Towards a Next Generation Enterprise LVC Scenario Generation Capability

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ABSTRACT

As simulations move towards the goal of seamless interaction between the Live, Virtual and Constructive (LVC) domains, numerous technological hurdles quickly become apparent. To explore these hurdles, the Program Executive Office for Simulation, Training, and Instrumentation (PEO STRI) and the Army Research Laboratory, Human Research and Engineering Directorate, Simulation and Training Technology Center (ARL-HRED STTC) have built a Risk Reduction Test Bed (RRTB) to replicate LVC environments, identify capability gaps, and offer potential technologies to fill these gaps. One gap that quickly moved to the forefront was the need for innovative solutions for LVC enterprise scenario generation. The first step was to conduct an analysis of current LVC tools identifying their requirements and shortfalls that typically required operators to spend significant time manually generating or updating portions of the scenarios. This analysis also looked at emerging tools that satisfied broader sets of scenario generation use cases. One such tool was the Web-based Military Scenario Development Environment (WebMSDE), which offers a web-based tool to author and update scenarios, thus allowing powerful collaboration, mapping, drawing, and other capabilities not available in current tools. The second step was to conduct an analysis of scenario representations looking at existing simulation agnostic representations including Order of Battle Service (OBS) and the Military Scenario Definition Language (MSDL), with the goal of indentifying promising approaches for a common scenario representation to automate consumption through the LVC domain. At the conclusion of our analysis, prototypes of potential solutions were planned. This paper reports on the findings of the two analysis phases along with recommendations for an enterprise capability. In addition, the paper reports on current innovative scenario generation developments with the potential to impact an enterprise solution. Finally, the paper consolidates the analysis findings along with technology examples to provide the LVC community with a vision for what an LVC Enterprise tool could be along with remaining challenges.

ABOUT THE AUTHORS

Henry Marshall is a Science and Technology Manager at the ARL-HRED STTC. His assignment experience spans across several agencies including Army, Department of Homeland Security (DHS), and Navy. His 30 years with the Government have been spent assigned to leading edge simulation technology efforts in Modeling and Simulation (M&S) Architecture, law enforcement training, embedded training technology, Semi-Automated Forces (SAF), and

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Bob Burch is the Chief Technology Officer at Dignitas Technologies, LLC. Mr. Burch has over 30 years of development experience in the modeling and simulation industry working in both the Virtual and Constructive domains. Mr. Burch has a wide range of simulation experience, ranging from simple maintenance trainers, to aircraft cockpit simulators, to large complex Constructive systems. His Virtual simulation experience focused on Virtual system architectures, executive scheduling systems, concurrent systems, simulation time management, hard real-time performance and monitoring, computational resource utilization, modeling frameworks, and I/O systems. His Constructive experience has been technology leadership positions of the Army's two largest Computer Generated Forces systems: Close Combat Tactical Trainer (CCTT) SAF and OneSAF. Mr. Burch was the Chief Scientist for the CCTT SAF. He was the Software Architect for OneSAF as well as Architecture Modeler and eventually System Architect. He has practical experience with Product Line Architecture development for OneSAF, Synthetic Environment (SE) Core, and the United Kingdom's Combined Arms Tactical Trainer (UK CATT) programs. Mr. Burch is currently supporting the analysis and development efforts for the STTC Risk Reduction Test Bed (RRTB).

Paul Dumanoir is the Chief Engineer for the United States (U.S.) Army Product Manager for Warrior Training Integration (PdM WTI) under the Project Manager for Constructive Simulation (PM ConSim) at PEO STRI. He is currently the PM ConSim RRTB project manager and has 26 years experience working in Department of Defense (DoD) simulation and training programs as Product Manager, Project Director, and Systems / Software Engineer. His current interests include component-based product-line engineering, and System of System (SoS) integration and interoperability. He earned his B.S. in Electrical Engineering from the University of South Alabama in 1987 and his M.S. in Computer Systems from UCF in 1991.

