Strategy Research Project

The Strategic Role of Unmanned Ground Logistics Systems

by

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Abstract

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The Strategic Role of Unmanned Ground Logistics Systems

Despite incredible technological advancements and the progress of civilization, the first 17 years of the twenty-first century have seen near continuous conflict. Centuries ago, the military theorist Carl von Clausewitz defined war as "…an act of force to compel our enemy to do our will."[1] He argued that force, both physical, and moral is "the means of war; to impose our will on the enemy is the object."[2] His definition reveals enduring concepts about the nature of war and the role of the United States (U.S.) Department of Defense (DOD). Clausewitz's assertion that war it is a means to achieve a political objective defines the strategic role of the U.S. DOD.[3] Secretary of Defense (SecDef) James Mattis states the mission of the U.S. DOD as "…to provide combat-credible military forces needed to deter war and protect the security of our nation…Reinforcing America's traditional tools of diplomacy, the Department provides military options to ensure the President and our diplomats negotiate from a position of strength."[4] The means of war, the projection of military power to accomplish a political goal is impossible without logistic support to sustain the force.

The nature of war and the role of the U.S. DOD to project power in support of U.S. political goals remain constant despite a rapidly changing character of warfare in the twenty first century. The pace of technological development challenges the U.S. military force projection, and logistic sustainment paradigm. Although the technological immaturity of unmanned systems creates weaknesses, they represent a disruptive future capability that in time will revolutionize logistics and advance U.S. force projection. The thesis of this paper is that despite limitations, the integration of unmanned ground and airborne logistics systems into the joint force increases the diversity, resilience, and flexibility of force sustainment, thereby mitigating vulnerabilities and exploiting opportunities within the evolving character of warfare. This paper explores the strengths and weaknesses of unmanned logistics systems with a limited scope analysis of three logistic regimes, and proposes an employment concept that blends the current logistic system with the capabilities of unmanned logistic systems

A Rapidly Evolving Strategic Environment

In the 2018 *National Defense Strategy*, SecDef Mattis states that "…for decades the United States has enjoyed uncontested or dominant superiority in every operating domain. We could generally deploy our forces when we wanted, assemble them where we wanted, and operate how we wanted. Today, every domain is contested—air, land, sea, space, and cyberspace."[5] The U.S. logistics distribution model projects force and sustains combat power by moving massive amounts of logistics material through sea port of debarkation (SPOD) or aerial port of debarkation (APOD) facilities. Once logistic material arrives it placed into the reception, staging, onward movement, and integration (RSOI) process.[6]

The RSOI process is a necessary constraint on movement of material and combat forces to ensure organization and cohesion. Security is critical during this transition. According to the Army Techniques Publication 3-93, *Theater Army Operations* "…[This] phase can provide the enemy with numerous opportunities to inflict serious losses and to delay the build-up of combat power by exploiting vulnerability of units in transit from the intermediate staging base to the tactical assembly area."[7] Staging areas become "iron mountains" and "lakes of liquid fuel" that are built up to support joint force operations.[8] The pace of technology development and proliferation of area denial and anti-access also known as A2AD capabilities threaten this construct.[9]

The operational reach of adversaries and their ability to disrupt and deny theater SPODs and APODs requires the development of new concepts and capabilities for strategic and operational logistics distribution.[10] General Neller, Commandant of the U.S. Marine Corps, recognized this requirement by tasking the Marine Corps to "redesign our logistics to support distributable forces across a dynamic and fully contested battlespace--because iron mountains of supply and lakes of liquid fuel are liabilities and not supportive of maneuver warfare."[11] The strategic imperative for innovation is echoed throughout the joint force.

As stated in *Gaining and Maintaining Access: An Army-Marine Corps Concept, Version 1.0*, "…U.S. Army and Marine Corps forces [must] reduce the number of lucrative targets available for adversary interdiction that could disrupt operational momentum."[12] The joint force mitigates the strategic vulnerability created by "mountains of iron" and "lakes of liquid," with a strategic focus on the development and integration of Unmanned Logistic Systems - Ground (ULS-G).[13] Over the past fifteen years, the joint force has made progress with the development of logistics networks and airborne unmanned logistics systems (ULS-A), but the conceptual employment and significance of ULS-G remains relatively uncharted.[14]

Analysis of ULS-G Strengths and Weaknesses

The strategic impact of ULS-G employment to the joint force can be seen in three roles: in the *tactical* regime with direct assistance to operators or "with the warfighter," as an *operational* distribution asset "on the road," or in *strategic* support to logistics distribution "in the warehouses." Although there is cross over and blending of ULS-G capabilities within these regimes, the terms tactical ULS-G (ULS-G(T)), operational ULS-G (ULS-G(O)), and strategic ULS (ULS-G(S)) are used for clarity purposes. The labels of tactical, operational and strategic do not preclude the application of any specific ULS-G system to only one regime. Analysis of each of these regimes reveals how ULS-G can enable joint forces to "…project more of the force into austere environments, increase tempo, and confront adversaries with multiple dilemmas."[15]

