2006 Command and Control Research Technology Symposium
THE STATE OF THE ART AND THE STATE OF THE PRACTICE

Battle Lab Simulation Collaboration Environment (BLSCE): Multipurpose Platform for Simulation C2

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Battle Lab Simulation Collaboration Environment (BLSCE):
A Multipurpose Network Platform

Abstract

Battle Lab Simulation Collaboration Environment (BLSCE) is a U.S. Army Training and Doctrine Command (TRADOC) initiative that was developed to support concept development and experimentation of Future Combat Systems (FCS) in a closed, distributed, simulation-rich environment.[1] The configuration, maintenance, administrative and security responsibilities have been assigned to the Battle Command Battle Laboratory – Gordon (BCBL-G).

This paper will specifically address the network services that are provided to facilitate the Command and Control (C2) aspect of every future force experiment. It will describe BCBL-G's primary function of providing a secure wide area network that supports a distributed, simulation-rich environment. Additionally, this paper will describe the administrative services provided over the BLSCE to include: voice over IP, video teleconferencing, and a web portal. Furthermore, a brief description of BCBL-G's NOSC responsibilities will be provided to include antivirus protection, intrusion detection, authentication, and accreditation, surrounding an enterprise-sized WAN. In conclusion, the paper will preview future evolutionary refinements anticipated for the BLSCE and its continued role as the environment for evaluating the Army future force development.

Introduction

"The Secretary of Defense has been driving the United States military to transform itself from a post-Cold War fighting force to one that is capable of addressing emerging 21st century challenges."[2] The Department of Defense (DoD) is evolving to a network-centric platform that requires great amount of flexibility, performance, security and connectivity. The BLSCE is one of the many evolving network-centric platforms that will succeed in the steps of meeting that challenge. The BLSCE's backbone is the Defense Research Engineering Network (DREN). The DREN is a robust, high capacity, low-latency nation-wide network that provides connectivity between and among the High Performance Computing Modernization Program's (HPCMP) geographically dispersed High Performance Computing (HPC) user sites, HPC Centers, and other networks.[3]

The structure of the BLSCE network began as a hybrid network that has evolved into a stable environment that uses the DREN as the transport backbone. The BLSCE is a secure network that connects and integrates 17 U.S. Army TRADOC Battle Labs and system proponents into a virtual warfare environment that focuses on primary capabilities necessary for a commander to synchronize events occurring on the battlefield with the required actions of his/her staff.

The BLSCE project is designed to digitally network and integrate TRADOC Battle Labs and Branch proponents. This connectivity enables interaction for remote collaboration, routine virtual teaming, and distributed models and simulation.[4] In addition, it can allow connections that reach other services such as Distributed Continuous Experimentation Environment (DCEE), which allows access to Joint Experimentation. BCBL-G is responsible for the functions associated with a Network

Operations and Security Center (NOSC), which are key roles for soldiers of US Army Regiment Signal Regiment.

The BLSCE provides a Network Centric Operations Conceptual Framework which explores the interaction of multiple organizations and various echelons. It allows multi-celled experimentations among several locations that cover all of the United States. It has become a gateway for Joint experimentation linking to the DCEE program, JEFEX, and other Service Labs. It has opened doors for additional technology collaborating with Communications Electronic Command (CECOM), Space and Naval Warfare (SPAWAR), and industry. It has allowed integration of environments to support development of system-of-systems combined arms capabilities across the Army and in support of Joint operations.[5] It has helped validate and refine concept documents. The BLSCE has help define the synergistic effect of ubiquitous battlefield situational awareness and how that information would be controlled in a Future Combat Systems environment in order to decisively win warfare engagements.

