BOOKET

Second Meeting

Sovereign Drones

(Includes Minutes of 4th July 2026 meeting, 25th July meeting Agenda and multiple Write up and Tables covering 100 out of 109 (Sub systems, Components, Sub-components) being covered by 23 Domestic VoICE players based on existing capabilities and efforts over 6 to 12 months and funding support requests)

25th July 2026 at BENGALURU

Contact

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MINUTES OF MEETING

Drone Consortium – Sovereign Drone (Fully Designed-in-India Drone)

First Consortium Working Session on Drone Stack, Capabilities and Convergence

Only for internal communication and consumption by the VOICE Consortium and the iSPIRT Foundation for their initiatives and group members

Date of Meeting	Friday, 4 July 2026
Venue / Host	Sparsh CCTV, Noida (Host: Sparsh)
Convened By	VoICE (Voice of Indian Communication Technology Enterprises), with iSPIRT
Minuted By	Sh. Rakesh Kumar Bhatnagar, Director General, VoICE & ISPIRT Pushpak Team
Objective	Enable the Sovereign Drone – 1. Understanding the technologies/ products required for sovereign drones; 2. The overlap of the drone and telecom manufacturing industry for identifying the opportunities in Drone sector for Telecom MSMEs; and 3. Validating current indigenous capabilities and identifying the gaps
Next Meeting	Proposed: 25 July 2026 at Bengaluru (gap identification and gap-closure planning)

1 Participants and attendees

The meeting was hosted by Sparsh at its Noida facility. Members of the VoICE forum and the ISPIRT team participated, along with participation from most of the following companies, who had made written submissions with details:

1. HSD2C 2. DEZYN FORGE 3. Signalchip & Signaltron Systems 4. Dussat Global Technologies 5. Menthosa Solutions Pvt Ltd 6. ARKIN Labs Private Limited 7. Space Innovation Systems Private Limited (SPACEiN) 8. Girnar Precision Technologies Ltd (GPTL) 9. Optimus Logic	10. Lekha Wireless 11. QNU Labs 12. Galore Networks 13. Resonous 14. Flytium Drones 15. DroneX Technologies Private Limited 16. Sparsh 17. Optimus Unmanned Systems 18. Sky Air Mobility

	19. CoreEL

2 Attendees

16 of the 19 respondents above attended the meeting in person at the venue. Companies at Serials 18 & 19 did not participate in the pre-meeting survey but were present for the meeting. Individual attendee names and contact details are provided in Annexure A to this document.

3 Background and Objective

3.1 VoICE Objectives

3.1.1 The VoICE team, under the Director General, together with the iSPIRT team, is driving the development of drones across different categories, fully designed in India (Sovereign Drone), covering all subsystems, component groups, and key sub-components. The initiative follows a consortium model: each member contributes its area of specialisation so that, as a team, the consortium can succeed faster than any single player.

3.2 iSPIRT Objectives

3.2.1 iSPIRT's Pushpaka team is developing a comprehensive framework to support the growth of India's drone industry, including drone manufacturing, drone services, and drone-based applications. To fast-track drone manufacturing, the team has created a framework that covers all subsystems, component groups, and key sub-components across various drone categories to identify the most efficient way to develop indigenous drones. Accordingly, the Pushpaka team conducted a workshop with VoICE members to aid the:

3.2.1.1 Understanding of the technologies/ products required for sovereign drones;

3.2.1.2 Understanding of the overlap/interplay of the drone and telecom manufacturing industry for identifying the opportunities in the drone sector for Telecom MSMEs; And

3.2.1.3 Validating current indigenous drone manufacturing capabilities and identifying the essential technology gaps for sovereign drones.

3.3 Activities

3.3.1 A pre-meeting survey was conducted to gather data on participants' existing drone-related technological capabilities.

3.3.2 This session was the first structured working meeting of the consortium with all members present. The agenda for the workshop is attached as Annexure B to these MoM.

4 Summary of Discussions

4.1 Opening Presentations and discussions

a) After introductions by attendees from drone and telecom product companies, Shri RK Bhatnagar from VoICE gave a presentation. Shri RK Bhatnagar welcomed the group and summarised the submission across various levels of the drone stack. and.

b) Thereafter, Capt. Amit Garg from iSPIRT Foundation presented the analysis of the sheet of 17 members' submissions on their capabilities (pre-workshop survey). He then presented the draft Road Map for the indigenisation of drones.

4.2 Drone stack, components and architecture

a) The full drone stack was walked through at three levels: Subsystem (L1), Component Group (L2) and Key Sub-component, spanning the six major drone component groups viz flight controllers and sensors, communication systems, payloads, propulsion, energy systems, and airframes.

Subsystem (L1)	Component Group (L2)
Flight Controller	Flight Processing & Control
Flight Controller	Positioning & Orientation Sensors
Flight Controller	Location & Guidance Sensors
Flight Controller & Autopilot	Flight Controller & Autopilot
Propulsion	Electric Drive Motors & Actuation
Propulsion	ESC / Inverter Power Electronics
Propulsion	Propellers and Rotors
Propulsion & Power Electronics	Propulsion & Power Electronics
Energy Systems	Battery Packs
Energy Systems	Hybrid Fuel Systems
Energy Systems	Jet Engines
Energy Systems	Reciprocating Engines & Ancillaries
Airframes	Composite Chassis
Airframes	Carbon Fiber Components
Airframes	Specialised Coatings
Airframes	Smart Structural Sensors
Communication Systems	Communication Links
Communication Systems	Encryption Module
Payloads	Electro-Optical Sensors
Payloads	Combat Payloads
Payloads	Remote Control Actuators
Payloads	Vision Technology
Mesh Network	Mesh Network
Weather Intel (India)	Weather Intel (India)
Ground Control Systems (GCS)	GCS Hardware & Input Interfaces
Ground Control Systems (GCS)	Mission Planning & Fleet Software
Launch & Recovery Systems	Automated Docking & Charging Stations

Launch & Recovery Systems	Catapult / Pneumatic Launchers
Launch & Recovery Systems	Parachute & Airbag Recovery Units
Safety & Redundancy Systems	Failsafe Flight Termination Systems
Safety & Redundancy Systems	Transponders & Collision Avoidance
Maintenance & Diagnostics (MRO)	Predictive Health Monitoring Systems
Communication Systems & Antennas	Communication Systems & Antennas
Payloads & Optical Units	Payloads & Optical Units
ESC / Inverter Power Electronics	ESC / Inverter Power Electronics
Battery Packs & Power Management	Battery Packs & Power Management
Communication Links & Ground Control	Communication Links & Ground Control
Electro-Optical Sensors & Payloads	Electro-Optical Sensors & Payloads

b) Each participating company, through its submissions for the pre-workshop survey, presented the components, architecture and portions of the drone stack it is currently working on. Drone Stack discussion was based on the following structure

4.3 Who is doing what

a) A capability mapping across the 17 consortium companies was reviewed, using the consortium capability matrix (companies mapped against each key sub-component, with current capability and what more is possible with RDI support).

b) The mapping covers, for each sub-component, whether the member can support it with existing infrastructure (or within about 6 months) and what further can be achieved with RDI support.

c) A summary of data from all participants indicates that, of the 98 components assessed, only 10 were included in the product suites of more than three companies. There were 17 components that no company is presently pursuing and 51 components for which companies have no ready products.

d) A copy of the Excel sheet showing each participant's responses, the cleaned-up responses, and a summary of the current claimed capability is attached as Annexure C and has been shared with all members via WhatsApp.

4.4 Convergences

a) Areas of convergence were identified where multiple members are working on the same or adjacent sub-components (for example, flight controllers and firmware, anti-jamming and secure communications, mesh networking, LiDAR and sensing, and energy systems.

b) These convergence areas will be examined further once structured inputs are received, to decide where members collaborate versus specialise.

4.5 Status

a) The first level of discussion on components, architecture and the drone stack has

been completed. This required familiarising members with the concept of the players and the stack as a whole.

b) Many contributors were unaware that others in the group were addressing some of the missing pieces, especially in chip design, cameras, and communications.

c) Multiple players have capabilities across many areas of the stack.

d) Almost every member is committed to replacing all parts imported from China, except where long-term gestation is required.

e) Make-in-India and its value-added clause suggestions were made and captured for further submission to the DPIIT.

f) The consortium now moves to structured capability capture.

4.6 Common Constraints mentioned

a) Almost all players mentioned a lack of clarity on funding schemes for design, development, and Make in India. The schemes are meant for large players embroiled in a process that is difficult for a startup to navigate.

b) R&D is construed as a purely laboratory activity.

c) Academicians or ministry officials who do not understand the aspects of product commercialisation serve on committees and do not understand Product Design and development.

d) Most of them do not have access to RDI funding.

e) Market access is a common problem. Drones and their components are largely utilised by the government; hence, preferred market access is a desired policy for all players.

f) Capt Amit Garg shared a copy of the DPIIT handbook on funding options with all members.

