurance (MALE) RPA	190
168.	Passive Surveillance System (PSS)/ Multi Static/ Bi Static Radar	191
169.	Dual Infrared Band and Ultraviolet Based Imaging Seekers for Man Portable Air Defence System	192
170.	Very High Frequency Radars	193
171.	Multi-Phenomenology Multi-Sensor Algorithm for Fusion of Data from Various Sensors	194
172.	AI/ ML Based Change Detection for Multi Payload Fused Imagery Data	195
173.	AI Based Comprehensive Framework (Indigenous) for Security Operation Centre	196
174.	Supersonic Aerial Targets	197
175.	Stealth Unmanned Combat Aerial Vehicle	198
176.	X-Band Mobile Doppler Weather Radar (DWR)	199



## INDEX

<b><u>Ser No</u></b>	<b><u>Challenges</u></b>	<b><u>Page No</u></b>
177.	Small Diameter Bomb (SDB) For HALE/ MALE/ UCAV	200
178.	Air-to-Surface Missile for HALE/ MALE/ UCAV	201
179.	Integrated High Mobile Tactical High-Energy Laser and Electromagnetic Weapon System	202
180.	NLOS Guided Ammunition	203
181.	Air to Surface Missile for Fighter and Bombers	204
182.	Smart Loitering BVLOS Munitions	205
183.	Universal Launcher for Aircraft	206
184.	Large Area Aerial Liquid Dispersion (LAALDE)	207
185.	Shaped Array Antenna	208
186.	On Demand Spares Through Additive	209
187.	Ejection Seat for Fighter Aircraft	210
188.	Standalone Data Decoder for AWACS Aircraft and Aero Engines	211



21

## **SECTION - I**

# **ONGOING PROJECTS** **UNDER DEVELOPMENT**



## AERIAL FUSE FOR BOMB

22



**A** proximity fuze (also Variable Time or VT fuze ) is a fuze that detonates an explosive device automatically when it approaches within a certain distance of its target. It is proposed to indigenously Design, Develop and Manufacture Aerial Fuse (with impact delay and proximity modes) for Mk 80 series General Purpose Bombs.



## 125 KG BOMB

23



**T**he 125 kg bomb (akin to Mk 81) is an aircraft delivered air to ground munition for use against targets such as buildings, troop concentrations and light armoured vehicles. The 125 kg bomb will comply to US military Mk 81 bomb design standards. This 125 kg bomb will be compatible for carriage by IAF Western and Russian origin aircraft. The Mk 81 type bombs can be carried by a wide range of aircraft, including fighter jets and attack aircraft. This bomb can also be equipped with guidance kits like the Paveway series for converting these into smart munitions.



## HELICOPTER LAUNCHED WEAPONISED DRONE

24



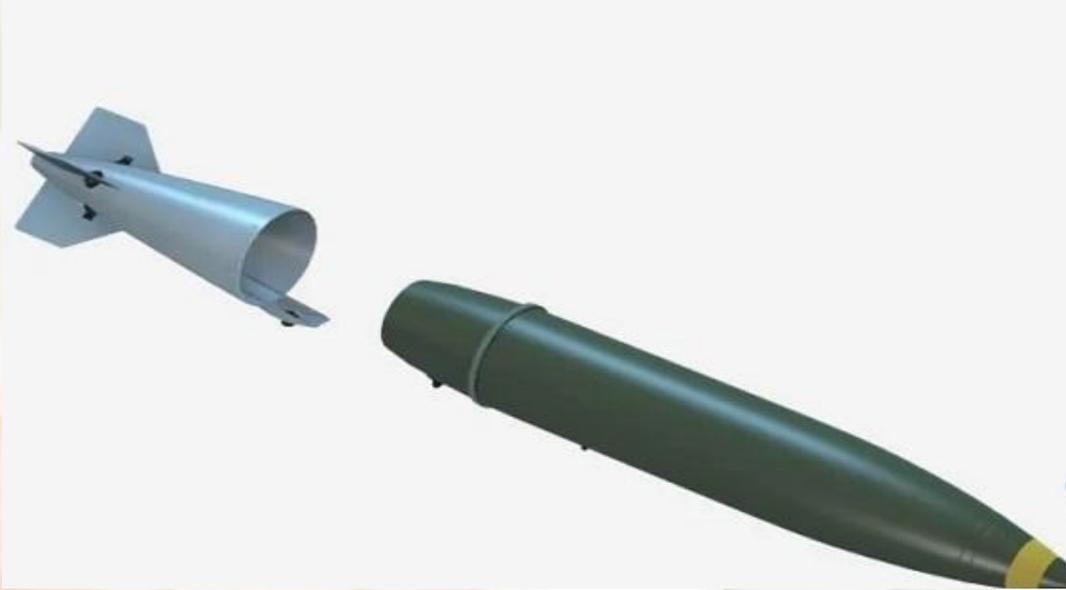
**A** helicopter launched weaponised drone with Man-unmanned teaming capability will be developed with capability of launching from Mi-17 class helicopter truss/ wings with a minimum warhead of 50 Kgs and a minimum range of 40 Kms. It will have following capabilities:-

- (a) Electro Optical/ Infrared (EO/ IR) head for guidance
- (b) GNSS denied environment navigation
- (c) Pilot in loop control and video relay
- (d) Compatible store with existing bomb rack
- (e) Circular Error Probable (CEP) of less than 5 meters
- (f) Capability to define impact angle and attack direction
- (g) Environmentally sealed for carriage and handling



## BOOSTER ASSISTED REK WITH EO-IR TERMINAL GUIDANCE

25



It is required to develop rocket/ engine assisted Range Extension Kit for conversion of 250 Kg High Speed Low Drag bombs with Electro Optical/ Infrared (EO/ IR) head for terminal guidance. The range should be greater than 150 Kms. The kit should have scene matching capability, ability to work in GNSS denied environment. It should strap-on to existing HSLD 250 Kg bombs Store and should be compatible with existing bomb rack of aircraft available in IAF. It should have accurate delivery Circular Error Probable (CEP) of less than 5 meters. It should have capability to define impact angle and attack direction through mission planning. The design should support ease of maintenance and handling Storage in strap-on condition.



## AIR LAUNCHED FLEXIBLE ASSETS –SWARM (ALFA-S)

26



**T**he Air Launched Flexible Asset-Swarm (ALFA-S) is to act as an offensive weapon from a stand-off range, effectively saturating enemy air defenses while performing roles such as Intelligence, Surveillance and Reconnaissance (ISR), Battle Damage Assessment (BDA) and radio relay to extend communication. The ALFA-S system, integral to developing the Manned-Unmanned Teaming (MUM-T) concept, necessitates the creation of a Minimum Viable Product (MVP) that includes five UAVs capable of hard kill, ISR and data relay functions, launched from NATO-standard launchers.

Equipped with advanced ATR capabilities supported by AI/ML algorithms, the system will achieve high impact accuracy within a 3-meter Circular Error Probable (CEP), with the ability to adapt target coordinates mid-flight. Furthermore, the design emphasizes modularity, ruggedness for transport and easy maintainability, ensuring the ALFA-S is operable under a wide range of environmental conditions while being compliant with relevant military standards for airborne applications and EMI/ EMC compatibility.



## MULTI DOMAIN LAUNCH CAPABLE LOITERING AERIAL INTERCEPTOR

27



**L**ong range drones are a threat to vital installations. The interception of these drones with missiles require large infrastructure and high per weapon cost. With increasing use of drones, an autonomous interceptor is required to detect, identify and destroy these drones. These counter swarm drones will be tube launched drone system that can be launched from helicopters, ground vehicles or static installations. The system will be capable of loitering over a vital installation while waiting for an incoming drone threat. The system must be able to home-on to drones. The neutralization may be a hard kill or any suitable technology for enemy drone neutralization. The system will be capable of integrating with IAF systems, when required. The minimum mandatory operating altitude is 8000 ft AMSL.



## SPACE DOMAIN AWARENESS

28



The proliferation of technology and reduced launch cost have led to a significant rise in the number of objects in the outer Space. There is also a confluence of commercial and military interest in space for Space operations. Hence there is a need to monitor the space objects. The space object observation data from the telescope will provide the Space Situational Awareness (SSA). SSA data will be used to track and monitor all activities in outer space.

SSA data services will be employed for the monitoring and tracking of space objects. This would enable detection, tracking and monitoring of space objects for generation of space objects catalogue towards space operation and simulation. It would also help in analytics for Space Surveillance and facilitate envisioned integrated Command and Control Centre for Space Operations.



## AUTONOMOUS DOCKING OPERATIONS FOR ON ORBIT MAINTENANCE AND REFUELLING (OOMR)

29



**S**pacecraft is intended to undertake maintenance and refuelling operations on friendly/ cooperative deployed Space Assets. This technology will not only be a force multiplier but will boost space operations supplementing increased satellite life, reduced down time, saving cost of replacement of space asset and increased operational flexibility.

The proposal is to develop technologies for docking operations with friendly/cooperative spacecraft to be serviced, refuelled or maintained. The technology for precise guidance during all phases of operation (proximity, terminal guidance and docking) and docking methodologies will be developed.



## INTELLIGENT ON-BOARD SYSTEM FOR SATELLITE MISSION PLANNING

30



**T**here is a requirement of an Intelligent On-board System for Mission Planning of satellites equipped with RF sensors, crucial for enhancing autonomous military operations. This system will execute missions independently by processing commands from ground control, reducing the need for continuous human oversight. By integrating advanced algorithms and processing capabilities, it efficiently collects and analyzes critical radio frequency (RF) data, essential for detecting and identifying various RF sources, which is vital for tasks like electronic warfare, surveillance and reconnaissance.

Autonomous operation ensures missions are carried out with minimal latency and high precision, adapting to dynamic operational environments without direct ground control intervention. This approach increases mission effectiveness and optimizes satellite resources by enabling real-time data collection and analysis. The proposed intelligent system significantly enhances the strategic value of satellites in military operations, providing timely and reliable RF data, crucial for maintaining a tactical advantage in complex and evolving scenarios. Overall, it will strengthen the capability of satellites in support of critical defence missions.



## GROUND CONTROLLED SATELLITE ANTENNA FREQUENCY SWITCHING SYSTEM

31



**T**here is a requirement of a space-based, multi-band antenna system for RF sensor satellites. The system to operate across multiple frequency bands, consolidating the functionality of separate antennas into a single, versatile unit. This capability is critical for enhancing the efficiency and flexibility of satellite operations. By integrating a multi-band antenna system having various operating frequencies, the satellite can adapt to various operational needs without the requirement for multiple, physically distinct antennas. This eliminates the complexity and weight associated with deploying separate antennas for different frequency ranges.

The antenna system's configurability via a ground-based control system allows precise switching and tuning across various frequency bands. For military applications such as electronic warfare, signal intelligence and communications, the ability to rapidly reconfigure antenna settings ensures optimal performance and adaptability. This system will enhance mission versatility, reduce hardware requirements and support more effective and agile satellite-based operations in diverse and demanding environments.



## MULTIBAND RF SENSOR DATA PROCESSING AND ANALYSIS SYSTEM



**T**here is requirement of Data Processing and Analysis tool for multiband RF data collected by RF sensor satellites, aimed at enhancing aerospace power strategically. This tool is essential for optimizing the analysis of complex RF signals gathered across multiple frequency bands. RF sensor satellites are key elements in tasks such as surveillance, electronic warfare and reconnaissance. Using a ground-based processing platform equipped with advanced AI tools, the system will improve data interpretation speed and accuracy significantly.

Multiband RF data presents diverse signals that are challenging to analyze manually. AI-driven analysis enables automated identification and classification of various RF sources and patterns, supporting more informed decision-making. The ground-based platform efficiently handles large data volumes, offering actionable intelligence and enhancing situational awareness. This capability is critical for responding to evolving threats and adapting to dynamic operational environments. By leveraging AI for data analysis, the IAF can achieve a strategic advantage through timely and precise insights, ultimately boosting aerospace power and mission effectiveness.



## L/P BAND CONTINUOUS WAVE SAR PAYLOAD FOR LEO SMALL SATELLITES



**T**here is requirement of L/P band Continuous Wave Synthetic Aperture Radar (SAR) payload for small satellites in Low Earth Orbit (LEO), aimed at providing high-resolution imaging capabilities essential for intelligence, surveillance and reconnaissance (ISR) missions. Deploying this advanced SAR system on small satellites allows continuous, detailed observation of ground targets, enhancing situational awareness and operational effectiveness. Integrating the SAR payload into small satellites offers strategic advantages, as these satellites are cost-effective, rapidly deployable and can operate in constellations for persistent coverage.

The Continuous Wave SAR payload enables the satellites to capture real-time, high-resolution imagery in all weather conditions and under varying light levels, crucial for tracking enemy movements and detecting hidden or camouflaged objects. This integration ensures the SAR payload functions efficiently within the satellite's compact form factor, maximizing performance while maintaining the satellite's agility and operational flexibility. In the military aerospace context, this capability enhances reconnaissance and target identification, supporting informed tactical decisions and maintaining a technological edge over adversaries.



## MINIATURISED MULTI-PAYLOAD SATELLITE UPTO 150 KGS

34



The miniaturization of electronic payloads has transformed satellite technology, enabling small satellites, around 150 kg, to perform tasks previously handled by large, dedicated satellites. This advancement is especially advantageous for Indian Air Force (IAF) operations, where cost-efficiency, rapid deployment and operational flexibility are critical. The proposed development of a modular small satellite that integrates various miniaturized payloads such as Electro-Optical (EO), Infrared (IR), Synthetic Aperture Radar (SAR) and Hyper Spectral sensors addresses these operational needs effectively. Such satellites can be manufactured at lower costs compared to traditional large satellites, while their smaller size and weight offer more affordable and flexible launch options.

In IAF operations, deploying a modular satellite with multiple sensing capabilities significantly enhances intelligence, surveillance and reconnaissance (ISR) missions. The integration of EO, IR, SAR and Hyper Spectral sensors into one platform provides comprehensive situational awareness and multidimensional data collection. This approach not only optimizes resource utilization but also improves the adaptability and responsiveness of military satellite systems, boosting overall operational superiority.



## MINIATURISATION OF PAYLOADS (EO AND SAR) FOR A SMALL SATELLITE UPTO 150 KGS

35



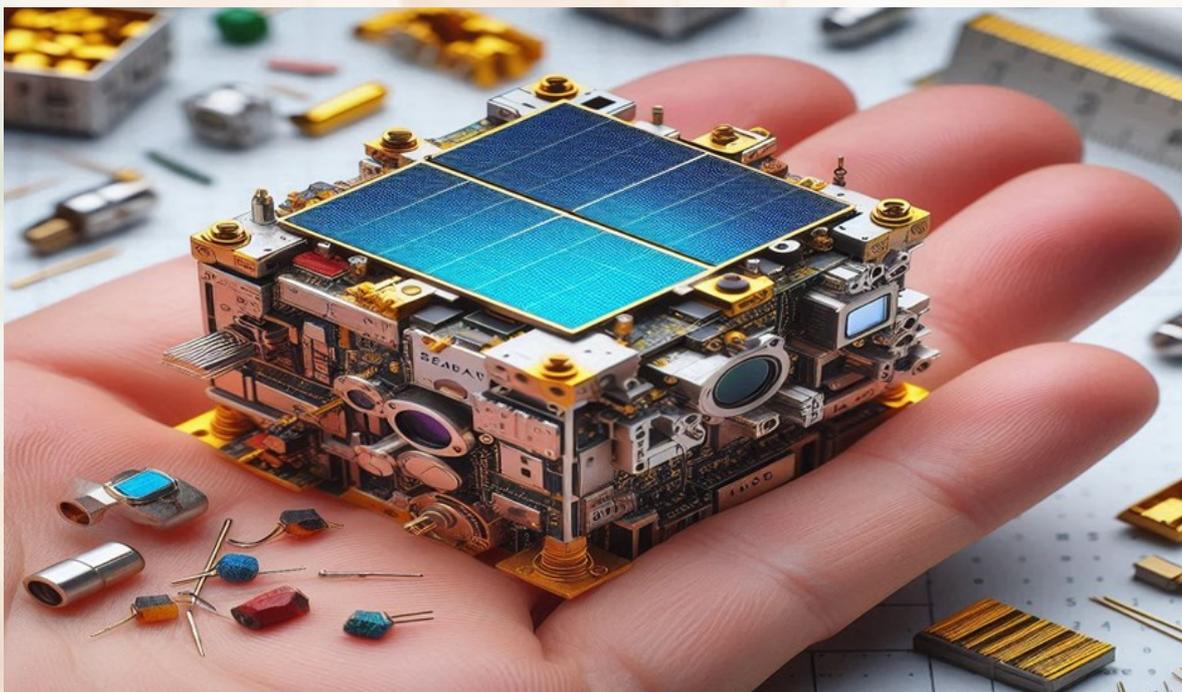
It is required to develop a miniaturized Electro-Optical (EO) sensor with sub-meter resolution and an X-band Synthetic Aperture Radar (SAR) sensor for integration into a compact small satellite. By combining these advanced sensors, the IAF can achieve high-resolution imaging in a streamlined, efficient system. The miniaturized EO sensor will provide detailed optical imagery, critical for precise reconnaissance and target identification in challenging environments. Complementing this, the X-band SAR sensor will deliver all weather, day and night imaging, ensuring continuous surveillance and tracking capabilities. Integrating these sensors into a small satellite, weighing under 150 kg, ensures a cost effective, highly deployable platform.

This satellite can be manufactured and launched with ease and at lower costs compared to larger systems, while still providing high-quality data. Such a platform enhances situational awareness, strategic intelligence and operational flexibility. Its compact design supports rapid deployment in constellations, ensuring persistent and versatile coverage, significantly bolstering the IAF's aerospace power by improving the effectiveness of satellite-based ISR missions.



## MINIATURISATION OF PAYLOADS (IR & HYPER SPECTRAL) FOR A SMALL SATELLITE UPTO 150 KGS

36



**I**t is required to develop a miniaturized Infrared (IR) sensor and Hyper Spectral sensor for integration into a compact small satellite, addressing critical military aerospace needs. This combined sensor package will enable a satellite weighing less than 150 kg to deliver advanced imaging capabilities for tactical and strategic missions. The miniaturized IR sensor will provide crucial thermal imaging, allowing for the detection and tracking of heat signatures in diverse conditions, including night operations and through obscurants. This capability is essential for target identification, thermal anomaly monitoring and search and rescue missions.

Meanwhile, the Hyper Spectral sensor will deliver detailed spectral analysis across a wide range of wavelengths, facilitating the identification of materials, environmental conditions and battlefield changes. These combined features significantly enhance reconnaissance, surveillance and environmental monitoring effectiveness. Integrating these sensors into a small satellite simplifies manufacturing and deployment, making advanced ISR capabilities more cost-effective and accessible, while the compact design allows for rapid deployment and improved operational flexibility, strengthening IAF's strategic advantage.



## MINIATURISATION OF ON-BOARD ANTENNA SYS USING ADDITIVE MANUFACTURING TECHNIQUES



**A**dditive Manufacturing (AM) is a transformative technology for military aerospace applications, especially in developing miniaturized on-board antennas for small satellites. AM utilizes computer-aided design (CAD) software or 3D scanners to guide hardware in layering materials to create complex, precise geometric shapes. This capability allows the production of high-performance components tailored to specific mission requirements. The proposed use of AM to fabricate miniaturized antennas for payload data download and telemetry/ command (TM/TC) communication on small satellites takes advantage of these benefits. AM enables the creation of compact, lightweight antennas crucial for efficient communication and data transfer in space, ensuring real-time data transmission and maintaining command and control links.

Additionally, AM allows rapid prototyping and customization of antenna designs, optimizing performance while reducing weight and space requirements. This approach supports the efficient deployment of advanced small satellite systems, enhancing operational capabilities while lowering costs. By incorporating AM, the IAF gains a strategic advantage with more agile, cost-effective satellite communication solutions, boosting overall mission effectiveness and responsiveness.



## HIGH SPEED ON-BOARD DATA PROCESSING TECHNOLOGY FOR LEO IMAGING SATELLITES

38



It is required to develop On-board Data Processing (OBDP) module. The increasing use of multi-payload satellites in military aerospace will lead to the generation of vast amounts of data. To efficiently manage this, high-speed on-board data processing systems are essential. The system must be capable of generating Level-1 products, particularly for Earth Observation (EO) and Synthetic Aperture Radar (SAR) payloads, directly in space. These systems will analyse and filter data before transmitting it to ground stations, ensuring only relevant and processed information is sent. This approach reduces transmission time and minimizes data overload on the ground, allowing for faster and more accurate decision making.

With advancements in future military aerospace technology, integrating such on-board processing systems is crucial for enhancing satellite communication, surveillance and intelligence operations. By processing data in orbit, these systems will optimize the flow of critical information, providing a significant advantage in real-time military applications.



## AI/ ML BASED CHANGE DETECTION FOR MULTI PAYLOAD FUSED IMAGERY DATA IN SATELLITE

39



It is required to develop an AI/ ML based on-board analytics system for Earth Observation (EO) imagery. This system would enable real-time change detection and intelligent decision making based on the outcomes of imagery analysis. By integrating artificial intelligence, the on-board system can process data from multiple payloads, extracting critical information and autonomously making decisions. This reduces the reliance on ground-based data processing, significantly improving the speed and efficiency of satellite operations. Such a system would enhance situational awareness and response times, allowing for faster and more accurate mission planning in defence and surveillance applications.

By leveraging AI/ ML technologies, future IAF operations will benefit from increased automation, allowing satellites to autonomously interpret and act upon data, providing real-time insights to decision-makers. This technological advancement represents a key step forward in the evolution of space-based defence systems, optimizing both performance and operational flexibility in the increasingly complex realm of IAF operations.



## MOTION CONTROLLER (HARDWARE AND SOFTWARE) FOR LEO ANTENNA STATIONS

40



It is required to develop an antenna motion controller for Low Earth Orbit (LEO) satellite stations, capable of steering the antenna at velocities of 16 degrees per second or more. Current ground stations for LEO satellites require a motion controller module to track satellites during their visibility window. These controllers comprise both hardware and software components. The proposed system should have key components, including axis control cards, safety logic cards, processor cards and high-power relays (3-phase, 440 volts) and should be indigenously developed. The software must support formats like Two-Line Element (TLE) sets and utilize IRNSS timing signals to precisely steer the antenna.

The system should allow for remote operation via an IP network. This will enhance the efficiency and accuracy of satellite tracking, a crucial factor in IAF's aerospace applications. By ensuring indigenous development of critical components and enabling remote control, this technology will boost the autonomy and flexibility of ground stations, improving mission reliability and responsiveness. Such innovations are key to IAF's future operations, allowing seamless communication, data collection and mission support from LEO satellites.



## INFRARED IDENTIFIER PATCHES

41



**T**here is a requirement of innovative solutions for Infrared (IR) identifier patches to enhance the identification of friendly and hostile entities in sub-con environments. Previously, IR tags and patches were procured with the intention of being identified by Electro-Optical/ Infrared (EO/ IR) equipment on airborne assets, which are crucial for distinguishing between friend and foe during critical operations.

However, the existing IR patches, which emit at a wavelength of 0.850 microns, have proven incompatible with the EO/ IR equipment on aircraft, which is calibrated to detect IR signatures within the 3 to 5 microns range. As a result, these patches could not be picked up by the EO/ IR systems during base defense sorties, leading to a gap in effective Identification capabilities. To address this issue, there is a pressing need to develop new IR identifier patches that operate within the 3 to 5 microns wavelength range, ensuring they are detectable by the EO/ IR equipment. The development of such patches is essential for improving identification accuracy, operational safety and situational awareness in complex environments.



## VEHICLE MOUNTED TRANSPORTABLE AEROSTAT WITH MULTIPLE PAYLOADS

42



**L**ow level coverage of radars and communication equipment are limited due to radio line of sight. The antenna elevation is one of the factors to increase radio line of sight. A portable system with aerostat or any similar technology that can provide low level coverage for 80-120 km with radar and radio communication equipment has been proposed to be developed.

The aerostat will be capable of operating up to an altitude of 5 km AMSL with integrated payload for radar. Radio communication and data connectivity will be available, with provisions to integrate with IAF systems. System will have mechanism to remain operational in case of limited damage caused to tether, aerostat or Power supply. The system will be capable of being operated with minimal manpower. The system can winch down/ deflate and become operational at new location in two hours. The helium gas used in aerostat will be recoverable or reusable.



## CHAFFS & FLARES

43



**C**haffs and flares are defensive countermeasures used by aircraft to protect it from Radar-guided and heat seeking missiles. They are essential tools for modern air combat as they significantly increase survivability of an aircraft. Chaff and flares of various dimensions will be developed for IAF and IA aircraft.



## INFLATABLE DECOY

44



**D**ecoys are used to conceal equipment from enemy. Inflatable decoys provide ease of handling and transportation and prove effective to divert attack without loss to own equipment. Multiple decoys of own equipment deployed in the field are required. These decoys may range from aircraft, SAM systems, Radars and other associated equipment to vehicles and ground equipment.



## PORTABLE SPOOF EMITTER FOR RADIATION (POSERAD)

45



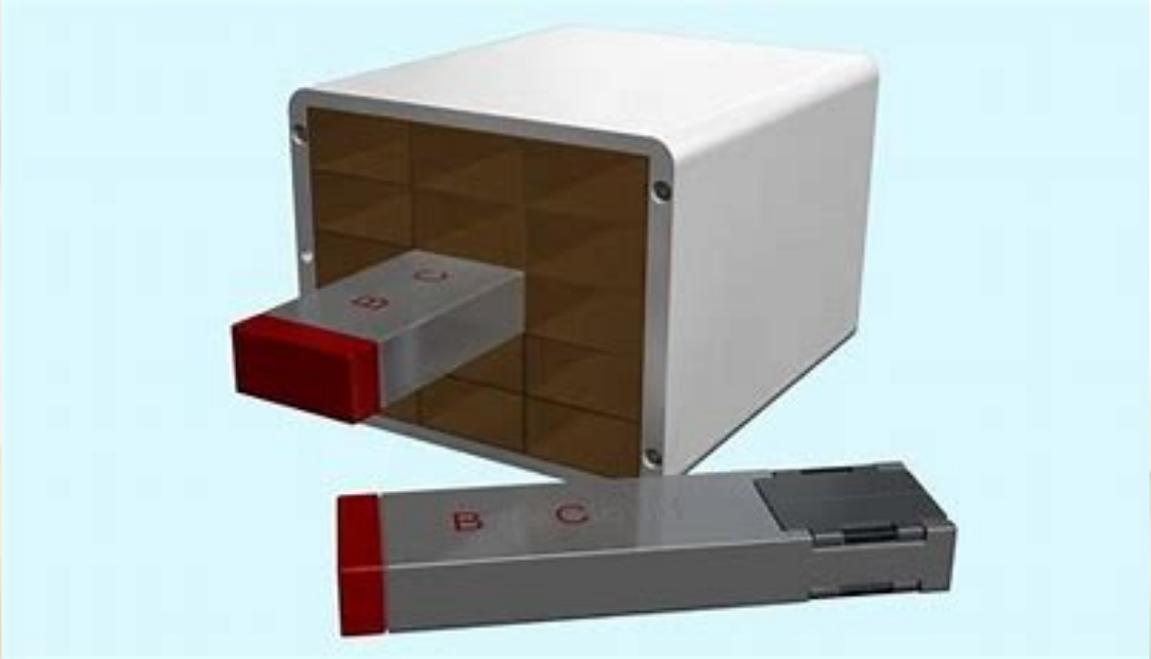
IAF uses various types of radiation emitting devices in Radars for surveillance and ground based air defence weapons. Due to operational requirements, there is a need to have spoof transmissions from a distant transmitter matching to Electro-Magnetic signature of original emitters. It is proposed to develop a Portable Spoofer Emitter for Radiation (POSERAD) for one sample emitter. Broad developmental requirements of POSERAD are:-

- (a) The operation of the POSERAD should be autonomous, as far as possible, with minimum intervention needed from the operator.
- (b) The overall construction should be rugged for deployment in terrains encountered in north, east and west of the country.
- (c) It should take two or less people to transport/ operate/ erect the POSERAD.



## EXPENDABLE ACTIVE DECOY (EAD) FOR DEFEATING RF-GUIDED MISSILE AND FIRE CONTROL RADARS

46



**D**evelopment of a self-contained active 'RF' decoy which can be dispensed from existing chaff/ flare dispensers. The system should be low cost solution and easy to integrate with the existing dispensers (form fit). It should have the capability for either pre-emptive or reactive threat counters. System should have a laptop based programming to ensure optimisation of the system against any existing and emerging threats.

The EAD should be triggered as the Chaffs/ Flares are currently dispensed. The EAD should use suitable technique e.g., DRFM to perform the decoying task. The EAD should be totally self-contained in performing its task, after being ejected. The EAD should have a aerodynamic support to allow longer float period after ejection. It should be adaptable to different size and shapes of chaff/ flare magazines in IAF inventory.



## SIGINT SYSTEM FOR HILLY TERRAIN AND HIGH ALTITUDE AREAS

47



**P**resently, ground based Signal intelligence (SIGINT) system have restricted capabilities in hilly terrain and are unable to triangulate the adversary's sensors due to inadequate Line of Sight. The system is proposed to be based on a compact 4x4 vehicle with a smart sensor for tactical Electronic Intelligence (ELINT) and micro Electronic Support Measures (ESM) system onboard the drones. The vehicle will be all terrain with engine capable of steep climbing and going off road. The system housed inside the vehicle will have erectable antenna. The vehicle will have a data link with the drone.

The drone vehicle will have a modular storage space (trays) for housing multiple drones with the purpose of storage, transportation, charging, launching and recovery. The drones will be stored in trays, which can be extended through a suitable mechanism for launch of drones and the trays could be retracted after the drones are recovered, for charging, storage and transportation. The system inside the vehicle should have compact receivers for both Communication Intelligence (COMINT) and ELINT. Suitable Satellite Communication (SATCOM) will be provided with the system to transfer data in real time to the higher echelon.



