Polygone LVC: The New Paradigm for EW Training

Lt Col Scott Case
United States Air Force
Warrior Preparation Center Detachment 3 Germany
Scott.Case@us.af.mil

Ryan McLaughlin
Northrop Grumman
Orlando, FL
Ryan.McLaughlin@ngc.com

ABSTRACT

By the end of 2015, the Multinational Aircrew Electronic Warfare Tactics Facility (MAEWTF) known as Polygone range, based on a tri-national agreement between France, Germany, and the United States will establish itself as a world-class Live-Virtual-Constructive (LVC) training range. Through working together with German Air Force Command, French Air Force Command, United States Air Forces in Europe-Air Forces Africa (USAFE-AFAFRICA), and several LVC industry leaders, Polygone will offer a first-of-kind capability that promises to usher a new paradigm of Electronic Warfare (EW) training. The initial operational capability reuses or repurposes existing Polygone range infrastructure while leveraging innovations made by other ranges, particularly the Joint Pacific Alaska Range Complex (JPARC). By avoiding a "home grown" approach, Polygone managed to save approximately $300 million in acquisition costs and yield a similar training capability.

The baseline of the Polygone LVC project, also known as Multinational Aviation LVC Training System (MALTS), provides a mobile LVC range capable of bringing advanced EW training to major exercises worldwide. The initial phase included developing innovative virtual surface-to-air missiles (SAMs) leveraging the expertise of professional German Air Force live SAM operators, improving training capabilities for future Special Operations Forces (SOF) and Joint Terminal Attack Controller (JTAC) mission readiness training, and establishing the framework required for a worldwide distributed training audience. The lack of modern advanced SAM training assets, increasingly prohibitive live training restrictions, and alarming increases in potential adversary air defense capabilities have led to the Polygone's development of virtual SAMs. These virtual SAM operator stations enable trained threat operators to utilize modern and advanced SAM techniques at virtual single and double digit SAM stations providing affects to live aircraft flying training missions at Polygone. This paper will discuss the MALTS LVC project, development of virtual SAMs for EW training, and how Polygone leveraged JPARC LVC innovations to advance Coalition training in Europe.

ABOUT THE AUTHORS

Lt Col Scott Case is the Commander, Warrior Preparation Center Detachment 3 in Bann, Germany. He is responsible for providing USAFE and NATO aircrew robust and realistic integrated air defense system scenarios using manned and unmanned threat systems. He leads a tri-national organization consisting of 31 US and over 100 French and German nationals with an area of responsibility over 7,000 square miles. His team provides training to over 21 countries and over 4400 training missions per year.

Lt Col Case was born in New Orleans, Louisiana. He entered the Air Force in 1997 receiving a commission through the Reserve Officer Training Corps. Lt Col Case had several combat deployments in support of Operation Enduring Freedom. During his deployments to Diego Garcia, he flew combat sorties and served as B-52 Mission Planning Cell Team Chief. He also served as a Bomber Liaison Officer at the Combined Air Operations Center at Al Udeid Air Base. Most recently, he deployed to International Security Assistance Forces Joint Command in Kabul, Afghanistan where he served as Chief of Plans for the Electronic Warfare Coordination Cell. Prior to his current assignment, he was the Director of the 53 WG Office of Readiness, Eglin AFB, FL.

Ryan McLaughlin is the Lead LVC Engineer for the LVC Mission Integration Department at Northrop Grumman. He has a B.S. in Computer Engineering from the University of Central Florida. Ryan has 9 years of experience developing mission-critical software for the Air Force, Army, and Navy. His current role includes technical lead for the PACAF Live Virtual Constructive (LVC) and United States Air Forces in Europe (USAFE) LVC programs.