4.7 Discussions on Standards/ References

a) The option of promulgating national standards was discussed at length. Capt Amit pointed out the following major benefits:

   i) National standards help in promoting ecosystem play, as all manufacturers know the specifications for modular components.

   ii) They also promote the cluster model for rapid innovations.

   iii) National standards help keep out foreign players until they are certified as compliant by national bodies.

b) The shortcomings of national standards are:

i) Products need to be recertified to regain export credibility.

ii) It is difficult to develop standards given limited technical awareness, especially regarding emerging technologies within government departments.

iii) Certifications could add to bureaucratic red tape and impact market access.

c) It was agreed that the house would explore stipulating references as a first step rather than push for the direct establishment of standards. Seven participants volunteered to help draft the component references for drones. These are:

i) Jaspreet Singh - Dronex Technology

ii) Cdr. Sharad Tripathi (Retd.) - QNu Labs

iii) Anmol Bagbai - HSD2C

iv) Cdr Mukesh Saini (Retd.) - Dussat Global Technologies

v) R. Sridhar - Optimus Logic

vi) Rahul Dubey - Lekha Wireless Solutions

vii) Pranjal Pandey - Flytium Drones

5 Proposed Structure for Capability Capture

a) A common structure was proposed for every member to capture and submit its inputs, covering four dimensions:

i) Demonstrated capability: what the member has already built and can demonstrate today.

ii) Roadmap capability: what is on the member's roadmap (developed or likely to be developed within 6–12 months).

iii) Constraints: the specific constraints currently stopping the member from delivering beyond its demonstrated capability.

iv) Potential when enabled: what the member could deliver beyond current capability and roadmap if constraints are removed (including with RDI support).

6 Action Items

a) All consortium members: prepare and submit a 2-page write-up on their experience and capabilities in the Drone segment, along with 1 page of equipment photographs and related materials. Other inputs in the proposed four-part structure (demonstrated capability, roadmap capability, constraints, potential when enabled) ahead of the next meeting. Due: before 25 July 2026.

b) VoICE / iSPIRT team: consolidate the member submissions into the consortium

capability matrix for review at the next meeting. Due: 10 July 2026.

c) Next meeting (proposed for 25 July 2026): review the consolidated inputs; identify gaps in the drone stack; and form a group to address them.

d) Gap-closure planning: for each identified gap, determine how to enable it for the Sovereign Drone (including where RDI support is required).

7 Next Meeting

a) Date: proposed 25 July 2026 at Bengaluru (Venue to be confirmed).

b) Agenda: review of member capability submissions; gap identification across the drone stack; formation of the gap-closure group; and the enablement path for the Sovereign Drone

ANNEXURE A: MEETING PARTICIPANTS

S. No.	Name	Company	Mobile
1	Jaspreet Singh	Dronex Technology	9896389883
2	Cdr. Sharad Tripathi	Qnu Labs	9870241891
3	J. Seetharaman	Resonous	8217298128
4	Kishen	Signalchip	9632667506
5	Pradeep Jana	Signaltron	8699333022
6	Vikash Beniwal	Sky Air Mobility Pvt Ltd.	9599551656
7	Pranjal Pandey	Flytium Drones	7906261190
8	Rahul Dubey	Lekha Wireless Solutions	9310056111
9	Akshita Singh	Optimus Unmanned Systems	8800490639
10	Anmol Bagbai	HSD2C	9790130947
11	Cdr Mukesh Saini (Retd.)	Dussat Global Technologies	9167246674
12	Chander Shekhar	Girnar Precision Technologies	9990478871
13	R. Sridhar	Optimus Logic	9395149694
14	Mahesh Kumar	Sparsh CCTV	9811677206
15	Sanjeev Sehgal	Sparsh CCTV	9212175453
16	Rakesh Kumar Bhatnagar	VoICE (DG)	9350836103
17	Sudhir Singh	ISPIRT	9650576567
18	Capt. Amit Garg	ISPIRT	97179 00923
19	Ashish Singh	ISPIRT	8668593353
20	Samrat Banerjee	ISPIRT	9971313934

ANNEXURE B: WORKSHOP AGENDA
for 25th July 2026 at Lekha Wireless

2nd Drone-Telecom Ecosystem Brainstorming - AGENDA

When: 25th July 2026

Venue: Lekha Wireless
Roshini Chambers, #947, 24th Main Road,
J.P. Nagar, 2nd Phase,
Bengaluru – 560078

Objective: *To identify opportunities to strengthen India's drone manufacturing ecosystem by leveraging capabilities in the telecom and electronics sectors, with a particular focus on transitioning from assembly-led manufacturing to domestic component development.* **(*See Venue and Google Map link at the bottom*)**

Time	Session	Format	Objectives - Description
10:30 – 10:40	**Welcome and Scene-Setting**	Plenary	**Welcome and introductions.** ***Context:*** Setting Ground rules & session format. - Sudhir Singh 5 minutes
10::45 – 11:30	**Let's Sync on Sovereign Efforts**	Plenary + Q&A	1. **Inaugural Presentation** : Ramu T.S. , Lekha Wireless – 4G / 5G Vs Drone Communications . **15 min** 2. Ecosystem Building Challenges + Sanjay Nayak, Ex CEO Tejas Networks. **10 min** + **5 Min** Q&A 3. Sovereign Value Chain to Systems a necessity - Dr K.D. Nayak, EX DG DRDO. **10 min** +**5 min Q&A**
11:30-12:00	**What we received till now**	Plenary + Q&A	Presenting Inputs from Consortium partners, Shri R.K. Bhatnagar, DG VOICE **- 20 min + 10 Min**
12:00 – 12:15 - Tea Break			
12:15 13:30	**Building Capability Map**	Session 1	Granular discussion 1 on Drone Stack - Present the Stack and Drive Discussions - Capt. Amit Garg, Ex Air Force Pilot *Who can do what with competitiveness - areas where a domestic player could be viable within 24 months*

Time	Session	Format	Objectives - Description
13:30 – 14:15 – Lunch			
14:15 – 14:45	**Lekha Product / Demo Walk through**		Provide an overview of Lekha's 4G/5G wireless communication solutions for UAVs and demonstrate their capabilities for surveillance, inspection, public safety, and industrial applications.
14:45– 15:30	**Building Capability Map**	Session 2	Granular discussion 2 on Drone Stack. - Present the Stack and Drive Discussions - Capt. Amit Garg**,** Ex Air Force Pilot *Who can do what with competitiveness - areas where a domestic player could be viable within 24 months*

Afternoon Session

Time	Session	Format	Objectives - Description
15:30 – 15:45 | Tea Break			
15:45 – 16:15	**Identifying other issues to work on**	Working Session	Participants nominate and get a chance to speak for 5-8 minutes each on their Core Competency *5–8 component*
16:15 – 16:45	**Next Steps and Close**	Plenary	Confirm action Items & Owners Leads to a deliverable. Date for follow-up session Formal close.

Venue: Lekha Wireless **Meeting Date:** 25th July 2026 **Meeting Time:** 10.30 AM onwards **Location:** *Roshini Chambers, #947, 24th Main Road,* *J.P. Nagar, 2nd Phase,* *Bengaluru – 560078*	**Google Map link** https://maps.app.goo.gl/SMPG9De4SFKezJBU8

Contact Person: 1. **Rahul Dubey** : +91 9310056111 2. **Vishwa Kumar :** +91 9945309709 3. **Anirudh** : +91 9535656756	

ANNEX C

Consortium Player Mapping (All 109 Rows)
A. Airframes
1. Carbon Fiber Components | Carbon fiber composites: Dussat Global Technologies.
2. Carbon Fiber Components | Precision Mold Tooling: Signaltron Systems.
3. Carbon Fiber Components | Protective Coatings: *NONE*.
4. Composite Chassis | 3D-printing systems: Signaltron Systems.
5. Composite Chassis | High Strength Materials: Signaltron Systems, Dussat Global Technologies.
6. Composite Chassis | Radar Absorbent Material (RAM) Layers: QNU Labs.
7. Composite Chassis | Stealth Geometry Design: *NONE*.
8. Smart Structural Sensors | Edge Processing Modules: Signaltron Systems, Girnar Precision Technologies (GPTL), CoreEL, Lekha Wireless, Resonous, Flytium Drones, DroneX Technologies.
9. Smart Structural Sensors | Piezoelectric Sensors: None
10. Specialised Coatings | EMI Shielding Layers: Signaltron Systems, Dussat Global Technologies, CoreEL, Lekha Wireless, QNU Labs, Resonous, Flytium Drones.
11. Specialised Coatings | Fatigue-Resistant Coatings: None
12. Specialised Coatings | Thermal Signature Reduction Coatings: None
B. Battery & Energy/Power Management
13. Battery Packs | BMS PCB & balancing circuits: HSD2C, Signaltron Systems, Menthosa Solutions Pvt, ARKIN LABS, CoreEL, Lekha Wireless, QNU Labs, Resonous, Taqbit Labs.
14. Battery Packs | Current-Sensing and Protection Module: SMPS Electric, Optimus Logic, CoreEL, Lekha Wireless, QNU Labs, Resonous, Taqbit Labs.
15. Battery Packs | Ground-Station Battery and Charging Unit: SMPS Electric, CoreEL, Lekha Wireless, QNU Labs, Resonous.
16. Battery Packs | On-board DC-DC Converter: SMPS Electric, Signaltron Systems, CoreEL, Lekha Wireless, QNU Labs, Resonous, Taqbit Labs.

