# The Synchronized Training & Testing System (STTS): Real time Control and Monitoring of LVC Training Events for Test and Evaluation

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## 1. Overview

The Synchronized Training & Testing System (STTS) will provide the capability to link test and training data from inside an operational unit and combat environment to a high-fidelity simulation of joint netcentric battle space components. This capability will stimulate netcentric systems under test in a mission level context integrated with a distributed Live-Virtual-Constructive dynamic joint net-centric operational environment. STTS will have the capability to stimulate friendly netcentric systems and units with threat system stimuli, simulated blue force interactions, simulated human-to-human/human-to-machine and decision interactions, Intel stimulus, and emulated network interfaces.

Users will be able to import actual operational data to test the system as if it were being deployed. The configured systems can be tested as if they were in actual theater operations without the systems actually being there. Various factors, levels and metrics can be evaluated in the test using real-time feeds that dictate and guide the evaluator's assessment.

Upon completion of the STTS, testers and trainers will be able to conduct in situ testing and training in a joint environment, using realistic data in an almost mirror image of the real world. During theater operations, test and training information will be able to be transferred from operational systems onto remote simulation servers (either CONUS or in theater) without any impact on the operational system. Both Test & Evaluation and Training will benefit from the real-time interoperability between operational and testing sites brought about by this netcentric system. NSTS will provide a joint testing/evaluation and training capability for use in Joint Netcentric Operations T&E as well as COCOM training exercises.

Standard network protocol stacks at the high data rates are required by the pipe yet lack sufficient resources to perform any other processing operations. Furthermore, despite being fully utilized, unit networks will not be affected significantly by the bandwidth limitations. STTS would accommodate the full bandwidth inherent with real-time synchronization and dissemination of data and information between operational and T&E/Training locations. Future users will be able to apply its capabilities in a operational testing environment without actually having to send teams of evaluators to theater; the testing and evaluation will be done via forward-reaching and pulling of mission and task data to structure the test environment in a Live, Virtual and Constructive (LVC) simulation at both service and joint levels.

For the participating training units, an added capability will be made in order to allow them to prepare and train with actual data and information, obtained in real-time from live systems. The training missions will mirror those required to meet the unit's Mission Essential Task List (METL) standards for a combat environment.

## 2. Background

### 2.1 T&E Benefits

The STTS will provide the capability to link test and training data from inside an operational unit and combat environment to a high-fidelity simulation of joint netcentric battle space components. This capability will stimulate netcentric systems under test in a mission level context integrated with a distributed Live-Virtual-Constructive dynamic joint net-centric operational environment. STTS will have the capability to stimulate friendly netcentric systems and units with threat system stimuli, simulated blue force interactions, simulated human-to-human/human-to-machine and decision interactions, Intel stimulus, and emulated network interfaces.

Users will be able to bring in actual operational data in order to test as if the system were being deployed and used in a virtual testbed (figure 1). The configured systems will be tested as if they were in actual theater operations without the systems actually being there. Various factors will be evaluated in the test while real-