Tactical employment of ULS-G with the warfighter creates significant advantages. The use of domesticated animals, and vehicles to increase speed, endurance and resilience of combat forces has benefitted warfighting forces throughout history. The employment of ULS-G(T) decreases risk to personnel by reducing the number of personnel in combat or imminent danger. There is also no emotional related performance degradation of ULS-G(T) engaged in high intensity combat. Based on payload and power requirements, ULS-G(T) can lighten the load for our warfighters, thereby increasing their endurance, rate of march, and tactical capabilities.[16] Additionally, ULS-G(T) can carry logistic payloads, and perform contingency support as a stretcher bearer for injured personnel, or reconnaissance asset in areas of mine or improvised explosive devices (IED) threat.[17]

Electronic warfare (EW) and cyber payloads allow ULS-G(T) to defend and strengthen joint mesh networks, detect and collect electronic and Infra-red signals, and disrupt and deny adversary use of the electromagnetic spectrum.[18] The ULS-G(T) support medium to heavy weapons payloads, and can be used as a fire support asset. As mobile power sources that support other types unmanned vehicles and capabilities, ULS-G(T) paired with operators and enablers in the field increase survivability, capability, and combat power.[19]

Despite the many benefits of ULS-G(T), the systems create risk that could become a liability when conducting combat operations. Current unmanned systems do not do not have the cognitive or mobility capabilities as their human counterparts. The tactical environment presents terrain, obstacle, rules of engagement (ROE), and weather challenges that may exceed the ability of ULS-G(T) to cope.[20] Due to the size and power required to carry required payloads, ULS-G(T) create audio, visual, and electronic signatures that limit their ability to avoid detection within the tactical environment.

The mechanical complexity of ULS-G(T)s, and harsh tactical environment lead to several drawbacks that should be considered: they are vulnerable to mechanical failure, require power sources or fuel, and potentially preventative maintenance for sustained operations in the field.[21] As capability and logistic payload increase, ULS-G(T)s become a critical, but vulnerable part of the combat team. The loss of a ULS-G(T) that contains the logistic, EW and cyber support for the supported unit significantly reduces combat effectiveness. The dynamic and high tempo tactical environment may outpace the ability of ULS-G(T) to provide required support. The inability to rapidly reconfigure a ULS-G(T) for specific missions in the field may also negate benefits.

In addition to weaknesses, there are second order effects that require consideration. There is the risk of an undesired strategic impact created by the international perception that the U.S. uses killing machines to do its dirty work. Another second order effect that must be considered is the training and focus of the combat team. Operation and interaction with ULS-G(T) is a technical skill-set that requires training and focus. Additional training requirements and technical skills take valuable time to develop within an infantry, operator, or enabler training cycle that is already full. When in the field, ULS-G(T) require human warfighting partners to monitor them, drawing critical awareness away from the environment and task at hand. Another consideration is the number of ULS-G(T) to be forward fielded. Specific analysis of the right number of ULS-G(T) is required to ensure that the benefits are maximized and risks minimized.

Figure 1. “A GUSS Follows the Beacon Signal of PFC Dylan J Hoffstatter”[22]

Despite weaknesses and risks, the benefits of ULS-G(T) employment should be pursued by the joint force. The Ground Unmanned Support Surrogate (GUSS) was developed and tested by Virginia Tech, TORC Robotics, and the Marine Corps Warfighting Lab.[23] The GUSS provided many benefits, but the level of system autonomy was inadequate and required further development (Figure 1).[24] The risks, second and third order effects of ULS-G(T) are mitigated through detailed analysis and proper method of employment. Similar to ULS-G(T), ULS-G(O) as a distribution asset brings many significant strengths.

The strengths of ULS-G(O) as a distribution asset are maximized in a supporting role. The distribution chain can be broken down into three areas. The first is the transportation and distribution actions within the warehouse.[25] The second leg is from the warehouse to the RSOI staging area or support base.[26] The third and final leg is from the distribution area to the customer or forward deployed warfighter. The capabilities, strengths and weaknesses of ULS-G(O) define their role within the distribution chain.

The advantages of ULS-G(O) as a distribution asset are range, payload and decreased risk to personnel because less service members are on the road. Convoy operations represent a significant strategic and operational risk to joint forces because they expose friendly forces to enemy IEDs.[27] Half to two-thirds of Americans conducting combat operations in Iraq and Afghanistan have been killed or wounded by IED attacks, "…according to data from the Pentagon's Joint IED Defeat Organization or JIEDDO, that's more than 3,100 dead and 33,000 wounded." [28] By decreasing the number of personnel on the roads, ULS-G(O) represent an operational advantage with strategic impact.