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Background

The US Secretary of Defense, French and German Ministers of Defense, established the Multinational Aircrew Electronic Warfare Tactics Facility (MAEWTF), or Polygone, with a tri-national memorandum of understanding in 1979. Since then, Polygone has become the focal point for aircrew electronic warfare (EW) training for continental Europe. The EW range provides robust EW scenarios employing a mix of real world and simulated surface to air threats. The real world systems are employed by highly qualified former East German operators. The 25 total threat systems are dispersed among 5 fixed sites in Germany as well as approximately 30 temporary sites throughout the Polygone training area in both Germany and France.

While the airspace over Polygone spans a 120 NM from north to south, and 40-80 NM east-west, the EW range is no longer confined to this airspace. Polygone's deployment capability has allowed Polygone to support more than 60 major exercises in 18 European countries in a period of only four years. This includes exercises for EUCOM, USAFE, NATO, Partners-for Peace, as well as other training events.

Polygone deployment operations exceeded local operations for the first time in 2011 with 243 off station training days vs 235 training days on station. In 2013, Polygone greatly exceeded the highest operations tempo of the previous 28 year history. The range shattered that record again in 2014 with a 150% increase over the previous year in deployed operations with 469 training days provided. A training day is defined as one threat system operating in a training scenario at a deployed location, not including weekends, travel, or holiday time. The remarkable increase in off station operations has driven the requirement for Polygone to develop a more complete mobile range concept that would allow concurrent deployed and local operations, both providing homogenous training capability.

EW training is a critical cornerstone for Joint Forcible Entry Operations and for overcoming Anti-Access/Area Denial (A2AD) challenges expected in the theaters. Central to the tenets of these activities is the ability to gain Air Superiority early and maintain through the campaign. Air Superiority hinges on the ability to neutralize or suppress Integrated Air Defense Systems (IADS). The ability to neutralize or suppress IADS is an extremely perishable warfighter skillset that relies heavily on richly representative threat systems to train against. Air Superiority is gained through holistic integration of US capabilities across the Joint community, to include Joint EW and cyber activities, supported by Coalition capabilities. Once these enablers permit Air Superiority, other Joint and Coalition forces are allowed access to desired battlespace with increased freedom of activity, mobility, resupply, and establishment of operable friendly forces zones.

Polygone Electronic Warfare Training

The training capability at Polygone currently consists of Soviet-era real-world Surface-to-Air Missile (SAM) systems, such as the SA-6 and SA-8, US-built threat simulators, mobile threat simulators, infrared and man-portable SAM simulators, and visual missile simulations. Table 1 below lists and describes the available EW) training assets available to the Polygone training audience. These assets may be used for Polygone's fixed site training capabilities such as the Multiple Threat Emitter System (MUTES) MUTES or mini-MUTES or be deployed with the mobile MALTS vehicle with assets such as VPQ-1, Roland, or SA-8.

Table 1: Polygone EW Training Capabilities

System type	Description	Number available	Notes
SA-6	Mobile short-medium range surface to air missile system developed in the 1970s.	3 x radar vehicles 1 x transporter erector launcher (TEL) with instrumentation 1 x TEL non-modified	Some systems have been upgraded with TENA instrumentation. Most unsustainable analog systems have been updated with digital systems.
SA-8	Amphibious wheeled short-range SAM designed to protect troop movements or point defense.	3	Some systems have been upgraded with TENA instrumentation.
Roland FGR	Command post and EW surveillance radar for highly mobile short-range air defense system.	2	TENA integration pending Controls up to 10 Roland FRRs
Roland FRR	Mobile low-level mobile missile system designed to protect mobile field formations and airfields.	5	TENA integration pending
VPQ-1	Tactical Radar Threat Generator (TRTG) is a single manned auto-tracking radar emitter. Each TRTG simulates either AAA or SA-8 radars	6	When combined with Digital Integrated Air Defense System (DIADS)_ and Radar Warning Receiver (RWR) reprogramming, the TRTG can simulate low fidelity SA-15 engagements
MUTES	Fixed site SAM emitter that simulates SA-2, 3, 6, 8, NAVAL SAMs, AAA, and limited air intercept radars.	1	
Mini-MUTES B	Movable (not mobile) SA-2 and SA-6 simulator	2	
Mini-MUTES M	Movable (not mobile) SA-15 and SA-19 simulator	1	TENA integration pending
RWR Lite	Portable RF stimulator that emulates transmission characteristics of an SA-3/6	1 – SA-3 simulator 1 – SA-6 simulator	Can be instrumented with ARES crew device for real time feedback
Mallina	Portable ground-based system which generates the UV stimulation required to produce threat declaration in UV Missile warning systems (MWS)	3	Current compatible systems include AN/AAR-47, 54, 57 (CMWS), 60 (MILDS) and MAW-200
MAST	The Man-Portable Aircraft Survivability Trainer (MAST) is a Man-Portable Air Defense System (MANPADS) live training device primarily used to	1	Current compatible systems include AN/AAR-47, 54, 57 (CMWS), 60 (MILDS) and MAW-200. Designed