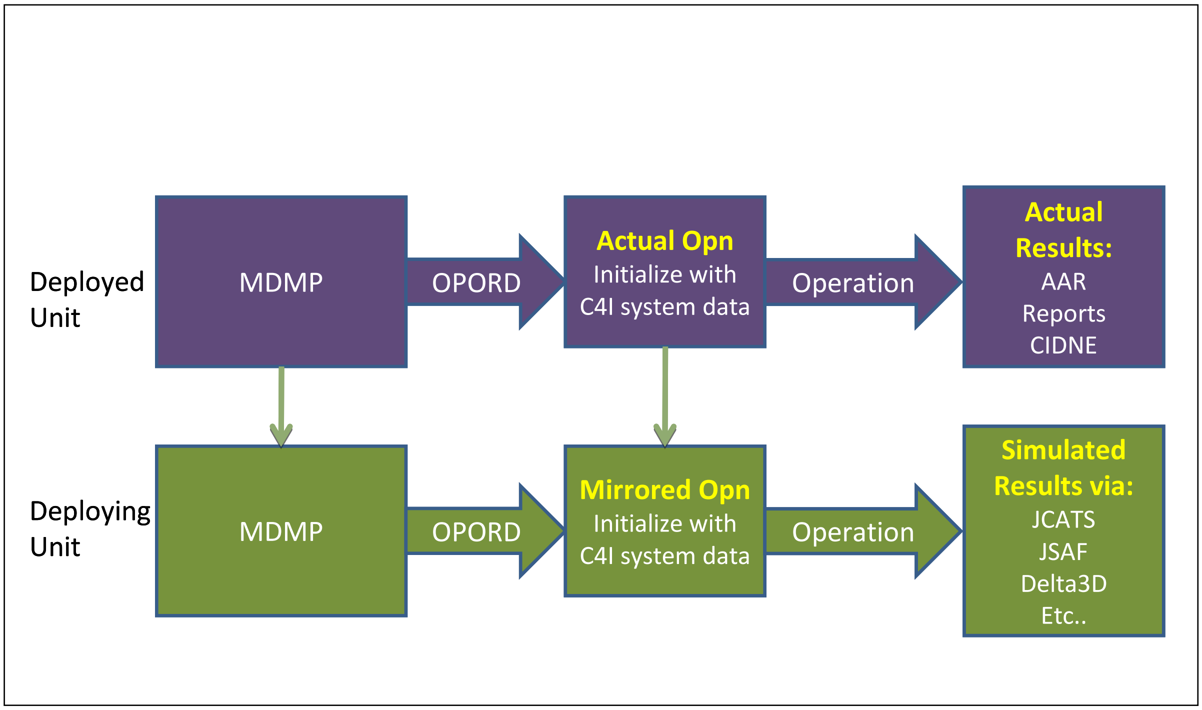


**Figure 1: Flow of data and information into STTS**

time feeds will dictate and guide the evaluator in choosing the parameters required for an accurate assessment. Standard network protocol stacks at the high data rates are required by the pipe yet lack sufficient resources to perform any other processing operations. Furthermore, despite being fully utilized, unit networks will not be affected significantly by the bandwidth limitations. STTS would accommodate the full bandwidth inherent with real-time synchronization and dissemination of data and information between operational and T&E/Training locations. Future users will be able to apply its capabilities in a operational testing environment without actually having to send teams of evaluators to theater; the testing and evaluation will be done via forward-reaching and pulling of mission and task data to structure the test environment in a Live, Virtual and Constructive (LVC) simulation at both service and joint levels.

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**2.2 S&T Technology Challenges**

This system will ensure that the user will be able to synchronize databases with actual operational data in order to test the system as if it were deployed and used in an in situ testing and virtual training environment. S&T challenges include:

- Data Translation and Semantic Matching: Various translators and tools allow some capabilities now, but this is still immature. The STTS will employ new technical translation and data matching tools and use the Test and Training Enabling Architecture (TENA) as part of the architecture to import real-world Command and Control data in real-time to adjust or identify new factors or levels of testing that may be required (figure 2). These various factors will be exported to the simulation enabling the testing to emulate real-time feeds that will guide the evaluator in choosing the parameters required for an accurate assessment.

- Fluid Systems and Change Management: Testing in an evolutionary acquisition environment means that the system has few fixed configurations. Entrenched V&V with compressed and hyper-compressed regimes will be necessary to mitigate the inevitable problems. Joint Mission Essential Task List (JMETL) driven V&V will be required to ensure that the system meets training needs (figure 3).