Derrick Franceschini is Vice President and Senior Systems Architect at StackFrame, LLC. Mr. Franceschini has over 18 years experience in the M&S industry. He has extensive experience in the Constructive and Virtual domains and is sought after in the industry for his expertise with architectural innovations for the U.S. Army's OneSAF Product Line. He is the leading force behind the conceptualization and development of the WebMSDE, a web-based Scenario Development Environment, WebSAF, a thin client, web browser-based application to visualize and control the Army's OneSAF Simulation, WebAAR, a modern, efficient web browser based After Action Review (AAR) system and the MobileSimCenter, a set of innovative products to provide easily deployable Constructive simulation capabilities. These products are in use for training and analysis with PM OneSAF in the OneSAF distribution, with RDECOM at the STTC Risk Reduction Test Bed (RRTB), and with the Army M&S Office (AMSO) for the U.S. Army National Guard. Prior to joining StackFrame, Mr. Franceschini served as the OneSAF System Architect from 2006 – 2010 and has held key development positions on the program since 2001. Earlier in his career, he served as the Lead Engineer on the Modular SAF (ModSAF) and OneSAF Testbed Baseline programs. He received his B.S. in Computer Engineering from UCF.

Robert A. Wells is a Project Engineer at Dynamic Animation Systems, Inc. He has led the development of the Risk Reduction Test Bed (RRTB) as part of the Advanced Simulation Systems Integration Modeling Interoperability Laboratory and Test Environment (ASSIMILATE) research effort. Mr. Wells has over 15 years of experience in the Modeling & Simulation (M&S) community and has managed a wide range of training systems within the industry. He has integrated LVC components from the LVC Integrating Architecture (LVC-IA) program as well as core-system components from the LVC domains to include Homesation Instrumentation System (HITS), Aviation CATT (AVCATT) & CCTT-SAF, and Joint Land Component Constructive Training Capability (JLCCTC) within the RRTB. He earned his B.S. degree in Computer Science from the UCF and his Masters in Business Administration from the Crummer Graduate School of Business at Rollins College.

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INTRODUCTION

The enterprise Live, Virtual, and Constructive (LVC) scenario generation research described in this paper is a collaborative effort between the Program Executive Office for Simulation, Training, and Instrumentation Project Manager for Constructive Simulation (PEO STRI PM ConSim) and the Army Research Laboratory, Human Research and Engineering Directorate, Simulation and Training Technology Center (ARL-HRED STTC). As part of a collaborative effort between the STTC Advanced Simulation Branch (ASB) and the PEO STRI PM ConSim, a Risk Reduction Test Bed (RRTB) has been developed as part of the Advanced Simulation Systems Integration Modeling Interoperability Lab and Test Environment (ASSIMILATE) research project. The purpose of the test bed is to perform research on technologies and solutions that benefit the PM ConSim portfolio. A critical technology gap that was highly prioritized was the need for an enterprise level approach for the development and initialization of scenarios, in particular as it pertains to Army's Integrated Training Environment (ITE) which is based on a system of systems architecture. The use case for this research focused on the Army's Live, Virtual, Constructive Integrated Architecture (LVC-IA) program (Dumanoir, 2012) and improving the workflow process for development and initialization of an exercise using LVC-IA. This ITE enterprise level approach will facilitate capability growth for ITE as it expands its scope of interoperating training devices. The following two capability gaps are addressed by this research: 1) No single scenario generation tool exists that can satisfy the majority of the ITE core system needs (each core system either lacks or has its own set of scenario generation tools and scenario initialization process); and, 2) No centralized scenario format exists that incorporates all of the core systems' data needs. This research provides a series of analysis and prototyping efforts focusing on the needs of the ITE enterprise to: 1) recommend a path forward for a common scenario development tool with the potential to be the enterprise solution; 2) provide recommendations for a flexible and common scenario representation format and initialization process; and, 3) show current prototype results and plans.

LVC-IA Version 1 Scenario Development Process

The current LVC-IA scenario development process requires subject matter expertise from each of the participating core systems as well as dedicated scenario developers. The whole process is complex and very laborious. The process relies on multiple disparate tools and requires tight coordination amongst the different stakeholders.

Under the current process, each of the core systems rely on using their own inherent scenario representation format for their respective system, ranging from various versions/variants of Order of Battle Service (OBS) eXtensible Markup Language (XML) formats, to the Military Scenario Definition Language (MSDL) XML format (Military Scenario Definition Language Product Development Group, Simulation Interoperability Standards Organization [SISO], 2008), to simply using Microsoft Excel spreadsheets. The scenario developer uses the Joint Remote Client (JRC) scenario development tool to construct the scenario, which involves dividing units and entities among LVC domains and the positioning of unit/entity locations. Simulated units and entities that are to be represented on Mission Command Systems (MCS) must also have a unique Unit Reference Number (URN) assigned to them. The scenario developer distributes the scenario development files out to each of the core system components via a web portal. This data can then either be ingested by the core-systems' inherent scenario generation system or in some cases the core system scenario developer is required to interpret the information and construct the scenario units manually for those designated units. Each of the core systems utilizes various scenario formats and development tools for scenario development activities.