	train aircrews to react to SAM threats during live training exercises.		to operate standalone.
Smokey SAMs	Consists of the GTR-18A Rocket and PVU-3A/E Igniter, is a pyrotechnic device designed to provide aircrews a visual indication that they are under attack by SAM.	3	
WESS	Weapons Effects Signature Simulator (WESS) supports IR SAM/MANPAD operations as part of outdoor training exercises for aircraft and ground based troops.	6	Upon initiation, the M176 simulator fires vertically out of the WESS up to 550 feet +/- 50 feet (160.75 m +/- 15.25 m).
BOSS	Battlespace Operations Support System is a Link 16 control system that allows operators to inject Virtual and Constructive simulations into Live training environments	3	

While the airspace over Polygone spans greater than 7,000 square miles, the EW range is no longer confined to this airspace. Polygone's deployment capability has allowed Polygone to support more than 60 major exercises in 18 European countries in a period of only four years. This includes exercises for European Command (EUCOM), USAFE, North Atlantic Treaty Organization (NATO), Partners-for Peace, as well as other training events.

Polygone currently operates only "single-digit" SAMs, which do not adequately train to the double-digit (SA-11, -12, -15, etc.) capabilities in-theater, for training to meet the needs of anticipated Joint Forcible Entry Operations locations. Not only is the Polygone core capability limited to "single-digit" EW threats, but enemy capability to defeat US EW capability is expanding rapidly. In a 29 Feb 2012 address to the US House of Representatives' Subcommittee on Emerging Threats and Capabilities, Dr Kaigham J. Gabriel, the Deputy Director of the Defense Advanced Research Projects Agency (DARPA), noted that due to the increasingly sophisticated electronics available commercially, "nearly a dozen countries are now producing EW system variants and new versions at a much faster cadence than we have; from a pace of a new system every 5 to 10 years 2 decades ago, to one every 1.5 years today." [3] The requirement to modernize Polygone's capabilities was postponed through 20 years of counter-insurgency-focused operations, and enemy capabilities to control and exploit the electronic spectrum are improving at a quickening pace.

USAFE-AFAFRICA is currently funding development of high-fidelity virtual SAMs and virtual/constructive systems that will allow Polygone to connect to virtual training audience and ensure LVC threat systems comply with Combat Air Force (CAF) Distributed Mission Operations (DMO) standards in order to provide training to a broader audience. Every platform that connects to Polygone for training will require integration. Polygone is capable of simulating radar emissions and launch of high fidelity single and double-digit (missile fly out only/no radar) SAMS in support of aircrew Electronic Warfare/Joint Suppression of Enemy Air Defenses and Joint Terminal Attack Controller (JTAC) Training. USAFE-AFAFRICA JTP still requires the capability to simulate high-fidelity Opposing Force (OPFOR) double-digit SAMs that present a realistic threat to stimulate aircrews and aircraft warning systems.