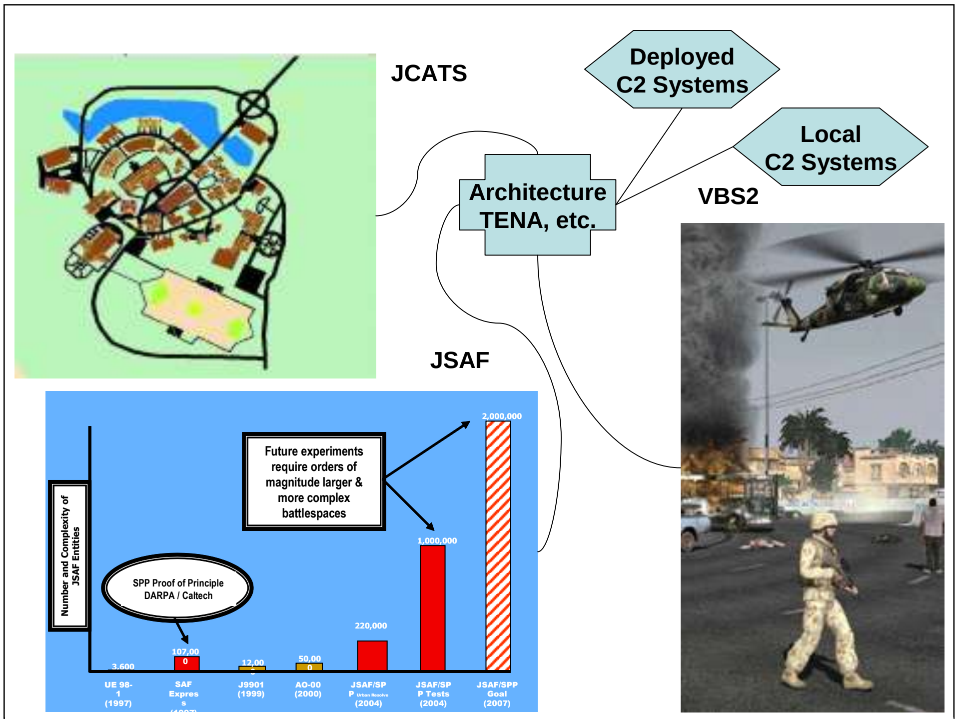


**Figure 2: Architectural View of STTS Environment**

- Figure 3: "Cordon and Search" Scenario
- Analysis of Results: Evaluating fluid systems and analyzing the results of training systems are challenging tasks. Verification and validation (V&V) support early development of Measures of Merit that match the system goals. Compressed V&V regimes may be addressed by appropriately-structured Designs of Experiment. This discipline is necessary for adequate analysis of results. In moving beyond kinetic scenarios, kinetic M&S and T&E have long histories in which problems have been encountered and solved. The challenges of non-kinetic M&S and T&E are just now being identified. Training has always included non-kinetic elements; in many respects, training has always been dominated by non-kinetic elements. Merging the strengths of each community with new M&S techniques will be a significant challenge. Solving these challenges as they impact STTS involves risks; however, the payoffs and return on investment are well worth the challenge.
- The Network. To achieve real-time interoperability and synchronization with in–theater systems requires not only large bandwidth, but intelligent bandwidth. Without consideration of the source and sink of the information being transferred, the provision of large bandwidth (a large pipe) results in the same problems encountered when a person attempts to drink from a fire hose. More specifically, processors or other communication endpoints would be completely consumed attempting to run the standard network protocol stacks at the high data rates required by the pipe and, leaving them no resources to perform any other intended processing. Furthermore, despite being fully utilized, they would be unable to accommodate the full bandwidth of the pipe.

## 3. Technical Approach

No one has been able to achieve near real-time synchronization. Instead of requiring evaluators in the field to conduct multiple replications and irrelevant testing, this approach would guide and filter out variations and factors that will have no impact on the testing outcomes. This effort not only cuts across several M&S communities of interest, but it also creates the test execution and evaluation tools critical for the interoperability demonstrations between net-centric systems. Initially STTS components will import data from command and control systems as they arrive from the operational units using standardized XML structures.

The Military Scenario Definition Language (MSDL) and its reconciliation with Joint Consultation Command and Control Information Exchange Data Model (JC3IEDM) provide steps in this direction; however, MSDL is not yet fully developed to include all of the desirable data elements. Further research is needed to

