To penetrate layered air defenses, both the US Army’s Future Attack Reconnaissance Aircraft (FARA) and Future Long Range Assault Aircraft (FLRAA) will launch unmanned air vehicles meant to create chaos and lengthen enemy decision cycles. The FARA “ecosystem” will be first in service around 2030 and teams the manned scout-attack helicopter with long-range precision munitions and expendable or recoverable air-launched effects (ALE). The Future Vertical Lift Cross-Functional Team (FVL CFT) — based at Redstone Arsenal, Alabama — envisions a family of ALE vehicles, payloads and mission systems. An industry prototyping effort now underway matures the lines of effort for integration and consolidation starting early in fiscal 2022.

FVL CFT acting deputy and senior advisor James Thomson provided insights into ALE plans with input from the Combat Capabilities Development Command (DEVCOM) Aviation and Missile Center (AvMC) and the Program Manager, Unmanned Aircraft Systems (UAS). ALE falls under the FVL Future UAS line of effort and “will extend FARA’s reach through the disaggregation of its sensors, allowing FARA to maintain stand-off while ALE provides stand-in capabilities facilitating extended lethality and survivability across the ecosystem.”

Used singly or in teams, ALE will decoy, disrupt or destroy integrated air defense systems (IADS), spot targets for connected forces and hike situational awareness of aircrews and ground soldiers. Project Convergence 2020 last summer at Yuma, Arizona, included 62 ALE surrogate flights and 38 automated ground recoveries. Surrogate vehicles logged 138 flight hours over 18 days and demonstrated the value of loitering sensors in warfighting scenarios. In one event, experimenters synchronized six ALE launches in 12 minutes from two Black Hawks, a truck and a ground launcher. Ground operators controlled all six unmanned vehicles simultaneously on reconnaissance, surveillance and target acquisition (RSTA) and battle damage assessment (BDA) missions.

The FVL CFT now plans modular, relatively inexpensive ALE in large and small versions. The small vehicle now under development study will approximate the form factor of today’s 110-lb (50-kg) Hellfire missile to reach operational-level targets. A larger version promises more range, speed and endurance for strategic targeting. Project Convergence used the 27-lb (12.2-kg) ALTIUS-600 autonomous tube-launched UAS from Marietta, Georgia-based Area-I, Inc. to play the small ALE in demonstration scenarios.

The electrically powered, propeller-driven ALTIUS-600 unfolds its wings after launch and provides up to four hours’ endurance with a choice of payloads. Some of the surrogate vehicles were tube-launched from Black Hawk helicopters at “tactically relevant” low altitudes and at airspeeds from hover to 90 kt (167 km/h). Others flew from rails on the high-flying, fixed-wing Gray Eagle.
UAS and from ground launchers. ALE surrogates teamed with the Gray Eagle stretched mesh network communications beyond 32 nm (60 km).

In one complicated night infiltration scenario, two Black Hawks launched two ALE each before inserting soldiers into a landing zone. The ground team leader took control of all four unmanned vehicles and received real-time video feeds on a display device. Though on-board control stations gave helicopter crews pre-and post-launch control over their ALE surrogates, the federated aircraft systems could not show the aviators remote sensor imagery. However, months before Project Convergence, a Black Hawk crew did demonstrate ALE level of interoperability (LOI) 4+, sufficient to control the UAS payload and all other functions except recovery.

The Army Program Manager UAS now leads an ALE prototyping effort with 10 vendors. Area-I, Northrop Grumman Alliant Techsystems Operations and Raytheon are developing ALE air vehicles. Leonardo Electronics US, Technology Service Corp, Raytheon and Alliant Techsystems are fabricating payloads. L3Harris Technologies, Rockwell Collins and Aurora Flight Sciences are making mission systems. Whatever its ultimate size and shape, ALE is expected to share the modular open system approach (MOSA) at the heart of the manned FARA and FLRAA and the ground-launched Future UAS.

**Down Low, Far Out**

The US Army today exercises LOI 4 interoperability between the AH-64E Apache Guardian helicopter and MQ-1C Gray Eagle UAS at ranges greater than 27 nm (50 km). The AH-64E and MQ-1C armed with Hellfire missiles nevertheless lack the standoff range needed to defeat advanced threats. FARA and ALE promise a new, more responsive concept of operations for manned-unmanned teaming (MUM-T) with enhanced survivability against IADS.

The Gray Eagle UAS is an Army division asset, launched independently and coordinated with the manned attack helicopter at the division, brigade or battalion level. The smaller RQ-7 Shadow UAS is integrated into air cavalry squadrons, but coordination still requires a cooperating ground control station arranged in advance. Organic ALE vehicles will team with FARA at the crew, team and platoon level, deploying as needed at the forward edge of a dynamic battlespace without hours or days of pre-mission coordination.

