Live Training Transformation (LT2) – A Strategy for Future Army and Joint Live Training

Paul Dumanoir
U.S. Army PEO STRI
Orlando, Florida
paul.dumanoir@peostri.army.mil

Jorge Rivera
U.S. Army PEO STRI
Orlando, Florida
Jorge.Rivera2@peostri.army.mil

ABSTRACT

The Live Training Transformation (LT2) is a strategy that utilizes product line engineering development concepts and principles to guide the acquisition of the family of live training programs under the purview of U.S. Army Program Executive Office (PEO) Simulation Training and Instrumentation (STRI), Program Manager for Training Devices (PM TRADE). The LT2 strategy addresses a set of operational requirements defined by approved Operational Requirements Documents (ORDs), and is being transformed into an Army program as a Family of Training Systems (FTS) documented in the LT2-FTS Initial Capability Document (ICD). The LT2 product line management concept of operations focuses on the holistic requirements of all Live domain training systems, with the objective to maximize component reuse, reduce fielding time, minimize programmatic costs, and enhance training benefits afforded to the soldier. Through successful execution of the product line strategy, LT2 will deliver a set of common components that provide integrated and interoperable training solutions for live collective training across the home stations, Combat Training Centers (CTCs), deployed, and Joint training domains. This paper describes the innovative approach PEO STRI is using to manage the LT2 product line. In doing so it details the combination of organizations, processes, and technologies that encompass the LT2 concept to include the product line architecture known as the Common Training Instrumentation Architecture (CTIA). In addition, this paper describes how the LT2 product line is being used to support the Future Combat System (FCS) Training Common Component (TCC) program and how it will interoperate with other Army and Joint architectures in support of a Live-Virtual-Constructive (LVC) training and test solution.

ABOUT THE AUTHORS

Paul Dumanoir is the LT2 chief engineer at U.S. Army Program Executive Office (PEO) Simulation Training and Instrumentation (STRI). Prior to his involvement with LT2 he was the project director for the OneSAF program, and a principal investigator at US Army RDECOM managing individual combatant simulation Science and Technology Objective (STO) programs. His current interests include Live test and training simulations, embedded training and mission rehearsal applications. He has 17 years experience working in DoD simulation and training programs. He earned his B.S. in Electrical Engineering from the University of South Alabama in 1987 and his M.S. in Computer Systems from the University of Central Florida in 1991.

Jorge Rivera is the LT2 Assistant Project Manager (APM) for LT2 at PEO STRI. His experience includes a strong software engineering background as the lead software engineer for several programs to include the Joint Readiness Training Center – Instrumentation System (JRTC-IS) and programmatic experience as the Project Director for Instrumented Ranges and Urban Operations efforts. He has 21 years experience working in DoD acquisition both from a technical and program management perspective. He earned his B.S. in Electrical Engineering from the University of Puerto Rico in 1983 and his M.S. in Electrical engineering from Fairleigh Dickinson University, NJ in 1987.

Live Training Transformation (LT2) – A Strategy for Future Army and Joint Live Training

Paul Dumanoir
U.S. Army PEO STRI
Orlando, Florida
paul.dumanoir@peostri.army.mil

Jorge Rivera
U.S. Army PEO STRI
Orlando, Florida
Jorge.Rivera2@peostri.army.mil

INTRODUCTION

To retain our Armed Forces effectiveness with less redundancy, we need to be ready to wring every ounce of capability from every available source. That outcome can only be accomplished through a more seamless integration of Service capabilities. To achieve this integration while conducting military operations we must be fully Joint: institutionally, organizationally, intellectually, and technically. Future commanders must be able to visualize and create the "best fit" of available forces needed to produce the immediate effects and achieve the desired results (CJCS, 2004).

Army Training Transformation across the Department of Defense (DoD) is a primary effort toward this imperative of jointness. This paper describes how the Army's Live Training Transformation (LT2) product line strategy is providing enablers for achieving an efficient joint Live training environment. LT2 provides the means to transform Army training as the Army, itself, is being transformed to a more deployable, more lethal, more survivable, information-age enabled force. LT2 will support efficient and effective use of training resources while maximizing collective combat proficiency from crew/squad to brigade combat team and selected division/corps brigade slice elements across the spectrum of conventional and special operations forces.

BACKGROUND

Live Training Transformation (LT2)

LT2 is an Army initiative to develop a live training product line that includes current capabilities centered on a common architecture, known as the Common Training Instrumentation Architecture (CTIA), and expands on those capabilities by eliminating gaps between current and future weapons systems and those live training systems available to support them. The LT2 product line strategy is required to synergize training instrumentation, targets, and tactical engagement simulation systems to ensure the efficiency and effectiveness of training during peacetime, mobilization, mission rehearsal, and in-theatre during deployed military operations. LT2 training systems, also referred to as "LT2 products", provide the means to plan, prepare, execute and provide training feedback for Force-On-Force (FOF) and Force-On-Target (FOT) training. LT2 training systems will also provide interfaces to virtual and constructive training domain systems, the Army's C4ISR infrastructure systems, Future Combat System (FCS) platforms, and to components of the Joint National Training Capability (JNTC). LT2 products are composed using a "family of components" approach, which maximizes software reuse, provides common functionality, and ensures hardware and interface performance standards.