Our research focused on analyzing various scenario generation tools and formats used by various core-systems and evaluating their characteristics and attributes. The analysis identified the following list of scenario development tools:

- JRC
- Joint Training Data Services (JTDS)
- Web-based Military Scenario Development Environment (WebMSDE)
- ForceBuilder
- Operation Environment Scenario Generation Tool (OE-SGT)
- Sketch-thru-Plan (STP)
- Scenario Generation Tool (SGT)

These tools were evaluated against a set of criteria identified as requirements by the LVC-IA Program of Record (PoR) for an enterprise scenario generation solution. Each of the criteria was further broken down defining suitable levels to meet different levels of compliance.

The results of the scoring evaluation concluded that the best near-term Course of Action (CoA) to aid in the development of LVC scenario generation was to enhance the existing JRC tool with a loosely coupled external service for force structure and URN alignment. In addition, the WebMSDE tool was identified as a longer-term solution for its innovative potential providing many of the enterprise needs. During the study, a series of technical interchange meetings were held to obtain data, perspectives on the issues, and potential solutions to the stakeholders identified for this effort. The two major observations included: Force mapping and URN mapping was the most onerous and error prone; and the Core systems scenario development is manual and very labor and time intensive.

To address the need for an enterprise level approach for the development and initialization of scenarios as it pertains to Army ITEs, two prototype development activities were commenced to provide both short-term and long-term potential solutions towards a next generation enterprise LVC scenario generation capability. The first prototype development effort addresses the short-term needs of LVC-IA and focuses on developing a services-based solution for the onerous scenario generation process of URN and Force Structure mapping to reduce the risks associated with generating LVC scenarios. The benefit of a services-based approach is the ability for any scenario development tool to access these services. The second prototype effort provides a scenario generation tool that can be executed within a web browser known as the WebMSDE. The WebMSDE application provides a scenario generation tool that is capable of generating scenarios in various formats while providing a robust user interface. It has the potential to provide a long term enterprise capability along with identifying requirements needed by an objective enterprise system. The WebMSDE is also a good candidate for addressing the ITE's scenario generation longer-term needs.

URN MAPPING AND FORCE GENERATION PROTOTYPE

The analysis identified force structure and MCS URN mapping as scenario generation tasks that are particularly error-prone and time-consuming. While specific data needs are different, these are common complex mapping tasks

that must be performed by all stakeholders. Each stakeholder system performs these mappings differently depending on its model needs and complexity of entity abstractions.

Force Structure and Equipment Specification Alignment Services

Typically, scenarios are generated using a specific Table of Organization and Equipment (TOE; sometimes referred to as TO&E) to represent the force structure and equipment types of units to be trained. These TOEs represent how the unit is organized for the training event and in many cases reflect some view of the real-world organization. Simulation systems have restrictions on the types of equipment that can be represented. This is especially true in the case where entities are visualized for "out the window views" and optical, or electro-optical, viewports due to limitations in image generation systems. Some simulation systems may have additional restrictions on what types of equipment that may be in a related TOE hierarchy. For example, a unit with an Unmanned Aerial Vehicle (UAV) may not be contained in the same hierarchy as mechanized armor. This is typically a restriction due to the modeling approach employed by the simulation system. The Master Entity List (MEL), which is derived from the Synthetic Environment (SE) Core Common Virtual Environment Management (CVEM) program, defines the equipment that is supported by the LVC-IA system of systems. In this case, the task required is to ensure that any entity or equipment listed in the scenario starting TOE can be unambiguously mapped to a corresponding entity description in the LVC-IA MEL-based force characteristic description.

There are many sources for unit TOEs (or Modified TOE [MTOE]). A common approach is to leverage existing force representations using a site's OBS XML file export. Over time, however, the force representation and equipment specifications in the authoritative sources may change as the Army evolves. For example, the OBS Repository is routinely refreshed, modified and expanded. New simulation attributes may be added and data modification may occur where existing units are reorganized and new units are added. Due to these changes, scenarios frequently become outdated since their force representation and equipment specifications are not automatically synchronized with the latest changes in the authoritative source. When loading existing scenarios into a scenario generation tool, these out of date representations of force structure and equipment specifications are routinely encountered and can be highly problematic. Typically, there are tedious, manual steps needed to resolve these types of inconsistencies and these steps are both time-consuming and error-prone.