## DRONE/ UNMANNED AIRCRAFT EMULATOR

48



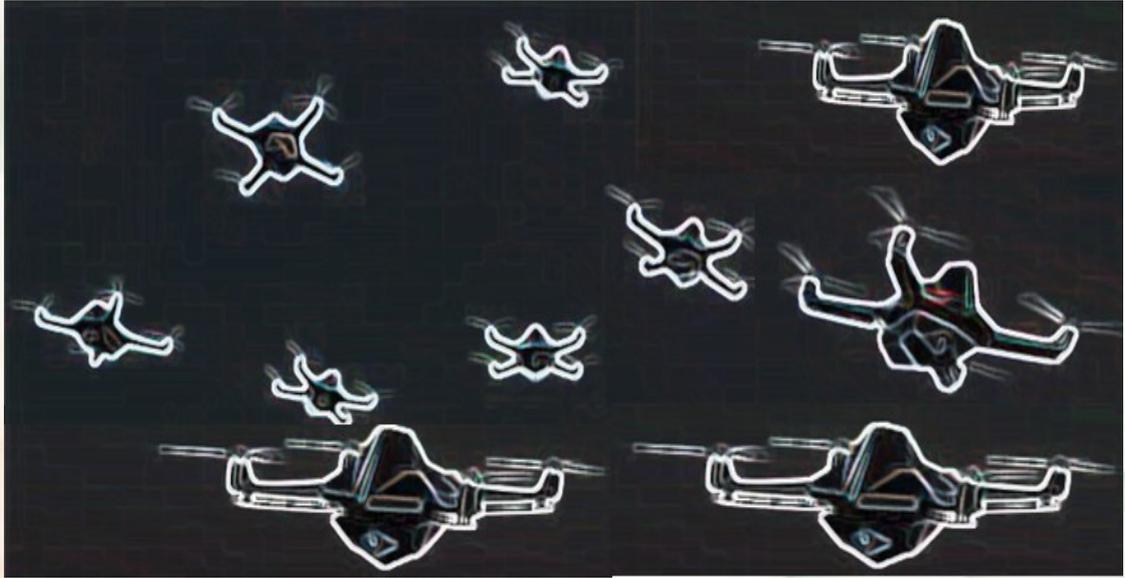
**D**rone/ UAS Mounted Emulators will comprise of a swarm of multiple drones, which shall be individually or collectively be able carry out surveillance operations as well as Deception and Jamming operation. These should be mounted with emulator suites which can emulate a variety of targets and misguide the adversary of potential threat to their defences.

The suites on-board need to be power efficient and offer a variety of use case combinations for multiple profiles to be flown. Swappable hardware and configurable systems will be required o enable this concept.



## ANTI-RADAR DECOY SWARM WITH CHAFF DISPENSATION AND EW PAYLOADS

49



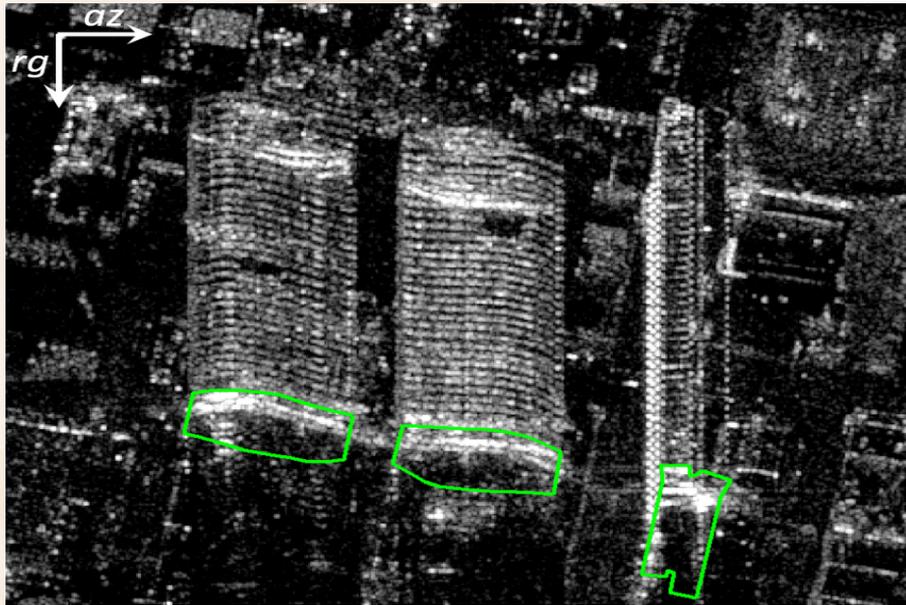
**A**n expendable active decoy swarm confuses enemy Air defence by employing Electronic Warfare (EW) payloads and chaff dispensation. It will have high speed drones with EW payloads and Chaff dispensation inbuilt in system. The range will be 500 kms or more with speed of 0.9 Mach or more. The drones will carry electronic warfare payload to detect and emit EW radiations automatically or as per the plan. Drone will carry large number of chaffs to assist in making a chaff corridor for EW planning.

The launch mechanism will be simple to use without requirement of runway. Infrastructure requirement will be minimal and self contained. Navigation system to be GPS independent. The payload space will be upgradable/ swappable for future requirements. These will be capable of being launched in large numbers from multiple locations and act in swarm for better capability/ combined payload.



## SAR IMAGE DISRUPTOR

50



It is required to develop a portable Synthetic Aperture Radar Image disruptor and prevent accurate imaging through SAR. The system should be able to disrupt SAR surveillance imaging from aerial platforms. It should have both swept noise and pattern distortion modes. must be able to target on-board Radars operating in side-looking mode of surveillance with synthetic aperture synthesis and strike aircraft on-board Radars operating in strip map mode. The system will be able to simultaneously jam up to four on-board Radars. It will be portable to relocate on vehicles or buildings and ground based as per requirement.



## TETHERED DRONE

51



**T**he problem involves developing a tethered drone system for security surveillance of Indian Air Force (IAF) assets, capable of day and night operations. The drone must operate within military bases, vital installations and around mobile military assets, as directed by IAF authorities. Deliverables include a tethered UAV with day/night sensors, a ground control station, two battery packs and all necessary peripherals. The drone must autonomously launch and recover, with a tethered endurance of 24 hours and untethered for 45-60 minutes, operating at altitudes of 1000 feet or higher with a 10 km range.

The dual sensor payload should provide clear video by day and night, with advanced flight modes like FTC and CG. The ground control station must be rugged, waterproof and MIL-STD compliant, with anti-glare displays and 90-minute battery life. Communication must be encrypted and resistant to jamming. Navigation includes autonomous operation in GPS-denied environments. The system should be modular, easy to operate, portable and maintainable.



## AIR-MINE : MEASURING AND SENSING OF AIR DISTURBANCE FOR DRONE DETECTION

52



The Air Mine Counter-Unmanned Aerial System (AMCS) sensor aims to detect and continuously track drones or I-JAS by observing air disturbances caused by their movement. It is designed for deployment around military airfields, vital installations and boundary lines to detect aerial intrusions. The system's deliverables include a network of sensors covering a 1 km diameter, a laptop-based command and control (C2) center and wireless communication receivers. Each sensor must detect drones up to 2000 meters altitude with defined horizontal ranges and operate both day and night. It must provide real-time data on range, bearing, speed and altitude of multiple drones simultaneously, including swarm threats with high accuracy. The sensor system should be portable, easily deployable without extensive infrastructure and operate autonomously for at least 24 hours using built-in power supplies.

The centralized C2 center will display fused data from all sensors and offer multiple operator workstations for real-time monitoring and control. The system should be rugged enough for harsh environments and be transportable using light vehicles. The entire system should be easy to assemble, dismantle and redeploy by two personnel in less than two hours.



## SWARM ANTI DRONE SYSTEM

53



**T**he Countermeasure Against Swarm Drone Attacks (CASDA) system is to be designed to neutralize illegal or hostile drones using one of three methods: kinetic strike (direct impact or detonation), capture and recovery (uses a net to catch the drone), or capture and carry (capturing the drone and transporting it to a secure location for forensic analysis). CASDA must be operable by 2-3 personnel and provide full 360-degree coverage. The system will include components such as kamikaze drones (with or without explosives), net drones equipped with onboard sensors & net catchers and necessary launching equipment like tubes or boxes. The system will be controlled through a GUI integrated with a command and control (C2) system to detect and track swarm drones with a maximum neutralization range of 3 km and detection range of 5 km (assuming 10m/s DJI-class drones).

CASDA should work both day and night, handle moving and hovering drones and have post-capture retrieval mechanisms. It should also operate in field conditions, be transportable, deployable within an hour and robust enough to handle rough terrain. The system should provide seamless communication with existing Indian Air Force CUAS systems.



## MULTIROLE AUTONOMOUS UAV FOR AIR DEFENCE UNITS & BASES OF IAF

54



**E**lasticopter will be a versatile, multirole autonomous UAV for the Indian Air Force (IAF), suitable for various applications. The Elasticopter must efficiently handle multiple tasks by swapping payloads, which include Electro-Optical/ Infrared (EO/ IR) surveillance, grenade dropping, logistics support and Radar calibration. The Elasticopter is expected to operate in diverse scenarios, such as security assistance during convoy movements, enhancing security at forward areas, logistics support in forward locations and Radar calibration.

Within bases, it will strengthen security, aid in daily tasks, assist in air crash scenarios and support humanitarian aid and disaster relief (HADR) operations. Operational characteristics include a hover endurance of 30-60 minutes with a 5-20 kg payload, maximum altitude of 5 km AMSL and operational range of at least 25 km. The UAV should feature autonomous vertical take-off and landing, waypoint navigation, real-time target tracking and advanced flight capabilities.



## NON-ROTATING ACTIVE ELECTRONIC SCANNED ARRAY (AESA) RADAR OF COUNTER DRONE APPLICATIONS

55



**T**he Non-Rotating Active Electronically Scanned Array (AESA) Radar for counter-drone applications is designed to integrate seamlessly with existing Anti-Drone Systems of the IAF. The system's core deliverables include one non-rotating AESA Radar featuring a four-plank design, capable of both static and vehicle installations. This Radar will enhance current anti-drone measures by providing early detection of incoming drones which is crucial for timely intervention. It will operate in S or X band, using AESA technology with four 90-degree azimuth coverage planks and an elevation coverage of 70 degrees or better. Detection ranges will vary with Radar Cross-Section (RCS), for a 0.05 sqm RCS to 4 sqm RCS.

Accuracy specifications include azimuth and elevation accuracy of 2 degrees, range accuracy of 10 meters, resolutions of 1 degree for azimuth and elevation and 5 meters for range. The Radar can track up to 200 targets. Self-calibration ensures the Radar adapts to environmental conditions without operator input. The system should be mobile, able to function in diverse terrains and transportable by various methods including air, road and rail. Maintenance will be facilitated by easy field repair options and a repair kit.



## HAND HELD HARD KILL COUNTER UAS SYSTEM

56



**D**rone/ UAS identified as illegal/ non friendly is neutralized by using a net drone or net grenade. The counter UAS should facilitate soft landing so as to keep collateral damage to minimum possible extent. Two methodologies have been proposed. The net is to be carried by Net Grenade, which is to be fired by a Rifle or use of Net drone, which should have an onboard sensor and at least two net cartridges. Capture is to be achieved using a single person operating the system. Initial detection is to be done visually and then orientate gun towards approach of Drone. The system to be capable of being deployed and operating up to an altitude of 10600 Feet AMSL and extreme temperatures.



## COMMUNICATION EQUIPMENT WITH INDIAN SECURITY PROTOCOLS

57



In the complex landscape of modern warfare, secure communication is a cornerstone of success. There is a requirement of secure communication grid to integrate IAF's weapon systems, air-defence elements, data-centres and end-users. It is required to setup an indigenous communication grid with self-designed protocols and secure architecture for encrypted communication. The set up will be used to establish communication between various weapon systems, ground to air and air to ground elements, data centres, end users and vice versa. The grid can be a mix of wired/ wireless hardware and protocols.



## WIDE BAND HF MODEM

58



**H**F communication could be achieved globally under all weather conditions. HF is a free of cost long distance (over the horizon) communication, akin to Satellite Communication (SATCOM). Each sub-band of HF range (3 MHz to 30 MHz) is unique in its behavior and affected by ionospheric conditions and sun-spot activities. Hence the available bandwidth at a given instant is limited between 100 KHz to 600 KHz, multiple bands inclusive. Given this limited bandwidth resource & environmental dependence, achieving bidirectional voice, data & video communication over HF is a challenging research activity. Development of all band High Frequency (HF) digital modem for video interaction targeting data rate capabilities in excess of 48 Kbps, ultimate data rate being 512 Kbps or better. The developed modem to be complaint with STANAG and MIL-STD-188-110D standards.



## WIRELESS HEADSET FOR FLIGHT GUNNER

59



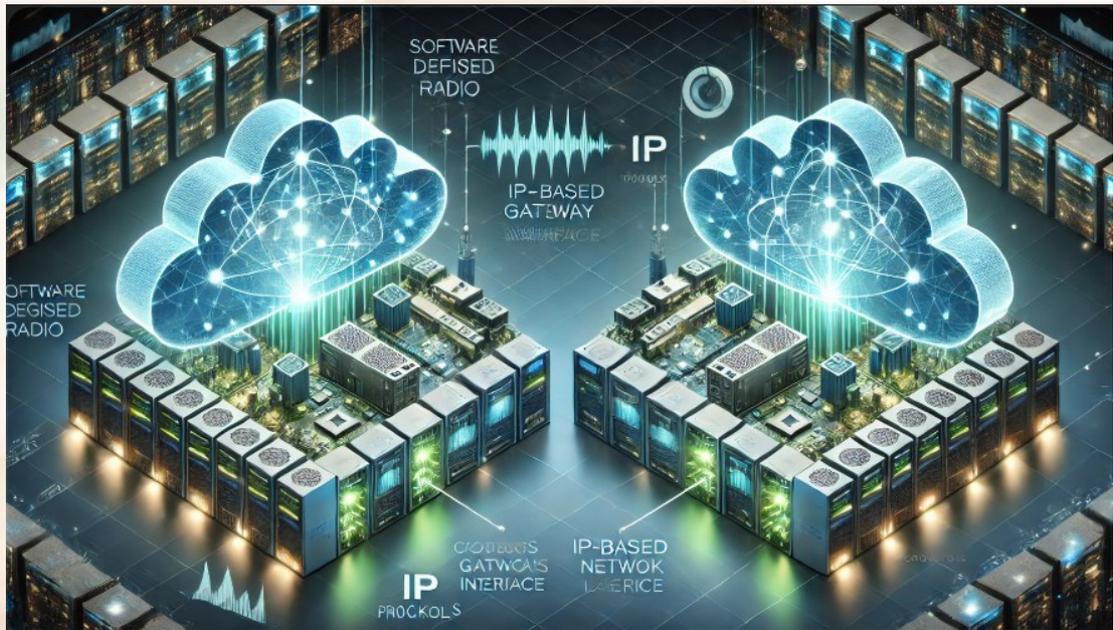
**R**equirement exists to improve communication between helicopter crew, which is currently hindered by external noise from engines and rotors. The legacy headsets in use allow excessive noise to interfere with communication, thereby reducing crew situational awareness (SA) and negatively impacting Crew Resource Management (CRM). This situation poses significant risks to flight safety, as clear communication is essential for coordinated operations. Furthermore, prolonged exposure to high noise levels has potential long-term health implications for aircrew, including the risk of hearing loss. The inability of the flight gunner to maintain communication with the captain and vice versa, creates operational challenges and compromises safety.

To address these issues, the development of a secure, encrypted, noise cancelling wireless headset with a communication range of 50 meters is proposed. The headset should be ergonomic and offer adequate battery life to support long-duration missions. Moreover, it should be easily integrated into the existing Intercommunication System (ICS) of the MLH, ensuring seamless compatibility and plug-and-play functionality.



# INTERNET PROTOCOL (IP) BASED GATEWAY INTERFACE FOR BRIDGING INTER-COMMUNICATION BETWEEN TWO DIFFERENT SDR NETWORKS

60



The IAF has a long-standing requirement for new-generation radios and data links that can talk to existing IAF SDR. Development of IP Based Gateway Interface will provide solution to establish interoperability between SDRs of different make and hardware without dependency on the interoperable SDR waveform.



## PART TASK TRAINER FOR MIRAGE 2000 AIRCRAFT

61



**T**he proposal is to develop a part task trainer for Mirage 2000 aircraft. The part task trainer should have an accurate replica of the Mirage 2000 aircraft stick and throttle. The Multifunctional Displays (MFDs), Head-Up Displays (HUDs) and other displays can be replicated on LCD/ TFT/ OLED display panels with touch screen. The pilots should be able to undertake basic flying and be able to accurately simulate all existing modes and functions of the aircraft. The cockpit controls, buttons, levers, switches etc. are required to be replicated for reasonably accurate form. Following objectives will be required to be achieved: -

- (a) Accurately model and simulate the cockpit controls and MFDs including all pages, sub pages and functions of Mirage 2000 cockpit.
- (b) Create simulation models to allow basic flying (CAT B) on the part task trainer.
- (c) Allow pilots to practice to practice various modes of operation of the aircraft.



## INFUSION OF AR/ VR IN TECHNICAL TYPE TRAINING

62



**T**raining methodology adopted in Technical Type Training (TETTRA) Schools and Training Institutes (TIs) on Aircraft and Systems require forward looking technologies such as Augmented Reality (AR) to enhance the quality of training and imbibe skills which otherwise could not be made possible. Smart AR Glasses for Engineers and Technicians while carrying out Maintenance activity could be a milestone in enhancing the training.

Technicians undertake maintenance activities which mandate them to refer to multiple publications, diagrams and animations to correctly diagnose and perform the intended activity. In the present form, there are limitations in terms of physically visualizing the systems/ subsystems and simultaneously referring to multiple documents.



## HAWK TWIN DOME FLIGHT SIMULATORS

63



**T**he Hawk Twin Dome Full Mission Simulator (TDS) is designed to provide comprehensive training for pilots on the Hawk Mk 132 aircraft. It covers missions including basic flying, aerobatics, air combat, air-to-ground operations, navigation and emergency handling. The TDS replicates the physical controls of the aircraft, providing a realistic training environment. It includes a cockpit module, instructor station and remote replay system, allowing for mission planning, execution and debriefing. High-fidelity simulation ensures accurate aircraft and engine performance, including failure states and supports multiple mission types.

Its visual system offers high-resolution terrain imagery and realistic environmental effects. Instructor Operating Station (IOS) allows for real-time monitoring and control of training exercises, including tactical scenarios with air, ground and sea threats. The TDS also simulates various flight and emergency conditions, offering the ability to adjust scenarios in real-time without pausing the simulation. The simulator is equipped with a robust power backup system and operates efficiently in different environmental conditions.



## SIMULATOR SYSTEM FOR FORCE-ON-FORCE TRAINING OF IAF GARUD COMMANDOS

64



**T**he Infantry Battlefield Training Simulator (IBTS) is an advanced system designed to enhance realistic combat training for the IAF Special Forces, particularly the Garuds, by simulating live ammunition using coded laser pulses of infrared energy. This system eliminates the risk of injury or equipment damage, offering a safe and effective training environment by simulating combat situations that mirror actual battlefield conditions. It aims to improve tactical skills, situational awareness, communication and overall safety during training. Key components of IBTS are laser attachments compatible with various weapons, body armor sensor assemblies and a command and control module for monitoring.

IBTS can be mounted on different types of firearms and can simulate various combat scenarios such as close-quarters battle (CQB) and long-range engagements. Key features include a laser transmitter that deactivates the weapon of a hit individual and provides audio and LED notifications. The infrared receiver, worn as part of the gear, provides full-body coverage, illuminates upon being hit and aids in identifying hit locations for medical purposes. The system supports large-scale exercises, distinguishing between friendly and enemy fire and is designed to be user-friendly with easy maintenance and calibration.



## INFRARED IMAGING SEARCH & TRACK SYSTEM (IRST)

65



**I**nfrared Imaging Search and Track (IRST) systems are essential components of modern fighter aircraft, providing pilots with a crucial capability for detecting and tracking airborne and ground targets, without employing actively radiating sensors. The IRST system will be able to detect and identify the airborne and ground based targets and supply the information about detected and identified targets in data as well as video format to the Mission Computer (MC) of the fighter aircraft for weapon aiming solutions in stand-alone mode or in master-slave mode. The system will be able to operate in day and night conditions.



## LIGHTNING DETECTION SYSTEM

66

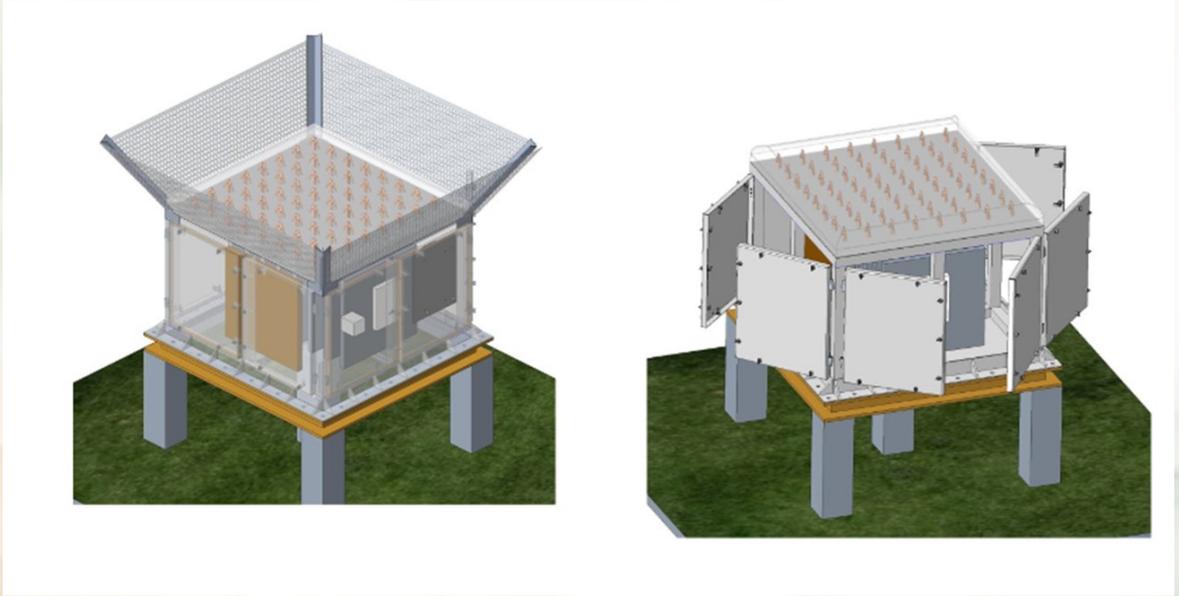


**A** Lightning Detection System consists of a network of sensors that detect electromagnetic (EM) radiation emitted during atmospheric lightning events. EM data is collected and processed centrally to determine the type, polarity, amplitude, time of occurrence and location (GPS based) of lightning with the help of scientifically proven software algorithms. LDS is utilised for real time alerting, situational awareness and assists in enhancing accuracy of short term weather forecast/ now-cast. The increased objectivity in tracking the lightning strikes associated with convective/ thunderstorm cells will result in enhanced operational preparedness, aerospace safety and effectiveness of the weather services provided in IAF.



## WIND PROFILER

67



**A** Wind Profiler is a Radar used for detection of upper wind speed and direction. Wind Profiler on an airfield is highly useful for providing wind information in lower atmosphere (up to 3 Km altitude and more). The data obtained from the profiler is highly useful for air operations, observation of wind shear & turbulence and assimilation of Numerical Weather Prediction (NWP) models.



## MULTI BAND NAVIGATION RECEIVER

68

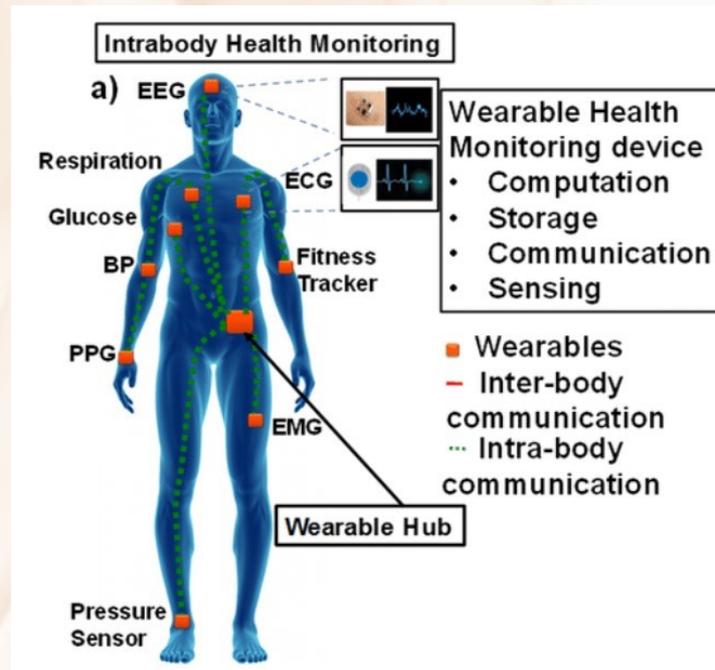


**N**avigation Receivers are used in Ground based Radars and Air Defence Systems to determine the accurate position. These receivers operate on GPS/ GLONASS based Satellite Navigations Systems to determine the position. In the event of Jamming or spoofing the performance of these systems can be degraded. It is proposed to design and develop a Multi Band Navigation Receiver capable of working with existing systems with anti-jamming and anti-spoofing capabilities.



## REMOTE REALTIME IN-FLIGHT HEALTH MONITORING OF AIRCREW

69



**R**emote real time In-flight health monitoring of aircrew will offer valuable medical data, analysis of which can enhance flight safety. Remote health monitoring, based on non-invasive and wearable sensors, actuators and modern communication and information technologies offers an efficient and cost-effective solution that allows healthcare personnel to remotely monitor important physiological signs of their patients in real time, assess, health conditions and provide feedback from distant facilities.

Wearable devices can monitor and record real-time information about one's physiological condition and motion-activities. Wearable sensor-based health monitoring systems may comprise different types of flexible sensors that can be integrated into textile fiber, clothes and elastic bands or directly attached to the human body. These sensors are capable of measuring vital physiological signs such as heart rate (HR), blood pressure (BP), respiration rate (RR), body temperature,  $SpO_2$ , ECG, EMG, electro dermal activity and Galvanic Skin Response.



## PORTABLE AUTOMATIC WEATHER STATION



**P**ortable Automatic Weather Station (AWS) aims to deliver a compact, reliable and highly accurate solution for real-time environmental monitoring in diverse terrains. It will be designed to meet MIL-STD-810G standards for ruggedness, and will be capable of operating under extreme conditions, including high altitudes, varying temperatures ranging from  $-40^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$ , high humidity and exposure to dust, rain and wind. Its lightweight, portable design will enable easy transportation, allowing for rapid deployment in remote or challenging environments.

The Portable AWS will incorporate advanced sensors to measure key meteorological parameters such as temperature, humidity, wind speed and direction, atmospheric pressure and precipitation. These sensors will be highly accurate, with error margins within 1% for humidity,  $0.5^{\circ}\text{C}$  for temperature and  $\pm 0.1$  hPa for atmospheric pressure. The system will also include solar radiation sensors and optional upgrades for UV index and air quality monitoring.



## FOLDABLE FIBREGLASS MAT (FFM) FOR RAPID RUNWAY REPAIR

71



**R**apid runway repair is a critical aspect of military logistics and operations, especially during wartime. A damaged or destroyed runway can severely disrupt the movement of aircraft, hindering resupply efforts, troop deployment and air support missions. Foldable Fibreglas Mat (FFM) for Rapid Runway Repair is a rigid lightweight composite material reinforced with specially developed Fibreglass polyester resin weaved and cut to shape.

The aim of Airfield Damage Repair (ADR) with FFM is to recover Minimum Operating Surface (MOS) in shortest time frame for recommencement of Air Operations. The mats can be used as Foreign Object Damage (FOD) covers over filled & rammed craters to make the damaged runway operational within the shortest possible timeframe.



## SMOKE GENERATORS FOR SARANG DISPLAY TEAM



It is required to address intermittent smoke issues during Sarang Helicopter Display Team sorties. The current smoke generators, which burn oil and 100 LL fuel often produce inadequate smoke due to reduced RAM air, compromising visual appeal. Repeated trials with coloured smoke have also failed to achieve the desired effect and the generators frequently clog with unburnt oil and colour particles. Since the helicopters fly at speeds ranging from zero to 210 kmph, the airflow required for smoke dispersion is insufficient and the fan on the smoke generator proves inadequate.

A canister-type smoke generator is proposed as a solution to reliably produce both white and coloured smoke during aerobatic displays. The goal is to develop a system that can be used consistently across all helicopter displays in the IAF, with an estimated demand for 100 sorties per year. Sarang, the only military four-helicopter display team, performs at numerous venues, including international events, making effective smoke generation crucial to enhancing display effectiveness.



## PRESSURIZED RADOME FOR DIFFERENT RADARS



**R**equirement exists for innovative solutions for the design and development of pressurized radomes for Low Level Transportable Radars (LLTR), Rohini Radars and Low Level Light Weight Radars (LLLWRs), which are currently deployed by the Indian Air Force. Radome plays a crucial role in Radar systems by protecting the sensitive Radar antenna from environmental factors such as extreme weather conditions and high-altitude pressures while ensuring minimal interference with Radar signals.

The specific challenge is to create radome that can operate effectively at high altitudes, where atmospheric pressure is significantly lower. Therefore, the required radomes must be pressurized to facilitate Radar functionality up to 5 kilometres above mean sea level (AMSL). Additionally, these radomes need to be dismountable to allow for easy reassembly at new locations, enhancing operational flexibility and adaptability. The expected deliverables are radomes that meet these stringent requirements to maintain optimal Radar performance and reliability in diverse and challenging terrains.



## GREEN AND SAFFRON DYE, FOR SANDERS SCSG-5R PODS OF SURYAKIRAN (HAWK MK132) AIRCRAFT

74



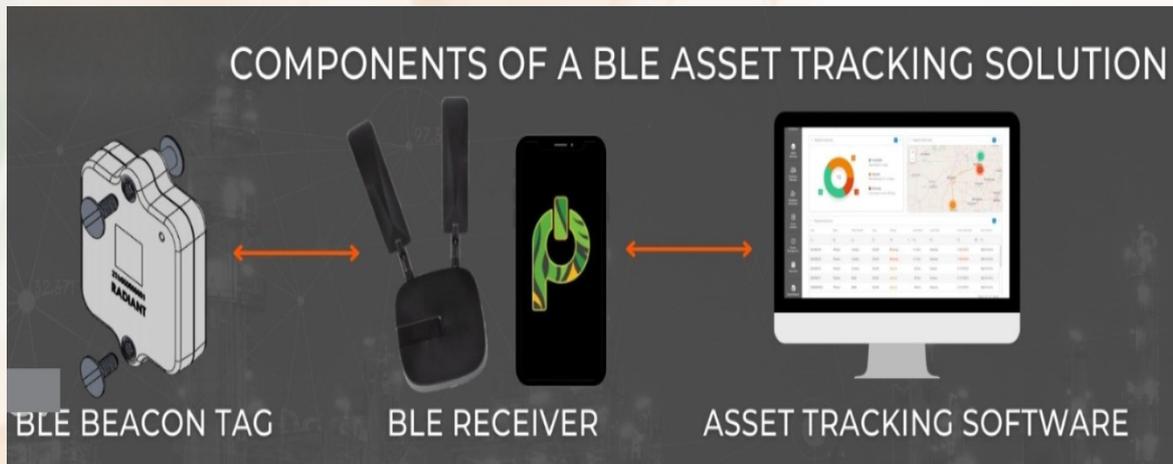
It is required to develop colored smoke dye for SCSG 5R smoke pods used by the Surya Kiran Aerobatic Team. To enhance the performance of SCSG 5R smoke pods there is a need to create colored smoke oils that can produce saffron and green colors, while adhering to specifications related to flash point, viscosity, corrosiveness and toxicity.

The innovation sought will enable the Surya Kiran Aerobatic Team to trail smoke in the colors of the Indian National Flag; saffron, white and green during their aerobatic displays. This is crucial for visually representing the Indian Tricolor in their aerial formations, which is a significant aspect of their performance, reflecting national pride and excellence. The expected outcome allows the team to incorporate saffron and green smoke into their displays, thereby elevating their showmanship and enhancing the patriotic appeal of their performances.