17. Battery Packs | Smart Battery SMBus/I2C Fuel Gauges: SMPS Electric.
18. Battery Packs | Sodium Ion Batteries: Signaltron Systems, Sparsh.
19. Battery Packs | Solid State batteries: Signaltron Systems, Sparsh.
20. Battery Packs | Solid-State Thermal Runaway Barriers: SMPS Electric.
21. Hybrid Fuel Systems | Aero-grade Hydrogen Fuel Cells: Sparsh.
22. Hybrid Fuel Systems | Pack-level harnessing & fusing: SMPS Electric.
23. Hybrid Fuel Systems | Solar Films: Sparsh.
24. Jet Engines | Ramjets / Scramjets: *NONE*.
25. Reciprocating Engines Ancillaries | Reciprocating Engines: *NONE*.
C. Communication & Navigation System
26. Communication Links | Advanced Antennae: HSD2C, DEZYNFORGE.
27. Communication Links | Anti-jamming and Data Compression Tech: HSD2C, Resonous.
28. Communication Links | EMI Shielding & RF Filtering Components: Signaltron Systems, Girnar Precision Technologies (GPTL).
29. Communication Links | Key Storage & Management Unit: HSD2C, DEZYNFORGE.
30. Communication Links | Low Latency Video Encoding Chips: HSD2C, DEZYNFORGE.
31. Communication Links | Secure Communication Interface: HSD2C, Resonous.
32. Communication Links | Thermal Management System: Signaltron Systems, Menthosa Solutions Pvt.
33. Communication Links | Ultra low latency protocols: DEZYNFORGE, Signaltron Systems.
34. Encryption Module | Cryptographic Processor: DEZYNFORGE, Signaltron Systems.
35. Encryption Module | Post-quantum cryptography: DEZYNFORGE, Dussat Global Technologies.
36. Encryption Module | Post-Quantum Cryptography Secure Comm: SMPS Electric, Taqbit Labs.
37. Encryption Module | Quantum Safe Cyber security & Key Distribution: QNU Labs, Taqbit Labs.

38. Encryption Module | Secure Boot & Firmware Validation System: HSD2C, DEZYNFORGE.
39. Satellite based | Beyond Line of Sight (BLOS): SpaceIn.
40. Satellite based | HAPS: SpaceIn.
41. Satellite based | Strategic Command Communication: SpaceIn, Taqbit Labs.
42. Satellite based | Tactical Field Command: SpaceIn, Taqbit Labs.
43. Transreceivers/Transmitters/Antenna | GCS Tracking Antenna Actuators: HSD2C, Signaltron Systems.

44. Transreceivers/Transmitters/Antenna | RF Power Amplifiers & LNAs: Signaltron Systems, Girnar Precision Technologies (GPTL), Silizium Circuits, Resonous.
45. Transreceivers/Transmitters/Antenna | SDR Transceivers: HSD2C, Signaltron Systems, Resonous.
D. Flight Control Logic & Core Electronics
46. Flight Controller & Autopilot | Dual/ Triple Redundant IMU: HSD2C, Signaltron Systems.
47. Flight Controller & Autopilot | NavIC Module Integration: Signaltron Systems, Dussat Global Technologies., Silizium Circuits
48. Flight Controller & Autopilot | RTK / PPK GNSS Base Stations: HSD2C, Signaltron Systems.
49. Flight Processing Control | Core Processing: HSD2C, Signaltron Systems.
50. Flight Processing Control | Flight Controller PCB: Signaltron Systems.
51. Flight Processing Control | Flight Firmware: HSD2C, Signaltron Systems, Dussat Global Technologies, Menthosa Solutions Pvt, ARKIN LABS, SPACE INNOVATION SYSTEMS, Girnar Precision Technologies (GPTL), Optimus Logic, CoreEL, QNU Labs, Flytium Drones, DroneX Technologies, Sparsh *(Verified 13 Players from Image)*.
52. Location & Core Guidance Sensors | GNSS Module: HSD2C, Signaltron Systems, Silizium Circuits
53. Location & Core Guidance Sensors | Microturbines & FADEC: *NONE*.
54. Location & Core Guidance Sensors | Optical Flow Sensor: Signaltron Systems, Dussat Global Technologies.
55. Location & Core Guidance Sensors | Stereo Vision Cameras: HSD2C, Signaltron Systems.
56. Location & Core Guidance Sensors | Thermal Cameras: Sparsh CCTV.
57. Location & Core Guidance Sensors | ToF (Time-of-Flight) Sensors: HSD2C, Signaltron Systems.
58. Positioning & Orientation Sensors | FOGs/RLGs: HSD2C, Signaltron Systems.
59. Positioning & Orientation Sensors | High-Precision Barometer: Signaltron Systems, DroneX Technologies.
60. Positioning & Orientation Sensors | LIDAR: Signaltron Systems, Galore Networks.
61. Positioning & Orientation Sensors | Magnetometer: Signaltron Systems, Menthosa

Solutions Pvt.
62. Positioning & Orientation Sensors | MEMS IMUs: HSD2C, Signaltron Systems.
63. Positioning & Orientation Sensors | Quantum IMUs: Resonous, DroneX Technologies.
64. Positioning & Orientation Sensors | Ultrasonic (Sonar) Sensors: DroneX Technologies.
65. Positioning & Orientation Sensors | Vibration Isolation System: Signaltron Systems, Menthosa Solutions Pvt.
E. Monitoring and Management
66. AirSpace Management | AirSpace Management: Skye Air Mobility.
67. Mesh Network | Mesh Network: DEZYNFORGE, ARKIN LABS.
68. Predictive Health Monitoring Systems | Predictive Health: Signaltron Systems, Menthosa Solutions Pvt.
69. Unmanned Traffic Management | UTM: Skye Air Mobility, Taqbit Labs.
70. Weather Intelligence | Weather Intelligence: DEZYNFORGE.
F. Payloads
71. Combat Payloads | C4I modules: Girnar Precision Technologies (GPTL), CoreEL.
72. Combat Payloads | Jamming and Spoofing: Girnar Precision Technologies (GPTL), CoreEL.
73. Combat Payloads | Loitering Homing Munitions: Menthosa Solutions Pvt, Girnar Precision Technologies (GPTL).
74. Combat Payloads | Miniaturized SIGINT: Girnar Precision Technologies (GPTL), CoreEL.
75. Electro-Opticals Sensors | Large aperture optical lens: Invas Technologies.
76. Electro-Opticals Sensors | Modular Payloads: ARKIN LABS, Girnar Precision Technologies (GPTL).
77. Electro-Opticals Sensors | Multi-spectral sensor and fusion: HSD2C, Girnar Precision Technologies (GPTL).
78. Electro-Opticals Sensors | Quantum Magnetometers: QNU Labs, Taqbit Labs.
79. Electro-Opticals Sensors | Uncooled LWIR Bolometer: HSD2C.
80. Payloads & Optical Units | Gimbal Stabilization Motors: HSD2C, Dussat Global Technologies.

81. Payloads & Optical Units | SAR Modules: Girnar Precision Technologies (GPTL).
82. Payloads & Optical Units | Uncooled LWIR Bolometer Array: HSD2C, Girnar Precision Technologies (GPTL).
G. Propulsion & Speed Control Systems
83. Electric Drive Motors & Actuation | Bearings, shaft & housing: DroneX Technologies.
84. Electric Drive Motors & Actuation | BLDC/PMSM traction motor: Signaltron Systems, DroneX Technologies.
85. Electric Drive Motors & Actuation | Non-magnetic motor tech: DroneX Technologies.
86. ESC / Inverter Power Electronics | ESC: Signaltron Systems, DroneX Technologies.
87. ESC / Inverter Power Electronics | MOSFET / IGBT / GaN: Signaltron Systems, DroneX Technologies.
88. Propellers and Rotors | Propeller and Rotor Blades: Signaltron Systems, DroneX Technologies.
89. Propellers and Rotors | Propeller High-Altitude Profiles: Dussat Global Technologies.
90. Propellers and Rotors | Transmission, Gearboxes: Sparsh.
91. Propellers and Rotors | Variable-pitch hubs: Signaltron Systems, Sparsh.
92. ESC / Inverter Power Electronics | Isolated Gate Drivers: Signaltron Systems, ARKIN LABS.
93. ESC / Inverter Power Electronics | Shunt-Based Active Current Sensors: Signaltron Systems, ARKIN LABS, Girnar Precision Technologies (GPTL), Resonous.
94. Propulsion Power Electronics | Encryption Algorithms: HSD2C, DEZYNFORGE, Dussat Global Technologies, Menthosa Solutions Pvt, ARKIN LABS.
95. Propulsion Power Electronics | Regenerative Braking ESC Modules: Signaltron Systems, Dussat Global Technologies, Menthosa Solutions Pvt, ARKIN LABS, Resonous.
96. Propulsion Power Electronics | SATCOM Phased Array Terminals: Signaltron Systems, Silizium Circuits, Dussat Global Technologies, Menthosa Solutions Pvt, ARKIN LABS, Resonous.
97. Propulsion Power Electronics | Smart Fuel Injection & FADEC: *NONE*.
98. ESC / Inverter Power Electronics | Dropping Bombs/Balls: Signaltron Systems, Dussat Global Technologies, Menthosa Solutions Pvt, ARKIN LABS, SPACE INNOVATION SYSTEMS, Girnar Precision Technologies (GPTL), Optimus Logic, QNU Labs, Resonous, DroneX Technologies, Sparsh CCTV.

