

SUPPORTING EXERCISE CONTROL AND FEEDBACK IN THE DIGITAL DOMAIN FOR VIRTUAL SIMULATIONS

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Abstract

The U.S. military and its contractors are developing digitized command and control systems to provide military units with information dominance over the enemy. Ironically, these digital systems have created training control and feedback challenges for exercise Observer/Controllers (OCs) in all simulation environments. OCs have the responsibility to assess and mentor exercise players on the effective use of digital systems. In addition, OCs must control the exercise. To do this, OCs need the capability to monitor and store all player digital traffic, inject digital messages and display digital information for post-exercise collective learning or after action reviews (AARs). However, today's OC may be unable to monitor player digital communications of key players or may be deluged by information and unable to identify those digital actions or inactions that most affected the training event's tactical outcome.

Under the sponsorship of the Simulation, Training and Instrumentation Command (STRICOM) and the Army Research Institute (ARI), we are developing a prototype training support system to overcome control and feedback problems associated with digitized units. We call the system the C4I Training Analysis and Feedback System (CTAFS). We are developing the CTAFS under our Intelligent-Decision Aids and Training Assistance (I-DATA) concept. We designed the CTAFS prototype to support digitized company team virtual simulation exercises. The first CTAFS prototype monitors tactical digital communications on a LAN and permits the OC to role-play notional units and inject control events into the exercise. Using an expert system, the second CTAFS prototype will alert the OC to significant digital activities and disparities in situational awareness among the players. CTAFS will automate the production and presentation management of C4I AAR products linking AAR displays to established doctrine and standards. In addition, CTAFS will provide the OC with discussion guides to facilitate AAR discussions on what happened, why it happened and how to improve performance.

This paper addresses the challenges of C4I digital training and presents information and lessons learned during our research and development of CTAFS and its AAR capabilities for the C4I portions of virtual simulation exercises. Additionally, the paper explores the role of C4I AAR systems in future C4I training environments.

About the Authors

Derick L. Gerlock is a Captain in the U.S. Army Reserves as an Observer/Controller (OC) for constructive simulations primarily including Brigade/Battalion Battle Simulations (BBS) and has practical experience in the operation of artillery digital command and control systems. He holds a M. A. in Computer Resource Management and Information Systems. He served as an analyst for the Training Analysis and Feedback Aids Study for Live Training Support and determined the training impact of existing and emerging C4I systems on the Maneuver Combat Training Centers and homestation training. He designed CTAFS' graphical user interface and defined expert system rules for the automation of C4I AAR products.

Dr. Larry L. Meliza is a research psychologist with the U.S. Army Research Institute Simulator Systems Research Unit at Orlando, FL. His experience includes developing AAR systems for use in virtual simulations, assessing behavior of computer generated forces, measuring the effects of tactical engagement simulation systems on unit performance in live simulations, and developing guidebooks to support exercise control and feedback functions at the Army's National Training Center (NTC).

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BACKGROUND

The readiness of today's military depends on training events that simulate real-world locations, equipment, scenarios and procedures. Today's military thrives on technology that promises to provide leaders, commanders and soldiers with "Information Dominance" that enables common Situational Awareness (SA) and efficient Command and Control (C2) operations through the use of networked digital systems. In recent times, the Army has been focused on the initial development and testing of these new Command, Control, Communication, Computers and Intelligence (C4I) digital systems. However, training programs for the use and operation of these new digital systems are becoming more important as we move toward widespread fielding of digital C2 and SA systems.

This paper investigates a number of challenges relevant to C4I training, exercise control and feedback issues. In addition, this paper discusses a prototype system designed to overcome many of these C4I training challenges. One of the challenges in developing a sound training program for these new C4I systems is that since they are so new, appropriate tactics, techniques and procedures are still being developed and discovered. So where do we start, is it with the actual system or with the training program? This is analogous to the question, "What came first, the chicken or the egg?" In this case, there must be a spiral development process involving: 1) The actual system, 2) Training packages that support the system, and 3) New and better ways to use the system. For example, soldiers should receive C4I systems with complete training packages that include a solid baseline of doctrine, Tactics, Techniques and Procedures (TTP). As soldiers use these new systems, they will discover new and better techniques, which must be quickly incorporated into follow-on training packages and documentation. Fortunately, electronic distribution mechanisms such as the General Dennis J. Reimer Training and Doctrine Digital Library (ADTDL) provides instant and worldwide access to the newest doctrine and training materials available (See the WebPages at: <http://www.adtdl.army.mil/atdls.htm>). The use of electronic distribution systems such as this will increase

our chances of matching the pace of training with the advancements in technology.