## TOOL TRACKING USING MODERN TECHNOLOGIES

75



One of the problems faced by flying units is error-free tool accounting. In spite of various existing SOPs, the incidents related to missing tools still occur regularly. An RFID based system was introduced in the IAF but it is employed mostly for tool accounting. It is suggested to develop a system which involves usage of technologies or any other radio technology like Bluetooth Low Energy (BLE) to accurately track the tools in the working areas like hangars, tarmac etc., without interfering with air operations.

The beacon should have form factor to be fitted even on the smallest tool available. The system should be able to continuously monitor the location of each tool and display the same. It should also have facility to raise alarm if a tracked tool leaves the designated electronically fenced premises.



## FLIGHT DATA RECORDER (FDR) USING ON-BOARD CAMERA

76



**C**urrently many aircraft utilized by the IAF have limited parameters being recorded in Flight Data Recorder (FDR). This leads to insufficient data during analysis of the flight. Multiple on board high-quality camera (with built in memory and battery) are used to capture the gauges live. The AI based image analysis is utilized to decode the gauge images to values every seconds. This data would provide the information of every gauge (Digital/ Analog) in the format required for analysis of sorties. AI based analysis can also be used for predictive maintenance issues.



## AIR TRANSPORTABLE STARTING AGGREGATE FOR STARTING APACHE HEPTR AT ALTITUDES UPTO 16000 FT



**T**here is a requirement of an air transportable starting aggregate capable of supporting the Apache helicopter's operations at altitudes up to 16,000 feet. The aggregate must provide critical output across three systems: electrical, hydraulic and pneumatic. For electrical output, it needs to supply 115V at 3 amps, DC-28V at 300 amps. Hydraulically, it must deliver fluid at 145-3,480 psi using Mil PRF 83282 or an equivalent standard.

Pneumatically, it should supply air at a minimum of 35 psi with a flow rate of 60 pounds per minute. The aggregate should operate efficiently from sea level to 16,000 feet and be modular for easy transport by Mi-17 class aircraft. Additionally, it must be capable of functioning autonomously or with input from a commercial 220V electric supply.



## INFLATABLE/ MODULAR SUN SHELTERS

78



**T**here is a requirement of innovative solutions for the development of inflatable or modular sun shelters to support combat units operating from off-base sites. These shelters are crucial for protecting sensitive equipment, such as Radars, missile systems, weapon storage and aircraft, as well as providing essential workspace for office operations. The shelters must offer environmental protection for mobile elements and be adaptable to various operational conditions. Key design features include rapid deployment and redeployment capabilities, resilience to extreme weather conditions and ease of transport across diverse Indian terrains, including hilly and desert areas.

Additionally, the shelters should be compact for storage in challenging environmental conditions and equipped with integrated power and network sockets, as well as modular facilities such as a kitchen and toilet. These shelters will not only provide cost-effective, non-permanent structures at airfields/ field locations but also help obfuscate critical equipment deployment from satellite ISR updates, enhancing operational security and effectiveness. This equipment will significantly improve the operational flexibility and logistics support for the Indian Air Force in varied and dynamic field environments.



## BULLET PROOF JACKETS FOR AIRCREW

79



**T**he present Bullet Proof (BP) Jacket is fluffy and bulky and it is difficult for the aircrew to wear while flying. A BP jacket is required which should be smart fit and can be in two parts with an inner jacket and an outer jacket. An inner jacket can be worn during flying and an outer jacket can be worn during combat survival. The jacket should be light in weight and maximum weight should not exceed 4 Kg during flying and 8 Kg during Combat Survival with a Level 3+ Ballistic protection with a combination of HAP and SAP. The jackets should be available in three sizes covering the upper torso completely and design should not hinder mobility of aircrew while flying.

The position of Velcro for name tab and ring for oxygen in the inner jacket should be as that in flying overall. The jacket should have flame retarding properties so as to complement the FR overall. The BP Jacket should be able to endure multiple shots, slash and stab attacks during Combat Survival. It should be able to protect the wearer from fragments of explosion as per BIS standards. SAP should be capable of providing protection from close combat/ bullets. HAP should be capable of providing protection at ranges of 25 m from various bullets. The colour of BP Jacket should be as per the existing guidelines of IAF regarding flying clothing.



## HUMANITARIAN ASSISTANCE AND DISASTER RELIEF PLATFORM FOR CHINOOK HELICOPTER

80



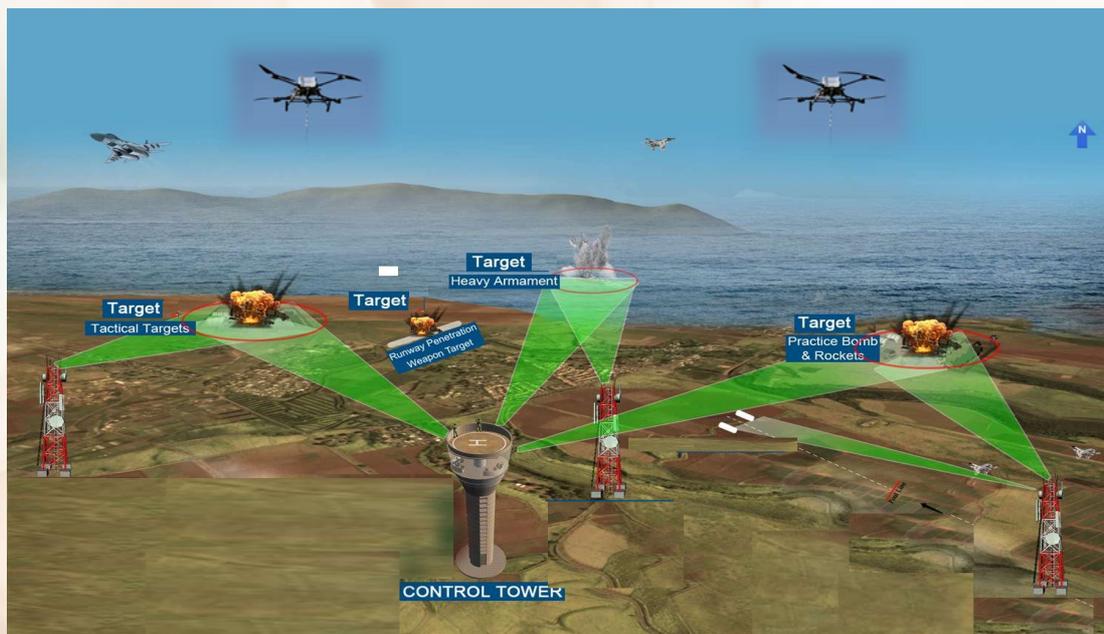
**T**o design and develop a light weight carriage platform for Chinook helicopter to undertake mass casualty evacuation from buildings, rivers, islands and mountain tops. The platform must have slings to be connected with helicopter under slung system. The platform to have multiple safety features to ensure safety of rescued personnel, individual restraints, directly connected to primary platform/ any other technology to preserve human life like ballistic parachute/ individual protection system etc.

Basic requirements include communication system with helicopter and ground teams, good visibility to enable carriage of rescue assistance teams, stability in flight to prevent any swing, rapid ingress and egress design. It should also have module for fire fighting equipment like rapid water filling pumps, hoses and storage, controlled rate water dispensation capability and water carriage from a water source to fire area.



## DRONE BASED/ INNOVATIVE RANGE SCORING SYSTEM FOR AIR TO GROUND WEAPONS

81



**A**ir to Ground weapon firing is one of the most important aspect of Air Power. It is absolutely imperative to assess the Weapon impact in peace time so that it can be used for training and improvement in Pilot's skill levels. Indian Army ranges are jointly utilised by IA and IAF but they do not have any standard infrastructure for scoring purpose. In addition, the specific utilisation of IA, extreme weather conditions and isolated terrain, creation of infrastructure is a long drawn process with huge costs. Therefore, a drone based Range Scoring System is found essential for training.

Such a system will be able to assess the score, provide error, instantaneous display to operators for transmission to the pilot. This system will be light weight/ man portable and operated by maximum of two personnel though a single console. The system will be All-weather and capable of operating in extreme temperatures. The system will have IN/ GPS system based for correcting errors. Additionally, emergency protocols will be incorporated in cases of emergencies like network failure etc.



## HELICOPTER ELECTRONIC GLIDE PATH BASED LANDING SYSTEM

82



**M**ost of the helicopter landings are carried out by visual references, this restricts operations of helipads during poor visibility conditions. The system will be able to provide electronic glide path signals. The system may be transportable, configurable for different locations, configured for non- standard glide path angles.

The system will be able to provide failure indications, deterioration data and monitor helicopter flight path and compatible with aircraft ILS system. The system may be a novel concept for guidance during landing by using ground equipment and compatible portable avionics to be carried on board helicopter for landing.



## BATTERY OPERATED TOWING TAXI BOTS FOR AIRCRAFT MOVEMENT

83



**C**urrent methods of aircraft movement, involving either taxiing under engine power or using a towing gang with an engine-powered tractor, are inefficient. Proposed battery operated taxi bots will enable aircraft to be towed from a standing start to the holding point before take-off and from the holding point to the parking bay after landing. This innovation will facilitate push-back starts and towing, reducing the need for taxiing, which in turn will increase available parking space and save aircraft fuel, engine hours and manpower.

Currently, a dedicated towing arm for each aircraft type is required. Solving this problem will allow for more efficient aircraft movement, reduce fuel and engine usage and streamline ground operations. Contemporary solutions include universal battery powered towing tractors that can tow various aircraft types with a smaller, less specialized towing team. The deliverable for this project is battery operated Taxi bots for aircraft movement.



## BODY MOUNTED PERSONAL OXYGEN DELIVERY SYSTEM FOR EXTENDED AERIAL OPERATION

84



**P**resently, there is no inbuilt oxygen delivery system in helicopters and the aircrew and passengers are required to carry independent oxygen delivery system. An oxygen system that can deliver oxygen to aircrew and passengers is required to be developed. The personal body oxygen delivery system is to be capable of operating till 22,000 ft and to have adapters for nasal delivery, pressurised delivery, warning alarms, high pressure storage for 1 hr 30 minutes.

The system to be light weight for carriage on aircrew body, easily replaceable oxygen bottles, charging system for mother cylinder and oxygen generators. The regulator to be able to reduce pressure as required for breathing. The rate of delivery will be as required by pilots during flying and passengers/ crew for loading/ unloading tasks. There will be alarms for low pressure, high pressure, no breaths via vibrations and aural alerts.



## AIR TRANSPORTABLE RUBBERISED FUEL STORAGE AND BRIDGING SYSTEM

85



**F**orward air fuel supply is undertaken by barrels and trucks. These barrels cannot be easily transported and immediately used by field operators. A rubberised fuel tank that can be air transported internally by fixed wing and as underslung by helicopter is required for fuel bridging and remote air operations.

These air portable rubberised tanks should not weigh more than 200 kgs, with 2000L usable capacity transportable till 18000ft in unpressurised environment. They should have carriage hooks for being underslung by helicopter and tie down points for carriage in aircraft cargo compartments. The tank should have MIL grade internal coating to prevent fuel contamination. The tank should be capable of being reused over extended operation.



## PULSE HVPS FOR ASPJ

86



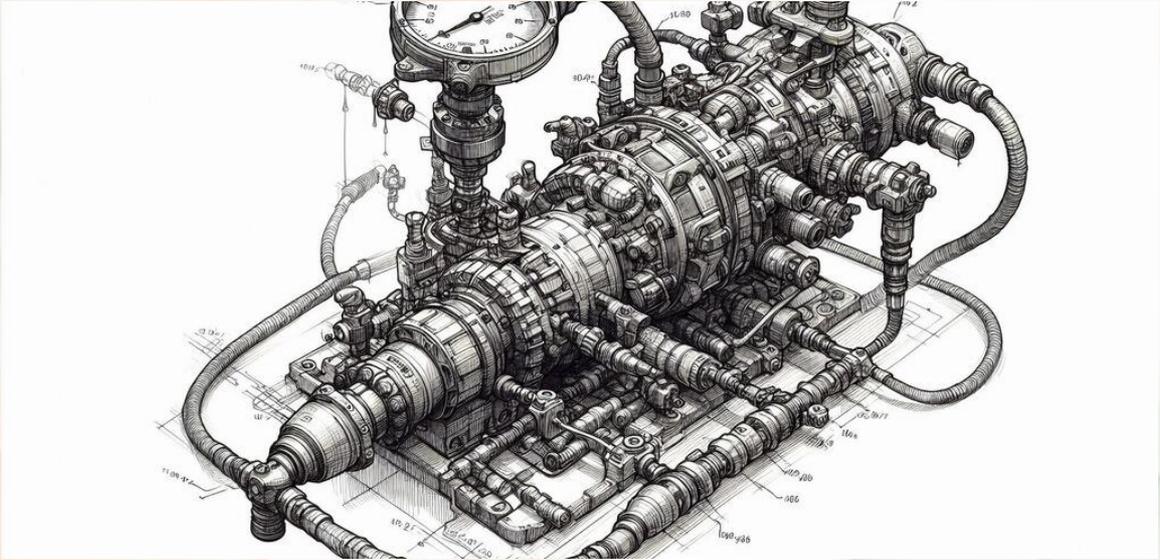
**T**o develop a Pulse High Voltage Power Supply (HVPS) for ELTA Active Self-Protection Jammer (ASPJ), designed to meet rigorous MIL standards for performance, environmental resilience and maintainability. This system will provide a reliable high-voltage pulse to support electronic countermeasures, offering advanced protection against Radar-guided threats in combat scenarios.

The Pulse HVPS must comply with MIL-STD-461 for electromagnetic interference (EMI) and MIL-STD-810 for environmental durability, ensuring it can withstand harsh conditions, including extreme temperatures ranging from  $-40^{\circ}\text{C}$  to  $+55^{\circ}\text{C}$ , high humidity, shock and vibration. The unit will be compact and lightweight for easy integration into the ASPJ system, maintaining the aircraft's agility and operational efficiency.



## FUEL FLOW METERING UNIT (BRZA-7) FOR FIGHTER AIRCRAFT

87



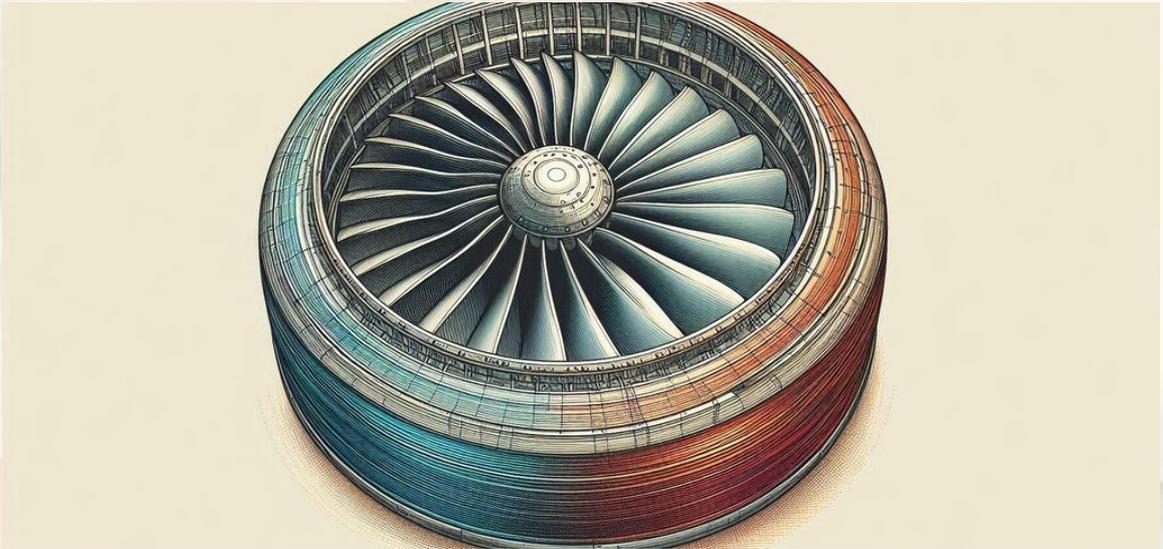
**T**o develop a Fuel Flow Metering Unit (BRZA-7) for fighter aircraft, designed to deliver accurate real-time fuel flow measurements in compliance with stringent MIL standards. The unit will play a critical role in enhancing fuel efficiency, engine performance monitoring and overall mission endurance. Designed for precision, the BRZA-7 must meet MIL-STD-461 for electromagnetic interference (EMI) compliance and MIL-STD-810 for environmental standards, ensuring resilience in extreme operational conditions, including temperatures from  $-40^{\circ}\text{C}$  to  $+55^{\circ}\text{C}$ , high altitudes, shock and vibration.

The Fuel Flow Metering Unit will utilize state-of-the-art flow sensor technology capable of measuring high fuel flow rates with accuracy in the range of 0.1% or better.



## CONCENTRIC RINGS FOR AERO ENGINE FOR AERO-ENGINE

88



The challenge is to develop three concentric rings for an aero engine, specifically designed to enhance the performance, durability and precision of critical engine components. These rings must meet stringent MIL standards, including MIL-STD-810 for environmental resilience and MIL-STD-461 for electromagnetic interference compliance. The rings will be engineered using high-grade materials capable of withstanding extreme operational conditions, such as high temperatures, pressure variations and intense vibration, ensuring optimal performance within the harsh environments typical of aero engines.

Each concentric ring will serve a distinct function within the engine assembly, providing essential support to components like turbines, compressors or bearings. These rings must exhibit exceptional thermal and mechanical stability, maintaining their structural integrity under temperatures exceeding 1,000°C and rotational speeds in excess of 20,000 RPM.



## CW HVPS FOR ASPJ

89



**T**he development of a Continuous Wave (CW) High Voltage Power Supply (HVPS) for the ELTA Active Self Protection Jammer (ASPJ) is focused on enhancing electronic warfare capabilities for modern aircraft by supplying consistent high voltage power to critical systems. The CW HVPS to be designed to meet stringent military standards, including MIL-STD-810 for environmental durability and MIL-STD-461 for controlling electromagnetic interference (EMI), ensuring it can perform reliably in harsh combat conditions.

This CW HVPS will deliver stable and precise high voltage output to power the Traveling Wave Tubes (TWTs) in the ASPJ system, supporting continuous jamming and signal disruption capabilities. The design will focus on high efficiency, offering steady output with minimal power loss, ensuring the system can operate for extended periods. Capable of withstanding extreme temperatures ranging from  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ , the HVPS will be suitable for varied environments, including high-altitude missions.



## GMI-32B (P-19 MODULATOR VALVE)



It is required to develop GMI-32B (P-19 Modulator Valve) to create a robust and reliable component for use in Radar systems, enhancing performance and ensuring compliance with stringent military standards. The GMI-32B is a high-power modulator valve designed to regulate and control pulse signals in Radar systems, ensuring efficient modulation for optimal Radar performance. This valve is critical for applications requiring precise control of high-voltage pulse outputs, such as air defence systems.

The GMI-32B modulator valve will adhere to MIL-STD-810 for environmental testing, ensuring it can operate under extreme conditions, including temperatures ranging from  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ , high humidity and exposure to dust and vibration. The valve's design will also comply with MIL-STD-461 for electromagnetic interference (EMI) and electromagnetic compatibility (EMC), ensuring smooth integration into modern Radar systems without causing interference to other onboard electronics.



## COLD FLAPS FOR M53-P2 AERO-ENGINE



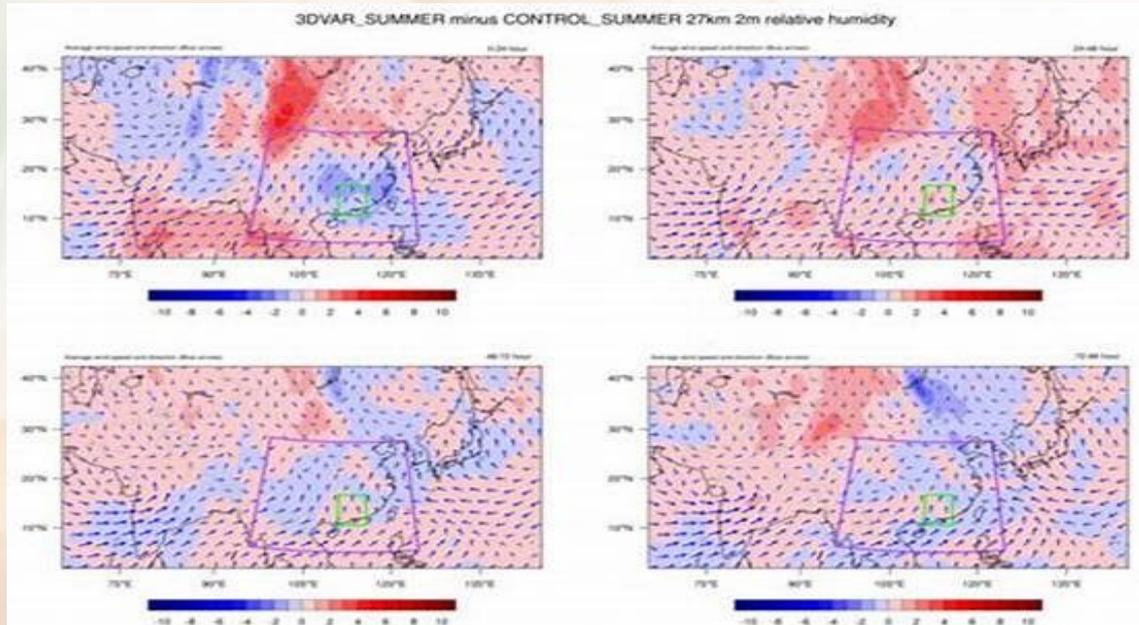
It is required to develop cold flaps for the M53-P2 aero-engine for four distinct types of high-performance flaps that enhance engine efficiency and reliability. These components are crucial for controlling airflow and maintaining optimal thermal management during engine operations, particularly in high performance aircraft. Designed to meet stringent MIL-STD-810 environmental standards, the cold flaps will operate effectively under harsh conditions, including extreme temperatures, vibrations and high-altitude environments.

The cold flaps will be manufactured using advanced materials that provide high strength, durability and resistance to corrosion while remaining lightweight. This ensures improved fuel efficiency and prolonged service life. Each type of cold flap will be tailored to meet specific operational requirements, providing superior airflow control and thermal insulation.



# ARTIFICIAL INTELLIGENCE BASED FORECASTING TOOLS FOR PREDICTION OF ATMOSPHERIC VISIBILITY

92



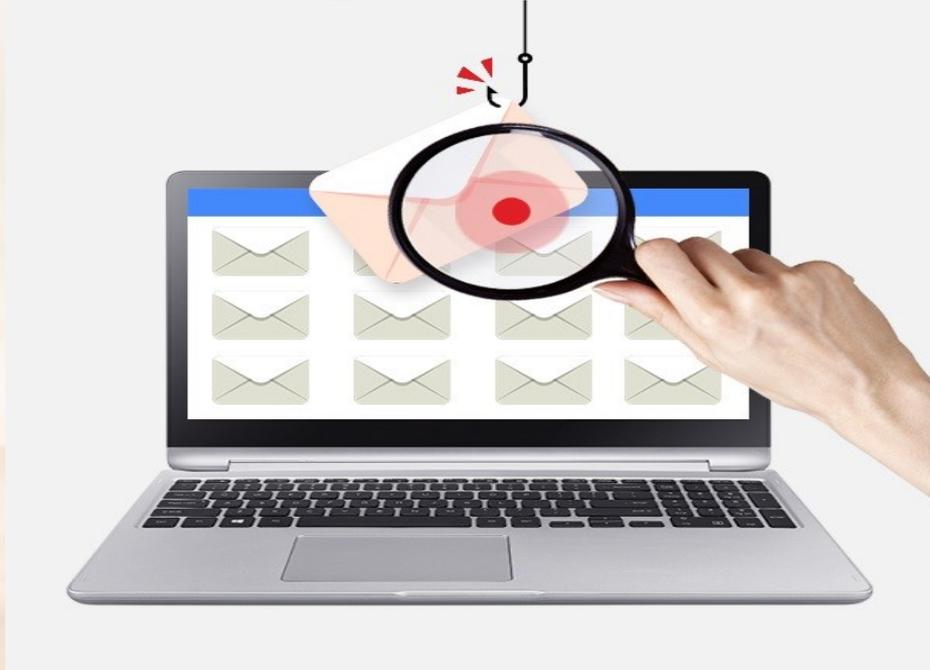
**C**onduct of air operations is dependent on the weather conditions/ visibility over an airfield/ area. It is imperative that the weather/ visibility forecasts are accurate, location and time specific and reliable for operational planning and decision making. The broad developmental requirements are as follows: -

- (a) Forecast for surface visibility for different geographical regions of India (space coverage).
- (b) Airfield or location specific forecast models generating hourly visibility forecast.
- (c) GUI based visibility guidance like web browser accessibility, user definable base layer like terrain, district boundaries, satellite imagery, on the fly data analysis features, generation and visualization of animation, contouring features, overlay of winds from model guidance and multi panel view of different geographical regions.



## CREATION OF A BROWSER PLUG-IN FOR CHROME AND FIREFOX TO DETECT PHISHING MAILS AND INITIATE APPROPRIATE ACTION

93



**C**urrently the Defence network is air gapped, however there is an internet presence in all three services where “nic domain” emails are used to exchange official information as well as other email services are being used by personals for various personal requirement. This poses a big risk of phishing attacks which is not being mitigated by standard security tools (antivirus/ firewalls) as the user has clicked undesired link and allowed the phishing malware to be downloaded. It is proposed to create a browser plug-in for Chrome and Firefox, which is able to detect phishing mails and take appropriate action. The solution should provide live detection of any malicious code being received on mail and alert/ block it, even before the user has clicked on mail.



## INTELLIGENT (AI BASED) DOCUMENT MANAGEMENT SYSTEM

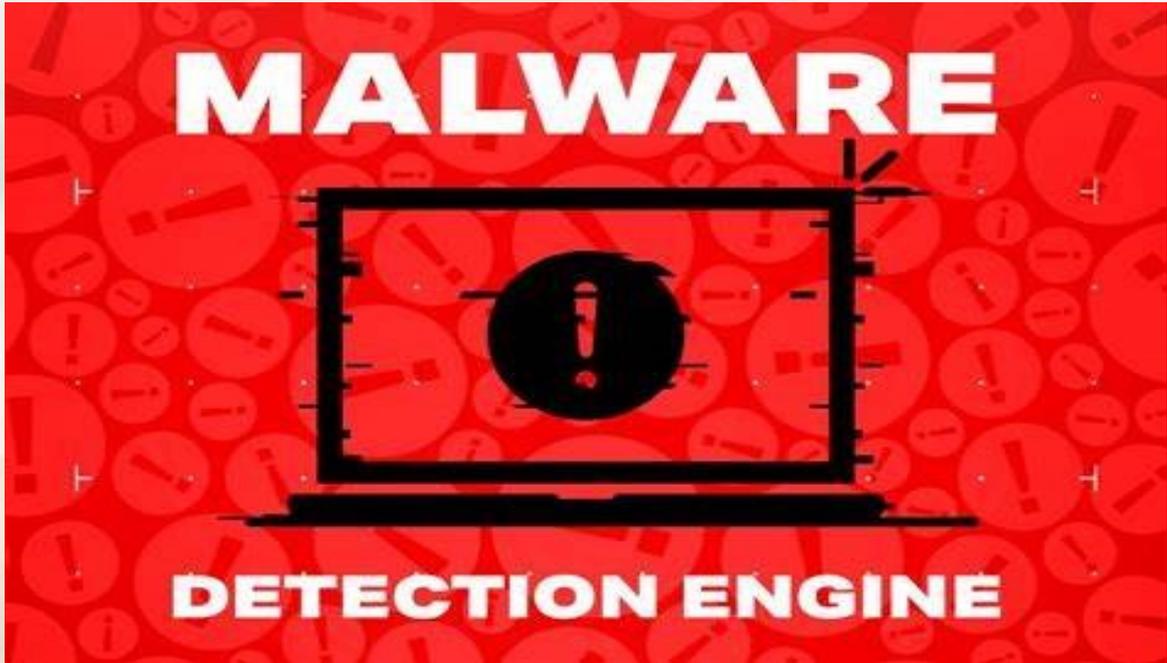


**A**n Integrated solution is required to manage access control, real time classification of data by content (preferably AI driven) and data encryption at client, transit and storage. The solution should also track the files using Digital rights management policies. The solution will be used to replace the existing COTS document management systems for the benefit of IAF users.



## MULTI-ENGINE AV SOLUTION CAPABLE OF HANDLING AND IDENTIFYING PRESENT DAY COMPLEX MALWARE

95



**P**resently, there is no standardized, indigenous antivirus (AV) solution with long term support for use by Defence institutions. Proposal is to develop a multi-engine AV solution that is capable of handling and identifying present day complex malwares. The envisaged solution should be for enterprise level deployment with central control and management of end point devices. The solution should provide round the clock support and regular updates keeping it up-to date, to reduce the window of vulnerability.



## AI/ ML BASED PREDICTION OF THUNDERSTORM AND GALE FORCE WIND OVER AN AIRFIELD

96



**T**here is a requirement of a GUI-based decision-aiding and visualization tool for forecasting and now-casting thunderstorms and gale force winds, utilizing AI/ ML techniques and accessible through common web browsers on the Air Force Intra Net (AFNET). Thunderstorms are meso-scale phenomena with limited spatial and temporal coverage, making accurate prediction challenging for meteorologists. Additionally, the downdraft from convective cells often results in strong, gusty surface winds known as gale winds, further complicating forecasting efforts.

The proposed tool aims to address these challenges by generating forecasts and now-casts, providing periodic updates on the track and intensity of convective cells and offering accurate estimates of gusts associated with downdrafts. Currently, meteorologists manually analyze various inputs such as satellite and Radar imagery, current weather conditions and other meteorological parameters to predict thunderstorm and gale force wind events. The new AI-based tool will integrate all these inputs, enhancing decision-making capabilities for meteorologists and decision-makers, thereby supporting safer operations and more effective planning.



## AI/ML ASSISTED PILOT DEBRIEF AND ASSESSMENT SYSTEM

97



**P**ilot debrief is based on memory of instructor and his ability to identify mistakes. Instructor takes assistance of tools like Flight Data Recorder (FDR), video playbacks and other tools for preparation of pilot debrief. This activity is time consuming and subjective. In the existing debriefing systems, human bias and personality traits which vary from instructor to instructor may transpire leading to loss of objectivity in pilot assessment. The aim is to develop a machine learning assisted pilot debrief and assessment system for debrief of Pilots by using Flight Data Recorder data for increased objectivity in performance assessment, improved efficiency and effectiveness of training along with enhanced safety. The debrief system should include: -

- (a) To develop techniques of fault analysis of an aircraft mission based on predefined rules, policies and instructions.
- (b) To generate an objective mission debrief using advanced statistical data techniques.
- (c) To prepare an application to enable flight instructors to provide tailored and personalized training to meet the needs of individual pilots.