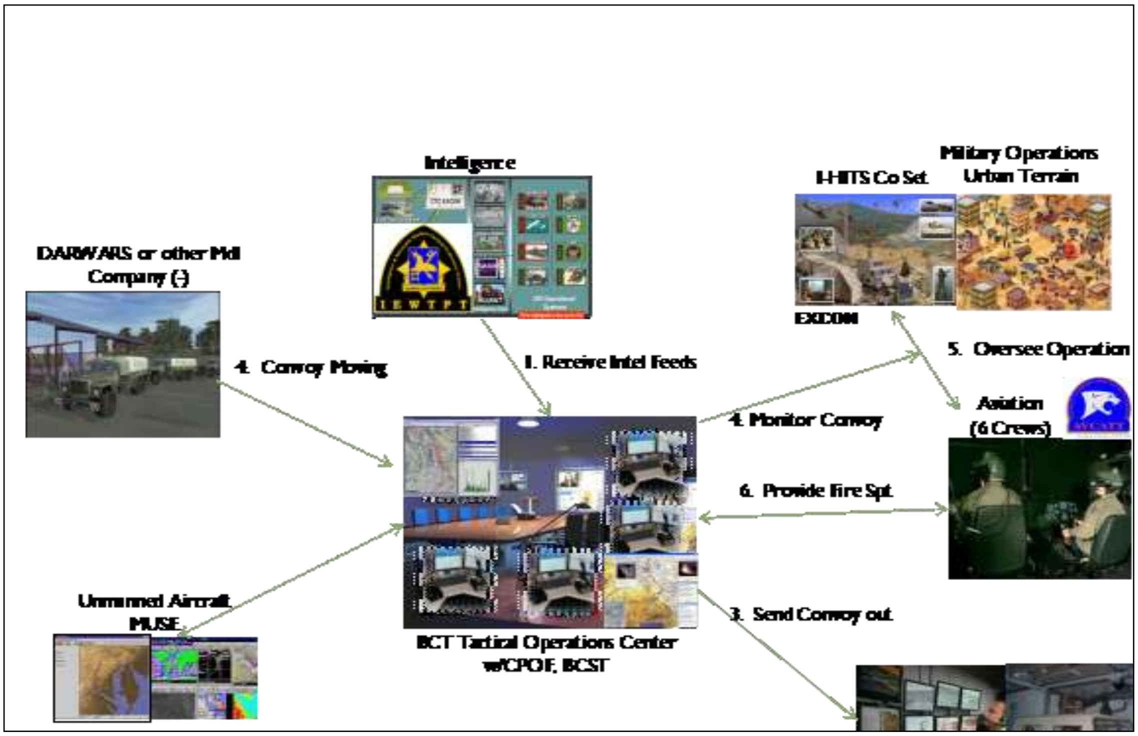


**Figure 3: "Cordon and Search" Scenario**

automate filtering, matching, and placement of data into the simulation model for immediate testing of variations in the levels and conditions identified from the operational environment. Data matching is required to correct inconsistencies and remove control characters that cause problems for simulation experiments. Completion of this capability will enable the military to add the tools into both the command and control systems and also into simulation federations for testing. An architectural framework will be established for evolving the STTS from concept to production. STTS will develop and mature two approaches involving hardware-assisted algorithms to address this problem and achieve real-time interoperability and synchronization with in-theater systems:

- The hardware-assist algorithms will be implemented as cores in reconfigurable Field Programmable Gate Arrays (FPGAs) with some software integrating into processors. FPGA technology is used widely in other defense areas where high performance processing is required in conjunction with the flexibility to accommodate different mission scenarios. Their inherent reconfigurability is also an asset in dynamic test and simulation environments and permits the use of a common hardware platform for multiple different deployments, in contrast to "stovepipe technology".

- The inherent configurability of the technology will also be used as a basis to develop built-in test mode algorithms to facilitate rapid system debug and accelerate maintenance operations, without requiring the insertion of additional test equipment into the system. The communication endpoints can be equipped with the facility to generate fixed, known test patterns, at line-rate, to exercise or simulate parts of the system and to verify that they have been correctly received. This will assist in rapidly isolating failures that are certain to be a challenging undertaking in complex closed-loop simulation environments.

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**Phase I – Build and Demonstrate Prototype**

This phase will begin with identifying models and simulations required for the evaluation and build an emulated configuration of the real systems. For example, the constructive model JCATS has demonstrated the capability to import force structure data from a C2 system using XML and provides a portion of the necessary M&S capability; Bohemia Interactive's Virtual Battlespace2 (VBS2™) provides configurable desktop virtual simulation; and JSAF provides a large scale joint simulation. Using Test and Training Enabling Architecture (TENA), this effort will link live simulation systems with the JCATS and JSAF simulations. At the end of Phase I, an environmental mock-up will be created to demonstrate and assess the prototype capability.