Companies such as TRW are delivering their C4I system, the Force XXI Battle Command Brigade and Below (FBCB2), with complete train-the-trainer programs and numerous training packages for individual operators. FBCB2's strength comes from its connected network of subordinate, adjacent and higher digital systems, which enable its tremendous ability to gain and share information. For Example, an operator may be completely competent with the operation of the FBCB2, but will be totally ineffective if the supporting communications architecture precludes his ability to send or receive the required information. Unfortunately, this is the Achilles Heel of C4I training since implementation of meticulous and standardized simulations of the Tactical Internet (TI) are still under development and the interfaces between C4I systems and simulations systems are still immature.

Another digital training challenge that must be overcome is the divergence of simulation data. Currently, there are parallel but disjointed paths for each of the following essential data-flow elements:

- The C4I digital data flow
- The simulation data flow
- The Observer/Controller (OC) data flow
- The testing data flow

The C4I digital data flow for C2/SA messages, the simulation's data flow, such as firing events, and the testing data flow are often on their own separate networks. In many cases, the OC's data flow is a completely manual process and isolated from the other three networks. Unless there is an OC located at each event location, OC data collection may not occur.

For the most part, C4I digital operations in constructive simulations, such as the Brigade/Battalion Battle Simulation (BBS), are

handled by hard wiring the digital systems together. When the digital device and the simulation must provide each other with data to ensure exercise synchronization, an OC must provide that link through a manual "swivel-chair" process. This means the OC must monitor both the simulation device and the C4I digital device. When something happens on the simulation, the OC must interact with the simulation system to obtain the "Simulation Event," then the OC must swivel over to the C4I digital device and manually input that "Simulation Event" into the C4I digital device. The OC must perform the converse operation when "C4I Digital Events" occur that must be input into the simulation. We call "Simulation Events" the Ground Truth (GT), because simulation events represent what actually happened on the ground during the simulation. We call the "C4I Digital Events" the Perceived Truth (PT), because C2 and SA messages represent the perceptions of the exercise players. In constructive simulations where the C4I messages are integrated into simulation system, the C4I messages do not interact with actual tactical C4I devices (or even exact replicas of the C4I devices). For example, the SPECTRUM simulation system has the capability to send C2/SA messages such as CONTACT Reports to exercise participants. However, SPECTRUM's C2/SA messages are in a proprietary format and do not look like tactical C4I messages nor do they link to the players' C4I digital systems.

In the case of some virtual simulations, such as the Close Combat Tactical Trainer (CCTT), developers have successfully integrated the C4I digital data-flow and the simulation data-flow. However, the OC's data-flow is only partially integrated and OC support functions for C4I issues are still limited. For example, CCTT has FBCB2s installed inside the CCTT simulators. The CCTT simulation system interfaces with the FBCB2 and encapsulates FBCB2's C4I messages into Distributed Interactive Simulation (DIS) Protocol Data Units (PDUs). These DIS PDUs contain C4I data and become part of the simulation network. This integration of C4I data and simulation data provides connectivity and synchronization between the exercise participants and the simulation. In addition, CCTT's computer generated friendly-units are also part of this integration and based on various exercise events will transmit actual FBCB2 messages from the simulation directly to the FBCB2 devices operated by exercise participants. This is an efficient integration of the simulation data-flow and the C4I data-flow. The OC's data flow; however, is still immature. For example, CCTT's C4I OCs can only monitor C4I traffic from three exercise participants at a time. If the OC wants to switch to a different participant's FBCB2, it can take as long as 5 minutes to reinitialize the system. In addition, each time the system is reinitialized all C4I data is purged from that FBCB2. The C4I exercise history associated with that

exercise participant is no longer available at the OC's FBCB2. In addition, C4I AAR organization and presentation tools are very limited. However, the current system does provide the OC with the capability to inject C4I exercise control messages into the exercise. For example, the OC has the capability to send and receive C4I messages in a role-player's mode, such as higher and adjacent units.

Another challenge for effective C4I training is the design focus for many of today's simulation systems. Currently, the primary design focus is on replication of the real-world system and the simulation's fidelity. Unfortunately, they do not necessarily start with a focus on the "training" aspects of the simulation system. Training seems to be an afterthought (Verstegen, D.M.L. & Barnard Y, F., 1998). Training as an afterthought places many constraints on the training system, such as available network connections, user interface dependencies, and database initialization schemes/procedures.