## AI BASED COMPILER FOR VERIFYING OPTIMIZING SOFTWARE

98



**T**o develop a certified optimizing compiler and code analyzer using AI techniques. Software, especially in mission-critical systems like avionics, is prone to bugs that can compromise cybersecurity or cause system failures. To reduce such risks, code verification tools are essential. The certified compiler must ensure correctness through formal verification, while a rule-based code analyzer will identify bugs, security vulnerabilities and performance issues. Deliverables include a certified LLVM-based compiler for C to x86 architecture, leveraging AI for optimized, formally verified code.

The rule based analyzer will check code against predefined rules and allow for custom rule creation. Deployment will include integration with version control systems and testing on mission-critical avionics software. Key operational characteristics include verified compilation, precision in bug detection and scalability for large codebases. The tool must also analyze both source and binary code, ensuring rule compliance throughout. A certified compiler and code analyzer leveraging AI technology, it ensures code reliability and compliance with standards by offering automated analysis and optimization for enhanced software development.



## AI-BASED NATURAL LANGUAGE PROCESSING

99



It is required to develop an AI-based Natural Language Processing (NLP) system focusing on creating an advanced solution capable of understanding, processing and generating human language for various applications. This system will employ state-of-the-art algorithms, including machine learning models like transformers and deep neural networks, to analyse and interpret text with high accuracy and efficiency. Designed to meet MIL-STD-882 standards for safety and reliability, the system will ensure seamless performance under demanding conditions.

Key technical specifications include the ability to process large volumes of unstructured data in multiple languages, with support for real-time text analysis, speech recognition and sentiment analysis. The NLP system will be optimized for low-latency processing, ensuring rapid responses in mission-critical environments. It will also incorporate natural language generation (NLG) capabilities, enabling it to produce human like responses in conversational settings, including military communications, intelligence gathering and automated reporting.



# INNOVATIVE DECISION SUPPORT SYSTEM (DSS) FOR ANALYSIS OF UNSTRUCTURED DATABASE

100



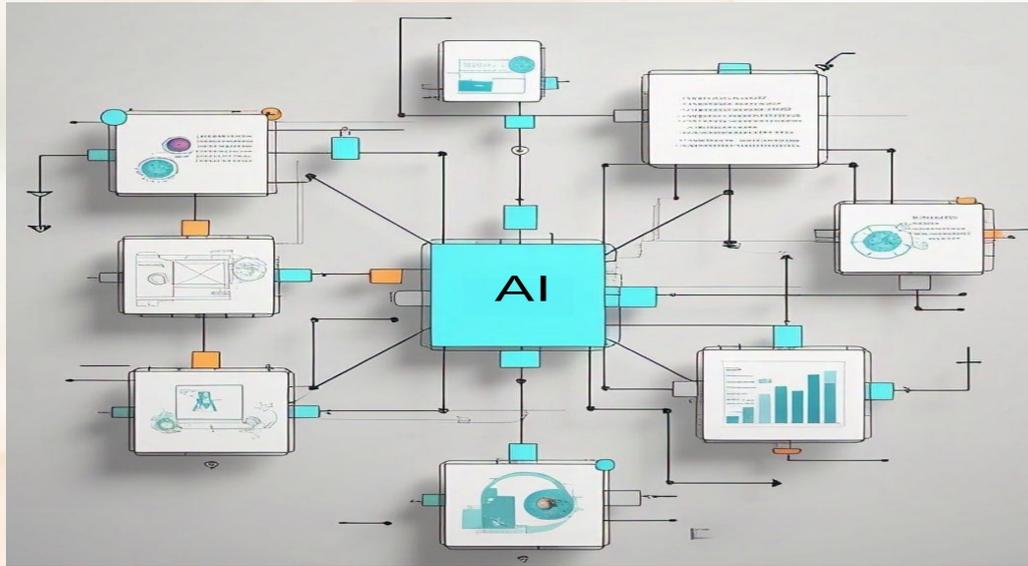
Intelligence operators at Air HQ are facing growing challenges of handling the large volume of varied data and its analysis. The data is often unstructured, which makes it difficult to analyse.

This AI tool will be able to handle data, sort, index and provide an easy solution. The system will be used for digitization, data storage, analysis and implementation of an intelligent AI driven solution/ application for use by intelligence functionaries. The application to be capable of working on analysing open source data as well. The system will be able to depict the reports on GIS platform and present data in a manner that is geo location wise sorted. The output of this application should be compatible with other IAF applications.



## ARTIFICIAL INTELLIGENCE FOR HUMAN RESOURCE MANAGEMENT IN IAF

101



**T**he Artificial Intelligence based HRM system will be used to plan and execute movement of personnel on postings to various locations. The AI based model will be based on organisational/ personal requirements and career progression, reference data parameters of officer's qualifications, tenure at location and professional growth in order to ensure organisational as well as personal contentment.

The AI system will be able to handle routine tasks involved in posting, planning process keeping personal and organisational needs including correspondence generation, analysis, skill mapping and personal choices.



## ARTIFICIAL INTELLIGENCE BASED PREDICTION MODEL FOR BIRD HAZARD MANAGEMENT SYSTEM

102



The software tool will be used to predict the risk of bird-aircraft collision in real time. The tool will model the spatial-temporal density distributions of key bird species in and around the target airfields. It will generate the bird density distributions based on extensive field observations and real time meteorological conditions along with expert knowledge. The tool will combine the model bird density distributions with historical bird collision data to predict the quantified risk of bird-aircraft collision at any point of time, any day of year at the target airfields of Indian Air Force.



## INDIGENIZED HYPOXICATOR TO PROVIDE NORMOBARIC HYPOXIA INDOCTRINATION TO AIRCREW

103



**T**here exists a requirement for an indigenized Hypoxicator to provide Normobaric hypoxia indoctrination for aircrew. Developing a local Hypoxicator would offer a safer, more effective platform for aeromedical training, matching international military standards. Normobaric hypoxia can be achieved through methods like air separation via semipermeable membranes or gas mixtures controlled by solenoid valves.

The simpler gas mixture approach avoids the need for air separation technology, which requires imported circuits. The equipment must be compatible with Indian electrical supply, simulate altitudes from 5000 to 30000 ft, run continuously for up to 10 hours and serve 1-5 users. It should maintain low noise (under 50 dB), have an output pressure between 14-110 psi and be operable in temperatures from 5 to 40 degrees Celsius, with mobility and durability prioritized.



## FULL COVERAGE ANTI-G SUIT (AGS)

104



**T**here exists a requirement for the development of a full coverage, lightweight, airworthy Anti-G suit to automatically provide protection up to 9 G without requiring the pilot to strain. Current Anti-G suits protect only up to 6 G, leaving the pilot to cover the gap, which can lead to G-induced loss of consciousness, fatigue, distraction and the potential need to abandon tactical advantages. The proposed Anti-G suit will cover the torso, legs and arms, using pressurized inflatable bladders, while the head, neck, hands and feet remain exposed.

Key development tasks include selecting a breathable, durable, non-stretchable, lightweight fabric that is gentle on the skin, designing an effective bladder system for protection without causing heat discomfort, ensuring snug and adjustable fitment and stitching that is tear-proof. The suit must integrate seamlessly with the IAF's current Anti-G system. If successful, this technology could significantly enhance combat effectiveness, providing a strategic advantage.



## INTEGRATED PATIENT TRANSPORTATION UNIT

105



**T**here is a requirement for the development of a complete, portable, integrated, lightweight and airworthy Patient Transportation Unit (PTU) with a lightweight oxygen supply system for use in all Indian Air Force transport aircraft and helicopters. The new PTU should be mounted on a rigid stretcher structure and include a transport ventilator, defibrillator, multi-parameter patient monitor, syringe infusion pump and suction apparatus, with an 8-hour battery life and 3,600 liters of oxygen in a carbon fiber cylinder pressurized at 180 kg/cm<sup>2</sup>, mounted on castor wheels for mobility.

The PTU must be secured to a molded plastic stretcher board compliant with the national ambulance code, with a harness system allowing for vertical winching. The entire assembly should be airworthy, ideally weighing less than 20 kg. This technology will enhance the capability of any healthcare establishment, enabling any ambulance to function as a critical care unit and transforming hospital beds into ICU beds, thereby ensuring widespread application and improved patient care.



## ACCELERATED COMPLETE ACCLIMATIZATION SYSTEM PRIOR TO INDUCTION IN HIGH ALTITUDE USING NITROGEN ENRICHED ATMOSPHERE

106

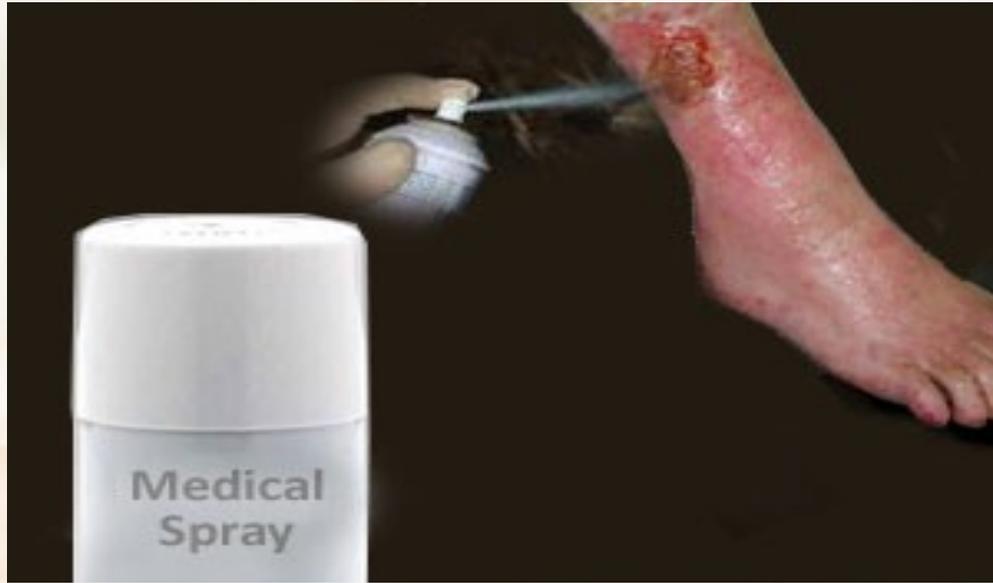


**A**t present induction to high altitude entails multiple stops at various altitudes for acclimatization, totaling 14 days. This delays troop induction and may make a significant difference to the response to a security threat. Pre-acclimatization will improve the response of Indian security forces. The system will consist of a nitrogen generation system, which will create nitrogen enriched atmosphere in a designated room and provide a partial pressure of oxygen between 16.6% and 16.0% (6000 ft to 7000 ft). Safety will be maintained using a quadruple redundancy and a separate hard-wired cut out, in order to prevent a common mode failure.



## SKIN SPRAY GUN

107



The problem involves addressing the shortage of autologous skin grafts for severe burn patients, where current international treatments include meshed and meek grafts, cadaveric skin and cultured keratinocyte sheets over dermal templates. A proposed solution will be the use of a spray-on skin graft system, in which a split skin graft from unburnt areas is micronized and sprayed over the burn site using a device powered by compressed air. This method could be deployed at burn and surgical centers. Though promising, the technology has not yet been tested on patients, so its efficacy, particularly in promoting healthy skin growth and patient survival, remains theoretical.

The system must be portable, user-friendly and suitable for field use, with autonomous operation to maintain sterility. It must also meet regulatory standards such as India's Drug Controller, US FDA, or EU CE certification. Clinical trials will be required to validate the scientific basis in real-life scenarios. Post-development, it must achieve 50% indigenous content under India's Make in India guidelines, with testing facilities provided by the manufacturer.



## SPATIAL DISORIENTATION AND UPSET RECOVERY SIMULATOR

108



The 360° Motion-Based Spatial Dis-Orientation Simulator will be a cutting-edge solution designed to provide hyper-realistic training for both fixed-wing and rotary-wing platforms. Utilizing multi-axis 360° motion technology, this simulator will offer unparalleled realism by replicating the full range of motion and dynamic responses experienced in real flight. It will be equipped with high-grade visual systems based on Virtual and Mixed Reality, delivering immersive and accurate visual representations of various flight environments and scenarios.

The simulator must support full rotational movements, enabling trainees to experience every maneuver and flight condition with precision. The visual system will be integrated with high-resolution displays to ensure clarity and depth, simulating diverse operational contexts from calm skies to turbulent conditions. The simulator will be a significant advancement in training technology, providing realistic and adaptable solutions for modern aviation training.



## UNIVERSAL ANTI-G SUIT TESTING RIG (PORTABLE)

109



**T**he Anti-G Suit (AGS) is a special garment worn by all the fighter aircrew to deal with the stresses of acceleration in flight. The importance of using a correct and fully functional AGS during combat mission is paramount. The Anti-G suits are required to be periodically inspected and tested for any wear and tear, degradation and effectiveness before being used by the fighter aircrew at Squadron level. However, the effectiveness of the Anti-G Suit cannot be tested visually, which requires a specific test rig to find out peak flow rate, fill time, time lag for filling, total suit volume and balance between both bladders.

It is therefore, necessary to have indigenous universal AGS Test Rig which can be placed at each Fighter Squadron as an aid to properly test the AGS in use for its maximum efficacy.



110

## SECTION - II

# PROPOSALS OPEN FOR INDUSTRY PARTICIPATION



## LONG RANGE LAND ATTACK CRUISE MISSILE

111

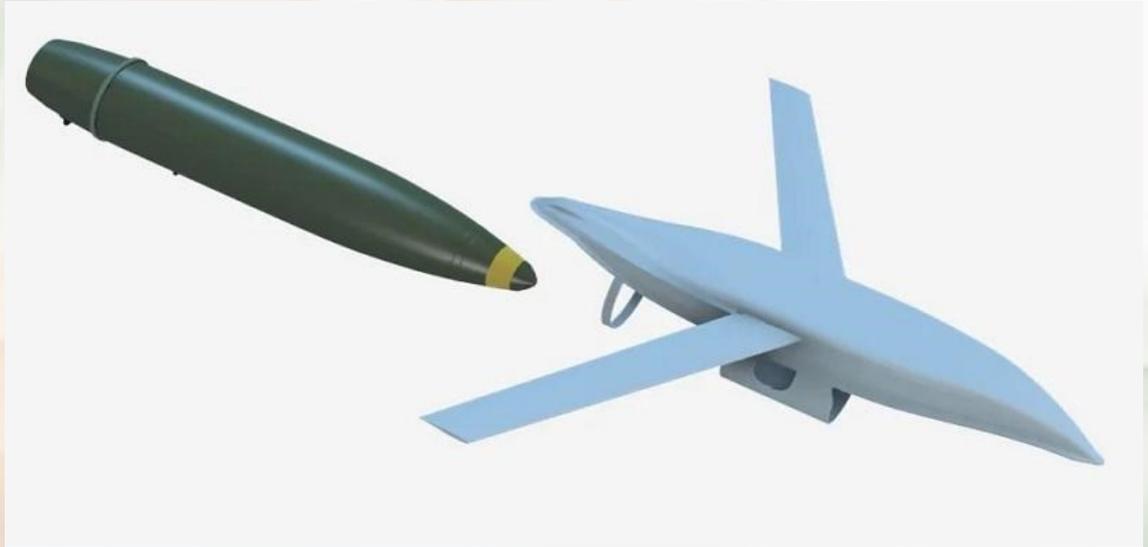


**L**ong-range land attack cruise missiles (LR-LACMs) have become essential weapons in modern military arsenals due to their versatility and effectiveness. They offer the capability to undertake varied warhead delivery into enemy territory with required precision and low probability of detection and interception with stand-off capabilities. Long range land attack cruise missile will be a low cost missile capable of cruising at around 0.8 Mach with a range of 1000+ kms. The missile will have independent navigation making it immune to jamming by adversary and will be capable of carrying multiple types of warheads.



## INDIGENOUS PRECISION RANGE EXTENSION KIT

112



**R**ange extension kits are devices that can be attached to aerial bombs to increase their effective range. They are particularly useful in situations where targets are located beyond the normal range of a bomber aircraft or when the desired impact point is at a greater distance. These kits are designed to convert bombs into glide bombs, allowing them to travel a greater distance before detonating. Indigenous precision range extension kits will be developed for aerial bombs being used by IAF. They will enable range extension and precision guidance for the bombs.



## AERIAL BOMB 1000KG

113



**A**erial bombs are aircraft delivered air to ground munition for use against variety of targets such as military installations, troop concentrations and armoured vehicles. The 1000 kg type aerial bombs can be carried by a wide range of aircraft, including fighter jets and attack aircraft. Aerial Bomb 1000 Kg are Mk-84 Class of bombs will be developed for carriage by IAF's Western and Russian origin aircraft. Presently these bombs are imported ex-abroad.



## COMMON AIR TO AIR LAUNCHER FOR SU-30 MKI AIRCRAFT

114



**S**u-30 MKI aircraft was bought from Russia along with required role equipment. Role equipment enable fitment of various weapons/ pods on to the aircraft as per the planned mission. Presently, OEM supplied launchers/ adapters are used for fitment of weapons/ stores onto the aircraft. These launchers/ adapters are restricted due to weight carrying capacity of the launcher and are different for each type of weapon/ stores. Common Air to Air Launcher for Su-30 MKI aircraft will be developed to enable carrying various air to air (A-A) missiles of IAF without the requirement of change of launcher.



## COMMON AIR TO GROUND LAUNCHER FOR SU-30 MKI AIRCRAFT

115

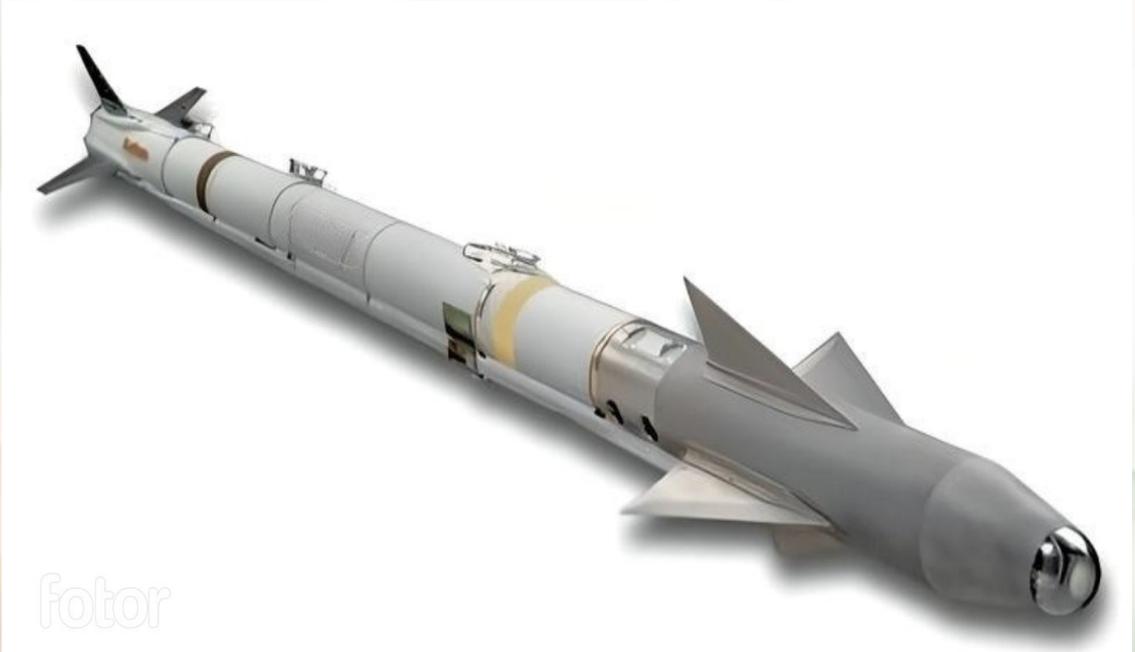


**S**u-30 MKI aircraft was bought from Russia along with required role equipment. Role equipment enable fitment of various air to ground weapons on to the aircraft as per the planned mission. Presently, OEM supplied launchers/ adapters are used for fitment of weapons/ stores onto the aircraft. These launchers/ adaptors are restricted due to weight carrying capacity of the launcher and are different for each type of weapon/ stores. Frequent change of launchers is required based on mission requirements and this leads to delays in availability of aircraft for operations. There is a need to develop a common launcher capable of carrying various air to ground (A-G) store.



## AIR TO AIR MISSILE

116



**I**AF operates multiple types of fighter aircraft. The aircraft are fitted with air to air and air to ground weapons based on the mission requirement. This short range air to air missile is carried by many of these aircraft. With the Atmanirbhar scheme in vogue, there is a requirement to manufacture this missile within the country.



## AIR TO GROUND MISSILE

117



**T**he Air to Ground Missile is a part of India's next generation air dropped precision guided munitions family. The weapon offers capability to target and destroy strategic high value enemy infrastructure from standoff distances. With the Atmanirbhar scheme in vogue, there is a requirement to manufacture this missile within the country. Multiple range options may be offered for production from 50 to 500 Km range with IAF fighters as launch platforms.



## MULTIBAND PROGRAMMABLE RF SENSOR SATELLITE

118



**D**etection of Radio Frequency (RF) sources from Low Earth Orbit (LEO) using space-based sensors to intercept Electronic Support Measures (ESM) parameters of interest. This includes emitter identification along with time of travel, direction of arrival, frequency range of emitter, frequency pattern, Pulse Repetition Interval and Pulse Group Repetition Interval (with all PRI pattern like Constant, Jitter, Stagger, Dwell & Switch etc.). Further, the system should be capable of deriving PRI associated with each spot frequency, Pulse Width, Effective radiated power of emitter along with type of Antenna Scan, Scan Rate, Polarization, Beam width (Elevation and Azimuth), Side Lobe Level (with Standard deviation), Time on Target Wave, Localisation Information (in user defined format) along with Intra Pulse data.



## INNOVATIVE SPACE APPLICATIONS OF FOURTH/ FINAL STAGE OF LAUNCH VEHICLES

119



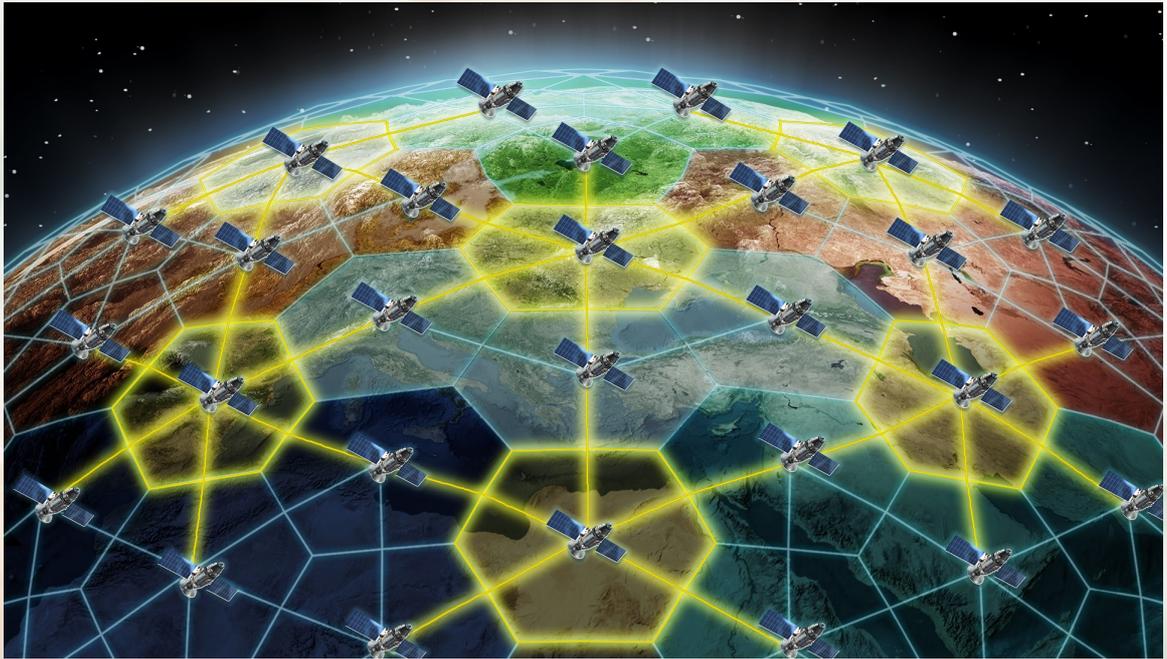
**L**ast stages of rocket engine after separation of spacecraft, loiter in outer space for a considerable time. During such launches adversary sensor/ emitters monitor such activities providing an opportunity to map these active Radio Frequency (RF) sources. Having an Intelligence Surveillance & Reconnaissance (ISR) payload integrated with the final stages of rocket will help in effectively utilizing its considerable loitering time for detecting and finger printing active RF sources of the adversary.

The ISR payload could be either Electro-Optical (EO)/ Infrared (IR)/ Electronic Intelligence (ELINT) or a combination of multiple sensors looking both upward and downward with data linking, accumulation and extraction facilities. Location of payload, power supply for payload, protection of payload during the ignition of rocket motors are the key challenges which are to be factored-in while integration with last stages of rocket.



## HIGH THROUGHPUT COMMUNICATION SATELLITE IN LEO

120



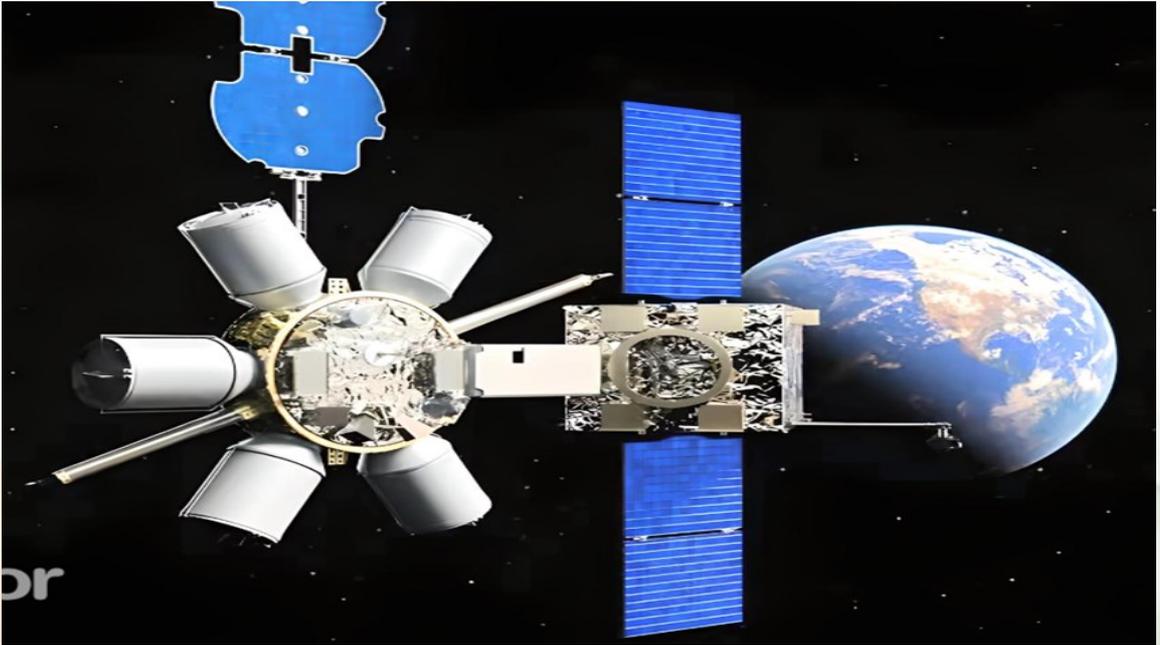
**L**EO constellation is proposed to be developed for extending satellite communication services. The payload configuration could be 'Ku' or 'Ka' or higher bands to accommodate high data rate applications. Having a dual use communication satellites in lower orbits will be advantageous in terms of security, availability (graceful degradation) and high data rate applications. The user segment could be static, airborne and mobile.

Airborne user segment could vary in size depending upon the type of aircraft (Fighters, Transport and Helicopter). Antenna radiation pattern of this user segment should possess the dynamic capability to withstand the aircraft rotor blade. User segments could preferably be Software Defined Radio (SDR) sets which are capable to operate at data rates of 100 Mbps or better.



## ON ORBIT MAINTENANCE AND REFUELING (OOMR) TECHNOLOGY IN LEO

121



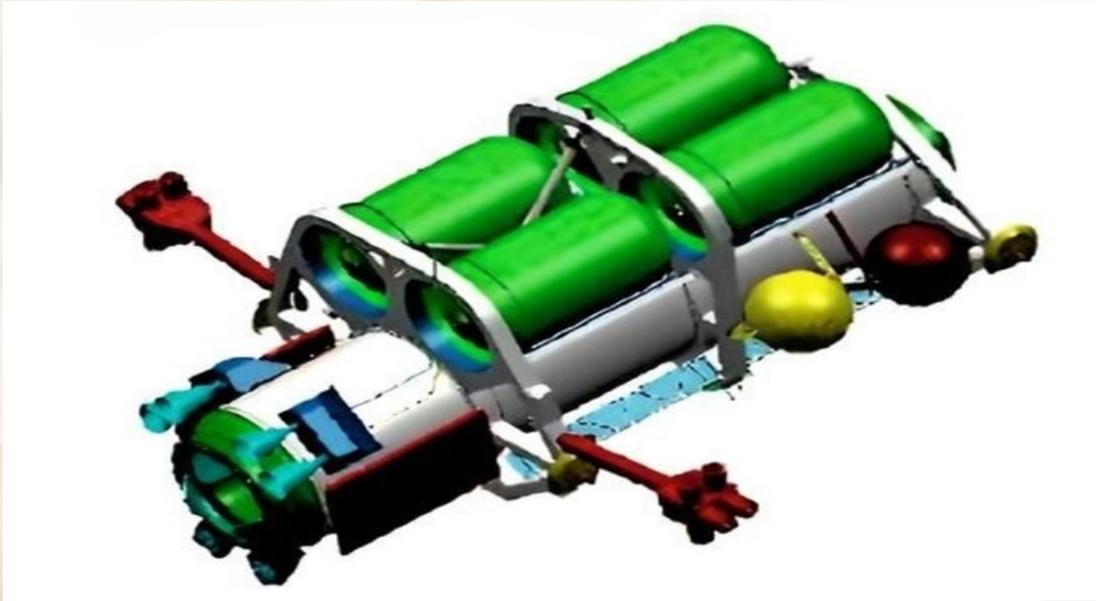
**E**xisting satellites, be it communication, ISR or PNT will become non-operational once its fuel is exhausted or in case of a malfunction to the component/ sub-system. Advanced space faring nations have demonstrated the capability on OOMR/ RV/ Proximity operations using robotic arms. The concept has strategic relevance as a spacecraft or the payload of a satellite could be serviced by a service module for the following purposes: -

- (a) Refueling the spacecraft thereby enhancing its Technical Life.
- (b) Service/ replace an unserviceable module.
- (c) Integrate/ replace an outdated component.
- (d) Accommodate additional payload for tactical use.



