It's About Repetitions

How the live, virtual, constructive training environment improves MAGTF integration and ACE-GCE tactical proficiency

by Maj Christopher Huff

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A fourteen-year-old can buy an Xbox, play *Call of Duty*, link up with friends from around the world, and broadcast playing in a simulated tactical environment on YouTube. How is it so easy for a fourteen-year-old to join a distributed interactive simulated (DIS) environment with other players from around the world? This is because Microsoft provides access to the same virtual high-level architecture for multiple players via the Xbox. The game, *Call of Duty*, made by Activision, is the same database of referenced simulated models that provides a common federation for each player to join. Everyone is playing the same game, on the same network architecture, through an Xbox. This concept is expanding in the private sector as multiple gaming systems (i.e., Xbox and PlayStation) are gaining the ability to join a single federation to play the same game, like *Fortnite* for example. This rapidly growing capability in the private sector is giving gamers the opportunity to seamlessly and easily join virtual gaming simulations from around the world. With the procurement and proliferation of so many virtual training devices within the Marine Corps, why are warfighters unable to link into a common simulated tactical environment with any simulator device to create a single simulated wartime environment, accessible for training across the FMF? Although the Marine Corps and DOD have classification requirements that exceed those for an Xbox, the need for ease of connectivity between devices still exists. In order for live, virtual, constructive training to improve, the Marine Corps needs to establish a greater demand for using a DIS environment, improve network requirements that bridge the Aviation Distributed Virtual Training Environment (ADVTE) with other high-level architectures (HLA), and ensure development of virtual training devices is contracted to support a DIS via the LVC-TE.

The Marine Corps has procured virtual training devices to improve training and proficiency via modeling and simulation. Each simulator is designed to meet the requirement the device is developed to support. But what happens when the Marine Corps decides it wants to link these devices into a virtual simulated environment to maximize MAGTF integration with Marine Corps assets from across the fleet? Virtual simulators developed to support specific training metrics across the Marine Corps are designed with "stove-piped planning," often by different companies, and with very different ideas of what type of training the device is attempting to support. As a result, either each device lacks the capability of linking into a combined virtual training environment or will require extensive work to develop a solution to bridge the device into a singular simulated tactical environment. As the demand for integrating these simulated devices grows, contractors are trying to develop software on the back side of device development to bridge HLA, together, into one distributed interactive simulation. A comparison would be trying to link an X-Box with a PlayStation with a Sega Genesis and have each of these systems play *Call of Duty* at the same time. Could you do it? Maybe. But a single high-level architecture would need to be developed that supported all systems, and bridges would need to be developed that allowed those systems to integrate into a single federation.

The demand for distributed interactive simulation is growing in some areas of the Marine Corps faster than others. The aviation community has embraced the federated live, virtual, constructive training environment. The integration of LVC-TE in aviation training and readiness (T&R) requirements has led the Marine Corps' Training and Education Command to transition some of its focus to expanding the capabilities of LVC-TE as was approved in 2015 by MajGen Lukeman and written in the Concept of Operations for the United States Marine Corps Live, Virtual, and Constructive–Training Environment (LVC-TE).[1] With the shift in focus to expanding the LVC-TE footprint, it is increasingly obvious that the growth in capabilities of live, virtual, constructive and federated training is not moving fast enough. In 2015, a group of company grade officers flexed the Marine Corps' capabilities in live, virtual, constructive training by conducting a series of MAGTF simulated integration exercises. The pilots worked out of Marine Corps Air Station Camp Pendleton with the support of the air station's Marine Aviation Training System Site personnel to test the capabilities of the Marine Corps' ADVTE—the distributed interactive HLA the Marine Corps has developed. This test included four separate MAGTF integration exercises that

Integration of multiple aircraft, ground, and fires simulators into one training environment provides Marines the "reps and sets" needed for mastery of tactical combined arms. *(Photo by Cpl Gregory Boyd.)*

brought in multiple virtual simulator devices and personnel from across the MAGTF to participate. These exercises incorporated Marines and Sailors that provided, to the simulated environment, a Marine Direct Air Support Center from Marine Air Support Squadron 3, a Tactical Air Control Center from Navy Tactical Air Squadron 21, Joint Terminal Attack Controllers from 11th Marines, Forward Observers from 1st Air Naval Gunfire Liaison Company, and pilots from the AV-8B, MV-22, UH-1Y, and AH-1Z communities. The after-action reports for the four exercises captured many of the shortfalls in virtual constructive simulations encountered while conducting the MAGTF simulated integration exercises and can be found on the Marine Corps' Center for Lessons Learned website.[2]