Polygone LVC

The Polygone LVC program addresses training gap issues, providing critical core training capabilities for future and anticipated US operations, and for training with our Joint, Coalition and Allied partners. By the end of 2015, the Multinational Aircrew Electronic Warfare Tactics Facility (MAEWTF), based on a tri-national agreement between France, Germany, and the United States will establish itself as a world-class Live-Virtual-Constructive (LVC)

training range. Through working together with German Air Force Command, French Air Force Command, USAFE-AFAFRICA, and several LVC industry leaders, Polygone will offer a first-of-kind capability that promises to usher a new paradigm of electronic warfare training. The initial operational capability reuses or repurposes existing Polygone range infrastructure while leveraging innovations made by other ranges, particularly the Joint Pacific Alaska Range Complex (JPARC). By avoiding a "home grown" approach, Polygone managed to save approximately $300 million in acquisition costs and yield a similar training capability. This is in comparison to buying an all live training infrastructure for Polygone instead of leveraging LVC capabilities.

Polygone is developing an advanced VC capability that will utilize low fidelity simulations to enhance high fidelity simulators or the live training environment. Low fidelity simulations include models and simulations such as Modern Air Combat Environment (MACE) that replicate high-fidelity systems such as SAMs and aircraft, but not at a level of fidelity required for training aircraft operators. This cost-saving approach enhances a high fidelity environment without sacrificing training quality. Simulators include a distributed training audience consisting of Mission Training Centers (MTCs), weapons systems trainers, and other aircrew training devices. This includes integration of virtual Command and Control, Intelligence, Surveillance and Reconnaissance (C2ISR) platforms, specifically virtual Airborne Warning and Control System (AWACS), Joint Surveillance Target Attack Radar System (JSTARS), and Rivet Joint. The project also includes integration of Polygone capabilities with CAF DMO fighter, bomber, and JTAC simulators and training systems.

The Polygone LVC project has been broken down into 4 major phases. Phase one established Polygone's first LVC capability, the MALTS. This concept leveraged government investments at JPARC and Nellis to yield a new capability in USAFE with significant cost savings and dramatically reduced delivery time. Phase two expanded MALTS capabilities throughout Polygone and enhanced deployed training capability. Phase three builds upon earlier investments by adding low fidelity advanced (double digit) SAM replication designed to provide high-fidelity simulators. These three phases set the foundation for next generation aircraft while preserving training capability for legacy aircraft. Phase four seeks integration with next generation aircraft MTCs as well as high-fidelity advanced emitters. The projects will likely change over time as improved capabilities, both commercial and government, become available.

The baseline of the Polygone LVC project, also known as MALTS, provides a mobile LVC range capable of bringing advanced EW training to major exercises worldwide. The initial phase included developing innovative virtual S leveraging the expertise of professional German Air Force live SAM operators, improving training capabilities for future Special Operations Forces (SOF) and JTAC mission readiness training, and establishing the framework required for a worldwide distributed training audience. The lack of modern advanced SAM training assets, increasingly prohibitive live training restrictions, and alarming increases in potential adversary air defense capabilities have led to the Polygone's development of virtual SAMs. These virtual SAM operator stations enable trained threat operators to utilize modern and advanced SAM techniques at virtual single and double digit SAM stations providing affects to live aircraft flying training missions at Polygone.

MALTS phase two allows Polygone to provide remote and dispersed Command and Control (C2) and LVC modelling with significant cost savings to multiple levels of training audience. The integration effort would allow the Polygone Exercise Team to control threat emitters via TENA architecture or provide man-in-the-loop SAMs in a virtual exercise. The capability leverages existing range emitters and infrastructure to provide near-live system capability while saving millions of dollars. This innovation will allow Polygone to inject realistic LVC events real time during exercises. It also allows for integration of C2ISR simulators in live training events.

