Adopting OneSAF as the Core Entity Driver for BLCSE

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ABSTRACT

The Battle Lab Collaborative Simulation Environment federation is replacing its primary entity driver OneSAF Testbed Baseline (OTB) with One Semi-Automated Force (OneSAF). OTB is at the core of the Army Capabilities Integration Center's (ARCIC) Battle Lab Collaborative Simulation Environment (BLCSE) federation. Currently, the BLCSE federation has OTB at the core with about 14 other federates that depend on the entities and interactions provided by OTB. The ARCIC Simulations Division envisions that OneSAF will not only replace OTB but will over time replace the functions provided by many of the other federates to create a more homogenous federation. As OneSAF is introduced into a mature federation such as BLCSE, there are federation considerations and site considerations that must be managed. This paper will address the BLCSE enterprise culture changes associated with procedures and challenges involved in community adoption. Economies are gained by replacing OTB and eventually one or more other federates with OneSAF. Configuration management procedures will have to be adopted to address users that are now able to compose behaviors of a simulation that are at the core of the federation. This paper will also address how a BLCSE site such as the Future Force Integration Directorate (FFID) in Ft. Bliss, TX is conducting OneSAF training for users and technicians, modifying/introducing infrastructure, participating in integration and stress testing of ONESAF, and performing configuration management. These activities and more are being synchronized and conducted to ensure a successful introduction and adoption of the primary entity driver, OneSAF, in the BLCSE federation.

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INTRODUCTION

The Army Capabilities and Integration Center (ARCIC) and its associated Army Battle Labs are currently on a transition path to adopt OneSAF. OneSAF will replace OneSAF Testbed Baseline (OTB) as the entity level combat driver within the Battle Lab Collaborative Simulation Environment (BLCSE) which is ARCIC's geographically distributed simulation environment that links over 14 Training and Doctrine Command (TRADOC) schools and centers and their associated simulation capabilities. To adopt ONESAF as the core entity level driver within BLCSE, ARCIC must ensure that OneSAF can represent the models and behaviors of OTB, interoperate with other BLCSE federates and tools, perform and function across a geographically distributed wide area network, meet the entity load requirements for ARCIC studies, and support or replace BLCSE technical and management enablers. The ARCIC Simulations Division is the lead agency for managing BLCSE and the adoption of OneSAF within ARCIC. The target date for initial capability of OneSAF within BLCSE is October 2007. To accomplish this, deliberate technical testing within the BLCSE and its sites is being conducted. Simultaneous with this adoption, ARCIC is managing the conditions for acceptance and use of this key simulation capability.

WHY ADOPT ONESAF?

The dynamic nature of studies and experiments conducted within the ARCIC and associated Army Battle Labs requires simulation tools that can be adapted to meet the representation and functional requirements called for by the event study objectives. Current and traditional tools such as OTB have proven too rigid in being able to adapt to meet the event requirements. Several factors lead to this observation such as code development for new and emerging behaviors, centralized and rigid control of source code, and simulation architectures which have achieved their limits in being able to be further enhanced to meet the demands of today's BLCSE fidelity and scalability requirements.

ARCIC's studies and experiments support many of the Army's future development efforts to transform the force. ARCIC experiences a very high operational tempo regarding experiment events, each of which demands that behaviors and functions be rapidly adapted to meet the needs of an event. As discussed above, current and traditional simulation tools were not meeting the demands of ARCIC's experiment environment. A cutting edge tool needs to be brought into ARCIC's "toolset" enabling Army Labs to experiment with new ideas involving the changing and adding of new functions and behaviors. The labs need to be empowered to adapt their simulations vice being required to go through an independent/outside model developer who may not understand their needs. The labs need a tool that allows them to explore in engineering level of detail and within the context of multiple brigade fights. OneSAF is the most promising tool that meets these needs.

BLCSE ENTERPRISE CHANGE

Within BLCSE, OneSAF will replace OTB as the core entity level combat driver. ARCIC Simulations Division will manage the replacement of OTB with OneSAF and will adopt the overall BLCSE architecture to accommodate OneSAF. Before we discuss what and how ARCIC will manage this change, an understanding of the role that OTB provided and the role that OneSAF will provide within BLCSE must be established.