In 2007,

> the Office of the Secretary of Defense (OSD) Modeling and Simulation (M&S) Steering Committee commissioned a study to examine various aspects of M&S development and make recommendations that could improve architecture interoperability.[3]

The steering committee determined "near-term actions were necessary to ease the problem of architecture integration. Integration should be made transparent, so that users would interact with a seamless "architecture of architectures."[4] Second, a longer-term goal emphasized an evolutionary process of Common Training Instrumentation Architecture (CTIA), High-Level Architecture (HLA), and Test-Training Enabling Architecture (TENA) architectural convergence.[5] In 2009, a team led by Johns Hopkins University Applied Physics Laboratory began designing a road map for live, virtual, constructive architecture. One of the focuses of the group was federation agreement templates. Gary W. Allen, PhD; Robert Lutz; and Robert Richbourg, PhD, wrote in the September 2010 *ITEA Journal*, with regard to federation agreement templates:

> Many agreements must be established for an LVC simulation environment to function properly. Examples include reference frames, shared databases, entity enumerations, and supporting tools such as loggers and viewers. In multi-architecture LVC environments, there is an even broader list of agreements that must be negotiated, including execution management mechanisms, gateways, and supporting middleware.[6]

Because of the large number of simulator devices and varying software infrastructures developed to support those devices, multi-architecture databases are where—it appears—the Marine Corps and the greater DOD is struggling to find solutions:

> For multi-architecture LVC development to be successful, the communities aligned with the different simulation architectures need to work together toward common goals; differences in the practices and procedures inherent to these communities can lead to misunderstandings, misinterpretations, and general confusion among team members.[7]

Demonstrating LVC-TE capabilities, the now disbanded Joint Forces Command in 2009, through the Joint Training Directorate (J-7), developed the Tactical Joint Training and Experimentation Network: a network that provides a joint training environment combining live and virtual players to execute tactical mission sets in an integrated live and constructive battle space. Joint Forces Command was able to leverage joint training assets, like the Naval Air Warfare Center Training Systems Division developed Virtual Tactical Bridge (VTB) and the Joint Virtual Tactical Radio system:

> The VTB integrated live and virtual radio communications, establishing voice communications between the forward observer, a virtual AC-130 gunship, and a Predator UAV over the JTEN. The connection [was] so seamless that often the trainees are unaware of what is real and what is simulated.[8]

An AC-130 gunship and UAV Predator are not assets that Marines have the ability to train with regularly and often Marines see them, are supported by them, and observe their capabilities for the first time when forward deployed. Improving simulation capabilities empowers Marines to receive the realistic training repetitions needed to be more proficient and lethal war fighters with low-density assets not frequently available for ground units to coordinate with during training and at significantly lower costs.

While the Tactical Joint Training and Experimentation Network exemplifies capabilities in live, virtual constructive simulation, shortfalls still exist in linking HLA among virtual trainers both in the Marine Corps and DOD wide. For example, in the execution of Virtual Flag 17-3, an observation was identified and highlighted in the *Marine Aircraft Group 39 After-Action Report*

for Virtual Flag 17-3 that highlighted connectivity issues between the Marine Corps' ADVTE and Air Force's JTEN.[9] The Marine Corps' MAGTF Fires Integration Center at Marine Corps Air Station Camp Pendleton was required to borrow equipment from the Air Force in order for the simulators to transmit and receive with Air Force virtual simulators integrated on JTEN through the Distributed Mission Operation Center. The borrowed equipment was misconfigured and Marine Corps simulators were only able to transmit to Air Force virtual simulators but could not receive radio transmissions. As a result, a training opportunity in a joint environment was lost. While this is one example, it is not uncommon and in order to have access to joint live, virtual, constructive tactical environments, the Marine Corps must focus on improving network requirements that bridge ADVTE with JTEN and other similar HLA.

In a continued effort to improve the simulated training environment, TECOM created the Marine Air Ground Task Force Tactical Integrated Training Environment concept and teamed with researchers from the University of Central Florida to test integrated training capabilities with both air and ground units. In early 2018, during Command Post Exercise 2 (CPX-2) while supporting Talon Exercise (TalonEx) 2-18, the MAGTF Tactical Integrated Training Environment brought together Joint Terminal Attack Controllers, Forward Air Controllers, and aviation units to flex the LVC-TE and sought to find gaps in training capabilities. Many of the issues discovered during CPX-2 with the simulated federated environment were the same issues that existed in 2015 during the MAGTF integration exercises being conducted at the company grade level within III MAW.