The Northrop Grumman Distributed Mission Operations Network (DMON) portal allows direct connection with any DMON high fidelity simulation participant. Due to dissimilarities in terrain databases, flight models, threat modeling, and other related issues, each weapons system trainer or aircrew training device must be individually integrated and tested with Polygone in order to establish a common operating picture. Polygone will also leverage the WPC as a distributed training hub enabling training across a broad spectrum of major distributed networks, such as Battlefield Information Collection and Exploitation System (BISCES) and Joint Training and Experimentation Network (JTEN). Those networks will allow Polygone to reach other non-traditional training audiences such as JTACS, NATO AWACS, and some approved NATO partner simulators. The multi-tiered framework establishes the baseline for future integration of F-35 and other advanced aircraft.

The intended primary applications of Polygone LVC are focused on enhancing, not replacing the live training environment. All training audiences must follow the same rulesets and constraints. Training rules, flight discipline, rules of engagement, safety rules, operational limits, etc., shall remain universal across the board regardless of whether the entity is live, virtual, or constructive. The objective is to provide full spectrum, or near full spectrum training requiring exercise planners to avoid scenarios that introduce excessive risk or situations that would not be expected in combat. For example, an SA-15 should be used in a scenario only if the appropriate threat warning can be received realistically by all players. In other words, if the aircraft requires an emitter on the ground to trigger the Radar Warning Receiver (RWR), any virtual SAMs must correspond (or be proxy threats for) an actual emitter on the ground. This affords all aircrew a fair, realistic chance to threat react. However, if all participants are virtual, this restriction is no longer applicable.

Polygone Time Space Position Information Sources

Radar tracking

The Polygone range utilizes numerous sources for aircraft position tracking. Since Polygone is located within the European Union, the range must utilize a variety of radar tracking sources. For operations taking place in Germany, Polygone utilizes the Civil-Military ATM Co-ordination Tool (CIMACT) to process German commercial radar feeds as this is the only radar source available for Polygone operations over Germany. Operations that take place over France require a different radar data source. Currently the Polygone's fixed site operations radar feed is limited to Germany and France. Other operations are conducted with the MALTS vehicle which does not have access to radar feeds.

Air Combat Maneuvering Instrumentation Pods

The Polygone, like the JPARC, utilizes Air Combat Maneuvering Instrumentation (ACMI) pods as a means to provide Time Space Position Information (TSPI) data for live United States Air Force (USAF) aircraft. These instrumented pods provide velocity, location, acceleration, callsign, and aircraft type data that is necessary for both live and virtual participants. Polygone currently utilizes the P5 ACMI pods to provide this information for training on the range. The P5 pod is the preferred source for aircraft position tracking that is used during and post mission debrief as it provides the highest fidelity for aircraft position information.

Live systems on the range, such as Adaptable Range Exercise System (ARES), Individual Combat Aircrew Display System (ICADS), and Track Data Fusion Engine (TDFE), use ACMI data to provide playback for debrief, data fusion, and Common Operating Picture (COP) capabilities at Polygone. These capabilities and systems are necessary in order to conduct training at Polygone.

Polygone converts the TSPI data from ACMI pods into Test and Training Enabling Architecture (TENA) Platform and PlatformDetails Stateful Distributed Objects (SDO) utilizing TENA middleware version 6.0.4. These SDOs are utilized by both live range systems as well as future virtual participants, through the use of DMO LVC Portal, to provide aircraft position information. The two SDO's combined provide data such as aircraft TSPI, velocity, acceleration, aircraft type, affiliation, and callsign.