BLSCE Configuration

At inception, there existed a communications requirement to provide full time, on-demand, high-capacity capabilities for TRADOC labs to participate in complex integrated simulations. Most battle labs had insufficient WAN bandwidth capabilities. This lack of sufficiency between the TRADOC battle labs resulted in the loss of productive man hours and involved extensive amounts of travel during experiments, which was counter-productive to the mission of the combat and material developers. At that time, the BLCSE consisted of several T1 (1.54Mbps) circuits running through a primary rate interface (PRI) channel bank, connected to KIV-19 encryption devices and into serial routers as seen in Figure 1. The first BLCSE network had the following limitations:

- It did not extend to all Battle Lab hubs.
- It did not provide sufficient bandwidth to support near real-time simulations.
- It did not connect proponents that had supportive missions for the primary manuever forces (i.e Transportation, Medical).
- The current environment did not provide a digitally connected, integrated environment to ensure integration of maneuver, maneuver support, logistics, Networked Fires, and C4ISR concepts.

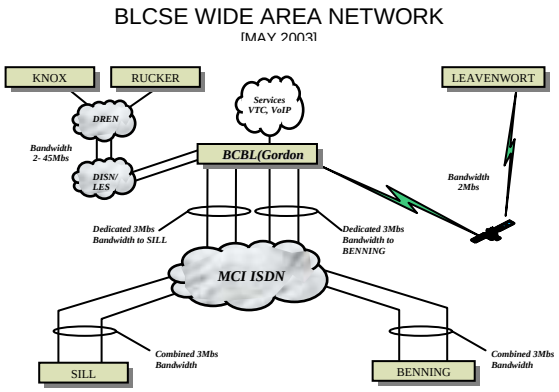

Figure 1

The BLSCE has gone through several years of integration trials and system upgrades. Currently, the BLCSE is configured as a secure Wide Area Network (WAN) with the BCBL (G) as the Network Operations and Security Center (NOSC) and seventeen other remote sites. BLCSE utilizes multiple Layer-3 circuits on the DREN connection as its backbone architecture. The NOSC uses an OC-12 (622Mbps) DREN circuit and the remote sites have at least a DS-3 (45Mbps) DREN circuit. The benefit of this high-speed broadband system is that it helps enhance the TRADOC mission of developing the objective force. BLCSE also has the capability to use Layer-2 ATM service for other non-TRADOC sites that would like to participate in future BLCSE experiments. For example, this was demonstrated in joint exercises like Joint Expeditionary Force Experiment (JEFX'04). Also, BLCSE is prepared to continue execution of specified tasks and provide all required collaboration services to include the provisions of on-site support for remote nodes in an ad-hoc experimental network as seen below in figure 2.

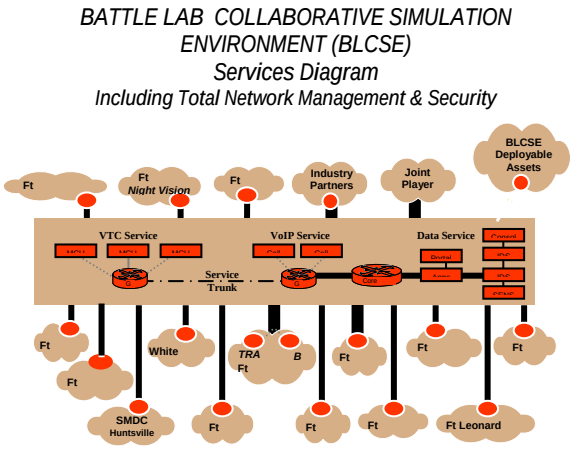

Figure 2

The BLCSE functions as a virtual private network (VPN) with the use of General Dynamics KG-175 encryption devices. Today, the backside of the KG-175 is connected to a router that serves as a gateway for distributed collaboration and simulation traffic. This architecture demonstrated cost effective use of existing and available resources to provide a Federation of models for distributed simulations.

BLSCE capabilities include:

- Operation in secure mode for data, voice, video, and collaboration.
- Support for simultaneous voice, video, network security and management and collaboration services.
- Capability for collaboration between entities on a variety of topics such as program information, data, metrics, lifecycle process, tools, simulations, and models.
- Knowledge management capabilities for further collaboration.
- Command and control capability of exercises from remote locations, including live-force play.
- Integration of combined arms experimentation in support of Army Transformation concept and materiel developments.