The product types included in the LT2 live training domain are as follows:

- Combat Training Center (CTC) – Objective Instrumentation Systems (OIS),
- Homestation Instrumented Training Systems (HITS),
- Instrumented - Military Operations in Urban Terrain (MOUT) Training Systems (I-MTS),
- Instrumented Ranges which include Digital Multi-Purpose Range Complexes (DMPRC), Digital Multipurpose Purpose Training Range (DMPTR), and Battle Area Complex (BAX).

A LT2 product is a specific instantiation of one of the product types. For example, the National Training Center (NTC) – OIS is an instantiation of a CTC-OIS. A battalion level HITS installation at Fort Knox is an instantiation of a HITS product type. Each instantiation will use CTIA as the product's instrumentation system architecture framework, in addition to a subset of the "family of components" common and unique to that product. This component subset will include a standard set of targets and battlefield effects based on the New Generation Army

Target System (NGATS) product, and a common solution set of Tactical Engagement Simulation Systems (TESS) as defined by OneTESS product.

LT2 Product Line Engineering Management Concept of Operation

The LT2 product line is implemented and managed as described in the LT2 Product Line Management Concept of Operations (CONOPS) (PEO STRI 2005). The purpose of the LT2 CONOPS is to delineate the implementation and management processes necessary to provide oversight and coordination during the definition, development, and sustainment of the LT2 product line products, and its architecture and components. This CONOPS also describes the processes, methods, roles and responsibilities, and tools required to manage the product line.

Figure 1 provides and overview of the LT2 management and execution relationships and the roles and responsibilities of the key groups and individuals who are involved with the LT2 product line strategy execution.

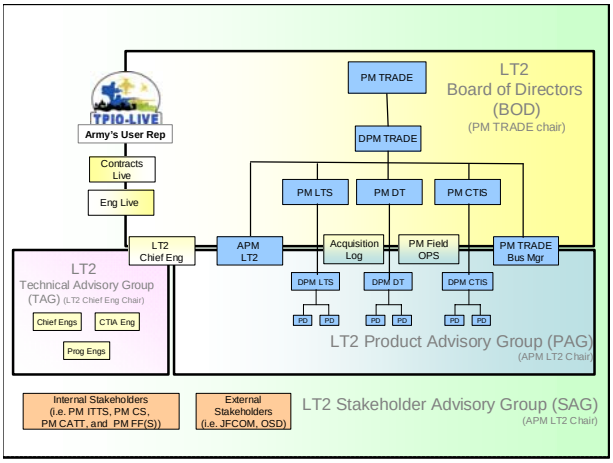

Figure 1. LT2 Management & Execution Relationships

Within this management and execution structure the LT2 Board Of Directors (BOD) is responsible for providing management oversight of the LT2 product line and is chaired by the PM TRADE with advice from the Product Managers (PMs). The LT2 Advisory Groups are responsible for providing the LT2 BOD with advice on external and internal technical and programmatic issues that affect the LT2 product line. The LT2 Product Advisory Group (PAG) serves as the programmatic advisor to the LT2 BOD, and coordinates issues relating to program cost, schedule, performance, and synchronization as it relates to the product line. The LT2 Technical Advisory Group (TAG) serves as the technical advisor to the LT2 BOD, the LT2 PAG, and to the APM LT2. The LT2 Stakeholders Advisory Group (SAG) is a forum for stakeholders to exchange product line information. The LT2 BOD uses this forum for updating LT2 stakeholders and user representatives on the status of product line efforts and to provide a collaborative environment for information exchange. The specific LT2 SAG composition will vary depending upon where the product line is in terms of program and system development, and the impact of these efforts on internal and external stakeholders. SAG composition will also be impacted by external events that have a potential impact to the LT2 product line.

The LT2 CONOPS includes three high level process groups used to acquire LT2 products and compliment normal acquisition processes. These LT2 processes are described based on who is responsible for the particular action, rather than in a sequential timeline. The LT2 CONOPS shows the process flow across and between the three responsibility areas. These three high level process groups are:

- Government Acquisition. These are the processes the Government LT2 Implementation and Product Teams conduct when a new requirement is provided and a component or product must be acquired. A Description of these processes is provided in the LT2 Acquisition Guide (PEO STRI 2005).
- Contractor Development. These are the processes the contractors follow to develop LT2 components and products according to the LT2 strategy and CONOPS. A description of these LT2 processes is provided in the LT2 Developers Guide (PEO STRI 2005).
- Government Product Deployment and Sustainment Management. These are the processes conducted by the Government to deploy and sustain the LT2 product. A description of these LT2 processes is provided in the LT2 Supportability Strategy (PEO STRI 2005).

LT2 Family of Training Systems (FTS) Requirements Evolution

The Live Training Transformation Family of Training Systems (LT2-FTS) is the Army family of interoperable Live training systems based upon a Common Training Instrumentation Architecture (CTIA) and a component-based product line that maximizes reusable, common, "plug and play" components and toolsets. The LT2-FTS is not a new start, rather it takes requirements from eight existing live training Operational Requirements Documents

(ORDs) and consolidates them into a single Family of Training Systems. Under the LT2 FTS strategy these eight "Legacy" requirement documents are being aligned with the Joint Capabilities Integration and Development System (JCIDS) while consolidating and eliminating the present stove-piped approach and duplicative requirements. The current LT2 set of live ORDs include the NTC-IS, JRTC-IS, CMTC-IS, IMTS, HITS, DMPRC, OneTESS, and NGATS ORDs.