As an example, in the LVC-IA federation the mismatch between the force data in a scenario and the current force data in the force characteristic file is diagnosed and fixed through several iterations of loading the scenario in both JRC and Joint Conflict and Tactical Simulation (JCATS)-based tools and manually changing the scenario until all force mapping errors are resolved. For moderate sized scenarios, this process has been taken anywhere from three to five days to accurately find unmatched entities, identify the corresponding correct entity, and update the scenario.

URN import/mapping

The process to update the scenario with proper equipment URNs is also common across stakeholder systems. This mapping requires mapping scenario units and entities to a variety of authoritative MCS URN repositories. Each of the stakeholder systems solves this mapping step in slightly different ways depending on the complexity of the scenario, the underlying modeling approach, and the scenario representation. The solutions vary from automated mapping with manual checking to manual mapping. Individually, this step is not technically difficult but does require a flexible approach to find specific unit and entity designations in the MCS URN source data and manually set the data in the scenario file. The main impact to the workflow for this effort resides from the number of times this mapping effort must be undertaken. For example, when mapping force characteristic data, once a corresponding match is found, all instances of that type are changed with one action. So, if A is to replace B in a 50,000 entity scenario, it is changed once. However, URN mapping is done on the unique instance of an entity. So the mapping action occurs uniquely once for every entity to be mapped. Using the prior example, if all 50,000 entities need URN mapping, which is unlikely, then 50,000 changes would need to occur. In practice, large exercises tend to need URN mapping ranging in the hundreds; however, future exercises are expected to require mapping ranging in the thousands of entities. In a typical exercise, URN mapping has taken as long as three weeks using a new organization for a moderate level exercise.

Analysis of Alternatives

The identification of a solution approach for the URN mapping issue was accomplished by conducting an Analysis of Alternatives (AoA). For this effort, we considered modification of several existing approaches from our stakeholder systems and new systems. We conducted analysis of each tool based on the criteria and experimentation with the tool where possible. The AoA identified a modified Order of Battle Alignment Tool (OOBAT) (Gupton & Day, 2011) as the best candidate for this effort based on our criteria and scope.

The identification of a solution approach for force structure mapping was to leverage existing approaches for automating the match of entity descriptions. Examination of the tools for URN mapping showed that the OOBAT tool provided an approach where we could leverage both the entity level matching capabilities and the graphical interface for results display and confirmation as the basis for a force mapping approach.

Tool Prototype Efforts

Figure 1 illustrates the prototype approach used for URN mapping using the OOBAT tools. This prototype consisted of two phases.

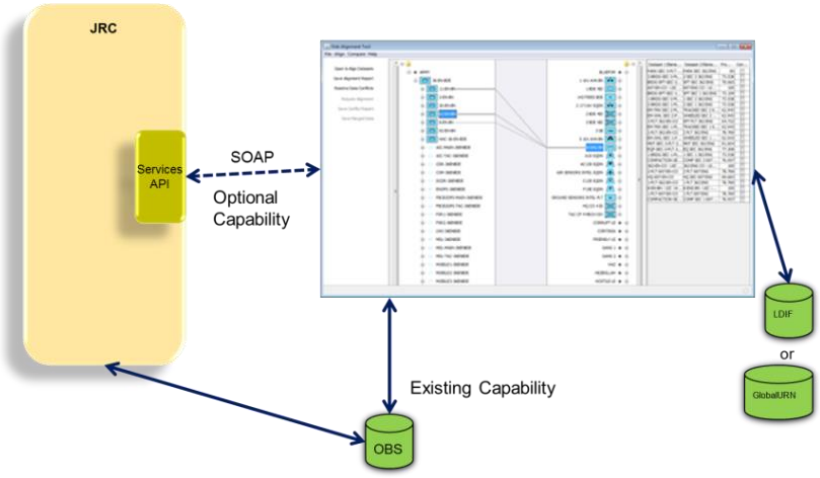

Figure 1: - URN Mapping Prototype

The first phase was conducted to extend the tool in the context of LVC-IA in order to provide better integration with the data sets used and to ensure the mapping approach provided adequate results using LVC-IA data. The tool was extended to integrate the LVC-IA JRC specific OBS XML file dialects. This supported a read and write capability that can be used in concert with the JRC tool. From a workflow perspective, using this approach, OOBAT operates standalone on a file saved by JRC during the scenario process. This replicates the manual workflow process prior to the prototype but adds an automated tool that supports the manual matching process. This phase also adapts the LVC-IA specific source data used for matching unit instances.