The BLSCE federation utilizes certified scenarios and authoritative data to expedite analysis and reduce travel and facility costs while offering expanded opportunities.[6] This approach assures scalability. The BLSCE consists of three levels of collaboration to assist and provide constructive and virtual simulations. The three levels of collaboration are: (1) Subject Matter Expert (SME) on site, (2) Distributed collaborative environment, and (3) Federation of models integrated to facilitate distributed simulation-based experimentation (as shown in figure 3).

SME (Level 1)

- Decreased reliance on on-site SMEs
- SMEs perform functions on a distributive platform

Distributed Collaboration (Level 2)

- Enables distributed Levels 1 & 2.
- Pre & post experiment coordination and products performed on a distributive platform
- Collaborative tools enable experimental C2 and technical coordination

Model Federation (Level 3)

- Core federation of models decreases experiment preparation time
- Can include additional nodes/models on an as needed basis (IAW established federation rules)
- Not intended to include all models/sites

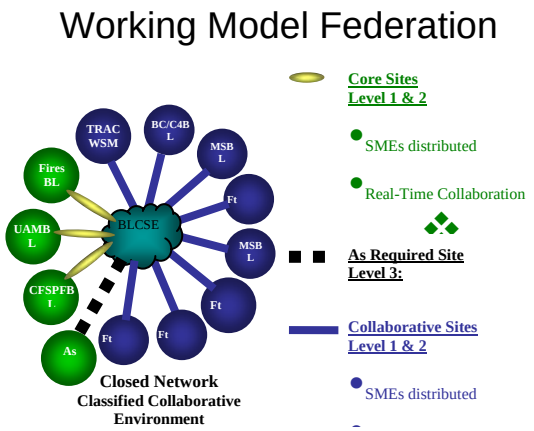

Figure 3

Command and Control

The DARPA Future Combat Systems (FCS) Command and Control (C2) Program has initiated the execution of battle command in a future force. In the FCS environment, the commander must command and control an information-enabled combined arms tactical organization to rapidly develop situational awareness and effectively control subordinate organic systems.[7] It has the capability to emulate future force concepts that support Command, Control, Communications, Computer, Intelligence, Surveillance and Reconnaissance (C4ISR), FORCEnet, and Joint Battle Management Command and Control (JBMC2), which are the future concepts for U.S. Army, U.S Navy and Joint Forces. The BLSCE has become the network-centric virtual C2 platform that has allowed FCS experiments to operate on predicted capabilities of FCS.

The FCS network is comprised of a common operating environment that provides ground truth for the commander.[8] A Battle Command software assists in maintaining contact with all staff at lower and higher echelons. The military is responsible to merge strategic, operational and tactical environments into an entity where each environment will support the other with an incredible amount of information to make decisions. These three environments must provide interoperability in order to provide the network centric platform that is necessary for a commander to send and receive timely information. The BLSCE provides a network platform that embraces the desired FCS concept.

With models and simulations as the major enablers running over the BLSCE, a primary focus of any given exercise is determining how effectively and efficiently command and control (C2) is facilitated up and down the chain-of-command. C2, in a real-time or virtual battlefield, encompasses the awareness and utilization of four primary elements: physical, information, cognitive, and social environment.[9] The simulations primarily recreate a real-time virtual battlefield that consider among many other physical attributes, implementation of autonomous robotic systems, management of indirect and direct fires, analysis of a plethora of information received from separate sensor platforms and executions of a tactical communications network.

The physical domain enables collaboration and routine virtual teaming to include voice, video teleconferencing, and whiteboard applications. It allows all sites to handle administrative functions in a secure environment. The physical domain links Warfighting simulations and experimented events together. This integrates virtual and live force play.

The information domain is directly associated with the data repositories and the web portal configurations that allow the sharing of information. The cognitive domain allows a commander to make decisions based on his/her vision of the institutionalized training and current real-time experiences in order to formulate a credible decision making process. Finally, the social domain displays the interaction between the commander and the staff elements. The commander's interaction with his staff determines whether that commander has adequate and effective command and control.