ARCIC primarily uses BLCSE when they perform integrated combined arms experimentation where the capabilities and subject matter experts from across the Army Battle Labs are linked. BLCSE linked sites consist of over 14 Army Battle Labs, Schools and Centers, as well as other simulation environments such as the Cross Command Collaborative Effort (3CE). To better understand BLCSE and assess the impacts associated with adopting OneSAF, one can look at the BLCSE enterprise in layers. These layers consist of the Network Foundation, Collaboration and Access to Data Component, Analysis Component, Distributed

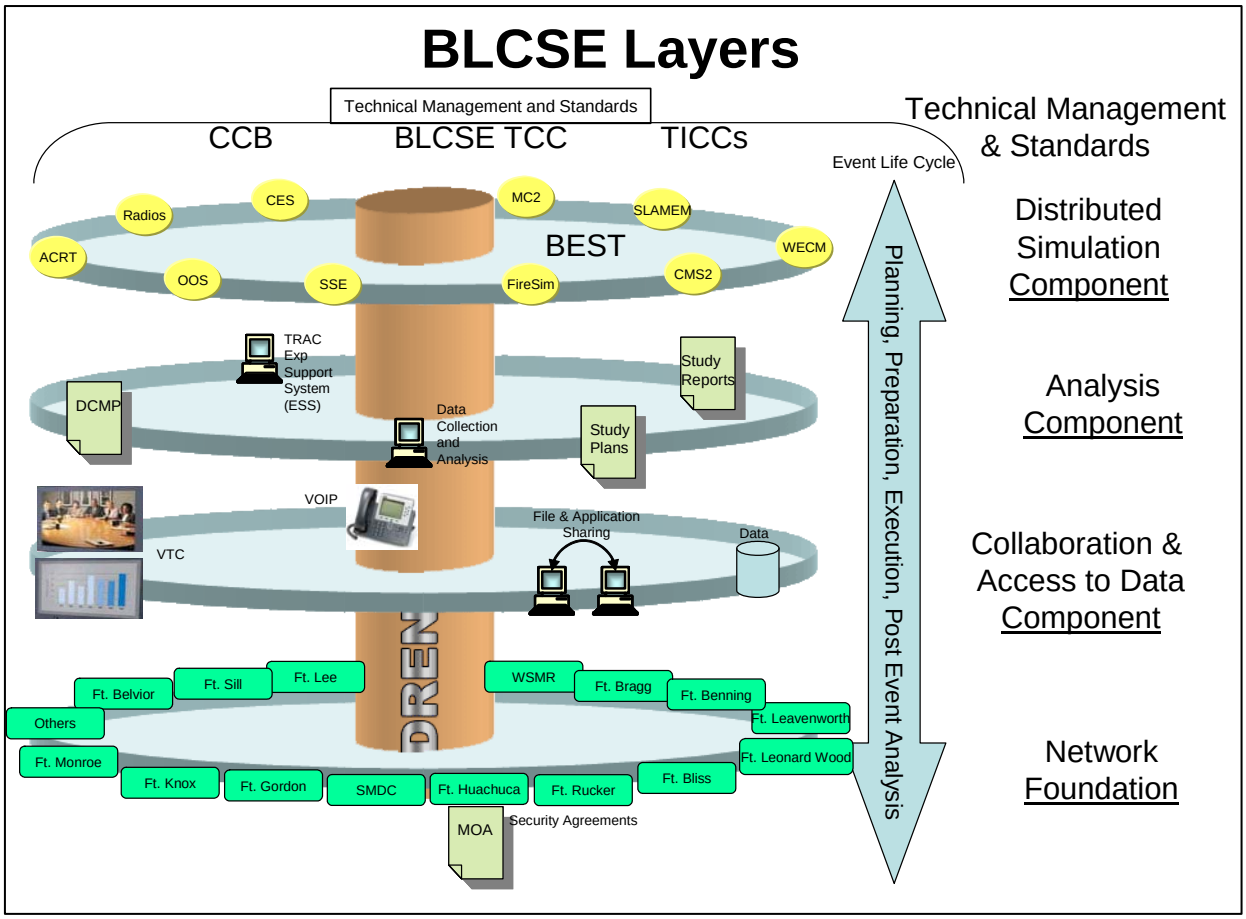

Figure 1. BLCSE Layers

Simulations Component, and the Technical Management and Standards. Figure 1 above illustrates the BLCSE Layers.