## ON ORBIT PROPELLANT STORAGE AND TRANSFER SYSTEM

122

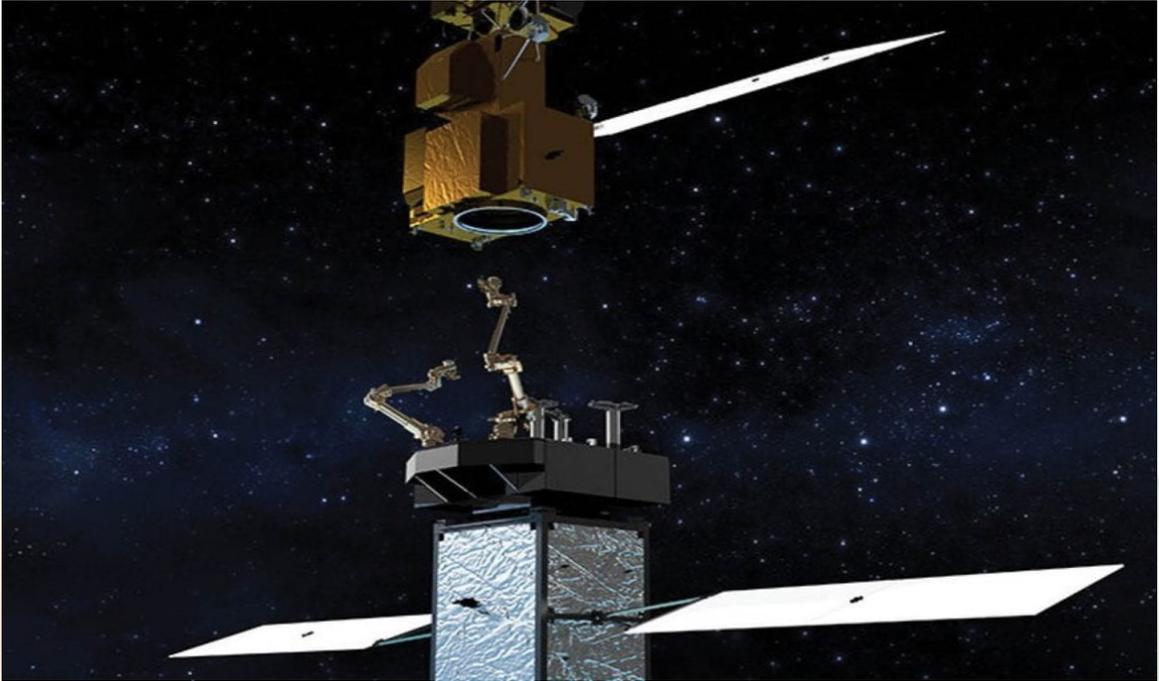


**O**n Orbit Propellant Storage and Transfer System is a component of On Orbit Maintenance and Refuelling (OOMR) Technology in Low Earth Orbit (LEO). This would necessitate transferring fuel from tanker satellite to the receiving satellite. Given the micro-gravity conditions and the extremities of the environment, space grade fuel storage and fuel-transfer system have to be innovated.



## ON ORBIT SPACE INFRA MAINTENANCE AND UPGRADE OPERATIONS

123

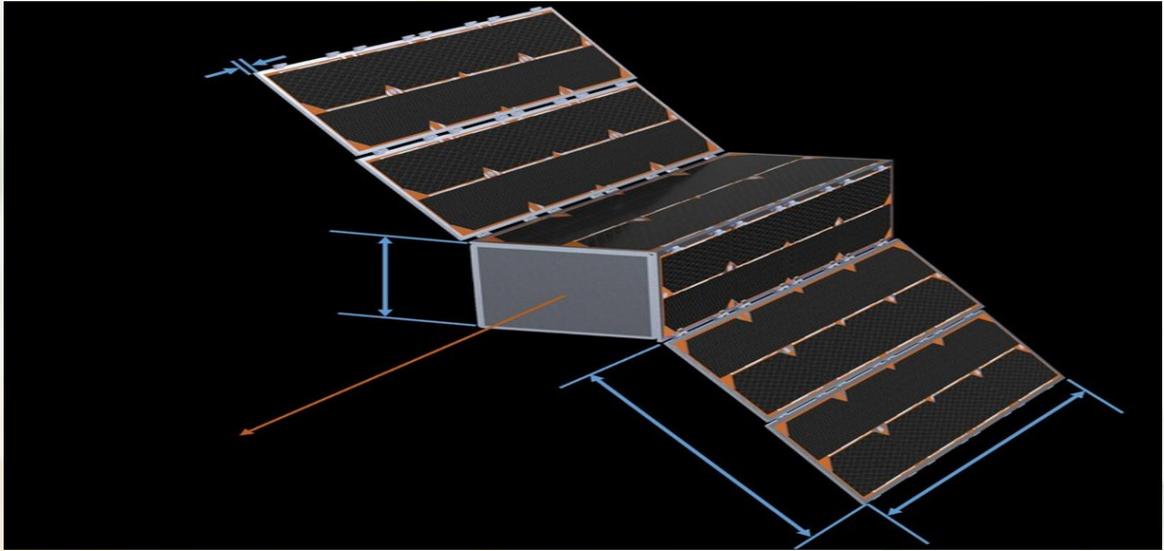


**O**n Orbit Space Infra Maintenance and Upgrade Operations is a component of On Orbit Maintenance and Refuelling (OOMR) Technology in Low Earth Orbit (LEO). On Orbit Space Infra Maintenance and Upgrade Operations will be able to perform on-orbit maintenance of space infra and upgrade operations of satellites/ payloads operating in LEO. As the satellite is still operational, it is cost effective to undertake maintenance activity to replace the payload via another satellite. Therefore, the system will enable replacement of payloads that become unserviceable or those which are not working as desired or those which have reached their end-of-life.



## MODULAR, MULTI PAYLOAD CONFIGURABLE VERY LOW EARTH ORBIT (VLEO) VEHICLE/ BUS

124



**P**resently, satellite bus and payloads are custom developed to meet each other's compatibility specifications. This could lead to problems of interoperability and delays in integration of payload with other bus. However, by decoupling the process of manufacturing the payloads and bus and instead development of payloads and bus in a 'Plug and Play' concept is beneficial to achieve greater production efficiency for manufactures, greater flexibility in designing and launch of satellite and reduction in timelines in manufacturing and assembling.



## CBRN THREAT DETECTION AND MONITORING SENSORS FOR VLEO BUS

125

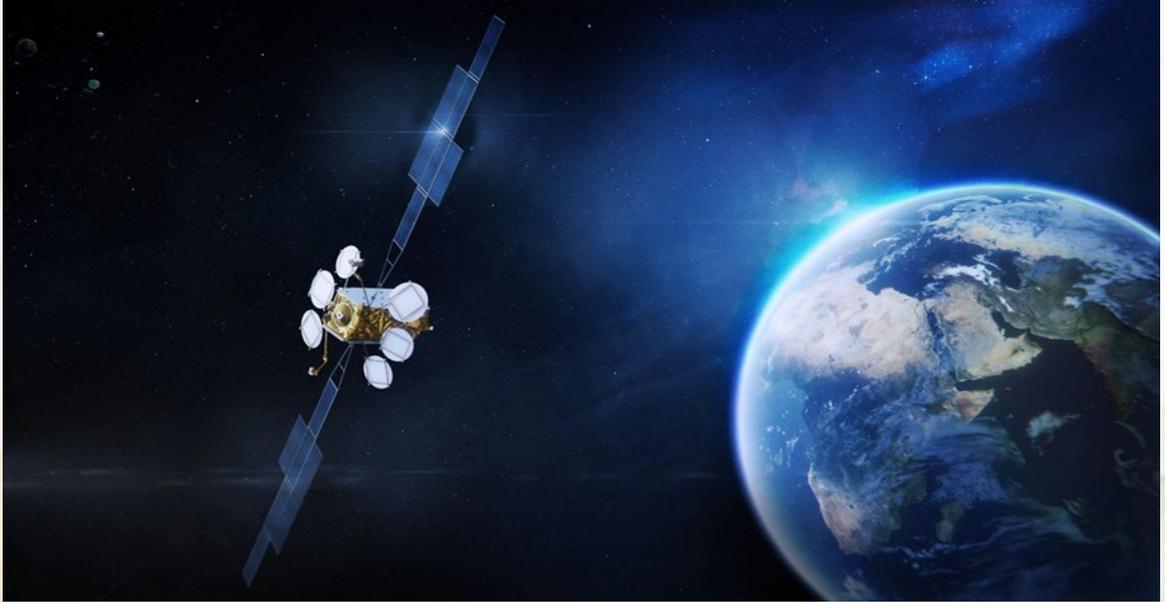


**S**pace based Ballistic Missile Defence (BMD) is the capability for Early Warning, Detection and Destruction of ICBMs along with location of launch points and prediction of impact points. Space based sensors will act as triggering layer for early detection of ballistic missiles. CBRN threat detection and monitoring sensors will be the payloads for a space based BMD system that will be deployed in VLEO. The sensors will be capable of detection and identification of Chemical, Biological Radiological and Nuclear (CBRN) activities and their sources.



## ADVANCED EXTREMELY HIGH FREQUENCY (AEHF) GEO SATELLITE FOR SECURE COMMUNICATIONS

126



**A**dvanced Extremely High Frequency (AEHF) GEO satellite for secure communications will provide a network of encrypted, jam-proof communications for strategic command and control and for tactical missions. The AEHF satellites should provide large bandwidth and feature advanced encryption technology to make satellite based communications more secure.



## L/P BAND SYNTHETIC APERTURE RADAR (SAR) SMALL SATELLITE

127



**X** band SAR is highly suitable for detection of manmade objects but fares inferior when dealing with natural concealment aspects like foliage or forest cover. L or P band SAR capabilities with sub-metric resolution for foliage penetration and detection of sub-surface targets could help to discover the targets concealed under. The development is required in order to upgrade the performance of X band SAR and to overcome its limitations when dealing with natural concealment aspects like foliage or forest cover. L/P band Synthetic Aperture Radar (SAR) is a type of imaging Radar technology that can detect sub-surface targets and penetrate foliage.



## ULTRA-LIGHT WEIGHT, SUB-METER RESOLUTION MONOLITHIC SiC TELESCOPE AS OPTICAL PAYLOAD

128

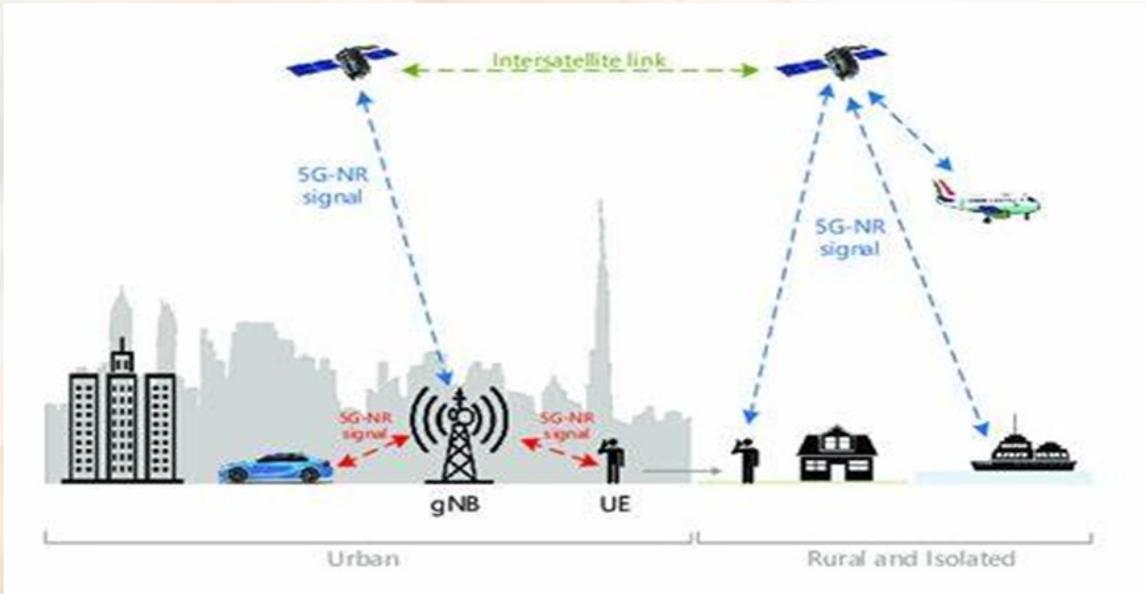


**S**ilicon Carbide (SiC) is the preferred material to develop optical telescopes due to its high stiffness, low coefficient of thermal expansion and high thermal conductivity. As a component of Def Space challenges, it is proposed to develop a space grade optical telescope using SiC which will offer a sub metric resolution. The optical telescope should be able to integrate as a payload on a small satellite with overall weight of 150 kgs.



## NETWORK MANAGEMENT PORT (NMP) FOR EFFICIENT SATCOM BANDWIDTH MANAGEMENT USING MULTIPLE SATELLITE

129



Towards effective utilisation of SATCOM bandwidth, a centralized dynamic bandwidth allocation centre i.e., Network Management Port (NMP) could be created wherein the bandwidth is assigned to needy user as per end user segment capability. NMP should have the complete control over the bandwidth available from all the satellites. Demand prioritization could be done at space port.

There is a requirement to convert each of these user equipment standard to a common standard of modulation and protocols for effective resource allocation through a unified Network Management System. NMP will be having multiple antennae aligned with different satellites. Further, unified resource allocation will require integration of all these antennae, which may be at distributed locations. NMP should also possess the capability to monitor the resource available from each satellite to understand the details of satellite resources available for utilisation.



## COMPUTER DEFENCE SYSTEM FOR CYBER SITUATIONAL AWARENESS TO SECURE OWN SATELLITES FROM CYBER ATTACKS

130

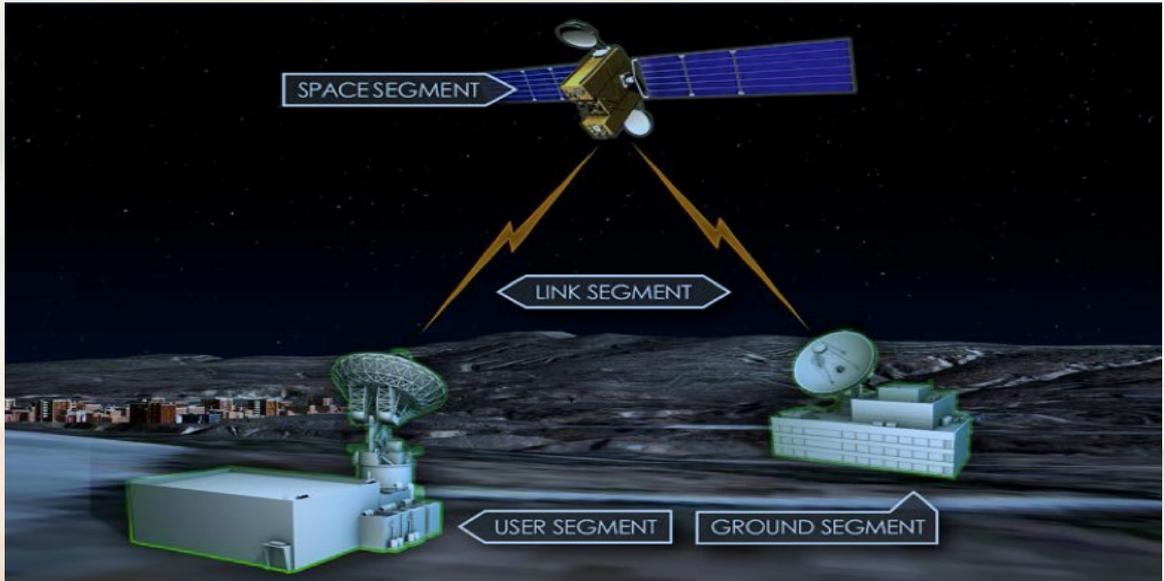


**T**he existing satellites have limited capabilities to withstand sustained EW or Cyber-attacks. With space being increasingly contested, it is matter of time that space assets become more prone to EW and Cyber-attacks by adversaries in a hostile climate. There is a need to identify vulnerabilities in the current satellites to develop EW and Cyber suites that overcome these vulnerabilities. Such suites will have to be incorporated in future satellites to make them EW and Cyber hardened. Therefore, it is proposed to develop EW and Cyber hardening suites for incorporation in LEO and GEO satellites.



## CYBER HARDENING SUITE FOR SATELLITE COMMUNICATION LINKS/ HUBS

131



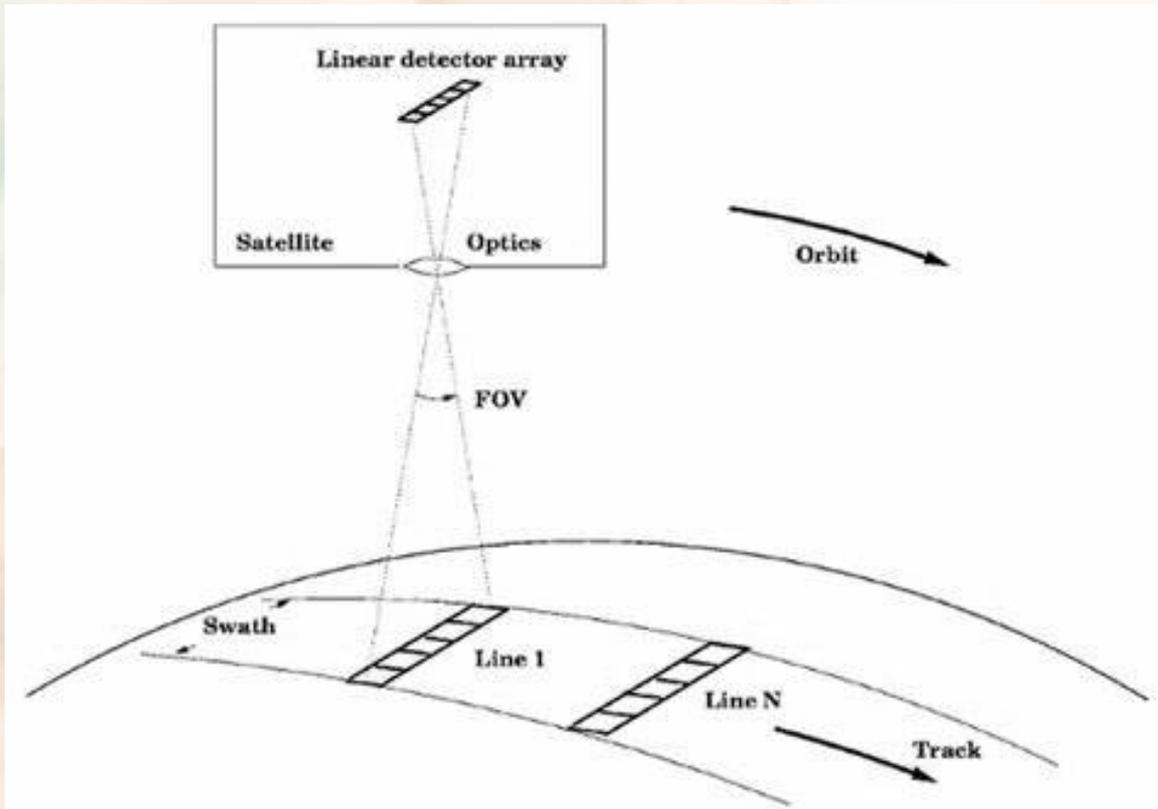
**C**yper hardening Suite is required to be developed for satellite Communication links / Hubs which can prevent the existing as well as near future threats to the satellites and their communication with salient aims to achieve: -

- (a) Immunity from RF based attacks like jamming
- (b) Enhanced space craft security
- (c) Mitigation of adversaries' threats in space-cyber domain



## ULTRA HIGH RESOLUTION OPTICAL PAYLOADS WITH EDGE COMPUTING FOR VLEO BUS

132

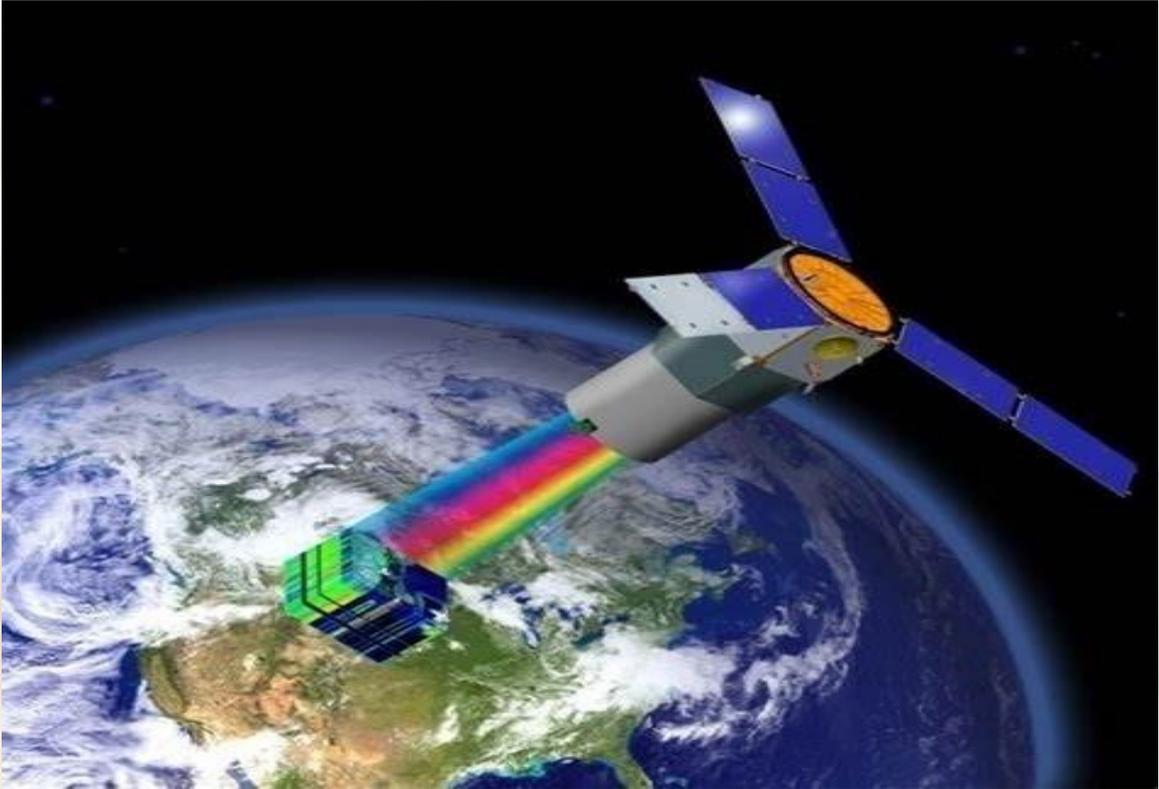


**E**dge computing is a distributed information technology architecture in which client data is processed at the periphery of the network, as close to the originating source as possible. An ultra-high resolution optical payload is a component of satellite that can be used for optical imaging and remote sensing. These payloads can achieve higher resolution when operating in a low orbit. As component of Def Space Challenges, it is proposed to develop an ultra-high resolution optical pay load to be deployed on a VLEO satellite along with Edge Computing based On-board processing system. This on-board edge computing tool should be able to process huge data received from UHR payload of VLEO satellite.



# HYPER SPECTRAL IMAGING SPECTROMETER (HySIS) PAYLOAD FOR VLEO (VERY LOW EARTH ORBIT) BUS

133



**H**yper Spectral Imaging Spectrometer will provide hyper spectral imaging services to India for a range of application in agriculture, forestry and in the assessment of geography such as coastal zones and inland water ways. As a component of Defence Space Challenge, Hyper Spectral Imaging Spectrometer (HySIS) payload is proposed to be developed for satellites to be launched in the Very Low Earth Orbit (VLEO). The challenge also includes real-time processing of data and storage of the data generated. This payload may be miniaturized for deployment on small satellites.



## RAPIDLY DEPLOYABLE BLAST PROTECTION SYSTEM: AN ALTERNATIVE TO SANDBAG

134



**S**andbags are currently used for blast protection against bombs, bullets and other threats, but they are inconvenient, difficult to maintain and labour intensive to deploy. There is a need for an alternative solution that provides similar or better level of protection, is modular to allow quick assembly into various shapes and sizes, is lighter for easier transport with minimal human effort and has a long lifespan even when exposed to environmental elements.

The solution should also allow for compact storage when not in use. Currently, the requirement is met by manually filling and deploying sandbags, but this process is time-consuming and the bags degrade over time. Additionally, sand availability is becoming a concern, further emphasizing the need for a more efficient and durable alternative.



## AERO-ENGINE FOR MI-17 V5 HELICOPTER

135



IAF operates more than 200 Mi-17 helicopters in three variants which are equipped with aero-engines sourced from Russia and Ukraine. Mi-17 & Mi-17 1V helicopters are equipped with earlier versions of TV3-117 engine which do not have adequate high altitude performance. The latest variant Mi17 V5 is fitted with better performance and payload capability VK-2500 aero-engines. There is a need to establish a green field Indian facility for Repair & Overhaul (ROH) and Manufacture of aero-engines within the country. It is proposed to repair, overhaul and manufacture Mi 17 V5 VK-2500 aero-engines in India.



## AIRBORNE STAND-OFF JAMMER

136



**M**odern battlefield is characterized by asymmetric warfare and low intensity conflicts which require effective Electronic Warfare measures to degrade the capabilities of EW systems of the adversaries. The Airborne Stand-Off Jammer (ASOJ) capability on a transport class of platform would provide enhanced capability to degrade/ suppress the enemy potential. It would permit attack aircraft to penetrate the dense Air Defence Network of enemy which may comprise of Air Defence Radars and SAM systems. An ASOJ would protect the attack aircraft from detection by enemy search, acquisition and tracking Radar systems.



## MOBILE GROUND BASED MULTI PURPOSE JAMMER SYSTEM

137



**M**obile Ground based Multipurpose Jammer System is used to gain upper hand in battle field by denying the enemy the freedom of use of Electro-Magnetic (EM) spectrum which would include ground Radar, airborne Radars, GPS navigation system and satellite links for guidance. Mobile Ground based Electronic Counter Measure (ECM) system can be deployed to jam EM spectrum/ links of enemy aircraft/Radars. The jamming will deny effective use of sensors and guidance systems to the adversary.



## HIGH ALTITUDE PSEUDO SATELLITE (FIXED WING AND AIRSHIP BASED)

138



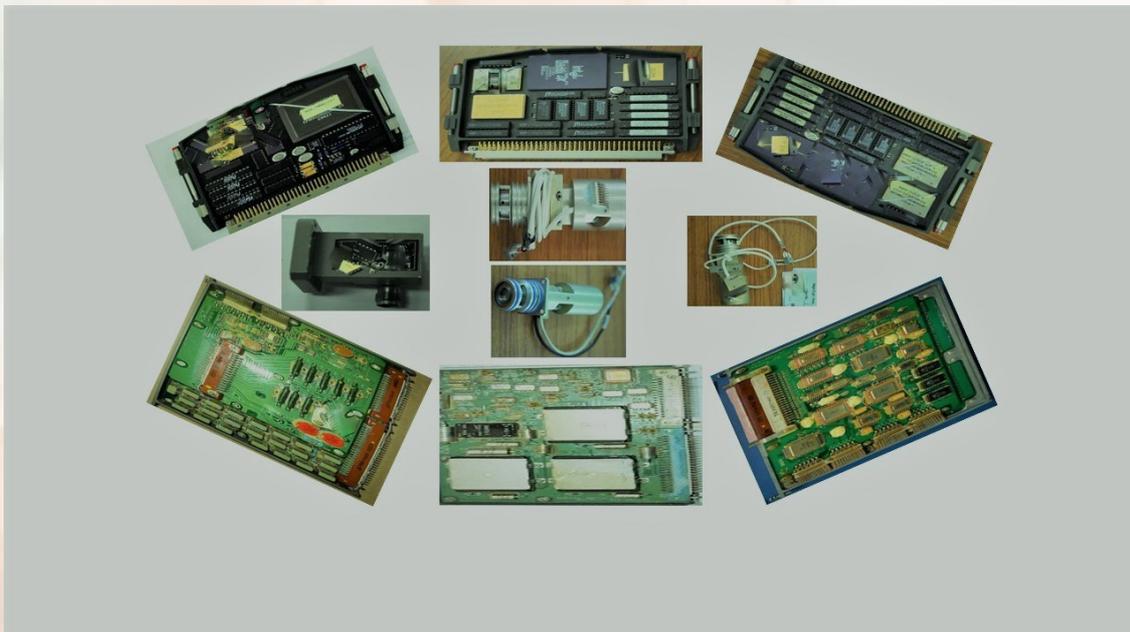
**H**igh-Altitude Pseudo Satellites (HAPS) are unmanned aerial vehicles (UAVs) that offer unique blend of satellite and UAV capabilities like persistent surveillance, assessment of target area, act as communication relays, provides Electronics Warfare (EW) capabilities and precision targeting. HAPS is required for surveillance over an area for long term weapons planning, assessment of target area and providing coverage over own forces in both offensive and defensive posture. It is a high altitude solar powered unmanned aircraft system that can maintain over an area for a long duration and carry various types of sensors.

This system will be of use to IAF in carrying out its primary task and generate target/ mission critical data. Two types of HAPS, Fixed Wing based and Airship based HAPS are envisaged to be developed offering unique capabilities to the IAF.



## INDIGENOUS REPAIR/ REFURBISHMENT OF ELTA JAMMER SYSTEM

139



Indian Air Force uses the ELTA Airborne Self Protection Jammer (ASPJ) system to protect aircraft by jamming hostile signals. There is a need to either repair the existing unserviceable PCBs or refurbish the system with modern state-of-the-art electronics in an Airborne Small Form Factor (3U). The repaired or modified ASPJ system must meet the environmental requirements of a modern fighter jet when mounted on an outboard weapon station, with a minimum mean time between failure (MTBF) of 400 hours.

Additionally, the updated system must be fully compatible with the aircraft's Mission Computer and Avionics, replicating all current Interface Control Documents (ICDs) of the original ASPJ system. Developing a reliable repair facility or upgrading the electronics is crucial for improved reliability and reduced mean time to repair, ensuring the equipment's availability for operational use.