During 2000-2001 a requirements analysis of the LT2 domain was conducted and determined that 90% commonality existed across this set of live training systems requirements. Given the extent of similarities and manageable differences within the LT2 family of programs, PEO STRI and the Army Training Support Center (ATSC) elected to formalize the LT2 product line strategy acquisition. In late 2002/2003 ATSC started an effort to consolidate the eight ORDs into a single requirement document under the old requirements process. As the JCIDS process started to emerge in 2003 and continues to mature, we abandoned the single ORD effort and started required capabilities development and validation in accordance with the JCIDS process. Since we wanted to consolidate duplicate requirements and documentation into a family of live training systems we felt that an Initial Capability Document (ICD) capturing the LT2-FTS approach, would be the best starting point to outline the initial capabilities and get Army and Joint buy-in to a Family of Live Training Systems. Upon JROC approval of our ICD, ATSC plans to start development of the appropriate Capabilities Development Documents (CDD) and Capabilities Production Documents (CPDs). The U.S. Marine Corps Training & Education Command (TECOM) has been actively participating in the development of the LT2-FTS ICD and believes that their Live ground maneuver training range requirements can and should be incorporated into these LT2-FTS capability documents. We believe that CTIA provides the standards, interfaces and protocols to meet the Live ground maneuver training range architecture requirements for all services.

LT2 PRODUCT LINE EVOLUTIONARY DEVELOPMENT

The LT2 product line is utilizing an evolutionary incremental acquisition and development approach which focuses on three main product groups: Combat Training Centers, Homestation and "core" LT2 solutions to include NGATS, OneTESS and CTIA. These three main product groups map into the three LT2-FTS CDDs within the JCIDS. Figure 2 below shows the notional evolution of the LT2 products, within these three main product groups, as more components and architecture capabilities become available, and reusability and commonality increases.

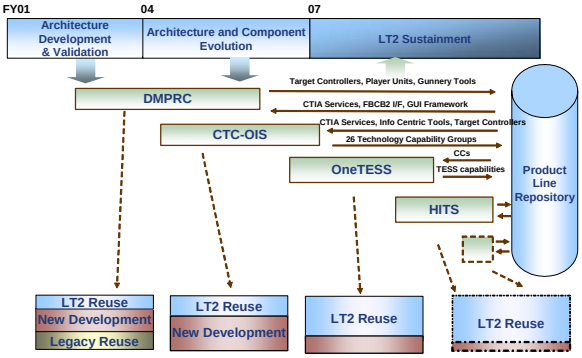

Figure 2. LT2 FTS Evolutionary Development

Under this evolutionary development approach, a detailed requirements analysis was conducted by PEO STRI to ensure that the CTIA could support all of the different programs describe by the LT2 set of ORDs. These requirements were documented utilizing a requirements traceability tool (DOORS) and serves as the foundation for the allocation of requirements for the LT2 components. Recently, a detailed bottoms up analysis was performed to identify process and resources needed to align the Instrumented Ranges and the CTC-OIS program so that a common solution, as desired by the strategy, could be achieved. A similar effort was conducted to define the required efforts to achieve the HITS solution by reusing the LT2 components and CTIA. This proved to be beneficial for all programs since we continue to attempt to align existing stove pipe efforts under the LT2 strategy, and we are improving each program by providing a LT2 solution that combines the best of all programs.

This section briefly describes the LT2 products and the "core" elements of the LT2 product line, which include the instrumentation system architecture, and the components that work with the architecture to provide live training product capabilities.

LT2 Products

The LT2 products are specific Live training system instantiations which are fielded to a specific location using the LT2 product line architecture and components. These LT2 products meet the requirements for specific program ORD/CDD, and are tailored to a location-specific user. These products are composed of the CTIA and the LT2 components. They are:

Combat Training Centers - Objective Instrumentation System (CTC-OIS). The goal of the CTC-OIS program is to replace the Instrumentation System (IS) at three CTCs with an IS that meets the Army's existing and future, advanced collective training objectives (CTC-OIS, 2005). . The three CTCs include the National Training Center (NTC), Fort Irwin, CA, Joint Readiness Training Center (JRTC), Fort Polk, LA, and the Combat Maneuver Training Center (CMTC), Hohenfels Germany. The CTC-OIS will provide support for all critical warfighting capabilities of all warfighting systems, allowing tactical engagement simulations throughout the full spectrum of conflict. The CTC-OIS program has been one of the trailblazers within the LT2 product line by making significant initial investments in the architecture and component development. The 1st CTC-OIS to be fielded will be at the NTC, with an Initial Operational Capability (IOC) of FY08. The CTC-OIS strategy is to incrementally provide early LT2 capabilities (e.g. early deployment) and collect valuable user feedback that will improve LT2 products across the product line. The CTC-OIS program, and the Army, will achieve considerable return on its investment once the second and third CTCs are fielded, since the percentage software being reused will be significant.