ARCIC is focusing its efforts on the Technical Management and Standards, Distributed Simulation Component and the Network Foundation as it gains an understanding and forms its OneSAF adoption strategy.

Core Entity-level Combat Driver

OTB played a key role within the Distributed Simulation Component. OTB is the core entity-level driver of the BLCSE federation. In this role, the majority of the models and entities are represented by OTB. The "core" concept is that OTB is the center-most important part of the BLCSE federation. Within the Technical Management and Standards Component, ARCIC adopted a business model in establishing federations. Most importantly ARCIC established that if the core entity level driver could provide sufficient representation of a key function then the core driver would be selected over any other tool. This practice precluded bringing in other "unnecessary" federates and thereby decreased the technical integration complexity. Given this critical role within BLCSE, ARCIC Simulations Division needs to ensure that the models and functional capability of OTB can be performed by OneSAF.

Interoperability with Other BLCSE Federates and Tools

Within the Distributed Simulation Component the Core entity-level driver must be interoperable with other BLCSE federates and tools. The other federates and tools are those functional models that are required to represent functions not provided by the core simulation and/or perform those functions to a higher degree of fidelity for a given event. BLCSE currently has the following technical interoperability standards established: IEEE 1278 (DIS) and IEEE 1516 (HLA). BLCSE is currently in the transition path moving from an OTB DIS-based federation to a OneSAF HLA-based federation. ARCIC Simulations Division is managing and assessing OneSAF performance within a OneSAF HLA-based federation.

The BLCSE federates other than OneSAF are mostly DIS simulations. ARCIC tasked SAIC to develop interface software to enable the DIS simulations to interoperate within an HLA BLCSE architecture. OneSAF will need to be interoperable with this integration approach.

ARCIC will also have to validate that OneSAF interoperates via the BLCSE Federation Object Model (FOM) and HLA Run Time Infrastructure (RTI).

Wide Area Network Implications

Within a typical BLCSE distributed event, OTB is run distributedly from many of the BLCSE sites, as opposed to a single simulation facility. In order for OneSAF to effectively replace OTB, it needs to be able to interoperate across a geographically distributed secure Wide Area Network (WAN). Bandwidth is typically not an issue within BLCSE since the Defense Research and Engineering Network (DREN) is utilized by all BLCSE sites.

CULTURE CHANGE

OTB has traditionally been the tool of choice as the primary entity driver for ARCIC's future force experiments for about the past 5 years, and is at the core of its geographically distributed simulation capability called the Battle Lab Collaborative Simulation Environment (BLCSE). Five years of a practiced business model must now change to adopt a new simulation that is at the core of the simulation environment. The challenge for ARCIC is to develop and institute the policies, business practices, and plans for adopting ONESAF within the Army Battle labs and within the BLCSE enterprise. These new changes must enable acceptance of OneSAF with the labs and within BLCSE. There are essentially two key areas where the BLCSE culture must change. The first change is in acceptance of OneSAF within the Battle Labs to perform functional representation of their respective proponents. The second change is in configuration management of the model that is at the core of the BLCSE federation. To assist in the management of the changes, ARCIC Simulations Division established centrally controlled Technical Integration Configuration Control (TICC) Teams. These teams are embedded throughout the Battle Labs but work for ARCIC. They work ARCIC's priorities with a deep understanding for the needs of the labs.

Battle Lab Acceptance

Battle Labs have at times competing priorities such as satisfying the needs of the proponent for which they are chartered to support, and satisfying the needs of ARCIC which is their higher headquarters. To achieve the needs of their proponent, such as air mobility, Battle Labs have Models and Simulations (M&S) which are optimized to perform their required representations. They have over time performed improvements in behaviors and functions to such a point that it would be very difficult for a lab to divest itself from the use of their internal M&S. It is also equally difficult to expect a newly developed simulation such as OneSAF to replace such an optimized tool especially since OneSAF is designed to satisfy the needs of a very broad community.