Strategic impact of ULS-G(O) are created by the increased resiliency of the supply system created through deception, and the diversification of distribution. The decoupling of logistic assets from their human drivers increases their ability to remain persistent within the contested battlespace. Persistence enables ULS-G (O) to be used as a logistics asset, an EW, Cyber platform, fires platform, airborne ULS support hub, or combination of all capabilities. Many of these capabilities defend the individual ULS-G(O) asset, but can also link them with other assets and systems within the battlespace, thereby forming a cohesive collective or mesh network.[29] Numerous ULS-G(O)s within the battlespace can deliver logistic support to distributed operations, provide services beyond logistics, and complicate adversary targeting. When used in conjunction with ULS-A(O) delivery assets, ULS-G(O) diversify how logistics get to supported units. By using airborne and ground-based delivery systems, the adversary must target assets in the air, and on land if they want to disrupt joint force logistic delivery.

In an environment where SPODs and APODs are denied, there are few ship to shore connectors that can transport ULS-G(O) because of their large size and payload. One answer may be to have them swim to shore on their own. The Headquarters Marine Corps NexLog Cell, in conjunction with Marine Force Systems Command, and the Marine Corps Warfighting Lab are pursuing the automation of the Assault Amphibious Vehicle, AAV-P7/A1.[30] An amphibious ULS-G(O) that can swim to shore without a connector creates significant advantages for logistics, and diversifies logistics distribution to the joint force. Another advantage of an amphibious ULS-G(O) is the ability to traverse water obstacles within the combat zone. Amphibious ULS-G can be used as part of a deception plan to confuse adversary tracking and targeting capabilities.[31]

Disadvantages of ULS-G(O), amphibious or otherwise are similar to those of ULS-G(T) paired with warfighters. Although the increased payload and range of ULS-G(O)s create advantage, there are drawbacks to their employment as a distribution asset. The ULS-G(O)s are large military vehicles that are relatively easy to identify, track and target. If in a logistics role, ULS-G(O) has significant value to joint warfighting assets forward, and if successfully targeted, joint force operational reach and ability to sustain combat operations are degraded.

Other drawbacks of ULS-G(O) in a distribution role are natural or man-made road related hazards that deny ULS-G(O)s from reaching their destination. When used on civilian traveled roads as is often the case in a joint force operation, ULS-G(O)s can the increase risk of civilian injury and property damage, or become maintenance casualties, which require additional assets and time for recovery. The speed of ULS-G(O) as a distribution asset is much slower that their airborne counterparts.[32] Slower speeds mean reduced response times and flexibility, and increased periods of vulnerability and exposure to enemy observation.

Other considerations include ULS-G(O) vehicle maintenance and systems management. Each vehicle requires a cross-functional team of highly trained technicians to maintain and monitor the ULS-G(O) once deployed to the field. Despite drawbacks, the employment of ULS-G(O) in a distribution role should be considered as a viable option. The strengths of ULS-G(O) are maximized in a supporting role by conducting distribution functions within the intermediate and warehousing porting of the distribution chain.

Efficiency in warehouse functions is increased by the precision, speed and endurance of strategic ULS-G systems (ULS-G(S)). Warehouse functions, as with any process, improve when mistakes or wasted resources are minimized. In conjunction with a robust and responsive mesh network, ULS-G(S) warehouse functions improve joint force logistics at the source. The brain of the warehouse function is the Global Combat Support System, a computer program that “integrates operations within every warehouse, supply room, motor pool, and property book office across the force."[33] From here, ULS-G(S) receive logistics requisitions and move necessary items from the warehouse to the distribution assets.[34] The precision, speed and endurance of warehouse operations can be improved through the use of ULS-G(S) automated pickers.

Pickers are the actors within the warehouse that pick the items off the warehouse shelf and sort them for shipment. This is an area where humans have traditionally had the edge due to the ability to recognize, grasp, and sort items of different sizes and shapes. This is now an area of focus for companies based on shipment and timely order fulfillment like Amazon. In the 2017 Amazon Robotics Competition several robots competed against each other in a picking challenge.[35] Although robotic systems have not outpaced humans yet, the capability is likely only a few years away. Future automated ULS-G(S) pickers receive requisition information from the network and move about the warehouse for order fulfillment.[36] Increased precision, speed, and endurance push material into the distribution system at a pace that improves support to the joint force.

Weaknesses of ULS-G(S) use in the warehouse are the dependence on the network, and maintenance requirements. As with any new system, additional technical training and specialized skills will be required to keep the machines running. The advantages of a relatively controlled environment mitigate risk allowing the strengths of the ULS-G(S)s to be maximized. A consideration that increases efficiency for ULS-G(S) warehouse machines is standardized item packaging.

Standardized item packaging should be focused on support to the customer and started as close to the source within the supply chain as possible. Although often overlooked, item packaging either helps or hurts the customer. The size of items within a day of supply can determine how quickly they can be distributed. The time that it takes a unit to break down the material and distribute it is time that is better spent focused on the mission and operational environment. Class I, V, and VIII (rations, ammunition, medical) items should arrive to the warfighter as custom loads based on their specific requirements.[37] Standardized packaging also supports ULS-G(S) employment because it reduces the requirement for automated systems to have to recognize, grasp and sort materials of different sizes, shapes and weights.[38] Standardized packaging into smaller loads helps with ULS payload management and allows diverse items to be packaged together based on the needs of the customer.[39] Standardized packaging at the strategic level increases interoperability of joint logistics, thereby increasing efficiency and effectiveness.

