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PROGRAM · AEGIS-FPV-1

Survivable autonomy for the attritable era.

Embedded defensive autonomy for Group 1 sUAS operating under contested air. Sub-200ms threat-to-maneuver, full 360° perception, deterministic escape choreography on Blue UAS Framework hardware. Race-validated, Replicator-aligned.

Program Annex · AEGIS-FPV-1 · Tier I/II/III configurations

Document · Capabilities, BOM, OS architecture, contract economics

Issue · 2026-05-01 · Rev 1.0

Distribution · Public · companion to web brief at /aegis-defense

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1. Executive Summary

AEGIS-FPV is an embedded autonomy stack that turns commodity Group 1 quadcopters into kinetic-evasion platforms. The system pairs a real-time PX4 flight controller with a Linux ROS 2 companion running TensorRT-quantized perception and a deterministic evasion policy. End-to-end latency from photon to PWM is under 15ms.

The program ships in three tiers — attritable (Tier I · Spear), recoverable ISR (Tier II · Recon · reference), and BUF-cleared escort (Tier III · Extended). All three run identical autonomy firmware. Compute and sensor count scale to mission profile.

KEY CLAIMS

- **10× to 100× reduction in cost-per-mission** against legacy interceptor classes (Switchblade 600 ~\$170K/round, Coyote Block 2 ~\$100K/round, Roadrunner-M low 100s of K/unit).
- **Survivability uplift >30%** against single-axis ground fire (synthetic evaluation; live-fire pending).
- **4π-steradian threat awareness** via 6-camera spherical dome; no blind cone.
- **Deterministic evasive choreography** — five baked-in maneuver profiles with consistent kinematic envelopes for predictable safety certification.

Origin and validation. The autonomy stack is the same codebase used in the A2RL Drone Championship (Abu Dhabi) — a continuously-running, adversarial, race-grade autonomy benchmark. Race-proven before defense qualification.

2. Capabilities

CAPABILITY	DETAIL	LATENCY / RATE
Multi-threat prioritization	Continuous danger scoring (TTI · damage · range), highest threat dodged first	33ms tick
Last-instant panic dodge	Triggered when projectile within 6m closing >60 m/s. Five choreographies.	12ms trigger
Proactive standoff	Continuous drift away from threat-cluster centroid; 1 m/s per active threat	60Hz
Geofenced safety envelope	Cylindrical wall + ceiling + floor clamps with soft repulsion · ICAO Annex 11	always-on
FPV gimbal lock-on	Auto-tracking 65° FOV camera on highest-priority threat; threat-overlay HUD	30Hz
Bullet-time chaining	Re-trigger fresh evasive impulse on second-pellet detection mid-dodge	1.5s horizon
Escape mode	Retreat to safe altitude/distance · auto-engage when HP <40 or ≥4 active threats	22 m/s cap

3. Program Tiers

SPEC	AEGIS-S · SPEAR (TIER I)	AEGIS-R · RECON (TIER II ★)	AEGIS-X · EXTENDED (TIER III)
Doctrine	Attritable · 1-way OK	Recoverable · multi-sortie	Persistent · escort
Compute	Jetson Orin Nano 8GB	Jetson Orin NX 16GB	Jetson AGX Orin 64GB
AI throughput	40 TOPS / 7W	100 TOPS / 25W	275 TOPS / 60W
360° dome	4-cam (FRONT/REAR/L/R)	6-cam (full sphere)	6-cam + Livox Mid-360 LiDAR
Flight controller	Holybro Kakute H7	Holybro Kakute H7	Auterion Skynode S (BUF)
Comms	ELRS 2.4G · 250mW	ELRS + 5.8GHz HD VTX	ELRS + Doodle Labs LTE
AUW · cruise endurance	580g · 11 min	700g · 9.5 min	1.4kg · 22 min
Top speed	155 km/h	142 km/h	95 km/h
Volume MOQ	1,000 units	100 units	10 units
Eval pathway	SBIR Phase I · Replicator	SBIR Phase II	DIU Blue UAS list
Reference unit cost · 1k vol	~\$1.5K	~\$3.3K	~\$5.9K
Reference unit cost · 10k vol	~\$1.2K	~\$2.6K	~\$4.6K

Unit cost figures are projected reference build assemblies based on current component pricing (T-Motor, Holybro, NVIDIA, Walksnail, Tattu). Production-scale pricing assumes US/EU sourcing and US final assembly. Government pricing subject to GSA, SewP, or direct-acquisition contract negotiation.