The second phase implements a Simple Object Access Protocol (SOAP)-based interface to invoke OOBAT with the scenario data obviating the need to save intermediate files using a separate tool. This approach provides interface software which allows the scenario developer to request URN mapping from JRC, populate OOBAT with the existing JRC data, and upon saving in OOBAT, re-populate JRC with properly mapped scenario data.

The approach for force structure mapping is similar to the one used for URN mapping. OOBAT matching is refined in two ways. The first is that the source data is a MEL-based entity description file. The second is that mapping is conducted across all unit hierarchies so that confirmation of a match propagates across the entire set of scenario data. The prototype also implements both an OBS XML file-based approach as well as a SOAP services approach for communicating properly mapped scenario data.

The prototypes will be tested for transition to the LVC-IA program in the RRTB to duplicate the operational context. The test and demonstration approach will involve conducting the typical LVC-IA scenario development process with these tools to compare the results to actual LVC-IA results. The test will consider the accuracy of the final scenario file, the ease of use, and the reduction in time and errors induced. Based on these results in the RRTB, a recommendation for transition will be made to the LVC-IA Program of Record (PoR).

Long Term

Several long term recommendations resulted from the analyses that were beyond the scope of this effort. One stakeholder program discussed a concept for providing a component-based tool for editing scenarios. Consideration of this approach may do well for an enterprise-based system like LVC-IA and the ITE. This approach uses a component-based registration to build scenarios allowing plug-ins to be provided by simulations for their data needs. The plug-ins would implement the particular business rules and data specialization that is required for simulations. The tool architecture would need to formalize the representation of entry data for a wide variety of simulation system needs. The tool would also formalize actions across the data as well as how to express validation and dependency rules. Simulation systems would use these formalizations to describe their data needs and rules to the editor. As the scenarios are developed, the individual plug-ins would render widgets to obtain data, query for missing data, notify for errors, and validate data to simulation rules. In addition, the plug-in approach could be used to specify capabilities, valid unit structures, and facilitate interactions that promote fair fight exchanges.

A second approach is one in which web-style services are used to retrieve scenario initialization data. Existing systems typically rely on providing scenario data with a static file, such as an OBS XML file or an MSDL file. A consumption services-based approach would allow a simulation to utilize loosely coupled services to retrieve scenario initialization data. The underlying representation would be abstracted and could be a variety of standard representations. This data would be provided to the clients via web services, which will utilize a common, transport-centric data model to facilitate communication between the services and the client. The transport model can originate from an existing and proven model, such as OBS XML or MSDL, but it need not be limited to the content in a particular version. This approach provides several benefits over current file-based implementations. First, when the schema for a file standard changes, i.e., an upgraded version is released, each simulation must make software changes in order to handle the updated schema. This maintenance cost may be high and may significantly hinder the ability to incorporate changes to each simulation. With a services-based approach, only the underlying service must be upgraded. As long as the interface to the service remains unchanged, each simulation that utilizes the service may remain untouched, unless it chooses to incorporate any new services. A second benefit is that simulations are immune to changes in data storage mechanisms. The third benefit of this approach is that, from an enterprise perspective, it reduces the overall costs and time required to make any scenario data schema changes. Changes required to handle any schema updates are made in a single software component rather than in each consuming simulation, which greatly reduces the time and effort to respond to these changes. This minimizes the software changes required for each simulation and overall, reduces integration costs for the enterprise. Additionally, it minimizes errors due to upgrading to new schemas since the overall amount of software changes are minimized throughout the enterprise. The fourth benefit is that it enhances configuration control of scenario data in that it centralizes the instance of data and ensures that modifications or lost files are minimized.

WEB-BASED MILITARY SCENARIO DEVELOPMENT ENVIRONMENT

WebMSDE Background

WebMSDE was initially developed under an Army Modeling and Simulation Office (AMSO) funded program run by ARL-HRED STTC. The WebMSDE is an application capable of generating simulation agnostic scenarios compliant with the SISO MSDL standards (Military Scenario Definition Language Product Development Group, Simulation Interoperability Standards Organization [SISO], 2008). Its goal is to improve the ease of building SISO MSDL-compliant scenarios by providing an easy-to-use user interface that is accessible via a typical web browser. WebMSDE has been integrated into OneSAF for release as part of v7.0 and is intended to replace the existing OneSAF MSDE application.

WebMSDE was developed to be a browser-based application, taking advantage of Hyper Text Markup Language v5 (HTML5) standards instead of relying on third-party plug-ins. This has the advantage of directly supporting a

variety of computing platforms including desktops, tablets, and smartphones with the same codebase. Additionally, the architecture of WebMSDE easily lends itself to remote or cloud deployments.