Drawbacks to standardized packaging are increased costs of policy implementation. According to joint regulation, "…DOD activities will encourage vendors to submit new or advanced commercial packaging methods, procedures, equipment, and materials for testing and approval…"[40] Despite the cost of aligning all DOD logistic activities, the benefits of standardized packaging cannot be ignored. Standardized packaging facilitates the incorporation of ULS-G(S), and improves interoperability, efficiency and effectiveness within warehouse and distribution functions.

Automated warehouse functions incorporated into intermediate supply distribution points is a way to reduce the liability of the "iron mountain." In a scenario that requires sustained operations within an environment in which SPODs and APODs are denied, autonomous ULS-(S) warehouse functions can be paired with ULS-A(O) distribution systems. The mutual support created by combined use of ULS-A and ULS-G at the tactical, operational, and strategic level allows the diversification of distribution models.

Rethinking the Logistic Distribution Model

The current joint force logistics distribution model is linear (Figure 2). Linear distribution is defined as one in which supplies flow from a parent unit that has the supplies, to a subordinate unit that needs the supplies.[41] The hierarchical method of moving supplies from a logistics unit to a combat unit allows items to be moved in bulk and enables distribution flexibility based on the requirements of subordinate units. This system is slow and can create bottlenecks, but seeks to mitigate deficiencies with precision.[42] Although the linear system can be effective, it requires an area close to the customer to store large amounts of supplies, which become “iron mountains.” Iron Mountains are vulnerable and build excess quantities of supply that must be moved at the completion of the operation.[43]

ULS and their unique capabilities enable alternate distribution methods. Two methods of distribution that apply to ULS employment are the hub-and-spoke, and swarm models.[44] These two models are described by Peter Singer as basic unmanned systems employment models that are made possible by the unique capabilities of ULS autonomous and semi-autonomous machines.[45] The hub-and-spoke method closely parallels the distribution models of commercial on-line merchants.

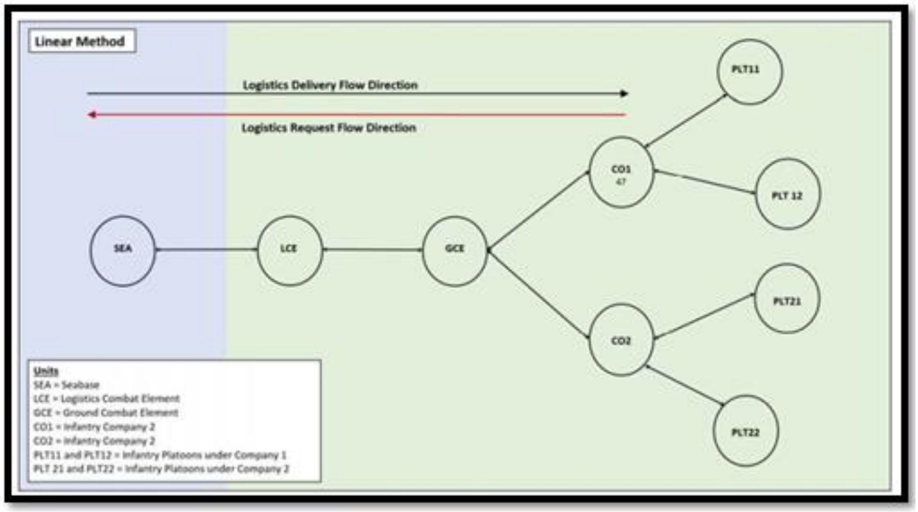

Figure 2. Linear Distribution Model[46]

The hub-and-spoke method is where a single logistics unit supports several distributed units simultaneously (Figure 3). This model increases speed and reduces bottlenecks by pushing supply items directly to subordinate units without passing through a higher headquarters or parent unit. The hub-and-spoke method relies on accurate and timely information from distributed units, and tailored, timely supply deliveries to the requesting units. The hub-and-spoke method eliminates the "middle man," thereby saving time and reducing excess supply materials.[47] The scale of delivery in this method can be tailored, but is dependent on the capability of the delivery vehicle.[48] The payload, speed, size and range of the ULS delivery vehicle has a critical impact on the efficiency and effectiveness of this model.[49] As ULS capabilities expand, the applicability of this model to joint logistics increases. The second alternate joint force ULS distribution model, enabled by ULS, is the swarm.[50]