## ACTIVE COUNTERMEASURES TO DEGRADE THE PERFORMANCE OF TERMINAL EO/ IR SEEKERS

140



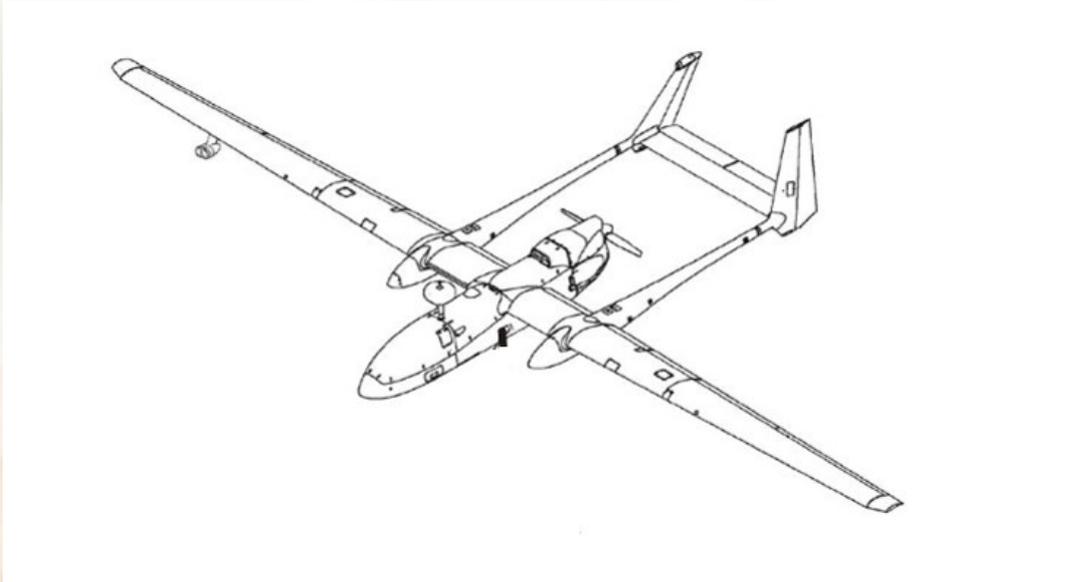
**E**lectro-optical/ infrared (EO/ IR) sensors are used for detecting, tracking and identifying objects or targets. These are often employed in target acquisition and identification for various weapon systems. To prevent enemy forces from using EO/ IR sensors for information gathering or targeting friendly forces, there is a need for an active countermeasure system capable of degrading performance of enemy's EO/ IR seekers. Such a system could be developed either as a single unit or as an array to provide 360-degree coverage with a minimum elevation of 70 degrees, causing significant degradation to EO/ IR seekers up to a range of 30 km.

The system should also be lightweight and transportable via light military vehicles (LMVs). Currently, this challenge is addressed through manual methods and camouflage techniques to avoid detection.



## REPLACEMENT OF EXISTING EO PAYLOADS IN IAF RPA FLEET

141



**C**urrent Electro-Optical (EO) pods, used for day and night photography and laser target designation, need upgrading to keep pace with advancements in electro-optics. There is a requirement to develop an advanced all-weather EO payload compatible with existing Remotely Piloted Aircraft (RPAs) that can perform effectively in cloudy environments.

Currently, the existing EO pods are used in RPAs, but they need to be replaced with state-of-the-art EO payloads to enhance capabilities in the IAF RPA fleet. The contemporary solutions for this upgrade are not yet known and specifications for form, fit, functionality and materials will need deliberation.



## LOW COST TRANSMITTERS AS AN ACTIVE DECOY AND AS AERIAL IMITATOR FOR TARGET PRACTICE IN EW ENVIRONMENT

142



It is required to develop a high-speed, recoverable and highly maneuverable practice target with electronic warfare (EW) capabilities for realistic training and validation. This target should mimic various aircraft, standoff weapons and cruise missiles, with an operational range from 30 meters to 20 kilometers and up to 50 kilometers in line-of-sight (LOS) and 350 kilometers with satellite link.

It must be capable of advanced maneuvering, carrying jamming payloads for EW training and integrating with eight to ten targets controlled by embedded AI to saturate ground based emitters. Additionally, these targets should be recoverable on land and sea and be able to return to the launch base if communication is lost. Currently, the Maneuverable Expendable Aerial Target (MEAT) are used, but they fall short of these requirements. Solving this problem is crucial for providing better training in more realistic conditions.



## AIR TO AIR REFUELLING POD SYSTEM

143



It is required to develop an Air-to-Air Refuelling Pod System to enhance aerial refuelling capabilities. This system will enable seamless mid-air refuelling of fighter aircraft, extending their operational range and mission effectiveness.

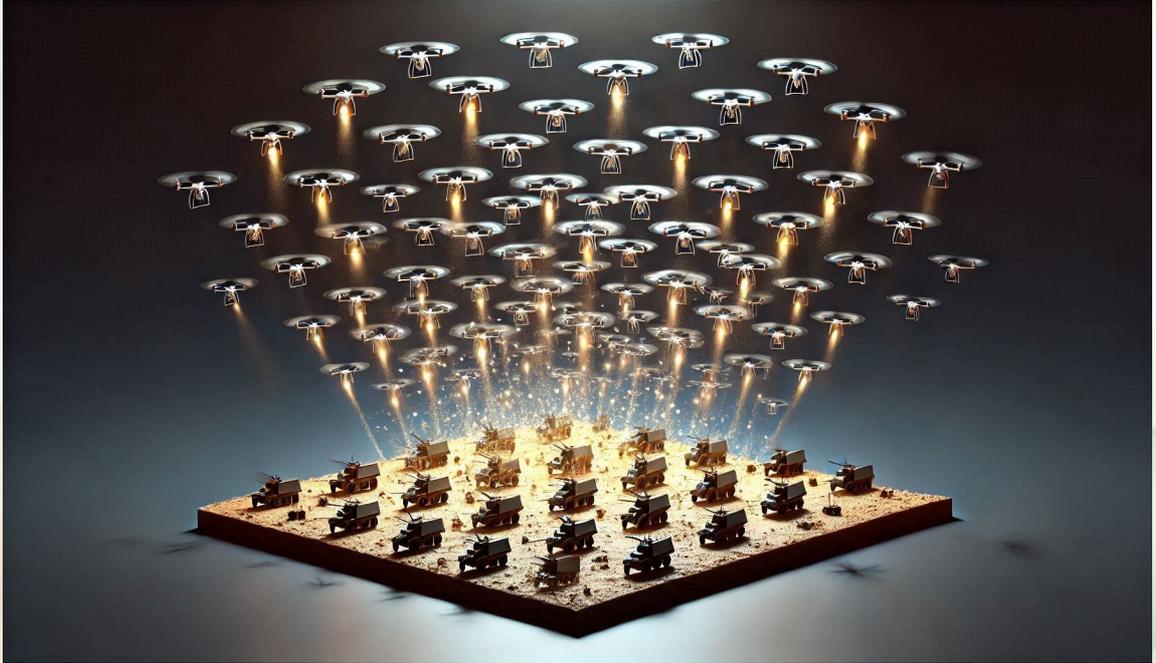
The refuelling pod will be designed to operate efficiently at high speeds and altitudes with operational requirements encompassing speeds of up to Mach 0.9 and altitudes from 10,000 to 40,000 feet, in adherence to MIL-STD-810 for environmental conditions. It will also feature a robust aerodynamic design to minimize drag and ensure stable flight performance, complying with MIL-STD-1530 for aircraft structural testing.

The pod will incorporate advanced fuel transfer technology, capable of delivering up to 2,000 gallons of fuel per minute, meeting the flow rate standards required for rapid refuelling operations. It will use high-strength, corrosion-resistant materials such as titanium alloys and composites, ensuring durability under extreme temperatures ranging from  $-50^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$ , as per MIL-STD-810.



## COLLABORATIVE LONG RANGE TARGET SATURATION/ DESTRUCTION SYSTEM

144



The system of swarm drones has the capability to bring mass and numbers to enemy airfields, AD systems and Radars. The Collaborative Long Range Target Saturation/ Destruction System should be consisting of multiple drones. The system should have autonomy in navigation, target selection and evasion and will be required to undertake missions at long range from launch base.

The swarm will have the capability to carry warhead and carryout navigation and avoidance functions. Sensor capability will be provided to the swarm by some of the swarm members. The swarm to have innovative launch techniques of multiple area launch. The attack profiles must be novel to provide maximum attrition. It is required to develop the swarm so as to have lower cost per launch. The enabling technologies are to be developed and complete solution needs to be delivered for achieving airfield denial and saturation of Air Defence systems.



## FULL MISSION SIMULATOR FOR APACHE HELICOPTER

145



**T**raining and currency of aircrew is an important aspect for operational flying. A simulator provides realistic training on scenarios which may not be feasible under actual flying helicopters. It also helps in saving of actual flying hours. Full Mission Simulator for Apache Helicopter will be developed to provide simulator training to the aircrew of Apache helicopter of IAF.



## SIMULATOR FOR TRAINING AND TESTING SAGW CREW

146



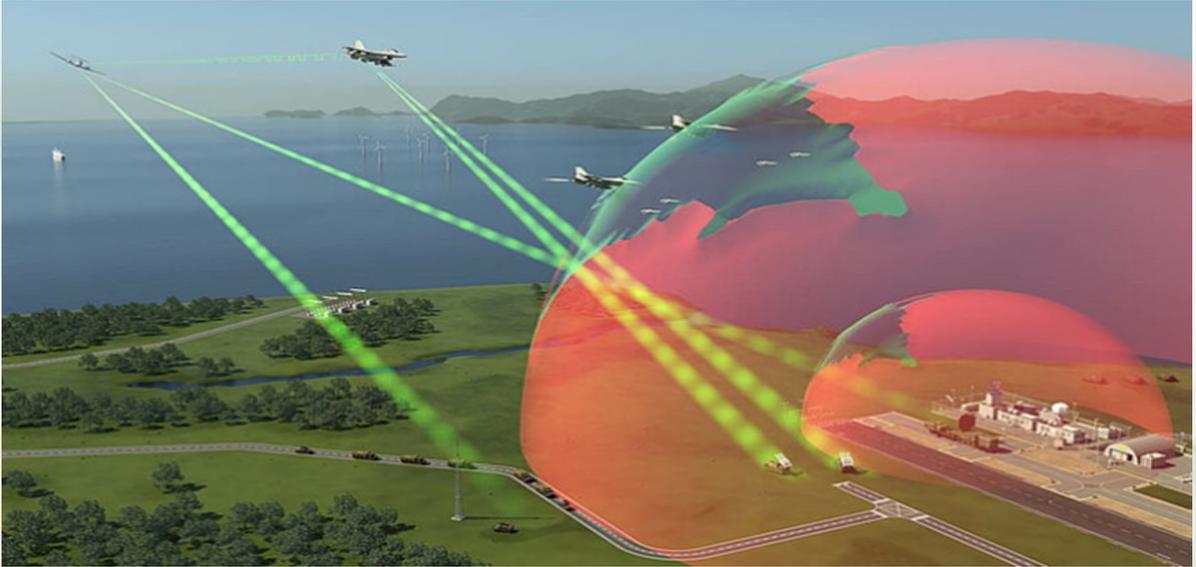
**R**egular training and skill assessment for Surface to Air Guided Weapon (SAGW) and Ground Based Air Defence Weapon Systems (GBADWS) crews require extensive and costly flying efforts, which are limited by peacetime safety norms and fail to create realistic scenarios. To address this, system-specific simulator is required that can generate synthetic targets with real-time maneuverability and simulate various contingencies in a combat-like cabin environment.

This simulator should allow for integration of different SAGW systems into an independent control cabin with a large display for simultaneous monitoring and control of multiple crews. The deliverable is a state-of-the-art simulator system, potentially integrated with AI, to create realistic training environments for SAGW operations crews.



## AIRBORNE ELECTRO-OPTICAL POD WITH GROUND BASED SYSTEM

147



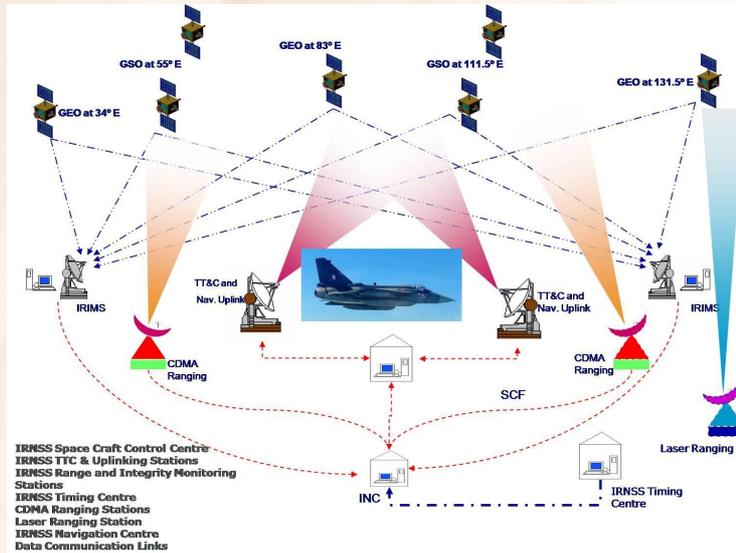
Intelligence gathering is a critical component of modern warfare. It provides situational awareness and assists in target selection, operational planning and force protection. The aim is to develop Airborne Electro-Optical (EO) Pods with a ground based system for image capturing and real time transfer of data to ground system. Airborne Electro Optical Pod is a reconnaissance pods carried on aircraft for airborne surveillance and monitoring.

Reconnaissance system consists of airborne pod and a ground-based system, connected through suitable encrypted data link. Airborne pods interact with ground-based system for transferring real time images. As a part of spiral development, the pods are planned to be equipped with other sensors such as Infrared (IR) and Synthetic Aperture Radar (SAR).



## AIRBORNE MULTI-CONSTELLATION GNSS RECEIVER & CONVERTER

148



The airborne platforms such as fighters, helicopters and transport aircraft are installed with GPS/ GLONASS receivers to determine the accurate present position to undertake navigation & weapon employment related tasks. However, in the event of jamming or spoofing by the adversary while undertaking operational missions, the performance of such systems will be degraded and if it remains undetected, will affect execution of role-related tasks. Also, most of these receivers operate on GPS (L1)/ GLONASS (L1) and therefore cannot operate on other Satellite Navigation System (SNS) constellations such as IRNSS, BEIDOU or GALILIO.

Since, the airborne platforms are intended to operate seamlessly in the intended geographical areas, it is necessary that the SNS receiver is capable of working on multiple SNS constellations. GPS or GLONASS may have poor coverage/ experience jamming/ spoofing in border areas/ areas of operation. The system should be able to detect jamming/ spoofing so that the aircrew can select alternate SNS constellation. The system will also enable existing receivers to operate on Indian IRNSS system, without the need for hardware upgrade of legacy system.



## CONTAINERS FOR RUSSIAN AIR LAUNCHED MISSILES

149



**R**ussian Air Launched Missiles (ALMs) are supplied and stored in wooden boxes, which do not adequately protect against damage from transportation jolts or prevent environmental factors such as humidity ingress. These missiles require strict environmental control to avoid life reduction and non-standard storage conditions can significantly reduce their shelf life. For example, if a missile is moved to a non-air-conditioned storage, its shelf life is reduced by twice the amount of time it is stored in those conditions.

Currently, non-NATO containers and missile stands are used, but they do not provide the same level of protection as NATO supplied containers. The solution is to design and develop indigenous containers similar to NATO standards, incorporating features such as shock sensors and nitrogen filling, to prevent life reduction and ensure better preservation of Russian ALMs during storage and transportation.



## AUTOMATIC TAKE-OFF AND LANDING RECORDING SYSTEM

150



IAF undertakes recording of all Take-Offs and Landings of aircraft at its bases to preserve vital evidence for utilisation during post accident/ incident investigation. The recordings are also used as debrief tool for aircrew training. Presently, video recording is being done by a person with hand-held recorder cameras. Being a manual system the coverage & resolution of the system is sub-optimal. Also, as normal camcorders are used, the system is not capable of night recordings.

Automatic Take-Off and Landing Recording System will be developed for recording all take-off and landing at IAF bases during day and night operations. The system, apart from recording all take-offs and landing will also monitor vehicular, human and animal movement on operational surfaces. The system will comprise of cameras and other sensors to achieve this capability.



## AIRCRAFT RECOVERY DOLLIES

151



IAF operates aircraft of various weight categories. In case of requirement to remove a disabled aircraft from the runway, aircraft recovery equipment is required. This equipment facilitates speedy removal of disabled aircraft for early clearance of runway for continuation of aircraft operations. Presently, such equipment is being imported by AAI from M/s KUNZ, Germany. It is proposed to indigenously design, develop and manufacture aircraft recovery dollies as part of Disabled Aircraft Recovery Equipment.



## TRANSITION PLATFORM WITH TRAILER

152



It is proposed to develop Transition Platform with Trailer as part of Disabled Aircraft Recovery Kit (DARK) which will be used to remove unserviceable aircraft that are stuck on or near the runway, taxiway, runway end safety area and other operational parts of the apron so that air traffic can quickly resume at airfields.



## AIRCRAFT LIFTING SLINGS

153

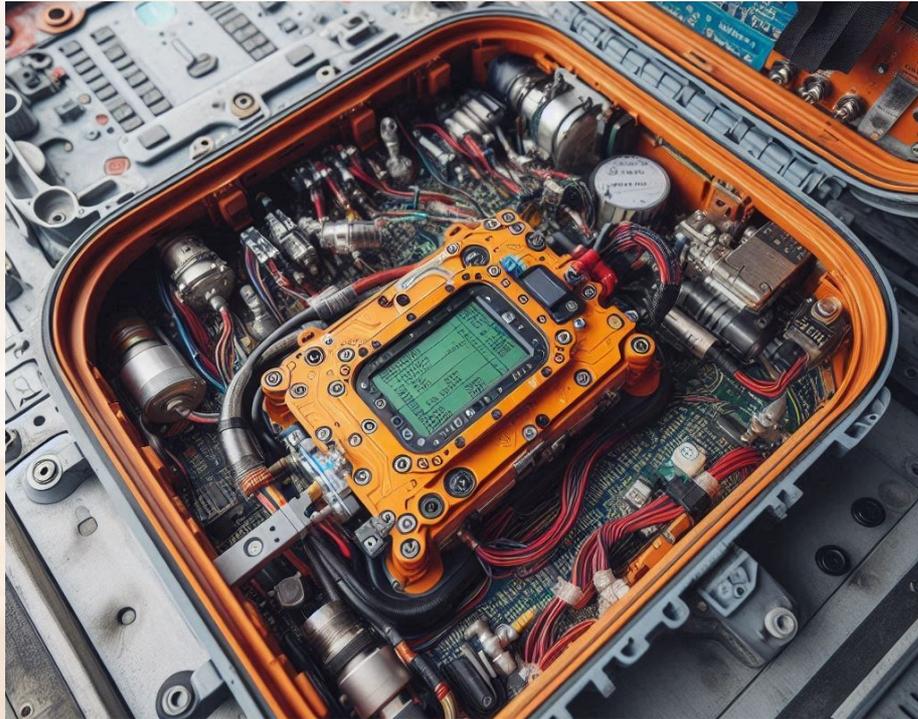


I AF operates aircraft of various weight categories. In case of requirement to remove a disabled aircraft from the runway, aircraft recovery equipment is required. Aircraft Lifting Slings facilitates speedy and safe removal of disabled aircraft for early clearance of runway for continuation of aircraft operations. It is proposed to indigenously design and develop Aircraft Lifting Slings to lift IAF aircraft of various weight categories. These along with other aircraft recovery equipment will facilitate speedy and safe removal of disabled aircraft for early clearance of runway, thereby enabling continuation of aircraft operations.



## AIRBORNE RUGGEDISED FLIGHT INSTRUMENTATION SYSTEM

154



**F**light test instrumentation is a crucial component of aircraft development, providing essential data for the test team to evaluate and improve aircraft performance, safety and reliability. These instruments collect a wide range of data points like aerodynamic data, performance data, structural data, environmental data, avionics data etc. Airborne Ruggedized Flight Instrumentation System will be developed for the Aircraft Systems Testing Establishment (ASTE) which is a premier Flight Test Institute and undertakes flight trials of various types of fixed wing and rotary wing aircraft.



## TAIL ROTOR BLADE FOR MI-17 HELICOPTER

155



It is proposed to design and develop Tail Rotor Blades for Mi-17 series of helicopters which will minimize the dependence on OEM in respect of spares. The indigenized Tail Rotor Blade is to be designed to perform satisfactorily and fulfil mission requirements, throughout the specified life in the specified environments with acceptable levels of safety and reliability.



## TAIL ROTOR CHAIN FOR MI-17 HELICOPTER

156



**T**he Tail Rotor Chain is a short life aggregate pertaining to Mi-17 helicopter of IAF and requires frequent replacement. Presently, the item is being imported ex-abroad. Tail Rotor Chain will be indigenously designed and developed for Mi-17 series of helicopters of IAF. This will minimise the dependence on OEM. The indigenised Tail Rotor Chain is to perform satisfactorily and fulfil mission requirements, throughout the specified life in the specified environments with acceptable levels of safety and reliability.



## MAIN ROTOR BLADE (MI-17 HELICOPTER)

157



IAF operates a number of Mi 17 Helicopters in various variants. Main Rotor Blade fitted on these helicopters have a limited Total Technical Life (TTL) and does not have any overhaul life. The item has short life and replacement is mandated after completion of Original Equipment Manufacturer (OEM) specified life period. Main Rotor Blade will be indigenously designed and developed for Mi-17 Helicopters of IAF. This will reduce the dependence on OEM and will also help to overcome the long lead time in supply of this aggregate.



## BREAKABLE PLUG VALVE OF HPU FOR AIR TO AIR MISSILE LAUNCH

158



It is required to develop a breakable plug valve for the Hydraulic Power Unit (HPU) in air-to-air missile launch systems focusing on enhancing the safety and reliability of missile deployment under rigorous conditions.

The breakable plug valve to be engineered should handle high pressure hydraulic fluids, with a pressure rating of up to 5000 psi, complying with MIL-STD-610 for hydraulic fluid systems.

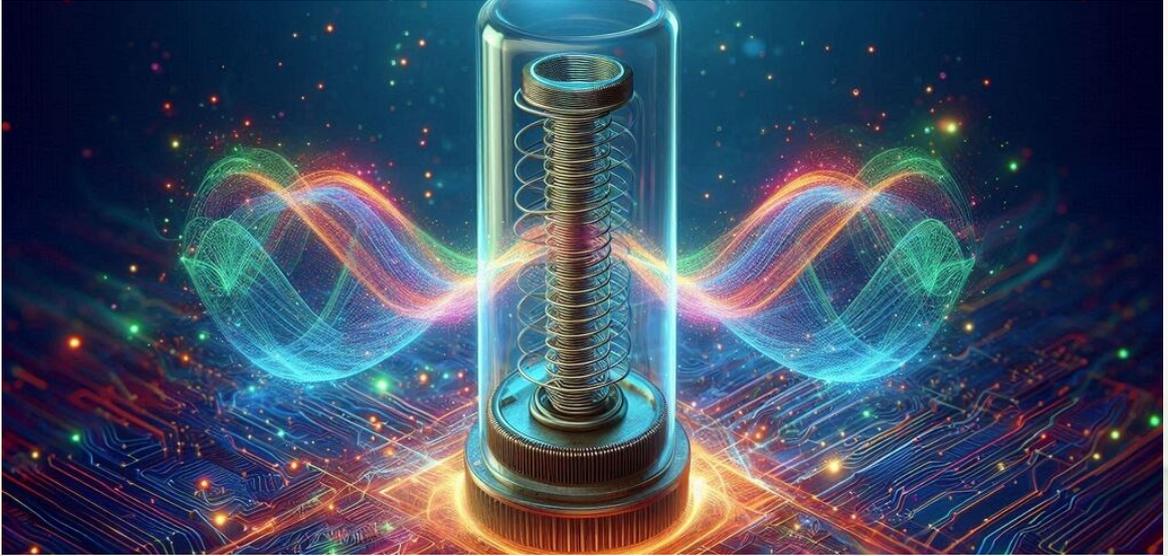
The valve's design should incorporate high strength materials such as titanium alloys or aerospace grade steel, which are resistant to fatigue and corrosion, ensuring durability and reliability under extreme conditions.

Environmental resilience is a key feature, with the valve built to withstand operational temperatures ranging from  $-40^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$ , as specified in MIL-STD-810 for environmental testing. It will also meet requirements for vibration and shock resistance, ensuring reliable function during high impact scenarios typical in missile launches.



## CONTINUOUS WAVE TRAVELLING WAVE TUBE FOR ASPJ

159



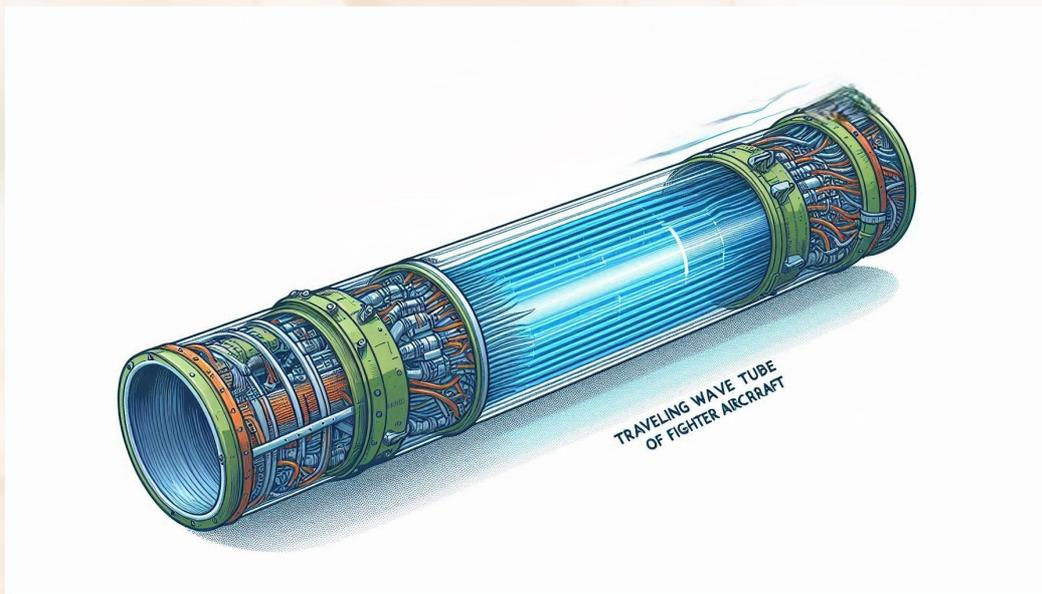
**T**o develop Continuous Wave Traveling Wave Tube (CW TWT) for the ELTA Active Self Protection Jammer (ASPJ), aimed at enhancing the electronic warfare capabilities of military aircraft. This high powered TWT will serve as the core amplification device in ASPJ systems, providing continuous wave output required to disrupt and jam hostile Radar signals effectively. Designed to meet stringent military standards, such as MIL-STD-810 for environmental durability and MIL-STD-461 for electromagnetic interference (EMI) control, the CW TWT will be engineered to operate reliably under extreme conditions.

The TWT will operate in high-frequency bands, delivering power outputs in the range of kilowatts, with high efficiency and low signal distortion. It will be built to withstand operating temperatures ranging from  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ , making it suitable for use in varied environmental conditions, including high-altitude, high-vibration and harsh thermal environments typical in airborne platforms.



## PULSE TRAVELLING WAVE TUBE FOR ASPJ

160



**T**o develop Pulse Traveling Wave Tube (TWT) for the ELTA Active Self Protection Jammer (ASPJ) aiming to enhance the electronic warfare capabilities of aircraft by providing high-power pulsed output to effectively jam and disrupt Radar signals. This Pulse TWT will serve as a critical component within the ASPJ system, designed to meet rigorous military standards, including MIL-STD-810 for environmental resilience and MIL-STD-461 for electromagnetic interference (EMI) control.

Technically, the Pulse TWT will operate in high-frequency bands, providing short bursts of high-power energy with rapid response times. This will enable the system to handle Radar pulses with precision and agility, crucial for countering modern Radar threats. The device will deliver kilowatt-level output power, ensuring effective Radar jamming with minimal signal distortion. Designed to operate under harsh conditions, the Pulse TWT will function within temperature ranges from  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ , making it suitable for diverse environments, including high-altitude and high-vibration scenarios typical in airborne operations.



## SMART MULTIFUNCTIONAL DISPLAY FOR JAGUAR AIRCRAFT

161



The need is to develop a new Smart Multifunction Display (SMD) for Jaguar Aircraft to replace the existing SMD 66J, which is built around a high-resolution, high-contrast active matrix liquid crystal display (AMLCD). The new display must operate upon Power Supply of 115V 400Hz 3-phase, 28V DC and 5V AC.

This development is crucial to address the shortage of AMLCDs and incorporate state-of-the-art technology into advanced smart displays. Currently, the SMD 66J is in use, but contemporary solutions are not known. The deliverable for this project is a minimum order quantity of 160 units.



## UNIVERSAL FDR DATA MINING SUITE FOR IAF

162



**W**ith the upgrade from photographic film-based Flight Data Recorders (FDRs) to solid-state FDRs in older fleets and the introduction of new-generation aircraft such as Rafale, C-130, C-17, C-295, Chinook and Apache, the volume of data generated has increased significantly.

Conventional FDR analysis software can handle known issues but struggles with identifying unknowns. These systems rely on predefined parameters and thresholds, meaning only issues within the predefined scope are detected, leaving emerging risks undetected. The current solution involves using FDRs specific to each fleet, but advances in artificial intelligence and data mining could enhance this approach. Developing a universal FDR data mining suite that can be networked and customized with a graphical user interface tailored to various aircraft fleets would improve aircraft health monitoring and safety.



## QUICK FLIGHT DATA RECORDER (FDR) ANALYSIS SOFTWARE/ TOOL FOR RAFALE AIRCRAFT

163



**O**riginal Equipment Manufacturer (OEM) provided Flight Data Recorder (FDR) Analysis Software for Rafale aircraft processes approximately 400 flight parameters, converting digital data into physical values and offering analysis in static, dynamic and 3D modes. However, this software is complex, slow and restricted to a specific OEM supplied Leader PC located only at the base, limiting its accessibility.

The aim is to develop a quick FDR analysis tool specifically for the Rafale fleet, which includes both the software and necessary hardware (PCs/ laptops and accessories). Currently, new development is required to create this efficient tool. Solving this problem is crucial to enhance the existing FDR processing capabilities with a quicker analysis tool.



164

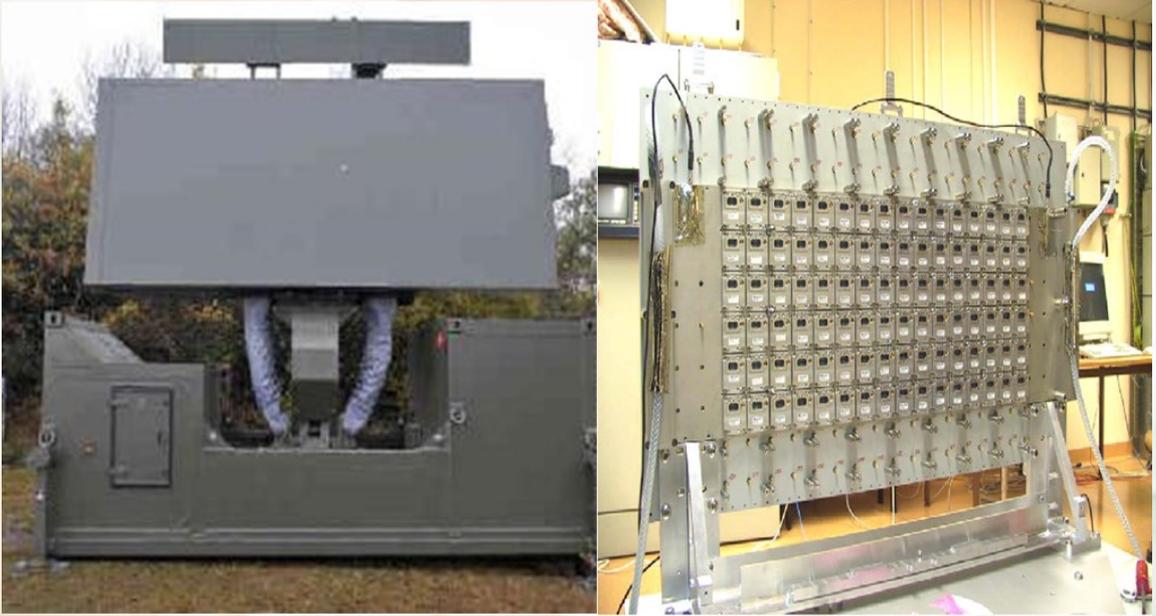
## SECTION - III

# FUTURE OPPORTUNITIES



## LOW LEVEL TRANSPORTABLE RADAR (LLTR) RECEIVER TILE

165



**L**ow Level Transportable Radar is a vehicle-mounted transportable active array air defence system supplied by M/s Thales, France. Its antenna consists of transmitter (Tx) and receiver (Rx) modules, or tiles. Repairing unserviceable Rx tiles is challenging, with low success rates and prolonged downtime. The Original Equipment Manufacturer (OEM) has declared the tiles obsolete due to lack of spares.