Homestation Instrumentation Training System (HITS). The HITS will provide a set of tools to train and sustain readiness at Homestation (HS) and Deployed. The HITS will:

- Support Live training certification of Army National Guard (ARNG) Enhanced Brigades (Platoon-level for combat arms and company-level for Combat Support (CS) and Combat Service Support (CSS));
- Support commander's battalion readiness assessment/ validation of maneuver, combat and combat support battalions and staffs;
- Prepare units for Combat Training Centers (CTC) rotations or actual deployments;
- Support forward deployed training at the Company and below level as well as new equipment training (NET).

The HITS will be a development effort based on LT2 product line in which the CTIA and LT2 component reuse will be a prerequisite.

Integrated - Military Operations in Urban Terrain (MOUT) Training System (I-MTS). The I-MTS will be a state-of-the-art, automated data collection and analysis system that assists control of the exercise, provides battlefield effects simulation and training performance feedback in the standard suite of Army approved Urban Training facilities. This includes: the Combined Arms Collective Training Facilities (CA-CTF) at Homestation (HS) and the CTCs, Shoot Houses (SH), and Urban Assault Courses (UAC). The I-MTS supports training and exercise events contained in proponent developed Combined Arms Training Strategy (CATS). The I-MTS will be an integrated system of computer software and hardware; workstations; databases; voice and video recording, production, and presentation equipment; interface devices; and communications and feedback devices. These fully instrumented training facilities provide capstone collective training facilities that support doctrinally correct, training events (with instrumented feedback) to assess the extent of full combat readiness at the battalion and brigade levels. The I-MTS will also be a development effort based on the LT2 product line in which the CTIA and LT2 component reuse will be a prerequisite.

Instrumented Ranges (IR). IR capabilities will be required for training management, a continuous process centering on feedback to enable leaders to properly focus peacetime training on their wartime mission (IR, 2005). The IR will replace obsolete and inadequate training methods and equipment in order to stimulate new weapon systems, stress Warfighters, incorporate the Digitized Force, and provide enhanced training data collection and After Action Review (AAR) capabilities. The IR will incorporate digital system training as well as integrate multiple ranges and training environments for the training units. This will be accomplished by leveraging the LT2 product line and by maximizing Commercial-Off-The-Shelf (COTS) hardware and software to meet Army requirements for state-of-the-art live training systems. Success in sustaining these types of complex training ranges will hinge on implementing the CTIA with LT2 components to implement a common LT2 solution set for the CTCs, HITS, I-MTS facilities, and the IR. Initial versions of the CTIA (spiral 3) have been used to begin fielding IR based on the LT2 product line in FY05. These LT2 based systems are the DMPRC at Ft. Hood, Texas, and the DMPTR at Ft Knox, Kentucky.

One Tactical Engagement Simulation System (OneTESS). The TESS capability, being developed by the OneTESS product, will provide a Live, precision, combined arms FOF and FOT training and testing capability that capitalizes on the "train-assess-train" model using leap-ahead technology (OneTESS, 2005). OneTESS will exploit recent advances in data processing and storage, communications, navigation, networking, interoperability, and modeling and simulation technologies to significantly advance the state-of-the-art of Real-Time Casualty Assessment

(RTCA) and automated data collection. OneTESS will be an integral part of a mobile, affordable, high fidelity, Live tactical engagement simulation and field instrumentation system; able to collect and report RTCA and other required data in support of its operational test mission.

LT2 Instrumentation Systems (IS) have a special dependency on OneTESS. The intent is the horizontal integration of OneTESS across the Live training environment. This horizontal integration with the LT2 instrumentation systems provides the information/data backbone to collect and store exercise data, and to pass training feedback information within the training systems and across all the domains. The end state will provide a common solution set to enable interoperability across the Live training environment. OneTESS, as the LT2 TES component, provides the means for instrumentation systems to collect training engagement data for exercise control and AAR purposes.

New Generation Army Target System (NGATS). The LT2 NGATS product will provide target components to replicate forces that are exposed to live-fire during training of current and future Army forces. NGATS will provide both infantry and armor targets that can be either stationary or moving based on the desired training event and target activity requirements. NGATS will provide modern capabilities to plan target training scenarios and manage their execution. The NGATS will be based on CTIA and is envisioned as an evolving system leveraging on lessons learned from fielded systems and the development of new technologies. NGATS will support deployability of capabilities to support both the Future Forces and the Future Combat System operational requirements. NGATS will allow deployed forces and systems to conduct weapon qualification and verification at deployed sites. NGATS will also enhance the future Army characteristics of lethality by increasing weapon and soldier effectiveness.

Common Training Instrumentation Architecture (CTIA)

CTIA is the Army's product line architecture for the LT2-FTS (CTIA 2005). The LT2 product line objective is for all LT2 products to use the CTIA as their main training instrumentation architecture. CTIA is being developed utilizing an incremental spiral approach to mitigate risks while evolving and providing an early look into the needed and desired capabilities required by the LT2 products. Under the LT2 evolutionary incremental approach, CTIA Spiral 6 will include all required architecture capabilities needed to support LT2 FTS increment 1. This section provides a description of the CTIA architecture.

The CTIA is a component-based client-server architecture, which allows for plug and play components to interact through the CTIA infrastructure. Figure 3 provides a layered view of this architecture which includes both wired and wireless communications components, supports several Operating System (OS), and provides the Data Distribution Manager (DDM), CTIA Services, Object Model and Graphical User Interface (GUI) Framework to facilitate re-use and standardization.