Our European allies do not employ the use of P5 pods, but still may be instrumented utilizing the Flight Profile Recorder (FPR). The FPR is the NATO standard for air-combat training systems in Europe. The German Air Force, the TLP (Tactical Leadership Program) Training Center in Albacete, Spain, as well as the air forces of over a dozen European countries use the instrumentation system in daily flight operations. Its capabilities are nearly identical to the P5 pod and are also able to provide important TSPI information for our coalition partners during training. This pod has been tested and demonstrated at Polygone, but the permanent installation of all necessary systems and components are yet to be completed. The performance and capability of the FPR system during testing appeared to be nearly identical to P5. This is promising for interoperability for environments at Polygone where both P5 and FPR may be used simultaneously. This system is in the process of being installed by the German Air Force.

Virtual Surface-to-Air Missiles

The lack of advanced SAM training assets and increasingly prohibitive live training restrictions have led to the Polygone's development of virtual SAMs. The objective of the virtual SAM is to allow the Polygone to employ their expert SAM operators to utilize advanced and modern double digit SAM tactics to the war fighter without having the cost prohibitive systems at Polygone. The Virtual SAMs would be modeled by a common off the shelf software called MACE. The MACE software was updated to model the instrumentation of SAMs enabling experienced operators to operate the software just like they are sitting in the real equipment. The software utilizes touch screen technology to allow the operators to throw switches, turn dials, and push buttons to utilize proven advanced techniques that were previously possible only in the real equipment. The MACE software built upon its radar and threat modeling pedigree to provide realistic SAM radar scopes as well as tracking and targeting behavior. Figure 1 shows all three SA-8 operator stations on a single touch screen.

Figure 1 MACE Virtual SA-8 threat station: All three operator stations on a single screen

The development of the virtual SAM is broken into multiple phases, with each phase representing a new SAM to model. The first SAM type that was modeled was the SA-8. This SAM requires a three person team to operate and fire missiles when operating a live SA-8. Each person has a distinct role and job function within the kill chain of the SAM. This functionality was captured by the MACE virtual SA-8, with each operator position having its own set of touch screens. Each set of screens have an exact replica of the scopes, dials, switches, and buttons allowing the virtual SA-8 operator to perform the same job functions. If there is a shortage of expertise or manpower, then a single set of touch screens on a single machine can run all three positions. This assumes the individual is capable running all three stations proficiently enough to perform all three jobs. This feature allows Polygone to increase the threats utilized on the range that can be paired up with the desired expert operators. This also saves USAFE money on costs for increased number of operators while still providing additional threats. This can only be achieved if the virtual SAMs can control live threats.

Software systems controlling live threat simulators, such as the Unmanned Threat Emitter (UMTE) at JPARC, are not a revolutionary concept, but having an expert that can utilize advanced tactics is a new approach for controlling live threats. In order for Polygone to fully realize its objectives for virtual threats, MACE virtual SA-8 will have to possess the ability to directly control them. The initial phase of the MACE Virtual SA-8 cannot yet directly control Polygone live threats. That portion is work in progress and should be completed by the end of 2015. Once

completed the threat operators sitting in the operations center at Polygone will be able to target and engage live or virtual aircraft using real emitters on the range.

The next phases will include the development of a Virtual SA-6 as well as SA-11 and SA-15. These next phases will enable the Polygone to utilize its array of virtual SAM stations as a variety of threat types that can complement the real world SA-8, SA-6, Roland, etc. that is deployed to train air crews today. Additionally the virtual SAMs will also be able to train pilots against advanced single and double digit SAM tactics in their simulators at their home stations. This will be achievable through Polygone's DMO network connections through the WPC.The WPC has a number of connections to high fidelity simulation networks for both USAF and NATO partners. With the WPC's connection to networks like the DMON, the CAF can take advantage and allow the warfighter to experience these advanced SAM tactics in their simulator for the first time and not while flying a mission in combat.