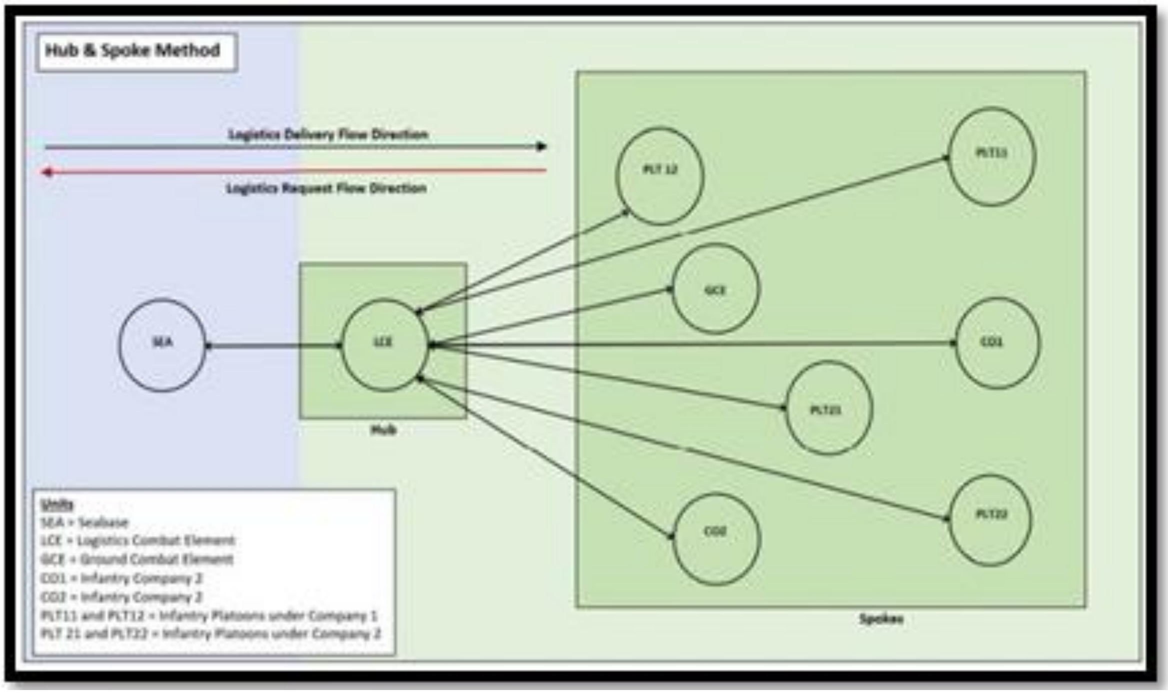

Figure 3. Hub and Spoke Distribution Model[51]

The swarm is a distribution method that mirrors how insects or animals interact. As Peter Singer states, "…rather than being centrally controlled, swarms are made up of highly mobile, individually autonomous parts. They decide what to do on their own, but somehow still manage to organize themselves into highly effective groups."[52] Like the hub-and-spoke method, the swarm eliminates the middle man and directly delivers logistics to the requesting customer, regardless of unit size.[53] The payload of deliveries is intentionally small and ideal for the customer, who wants only what is requested with no excess. The swarm is heavily dependent on the network, but is otherwise difficult to target and disrupt unless massed on a single point. As with the hub-and-spoke, this ULS distribution method is only made possible by the capability of the swarm vehicles. As ULS vehicles and capabilities continue to develop at an exponential pace, the ability to realize alternate distribution methods becomes reality.[54]

Due to the pace of change and technological capability there is risk that increased ULS capability will be lost by the inability of the joint force to adapt the doctrinal logistics system that employs them.[55] Fortunately, joint force distribution methods can integrate new methods as an evolutionary process.

The linear, hub-and-spoke, and swarm distribution models can be combined in support of hybrid logistics in a manner that maximizes strengths and mitigates weaknesses.[56] It also allows a resilient distribution foundation in which emerging ULS capabilities can be tested and applied. In a contested environment, the success or failure of the joint force logistics distribution method is contingent on the strength of the network, and the reliability and survivability of delivery assets. The mutual support created by the use of ground and air ULS within a hybrid distribution concept generates the flexibility and resilience demanded by future distributed and contested environments.[57]

Integration of ULS-G into Lieutenant General Dana's Hybrid Logistics concept ensures that the supply chain is diversified and robust. Hybrid Logistics employs all available means to get supplies to the distributed force.[58] In this model a mix of distribution methods are leveraged by a resilient and pervasive mesh network. The network and its ability to connect distributed logistics functions to their customers is the strategic underpinning that enables the speed and precision of the hybrid logistic system.[59]

Future Unmanned Logistic System Employment Concept

Future unmanned ground and air capabilities enable the scalable application of linear, hub-and-spoke, and swarm logistics distribution models.[60] The foundation of the hybrid logistics system is the encrypted, ad hoc, mesh network that leverages several waveforms to provide robust, high bandwidth data transmission.[61] The network of the future is an enhanced variation of the Tactical Targeting Network Technology (TTNT) waveform technology that exists today. The mesh network is an internet protocol signal sustained by line-of-sight, interconnected users who enter and depart as mission dictates (Figure 4). The mesh network is closed system that uses the signal power of ad hoc users to gain and maintain control of the electromagnetic spectrum between networked users.[62] The collective mesh network enables friendly operations to be conducted without prohibitive interference, and is monitored and defended by human cyber operators assisted by artificial intelligence systems.[63]

The electromagnetic spectrum is a contested battlespace that can be degraded by adversary activity despite the strengths of the mesh network. Manned and unmanned functions within the system withstand degraded network conditions through clearly defined roles and behavior patterns.[64] The data-burst signals from customer to logistic provider update supply-planning factors, and push intelligence from imbedded cyber and EW sensors to joint force decision makers.