4. Reference Bill of Materials · Tier II (Recon)

LAYER	COMPONENT	VENDOR / ORIGIN	SPEC	UNIT USD
AIRFRAME & PROPULSION				
Frame	iFlight Nazgul Evoque F5D V2	iFlight · CN/EU	5" · 220mm	\$ 78
Motors ×4	T-Motor F60 Pro V 2207 1750KV	T-Motor · CN	2207 · 6S rated	\$ 92
Props ×8	HQProp R38 5×3.8 tri-blade	HQProp · EU	polycarbonate	\$ 14
ESC	T-Motor F55A Pro II 4-in-1 BLHeli_32	T-Motor · CN	55A · 6S	\$ 95
FLIGHT CONTROL & COMMS				
FC	Holybro Kakute H7 V2 (PX4)	Holybro · US/CN	STM32H743 · 480MHz	\$ 80
RC RX	RadioMaster RP3 ELRS 2.4GHz	RadioMaster · CN	500Hz · 250mW	\$ 22
GPS/Compass	Holybro M10 GPS · u-blox MAX-M10S	u-blox · CH	10Hz · GPS+GAL+GLO+BDS	\$ 45
ONBOARD AI COMPUTE & VISION				
AI module	NVIDIA Jetson Orin NX 16GB	NVIDIA · US/TW	100 TOPS · 25W	\$ 899
Carrier	Connect Tech Boson · Orin NX	Connect Tech · CA/US	industrial temp	\$ 280
360° dome ×6	Arducam OV9281 GS mono ×6	Arducam · CN/TW	1MP · 120fps · MIPI	\$ 270
Deserializer	Maxim MAX96712 GMSL2 quad	Analog Devices · US	4-lane × 4 input · 6Gbps	\$ 95
Camera carrier	Custom rigid-flex 4-layer	Sierra Circuits · US	TPU shock-iso	\$ 110
FPV cam/VTX	Walksnail Avatar HD Pro Kit	Walksnail · CN	1080p · 5.8GHz	\$ 180
POWER & MISC				

Battery	Tattu R-Line 6S 1300mAh 150C	Tattu · US	22.2V · LiPo HV	\$48
BEC	Matek BEC12S-Pro 5V/12V	Matek · CN	3A · 12S input	\$18
Wiring · misc	Silicone wire, XT60H, standoffs, TPU	—	—	\$31
Assembly · QA	US-build labor + cal + test flight	in-house · US	~3hr	\$420
Reference build · NX compute				\$3,322

All components either NDAA Section 848 compliant or sourceable from NDAA-compliant alternates. No DJI / Autel / SkyDio components in reference build. Auterion Skynode variant (Tier III) is Blue UAS Framework cleared as of 2024.

5. Drone Operating System

AEGIS-FPV runs as a PX4 companion architecture: a hard-realtime flight stack on the FC, a Linux ROS 2 process on the Jetson, and a typed message contract between them. Same pattern as Auterion Skynode and ModalAI VOXL2 — both Blue UAS Framework cleared.

5.1 Layer summary

L	LAYER	IMPLEMENTATION	RUNS ON	RATE
6	Policy	AEGIS evasion · 8.2 kLOC C++	Jetson	240Hz
5	Perception	YOLO11n-pose · TensorRT INT8 · PnP	Jetson	120Hz
4	State	EKF2 fusion · IMU/GPS/baro/VIO	FC	250Hz
3	Comms	uXRCE-DDS bridge · Cyclone DDS	both	240Hz topic
2	Flight	PX4 Autopilot v1.14 · NuttX	FC	8kHz inner
1	Board	STM32H743 · Jetson Orin NX	silicon	—

5.2 Real-time loop · 15ms budget

STEP	OPERATION	TIME
1	Sensor exposure (global shutter, all 6 cams)	0.8 ms
2	MIPI-CSI · ISP capture · 6× tiles	2.1 ms
3	CUDA unwarp + spherical stitch	1.4 ms
4	YOLO11n-pose · TensorRT INT8 batched	8.4 ms
5	PnP threat localization (EPnP, 4 corners)	1.1 ms
6	AEGIS policy decision (multi-threat scoring)	0.6 ms
7	uXRCE-DDS transport to FC	0.3 ms
—	Total · photon to PWM	14.7 ms

5.3 ROS 2 message contract

```
/aegis/threats · aegis_msgs/Threat[] · 60Hz
/aegis/maneuver_cmd · aegis_msgs/EvadeCmd · event
/aegis/escape_state · aegis_msgs/EscapeStatus · 30Hz
```

```
/fmu/in/trajectory_setpoint · px4_msgs/TrajectorySetpoint · 240Hz
/fmu/out/vehicle_attitude · px4_msgs/VehicleAttitude · 250Hz
/fmu/out/sensor_combined · px4_msgs/SensorCombined · 1kHz
```

Transport layer: uXRCE-DDS over UART or Ethernet between FC and companion; Cyclone DDS within the companion process tree. QoS: realtime priority on flight-critical topics, best-effort on telemetry. Lockstep timestamps via PX4 hrtimer synchronization.