This paper addresses a number of topics relevant to C4I training, exercise control and feedback issues. In addition, this paper addresses the development of a prototype system called the C4I Training Analysis System (CTAFS). CTAFS falls under an advanced training concept called Intelligent-Decision Aids and Training Assistance (I-DATA) and is designed to overcome many existing/emerging C4I training challenges.

TRAINING CHALLENGES FROM THE EMERGENCE OF C4I DIGITAL SYSTEMS

The goal of the Army's digital systems is to provide "Information Dominance" over the enemy and enable commanders and soldiers to operate inside the decision-cycle of their opposing forces. Unfortunately, this information dominance has a negative side effect in terms of training. For example, C4I OCs:

- May not have the capability to monitor digitized data.
- Receive extremely limited digitized data or conversely, they receive so much digitized data that they become overloaded and lose their focus on training and mentoring.
- Do not have the tools needed to identify critical digitized information.
- Must master complex processes that provide infinite display and data access options.
- Must "close-the-loop" between an exercise event, the analysis of that event and the creation

of appropriate exercise feedback for the exercise participants.

- Must always be mindful to incorporate performance improvement processes into the exercise and especially the After-Action Review (AAR).
- Must collect and organize exercise data into meaningful learning products for presentation during the AAR.

ADVANCEMENTS IN TRAINING REALISM INCREASE DIFFICULTY FOR TRAINING AND AAR SYSTEMS

Communication modeling will make training events more realistic, but will also increase the difficulty for training and AAR systems. For example, signal profiling is a process/concept to make communications training with digital systems more realistic. In the tactical environment, most digital systems operate over a wireless Tactical Internet (TI). This wireless network is subject to all of the capabilities and limitations associated with the real-life operation of tactical radios. Some of these limitations include signal attenuation, radio frequency (RF) masking and crosstalk. For example, if two distributed radio operators are trying to talk to each other, but there is a large steep hill between them, they may not receive a good connection. This is an example of RF masking. If the two operators are beyond the range of the radios, they are victims of attenuation.

These types of communications limitations do not generally affect communications in virtual simulation facilities because all of the units on that simulation are wired together by network cable. This is called "perfect communications" and occurs when unit commanders decide not to use signal profiling. Signal profiling is the simulation of realistic communication constraints. Unit commanders have the right and responsibility to train on the skills and processes that they deem necessary. However, perfect communications may create negative training transfer since soldiers can successfully complete missions without needing to worry about the normal constraints of the radio (Manoski et al., 1997).

When a simulation requires/allows participants of the simulation to perform different actions in the simulation than they would/could in the actual environment, one of two things must happen to reduce negative transfer: 1) OCs have an additional workload to enforce proper procedures that would normally be enforced by the situation or 2) the real-world constraints must be simulated (i.e., signal profiling must occur). One example of a signal profiling system is the Tactical Internet Model (TIM). The TIM simulates realistic radio conditions within the Task Force XXI communications structure. The TIM applies appropriate communications effects such

as signal delay, signal loss and signal corruption to both voice and digital communications within the virtual simulation exercise. In addition, the TIM encapsulates the communications data inside DIS Signal PDUs for transmission on the simulation network (Manoski et al., 1997). This type of simulation realism will be critical when soldiers move from their procedural training with C4I digital systems to combat/tactical training while equipped with C4I digital systems.

Signal profiling may cause additional problems for AAR systems that must have access to all of the exercise data and must have access to the simulation "dice roll", which determines if the radio transmission was successful or not. In addition, the AAR system needs access to the "Why" of communication failure. The AAR system must know "Who" sent "What" to "Whom" and did the communications model block or prevent successful radio communication.

The Simulation Testing Operations Rehearsal Model (STORM) provides a simulated battlefield for the preparation and conduct of unit-level C4I and TI testing. STORM links the FBCB2 systems, via tactical communication models. Observations from initial STORM testing suggested that the ability to trace message paths and delays was essential for verification of proper TI representation and C4I training (Greenfield, B. & Hoang, T. 1998). Additionally, the integration/interoperability of the Army Battle Command Systems (ABCS) is continuing at an exponential rate. Developers of simulators, C4I devices and simulation fidelity systems must provide embedded connections for AAR systems, intelligent tutoring devices and performance support systems (Institute for Defense Analysis, 1999).

Our armed forces must contend with increased operational tempo due to more frequent deployments broader mission requirements, fewer personnel, additional digitization requirements, training sustainment issues and resource constraints. The Homestation Instrumentation Training System (HITS), formerly Homestation Training Instrumentation (HTI), is one of the strategies the Army is developing to provide solutions to the above listed challenges. Some of the proposed functionality of the HITS includes: the collection of unit performance data; integration of live, virtual and constructive simulations; exercise management capabilities; feedback on training performance and cohesive/comprehensive AAR capabilities.