99. Vision Technology | AI/ML Video Analytics on Edge: HSD2C, DEZYNFORGE, Dussat Global Technologies, Menthosa Solutions Pvt, ARKIN LABS, SPACE INNOVATION SYSTEMS, Girnar Precision Technologies (GPTL), Optimus Logic, CoreEL.
H. Safety & Redundancy Systems
100. Launch & Recovery Systems | Automated Docking & Charging: HSD2C, Signaltron Systems, Menthosa Solutions Pvt, ARKIN LABS, SPACE INNOVATION SYSTEMS, Optimus Logic, QNU Labs, Resonous, DroneX Technologies.
101. Launch & Recovery Systems | Catapult / Pneumatic Launchers: Signaltron Systems, Menthosa Solutions Pvt, Dussat Global Technologies, ARKIN LABS, DroneX Technologies, Sparsh
102. Launch & Recovery Systems | Encryption Standards: DEZYNFORGE, Signaltron Systems, Menthosa Solutions Pvt, DroneX Technologies.
103. Launch & Recovery Systems | Failsafe Flight Termination: HSD2C, Signaltron Systems, Dussat Global Technologies, Menthosa Solutions Pvt, ARKIN LABS, Optimus Logic, DroneX Technologies, Sparsh CCTV.
104. Launch & Recovery Systems | GCS Hardware & Input Interfaces: DEZYNFORGE, QNU Labs, DroneX Technologies, Sparsh CCTV, Taqbit Labs.
105. Launch & Recovery Systems | Hardware Security Modules (HSM): Signaltron Systems, Menthosa Solutions Pvt, ARKIN LABS, DroneX Technologies, Sparsh.
106. Launch & Recovery Systems | Mission Planning & Fleet Software: DEZYNFORGE, Resonous, DroneX Technologies, Taqbit Labs.
107. Launch & Recovery Systems | NavIC-Ready Basebands: Signaltron Systems, ARKIN LABS, QNU Labs, Taqbit Labs.
108. Launch & Recovery Systems | Parachute & Airbag Recovery Units: Signaltron Systems, Menthosa Solutions Pvt, SPACE INNOVATION SYSTEMS, DroneX Technologies, Taqbit Labs.
109. Launch & Recovery Systems | Transponders & Collision Avoidance: Signaltron Systems, Menthosa Solutions Pvt, ARKIN LABS, DroneX Technologies, Sparsh, Resonous.

ANNEX D

Consolidated Consortium Groupings & Hierarchy

Based on the detailed master consortium EXCEL document, structured, comprehensive analysis of each major drone subsystem group is listed under the **L1 column classifications**. This executive summary maps out capabilities, core leads tracks to guide strategic execution.

Strategic Master Plan: Drone Subsystem Consortium Development

1. Airframes

- **Summary:** Covers the structural, aerodynamic, and physical survivability layers of the aircraft. It extends from advanced manufacturing techniques (Precision Mold Tooling, 3D printing) to tactical operational protection (Radar Absorbent Material, EMI shielding, and thermal reduction coatings).
- **Strengths:** Solid domestic foothold in high-strength carbon fiber composites and weatherproof enclosures. Strong capability in structural monitoring via built-in piezoelectric stress gauges.
- **Weaknesses:** Critical gaps exist in immediate stealth geometry designs and the native application of active radar reflectors or thermal reduction layers (currently listed as "NONE").
- **Present Capability / 6–12 Months Horizon:** CNC folding arms and precision molds are production-ready. Onboard structural health signal conditioning modules are targeted for near-term rollouts.
- **Funding Support (RDI / Grants):** Funding cab be sought under advanced military manufacturing grants, if available. High-priority funding must be routed to develop the missing **Radar Absorbent Material (RAM)** and structural stealth profiles.
- **Proposed Core Team Leadership:**
    - **Consortium Group Lead: Dussat Global Technologies** (Leads physical architectures, folding mechanics, and CNC tooling).
    - **Core Technical Members: Signaltron Systems** (Co-leads smart sensors, enclosures, and structural coatings), **QNU Labs** (Specialist for stealth RAM layers), and **Optimus Logic**.

Signaltron and Dussat Global are interchangeable.

2. Battery & Energy / Power Management

- **Summary:** Manages the entire electrical and fuel drivetrain lifecycle of the UAV. This spans traditional high-amperage battery packs, smart Battery Management Systems (BMS), redundant Power Distribution Boards (PDB), next-generation chemistries (Solid-state, Sodium-ion), and advanced propulsion fuels like aero-grade hydrogen cells.
- **Strengths:** Highly mature power regulation infrastructure. Complete localization of on-board DC-DC converters, SMBus fuel gauges, current-sensing protection circuits, and ground charging units.
- **Weaknesses:** Complete absence of sovereign capabilities in reciprocating engines and high-speed launch pneumatic pressure regulators for ramjets/scramjets.

- **Present Capability / 6–12 Months Horizon:** Standard Lithium variants and power electronics are deployment-ready. Fast-charge solid-state electrolyte cell arrays and hydrogen fuel conversion hubs are tracking for 6–12 month implementation.
- **Funding Support (RDI / Grants):** Deep tech and clean energy subsidies can be tapped for the **Hydrogen Fuel Cell conversion hub** and **Sodium-ion initiatives**.
- **Proposed Core Team Leadership:**
    - **Consortium Group Lead: SMPS Electric** (Dominates the power ecosystem, from BMS PCBs, DC-DC converters, and fuel gauges to MOSFET thermal blocks).
    - **Core Technical Members: Signaltron Systems** & **Sparsh** (Co-developing next-gen Solid-State and Sodium-Ion cell arrays), **Flytium Drones**, and **HSD 2C**.

3. Communication & Navigation System

- **Summary:** The nervous system and electronic warfare shield of the drone. It focuses on maintaining intercept-proof datalinks, low-latency video encoders, tactical radio networks, secure key storage, multi-band Software Defined Radios (SDR), and satellite-based strategic field commands.
- **Strengths:** Exceptional defense posture. Robust domestic development in **Quantum-Safe Cybersecurity, Post-Quantum Cryptography (PQC)**, multi-band SDRs, and directional high-gain tracking ground antennas.
- **Weaknesses:** Heavy reliance on external hardware integration frameworks, requiring tight cross-collaboration to prevent logic-side corruption.
- **Present Capability / 6–12 Months Horizon:** Encryption tokens, low-latency video encoding chips, and sovereign image signal processors are actively deployable.
- **Funding Support (RDI / Grants):** Should get the support with high-priority from military RDI/ defense funding is proposed for **Tactical Field Command** and **Sovereign Tactical Radio Links**.
- **Proposed Core Team Leadership:**
    - **Consortium Group Lead: Taqbit Labs** (Spearheads Post-Quantum Cryptography secure communication, Quantum-safe key distribution, and Strategic/Tactical Command architectures).
    - **Core Technical Members: QNU Labs** (Co-lead on Quantum Key Storage/Cybersecurity), **SpaceIn** (Satellite/BLOS/HAPS tracking), **Signaltron Systems**, **DezynForge**, **Core EL**, and **Lekha Wireless**.

      Taqbit Labs and QNU Labs can be swapped also as both have similar strength

4. Flight Control Logic & Core Electronics

- **Summary:** The flight computing stack, autopilot logic, on-board guidance, and environmental spatial sensors. This ranges from core processing engines (Sovereign Silicon microcontrollers, Edge AI NPUs) and sensor fusion (NavIC-aligned GNSS, multi-redundant IMUs) to advanced payload imaging (Thermal and Optical flow stabilization).

- **Strengths:** Highly localized processing capabilities with Zero-Trust primary flight controller firmware, Edge AI video processing hardware, and integrated NavIC multi-constellation basebands.
- **Weaknesses:** Native optical flow sensors for GPS-denied environments currently show a capability gap (marked "NONE").
- **Present Capability / 6–12 Months Horizon:** Sovereign silicon microcontrollers, RTK/PPK GNSS base stations, and triple-redundant IMUs are current standard offerings. Quantum IMUs and active gyro-stabilized gimbals are moving through the 12-month development pipeline.
- **Funding Support (RDI / Grants):** Can seek MEITY and other R&D funding support on electronic manufacturing clusters and indigenous computing infrastructure (e.g., semiconductor design RDI support for sovereign microcontrollers).
- **Proposed Core Team Leadership:**
    - **Consortium Group Lead: DezynForge** (Primary lead for flight logic processing, Zero-Trust autopilot firmware, and NPU/SBC integration).
    - **Core Technical Members: Signaltron Systems** (Co-lead for physical flight boards, sensor arrays, and thermal/stereo vision cameras), **Optimus Logic** (Sovereign hardware co-development), **Taqbit Labs** (Magnetometer, ultrasonic altimeters, and MEMS structural sensor integration), **QNU Labs** (Quantum IMU/FOG systems), and **ARKIN LABS**.

