Transformative Logistics Distribution

Employing unmanned logistics systems–air (ULS-A)

by MGySgt Chris Anson & Thomas Heffern

Unmanned logistics systems-air (ULS-A) will transform and diversify distribution in expeditionary advanced based operations (EABO).[1] Acting on the *38th Commandant's Planning Guidance* calling for austere, risk-worthy, logistics capabilities,[2] the ULS-A team has a running start facilitating needed actions. This article provides a developmental background and vision for high tempo logistics in EABO using ULS-A.

Figure 1 describes the vision for ULS-A in an EABO environment.

In 2016, the Headquarters Marine Corps' Logistics Innovation Office (LIO) forecasted the coming requirements for effective logistics in EABO. They created three distinct lines of effort: small ULS-A, medium ULS-A, and large ULS-A (or Light Utility Transformative Vertical Lift [TVL], as it is now sometimes called). Figure 2 provides distinguishing characteristics of the ULS-A and TVL lines of effort.

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"ULS-A provide logistics and ground units with their own, highly autonomous, unmanned aerial logistics systems that reduce risk, while increasing flexibility and speed of delivery to small units at the last tactical mile."

Small ULS-A

In 2016, the LIO team recognized that although there was considerable hype regarding "cargo drones," developmental efforts touted in the commercial sector were not well-suited for expeditionary operations. Companies like Amazon and Google were focused on small package delivery (~ten lbs) within controlled confines and short distances of urban environments. There was almost no commercial development of logistics drones beyond the Federal Aviation Administration limitation of 55lbs. At the beginning, Marine Corps Warfighting Lab (MCWL) efforts cultivated the concept by fostering and hosting a variety of demonstrations using early prototypes and surrogates. The Marine Corps' LIO and MCWL teams developed working relationships with Army Combat Capabilities Development Command activities in both Aberdeen, MD, and Picatinny, NJ, as well as Army Futures Command at Fort Lee, VA. Between 2016 and 2018, the Army and Marine Corps developed draft requirements, concepts, and strategies that created prototype systems like the tactical resupply vehicle (TRV)-5, TRV-50, and the TRV-80. Combined with more advanced sensor payloads that added improved autonomy, these systems verified the potential of small ULS-A during the August of 2019, Fort A.P. Hill, Joint Capability Technology Demonstration (JCTD) Phase 1. Phase 2 of the JCTD recently completed in Fort A.P. Hill, with the TRV-150 demonstrating a variety of automated and

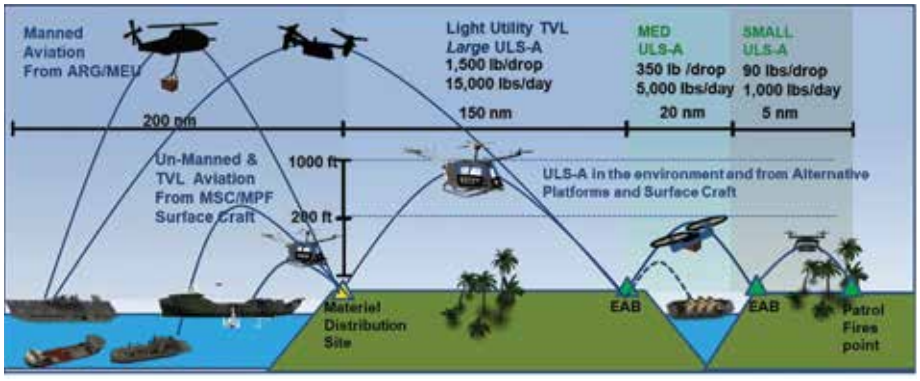

Figure 1. EABO Distribution with ULS-A and Light Utility Transformative Vertical Lift. *(Figure provided by author.)*