In reality, that commander will have global access to his staff and supporting units via the Global Information Grid (GIG). The GIG services are available to maintain C2 analogous to the primary services the BLSCE: voice, video, and web portal. The excerpt below gives a futuristic description of the network that will be necessary for the warfighter to have command and control.

> *"Our warfighting backplane will employ multi-mode data transport capabilities, including military and commercial satellite communications capabilities, multiple types of data links and radios, and commercial information services. These data transport capabilities will both provide the users with access to appropriate elements of a distributed computing environment, as well as providing the interconnecting fabric for a wide range of computational and storage capabilities. The backplane supporting the infostructure will employ a multi-tiered architecture for information transport and processing to increase capacity and improve interoperability. By exploiting emerging technology for providing quality of service across Internet protocol (IP)-based networks, the architecture of the infostructure will enable multiple stand-alone networks to be integrated into an adaptive and reconfigurable network-of-networks. This operational flexibility will enable commanders to plug and play sensors, shooters, command and control, and support capabilities into task-organized combat packages, including appropriate collections of sensors and weapons."* [10]

Supported Services

The BLCSE allows secure IP telephony, video teleconferencing (VTC), and data repositories from multiple fixed and mobile sites nationwide. These three services are vital features that are widely used by participants during exercise planning and execution.

Voice

The BLCSE uses Cisco System call-processing server software known as the Cisco CallManager (CCM) for an IP telephony solution. Its software extends enterprise telephony features and capabilities to packet telephony network devices such as IP phones, media processing devices, VoIP gateways, and multimedia applications. Additional data, voice, and video services such as multimedia conferencing systems interact with the IP telephony solution through CCM open telephony application programming interfaces (APIs). The CCM is installed on specified third-party servers. The CCM software has a suite of integrated voice applications and utilities, including the CCM Attendant Console. Its functions include an analysis and reporting tool, the Real-Time Monitoring Tool (RTMT), the Tool for Auto-Registered Phone Support (TAPS), and the IP Manager Assistant (IPMA) application[11].

The latest CCM version provides a scalable, distributable, and highly reliable enterprise IP telephony call-processing solution. The BLCSE has multiple CCM servers that are clustered and managed as a single entity. By clustering these multiple call-processing servers on an IP network, it provides a unique capability across the WAN architecture. This CCM clustering yields scalability from 1 to 5,000 IP phones per cluster, telephony load balancing, and call-processing service redundancy. By

interlinking multiple clusters, system capacity can be increased up to thousands of users in a twenty plus (20+) site system. Call Admission Control (CAC) helps ensure that voice quality of service (QoS) is maintained across constricted WAN links and automatically diverts calls to alternate CCM routes when WAN bandwidth is not available.

Video

Historically, BLCSE videoconferencing was done primarily over ISDN and time-division multiplexed (TDM) networks using the standard H.320 protocol. Running interactive video over such data networks was not a viable option because of the shared media characteristics of video, its connectionless nature, and its lack of guaranteed data flows. With the introduction of switched 10/100-Mbps networks, high-end routers, and multi-layered quality of service (QoS), delivering interactive video over IP is now routine. Today there is a large installed base of H.320 networks, but they incur large monthly access and switched usage charges which not include additional charges to provide a secure network.

With the current advances in high-speed broadband IP networks, it is now possible to run interactive video over an existing IP network, thus saving customers thousands of dollars a month by converging voice, video, and data traffic over a common path. This is an added advantage for the Warfighter because videoconferencing terminals no longer need to support complex network aggregation devices such as Inverse Multiplexers (IMUXs) but can instead rely on simple Ethernet network interface cards (NICs) for network connectivity.

The BLSCE Videoconferencing System integrates multi-point conferencing, multimedia gateway, and data collaboration into a single platform for cost-effective deployment of IP-centric, converged networks. It is built upon industry-standard H.323 technology. Our configuration also enables a wide range of customized and fully converged voice, video, and data solutions, ultimately saving money and scaling to larger deployments. The inexpensive replacement to the H.320 terminals with H.323 terminals has caused a significant increase in the number of H.323 terminals (cameras) positioned on the network. This allows our BLCSE customers to move videoconferencing assets from shared areas (such as conference rooms) to the user desktop or to remote field locations.