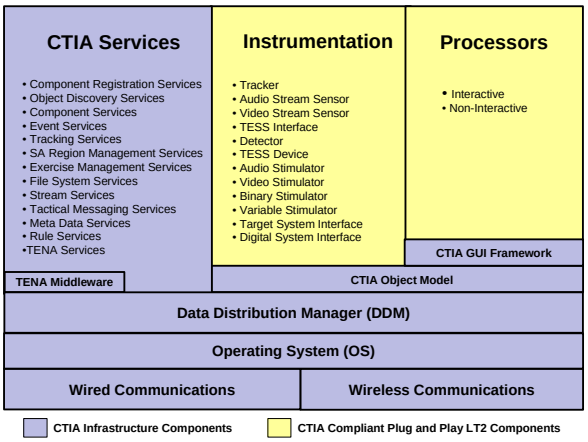

Figure 3. CTIA Layered View

The CTIA compliant plug and play components may be common to multiple products or unique to a specific product. The plug and play components have been divided into two primary types, instrumentation and processor. The CTIA compliant instrumentation plug and play components perform data collection and stimulation functions in support of live training. Instrumentation components provide the interfaces to other subsystems and systems such as Tactical Engagement Simulation Systems (TESS), target systems, and Command and Control (C2) systems. In addition, they provide encapsulation of training facility instrumentation such as individual TESS devices, trackers, video cameras, Battlefield Effects Simulators, and control devices.

The CTIA compliant processor plug and play components provide data manipulation and analysis capabilities. Processor components can be interactive or non-interactive. Interactive processor components have a user interface and are comprised of the common toolset required across the family of LT2 systems to plan, prepare, execute and evaluate training. Non-interactive processor components include gateways to

other simulation or training systems and instrumentation system-based simulations (e.g., Area Weapon Effects). Processors components encapsulate computational functions that have the capability of producing and consuming all types of CTIA data.

The CTIA Services provide domain specific services to support plug & play component clients. When deployed, these services are tailored to account for things such as training exercise scale, available infrastructure, and network variability. The service interfaces use a predefined object data model to ensure component interoperability and eliminate "stove pipe" systems. These interfaces are defined using the Common Object Request Broker Architecture (CORBA) interface definition language (IDL), which defines object data structures without methods. The CTIA Object Models provide methods and higher-level abstractions (e.g. proxies for remote objects). The CTIA services maintain objects representing exercises, organizations, and participants. It provides services accessible through the DDM such as unique ID, entity filtering, and brokering control of instrumentation. It provides access to databases for exercise specific and exercise independent data, and encapsulates the databases. The DDM provides the backbone into which CTIA compliant components plug into. The Graphical User Interface (GUI) Framework provides a common mechanism for the LT2 Interactive Processors to have a consistent look and feel. All GUIs are developed in accordance with the LT2 Human Computer Interface (HCI) Style Guide (PEO STRI 2004) to ensure that all actions, screens, symbols are consistent throughout all LT2 product GUIs. This common HCI will not only make products easier to use but will also facilitate cross training of operators between LT2 products.

LT2 Components

A LT2 component is a plug and play architectural element of the LT2-FTS. These components serve as building blocks for any LT2 product. A LT2 component can be in the form of software (e.g. source or executable code) with associated software specifications, hardware specification, or an Interface Control Document (ICD). A LT2 component can be a common component or a unique component for a specific LT2 product. A LT2 common component is defined as any component shared by more than one product. A LT2 unique component is one that is developed for a single product with a unique requirement. A LT2 component is also referred to as a LT2 asset, so the term LT2 common asset or unique asset may be used. An example of a LT2 asset is a Cause and Effect Tool. The term "asset" is used in the context of a LT2 repository and the artifacts available in that repository.

All LT2 component capabilities are traced back to an ORD requirement. Each component has a defined set of product dependencies that are tracked to make sure the component will meet its expectations. All LT2 components are designed, developed, and tested by the LT2 product teams and are placed on the LT2 repository to facilitate re-use. LT2 components are expected to evolve as technology and requirements evolve. Figure 4 provides a notional representation of the LT2 components from a LT2-FTS Product Line Architecture Framework (PLAF) perspective.

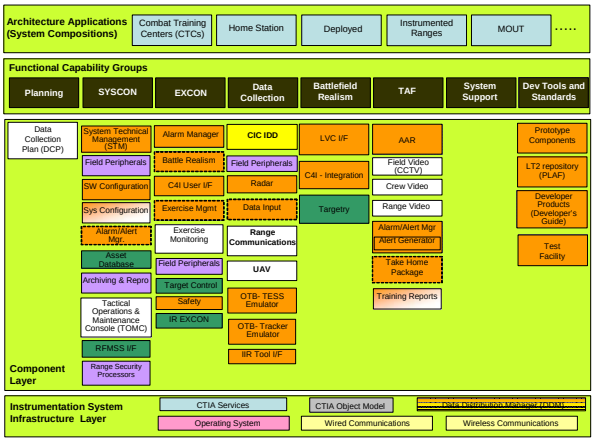

Figure 4. LT2 FTS Notional Product Line Architecture Framework

This LT2-FTS PLAF view depicts the LT2 components that can be used to implement an instantiation of a LT2 system based on the CTIA. These LT2 components are grouped into Functional Capability Groups (FCGs) that focus on TRADOC Doctrine (U.S. Army, FM 7-0) of plan, execute and assess.