OneSAF is designed to meet the needs of the following M&S domains: Advanced Concepts and Requirements (ACR), Training, Exercise and Military Operations (TEMO), and Research, Development and Acquisition (RDA). To meet the needs of such a broad community, the OneSAF program targeted the following simulations to replace: BBS, OTB, JANUS, JCATS (Urban Operations functionality), CCTT SAF and AVCATT SAF (OneSAF Objective System, 2007). Note that OneSAF does not have the requirement to replace the functional models that the Battle Labs use in support of their proponents. However, the potential is great for OneSAF to do just that over time. The more the Battle Lab's capabilities are migrated over to OneSAF, the higher value a "common" tool will have to the community.

As stated earlier, the labs have tools (functional models) optimized to perform their required behaviors and functions. These functional models represented the needs of a particular lab very well, but typically represent the needs of other labs to a lesser degree. If these tools are used in a stand-alone fashion then experiment objectives are achieved without a complete integrated combined-arms context. To provide a more accurate combined-arms context the functional model may be integrated with a combat driver such as OneSAF or OTB. When we integrate with other tools then we increase technical risk.

The need for a common tool such as OneSAF has clearly been demonstrated with the extensive use of OTB throughout the Battle Labs. To adopt OneSAF within the Battle Labs, a strategy must be developed by ARCIC such that the labs do not have to sacrifice their fidelity within their respective proponents. ARCIC has the challenge to develop such a strategy to:

- Incorporate OneSAF within the labs to give them the best possible representation of most of the combined-arms warfight.

- Integrate with proponent functional models to bring in the additional required functionality.
- Incorporate over time specific functional capability used by Battle Lab functional models into the OneSAF baseline.

Configuration Management Culture Change

Event preparations within a BLCSE supported event are typically time constrained with dynamically changing representation requirements emerging shortly before event execution. BLCSE has developed a configuration controlled event preparation process that enables as much flexibility to the event director as feasible. The reality is that representation requirements will change and they currently do change unexpectedly with little planning time.

With OTB as the core entity-level driver, such changes involving enhanced behaviors or new representation requirements had to be hard coded by a very experienced simulation engineer. This necessity was not trivial and involved some development time. Given the compressed preparation timeline, minimal interoperability checks were performed across the federation to validate these changes. Other sites participating in these events with non-OTB federates often risked anomalies within their simulation due to these changes. Even given this negative aspect of OTB, it allowed for more centralized configuration control because fewer people could make changes.

With OneSAF as the core entity-level driver, experienced users will be able to compose new entities and behaviors utilizing the composer tool. This capability enables more rapid development of these model enhancements in a decentralized fashion. However, this creates a challenge for ensuring these changes to the model libraries are made available to all other users of OneSAF prior to conduct of an event.

Homogeneity

If ARCIC can overcome these culture changes, the result will move BLCSE to a more homogeneous federation with OneSAF at its core. As BLCSE moves towards homogeneity, fewer federates will be required to achieve the representation requirements of an event. Battle Labs will have a more powerful combat model for more faithful representation of the battlefield. Event federations will have fewer anomalies occurring due to interactions of heterogeneous federates and associated correlation issues. Event preparation timelines will be reduced due to less time required for integration of and accounting for interactions between federates. The federates other than OneSAF will be mainly used for limited or focused functions which can be isolated, or concentrated on in integration preparations for an event. This benefit for ARCIC and their BLCSE supported events are more efficient use of resources (time and people) gained through focused effort, focused integration, and reduced preparation timelines.

MANAGING ONESAF ADOPTION

ARCIC has an aggressive schedule to adopt OneSAF as its core entity driver within the BLCSE federation and at BLCSE sites. To manage the adoption of OneSAF, ARCIC is: conducting performance testing of OneSAF as a combat driver and its ability to serve as the core entity driver of the BLCSE distributed over the wide area network; configuration managing the changes to OneSAF use within the BLCSE federation and use within the Army Battle Labs; and managing the development of OneSAF for use within BLCSE and the Battle Labs. ARCIC recently established teams of technical experts to assist with the tasks above. These teams are the Technical Integration and Configuration Control (TICC) Teams and the BLCSE Engineering Support Team (BEST).