There is a need to develop indigenous LLTR Rx tiles that match the dimensions of the existing ones to fit into the same antenna slots, achievable through modern PCB fabrication techniques and advanced electronics. This development would ensure sufficient spare availability and reduce repair times. Currently, Indian agencies repair unserviceable cards to address the problem, but continuous Radar availability is crucial for maintaining uninterrupted surveillance and indigenizing the Rx tile would improve mean time between failures (MTBF) and mean time to repair (MTTR), enhancing RADAR uptime.



## UNDERGROUND OPTICAL FIBRE CABLE DETECTOR

166



**A** large number of underground optical fiber cables (OFCs) have been laid at various bases, but these cables are frequently damaged due to digging operations, as tracking and marking their positions with traditional markers have limited effectiveness. There is a need for a system that can detect the presence of these underground OFCs and accurately track their entire length.

The system should be portable for use in various terrains and allow extended operational hours. Ideally, it would also automatically update a georeferenced database or map. Currently, the position of these cables is identified using user placed markings, but this method is insufficient. Detecting underground OFCs before digging is crucial to prevent damage and improve maintenance and fault rectification. While ground penetrating Radars are used to detect underground cables, future solutions could integrate the detection system with drones for enhanced area coverage and efficiency.



## VISUAL CHECK OF UNDERCARRIAGE BY HIGH INTENSITY VERTICALLY FOCUSED BEAM LIGHT

167



**W**hen an aircraft approaches for landing, it is crucial for ATC staff to verify the correct position of its landing gear. At night, this is typically done by firing flares to illuminate the area around the aircraft, allowing visual confirmation of the gear's position. However, there is a need for a high-intensity, vertically focused ground light that can be operated instantly from the ATC tower.

This system should provide sufficient illumination to ensure that the landing gear's position is visible from the tower, especially when radio communication is unserviceable. Implementing this lighting system would improve redundancy and flexibility, enhancing the handling of aircraft emergencies.



## UNIVERSAL RESCUE LADDER

168



**T**here exists a requirement for a universal rescue ladder for Aircraft Rescue and Fire Fighting (ARFF) crews, as current ladders are specific to individual aircraft types and must be carried on top of the Crash Fire Tenders (CFTs) during emergencies. This presents a problem during detachment operations due to the unavailability of spare ladders.

Therefore, a universal rescue ladder that can be adjusted for all aircraft types is necessary. The ladder should be multidimensional, adjustable, sturdy, self-propelled with a pneumatic system and have a self-contained battery to facilitate rescue operations across various aircraft types. A universal ladder would resolve the issue of transporting multiple ladders and simplify procurement and maintenance.



## TELESCOPIC TELEVISION IN VISIBLE & IR SPECTRUM

169



**S**urface to Air Guided Weapon (SAGW) and Ground Based Air Defence Weapon Systems (GBADWS) currently lack the capability to search, track and engage targets with telescopic television systems, especially at night, due to outdated technology. The challenge is to develop a high-resolution, all weather telescopic television system that can detect aircraft, such as a MiG-21, from over 25 kms away and integrate this technology into existing Surface to Air Missile systems.

The system should provide output on an LCD/ LED display within the combat cabin with a user friendly graphical interface and should be able to replace current systems with similar functionality. Additionally, it should be designed for easy integration with other systems lacking this capability.

Addressing this need is important as it enhances the utility across tri-services, where similar systems are already in use and increases the employability of these systems by allowing integration with other platforms.



## HEAT EXCHANGER (PRIMARY)

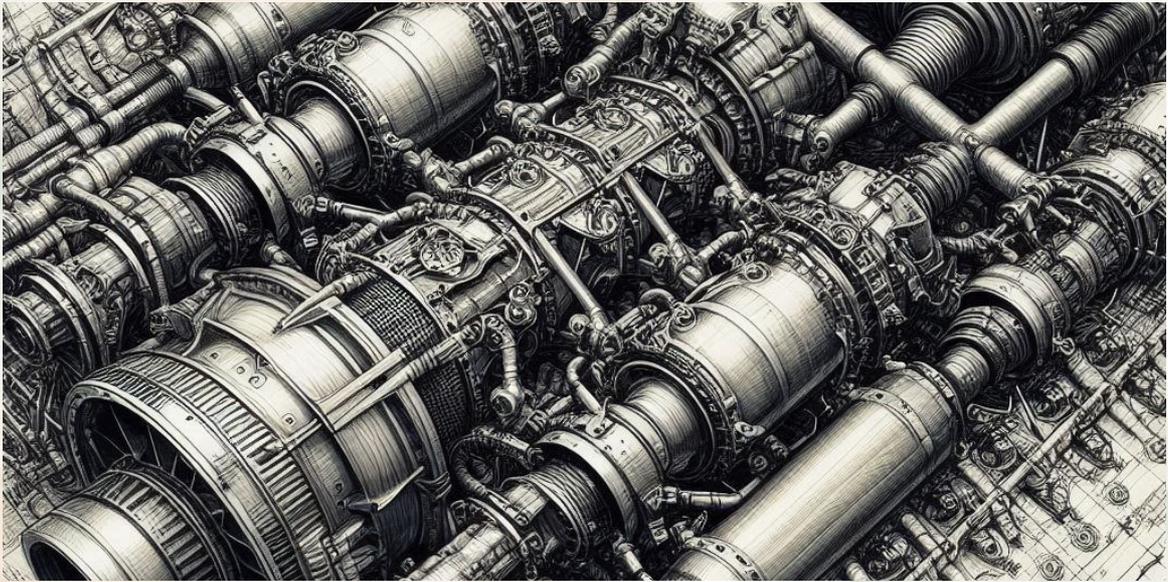


The obsolescence of the oil cooler system in the Primary Heat Exchanger of Jaguar aircraft, which has been experiencing increasing serviceability problems. There are issues in repair of these items due to supply chain constraints. The new Primary Heat Exchanger needs to meet specific requirements: a mass of 15.95 kg (35 lb), a maximum charge flow of 61.24 kg/min (135 lb/min), a maximum charge inlet temperature of 420°C and a maximum coolant flow of 86.18 kg/min (190 lb/min).

Currently, the existing Primary Heat Exchanger is being used, but new development is necessary to address the shortage of these components. Contemporary solutions are not known and specifications for form, fit, functionality and materials needs deliberation.



## HEAT EXCHANGER (SECONDARY)



171

**T**he Secondary Heat Exchanger is a crucial component in the air conditioning system of Jaguar aircraft which is facing obsolescence challenges. There are issues in repair of these items due to supply chain constraints of these components. The new Secondary Heat Exchanger must adhere to specific functional parameters: a mass of 7.8 kg (17 lb), a maximum charge flow of 24.48 kg/min (54 lb/min), a maximum charge inlet temperature of 300°C and a maximum coolant flow of 86.18 kg/min (190 lb/min).

Currently, the existing Secondary Heat Exchanger is in use, but new development is needed to address the shortage. Contemporary solutions are not known and details regarding form, fit, functionality and materials needs to be deliberated.



## FUEL COOLED HYDRAULIC OIL COOLER

172



**F**uel Cooled Hydraulic Oil Cooler of Jaguar aircraft, which features a matrix in its housing integral to the filters and cooler block, is facing obsolescence and supply chain issues. This cooler, which continuously cools oil flow with engine fuel and includes a bypass valve to ensure lubrication and protect the matrix under low temperatures, needs to be developed anew. The exact form, fit, functionality and material specifications must be met.

Currently, the existing fuel-cooled cooler is in use, but new development is necessary to address the shortage of Fuel Cooled Hydraulic Oil Coolers (FCHOCs).



## EJECTION SEAT FOR JAGUAR AIRCRAFT

173



**M**artin Baker ejection seats of Jaguar aircraft are encountering obsolescence problems due to the unavailability of spares from the Original Equipment manufacturer (OEM). Specifically, Martin Baker has indicated an inability to supply 256 lines of necessary spares.

To address this, currently repairing of existing ejection seats is being carried out in-house. However, solving this problem is crucial to prevent further obsolescence of the ejection seats. The exact form, fit, functionality and material specifications need to be met.



## PLATINUM RHODIUM CATALYTIC IGNITERS FOR JAGUAR AIRCRAFT



**J**aguar aircraft engines are increasingly becoming unserviceable due to the frequent failure of Platinum Rhodium Catalytic Igniters in the Module 12 afterburner assembly, which often fail before completing even one “Time Between Overhaul (TBO)” life. To address this issue, there is a need to design new catalytic igniters using materials other than Platinum Rhodium to reduce these frequent failures.

Currently, the problem is managed through the costly and frequent replacement of these igniters. Solving this issue is crucial to minimise the need for replacements and ensuring reliable performance. The new design must meet specific requirements for form, fit, functionality and constituent materials.



## WIRELESS HEADSETS FOR TARMAC OPERATIONS BETWEEN PILOTS AND TARMAC CREW

175



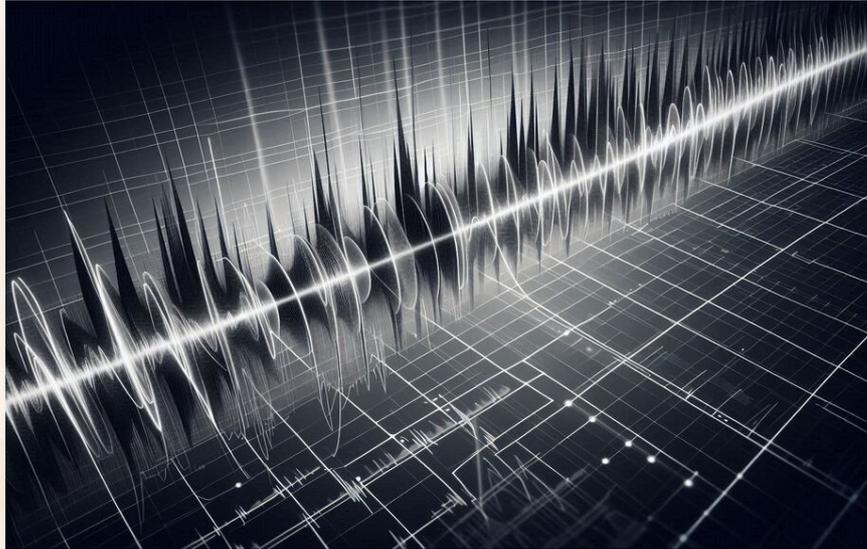
**C**ommunication wires restrict both ground crew and aircrew operations during critical phases of flight preparation, such as see-off, arming and tyre inspections. Wireless headsets are needed to facilitate seamless communication between the flying crew and the see-off party/ load masters on the ground, as well as between loadmasters/ PJI/ flight engineers and pilots in the air.

Currently, communication is managed through wired headsets connected to the stationary aircraft or through marshalling signals, which often results in delays. Solving this problem will improve coordination and efficiency during mission launches by enabling detailed and uninterrupted communication. Contemporary solutions include headsets that provide both ear and eye protection while offering high fidelity wireless communication and noise cancellation.



## INDIGENOUS JOINT WAVEFORM FOR SOFTWARE DEFINED RADIOS

176



**T**he development of an Indigenous Joint Waveform for Software Defined Radios (SDR) is vital for advancing secure voice and data communication across the Indian Air Force (IAF) and other military branches. This waveform will enable seamless integration and interoperability among SDRs used by the Army, Navy and Air Force, enhancing Situation Awareness (SA) and tactical operations in joint battlefield scenarios.

Designed to support encrypted voice and data transmission, the waveform must be compatible with existing SDR systems across the services. It should support both narrowband and wideband modes to meet diverse operational requirements. The waveform must deliver low latency and high reliability in varied environmental conditions, including extreme temperatures (-40°C to +55°C), high humidity (up to 95% at 40°C) and rugged terrains.



## FUTURE PORTABLE MOBILE COMMUNICATION SOLUTION FOR GROUND BASED WEAPON SYSTEM

177



Industry partners are required to develop a Future Portable Mobile Communication Solution for ground based weapon systems. The technology must ensure secure, high output connectivity with redundant, jam proof communication between weapon systems and control agencies. The solution should support secure data exchange up to 100 Mbps, integrated with SATCOM within the AFNET architecture and be compact for portability and field integration.

The system must comply with military standards, for electromagnetic interference and environmental resilience. The system must be robust against Chemical, Biological, Radiological and Nuclear (CBRN) threats and Electromagnetic Pulse (EMP) attacks. The communication solution must integrate with both higher and lower echelons, ensuring efficient data exchange. The system should be easy to maintain and upgrade, with seamless adaptation to future technological advancements.



## INDIGENOUS SECURE ADS-B IN & OUT

178



Industry partners are required to develop an Indigenous Secure Automatic Dependent Surveillance–Broadcast (ADS-B) In & Out system to address the security risks of unencrypted ADS-B communications crucial for military aircraft on sensitive missions. This system will utilize Format Preserving Encryption (FPE), an advanced cryptographic technique that secures ADS-B data while maintaining its original format. The system must integrate a cryptographic module with FPE algorithms to prevent interception and tampering.

The system needs to comply with military standards for environmental conditions and electromagnetic compatibility. It must function reliably in temperatures from  $-40^{\circ}\text{C}$  to  $+55^{\circ}\text{C}$ , humidity up to 95% at  $40^{\circ}\text{C}$  and resist electromagnetic interference (EMI) and electromagnetic pulses (EMP). The system should integrate seamlessly with existing ADS-B equipment and aircraft systems, ensuring no disruption to operational procedures.



## DATA LINK CAPABILITY IN COCKPIT USING SOFTWARE DEFINED RADIO & DIGITAL AVIATION SOLUTIONS

179



Industry partners are required to develop a Data Link Capability between aircraft to aircraft and aircraft to ground and vice versa in the cockpit using Software Defined Radio (SDR) and Digital Aviation Solutions for enhancing in-flight operations and situational awareness. This system should enable secure, high-speed tactical data transfer, allowing real-time updates for onboard equipment. Integrating an Electronic Flight Bag (EFB) with live enroute weather and traffic information necessitates robust data connectivity provided by the indigenous system. It must include a digital aviation grade map database with high resolution terrain elevation data for near real time updates, supporting precision navigation and situational awareness.

Utilizing SDR technology, the system to offer versatile communication options, handling multiple data formats and integrating seamlessly with existing systems. The system must adhere to MIL-STD for environmental conditions, including extreme temperatures, humidity and vibration and for electromagnetic interference and compatibility. This indigenous solution will enhance operational security and align with national defense protocols.



## AIRBORNE GPS JAMMER

180



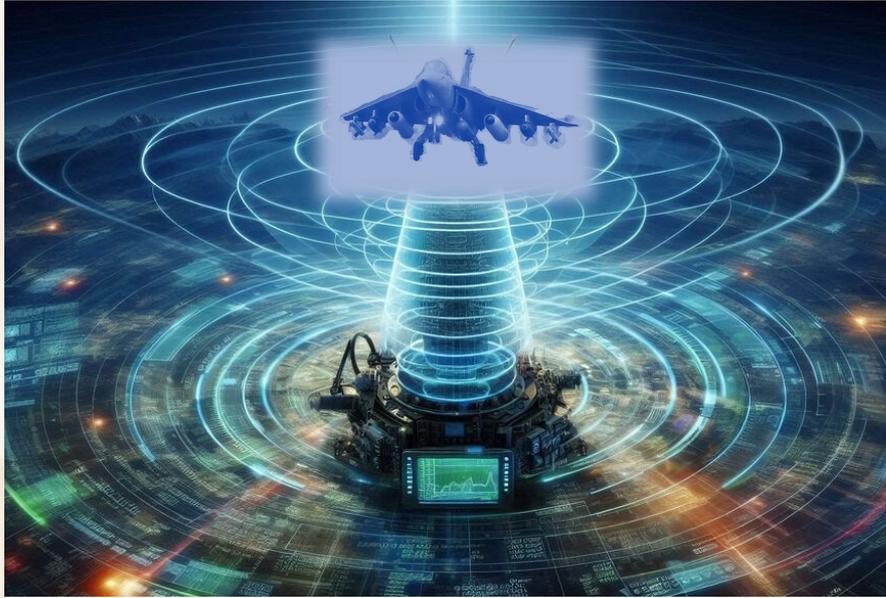
Industry partners are required for the development of an advanced Airborne GPS Jammer to enhance electronic countermeasure capabilities. This system must be designed to disrupt satellite navigation systems by targeting multiple global navigation satellite systems (GNSS) such as GPS, Galileo, GLONASS, Beidou and IRNSS, with a focus on L1/ B1 and L2/ B2 frequency bands. It must be adaptable for installation on various platforms, including transport aircraft, helicopters and drones, with minimal modifications for seamless integration into electronic warfare missions.

The jammer should offer robust performance with an effective range of 100-150 kilometers, capable of jamming both ground based and airborne navigation systems. Advanced signal detection to autonomously identify and disrupt navigation signals without continuous operator input. The system must comply with MIL-STD for environmental resilience, ensuring durability under extreme temperatures, humidity and vibration. Adherence to MIL-STD-461 for electromagnetic interference is essential.



## LOW BAND JAMMER FOR EXISTING FIGHTER AIRCRAFT

181



Industry partners are required to develop a Low Band Jammer pod for fighter aircraft, aimed at enhancing electronic countermeasure (ECM) capabilities in lower frequency bands. The jammer must cover frequencies from 0.5 to 6 GHz, addressing a broad spectrum of threats. It must function as an escort jammer, integrating seamlessly with existing onboard electronic warfare (EW) systems of the aircraft to provide enhanced ECM during missions.

The design must adhere to military standards for environmental resilience, ensuring reliability under extreme temperatures, humidity and vibrations. Compliance with MIL-STD-461 is required to prevent electromagnetic interference (EMI) that could disrupt other onboard systems.

The jammer should be easily integrated into the aircraft without affecting flight performance or maneuverability. It must maintain full operational capabilities and not impose limitations on mission effectiveness. Additionally, it should include ground support and handling equipment for easy maintenance and repair in the field, ensuring sustained operational readiness.



## NEXT GENERATION RADAR WARNING RECEIVER (NG RWR) FOR TRANSPORT AIRCRAFT

182



Industry partners are required to develop the Next Generation Radar Warning Receiver (NG RWR) for transport aircraft, aimed at advancing electronic warfare (EW) capabilities through cutting-edge, open-architecture design and AI-based digital processing. This system will replace the existing Tarang RWR. The NG RWR must seamlessly integrate with the aircraft's mission computer, enabling efficient loading, sampling and downloading of EW and operational data.

The NG RWR should comply with MIL-STD for environmental resilience, addressing temperature extremes, humidity, vibration and to minimize EMI/EMC. Additionally, it should conform to MIL-STD-1275 for electrical power quality and MIL-STD-704 for aircraft electrical power standards. The system needs to perform real time threat analysis and deliver actionable alerts without affecting the aircraft's flight performance. Its modular design should support future upgrades and integration with new technologies.



## MULTI GNSS JAMMER AND SPOOFER

183



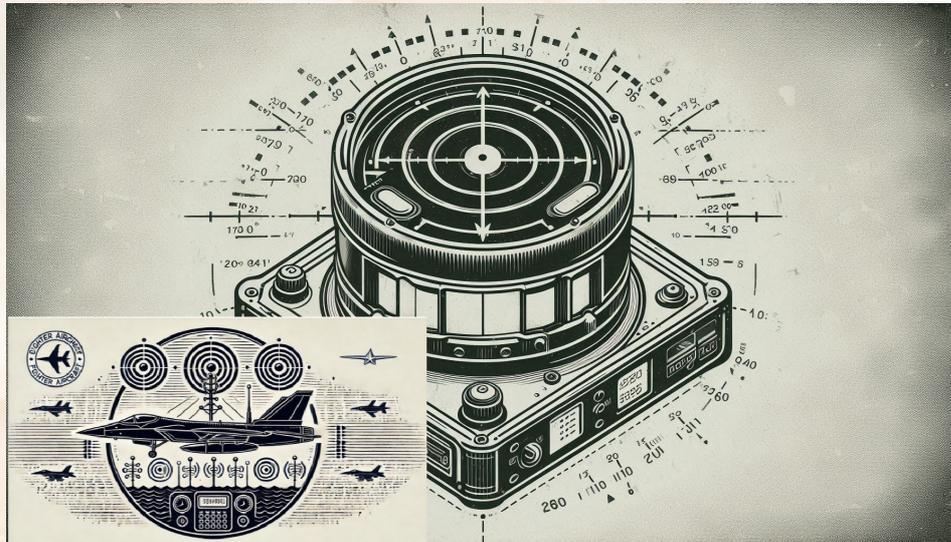
Industry partners are required to develop all terrain, vehicle mounted Ground-Based Multi-GNSS Jammer and Spoofer designed to deliver comprehensive electronic countermeasures against a range of satellite navigation systems, including GPS, Galileo, GLONASS, BeiDou and IRNSS, operating in the L1/ B1 and L2/ B2 frequency bands. This system must be capable of jamming and spoofing both ground based and airborne satellite navigation signals within a range of 200 to 250 kilometers.

The jammer must ensure reliable performance under extreme environmental conditions. Compliance with MIL-STD to avoid electromagnetic interference (EMI) affecting other systems and MIL-STD compatibility with military vehicle power systems and electrical quality. Equipped with advanced signal detection, the system should autonomously identify and process navigation signals for effective countermeasures. It must integrate seamlessly with existing military communication and control systems.



## NEXT GEN RWR & ASPJ FOR EXISTING FIGHTER AIRCRAFT

184



Industry partners are required to develop Next Generation Radar Warning Receivers (NG RWR) and Active Self Protection Jammers (ASPJ) for existing fighter aircraft to enhance electronic warfare (EW) capabilities. The external EW suite should include an RWR operating across 1-40 GHz and an ASPJ covering 4-40 GHz, suitable for advanced fighter platforms. For internal EW systems, the RWR should span 1-40 GHz and the ASPJ should operate within 2-18 GHz.

The equipment must ensure resilience in extreme temperatures, humidity and vibrations, while adherence to MIL-STD-461 is necessary to prevent EMI/EMC. The system must also meet MIL-STD-1275 and MIL-STD-704 standards for military power system compatibility. The RWR should feature open architecture with digital and AI-based processing to replace the current Tarang RWR, integrating seamlessly with onboard EW systems and mission computers.



# MISSILE APPROACH WARNING SYSTEM (MAWS) AND DIRECTED INFRA-RED COUNTER MEASURES (DIRCM) FOR TRANSPORT AND HELICOPTERS

185



Industry partners are required to develop a Missile Approach Warning System (MAWS) and Directed Infra-Red Counter Measures (DIRCM) for transport aircraft and helicopters to enhance flight safety and defensive capabilities. The MAWS should detect and provide situational awareness of incoming missile threats using multi-sensor fusion for precise identification. It must ensure reliable operation in extreme temperatures, humidity and vibrations. Compliance with MIL-STD-461 is necessary to minimize electromagnetic interference and it must be compatible with military power systems per MIL-STD-1275 and MIL-STD-704.

The DIRCM system must be designed to acquire, track and neutralize incoming missiles by directing high-intensity laser energy to disrupt the missile's guidance. It should operate effectively in all conditions with precise tracking and engagement, integrating seamlessly with the MAWS for automatic threat response. Comprehensive testing and validation are required before deployment.



## DRONE/ UAV BASED HIGH BAND JAMMER

186



**T**o address emerging threats, the development of a Drone/ UAV based High Band Jammer is essential. This advanced electronic warfare system should operate across a frequency range of 0.5 to 40 GHz to effectively counter high-band threats. Designed for high-altitude operations, it must function reliably in dense electronic warfare environments. The jammer should be capable of radiating on pre-programmed frequencies with adjustable parameters to simulate and counteract airborne threats. Its lightweight and cost effective design is crucial for mounting on drones or UAVs without sacrificing performance.

The system must adhere to stringent military standards for environmental resilience and operational robustness. It should operate reliably in extreme temperatures from  $-40^{\circ}\text{C}$  to  $+55^{\circ}\text{C}$  and resist dust and moisture to perform in diverse terrains and weather conditions. Compliance for electromagnetic interference is necessary.



## UAV BASED ELINT SYSTEM WITH AI ENABLED ANALYSIS

187



Industry partners are required to develop a UAV based ELINT (Electronic Intelligence) system with AI driven analysis for advanced electronic warfare. This compact system, designed for integration on UAV platforms, must cover a wide frequency range, with Electronic Intelligence (ELINT) capabilities from 0.03 to 40 GHz and Communications Intelligence (COMINT) from 30 MHz to 6 GHz. It should deliver real-time data collection and analysis, utilizing AI to improve signal processing and threat detection accuracy.

The system must also include Satellite Communication (SATCOM) capabilities to ensure robust data linkage between the UAV and the base station, providing reliable communication and data transmission. Equipment must withstand environmental extremes, while adherence to prevent electromagnetic interference with other systems. The ELINT system should be easily deployable and integratable with existing UAV platforms, requiring minimal modifications.



## HIGH ALTITUDE ELINT SENSORS

188



Industry partners are required for the development of high altitude Electronic Intelligence (ELINT) sensors designed to intercept a wide range of emitters across low, medium and high bands. These sensors must operate effectively at altitudes exceeding 15,000 feet Above Mean Sea Level (AMSL) and comply with MIL-STD-810 for environmental robustness, ensuring durability in extreme temperatures from  $-40^{\circ}\text{C}$  to  $+60^{\circ}\text{C}$ .

The system should offer a minimum operational range of 500 kilometres and include automatic recording of intercepted data, with capabilities for later analysis without human intervention. Continuous display of recordings is essential until they are marked as analysed, with high-frequency resolution to distinguish between electromagnetic reflections and actual targets. The sensors must also feature alarm capabilities for different target types and intra-pulse analysis for precise identification. Integration with Satellite Communication (SATCOM) is required for seamless data transmission.



# SURVEILLANCE, DETECTION AND TRACKING SYSTEM FOR TARGETS MOVING AT HYPERSONIC SPEED

189



Industry partners are required for the development of a comprehensive Surveillance, Detection and Tracking System designed to address the challenges posed by high velocity hypersonic threats with low Radar Cross Section (RCS). This advanced system must detect and track hypersonic targets at high altitudes and long ranges, operating effectively across diverse environments. It must include ground-based, airborne and space-based segments to provide broad coverage and flexibility.

The system must feature high resolution Radar capable of tracking objects at speeds over Mach 5, employing sophisticated algorithms for target discrimination in cluttered conditions. Integration with the Indian Air Force's Integrated Air Command and Control System (IACCS) is essential for seamless data fusion and real-time situational awareness. Advanced signal processing and high-bandwidth communication, including satellite communications (SATCOM), are required for efficient data relay.



## MEDIUM ALTITUDE LONG ENDURANCE (MALE) RPA

190



Industry partners are required for design and development of Medium Altitude Long Endurance (MALE) Remotely Piloted Aircraft (RPA) for a diverse range of missions including search and reconnaissance, moving target tracking, artillery adjustment, security, combat search and rescue (SAR), coastal and maritime patrol, disaster control and facility protection.

The system must be capable of operating at altitudes of approximately 30,000 feet or higher, the RPA should have an endurance exceeding 24 hours with Synthetic Aperture Radar (SAR) and Electro-Optical/ Infrared (EO/ IR) payloads. It should offer a maximum range of over 250 km in line-of-sight (LOS) mode, extending further with (Satellite Communication) SATCOM links. The RPA must be equipped with detachable payloads, which may include Electronic Support Measures (ESM), Electronic Intelligence (ELINT), Electronic Counter-Countermeasures (ECCM), Communications Intelligence (COMINT), EO/ IR sensors and SATCOM links. It must support modular payload configuration for operational flexibility and adaptability to various mission requirements.



## PASSIVE SURVEILLANCE SYSTEM (PSS)/ MULTISTATIC/ BI STATIC RADARS

191



Industry partners are required for development of Passive Surveillance System (PSS) for multi-static and bi-static operations, designed to enhance air target detection using advanced passive sensors, including Electronic Support Measures (ESM) and Passive Coherent Locators (PCL). This system must integrate these technologies within a unified command and control centre, ensuring effective monitoring and management of detected targets.

The PSS must be capable of being deployable on all terrain vehicles, capable of operating in off road conditions and suitable for deployment at altitudes up to 5,000 meters above sea level. The system must have a detection range of up to 100 kilometres and should be capable of seamless integrates with the Integrated Air Command and Control System (IACCS), enabling data sharing and operational coordination. The equipment must be designed for low-maintenance, with remote data operations capabilities and quick redeployment features to adapt to dynamic operational scenarios.



## DUAL IR BAND AND UV BASED IMAGING SEEKERS FOR MAN PORTABLE AD SYSTEM

192



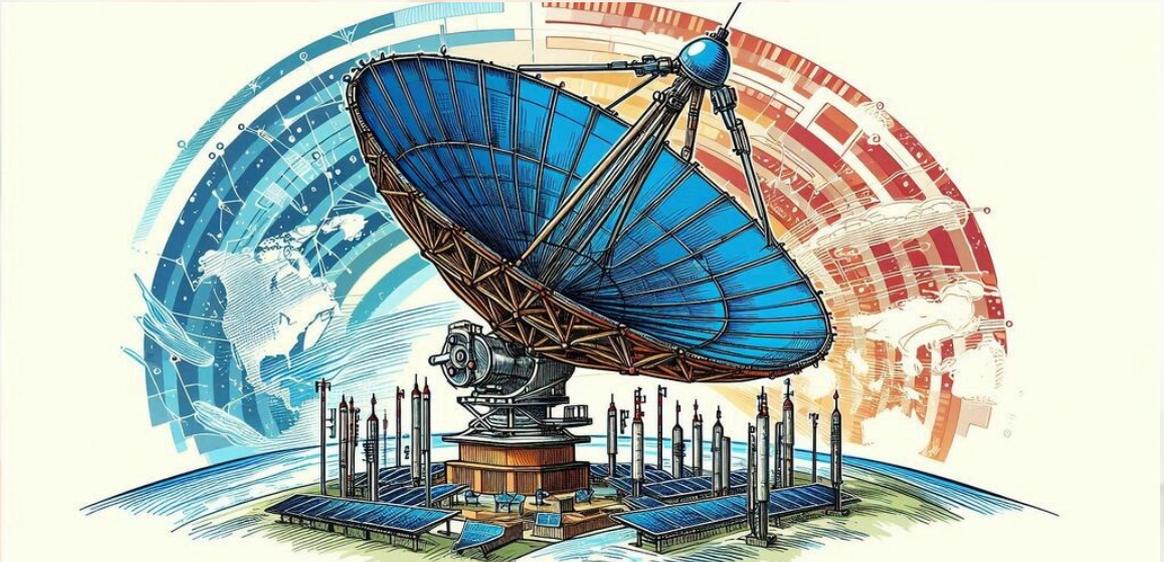
Industry partners are required for development of dual IR band and UV-based imaging seekers for a man-portable air defence (AD) system. This requires advanced technology to ensure effective target detection and tracking. These seekers must operate across near IR, far IR and UV bands to accurately identify and differentiate between aircraft, drones, helicopters and missiles.