The BLCSE uses Cisco series videoconferencing products that enable federation participants in multiple remote locations to attend the same video teleconference (VTC) meeting with full, real-time interactivity. It allows end users to connect their Internet-protocol (IP)-based H.323 video camera systems to an IP-based H.323 network. For scalability, the BLCSE videoconferencing equipment includes the combination of a Multipoint Control Unit (MCU) and a videoconferencing Gateway, a rate matching module, and a data collaboration server. The BLCSE video network uses voice-activated conferences (for small 1-3 participants) or it can support continuous presence formats (for 4 or better) to manage bandwidth. It can also allow data sharing (presentations) as part of a multipoint conference. This combination allows for the integration with any H.323-compliant endpoint running any where on the IP network.

During normal BLCSE operation, VTC usage is roughly 5-10 sessions a week. However, during an event or exercise VTC usage often exceeds 5-10 sessions a day,

depending on the number of remote sites participating. BLCSE's videoconferencing service is also integrated with their voice over IP (VoIP) telephony system.

Web Portal

The BLCSE Portal is a real-time, federation-wide data repository (web-based) used for C2 planning, collaboration and data analysis. The Portal provides a central point-of-presence (POP) for all data sharing services throughout the BLCSE federation. The Portal is used as a powerful collaboration tool that allows users to share information across demographically diverse locations. Authorized users are able to upload mission critical information to a documents library where other members can make necessary revisions and/or comments. The Portal supports all experimentation and information dissemination needs within the BLCSE community.

The Portal runs on a Lotus (IBM) QuickPlace Server platform and is a highly customizable tool that is based on a hierarchical structure. The QuickPlace Server allows for many different collaboration capabilities. The Portal documents can be organized into many different areas, i.e. rooms, folders and pages, which are mostly used as a structuring tool for the BLCSE Portal. The Portal has the capability to allow documents to be dragged directly from a user's desktop onto the Portal and vice versa. Along with the integration of Microsoft Office, the Portal also gives the end-user the capability to create, view, and edit Office documents within a Team Workspace. The QuickPlace Server has the ability to provide discussion forums, task tracking, and calendar functions. The QuickPlace Server has numerous other capabilities such as e-mail integration on a Domino Server platform. However, end-users mostly utilize the Lotus Sametime Server to perform these particular functions within the BLCSE community.

The overall purpose of the BLCSE Portal is to provide the experimentation community with an information dissemination management tool. For the Warfighter, the Portal's web-enabled tools provide easy access through limited end-user training since it runs through various supported web browsers. The Portal allows data to be shared federation-wide or enables different entities to only view information on an as-needed basis. The Portal is very easily organized to meet individual site preferences either for security purposes or to make things easier for the end-user. Security parameters are easily controllable if you are the creator of the individual room, folder, or page.

The BLCSE Portal meets a baseline objective which is to provide a data repository for planning, execution, and collaboration during experimentation and exercises. It provides exercise planners and controllers a central point for all data collaboration and 'pre and post' coordination during small and large-scale exercises. All three services voice, video, and web portal are heavily utilized for every experiment for design, implementation, and final data analysis.

Simulated Experiments

The simplification of M & S integration and event collaboration was the driving force behind the initial existence of the BLSCE. The BLSCE is prepared to support 2-3 large distributed simulated experiments every year. These experiments support TRADOC Battle Labs, Joint Agencies, and industry partners. TRADOC's Integrating Experiment 2004 (IE '04) and Omni Fusion 2005 (OF '05) are two examples. Both of

these experiments support FCS concepts that represented primary division staff positions and subordinate brigade commanders. These experiments focused on interactions between separate command hierarchies in order to validate capability gaps in a distributed, simulated environment. IE '04 and OF '05 had separate goals to refine concepts and development, but the implementation of the network that BLSCE supported was the same. There were no network configuration changes to support these TRADOC experiments.