The AH-64E aircrew training manual specifies the tasks, conditions and standards for MUM-T with the Gray Eagle and Shadow UAS. The Apache front-seater controls the UAS electro-optical payload and laser designator, but has no authority to launch UAS munitions. In contrast, the integrated FARA ecosystem depends on ALE to find the enemy and return targeting data to the helicopter crew via a resilient mesh network. Combat aviators will use on-board, long-range, precision munitions or networked, long-range, precision fires to destroy targets with a shorter kill chain from sensor to shooter. The unmanned ALE itself is also expected to put its own kinetic or non-kinetic effects on target.

The FVL CFT also noted, “The AH-64E has the Manned-Unmanned Teaming (MUM-T) capability; however, it is only one-to-one control by constant linkage between helicopter and Gray Eagle. FARA and ALE will operate one-to-many, launching multiple ALE to find the enemy IADS with advancements in artificial intelligence (AI) and man-on-loop control.” The Scalable Control Interface (SCI) for ALE and FTUAS will enable a single operator to control multiple UASs.

**Separation Anxiety**

The Gray Eagle UAS flies at up to 25,000 ft (7,600 m) to maximize endurance and remains largely undetectable in a counterinsurgency environment. The much smaller ALE has to leave its launch aircraft at low tactical altitudes and loiter down low to evade near-peer threats.

The ALTIUS-600 surrogates used for Project Convergence were initially launched from a high-flying, fixed-wing platform under a 2013 small business innovative research contract from the...
Air Force Research Laboratory. The air vehicles have since been integrated with several fixed-wing platforms, including the Special Operations AC-130J gunship. The Army DEVCOM ALE team conducted flight tests in late 2018 to expand the ALTIUS-600 launch envelope from a UH-60 and collect more engineering data on both the UAS and launch helicopter.

In contrast to the fixed-wing launch environment, helicopter-launched ALE have no altitude margin to freefall and spread their wings. Helicopter-launched vehicles must also contend with the turbulence of rotor downwash. Area-I engineers modeled the ALTIUS-600 launch fly-out using their in-house flight model with rotor downwash data provided by DEVCOM. “Obviously the biggest thing is you don’t have the altitude you’d have higher up,” explained Area-I chief operating officer Josh Steele, “and you have the rotor disk creating a lot of unfavorable turbulence. We knew you could model that all you want, but it’s a complex model. The only way to do it for real is crawl, walk, run.”

Area I developed a pneumatic integrated launch system (PILS) specifically for the helicopter launch environment. “You don’t have altitude to play with, so you’ve got to come out quick and get out above stall speed and the host platform.” DEVCOM and Area-I first ran ground tests to collect engineering data including launch loads applied to the aircraft ejector rack and Black Hawk external stores support system (ESSS), blast pressures on the helicopter fuselage and UAS exit velocities and drop after launch. They also investigated dispersion paths taken by the vehicles after tube launch.

First helicopter launch of the ALTIUS-600 occurred in late 2018. Steele explained, “The whole idea was to take the technology that the Air Force provided and put it on helicopters and test it at high altitudes just to show you could launch UAVs from helicopters.” In the spring of 2019, the FVL CFT and DEVCOM ALE team launched ALE from a Black Hawk supporting opposing forces in a joint warfighter assessment Yakima, Washington.

A tactical altitude launch system was first tested on the ground. In March 2020, DEVCOM AvMC demonstrated an ALTIUS-600 launch from a Black Hawk in forward flight at Yuma. In August and September, Project Convergence put PILS tubes on the ESSS inboard stores stations of a utility UH-60M and Special Operations MH-60M. According to the FVL CFT, the launch helicopters provided global positioning system reference signals to the UAS for pre-flight initialization. The UH-60M had an engineering development control station for pre-mission planning and launch control. The MH-60M crew used an airborne mobile control station. Additional radios on each Black Hawk supported mission monitoring datalinks for the UAS, airborne control station, and ground control station.

The FVL CFT expects some ALE to be recovered and reused. Project Convergence deployed the flying launch and recovery system (FLARES) developed by Hood Tech Corp-Mechanical, Inc. in River, Oregon. As ALTIUS-600 vehicles returned to “friendly” airspace, FLARES used a hovering electric octocopter dangling a recovery cable above a prepared site. Area-I put hooks on the ALTIUS-600 wings to snag the cable and let the vehicle slide down to a recovery crew, avoiding any damage.

Other ALE concepts also build on small unmanned aircraft systems. The Raytheon Coyote UAS has been deployed from fixed-wing Orion patrols aircraft into hurricanes and provides about one-hour endurance. The current ALE UAS configuration trades and analyses (CTA) study will inform the Army for an ALE acquisition program with acceptable risk. Plans call for the new, small UAS with its modular payloads and mission systems to be integrated on both the AH-64E attack helicopter and MQ-1C extended range UAS with initial operational capability around fiscal 2024.