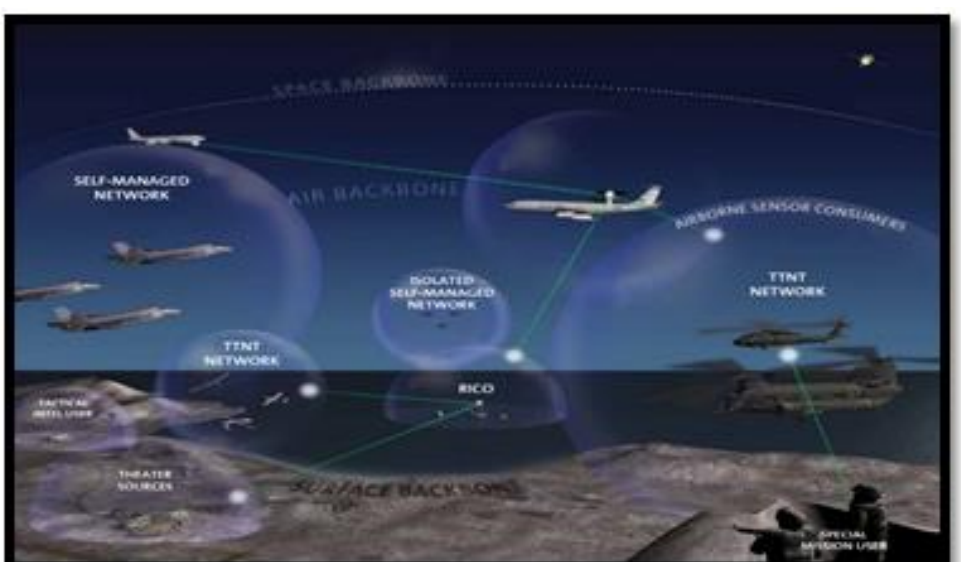

Figure 4. TTNT Mesh Network[65]

The distribution method changes with the scale of logistical requirement. For large unit operations, a battalion or larger, a linear distribution method is used, with larger payloads delivered to parent units in the field.[66] Parent units transport excess supply items with accompanying ULS-G(T) systems. For smaller sized units, ULS-G(O) systems use a hub-and-spoke or swarm distribution method is used. All systems can be used simultaneously to cover gaps and seams within the logistic system, and are synchronized through the common network. The high bandwidth ad hoc mesh network supports end users and decision makers with timely, high fidelity friendly and enemy updates.[67]

The network is both a critical enabler and vulnerability to the future logistic system; it must be projected forward to support distributed forces in the field. Unmanned Logistic Systems both ground and air, are nodes and power sources that push the network forward, and ensure its persistence. Logistics, cyber, EW, and communications functions are combined by ULS-G(O&T) that are repeaters for the ad hoc mesh network.[68] Multi-role logistic functions are accomplished by a modified ISO-container, creates flexibility and resilience within future joint force logistics (Figure 5).[69]

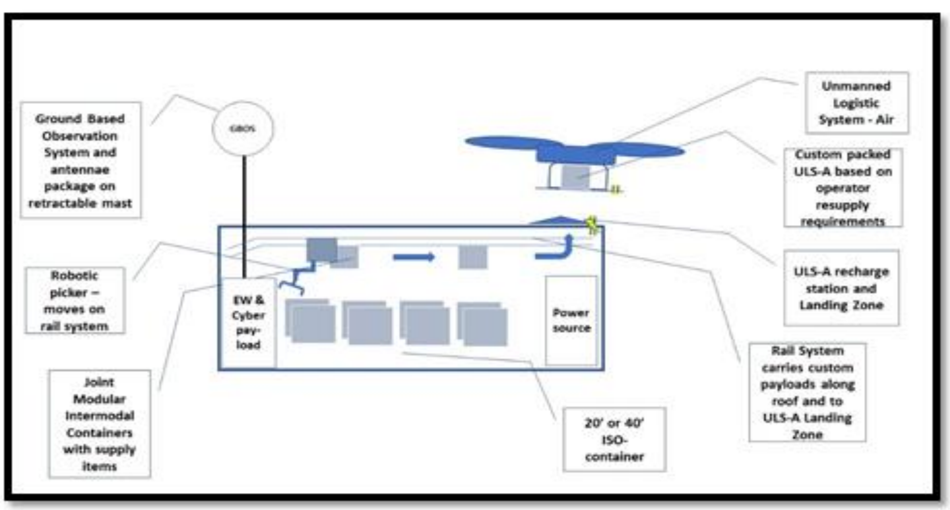

Figure 5. ISO-matic Container Concept[70]