Capable of tracking targets at a maximum distance beyond 12 Km, the system should integrate advanced imaging techniques to discern targets from decoys such as flares. The dual-band capability allows for comprehensive threat identification in diverse environmental conditions, including varying light levels and atmospheric conditions. The seekers must be compact and lightweight for portability, adhering to MIL standards for ruggedness and reliability. They should withstand harsh environmental factors such as extreme temperatures and humidity, ensuring operability in diverse combat scenarios.



## VHF RADARS

193



Industry partners are required for design and development of VHF Surveillance Radar system for operation at altitudes up to 5,000 meters AMSL, with detection ranges exceeding 300 Kms. The radars must feature advanced active phased array technology, ensure high update rates and minimal scan times. It must be capable to detect low Radar Cross Section (RCS) and stealth threats, including Stand-Off Weapons (SOW), with robust Electronic Counter-Countermeasures (ECCM) and integrated decoy systems.

The Radar's modular design must facilitate future upgrades while ensuring low maintenance and rapid redeployment. The system to support remote data operations, maintaining efficiency in varied operational conditions. Additionally, it needs to be integrated seamlessly with the Integrated Air Command and Control System (IACCS), enabling comprehensive situational awareness and operational coordination. Designed for all-terrain adaptability, the Radar system to be operate in challenging environments.



# MULTI-PHENOMENOLOGY MULTI-SENSOR ALGORITHM FOR FUSION OF DATA FROM VARIOUS SENSORS

194



Industry partners are required for design and development of the Multi-Phenomenology Multi-Sensor Algorithm to deliver near-real-time actionable intelligence by integrating data from diverse sources, including Open Source Intelligence (OSINT), commercial satellites and classified military sensors (space, air and surface-based). The system needs to employ advanced data fusion techniques to provide comprehensive situational awareness. It must feature automated threat evaluation, leveraging access to a centralized repository of satellite and sensor data.

The algorithm to support high-speed processing to ensure timely and accurate information dissemination. It must function seamlessly within military communication infrastructures, including the Integrated Air Command and Control System (IACCS). The modular design must allow for upgrades with minimal disruption, while robust security protocols safeguard the integrity of both classified and unclassified data.



## AI/ ML BASED CHANGE DETECTION FOR MULTI PAYLOAD FUSED IMAGERY DATA

195



Industry partners are required for design and development of an AI/ ML based change detection system for multi-payload fused imagery data addressing the need for advanced processing and management of extensive satellite data volumes. This system must integrate AI, block chain and big data technologies to enhance the security and efficiency of data solutions. By leveraging these technologies, the system must provide rapid processing and analysis of imagery data, significantly reducing the time required for data interpretation.

Additionally, the use of AI and ML algorithms should allow for precise change detection by comparing images from multiple sensors within the same time window, offering a comprehensive assessment of targets. This capability will not only accelerate operational decision-making but will also minimise launch costs by optimizing the use of available data.



## AI BASED COMPREHENSIVE FRAMEWORK (INDIGENOUS) FOR SECURITY OPERATION CENTRE

196



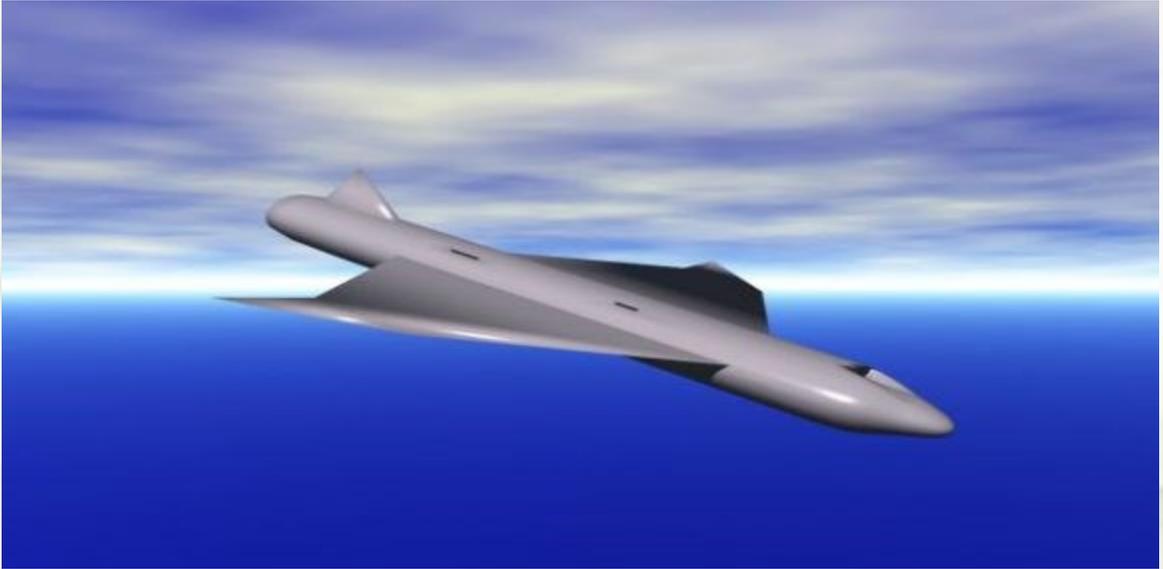
Industry partners are required for design and development of an AI based comprehensive framework for a Security Operations Centre (SOC) which must autonomously prevent, detect and respond to cyber security incidents. The framework should integrate and correlate logs from various SOC tools, including Log Collectors, Security Information and Event Management (SIEM) systems, Endpoint Detection and Response (EDR) platforms and Vulnerability Assessment tools.

The framework should be equipped with advanced AI algorithms to continuously monitor and assess environmental behaviour, identifying deviations indicative of potential threats. The framework must be capable of evaluating the severity of data breaches and implementing automated remediation processes to contain and mitigate damage. It should be designed for high resilience, with robust cyber security measures to protect against external and internal threats. Additionally, the framework should offer modularity for future upgrades and scalability to accommodate evolving security needs.



## SUPERSONIC AERIAL TARGETS

197



Industry partners are required for design and development of supersonic aerial targets which can exhibit a minimum speed of Mach 1.5 and feature a low Radar Cross Section (RCS) for effective simulation. These targets should possess the capability to mimic larger aerial threats and replicate thermal and electronic signatures. They must support programmable flight profiles, including sea-skimming manoeuvres and be equipped for Anti-Ship Missile Defence (AMD) and Direct Missile Defence Integration (DMDI). The control system should enable surface or aerial platform management within a Line-of-Sight (LOS) range of 150 to 200 km.

Additionally, the targets should incorporate reusable (for up to 10 operational cycles) smoke, chaff and flare dispensing systems to enhance realism by utilising ballistic parachutes and inflatable envelopes for recovery. The design should include pylons for carrying expendable tow targets or mimic payloads. The operational ceiling of the targets should not be less than 8 km to ensure versatile training scenarios.



## STEALTH UCAV

198



Industry partners are required for design and development of Stealth Unmanned Combat Aerial Vehicle (UCAV) of supersonic speeds with super cruise capability while maintaining low observability across all spectrums. The UCAV should be highly manoeuvrable, enduring high-G loading and capable of carrying up to 4,000 kg of internal weapons for both air-to-air and air-to-surface operations. It must support Manned-Unmanned Teaming (MUMT) in a loyal wingman role and feature a programmable flight profile with AI-enabled avionics for advanced targeting and cueing using Low Probability of Intercept (LPI) Radar, Electro-Optical/ Infrared (EO/IR) and Short-Wave Infrared (SWIR) sensors.

The system should have an electronic, low-latency, secure, encrypted satellite link for Beyond-Line-of-Sight (B-LOS) control and maintain operational capability at a Line-of-Sight (LOS) distance of up to 300 km from surface or aerial platforms. It must be equipped with conformal defensive electronic and expendable stores, autonomous aerial refuelling capabilities and operate at an altitude ceiling of 15 km or more.



## X-BAND MOBILE DOPPLER WEATHER RADAR (DWR)

199



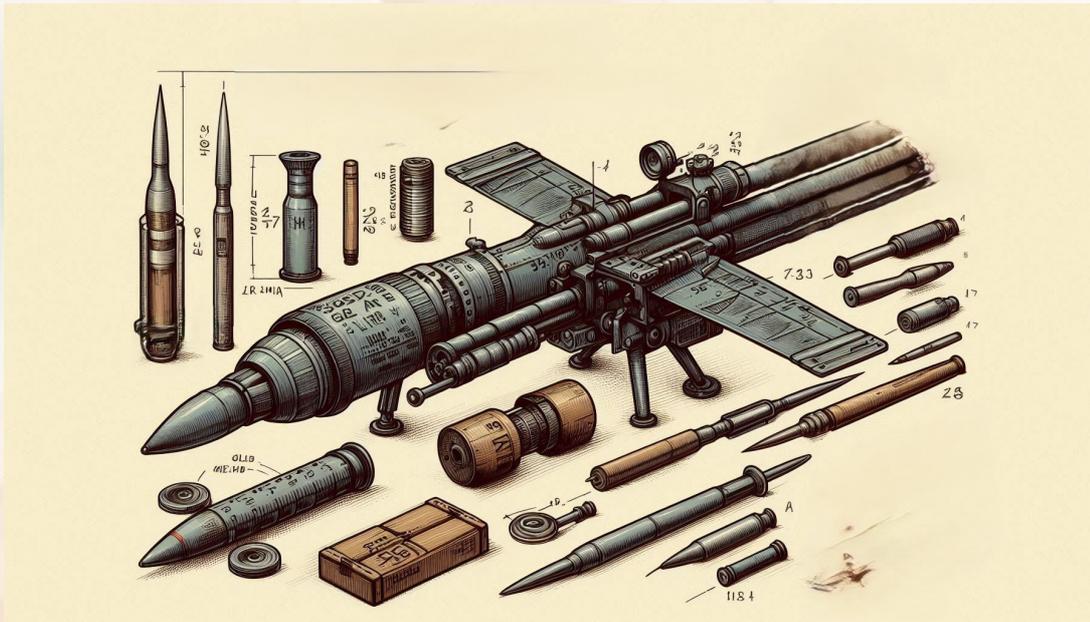
Industry partners are required for design and development of an X-Band Mobile Doppler Weather Radar (DWR) engineered to deliver precise meteorological data, essential for aviation safety. This Radar system, should be optimized for detecting and assessing severe weather phenomena such as thunderstorms, provides critical information on rain, turbulence, strong winds, lightning, low-level wind shear and icing.

The Radar should operate effectively in the X-band spectrum, with high resolution and capability to discern fine details. It should feature dual polarization for enhanced data accuracy, with a minimum detection range exceeding 100 kilometres. The X-Band DWR should be compact, facilitating ease of deployment and operation. Its mobility should ensure bridging gaps in existing coverage and offering flexibility in military contexts. The Radar's design should adhere to military standards, ensuring robust performance in diverse environmental conditions.



## SMALL DIAMETER BOMB (SDB) FOR HALE/ MALE/ UCAV

200



Industry partners are required for design and development of Small Diameter Bomb (SDB) for High Altitude Long Endurance (HALE), Medium Altitude Long Endurance (MALE) and Unmanned Combat Aerial Vehicles (UCAV) which must be designed for versatile, precision strike capabilities. The SDB must feature a modular warhead weighing between 10 to 15 kg, with individual warhead components ranging from 1 to 2 kg, scalable up to 100 to 120 kg for UCAV deployment with its length ranging from 1.5 to 2.0 meters.

The bomb should be engineered to engage a variety of targets including Class 'A' vehicles, Radars, soft-skinned targets, troops, bunkers, ammunition dumps, gun positions, logistics and communication nodes. The warhead options should include Multipurpose Tandem, Thermobaric and Sub-munitions, with a variable fuse delay of up to 7 days. The SDB should have a range of 12 km with ballistic drop and up to 20 km with a rocket-boosted option. It should ensure high accuracy with static targets within 0.5 meters and mobile targets within 1 meter with Integrated GPS (INGPS) terminal.



## AIR-TO-SURFACE MISSILE FOR HALE / MALE / UCAV

201



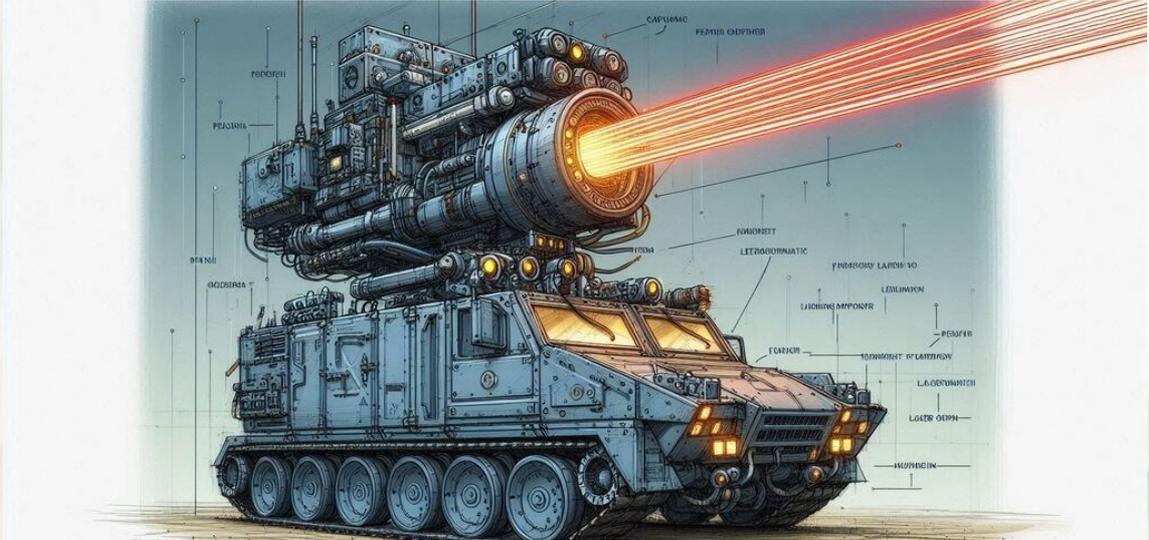
Industry partners are required for design and development of Air-to-Surface Missile for High Altitude Long Endurance (HALE), Medium Altitude Long Endurance (MALE) and Unmanned Combat Aerial Vehicles (UCAV) which must be designed for precision strikes. The missile should feature a total weight of 10-15 kg and a warhead weighing between 1 -2 kg, with an overall length of 1.5-2.0 meters. It should be engineered to engage a variety of targets including Class 'A' vehicles, Radars, soft-skinned targets, troops, bunkers, ammunition dumps, gun positions, logistics and communication nodes.

The warhead options should include Multipurpose Tandem and Kinetic hard nose penetrator/slicer types. The missile offers a range of 12 km with ballistic drop and up to 20 km with a rocket boost. It should provide high accuracy, with static targets within 0.5 meters and mobile targets within 1 meter and feature an Integrated GPS (INGPS) terminal accuracy of less than 10 meters. It should incorporate dual seeker mode for engaging both static and mobile targets, with day and night capability. The missile should also support programmable approach and impact angles.



# INTEGRATED HIGH MOBILE TACTICAL HIGH-ENERGY LASER AND ELECTROMAGNETIC WEAPON SYSTEM

202



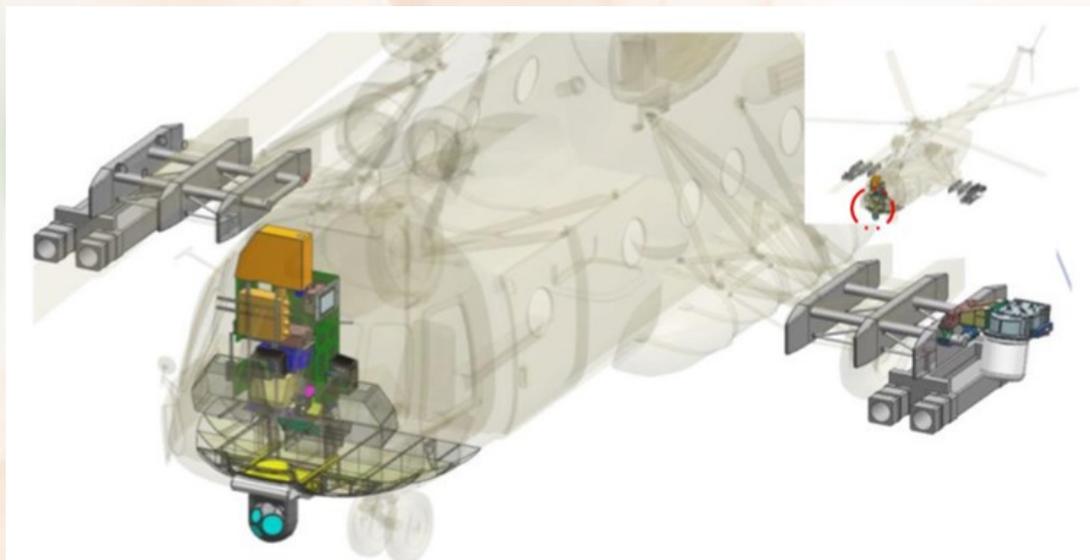
Industry partners are required to design and develop an integrated high-mobility, tactical High-Energy Laser (HEL) and High-Power Electromagnetic (HPEM) Weapon System. The HEL component aims to degrade or destroy electronic warfare systems, communication networks, Radars, antennas, microwave towers and cables. It should have an effective capability to engage soft-skinned vehicles and troops, extending its range up to 20 km.

This system should also support anti-satellite operations from both ground and aerial platforms, with features like simultaneous threat engagement, an integrated power source and gyro-stabilized aiming. The HPEM component must be designed to disrupt enemy electronic and electrical systems at ranges exceeding 15 km. It must be capable of targeting cellular and microwave towers, communication networks and command-and-control setups and be effective against aircraft avionics, Radars and RPAs. The system should radiate peak power of 30-50 kW to neutralize large projectiles, including cruise missiles and drones and counter airborne and space-based threats.



## NLOS GUIDED AMMUNITION

203



Industry partners are required for design and development of NLOS (Non-Line-of-Sight) guided ammunition system designed for high-precision engagement from helicopters, even in challenging environments. This system must enable the helicopter crew to accurately guide the ammunition to specific ground targets, reducing collateral damage and minimizing friendly fire risks. It should support a standoff range of 50-60 kilometres, enhancing crew safety by keeping the helicopter out of enemy engagement zones.

The guidance system must be capable of real-time video feedback and man-in-the-loop control, allowing operators to adjust or abort the mission enroute to the target. The ammunition must be effective against a broad spectrum of targets, including armoured vehicles, structures and fortifications, while maintaining effectiveness against both armoured and softer targets. Emphasis should be placed on the system's lightweight and cost-effectiveness to ensure compatibility with light helicopters.



## AIR TO SURFACE MISSILE FOR FIGHTER AND BOMBERS

204



Industry partners are required for design and development of air-to-surface missile system designed for integration with tactical fighter aircraft and bombers engineered to deliver precision strikes at ranges of 75-100 kilometres. The missile must feature an Inertial Navigation System (INS) for accurate midcourse guidance and a choice of TV or Infrared Imaging Radar (IIR) sensors for terminal guidance. It needs to incorporate a man-in-the-loop capability, allowing operators to guide the missile in real-time via a secure data link that transmits live seeker footage from the missile to the host aircraft.

This system should enable operators to make adjustments or abort the mission if necessary, aiming for a Circular Error Probable (CEP) of 3 meters. The missile is to be designed lightweight and versatile, suitable for various aircraft platforms while meeting rigorous military standards for environmental resilience and maintainability. It needs to be of robust design reliable performance under diverse conditions, allowing it to engage a broad spectrum of ground targets with high accuracy, minimizing collateral damage and enhancing operational effectiveness.



## SMART LOITERING BVLOS MUNITIONS

205



Industry partners are required for design and development of Smart loitering Beyond Visual Line Of Sight (BVLOS) munitions which are advanced ground-launched, electro-optically guided systems with a range of 500 to 1,000 km. These munitions are to be designed to carry a 50 kg explosive warhead and sustain loitering operations for over 6 hours. The system must be integrated with comprehensive mission capabilities including search, attack and battle damage assessment, independent of external targeting and intelligence systems.

Prior to launch, munitions should be programmed to autonomously navigate to a predefined holding area where they loiter until directed. The operator should be able to guide the munitions to the target area using real-time video imagery, select the target and initiate the attack. The munitions will track the target and execute a precision dive, detonating the warhead upon impact. The system should be integrated into existing military frameworks. This capability will enhance tactical flexibility and precision, significantly reducing collateral damage and improving mission efficacy.



## UNIVERSAL LAUNCHER FOR AIRCRAFT

206



Industry partners are required to develop a Universal Launcher for aircraft, designed to streamline weapon integration and enhance operational efficiency. This versatile launcher must support a wide range of air-to-ground (A-G) stores and air-to-air (A-A) missiles, accommodating both long and short-range A-A missiles, as well as A-G missiles and guided bombs. It should be adaptable to a variety of Western and Russian weapons, ensuring broad compatibility and operational flexibility.

The launcher must also be upgradeable to accommodate additional stores such as reconnaissance and flight refuelling pods. Designed to minimize role changes, it should require minimal modifications for different mission profiles, thus reducing aircraft downtime. The system must ensure reliability under extreme temperatures, humidity and vibrations. Additionally, adherence to MIL-STD-461 for electromagnetic compatibility is crucial. The design should prioritize ease of maintenance and sustainment, with modular components for straightforward repairs and upgrades.



## LARGE AREA AERIAL LIQUID DISPERSION (LAALDE)

207



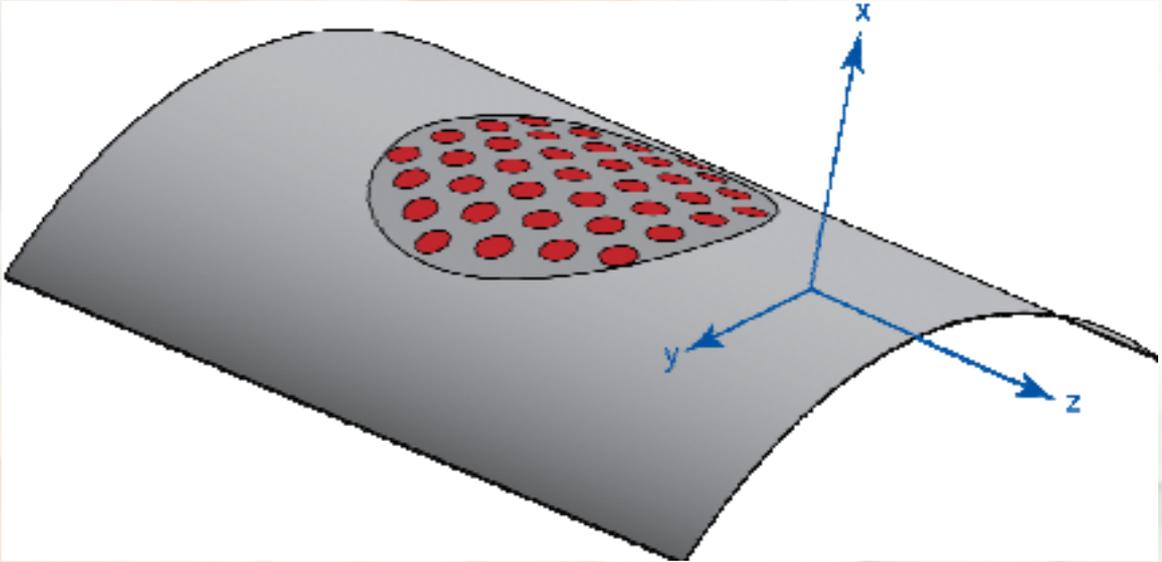
**T**o address the increasing risks of forest fires and large-scale urban or installation fires, the IAF requires the development of a Large Area Aerial Liquid Dispersion (LAALDE) system. This system will enhance the aerial fire fighting capabilities of helicopters, crucial for mitigating the impact of such disasters. The LAALDE system should be compatible with various helicopter models, including the Mi-17 V5, which has successfully demonstrated aerial fire fighting capabilities using HL-5000 Bambi Buckets.

The system must feature a robust liquid dispersion mechanism, capable of handling different capacities based on the helicopter's specifications. It should ensure efficient and controlled release of the liquid to cover extensive areas effectively. Ensuring reliable performance in extreme temperatures, humidity and vibrations is a must. Additionally, it must meet MIL-STD-461 for electromagnetic interference. The LAALDE system should be designed for ease of maintenance, with modular components for quick repairs and upgrades, ensuring readiness and operational efficiency during Humanitarian Assistance and Disaster Relief (HADR) operations.



## SHAPED ARRAY ANTENNA

208



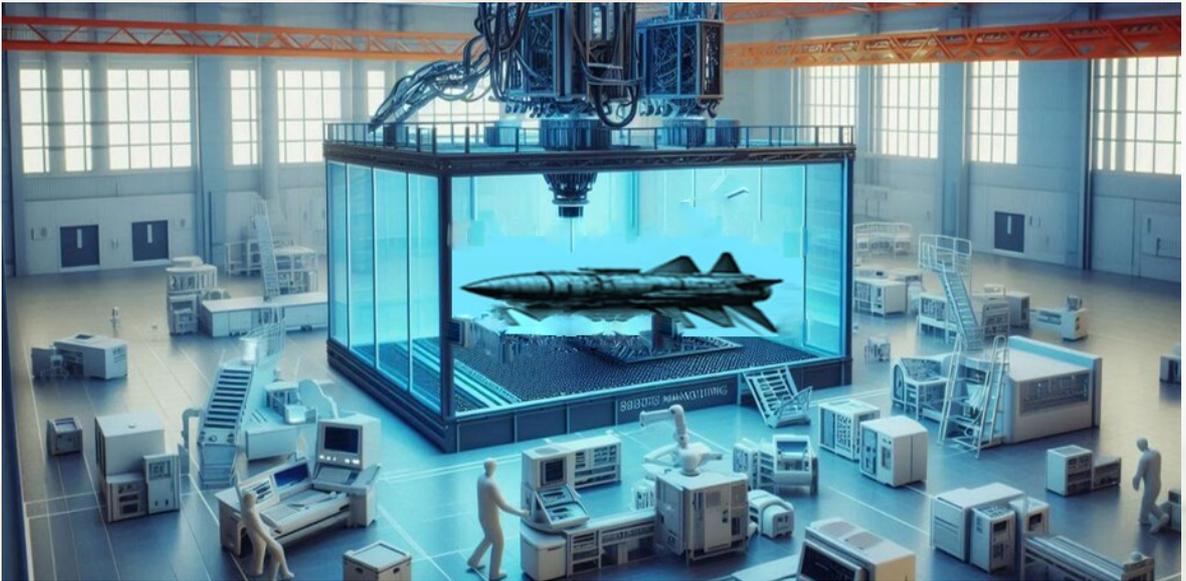
Industry partners are required for development of a conformal shaped array antenna for fighter aircraft for advance communication capabilities. The antenna must be flush-mounted to the aircraft's structure to maintain aerodynamic efficiency and minimize drag. It should cover a range of frequency bands including V/UHF, L, S, C, X and future bands, with advanced beam-steering technology to enable Low Probability of Intercept (LPI) communication with other aircraft and ground stations. The system needs to incorporate beam-steering technology for precise targeting and identification of other aircraft, ensuring seamless integration with existing avionics.

The conformal antenna should be designed to replace current whip and blade antennas without any performance degradation, maintaining or enhancing operational effectiveness. Additionally, it must adhere to MIL-STD-1275 and MIL-STD-704 for power quality, ensuring compatibility with military aircraft power systems and operational reliability.



## ON DEMAND SPARES THROUGH ADDITIVE MANUFACTURING

209



Industry partners are required for development of an on-demand spares system through additive manufacturing for efficient aircraft maintenance. This technology must enable the rapid production of mechanical spare parts directly from a database and physical part specifications. It should be capable of using certified materials that meet rigorous standards, including CEMILAC certification for end products, ensuring reliability and safety. The additive manufacturing system must adhere to MIL-STD-810 for environmental durability. It should also comply with MIL-STD-461 to prevent electromagnetic interference with other systems.

The technology should be designed for ease of integration into existing maintenance workflows, providing rapid turnaround times for spare parts while maintaining high precision and quality. Additionally, the system should be equipped with robust maintenance protocols and diagnostics to ensure operational readiness and reliability. The overall design must focus on operational efficiency, allowing for quick adaptations to varying parts requirements and minimizing aircraft downtime.



## EJECTION SEAT FOR FIGHTER AIRCRAFT

210



Industry partners are required for development of an advanced ejection seat for fighter aircraft for ensuring pilot safety across diverse operational scenarios. This ejection seat must facilitate safe ejection and recovery from the aircraft at any speed, from zero to maximum and at all altitudes, including high altitude conditions. It should be designed to fit various classes of fighter aircraft with minimal or no modifications, ensuring broad compatibility.

The seat needs to feature state-of-the-art technology, enabling ejection in any aircraft orientation and must meet stringent performance standards. It should comply with MIL-STD 810 for environmental resilience, ensuring reliability under extreme temperatures, humidity and vibration. Additionally, adherence to MIL-STD-461 is essential to prevent electromagnetic interference that could affect seat operation. The seat's design must include robust maintainability features, such as modular components for easy field repair and servicing.



## STANDALONE DATA DECODER FOR AWACS AIRCRAFT AND AERO ENGINES

211



Industry partners are required for development of a standalone data decoder system specifically designed for the AWACS aircraft and its aero engines. Currently, the processing of flight data, which is stored on the memory cards of solid-state recorders like the TBN-K and DFDR units, is carried out using the ground-based integrated processing system TOPAZ-M. This system relies on specialized software SKAT, which operates on Dell P37 G laptops running Windows XP/7 operating systems. Additionally, the SKAT software requires a HASP key provided by the OEM to function, creating a dependency on external support.

Similarly, the recording and processing of engine parameters are managed by the ASK-PKO system, which uses a range of software tools including ASK-convert, ASK-DB, ASK-PRO and ASIC TCP, all of which are also running on the outdated Windows XP platform. The proposed innovation seeks to address these issues by porting the existing Topaz-M and ASK-PKO software, along with all necessary tools, keys and functionality, onto additional PC or desktop computers. This will modernize the data processing capabilities while maintaining compatibility with current systems.