WebMSDE can run as a component embedded within OneSAF as well as standalone. When embedded within OneSAF, WebMSDE's capabilities are enhanced to include direct access to the library of units and entities within OneSAF, and direct access to the road and river network and building structures in Objective Terrain Format (OTF) for improved visualization and interactions with simulated terrain.

As shown in Figure 2, WebMSDE provides a map view to visualize a geographic area and allow users to place organizations and equipment. Map interactions work consistently with expectations of modern map applications for pan and zoom and include support for multi-touch interactions. WebMSDE can display a variety of terrain imagery, including satellite (commercial and OpenStreetMap), Compressed Arc-Digitized Raster (CADRG), and the format used by the OneSAF Plan View Display (PVD).

WebMSDE provides a task organization tree that allows users to add arbitrary sides and forces and populate them from organizations and equipment in the actor palette. Users place units or equipment on the map using modern drag and drop mechanics. They can search for elements in the actor palette by traversing the tiled palette, or using the built-in search capability depicted in the top right of Figure 2. Users can specify relationship between sides or forces in the task organization and the relationships can be asymmetric. They can also utilize a large set of tactical graphics in WebMSDE to provide context for scenario execution; users can select from a palette of Mil Standard 2525 tactical graphics to place on the map. WebMSDE provides an efficient editing capability to move, rotate, or otherwise edit the graphics.

At any point during scenario generation using WebMSDE, users can save their scenario. The save process generates an MSDL document and saves it to the user's downloads area configured in their browser. WebMSDE also supports round-trip of the MSDL scenarios, so users can load and modify existing MSDL scenarios.

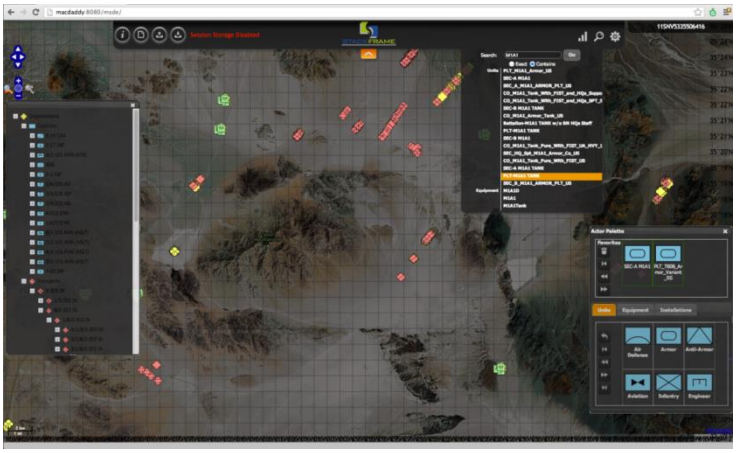

Figure 2: WebMSDE User Interface

Current and Planned WebMSDE Upgrades

WebMSDE is undergoing a number of follow-on enhancements to the initial prototype development effort scheduled for completion at the end of this calendar year. These include adding support to allow users to specify activities for organizations and equipment to perform in the form of a Synchronization Timeline, allowing users to populate elements of their scenario from Army Battle Command Systems (ABCS) sources, providing the capability to import and export OBS scenarios, providing the capability to visualize terrain with equipment and graphics placement in a three dimensional view, providing the capability to partition a scenario by domain, and providing the capability to support concurrent multi-user scenario collaboration.

Synchronization Timeline

One common activity for scenario generation for Constructive Simulation is assigning orders to units and entities to instruct them as to the actions to perform during the course of a scenario. This repeated activity is not supported in most scenario generation tools and the absence leads to some widespread enterprise scenario issues: 1) users avoid tools that force them to re-establish activities each time a scenario update occurs; and 2) scenarios are executed inconsistently with the scenario developer's intent because the intent is never captured as part of the scenario.

The Synchronization Timeline extends and enhances the WebSAF prototype, which provides complete simulation behavior access in a web browser application. It adds the capability for users to establish the time-synchronized activities for organizations and equipment in a scenario, referencing tactical graphics where appropriate as activity inputs. As shown in Figure 3, the activities are presented as a palette for the user to choose from and the selections are captured in a Gantt chart-like view, with start and end times easily modifiable.