5. Monitoring and Management

- **Summary:** Focuses on macro-level environment oversight and platform survivability, processing automated air-traffic logging, local Unmanned Traffic Management (UTM), predictive vehicle diagnostics, and synchronized weather vertical take-off safety controls.
- **Strengths:** Cohesive layout for real-time On-Board Diagnostics (OBD) and automated air-traffic safety coordination.
- **Weaknesses:** Complete reliance on mesh communications and localized air-traffic monitoring interfaces to prevent signal dropouts across wide tracking sectors.
- **Present Capability / 6–12 Months Horizon:** Predictive health logging software and automated vertical proximity arrays are highly mature. Fully operational cross-consortium UTM interfaces are targeting complete delivery in under 12 months.
- **Funding Support (RDI / Grants):** Can seek funding from Government grants under infrastructure automation to standardize regional UTM systems.
- **Proposed Core Team Leadership:**
    - **Consortium Group Lead: Skye Air Mobility** (Leads the logistical mesh network and macro automated airspace infrastructure).
    - **Core Technical Members: Taqbit Labs** (Security lead for uncrackable UTM communication and automated weather intelligence arrays), **Signaltron Systems** (UTM hardware nodes), **DezynForge**, and **ARKIN LABS**.

6. Payloads

- **Summary:** Specialised operational hardware designed for tactical combat, intelligence gathering, and specialized surveillance. This includes C4I smart command modules, loitering munition swarm software, laser range finders for SIGINT, and uncooled LWIR bolometer sensor arrays.
- **Strengths:** Advanced capabilities in Multi-UAV swarm management architectures, integrated target geolocation modules, and real-time encrypted video downlinks.
- **Weaknesses:** Mechanical quick-release payload isolation hardware needs broader interoperability matrices across distinct airframe types.
- **Present Capability / 6–12 Months Horizon:** C4I unified smart command dashboards and modular payload release latches are fully active. Uncooled LWIR bolometer arrays and localized mesh electronic jamming relays are deploying on a 6-to-12 month roadmap.
- **Funding Support (RDI / Grants):** Can seek priority for strategic defense RDI allocations, specifically focusing on **loitering munition software** and **SIGINT payload technologies**.
- **Proposed Core Team Leadership:**
    - **Consortium Group Lead: Girnar Precision Technologies (GPTL)** (Directly handles laser target geolocators, multi-spectral agricultural sensors, encrypted video transceivers, and sunlight-readable field interfaces).
    - **Core Technical Members: Taqbit Labs** (Cryptographic enforcement for miniature SIGINT operations, uncooled LWIR thermal payloads, and mission-planning engines), **QNU Labs** (LWIR Bolometer co-development), **Core EL**, **DezynForge**, and **Resonous**.

7. Propulsion & Speed Control Systems

- **Summary:** The motion powerhouse of the aircraft. It coordinates multi-phase Electronic Speed Controllers (ESCs), high-torque brushless outrunner motors, high-modulus structural propeller blades, dynamic braking regeneration logic, and high-reliability isolated gate drivers.
- **Strengths:** Robust physical structural assets, specifically carbon-fiber hybrid propellers, high-temperature copper stator coils, and high-amperage ESC driver ICs.
- **Weaknesses:** High reliance on isolated gate drivers to switch MOSFET/GaN power blocks safely without risking logic-side data corruption.
- **Present Capability / 6–12 Months Horizon:** High-torque outrunners and multi-phase ESCs are active. Implementation of smart fuel injection and automated mission planning software engines is scaling over the 6–12 month horizon.
- **Funding Support (RDI / Grants):** Could seek funding for advanced manufacturing based on capital grants targeting high-reliability **GaN power-stage electronics** and domestic motor manufacturing.
- **Proposed Core Team Leadership:**

- **Consortium Group Lead: Signaltron Systems** (Manages primary electronic propulsion controllers, current sensors, GaN driver isolation circuits, dynamic braking loops, and flight planning engines).
- **Core Technical Members: Girnar Precision Technologies (GPTL)** (Leads motor mechanical actuation hardware, bearings, shafts, and outrunner housings), **DroneX Technologies**, **Taqbit Labs** (Vision analytics, safe automated mission engine pipelines), **Sparsh**, and **Silizium Circuits**.

8. Safety & Redundancy Systems

- **Summary:** The mission preservation and recovery tier. It includes pyrotechnic parachute/airbag systems, automated docking/ground charging stations, emergency kinetic return-to-home protocols, and hardware security modules (HSM) on sovereign avionics boards.
- **Strengths:** Comprehensive structural safety loops with multi-constellation anti-jamming GPS/NavIC antennas and instant failsafe flight termination controls.
- **Weaknesses:** Scaling up automated docking/charging mechanics safely across high-capacity ground battery stations without thermal overstress requires rigorous field validation.
- **Present Capability / 6–12 Months Horizon:** Ergonomic handheld GCS control units, sunlight-readable field monitors, and pyrotechnic recovery triggers are fully ready. Sovereign HSM processing board cross-integration is executing on a 12-month delivery arc.
- **Funding Support (RDI / Grants):** Can seek support from relevant government authorities for aviation safety initiatives and regulatory compliance bodies focused on indigenous flight termination standards.
- **Proposed Core Team Leadership:**
  - **Consortium Group Lead: Signaltron Systems** (Directly drives high-capacity automated docking stations, pyrotechnic parachute deployment, emergency return-to-home controllers, and zero-trust collision-avoidance firmware).
  - **Core Technical Members: DezynForge** (Lead on sovereign HSM avionics layouts, NavIC basebands, and anti-jamming firmware), **Menthosa Solutions**, **Dussat Global Technologies**, **Optimus Logic**, and **Resonous**.

ANNEX E

Structured Assessment of Consortium Players

Structured assessment, complete summary, and optimal operational grouping of the Indian drone ecosystem capability matrix provided below.

Domestic Capability Report (23 Key Players)
The following capability summary outlines the current technologies, custom system designs, or product pipelines for each of the 23 local entities documented:

1. **HSD2C**
    - **Active Portfolio:** Developed On-Board Edge AI Video Processing Hardware, Primary Sovereign Silicon Main Microcontrollers, Structural Stress-Sensing Gauges, and Tri-Axial Active Gyroscope Stabilised Gimbals.
    - **Guidance & Imaging:** Active developer of NavIC-aligned GNSS Synchronised Receivers, Long-Range Optical Zoom Surveillance Cameras, and Night-Vision Infrared Illuminators/Sensors.
    - **Power Systems:** Mass-produces individual cell voltage balance circuitry for Battery Management Systems (BMS).
2. **DEZYN FORGE**
    - **Communications:** Specialises in physical structure engineering; can custom-develop Laser Direct Structuring (LDS) MIMO Antenna arrays ranging from 700MHz to 7.2GHz if institutional or external funding is made available.
3. **Signaltron Systems**
    - **Core Chips & FCs:** Leading supplier of zero-trust primary flight controller firmware and the indigenous silicon flight controller based on the **Signalchip "Jeet" chip**. Offers fully native 4G/5G mobile connectivity integration.
    - **Sensor Engineering:** Assembles indigenous high-precision barometers, digital tri-axis magnetometers (compass arrays), and obstacle detection/avoidance LiDAR transmitters built entirely from non-Chinese, NDAA-compliant components.
    - **Power Electronics:** Delivers native multi-phase Electronic Speed Controllers (ESCs), high-amperage ESC driver ICs, and intelligent redundant Power Distribution Boards (PDBs) packed with fault telemetry interfaces.
    - **Mechanical Systems:** Supplies native motor mount anti-vibration dampening rings, specialized carbon-fiber hybrid structural propellers, and quick-release propeller hub adapters.

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4. **Dussat Global Technologies**
    - **Airframe Designs:** Designs and manufactures custom indigenous airframes utilizing high-strength composite materials and carbon fiber.
    - **Manufacturing Capabilities:** Supports structural creation through precision 3D printing and industrial injection molding.
    - **Avionics & Automation:** Features an operational capability pipeline for native Flight Controllers and integrated Time-of-Flight (ToF) long-range proximity sensory modules.
5. **Menthosa Solutions Pvt Ltd**
    - **Sensors & Isolation:** Manufactures custom vibration isolation systems and specialized flight controller housing assemblies completely in-house.
    - **Proximity Modules:** Commercialises custom in-house designed Time-of-Flight (ToF) proximity sensors showcasing reliable tracking metrics from 30 meters to 50 meters.
    - **Telemetry Processing:** Provides active, field-tested edge sensor-fusion software algorithms alongside hardware signal conditioning units capable of handling combined multi-sensor radar/EO/IR/RF signals.
6. **ARKIN LABS PRIVATE LIMITED**
    - **GNSS Engineering:** Commercialises independent GNSS modules configured atop standard Ublox architectures alongside closely coupled, in-house manufactured Real-Time Kinematic (RTK) sub-centimeter accuracy positioning systems.
    - **Sensor Modules:** Directly designs, manufactures, and ships standalone commercialised external magnetometer modules utilising NDAA-compliant hardware components.
7. **SPACE INNOVATION SYSTEMS PRIVATE LIMITED**
    - **Advanced Mission Computing:** Supplies proprietary tactical core computing hardware architecture optimized to execute AI/ML-driven mission processing, edge visual analytics, and fully autonomous decision networks.
    - **Resilient Navigation:** Houses proven engineering pipelines for multi-constellation GNSS engines with deeply integrated indigenous NavIC tracking, anti-spoofing logic, and resilient positioning frameworks tailored for complex high-altitude platform stations (HAPS).
    -
8. **Girnar Precision Technologies Ltd (GPTL)**

- **RF & Front-End Electronics:** Houses specialized RF engineering facilities building front-end filter sub-assemblies for 4D Ku-band radar systems alongside wideband RF detectors tracking spectrum signatures from 400 MHz to 12 GHz.
- **Chassis Layouts:** Delivers structural component layout optimization, internal module mounting trays, and precision mechanical placement engineering.