The PLAF, through the Product Line Architecture Specification (PLAS), defines the product line architecture and its attendant standards, interfaces, and protocols, and establishes the framework that defines the architecture's services and models. This PLAF is currently instrumentation system-centric since the infrastructure layer components are based on the CTIA. It is expected that this PLAF will evolve to support TES and target system frameworks, and interoperability with virtual and constructive, and Joint National Training Capability (JNTC) capabilities through the Test & Training Enabling Architecture (TENA).

LT2 Component Agreements

To facilitate communication between the different programs and vendors developing LT2 components, a standard document is used to document the detail component requirements, test parameters and interfaces. This standard document is referred to as the LT2 "component agreement". The LT2 component agreement is a collection of LT2 component details that serves as an agreement for the component developer and user. The component agreement includes:

- CTIA compliance levels,
- component requirements (e.g. functional, quality, physical, and interface) Specification (e.g. Software Requirements Specifications (SRS), Interface Control Definition (ICD), etc),
- design (e.g. Unified Modeling Language (UML) and/or DOD Architecture Framework (DODAF) artifacts),
- test documentation used for validation of components during asset handover (e.g. test conditions, procedures, etc)
- Component dependencies that may include other components, data stores, and Commercial Of The Shelf (COTS) /Government Of The Shelf (GOTS) equipment.

CTIA compliance is defined at two levels, product and component. Basically, products (or "training systems") are CTIA compliant if they use CTIA as their architecture framework to communicate with all of their system components. On the other hand, "components" can have 4 levels of CTIA compliance.

- Level 1, Unique Component
- Level 2, Integrated Component
- Level 3, Systematic Component
- Level 4, Optimized Component

All levels of component compliance perform data exchange using interfaces defined in the CTIA PLAS. Level 2-4 compliant components have component agreements, and are validated through the component handover process. Level 3-4 compliant components meet to the LT2 HCI Style Guide if they are GUIs. Level 4 compliant components use the CTIA Object Model (OM), and use the LT2 GUI Framework, if they are GUIs. Levels of component compliance do not define levels of component "goodness"; instead it only quantifies the potential for reuse, commonality, and standardization across LT2 products.

LT2 Portal

The LT2 Portal is a web site that provides access to all LT2 assets contained in the LT2 repository. LT2 assets contained in the LT2 repository include:

- Software (e.g. CTIA spirals, LT2 Components, Interfaces, Data)
- Thread Analysis reports
- Product Requirements (e.g. ORDs, ICD, CDDs, CPDs)
- Specifications (e.g. PLAS, Component performance, product, interface, standards)
- Designs
- Rules & Guidelines
- Process Definitions
- Tools/Services

RELATIONSHIP TO OTHER ARMY AND JOINT PROGRAMS

There are several other external systems and architectures that play an important role in enabling the linkages between the LT2 FTS and other external systems and domains. This section briefly describes these external systems and architectures and how they facilitate the Army and Joint Live Training and Testing objectives. Figure 5 provides a top level operational view of the external systems and architectures interoperating with LT2-FTS.

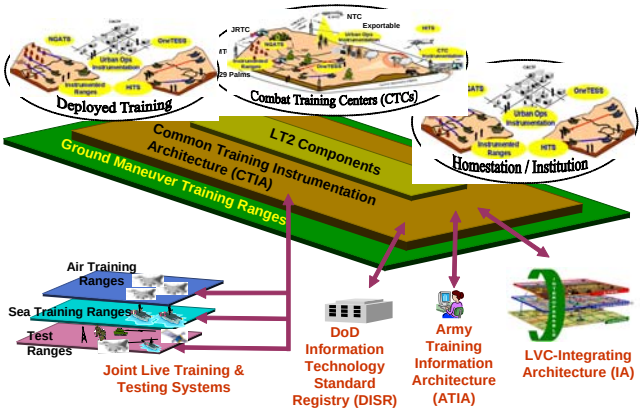

Figure 5. LT2 FTS Operational View

Test & Training Enabling Architecture (TENA)

The Test & Training Enabling Architecture (TENA) is a product of the Foundation Initiative 2010 (FI 2010) project (Cozby, 1998). The FI 2010 concept builds on the HLA and includes a core set of tools, inter-range communication capabilities, and interfaces to existing applications that facilitate multi service test and training exercises. The FI 2010 overall vision is to design and prototype a technological infrastructure to

enable interoperability and reuse within the range community. This infrastructure would provide seamless environments that integrate test ranges and facilities, training ranges, laboratories, and M&S assets. The purpose of TENA is to provide the communication architecture necessary to enable joint interoperability.

The CTIA program is currently integrating the TENA standard middleware component within CTIA Services. This capability will provide the required interoperability between JNTC assets and the LT2-FTS products by using a common Logical Range Object Model (LROM), and implementing TENA object services. This approach will support future LT2 product participation within JNTC training environment and inter-range interoperability.