This Synchronization Timeline view is consistent with the synchronization matrix description in the Army Field Manual (FM) 101-5 the Military Decision Making Process (MDMP) for CoA development, making this potentially an aid in COA development and analysis. Minimally, this capability allows the intent of a scenario designer to be captured with the scenario.

Figure 3: Synchronization Timeline

The representation of the Synchronization Timeline is persisted in an internal data format at present as an accompanying document to the MSDL scenario. Future plans for WebMSDE include encoding the timeline in an independent format such as Coalition Battle Management Language (C-BML) (Coalition Battle Management Language Product Development Group, Simulation Interoperability Standards Organization [SISO], 2012; Pullen, Corner, Brook, Wittman, Mevassvik, & Alstad, 2012) to ensure a wider audience can ingest the activities from within a scenario. C-BML provides a simulation agnostic representation for providing command and control of forces and equipment conducting military operations and is currently undergoing balloting to become a SISO standard.

OBS Support

While WebMSDE's primary focus is to generate MSDL-defined scenarios, there are other scenario formats that are widely used that could expand the potential user-base of WebMSDE. OBS, for example, is used in the Joint and Coalition Warfighting (JCW) Joint Live, Virtual, Constructive (JLVC), JLCCTC Entity Resolution Federation (ERF), and LVC-IA for representing scenarios. There are key differences between the OBS and MSDL formats. This makes supporting both formats non-trivial, despite the fact that they overlap in some areas of scenario representation. Some of these differences include objects and attributes in OBS that do not exist in MSDL, such as class definitions for objects, radio transmitter characteristics, and supply information. Similarly, tactical graphics are represented in MSDL but not present in OBS. Further, there are version differences within individual formats that must be accounted for to generate valid files.

The addition of an import and export capability for OBS scenarios has pushed WebMSDE to support a plug-in architecture for extending the scenario data model. The WebMSDE scenario data model, based on the MSDL data specification, provides a core scenario representation, including a reasonable intersection of the supported data model formats. Plug-in extensions provide the additional details to account for format-specific representations, like OBS class information. Additionally, core sets of attribute editors allow user modification or addition to a scenario, and extension plug-ins editors allow modifications to format specific detail. WebMSDE also supports cross format support, e.g., loading MSDL and generating OBS. While there are data gaps that emerge when performing transformations between the supported formats, due to differences between format-specific data representations, WebMSDE mines existing internal data when available or prompts the user for additional information.

Finally, the size of typical OBS enterprise scenarios can be large. To support handling this volume of information in a reasonable timeframe, WebMSDE added a web service to import OBS scenarios into its data representation. This mechanism is transparent to the end user and keeps load time of a 44 Megabyte (MB) OBS scenario that contains more than 51,000 entities and 5,100 units split across 12 sides down to approximately two minutes.

Scenario Initialization from ABCS Resources

When interoperating with MCS, or wanting to use simulation to support Mission Rehearsal and Course of Action Analysis, setting up a simulation scenario is currently a tedious process. Although MCS have a representation of a task organization and a representation of positional information for friendly and enemy forces, that information has to currently be laboriously duplicated in a simulation scenario. WebMSDE now provides a capability that simplifies this process by allowing the information that already exists in MCS to easily be added to the simulation scenario. It does this by connecting to the data representation in MCS using a purpose-built web service that interfaces with the Data Dissemination Service (DDS) and retrieves attributes of reported friendly and enemy forces, their names, locations, and URNs. Additionally, WebMSDE provides a service to lookup the force structure as represented in an LDIF address book and create that matching task organization in the WebMSDE scenario. This populates the task organization in the scenario, including attribution on the units and equipment with names and URNs. Additionally, WebMSDE users can import elements, such as units or equipment from LDIFs into the scenario task organization hierarchy, then use drag and drop actions to set locations on the map or move within the task org. This accelerates WebMSDE scenario development for scenarios intending to interface with MCS.

3-Dimensional (3D) Terrain Support

The initial version of WebMSDE presented a flexible terrain imagery visualization capability; however, the view is restricted to two dimensions making detailed positioning of equipment on the terrain for maximum tactical advantage in a scenario challenging, especially for scenarios involving interaction with Virtual simulators. WebMSDE began an initiative to add support for a 3D view similar to views commonly seen in commercial products, such as Google Earth™. The advent of the Web Graphics Library (WebGL) standard in HTML5, which adds native browser support with Graphics Processing Unit (GPU) acceleration all without a plug-in, provides the technical mechanism to enable delivering a 3D scene in the browser. WebMSDE was updated to abstract its interface to the map enabling it to work equally well on different map representations 2D and 3D. Units, Installations, and Equipment are viewed as billboard representations using Military Standard (MILSTD) 2525 symbols. WebMSDE will support Common Moving Models (CM2) 3D models for equipment in the future to provide a more natural view of equipment in a three dimensional view.