The ISO-matic container uses a standardized ISO container used in the international shipping industry (Figure 6). The ISO container is an internationally standardized container, and almost all shipping functions are oriented around it, to include joint force logistics.[71] Although the outside of the container remains standard, inside is an EW and cyber package, an electro-optical infra-red ground-based observation system, an antennae system on a retractable mast, an autonomous item sorting and picking machine, and a rail system that transports customized payloads to the top of the container (Figure 5). On top of the ISO-matic container is a landing zone where a ULS-A(O) can load and unload payloads and conduct landing and take-off operations.

Figure 6. ISO Containers Await Transport.[72]

Inside the ISO-matic container is the robotic picker, which sorts supply items and repackages them into smaller loads for ULS-A delivery via hub-and-spoke distribution method.[73] As demonstrated by the 2017 Amazon Robotics challenge, a small, viable, and cost effective robotic picking system will soon be available (Figure 7).[74] The joint force has the added advantage of being able to prescribe and standardized the packaging for supply items. Standardized packaging creates uniform size, weight, and shape of supply items, thereby significantly simplifying the robotics challenge of picking and sorting items for order fulfillment.

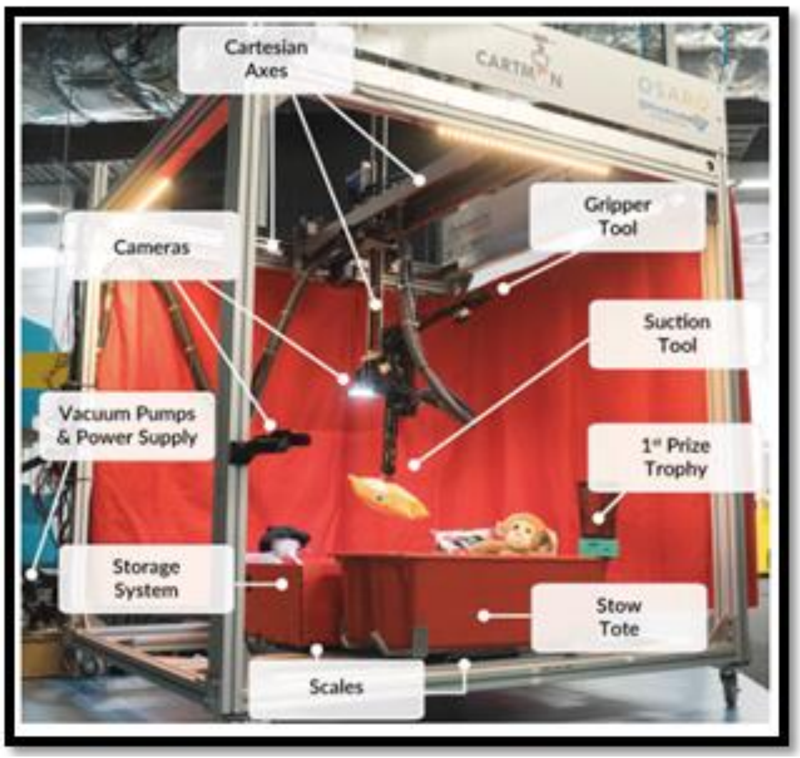

Figure 7. 2017 Amazon Robotics Winner: Cartman[75]

The flexibility offered by the ISO-matic container allows it to act as a hive for swarming unmanned airborne systems (UAS). Forward deployed ISO-matic containers house UAS swarms in distributed locations throughout the battlespace. When activated, the swarm is released to conduct joint force logistics, reconnaissance, or fires tasking.[76] The ISO-matic containers distributed throughout the battlespace are a way to reduce the requirement for the "iron mountain."

The autonomous capabilities of the ISO-matic container (IMC) allow it to create logistic mass and flexibility from distributed locations. The IMC require power that can be generated in several ways: through on-board internal-combustion generator, associated vehicle, batteries, solar, wind, hydro-electric, tidal, or a combination of several of these.[77]

The IMC resist targeting by being placed in remote locations on land, moored off shore, or mounted on ULS-G(O) trucks that change their location often or constantly. IMC can be used offshore, but would require additional onboard systems including: a ballasting system to raise and lower the IMC in the water and aid stability, a method to seal the IMC against pressure and wave action, and an anchoring system. Offshore use of IMC in hub-and-spoke operations have more challenges than use in a swarm model. In the latter model, the IMC only needs to ballast above the surface for a one-time launch of the swarm. Return of the swarm to separate location reduces the challenges required by sustained offshore IMC operations.