A key requirement of the HITS is to provide units with the same type of situational awareness that they would receive on the battlefield. This means the HITS must feed actual C4I devices with sensor information, friendly and enemy locations, etc. and all of this must be within the framework of realistic scenarios. Under the HITS, exercise controllers must have the ability to manage the exercise and inject events into the training that facilitate the unit commander's training objectives and Mission Essential Task List (METL). In addition, the HITS directs detailed data collection to exercise systems, external systems and to all systems linked to the exercise. This includes connections to the actual tactical C4I devices, as well as utilities for acquiring subjective and objective input from OCs (Department of the Army, 1998). This requirement calls for a high degree of interoperability and seamless interaction between actual battlefield systems and all of the training devices necessary for realistic training. This will again require developers of these tactical and training systems to include connections to and interactions with AAR, intelligent tutoring and performance support systems. An example of this type of integration is a tactical C4I system that provides mechanisms known as "hooks." These "hooks" enable the training system to gain access or hook into all of the system events such as operator button presses, mouse clicks and the amount of time each operator viewed various displays.

INTELLIGENT-DECISION AIDS AND TRAINING ASSISTANCE (I-DATA)

I-DATA is a concept that leverages information management utilities, near-real-time decision aids and automated AAR products to assist the exercise OC. I-DATA strives to provide the OC with the "Who, What, Where, When and How" of the exercise, both for ground truth and perceived truth events. In addition, I-DATA also strives to provide the OC with the "Why" and the "What does this mean to me" of the exercise.

I-DATA Goals

The I-DATA concept identifies processes that enable reduction of the OC's workload and provide tools for the OC to make efficient assessments and decisions. I-DATA provides a framework for the monitoring and organization of exercise data as well as the transformation of exercise data into usable information. Additionally, I-DATA provides a framework for on-going performance improvement processes.

I-DATA Processes

The I-DATA concept directs the development of:

- Automated tools to monitor exercise data and events.

- Exercise training tools with expert systems that track the procedures and performance of exercise participants by monitoring exercise events and then comparing those events to rules. Computers are well suited to this type of task, which leaves the OC to perform duties that humans are well suited for, such as mentoring and coaching.
- Automated tools that compare and analyze exercise data and events, such as the perceived truth shared between players and ground truth with the perceived truth.
- A pre-planned set of expected/desired participant responses based on exercise events and training objectives and the automated identification and comparison of the actual participant responses with the expected and desired responses.
- Automated systems that use the above comparisons to automate the creation of trainer alerts and AAR products.

Exercise OCs are experts in doctrine and tactics. Generally, they have years of experience in the tasks they are teaching, so they bring important strengths to the training event such as intuition, wisdom and other traits that are purely human. However, there is a dangerous trend emerging with the training of today's digital systems. The simulation and training community is requiring these expert teachers to focus less on the mission and more on the identification and filtering of volumes of exercise data. The I-DATA concept calls for computers to monitor, track, sort, filter and analyze these massive amounts of data, while the expert OC is left to focus on the exercise and specific events that require personal attention.

I-DATA Performance Improvement

The I-DATA concept calls for the inclusion of performance improvement products along with every automated AAR product. Performance improvement products include, but are not limited to:

- Candidate open-ended questions to encourage participation and self-discovery in the AAR.
- Identification and presentation of the associated Tactics, Techniques and Procedures (TTP) or doctrine that dictated creation of the AAR product. This adds objectivity and standardization to the AAR.
- Suggestions for improvement. These can be illustrations of historically successful methods, presentation of "work-arounds," or TTPs that help bridge the gap between the completed training event and future events.

DEVELOPMENT OF A PROTOTYPE I-DATA SYSTEM

Under the direction of ARI and STRICOM, we are currently developing a prototype I-DATA system for the C4I digital portions of armor and mechanized infantry Company/Team level operations in virtual simulation environments. We are attempting to use the I-DATA concept to address many of the challenges associated with training the proper use of the FBCB2 system. FBCB2 is a C2 and SA system that uses JVMF messages to provide its C2 and SA capabilities. The prototype system we are developing is called the C4I Training Analysis and Feedback System (CTAFS).

CTAFS

The CTAFS prototype is a Phase II Small Business Innovation Research (SBIR) project that calls for the development of a command, control, communications, computers and intelligence (C4I) AAR subsystem to support exercise control and AAR preparations for digitized Company/Teams in virtual simulations.