What do improvements in the DIS environment provide? Improvements provide more than the proficiency of a single pilot or of a single infantry commander's integration of his Tactical Air Control Party with aircraft in the battlespace. Expanded DIS capabilities enable commanders to develop large scale plans, implement them in a virtual environment, test their theories, and receive more realistic feedback that can be captured with detailed after actions developed from recorded and studied simulation data. Expanded DIS capabilities provide the ability to increase necessary repetitions that war fighters and leaders need to be more lethal, accurate, and rehearsed across the entire Marine Corps at a significantly reduced cost. Expanded DIS capabilities empowers the small unit leader by giving opportunities to participate in training that, otherwise, occurs on an irregular basis and is not likely available without high level coordination. Expanded DIS capabilities reduce the pressure to keep aircraft flying as many hours in order to support pilot qualifications and proficiency, extend airframe life, and improve aircraft readiness rates. Expanded DIS capabilities improve training by providing opportunities to train with low-density assets and enables training opportunities in a joint environment, both of which may not otherwise be possible unless forward deployed.

What is equally important as improving the network of HLA for distributed interactive simulation is the quality and fidelity of the simulation to true life. If the end user does not feel that the simulation is benefitting them because it is "not real" or "not like the real thing," then the end user is not likely to use it. Lack of quality in the simulation could also result in developing bad habits for the user. An example in lack of simulation quality affecting end user experience is illustrated in the Joint Fire Support Executive Steering Committee Accreditation of the United States Marine Corps Supporting Arms Virtual Trainer for Joint Terminal Attack Controller Training issued by the Joint Staff in 2016. Significant Simulation System Accreditation Team observations included errors in the simulation that deviated from expected or required training experience. For example, one issue was "20mm weapons effects do not meet Simulation Accreditation Criteria (SAC) 2.4.1 requirements for damage." Weapons effects must include damage (structural damage, casualties proportional to weapon size and effects). The Significant Simulation System Accreditation Team observed,

> The 20mm aircraft high explosive incendiary (HEI) round has no damage/collateral damage effects. Simulation does provide visible explosions upon impact. Weapons effects should provide realistic feedback to the trainee and be based on munitions capability.[10]

The simulations have to be of quality. The more deviations to what would be experienced in real life, the less likely the end user is to want to train with the simulator device.

The virtual, constructive tactical environment provides increased tactical proficiency at a fraction of the financial cost of live training and reduces risk. This is evidenced by the ever increasing cost of Marine aviation. The virtual, constructive training environment can be the pressure relief valve for aircraft readiness that commanders have been looking for. Increasing the capabilities of a federated simulated environment with improved graphics, modeling, and unified databases across multiple virtual devices means that commanders can do more with less. It means commanders can reduce the need to fly as many hours in an actual aircraft because commands can achieve Mission Essential Task training requirements in a simulator. If pilots fly the same number of hours or less, achieve more training requirements, and are better trained with simulators, the Marine Corps can extend the life of the aircraft and increase maintenance touch time to improve aircraft readiness. Improved simulation can make better instructors, enable better training environments, and improve overall qualifications for squadrons.

The GCE can benefit in a similar capacity. To conduct a live fire field exercise, months of planning occurs. Tremendous man hours are spent with logistics planning, movements, and range scheduling. Field exercises typically result with only a few days in the field and generally, a single culminating event. These efforts are good in building proficiency in planning but are limited in giving the number of repetitions for operational and tactical level war fighters to be the most proficient in the world. A virtual, constructive training simulation can produce an environment

with an enemy that shoots back and can be set up in minutes.