Technical Integration and Configuration Control (TICC) Teams

TICC Teams are embedded within key “hubs” for experiments within the BLCSE environment. The main benefit of the TICC Teams is that they can work ARCIC’s priorities within Army Battle Labs. Through the use of these teams, ARCIC can maintain momentum on the adoption of OneSAF without being hindered by competing priorities that the Battle Labs may be working on. With these teams, the Battle Labs benefit in that they can continue work on their projects and leverage the work that ARCIC is doing within their labs. With respect to OneSAF, the TICC Teams: maintain and assess knowledge of functional needs for simulations of the labs for which they are responsible; provide site participation in the distributed testing of OneSAF during BLCSE Technical Integration Events (TIEs); perform as subject matter experts for sites to go to first when they have issues associated with using and implementing OneSAF; ensure configuration control of OneSAF; compose behaviors and entities as needed by their respective sites; and will act as primary coaches for OneSAF use within their sites. Generally, the TICCs are the OneSAF user interface for ARCIC.

BLCSE Engineering Support Team (BEST)

The BLCSE Engineering Support Team provides ARCIC a means to engineer solutions with OneSAF use in BLCSE. The BEST can conduct engineering

that exceeds the roles and responsibilities of the TICC Teams. The BEST explores OneSAF on various hardware and operating system configurations that are expected for use at BLCSE sites. The BEST develops integration solutions between OneSAF and other BLCSE federates.

CONFIGURATION MANAGEMENT

The most significant challenge associated with OneSAF Configuration Control (CC) is enabling users to compose behaviors that they need for their events, while maintaining a configuration controlled baseline that is available for all BLCSE sites. ARCIC's objective is to maintain a Configuration Controlled OneSAF baseline version that contains enhancements of the model libraries that are needed for BLCSE customers. A dynamic that ARCIC faces is that the BLCSE federation is also part of the Cross Command Collaborative Effort (3CE) environment. 3CE is also maintaining a Configuration Controlled version of OneSAF model libraries. Additionally, the Program Manager for OneSAF is maintaining its Configuration Controlled version of OneSAF model libraries. To enable the CC efforts of each of the organizations just described, ARCIC established a version manager software package. The product chosen was Serena™ Version Manager which will enable archiving of the various baseline versions of the model libraries so that when a particular site is participating in its own event, a BLCSE event, or a 3CE event, ARCIC can be assured that the proper version is being used and that it is available.

Within the ACR community "what-if" analysis is common place. Rigid and slow adapting CC processes are not acceptable. For example, for a particular event a requirement for a system to have a different capability or behavior may develop just a few months before an event. With OneSAF the user, with the assistance of the TICC team, will be able to compose this new behavior/model in a timely fashion. The ARCIC CC procedures will enable this to happen and the new development to be shared with those participating in this particular event. Upon conclusion of the event, changes will be reviewed and considered for inclusion into the BLCSE Baseline Reference Version for future event use. Figure 2 depicts the plan for how ARCIC will perform version management of OneSAF within BLCSE.