	ULS-A – TVL System	Basic Spec (thres – obj)	Description	Desired Operational Capability
GROUP 3 UAS	**Small ULS-A (TRUAS)** Sized for **Squad / EAB Site** Resupply-Redistro	• 60-150+lb payload • 10-20+ km radius • Daily throughput • **~1,000 lbs/day/sys**	• Organic logistics for any ground unit. Highly automated to enable simple operations for a wide range of users. • Provides emergent and routine redistribution • "Company Gunny's tool"	• Early Operational Capability by 2023 • Full Operational Capability by 2026
	Medium ULS-A (JTAARS) Sized for **Platoon / Intra EABO** Resupply	• 300 -500+lb payload • 35 -200+ km radius • Daily throughput • **~5,000 lbs/day/sys**	• Logistics and potentially limited CASEVAC/Emergency Extract (1-2) • Automated & Autonomous • Operated & managed by logistics personnel in coordination with air C2	• JCTD until 2021 • Early Operational Capability by 2025 • Full Operational Capability by 2030
GROUP 4 UAS	**Light Utility Transformative Vertical Lift (TVL)** Sized for Low cost and Longer range **EABO Emergency Resupply**, CASEVAC & Admin Transport	• 1,000 - 3,000+lb payload • 300+ km combat radius • Daily throughput • **~15,000 lbs/day/sys**	• Logistics and potentially personnel (4-8) transport • Automated & Autonomous (no pilot) • Operates from small austere landing zones and small ships with limited manning requirements, Low cost aviation alternative	• Early Operational Capability by 2026 • Full Operational Capability by 2030

Note: Systems presented are experimentation systems and are meant to be "representative" of the capability.

Figure 2. Overview of the family of ULS-A and TVL systems. *(Figure provided by author.)*

Headquarters Marine Corps' Logistics Innovation Office forecasted future requirements for innovative distribution in EABO and created three lines of effort: small and medium ULS-A and Light Utility Transformative Vertical Lift (TVL). *(Photo provided by author.)*

autonomous techniques and showcased the ability to carry 120lbs to a combat radius of 7km.

Work during Phase 1 of the JCTD, as well as concept development and funding work within HQMC Combat Development and Integration, enabled refinements in requirements, concepts of operation (CONOPS), and an emerging program. Working with HQMC Aviation, HQMC Installations and Logistics facilitated a Secretary Geurts (ASN/RDA) 30 November 2018 memorandum, assigning Program Executive Office for Unmanned Systems and Weapons as the acquisition agent for this capability area. In 2019, Program Executive Office for Unmanned Systems and Weapons assigned Group 3 ULS-A efforts to Program Management Activity-263.

The near-term goal is to field a small ULS-A that can move materiel of approximately 90lbs at least 10km. These systems are envisioned to operate organically within ground and logistics elements operating ashore in support of tactical distribution efforts in their area of operations. These are sized to be "company gunny" type assets meant to augment other transportation assets when the risk, environment, or timing requires an unmanned air system delivery. Appropriately-sized distribution "tools" at the tactical level free-up more capable, multifunction aviation assets for other missions. The goal is to field systems beginning in 2023. In an EABO environment, each operating site should have several systems organic and readily available to provide on-call resupply. For example, a security patrol runs out of water mid-mission and is resupplied in ten minutes with enough water to complete the mission.

Medium ULS-A

As with small ULS-A efforts, this capability grew out of a combined vision between Army and Marine Corps logistics organizations. Together, the joint team created early rationale, requirements, and resourcing to begin developing a much larger Group 3-sized unmanned aerial systems (UAS) to conduct logistics. Army and Marine Corps analysis pointed at a need for

The Office of the Secretary of Defense Joint Capability Technology Demonstration for ULSA-A saw further Marine Corps–Army partnership. *(Image provided by author.)*

300–600lb payload capability. Initially, there were virtually no commercial UAS sized to conduct resupply in this weight range. Although some Group 4 UAS were available, Group 3 UAS was selected to enable ground units to organically employ vice larger Group 4 systems that would require aviation specific organizations.

Early on, the ULS-A Team recognized value in leveraging an Office of the Secretary of Defense JCTD in partnership with Army materiel and capability developers. Despite contention from many in the aviation and the science and technology communities, the team formally gained approval in late FY 18 for a three-year JCTD. The primary output of the JCTD is refined capability requirements in the form of a draft Capability Development Document and CONOPS. Additional outputs include developing command and control (C2) and autonomy sensors, payloads, software and architectures, as well as developing representative Group 3 prototype UAS for this mission. The following figure is representative of what a future medium ULS-A may look like.