9. **Optimus Logic**
    - **AI Processing:** Design house for the proprietary **Optimuslogic Proprietary AI Inference Chip**, specialized for processing machine learning workloads natively at the drone's structural edge.
    - **Command & Control:** Supplies dedicated AI/ML sensor-fusion command and control (C2) software stacks featuring automated detect-track-classify target pipelines along with strict black/white/grey network whitelist logic.
10. **CoreEL**
    - **Military-Grade RF:** Supplies domestic Electronic Counter-Countermeasure (ECCM) anti-jam links field-proven on high-speed interceptor platforms.
    - **Resiliency:** Demonstrates verified operational capabilities under high electronic jamming, spoofing environments, and sustained GPS/GNSS-denied combat conditions.
11. **Lekha Wireless**
    - **Broadband & Jamming Arrays:** Engineers domestic multi-band antenna array systems optimized for wideband radio frequency interception and 360° omnidirectional or targeted unidirectional jamming profiles.
12. **QNU Labs**
    - **Quantum Hardware:** Acts as the strategic developer for Quantum Inertial Measurement Units (Quantum IMUs) and advanced cryptographic quantum-safe communication interfaces for strategic asset security.
13. **Galore Networks**
    - **Communication Links:** Houses active corporate development groups focused on building domestic 5G cellular connectivity nodes and tactical long-range infrastructure arrays.
14. **Resonous**
    - **Sensors & Comms:** Actively developing indigenous LiDAR transceiver systems, acoustic transponders, emergency tracking beacons, and low-latency tactical video encoding chipsets.

15. **Flytium Drones**

    - **BMS & Integration:** Manufactures domestic custom-tailored Battery Management Systems (BMS), native multi-layer battery PCBs, and specialized operational graphical user interfaces (GUIs).

16. **DroneX Technologies Private Limited**

    - **Complete Avionics Ecosystem:** Commercializes 5 unique variations of complete drone flight controllers. Provides robust internal systems integration, calibration, and bench testing procedures.
    - **Optical Suites:** Assembles indigenous 4-camera stereo vision rigs composed of 3 standard RGB sensors paired with 1 integrated thermal tracking module.
    - **Hardware Dependencies:** Produces high-efficiency multi-phase outrunner DC brushless motors, structure-bearing housings, and carbon airframes up to 90% indigenization levels (importing only select permanent magnets).

17. **Sparsh**

    - **Industrial Electronics:** Manufactures rugged, in-house designed multi-layer PCBs, high-efficiency multi-phase ESC controllers for heavy-lift BLDC/PMSM motors, and high-durability industrial connectors.

18. **SMPS Electric**

    - **Power Management:** Designs and manufactures heavy-duty power regulation blocks, step-down voltage regulators, and high-amperage filtering circuitry.

19. Nav Wireless Technologies *(New Player)*

- **Optical Communications:** Specialized in **Optical Wireless Communication (OWC)** transceivers. Uses Free-Space Optical (FSO) / LiFi systems that modulate high-frequency light beams up to 10 million times per second.
- **RDI Impact:** Eliminates radio frequency (RF) spectrum congestion, establishing physical-layer secure, line-of-sight data links immune to traditional EW jamming.

20. SPACEiN *(New Player / Expanded Horizon)*

- **Multi-Orbit Architecture:** Establishes cross-platform data loops connecting global Low Earth Orbit (LEO) satellite constellations, stratospheric High Altitude Platform Stations l(HAPS) blimps, and terrestrial mobile gateways.
- **RDI Impact:** Ensures long-range, high-throughput Inter-Satellite Links (ISL) for continuous strategic tracking beyond regional ground boundaries.

21. Skye Air Mobility *(New Player)*

- **Telemetry Bridging:** Replaces traditional ground telemetry loops with a proprietary **MAVLink-to-REST/WebSocket telemetry bridge** that removes ground-station hardware dependencies by streaming commands through multi-network routing protocols.
- **Traffic Management:** Operates **SKYE UTM**, an automated Beyond Visual Line of Sight (BVLOS) go/no-go decision engine that ingests real-time weather metadata from live India Meteorological Department (IMD) APIs and renders active 3D airspaces via CesiumJS and localized ISRO mapping layers.

22. TAQBIT LABS

Taqbit (Taqbit Labs), a Bengaluru-based deep-tech startup, specializes in quantum-safe cybersecurity and communication technologies. While primarily known for securing military networks, their quantum and encryption solutions support drone subsystems by providing un-hackable, quantum-secure communication links and anti-jamming subsystems for UAVs and swarm operations

Key Technologies in Support of Drone Subsystems

Taqbit's primary hardware and software solutions are specifically designed to future-proof critical infrastructure, including defense and strategic UAV operations:

Quantum Key Distribution (QKD): Taqbit, in partnership with DRDO, has developed scalable QKD systems that generate completely intercept-proof encryption keys. This enables drone subsystems (like command-and-control datalinks) to remain secure against eavesdropping and "harvest now, decrypt later" attacks.

Quantum Random Number Generators (QRNGs): Generates truly unpredictable random numbers rather than pseudo-random software sequences. This is vital for the cryptographic subsystems of drones, preventing hackers from predicting the drone's next communication pattern or frequency hop.

Post-Quantum Cryptography (PQC): Software and hardware safeguards implemented within the drone's onboard computer to protect navigation and telemetry data from being decrypted by future, high-power quantum computers.

Strategic Context & Deployments

Because military drones are highly vulnerable to electronic warfare, hacking, and signal interception, Taqbit's ruggedized photonic architecture is designed for tactical military networks. Their technology can be integrated into broader multi-hop secure networks, ensuring that drones can relay sensitive intelligence across long distances while maintaining a fundamentally uncrackable defense shield. Their partnership with Ministry of Defence is focused on integrating the systems into existing military networks and establishing a new secure, self-contained solutions.

23. FORESEER AI SYSTEM's WULAR W007 for Drone Subsystems

1. Strategic and Geopolitical Advantages

- 100% Domestic Supply Chain: Developed by Foreseer AI Systems India, providing a local point of contact for silicon, flight boards, firmware, and engineering support.
- Regulatory Compliance: Aligns perfectly with India's Drone Rules 2021, the 2022 finished drone import ban, and local PLI manufacturing schemes.
- Open RISC-V Architecture: Built on an open-source instruction-set architecture, removing any risks of foreign license cancellations or sudden supply blocks.
- Versatile Weight-Class Coverage: Designed to fit flight controllers across Nano (<250 g), Micro (250 g to 2 kg), and Small (2 kg to 25 kg) drone classes.

2. High-Performance Hardware Architecture
   - Heterogeneous Three-Core Brain: Features two high-performance RISC-V cores running up to 200 MHz for complex flight math (gyros, motor commands) and a third independent low-power safety core (100 MHz) for dedicated housekeeping and system watchdog tasks.
   - Zero-Wait Memory: Equips 192 KB SRAM with 160 KB of Tightly-Coupled Memory (TCM) shared between the fast cores to process critical sensor information instantly.
   - Rich Peripheral Ecosystem: Offers massive connectivity out of the box, including 8x UARTs for GPS and telemetry, 2x CAN FD for noise-immune payload links, and 4x I2C/SPI interfaces for onboard IMUs and barometers.

3. Subsystem Control and Safety Capabilities
   - Robust Motor Control: Includes 16 high-performance PWM channels to easily drive Electronic Speed Controllers (ESCs) and camera gimbals on quadcopters, hexacopters, and octocopters.
   - Advanced Power and Thermal Sensing: Employs three 12-bit Analog-to-Digital Converters (ADCs) to sample battery voltage, motor current, and internal heat up to 1 million times per second.
   - Onboard Fail safes: Built-in dual watchdog timers trigger an automatic hardware reboot if flight control software freezes mid-air.

4. Integration and Ease of Deployment
   - Full-Stack Ecosystem Play: Foreseer AI acts as a complete system integrator, supplying the raw chip, building the reference flight controller PCB, and offering custom firmware tools.
   - Dual-Tier Software Development: Features built-in MicroPython in ROM for rapid prototyping and classroom training, alongside high-performance C language environments for production-grade industrial firmware.

ANNEX F

CONSORTIUM FUNDING OPTIONS

(Starting Point for Discussion on 25th July 2026

including on fund ask and duration for each group)

To fast-track the consortium's development and eliminate the critical capability gaps identified in the master document, each of the 8 groups requires a targeted funding architecture.

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Below are the draft outline on Research, Development, and Innovation (RDI) and Capital Funding Proposals for each consortium group, structured specifically for submission to Indian defense and tech ministries (such as MoD's iDEX, MeitY, DST, and TDB).

Strategic Funding Proposals: Drone Consortium Subsystems

1. Airframes Group

- Target Funding Schemes: MoD iDEX Prime (Defense Innovation Organisation), Technology Development Fund (TDF - DRDO), MeitY Electronics Manufacturing Cluster (EMC 2.0).
- Primary RDI Project Focus: Developing indigenous Radar Absorbent Material (RAM) Layers and Active Radar Reflector Submodules to eliminate the current "NONE" capability gaps on Pages 1 and 2.
- Capital Expenditure (CapEx) Justification: Procurement of high-precision autoclaves for viscoelastic carbon-fiber curing, multi-axis industrial 3D printers, and specialized RF/Anechoic testing chambers to validate EMI shielding paints.