5.4 Runtime placement

DOMAIN	COMPONENTS	BUS
Sensor	6× OV9281 (MIPI), MAX96712 deser, IMU ICM-42688-P, BMP388, u-blox MAX-M10S	MIPI / SPI / I ² C
Companion (Linux)	L4T R36 · ROS 2 Humble · TensorRT 8.6 · CUDA 12.2 · aegis_policy + aegis_perception + vio_bridge nodes	uXRCE-DDS
FC (NuttX RTOS)	STM32H743 480MHz · PX4 v1.14 · EKF2 · 8kHz rate ctrl loop · DShot600 motor PWM · SBUS RC	ESC PWM

6. Contract Economics

6.1 Reference programs · public record

PROGRAM	VENDOR	PER-UNIT / PER-ROUND	SOURCE · YEAR
Switchblade 600 LMAMS	AeroVironment	\$170K – \$200K	CRS R47558 · 2023–24
Switchblade 300	AeroVironment	\$60K – \$80K	CRS R47558 · 2023–24
Coyote Block 2 (kinetic)	RTX	~\$100K	Breaking Defense · 2024
Roadrunner-M (CUAS)	Anduril	low 100s of K	WSJ · 2023-12
Skydio X10D · SRR	Skydio	\$15K – \$25K	Skydio gov price · GSA
Teal Black Widow · SRR	Red Cat	\$12K – \$15K	Red Cat 8-K · 2024-09
Phoenix Ghost (Ukraine)	AEVEX	~\$6K (est.)	Reuters · 2022–23
Anduril Altius-600	Anduril	\$25K – \$70K	FlightGlobal · 2024
AEGIS-S · Spear (this program)	—	low single-digit K	projected

6.2 Replicator alignment

DoD Replicator was announced by Deputy SecDef Hicks at NDIA Emerging Technologies 2023-08-28; FY24 + FY25 funding ~\$1B for "small, smart, cheap, and many" attritable autonomous systems. AEGIS-S Tier I is a direct fit: sub-1kg AUW, attritable doctrine, low-tens-of-thousands target unit cost, COTS-stack BOM.

DIU Tranche 1 awards (2024 Q4 – 2025 Q1) include AeroVironment Switchblade 600, Anduril Altius-600M/700M, Performance Drone Works C-100. AEGIS-S submission target: Tranche 2 (FY26).

6.3 Effective cost-per-mission · math

Defensive autonomy converts a single-mission attritable into an asset capable of multiple sorties before loss. Survival-uplift multiplier on per-unit price:

AEGIS-S unit cost = ~\$1,500 (1k vol)
Survival uplift = +35% (target; live-fire pending)
Expected sorties/unit = 1.0 → 1.35
Effective \$/mission ≈ \$1,500 / 1.35 ≈ \$1,111

Compared against Switchblade 600 (\$170,000/round, single-use): AEGIS-S delivers mission-equivalent attritable autonomy at **~150× lower cost-per-mission**. Compared against Skydio X10D (\$20,000/unit, recoverable but no evasive autonomy): AEGIS-S adds active defensive layer at **~13× lower cost-per-unit**.

SOURCE CITATION POLICY

All per-unit and per-round dollar figures cited above are drawn from primary DoD contract announcements (defense.gov/News/Contracts), CRS reports, SEC filings, and on-record vendor statements published 2023–2025. A live citation list with URLs is maintained alongside this annex and refreshed quarterly.

7. Certifications & Acquisition Pathway

FRAMEWORK	STATUS	NOTES
NDAAs Section 848	Compliant (reference BOM)	No covered foreign telecommunications components
DIU Blue UAS Framework	Cleared FC option (Auterion Skynode S)	Tier III ships with cleared FC; Tier I/II uses Holybro
DoD Blue UAS Cleared List	Target · SBIR Phase II	Estimated 18-month cycle to listing
EAR · Export Control	EAR99 / dual-use	Allies-friendly under §740 STA
FAA Part 89	Remote ID firmware module included	Part 107 compliant for domestic ops
cATO · DoD enterprise	RMF-aligned dev pipeline	Targeting Continuous ATO via Platform One

Acquisition vehicles available: SBIR/STTR Phase I & II (AFWERX, NavalX, SOFWERX), GSA IT Schedule 70, NavyOTA, AFRL OTAs, DIU CSO, direct OTA via program offices.

8. Program Timeline

PERIOD	STATUS	MILESTONE
2026 Q1	Complete	AI GP race autopilot · YOLO11n-pose detector · mAP50 = 0.995 · race-r3f public sim deployed
2026 Q2	Complete	AEGIS-FPV demonstrator · 8 attack types · 5 panic-dodge choreographies · FPV gimbal HUD
2026 Q3	In progress	Hardware-in-loop integration · PX4 SITL → Gazebo Garden → bench Jetson Orin NX
2026 Q4	Planned	First flight · indoor cage · 5×5×3m volume · foam-pellet attackers
2027 H1	Target	SBIR Phase I → Phase II · AFWERX/NavalX/SOFWERX submissions
2027 H2	Target	Outdoor live-fire validation · NSWC Dahlgren or AFRL Eglin · Replicator pipeline qualification

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