**Phase II –Develop and Demonstrate Operational Replication**

For a realistic portrayal and demonstration, STTS will operate in a test and evaluation net-centric environment that replicates live, distributed tests imported from operational systems. Targeted protocol and application offload techniques will be implemented to employ hardware acceleration engines to assist processors and other communication endpoint devices, reducing their overhead burden of running the protocol or performing elements of the application (e.g., translation of data from XML to another format required by a processor). Building on more-general technology already developed, new algorithms and methods will be devised to target and optimize the offload for the problems unique to the STTS operating environment. The development will be based on an analysis of the characteristics of the data to be transferred (e.g., packet sizes, frequency, format), hardware architecture of the system (e.g., bus structures of servers and other devices being used), and system-level functionality of the STTS (e.g., synchronization, how data is used). At the end of Phase II, STTS will represent a T&E/training net-centric environment that replicates and integrates live, distributed tests synchronized with data and information from operational systems.

**Phase III – Incorporate Operational Data**

This phase will incorporate operational data in real-time to adjust and control ways to guide and structure the experimental design in order to test multiple factors and levels using M&S. To alleviate congestion STTS will employ hardware engines to perform line-rate packet inspection of the incoming data and intelligently filter it, based on content, to reduce the amount of unnecessary data reaching the processors or communication endpoints. Filtering rules and methods will be developed and optimized based on an analysis of the system-level functionality and characteristics of the information being transferred, to ensure that processors do not need to spend cycles evaluating data that is not relevant to their needs at particular instances. Real-time feedback will also provide insights and direction on ways to structure or restructure developmental and operational testing. At the end of Phase III, we will incorporate operational data in real-time to adjust and control ways to guide and structure the experimental design in order to test multiple factors and levels using M&S.

**Phase IV – Harden for Integration into Programs**

In this final phase, team members will harden the system interoperability tools in STTS to integrate into impending programs such as the Future Combat System (FCS) for net-centric testing capabilities. At the end of Phase IV, STTS will possess the system interoperability tools that enable integration and connectivity with appropriate end user systems and programs (e.g., FCS, NECC).

Throughout each phase of the process, the team will adhere to two key principles. First, they will elicit the views of the training and T&E communities and institute their insights in the succeeding phases. Second, the team will be ready to transition to greater technological advances that surface during the program from future or existing T&E and Training programs (e.g., CTEIP, JMETC, Joint Rapid Scenario Generation, Joint National Training Capabilities).

## Potential Applications and Customers

There are five key focus partners interested in using this capability. These potential users are JFCOM J7, USARPAC/25th Infantry Division, PACOM J7 and J8 and the Army's Director for Modeling and Simulation in Army G-3/7. In order to create a value-based system, the phases throughout STTS will include an end of period evaluation with all of the partners' participation. This will provide merits of measure to show not only performance value but also the effectiveness of the performance. The partners will then be similar to stakeholders in this system since their evaluations and account perspectives will guide the next phase. There is a need for early testing using modeling and simulation. Such a process will align testing ranges with joint netcentric operational missions and tasks.

## Conclusion

As the partners and agencies use STTS, they will gain more familiarity with in-theater usage requirements and capabilities built on the types of missions and tasks where netcentric systems are essentially a weapon system. Simultaneous training and testing will create a synergy of effectiveness in both resources and time for trainers and evaluators. The end result will provide a way to "co-evolve" and make the systems more effective and cost efficient. The STTS will also be available to units for training and operations that evolve to new net-centric systems to speed up force integration and training enable by live, virtual and constructive simulations. From a service perspective, the STTS will allow organizations to test and train without interruption while the joint net-centric operational environment is simultaneously integrated and adopted for use. Creating system involvement and monitoring early will save time and money. STTS will accommodate acquisition, evaluation and training to modify systems at an initial and more malleable point in time.

## Author Biographies

**George F. Stone III** is the Vice President for Program Management and Modeling and Simulation Senior Scientist for Alion Science and Technology. His previous positions include Research Coordinator for the Joint IED Defeat Organization (JIEDDO) and Acting Director, Battle Command and Simulation Directorate, Army G-3/5/7. George has a PhD in Industrial Engineering from the University of Central Florida and MS in Industrial Engineering from Texas A&M University. He also had technical positions in several Joint and Army simulation programs.

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