The BLSCE supports several joint experimentations a year in conjunction with TRADOC. BCBL-G has supported previous joint exercises such as JEFX in 2002 and 2004 and Joint User Interoperability Communications Exercise (JUICE) in 2004. JEFX is a bi-annual exercise that provides solutions to the integration of air, space, and ground assets on a net-centric platform.[12] The JUICE 2004 principle benefits included a full dimension of secured VoIP platform with high-bandwidth efficiency using commercials off-the-shelf (COTS) solutions for ships and deployed forces constrained by low bandwidth through legacy communication systems.BLSCE anticipates support for Urban Resolve in Spring of 2006. Urban Resolve is a US led coalition force that fights in an urban environment which is expected in 2015 Configuration changes were required to support the joint experiments which included a separate, parallel encrypted Layer-2 ATM connection.

Thus far, the BLSCE has an on going agreement to support FCS led industry partners. The Cross Command Collaborative Effort (3CE) is the industry partners connection into the BLSCE. In July 2003, a Memorandum of Understanding was reached between TRADOC, U.S. Army Test and Evaluation Command (ATEC), U.S. Army Research, Development and Engineering Command (RDECOM), and Boeing's Leading Systems Integrator (LSI) to connect several separate distributed networks together.[13] The purpose of 3CE is to support concept exploration, systems integration, analysis, and acquisition of the FCS-Equipped UA System-of-Systems in a distributed environment. 3CE Wide Area Network (WAN) now connects four peering point routers at Ft Gordon, GA, ATEC, White Sands Missile Range, RDECOM, and Boeing LSI.[14] The full mesh architecture connects and all four peering points use Generic Routing Encapsulation (GRE) tunnels and is encrypted by E-100 TACLANEs (KG-175). Default configuration settings are used for the GRE tunnels and backside Local Area Network (LAN) connections to peering point routers. Static routes are used to identify tunnel destinations; Open Shortest Path First (OSPF) was used as the routing protocol. The connection to the 3CE network required the most significant network configuration implementations.

Future

The major functionality of Network Operations (NETOPS) for FCS includes Information Assurance, Network Management, and Information Management.[15] Currently the BLSCE focuses on the deployment of Information Assurance and Network Management functions as required by Department of Defense (DoD) regulations. In the future, Information Management will become an increased focus as the commander's information capability and enhanced situational awareness continues to increase exponentially with only a small amount of time for analysis. The BLSCE will be

responsible for implementation of an information management tool, Information Dissemination Management – Tactical (IDM-T), to systematically organize the amount of information that a FCS commander would be responsible for. IDM-T would be a standardized information management tool that would be utilized during future assistance in planning, executing, and analysis for TRADOC experiments.

Conclusion

BLSCE has formed a federation of Army, Joint, and Industry test centers with connectivity to establish a distributed network infrastructure of varying assets and resources. At inception, the federation included only Army TRADOC Battle Lab nodes, and now it encompasses over twenty (20) Army and industry partner nodes with ad-hoc joint connections as well. The U.S. Army is going through a modular transformation that will affect the way that it fights. Developing communications and networking models and simulations that accurately portray the network effects is critical to the achievement of NCW. Models and Simulation will continue to be the primary method of defining the concepts for the NCW, and the BLSCE is a network-centric platform for the U.S. Army's virtual environment. The BLSCE will continue to proliferate into network-centric platform that supports the FCS generation and sustain flexibility in order to support TRADOC with a growing population models and simulations experiments. Also, it will continue to be the bridge between the U.S. Army, Joint Forces, and industry in order to excel in concept and development for an evolving service.

> *"Commercial information technology is driving the convergence of technologies for voice and data services. This technology will enable data traffic to be provided wit the reliability and quality of service assosciated with dial tone, as well as new and exciting capabilities that we have not yet imagined. The technologies that emerge from the commercial sector, went augmented with specialized information technologies develop by the DoD, such as high end encryption, low-probability of intercept and detection communications, and specialized intelligent agents will provide the brick an d mortar for our Global Information Grid (GIG)."*[16]

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