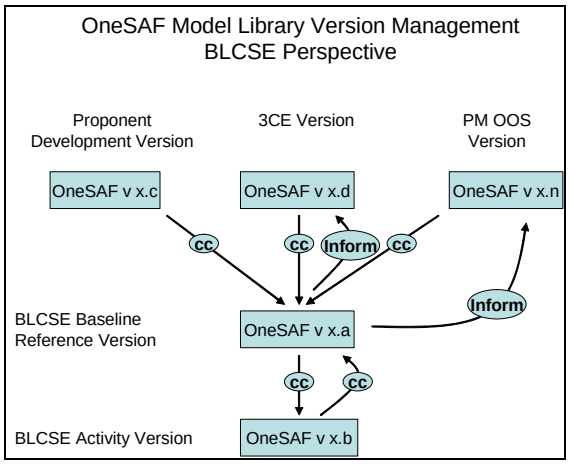

Figure 2. BLCSE OneSAF Version Management

A Battle Lab may have a need for a behavior in OneSAF for a particular experiment that is not in the BLCSE Baseline Reference Version for OneSAF. The TICC Team will assist that Lab with composing the needed behavior. At the conclusion of that experiment, the BLCSE Technical Configuration Controller (TCC) will make a decision via the BLCSE Configuration Control Board if that enhancement to OneSAF should be brought into the BLCSE Baseline Reference Version. If it is decided that this enhancement is needed, then further testing by the BEST will be performed to ensure that OneSAF is stable and that this new model library for OneSAF is integrated with the rest of the tools in the BLCSE Federation.

Battle Labs may also compose entities for OneSAF that meet their own needs outside the use in a BLCSE supported experiment. In this case the lab composes OneSAF to meet their needs for their internal use. If it is decided later that this is a good enhancement for the overall BLCSE community, then the change is brought under CC and the BLCSE reference version is changed to include this enhancement. Again, the BEST will perform the integration testing.

Inclusion of 3CE developed OneSAF changes and Program Manager OneSAF developed OneSAF versions follows similar procedures. The exception is that BLCSE will provide these organizations with enhancements made to the BLCSE reference version and why these enhancements were made. These organizations will decide if they will then change their versions to incorporate the BLCSE changes.

BLCSE TECHNICAL INTEGRATION EVENTS

The BLCSE environment, as mentioned earlier, is geographically distributed to over 14 sites. This presents some special challenges for a newly developed simulation such as OneSAF. These challenges are different from distributed use of a simulation on a Local Area Network. ARCIC has been conducting a series of incremental steps to transition in a series of tests called Technical Integration Events (TIEs) in order to gain insight on how to best implement OneSAF on the BLCSE WAN. The TIE's primary test objectives are associated with entity load, integration with other BLCSE federates, hardware and software configurations, and operator to OneSAF task load.

TIE Test Objectives and Schedule

In accordance with the ARCIC's BLCSE transition plan, the Simulations Division is conducting the following test schedule and Objectives:

- TIE-1 (12 - 15 Feb 07). Purpose was to introduce OneSAF and High Level Architecture to BLCSE. Key objectives were to assess OneSAF and Modeling Architecture for Technology, Research, and Experimentation (MATREX) RTI in the BLCSE federation.
- TIE-2 (30 Apr - 3 May 07). Purpose was to build up stress on the BLCSE federations. Key objectives were to add Objective Force (OF) OneSAF, increase entity load to 5,000 medium resolution entities.
- TIE-3 (23 - 27 July 07). Purpose is to stress BLCSE federation to 10,000 entities. Key objectives are to increase entity load to 10,000 medium resolution entities, and to test OneSAF Clusters to identify optimal configurations.
- TIE-4 (13 - 17 Aug 07). Purpose is to continue testing TIE-3 Objectives.
- TIE-5 (1-5 Oct 07). Purpose is to achieve a full 10,000-25,000 entity scenario, add virtual simulations, and add OneSAF V1.5. Key objective is to integrate the newly developed OneSAF hosted Advanced Concepts Research Tools (ACRTs).

Entity Load

BLCSE simulation events have routinely supported studies that explore and analyze capabilities associated with Brigade Combat Teams (BCTs) with appropriate support elements and opposing forces. This level of representation translates to about 40,000 entities. ARCIC's requirement for the immediate future will be to ensure a OneSAF-based BLCSE federation can achieve 25,000 entities. This translates to representing a Combined Arms Battalion (CAB) in heavy contact and another CAB in medium contact. The TIEs are exploring if 25,000 medium resolution entities can be achieved while still maintaining a stable federation (Miller, 2007). For the expected use of OneSAF in FY08 this will be more than sufficient.