The CTIA adds capabilities to a JNTC using TENA by providing the required framework, services, and components to meet Army and Joint interoperability requirements. CTIA provides the Army's LT2 product line architecture framework and is also the DoDs Ground Maneuver Training Range Architecture. TENA is DoD's Test and Training Range architecture which primarily provides a data distribution mechanism for all service applications and their specific range architecture

Army Training Information Architecture (ATIA)

The Army Training Information Architecture (ATIA) is one of two major parts of the ATIA program. The other part of the ATIA program is the integrated set of automated information systems (AIS) that deliver training management functionality to system users. The collection of these AIS delivered in accordance with the architectural framework is referred to as the ATIA-Migrated (ATIA-M). ATIA-M provides an integrated, interoperable training information automation infrastructure with user configurations. The ATIA-M provides development, storage, and delivery of Army doctrine and training materials to Soldiers and units anywhere in the world. The ATIA-M supports all levels of Army training and includes training products for all three pillars of Army training (Unit, Institutional and Self-development). When fully implemented, the ATIA will enable the provision of real-time training and training support to the Army worldwide (institutions, operational units, and individuals), through a logically centralized, physically distributed network. LT2 systems will access training information systems by interfacing with the information architecture (e.g. ATIA) through CTIA.

DoD Information Technology Standard Registry (DISR)

The DoD Information Technology Standard Registry (DISR) is a joint effort to identify and mandate IT standards for use in the acquisition/development of DoD systems that use, develop and exchange information. The DISR is focused on the interoperability and standardization of information technology and support to net-centric operations and warfare. The Joint Technical Architecture (JTA) and the Joint Technical Architecture – Army (JTA-A) was retired and replaced by the DISR on Jul 2004. All Army systems will now comply with the requirements of the DISR. LT2-FTS products will adhere to the IT standards defined in the DISR to interoperate simulations with operational BCSs and with other simulations. LT2 FTS products will provide trainers and trainees a Common Operating Picture (COP) by interfacing to the GIG using these IT standards. This COP will be provided through defined APIs between the CTIA and the GIG systems which use a 'smart pull' capability to access the data that is available all the time through a global wireless internet. This should allow LT2-FTS to meet their Net Ready Key Performance Parameter (KPP) requirement.

LVC- Integrated Architecture (LVC-IA)

The LVC- Integrated Architecture (LVC-IA) is a set of protocols, specifications and standards that support a seamless and interoperable, integrated LVC environment where common hardware, software and network components and modules are interchangeable with other LVC components and Battle Command Systems (BCS). The goal of the LVC-IA is to seamlessly interconnect and ensure interoperability with JNTC, Army Constructive Training Federation (ACTF), ATIA-Migrated (ATIA-M), CTIA, and SE Core. A LVC-IA Initial Capabilities Document (ICD), which provides the foundation for overarching requirements, is currently going through JROC approval. LT2 provides the "Live" piece of LVC-IA. The LVC-IA required capabilities will drive existent and future programs to focus on developing the most critical capabilities that have the highest return on training and readiness from an integrated LVC and Joint perspective.

Figure 6 provides a notional view of PEO STRI objective systems and their respective product lines and how they relate to LVC-IA, FCS and current and future BCS. The objective is for these PEO STRI product lines to be the key enablers of a Joint LVC -Training Environment (JLVC-TE) based on PEO STRI objective systems.

Within the constructive environment, the objective constructive simulations (WARSIM and OneSAF) will share components to provide flexibility and adaptability with respect to entity and aggregate level constructive models. The ACTF simulations will be integrated and interoperable, to include interoperability with the Joint Deployment Logistics Model (JDLM).

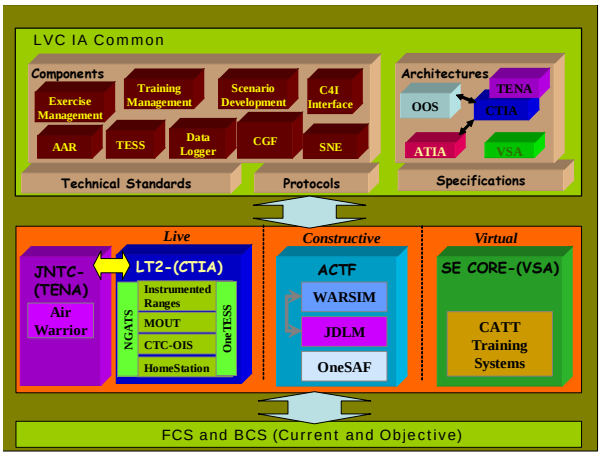

Figure 6. LVCTE Objective Systems

Currently CTIA and OneSAF Objective System (OOS) are exploring alignment of their specific simulation object runtime data models to provide additional interoperability flexibility between the Live and Constructive domains (Dumanoir, Pemberton, Samper, 2004). This data model interface is being explored to try to provide additional interoperability fidelity when using constructive simulations as the "wrap around" simulation in a Live exercise.

In the virtual environment, virtual simulators will be built on top of SE Core. SE Core will consist of a series of interoperable software and hardware components to enable an Army common virtual environment and integrate virtual simulations to the LVCTE.LT2-FTS is planning to leverage SE CORE capabilities in the from of Environment Data Models, Environment Runtime Components and Terrain Databases to support LT2-FTS Synthetic Natural Environment (SNE) requirements. These SE CORE SNE capabilities are largely based on initial OOS SNE capabilities.

The LT2 FTS, in conjunction with the Constructive and Virtual domain product lines, is also providing key capabilities to support the FCS embedded training requirements. These FCS embedded training requirements are being captured through a set of Training Common Components (TCCs) that will be leveraged by LVC-IA. These FCS TCC capabilities will be using the FCS System of System Common Operating Environment (SoSCOE) as their main architectural services layer. PEO STRI contributing programs to these TCCs include CTIA, OneTESS, OOS, and ATIA.