Leveraging JPARC Technologies and Approach to LVC

In order to reduce acquisition costs, implementation time, and integration risks, Polygone chose to leverage the LVC technologies developed at the JPARC. JPARC utilizes TENA, the cornerstone of JPARC's architecture, and was also chosen for Polygone. Marsden [1] et al. describe the JPARC's architecture and solutions developed to enable LVC interoperability. This would be the foundation for leveraging JPARC technologies and reducing time required to deliver a functional training capability. Like most open air ranges, Polygone utilizes the P5 instrumentation pod as well as the radars and Tactical Data Links or Link16 to provide TSPI data. These same data sources would be utilized at Polygone as well.

In order to take advantage of these data sources, Polygone would leverage native TENA systems, which many were developed for JPARC, to interface with the sources of data and turn them into TENA objects. Polygone would leverage Government Furnished Equipment (GFE) software such as TENA Individual Combat Aircrew Display System (ICADS) to handle the translation of P5 instrumentation translation to TENA and Adaptable Ranges Exercise System (ARES), was used to provide a native TENA common operational picture. Additional Common Off-the-shelf (COTS) software such as TDFE, SimShield, and TENA gateways were used to complete tasks including track correlation, Cross-Domain Solutions (CDS), and weapons and SAM simulation.

The ARES system is a robust multi-purpose COP which possess the ability to display the TENA battlespace on a two dimensional map. The ARES software is fully customizable to display many operational features such as regeneration zones and bulls eye locations. The ARES software is also capable of allowing operators to assign aircraft targets to remote range SAM threats, for both simulated and live aircraft. This allows OPFOR threat management from a single screen allowing operators to see the entire LVC battlespace in a single location and assign live or virtual targets to live threat assets.

The Digital Integrated Air Defense (DIADS) system is a GFE piece of software that is responsible for high fidelity modeling of Integrated Air Defense Systems (IADS). This software is utilized at JPARC, Nellis, and now Polygone to provide high fidelity SAM modeling and missile fly-outs in a native TENA format. DIADS is capable of communicating with software systems such as ARES, as well as simulated and real SAM threats, to model SAM engagements and provide near real time engagement results. This allows for high fidelity SAM shot reports for post flight debrief. This information is important for EW training ranges such as JPARC and Polygone which primarily provide EW training.

The TDFE system and its corresponding TENA gateway are the core of Polygone's ability to provide fused aircraft positioning. TDFE is responsible for track correlation between the various radar feeds, P5, and Link16 track sources at Polygone. The result of its correlation is a single fused TENA object that Polygone uses as a trusted source for aircraft position. This is an important component due to many of Polygone's coalition nations that do not have their aircraft instrumented with P5 pods, but may be Link16 capable. The TDFE system is the correlation software that is used for JPARC's 9C2 correlation system and therefore a perfect fit for Polygone's JPARC-like architecture.

The JPARC utilizes the COTS SimShield CDS to protect its high side data from its low side. JPARC has established the path to getting an Approval To Operate (ATO) for its native TENA CDS device. This CDS is used for daily training as well as large force exercises such as Red Flag Alaska and Northern Edge. Polygone, with its

TENA architecture, would take advantage of all of the good work done at JPARC getting the CDS ATO for its own SimShield ATO. McLaughlin [2] et al. describe the process and lessons learned during JPARC's journey in obtaining and maintaining their CDS ATO. These lessons learned were directly utilized at Polygone. This is only possible due to the likeness Polygone's architecture is to JPARC. This allows Polygone to save both time and money to receive its ATO for SimShield allowing it to reduce the time required to wait before simultaneous classified and unclassified operations can begin.

Conclusions

Utilizing the same architecture approach as JPARC at Polygone has greatly reduced many aspects of LVC integration at Polygone. The cost and schedule reductions have enabled Polygone to develop and deploy the mobile MALTS vehicle and provide the Polygone its first major upgrade in a timeframe that required little software or systems modifications. This was possible due to Polygone taking the approach to leverage established technologies and integration techniques developed and integrated at other ranges. This approach has proven that training ranges can migrate towards a LVC training architecture with reduced costs and time to train while at the same time greatly increasing the fidelity of training provided to the warfighter.

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