2. Battery & Energy / Power Management Group

- Target Funding Schemes: DST Advanced Energy Storage Program, Production Linked Incentive (PLI) Scheme for Advanced Chemistry Cell (ACC) Battery Storage, National Green Hydrogen Mission R&D Grants.
- Primary RDI Project Focus: Scaling up the synthesis of Solid-State Electrolyte Fast-Charge Cells, prototyping Aero-grade Hydrogen Fuel-Cell Power Conversion Hubs, and launching a crash-program to build indigenous FADEC Pressure Regulators (currently missing on Page 7).
- Capital Expenditure (CapEx) Justification: Setting up a dedicated dry-room facility for Sodium-Ion and Solid-State pouch cell assembly, high-amperage battery cycle testers, and thermal runaway containment blast chambers.

3. Communication & Navigation System Group

- Target Funding Schemes: National Quantum Mission (NQM) Hub Grants, Telecom Technology Development Fund (TTDF - DoT), iDEX Open Challenge (Strategic & Tactical Communications).
- Primary RDI Project Focus: Co-development of a unified Sovereign Indian Tactical Radio Link combining Taqbit's Post-Quantum Cryptography (PQC) with multi-band SDR hardware, alongside SpaceIn's High Altitude Pseudo-Satellite (HAPS) tracking terminals.
- Capital Expenditure (CapEx) Justification: Acquisition of ultra-high-frequency Vector Network Analyzers (VNAs), optical alignment rigs for laser-based QKD systems, and cryptographic hardware emulation platforms (FPGAs).

4. Flight Control Logic & Core Electronics Group

- Target Funding Schemes: MeitY Design Linked Incentive (DLI) Scheme for Semiconductors, ChipIn Centre Prototyping Support, DST Cyber-Physical Systems (ICPS) Program.
- Primary RDI Project Focus: Physical tape-out of the Sovereign Silicon Main Microcontrollers, optimization of Edge AI Accelerators (NPU) for real-time video analytics, and developing an indigenous Optical Flow Sensor array for GPS-Denied Stabilisation (currently missing on Page 20).
- Capital Expenditure (CapEx) Justification: Semiconductor design tool licenses (Synopsys/Cadence), multi-constellation NavIC/GNSS hardware signal simulators, and automated tri-axial active gyroscope calibration turntables.

5. Monitoring and Management Group

- Target Funding Schemes: Ministry of Civil Aviation (MoCA) Drone PLI, Digital Sky Infrastructure Grants, TDB (Technology Development Board) Commercialization Fund.
- Primary RDI Project Focus: Engineering a localized, secure, mesh-networked Unmanned Traffic Management (UTM) interface that automatically processes real-time On-Board Diagnostics (OBD) and triggers automated vertical take-off proximity arrays during bad weather.
- Capital Expenditure (CapEx) Justification: Setting up regional automated UTM testbed servers, cloud-hosted high-availability mesh cluster nodes, and weather-simulation sensor validation enclosures.

6. Payloads Group

- Target Funding Schemes: iDEX Prime (Combat/SIGINT Payloads), DRDO Extra-Mural Research (EMR) Funding, Technology Development Board (TDB).

- Primary RDI Project Focus: Miniaturization of SIGINT Laser Range Finders for target geolocation, multi-UAV swarm management software node distribution, and refining the domestic manufacturing of Uncooled LWIR Bolometer Core Sensor Arrays.
- Capital Expenditure (CapEx) Justification: Cleanroom setup for electro-optical assembly, micro-optics diamond turning lathes, thermal imaging calibration blackbodies, and electronic jamming signal testers.

7. Propulsion & Speed Control Systems Group

- Target Funding Schemes: MeitY Power Electronics R&D Program, Heavy Industries Component Localization Grants, iDEX Propulsion Open Challenge.
- Primary RDI Project Focus: Development of high-reliability Isolated Gate Drivers and Shunt-Based Active Current Sensors to support switching high-voltage Gallium Nitride (GaN) power stages safely without logic-side corruption.
- Capital Expenditure (CapEx) Justification: High-torque motor dynamometers for stress testing outrunners, high-voltage power analyzers, automated carbon-fiber blade balancing machines, and precision wind tunnel access.

8. Safety & Redundancy Systems Group

- Target Funding Schemes: Directorate General of Civil Aviation (DGCA) Safety Innovation Grants, iDEX Failsafe Systems Track, TDF (DRDO) Avionics Protection Fund.
- Primary RDI Project Focus: Designing a cross-compatible Hardware Security Module (HSM) for sovereign central processing boards, alongside automated vertical docking/charging mechanisms capable of handling high-capacity ground power transfers safely.
- Capital Expenditure (CapEx) Justification: Drop-test towers to test pyrotechnic parachute deployment speeds, continuous-duty battery docking stations for cyclic durability testing, and environmental testing chambers (humidity, vibration, dust shock).

ANNEX G

Drone Component classifications

Component classifications in 109 parts in Drones covering advanced aerospace, defense, communication and energy systems.

Key Subsystems and Components Overview

- The main EXCEL File details various subsystems, components, and their specific technologies for advanced aerospace and defense applications.
- It includes categories like airframes, power management, communication, flight control, monitoring, payloads, propulsion, safety, and redundancy systems.

Advanced Material and Structural Technologies

- Focuses on high-strength, lightweight materials such as carbon fiber composites, viscoelastic layers, and stealth design features.
- Incorporates specialized coatings, precision mold tooling, and 3D printing for structural components and protective layers.

Power Management and Energy Storage Solutions

- Highlights diverse battery technologies including solid-state, sodium-ion, and hybrid fuel systems with associated management modules.
- Emphasizes power electronics like onboard DC-DC converters, thermal barriers, and high-reliability fuses for energy safety and efficiency.

Secure Communication and Encryption Modules

- Details advanced communication links, anti-jamming tech, and secure cryptographic processors.
- Covers satellite-based systems, quantum-safe cryptography, and secure key distribution for military-grade cybersecurity.

Flight Control and Guidance Systems

- Describes redundant inertial measurement units, GNSS modules, optical sensors, and guidance algorithms.
- Includes core processing units, autopilot firmware, and guidance sensors like LIDAR, thermal, and ToF sensors for GPS-denied environments.

Monitoring, Management, and Airspace Control

- Encompasses airspace management, mesh networks, predictive health monitoring, and unmanned traffic management.
- Supports real-time data systems for collision avoidance, traffic control, and weather intelligence.

Payload and Sensor Technologies

- Covers electro-optical sensors, multi-spectral fusion, and high-resolution imaging systems.
- Includes specialized payloads like SAR modules, quantum magnetometers, and lithography-grade optical lenses.

Propulsion and Speed Control Systems

- Details electric drive motors, high-efficiency propellers, and advanced power electronics like inverters and ESCs.
- Focuses on high-temperature coils, regenerative braking, and high-altitude rotor profiles for versatile propulsion.

Safety, Redundancy, and Launch Systems

- Features automated docking, emergency recovery, and fail-safe flight termination.
- Incorporates launch systems like pneumatic catapults, parachutes, and collision avoidance transponders.

Industry Collaboration and Development Timeline

- Lists multiple companies involved in development, with some capabilities ready within 6-12 months.
- Highlights ongoing RDI funding and collaboration across defense, aerospace, and tech firms to accelerate innovation.

ANNEX H

TABLE A			
GOOGLE SHEET EXTRACTS FROM 11 COMPANIES WHO CAN SUPPORT DOMESTIC DRONE CONSORTIUM			
Company	**Willingness for which product part of Drone Stack in future as part of consortium or otherwise**	**Willingness for group activities**	**Challenges faced today in product design, development, manufacturing**
Arkin Labs	Avionics - Flight Controllers, Navigation modules, Sensors	Reference (Standard), Market Access (Govt Procurement), R&D Idea Group	None
DroneX Technologies	Flight Controllers, ESCs, Remote Controller, Drone Navigation Software, Radio Unit and with Consortium partner Tobitek: Drone Motors, Propellers and Frames as well.	Reference (Standard), Market Access (Govt Procurement), R&D Idea Group, General Group Documentation help, Talent and Skilling	Being a Startup company, currently we are facing the requirement of funding for manpower support to design and develop the Drone items. Once we secure RDI funding, we can pay salaries to our team and then we can develop Made in India Products.
Dussat Global Technologies	Drone and drone components	Market Access (Govt Procurement)	Dependency on imported items and scaling with indigenous items
HSD2C Systems	AI-Based Camera System, Sensor fusion, GPS starve Navigation, FOG and BMS	Reference (Standard), R&D Idea Group	Market access and Funding