In addition all three domains are working together to leverage the PEO STRI common C4I adaptor component to interoperate with Army Battle Command Systems (ABCS) C4I device. This approach will enable increased interoperability and flexibility by using common components across an enterprise of PEO STRI architectures in support of a JLVC-TE.

CHALLENGES

There are several challenges that need to be overcome in order to make any product line strategy a success. This section briefly provides some suggestions on areas addressing one of the most critical challenges -- managing the changes that will allow the execution of a product line like LT2. We suggest using a risk mitigation plan that addresses the changes required to implement the product line as a mechanism to getting the required buy in from the product line stakeholders. One of the risk mitigation areas needs to address an incremental development approach with regular demonstration and fielding of capabilities to maintain interest. This incremental approach needs to provide tangible pieces of the product line that can be used by the stakeholders, on at least a yearly basis, if not more frequent. In the case of LT2, these capabilities need to show value added to the warfighter! Another risk mitigation area is finding a way to effectively manage product line expectations from a cost, schedule, and performance perspective. This falls under the category of the coordination and constant communication that is required in an ever changing environment. From a cost perspective there is a need to provide a clear definition of what is the return of investment associated with the up front investment of a product line approach, clearly articulating, and quantifying, the "benefits" of the product line approach, even if the quantifiable justification is not at a detailed dollar amount. Another risk mitigation area is related to getting industry buy in and participation of the specific Government product line concept, and helping define how industry can profit from this approach. LT2 has been trying all of these risk mitigations strategies in one way or another, but it is rarely easy, in particular with ever increasing budget reductions and changing missions.

CONCLUSION

Training transformation creates joint warfighting conditions through a network of interoperable training sites and nodes that bring together personnel, doctrine, and technology to achieve both joint and service training objectives. Providing realistic combat training, offering an adaptive and credible opposing force, establishing common ground truth, and giving high quality feedback are the founding pillars of this joint training capability. As a result of this enhanced training environment, participants will have a global, network-centric capability that strengthens military transformation efforts to promote war fighter effectiveness. It is important, from a Service perspective, to build our JNTC participation upon existing Service training programs. We must retain the training that builds individual Service core capabilities while improving the joint context of training, in order to maintain the operational tempo levels.

The LT2 product line offers the Joint community a key piece of the Joint Test and Training Environment - the "Ground Maneuver Training Range" capability. This capability can support a Joint LVC Training Environment in conjunction with other Services sea and air assets. The LT2 product line is the Army's choice for a Live Training solution set that is based on sound engineering practices, emerging technology and efficient business model. With the help of the LT2 product line, the JNTC can continue to evolve emerging technologies, innovative training, and operational concepts while the Army continues to focus on fielding LT2 products that will benefit our warfighters and are based on open architecture principles that facilitate quick product development, technology insertion, and ease of use at a lower sustainment cost.

ACKNOWLEDGEMENTS

The authors wish to thank COL James Ralph, Project Manager Training Devices (PM TRADE), Mr. Wayne Koenig, Training and Doctrine Command (TRADOC) Program and Integration Office (TPIO) – Live, and Mr. Robert Parrish, Director Live Engineering Division, PEO STRI for their vision, contributions and assistance in the development of this paper.

REFERENCES

Combat Training Center-Objective Instrumentation System (CTC-OIS) web site. Retrieved 2005 from http://www.peostri.army.mil/PRODUCTS/CMTC-OIS/

Common Training Instrumentation Architecture (CTIA) web site. Retrieved 2005 from https://ssl.peostri.army.mil/CTIAPortal/index.jsp

Cozby, Rick (1998). *Foundation Initiative 2010 Report.* Aberdeen Proving Ground, MD: U.S. Army Test & Evaluation Command.

Dumanoir, P., Pemberton, B, Samper, W (2004). *OneSAF Interoperability with CTIA – A LVC Connectivity Approach*. 2004 Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC), Orlando Florida.

FM 7-0 Training the Force (2002). Washington DC: Headquarters Department of the Army. http://www.army.mil/features/FM7/FM%207-0.PDF

Instrumented Ranges (IR) web site. Retrieved 2005 from *http://www.peostri.army.mil/PM-TRADE/dmprc.jsp*

Joint Vision 2010: America's Military: Preparing for Tomorrow (2004). Washington DC: Chairman of the Joint Chiefs of Staff

Live Training Transformation (LT2) DRAFT Acquisition Guide (2005). Orlando FL: U.S. Army PEO-STRI.

Live Training Transformation (LT2) Product Line Management Concept Of Operations (2005). Orlando FL: U.S. Army PEO-STRI.

Live Training Transformation (LT2) Developers Guide, Version 1.2, (2005). Orlando FL: U.S. Army PEO-STRI.

Live Training Transformation (LT2) HCI Style Guide Version 2.1 (2004). Orlando FL: U.S. Army PEO-STRI.

Live Training Transformation (LT2) DRAFT Supportability Strategy (2005). Orlando FL: U.S. Army PEO-STRI.

One Tactical Engagement Simulation System (OneTESS) web site. Retrieved 2005 from http://www.peostri.army.mil/PRODUCTS/ONETESS/