Enterprise Partitioning of Scenarios

Enterprise-wide scenario development often requires mapping of elements of the task organization to which application is going to simulate it. This partitioning is accomplished in WebMSDE using simple drag and drop mechanics. WebMSDE users can create new partitioning domains, e.g., Live, Virtual, or Constructive. WebMSDE preserves existing mappings that are present in OBS scenarios and presents those for scenario developers to view or modify. As shown in Figure 4, users drag elements of the task organization over to a given domain to make the mapping. Users can add new domains by selecting the plus button at the top center of Domain Allocation Tool. Selecting one of the domains on the right of Figure 4 shows the complete task organization allocated to that domain. Upon export of the scenario from WebMSDE, users can choose to export the entire scenario or just those parts applicable to a given domain.

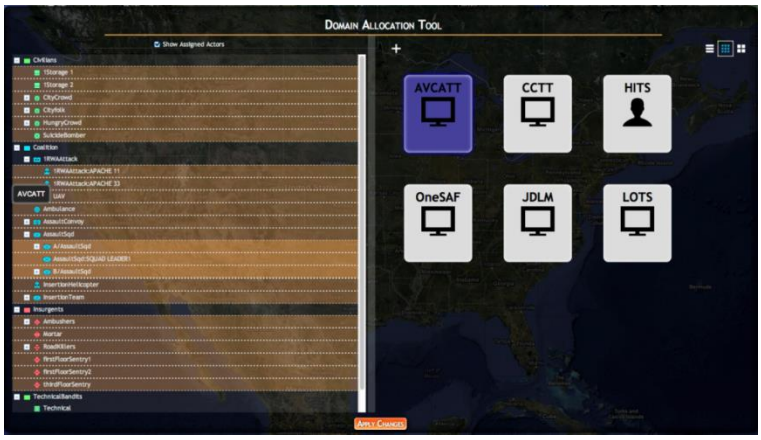

Figure 4: WebMSDE Domain Allocation Tool

Multi-User Collaboration

Development of large-scale scenarios typically involves many stakeholders. Previous scenario generation systems relied on ad hoc transferring snapshots of in-progress scenario products between scenario developers. This often leads to scenario integration issues, expansion of scenario development time due to communication issues, or poor quality scenarios. To address this deficiency, WebMSDE is adding support for multi-user scenario generation collaboration. In addition to the ability to allow multiple users to update the scenario concurrently, WebMSDE is adding additional collaboration services to help scenario developers communicate. This includes automatic notifications of changes to the scenario, user-initiated notes (e.g., "S2 expects 2 Air Defense Artillery [ADA] units here, not 3"), chat support, and "To Do" items (e.g., "Ensure medic units have proper supplies"). All of this information is stored with the scenario, but is not persisted as part of the scenario. The chat service utilizes the Extensible Messaging and Presence Protocol (XMPP) standard and directly interfaces with WebMSDE's authorization service to ensure that role management in WebMSDE is synchronized with roster management in the chat service.

WebMSDE Path Forward

The base capabilities in WebMSDE along with ongoing upgrades address a variety of scenario generation issues that confront scenario designers. From tools to help capture the scenario developer's intent for activities, support for multiple scenario formats, direct interface to C2R to pull in address book information, simplify scenario initialization from Mission Command systems, help visualize the placement of equipment in a 2D or 3D view, easily partition a scenario for multiple simulations, and support remote scenario collaboration, WebMSDE is addressing scenario generation shortfalls. The combination of these changes is intended to help put tools for developing simulation scenarios in the hands of military subject matter experts instead of simulation experts. This prototype has potential to provide the way forward to the LVC enterprise vision for scenario generation.

SUMMARY

This on-going research program focuses on a twofold approach. The first focuses on near term gaps and provides small prototypes that address critical technology issues identified by the LVC-IA developers, such as the URN and Force mapping issues the initial prototype addressed. The second focuses on longer term gaps and provides technology-based efforts, such as WebMSDE, that create prototypes focused on the enterprise with the goal of providing a platform to determine the functional requirements for the objective enterprise systems. The RRTB team plans to continue research in this area with the goal of providing the way forward to a seamless, easy to use enterprise scenario solution for the future builds of the LVC-IA program.

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