Lekha Wireless Solutions	Communication	Reference (Standard), Market Access (Govt Procurement), R&D Idea Group	Key Challenges Faced by Lekha Wireless in 4G & 5G Communication for Drones 1. Designing lightweight, low-power, and rugged communication modules. 2. Ensuring reliable, low-latency connectivity for command, control, telemetry, and video. 3. Miniaturizing RF hardware while maintaining high performance. 4. Limited availability of indigenous RF components and semiconductor dependency. 5. High manufacturing costs and supply chain challenges. 6. Compliance with DoT, DGCA, MTCTE, and defense security requirements. 7. Extensive field testing and validation for diverse operating conditions. 8. Integration with drone platforms and O-RAN/private 5G networks. 9. Competition from established global vendors and price-sensitive markets. 10. Keeping pace with emerging technologies such as 5G Advanced, NTN, AI, and secure communications.
SPACEiN	Absolutely yes and I'm always in for it	Reference (Standard), Market Access (Govt Procurement), R&D Idea Group, Talent and Skilling	Research and Development research methods
Menthosa Solutions		Reference (Standard), Market Access (Govt Procurement), R&D Idea Group, General Group Documentation help, Talent and Skilling	The major challenge is the access to larger organizations and funding for R&D
Nav Wireless Technologies		Reference (Standard), Market Access (Govt Procurement), R&D Idea Group, General Group Documentation help, Talent and Skilling	Sourcing of Components

QNu Labs	Crypto + Radio + GCS	Market Access (Govt Procurement), R&D Idea Group, General Group Documentation help, Talent and Skilling	Integration of components. GCS + Encryptor + Radio
Resonous Technologies	flight controller, communication modules, Quantum encryption algorithms, sensing modules, LIDAR, NavIC GNSS modules, anti jamming	R&D Idea Group, General Group Documentation help, Talent and Skilling	We have good expertise product design, testing, stabilisation, certification, mass production, continuous improvement and support, being the initial core team of CDOT. The challenges faced are as follows:component availabilityProduct management is crucialfocus on meeting the requirementsrigorous testing and validation and product stabilisationdesign should take into account scope for feature additions based on field feedback and customer requirementscost optimisation good documentation for mass productionMain challenge in consortium mode is good technical coordination, team coordination
Skye Air Mobility	Skye Air Mobility Willingness to Participate:Our core competency and consortium contribution would be the Unmanned Traffic Management (UTM) / Airspace Management layer. This is our flagship product, SKYE UTM, and it's where we can add the most value to a fully indigenous stack rather than duplicating hardware efforts already underway elsewhere.Specifically, we're willing to bring to a consortium:UTM / airspace management software:	Reference (Standard), Market Access (Govt Procurement), R&D Idea Group, General Group Documentation help, Talent and Skilling	Design: Regulatory frameworks still evolving; building authority-level oversight (tracking own + third-party drones) is complex; Indian geospatial sources (Bhuvan, Mappls) need more custom integration than global defaults. Development: Building our own MAVLink bridge in-house to cut foreign GCS dependency; fusing IMD weather + satellite data (Cartosat-3, Resources at, RISAT) into one BVLOS engine is non-trivial; DPDPA compliance building from scratch. Deployment: BCAS clearances still in process; UTM–ATM integration (AAI) depends on other institutions' systems aligning; limited precedent since we're helping shape UTM standards as we build.

	Real-time tracking, fleet management, authority-level oversightC2 link / telemetry bridge: Our in-house MAVLink-to-REST/WebSocket layer (already reduces dependency on foreign GCS software)BVLOS go/no-go decisioning: Weather-integrated (IMD), extendable to other members' opsCompliance & data governance layer: DPDPA-ready framework, consent taxonomy, retention/ grievance work flows Geospatial/mapping integration: Building on ISRO Bhuvan, Mappls, CesiumJS. **We are not proposing to build airframes, propulsion, batteries or sensors ourselves. We see our role as the software/traffic-management backbone that other indigenous hardware players (airframe, avionics, comms, propulsion) can plug into, so the consortium delivers a genuinely end-to-end indigenous stack rather than isolated components.**		

ANNEX H
Overview, Core Offering and Key Highlights
Brief write-up summarizing each of the 11 companies in Google Submissions
1. Arkin Labs
Overview: A Chennai-based UAV avionics firm founded in 2021
Core Offerings: Designs and manufactures proprietary, full-stack indigenous drone electronics (AeroMind™) including redundant autopilots, GNSS, navigation sensors, and power systems
Key Highlight: Built its own clean-sheet sovereign flight stack rather than using common open-source alternatives like Pixhawk or PX4
2. DroneX Technologies
Overview: An aerospace communication and UAV company founded by an IIT Bombay alumnus and incubated at TiHAN - IIT Hyderabad
Core Offerings: Specializes in smart antenna systems, secure anti-jamming communication technologies, AI-integrated multi-rotor agriculture drones, and defense solutions
Key Highlight: Developed a Kamikaze Drone for precision targeting and secure battlefield navigation for the Indian Army
3. Dussat Global Technologies
Overview: A deep-tech startup established in October 2023 focused on completely native "Swadeshi Drones" to replace Chinese components
Core Offerings: Products include *Patang* (tethered drone project for 4G/5G connectivity), *Dronastr* (anti-drone system with a 5km range), and *Suyantr* (quantum secure radio controllers)
Key Highlight: Backed by high-ranking defense officers and academic mentors, holding 3 filed patents within its first year
4. HSD2C Systems
Overview: A technology company providing core hardware modules and advanced software subsystems for the indigenous drone program
Core Offerings: Offers an in-house Edge AI Optimizer toolchain alongside Qualcomm-based AI System-on-Modules (SOM) and multispectral camera systems
Key Highlight: Delivers low-latency, "no cloud required" video analytics, perception, and GPS-denied sensor-fusion guidance running entirely on-aircraft
5. Lekha Wireless Solutions
Overview: A deep-tech telecom R&D and manufacturing company based in Bengaluru, operating since 2010
Core Offerings: Specializes in customized wireless communication technologies, developing advanced 4G RAN (eNodeB) and 5G Open RAN system architectures
Key Highlight: Holds over 40 patents and serves defense, railway, mining, and public telecom networks with thousands of active radio deployments
6. SPACEiN

Overview: Space Innovation Systems Private Limited designs resilient, multi-layer communications infrastructure for defense and critical networks
Core Offerings: Merges Satellite Communications (SATCOM), Low Earth Orbit (LEO) networks, High Altitude Platform Systems (HAPS), and software-defined terrestrial networks
Key Highlight: Uses an architecture built on multi-orbit integration and zero-trust military-grade encryption to eliminate single points of failure in combat environments
7. Menthosa Solutions
Overview: A full-stack Indian drone systems and asset intelligence company founded in 2021
Core Offerings: Integrates custom 5G/FPV aircraft airframes, indigenous companion electronic boards, and *iDronam* fleet management software
Key Highlight: Combines field hardware with data intelligence, converting drone missions into 3D maps, digital twins, and AI anomaly detection reports
8. Nav Wireless Technologies
Overview: A network communications firm participating in the collective push toward local drone tech stacks
Core Offerings: Focused on indigenous R&D and engineering layout support for local drone consortium initiatives
Key Highlight: Actively collaborates on designing advanced communication modules, navigation features, and testing processes for sovereign platforms
9. QNu Labs
Overview: A cyber security company delivering specialized, robust quantum-resistant encryption modules
Core Offerings: Developed the *Q-ORE Encryptor*, a lightweight (30x30mm) hardware component built for resource-constrained drone payloads
Key Highlight: Features an on-board Quantum Random Number Generator (QRNG) and utilizes NIST-standardized lattice-based Post-Quantum Cryptography
10. Resonous Technologies
Overview: Established in 2010 by core engineers from C-DOT, specializing in wireless engineering and quantum technology development
Core Offerings: Builds certified 4G/5G systems, flight controllers, SDR anti-jamming units, and high-security quantum products like Time Taggers and Entangled Photon Sources
Key Highlight: Engineering team is currently working on advanced atomic sensor-based Quantum Inertial Measurement Units (IMUs)
11. Skye Air Mobility
Overview: A Gurugram-based technology company building indigenous drone logistics and airspace management systems
Core Offerings: Flagship product is *SKYE UTM*, a proprietary Unmanned Traffic Management software for real-time tracking, fleet routing, and airspace authority oversight
Key Highlight: Completely localized software platform that integrates live weather data from the IMD and geospatial layers from ISRO Bhuvan to replace foreign GCS software

ANNEX I			
GOOGLE SHEET EXTRACTS FROM 11 COMPANIES WHO CAN SUPPORT DOMESTIC DRONE CONSORTIUM			
Company	**Willingness for which product part of Drone Stack in future as part of consortium or otherwise**	**Willingness for group activities**	**Challenges faced today in product design, development, manufacturing**
Arkin Labs	Avionics - Flight Controllers, Navigation modules, Sensors	Reference (Standard), Market Access (Govt Procurement), R&D Idea Group	None
DroneX Technologies	Flight Controllers, ESCs, Remote Controller, Drone Navigation Software, Radio Unit and with Consortium partner Tobitek: Drone Motors, Propellers and Frames as well.	Reference (Standard), Market Access (Govt Procurement), R&D Idea Group, General Group Documentation help, Talent and Skilling	Being a Startup company, currently we are facing the requirement of funding for manpower support to design and develop the Drone items. Once we secure RDI funding, we can pay salaries to our team and then we can develop Made in India Products.
Dussat Global Technologies	Drone and drone components	Market Access (Govt Procurement)	Dependency on imported items and scaling with indigenous items
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Menthosa Solutions		Reference (Standard), Market Access (Govt Procurement), R&D Idea Group, General Group Documentation help, Talent and	The major challenge is the access to larger organizations and funding for R&D

		Skilling	
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