The community that is using these systems, the ACE, and maximizing these systems has created a demand to use virtual trainers in the form of each type, model, and series integrating simulation into their T&R standardization manuals. As a pilot, many, not all, T&R requirements can be met with a virtual simulator because of the expansion of capabilities in visual graphics quality, interactive threat models, and improvements in the federated network integration of virtual devices. As the simulated environment improves with graphics, effects, and experience, the number of aviation T&R requirements that can be evaluated by simulation grows. The T&R requirements drive a demand for the simulator and reciprocally as the aviation community's T&R manuals lean more into relying on the virtual and constructive training environment, improvements in the capabilities of the distributed, virtual, constructive training environment grow. Integration of Virtual Battle Space 3, Mobile Fire Support Trainer, MAGTF Tactical Warfare Simulation, SAVT, TDKs, Fire Support Coordination Center simulators, OASIS, and aircraft virtual simulators like the AH-1Z, MV-22, UH-1Y, and F-35 on the ADVTE is only the beginning. An increase in the number of simulator devices linked on ADVTE or bridged into a distributed interactive simulation would allow commanders to truly wargame with assets and personnel from across the MAGTF against a simulated target array that shoots back, thus making the Marine Corps the most tested, current, and proficient war fighting organization in the world.

The Marine Corps needs to focus on improving the ADVTE network, an HLA that already exists, and improve the ability of every virtual trainer to link to a digital interactive simulation. Additionally, to continue driving demand for the use of virtual trainers and allow access to a greater number of training repetitions for Marines, virtual trainers need to be incorporated into T&R manuals across the Marine Corps. Additionally, when developing and procuring future virtual trainers, the capability of those virtual devices to join the ADVTE needs to be written into the procurement contract, thereby ensuring the growth of LVC-TE via a common HLA like ADVTE. The ability for present and future Marine warfighters to train via simulation and have access to a higher number of training repetitions against an active threat, with multiple linked virtual devices should be as easy as a fourteen-year-old turning on an Xbox. In a time of reduced conflict and in an era where a growing number of young Marines have not seen a combat zone, Marines need more tactical repetitions to be the most lethal warfighters in the world. Distributed interactive simulations via the LVC-TE can provide those repetitions.

Notes

1. MajGen J.W. Lukeman, *Concept of Operations (CONOPS) for the United States Marine Corps Live, Virtual, and Constructive-Training Environment (LVC-TE),* (Quantico, VA: TECOM, date).

2. Marine Corps Center for Lessons Learned: *Linked Simulator Vertical Assault After Action Report* (2015-10-07), *Linked Simulator Vertical Assault After Action Report* (2015-09-20), *Linked Simulator Aerial Interdiction Strike After Action Report* (2015-11-05), *MAG-39: Linked Simulator After Action Report* (2016-07-07).

3. Gary W. Allen, Robert Lutz, and Robert Richbourg, "Live, Virtual Constructive, Architecture Roadmap Implementation and Net-Centric environment Implications," *ITEA Journal*, (Fairfax, VA: International Test and Evaluation Association, September 2010). "The Office of the Secretary of Defense (OSD) Modeling and Simulation (M&S) Steering Committee commissioned a study to examine various aspects of M&S development and make recommendations that could improve architecture interoperability."

4. "Live, Virtual Constructive, Architecture Roadmap Implementation and Net-Centric environment Implications," "The steering committee determined that, "near-term actions were necessary to ease the problem of architecture integration. Integration should be made transparent, so that users would interact with a seamless 'architecture of architectures.'"

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7. "Live, Virtual Constructive, Architecture Roadmap Implementation and Net-Centric environment Implications," "For multi-architecture LVC development to be successful, the communities aligned with the different simulation architectures need to work together toward common goals; differences in the practices and procedures inherent to these communities can lead to misunderstandings, misinterpretations, and general confusion among team members."

8. Live and Virtual Assets Train Jointly, June 2010, John S. Kostoff, "Live and Virtual Assets Train Jointly," *Signal Magazine*, (June 2010), available at https://www.afcea.org: "The VTB integrated live and virtual radio communications, establishing voice communications between the forward observer, a virtual AC-130 gunship, and a Predator UAV over the JTEN. The connection [was] so seamless that often the trainees are unaware of what is real and what is simulated."

9. Marine Aircraft Group 39, "After Action Report for Virtual Flag 17-3," (Camp Pendleton, CA: June 2017).

10. Memorandum for Chairman, Joint Fire Support Executive Steering Committee (JFS ESC), JFS ESC Accreditation of the United States Marine Corps (USMC) Supporting Arms Virtual Trainer (SAVT) for Terminal Attack Controller (JTAC) Training, August 2016; for additional reading: reference previous *Gazette* Article, "The Tip of the Live, Virtual, Constructive Spear" and the Department of the Navy Science and Technology ONR BAA Announcement #11-005, Live, Virtual, and Constructive (LVC) Training Fidelity.