If vehicle mounted, IMCs can be massed in a swarm to create forward arming and refueling points (FARP) for joint force aviation or ground operations. The FARPs consolidate IMC equipped ULS-G(O) assets and then disperse them again within a timeline that avoids adversary detection and targeting. This allows for resupply and refuel of manned, unmanned aviation assets, and ground assets, to include the resupply of IMCs. The synchronized swarming of ULS-G(O) assets allows the joint force to realize the benefits of the “iron mountain” while mitigating vulnerability.[78]

The IMC strengthens the network by being a static or mobile network node that boosts signal strength, uses EW and cyber functions to mask friendly positions, and targets enemy assets and capabilities. Network persistence functions that reinforce manned and unmanned airborne cyber, EW, and network capabilities are accomplished by IMC equipped ULS-G(O) assets while providing logistics to sustain distributed operations and joint force operational reach.[79]

The Argument Against Using Unmanned Systems in Joint Force Logistics

Critics of ULS employment contend that the payloads and capabilities of ULS within a hub-and-spoke or swarm distribution method are insufficient to meet requirements. The limited scale of ULS operations is a valid point that speaks to the restricted nature of unmanned capabilities as they currently exist. The limitations of ULS are mitigated by the hybrid logistics approach, which reinforces existing capabilities rather than completely altering joint force logistics. The joint force mitigates the threat of obsolescence by creating ULS employment concepts that allow for capabilities experimentation, integration and evolution.

Cost is another challenge of ULS integration into joint force logistics. The volume of material that must be moved to support large scale joint force operations requires a quantity of ULS that far exceeds the capability of industry to create, or the joint force to procure. This point is true as ULS exist now, but the exponential rate of ULS advancement require an investment into a disruptive logistic capability.[80] As the speed, payload, range and skills of ULS evolve, the ability to place the “iron mountain” out of harm’s way becomes reality.[81]

Vulnerability of joint force logistics to adversary influence is not denied through the employment of ULS. Although distributed and more difficult to target than the “iron mountain,” ULS hide in plain sight and have a limited ability to defend themselves. Laws of war such as the Geneva Convention and theater specific ROE limit the use of lethal force by autonomous systems and increase ULS vulnerability.[82] This risk is mitigated through the use of designated ULS and IMC handlers who use onboard sensors to assess and mitigate threats. The ULS handlers network threat information to separate fires or reconnaissance assets who support ULS defense. Defensive actions required to protect ULS and joint force logistics are not executed without a “man-in-the-loop” to ensure adherence to ROE. The increased risk of distributed logistics is mitigated through networked detection and defense of ULS in accordance with ROE.[83]

As networked systems reside in plain sight, each ULS is a physical entry point into the joint force network. The same assets that support the network can be physically compromised to disrupt or degrade joint force logistics and operations. This vulnerability is mitigated through two aspects of the ULS employment concept.

The first is the ability of ULS to dominate the electro-magnetic spectrum through EW and cyber capabilities. Forward deployed ULS project disruptive electronic attacks and jamming into adversarial networks, allowing the joint force to predict enemy movements, blind their intelligence collection efforts, and outpace their ability to react to joint force operations. To reduce the likelihood of detection, ULS assets are electronically masked to the enemy.

The second aspect of ULS employment that mitigates network intrusion is that any breach of the joint force network by another network creates an opportunity for exploitation. As adversary networks interact with friendly networks they create openings into their system that reveal critical information about enemy activity and capabilities. A drawback to forward deployed ULS is that they are dependent on power.

The power requirements for ULS operation are a significant and detrimental factor to their employment. Although there is no way to mitigate ULS demands for fuel or power, their ability to swarm can aid in rapid refuel or resupply at a massed point. The capability to rapidly swarm on a refueling point in an orderly manner reduces the time required to refuel, resupply ULS and get them back to work.

The IMC, as a static system can be configured to draw power from the environment to offset resupply or refuel requirements. Wind, solar, hydroelectric, or tidal power sources can allow pre-positioned IMCs to operate for years without refueling or resupplying power. Prepositioned IMCs submerged in coastal waters or riverbeds, use tidal or hydroelectric generators to augment battery power.[84] If prepositioned in coordination with host nations, IMCs can be pre-positioned in urban centers on rooftops and use solar, wind or local power sources to sustain operations.

Conclusion

The strategic vulnerability created by the “iron mountain” can be partially mitigated by integrating ULS capabilities into the joint force logistic model.[85] Despite weaknesses, the disruptive capability of future ULS increase the resilience, diversity, and flexibility of joint force logistics. The exponential rate of technological development and changing character of warfare is ignored at our own peril. Dr. Freier of the U.S. Army War College argues that “…senior defense leadership cannot ignore opportunities or current and future competitive advantages that may in fact reduce or eliminate risk that has not yet fully materialized but is nonetheless anticipated.”[86] An evolutionary approach to ULS integration is the best way to experiment, integrate and leverage rapidly emerging capabilities. As stated by General Milley, US Army Chief of Staff, “…simply put, the United States does not want a fair fight among equal forces, but rather it seeks to end wars quickly and decisively."[87] If the joint force is to maintain an unfair advantage it must innovate, and integrate emerging unmanned logistic technologies.

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