Figure 3. TRV-400 Static Display During Phase 1 of JCTD Operational Demo. *(Figure provided by author.)*

The JCTD recently finished year two of development with objectives of advancing C2 and autonomy architectures, refining CONOPS, and conducting initial experimentation with these larger systems. During the Phase 2 JCTD demonstration, the TRV-400 showed a capability to lift 300lbs and conducted a 10km flight with 150lbs. In year three, the JCTD plans to refine C2/autonomy techniques to include some global positioning system denied capabilities and demonstrate an ability to carry at least 300lbs out to 20km.

At the completion of the JCTD period, the intent is to transition these requirements, CONOPS, and prototype technologies to the Army and Navy/Marine Corps acquisition teams to carry the concept forward with a goal of achieving initial operating capability by 2026. We envision the small ULS-A to be the most forward asset in the portfolio and the medium ULS-A operated at least one echelon higher. A medium ULS-A is planned to be organic to ground and logistics elements and used at a battalion or regiment level. It should deliver between 300–500 lbs of supplies out to approximately 30km with a goal of continued range extension through technology leaps, eventually out to 100+ km. Ultimately, this capability will integrate with ships and landing craft, fulfilling some ship-to-ship and ship-to-shore needs.

Medium ULS-A will play a key role in the diversified distribution portfolio of EABO by providing larger capacity organic logistics distribution tools directly to each operating site. Medium ULS-A will enable rapid distribution of materiel and supplies both inter and intra-EAB, providing risk-worthy air delivery capabilities when ground transportation is not viable, or aviation transportation is not available.

Large ULS-A (Light Utility TVL)

Although still just a vision, large ULS-A is a Group 4 sized aircraft that would likely be managed within an aviation-based organization. It could even carry personnel, especially for the casualty evacuation mission. It could be described as "optionally manned." The current strategy to achieve this capability

ULS-A can operate in urban terrain. *(Photo by PO Phot Si Ethell, of the Royal Navy.)*

is built on the foundation of National Aeronautics and Space Administration and the commercial industries' Urban Air Mobility and Advanced Air Mobility concepts. The concept looks to repurpose emerging commercially developed distributed electric propulsion vertical takeoff and landing systems (VTOL) often referred to as electric VTOL. These concepts have also been referred to as transformative vertical lift (TVL).

If the capability is funded for development, Light Utility TVL would provide stand-in, risk worthy, highly automated, transportation, distribution, and casualty evacuation capabilities directly to tactical units. Systems could operate from ships, small vessels, and EABs with minimal manning and maintenance requirements. The initial target is to develop an aircraft with a high degree of automation and autonomy such that it can be operated by an "operator" (not a "pilot") or without any personnel onboard as an unmanned system. It may carry up to 1500lbs of logistics or carry four Marines out to at least 150 nautical miles. As the technology matures, systems with greater capacity and range could be added to the portfolio, enabling a "larger" ULS-A capability.

Systems could operate from ships, small vessels, and EABs with minimal manning and maintenance requirements.

Figure 4. Example of a possible future Light Utility TVL (Large ULS-A). *(Figure provided by author.)*

This capability is in the early stages of development with the Air Force "Agility Prime" Innovation Teams. Experimentation may begin as early as 2021 with a stretch goal of fielding some capability by 2030. If resourced, this capability would play a significant role in EABO and enable more forward deployed, lower signature, lower cost, aviation-based capabilities operating from EAB sites and smaller ships.

Summary

As the Marine Corps introduces small ULS-A to the FMF around 2023, lessons learned, and operational validation of changing logistics distribution concepts will inform our medium ULS-A effort. With successful introduction of a medium-sized ULS-A capability and possibly a light utility TVL, Marine Corps logistics will be postured to support widely distributed EABO options with diversified distribution. These lower signature, widely distributed, accessible air systems will provide fast, flexible, logistics capabilities to the FMF, freeing assault support aircraft to conduct tactical maneuver operations.

Notes

1. MCWL Concepts and Plans Division, *EABO Handbook*, (Quantico, VA: 2018.)

2. Gen David H. Berger, *38th Commandants Planning Guidance*, (Washington, DC: July 2019).