Integration with Other Federates on WAN

The TIEs are also exploring the integration of the entire BLCSE toolbox utilizing OneSAF as its core entity driver. Technical Integration Threads are documented simulation representation requirements of combat operational functions. These representation requirements for each operational thread are expressed in an orderly sequence of events that can be measured and observed while conducting technical integration and validation of a simulation federation. These threads usually involve several federates to asses all required interactions. The thread tests are conducted singularly, simultaneously, and under various loads for each thread. ARCIC documented nine technical integration threads that if reliably represented in BLCSE will generally account for about 90% of the typical interactions that should be tested. This precludes having to perform exhaustive pair-wise testing of all interactions. It also minimizes unexpected anomalies occurring during event execution. Before mid-October 2007, OneSAF will have completed validation of all nine threads while interacting with all other BLCSE federates.

Testing over the Wide Area Network (WAN) is especially important for BLCSE. Performance over an encrypted long haul network is providing some useful insight into OneSAF capabilities. OneSAF, at the time of release, has mainly been tested distributedly on local area networks. ARCIC needs to validate that OneSAF can perform on the WAN which is its typical use for ARCIC experiments. The TIE testing will ensure that OneSAF works with the BLCSE HLA architecture and test that these interactions work on a geographically distributed network. The thread testing above has already identified some distributed interaction issues that have been reported to the Program Manager (PM) OneSAF for resolution.

Hardware and Software Configurations

The TIEs are generating information that will aid site infrastructure decisions about hardware and software configurations. ARCIC is exploring operating systems other than those recommended and tested by PM OneSAF. PM OneSAF tested and supports Microsoft Windows and Red Hat Enterprise Linux (RHEL).

Procuring RHEL would be an expensive option given that many of the BLCSE sites will implement hundreds of OneSAF hardware platforms. The TIEs are exploring whether CentOS is a feasible and acceptable option. CentOS is a freely distributed operating system that is based on REHL. To date, CentOS is proving to be a stable and acceptable option. CentOS is free to use but comes with no technical support. ARCIC plans to use the Windows operating system only with the OneSAF tools that specifically require it, such as the Military Scenario Development Environment (MSDE) and After Action Review (AAR) tools.

The use of OneSAF clusters and how to configure them is another key focus of the TIEs. A OneSAF cluster is a means of distributing OOS functionality and processing across multiple, collocated machines. The main reason for implementing such an approach for BLCSE is to help distribute the load and gain stable performance. The following tools make up the clusters: Management and Control Tool (MCT), Simulation Core (SimCore) and Interoperability Tool (Interop). The MCT uses the most RAM and therefore should be run on machines with high amounts of RAM. The SimCore requires the greatest processing capability and therefore should be run on machines with large processor capability. Upon conclusion of these tests, ARCIC will be able to make recommendation to the Battle Labs in terms of system specifications as to how to best configure computers within their infrastructure.

Operator to OneSAF Task Load

Operators of OneSAF need to be able to effectively control the entities for which they are responsible. The TIEs are exploring the number and types of entities that one can effectively control. Part of this task also involves assessing the ability of OneSAF to aggregate to higher echelons. Not all simulation events conducted within BLCSE have fidelity requirements at system level. For example an event focused mostly on live testing and needing only a simulation wrap around may only require the simulation wrapper to have platoon level granularity. From a management perspective, resources can be saved if OneSAF can aggregate effectively to the platoon level and save on the requirement for OneSAF operators.

SUMMARY

ARCIC Simulations Division is pursuing a sound management approach that validates the readiness of OneSAF to function as the BLCSE federation core entity driver and ensures that OneSAF is able to meet the representation needs of the command for the near future. Their plan is assessing OneSAF within the environment for which it will be utilized. Additionally, the incremental adoption approach allows for ARCIC to learn how to effectively employ this new technology. PM OneSAF has been especially interested in ARCIC's Technical Integration Events in that the events are stressing OneSAF in ways that could not have been done by the program. ARCIC is working with PM OneSAF and others within the community to ensure the overall readiness of OneSAF and to ensure that they have a cutting edge tool that can meet their needs in transforming our force.

ACKNOWLEDGEMENTS

Special thanks to Mr. Larry Rieger, BLCSE Technical Configuration Controller (TCC), who provided much of the government vision and management mechanisms described within this paper. Additional thanks to Ms. Alex Jones and Mr. Steve Wurster who provided technical editing of this paper.

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