Current CTAFS Prototype Capabilities

CTAFS currently supports the Variable Message Format (VMF) messages for Appliqué Version 1.02a and has the capability to monitor the VMF traffic of key players on a LAN. CTAFS records and stores all of its monitored players' sent and received messages. Then from one workstation, CTAFS enables the OC to selectively display the C4I messages of any of the monitored players or key leaders in real time or in exercise history. Additionally, the OC may instantly switch between any of the monitored nodes (without losing any information), and unobtrusively page through the various overlays and reports within that player's C4I digital system.

CTAFS provides a basic, yet critical ability for the C4I OC to know exactly what digitized information specific players sent or received at any point during the exercise. Additionally, CTAFS provides the OC with the ability to instantly display any of that information during the exercise and/or during the AAR. For example, the OC can quickly select any of the monitored or role-played nodes, such as the Company/Team Commander. Then, the OC can search through that player's database for either sent or received messages. Next, the OC can display that information on the CTAFS workstation (see Figure 1).

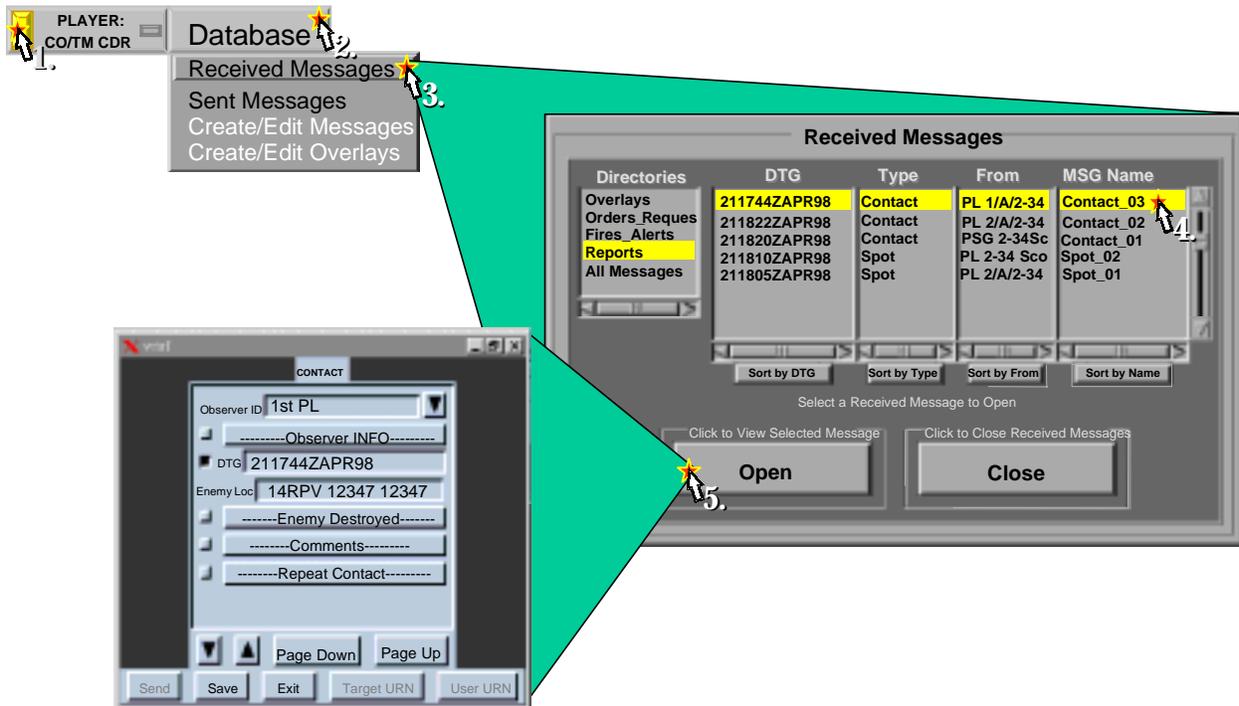


Figure 1. Complete OC access to C4I data in each exercise players' sent and received database

CTAFS enables the OC to carry out his exercise control functions by allowing the OC to send and receive VMF

messages as various role-played or notional entities (i.e., higher and adjacent units). CTAFS provides

emulated Appliqué and FBCB2 functionality for the OC's communication with the exercise participants and the operation of the system. CTAFS advises the OC of digital messages he receives from the monitored players to any of the role-played entities. CTAFS is currently a perceived truth system. This means CTAFS concerns itself only with an exercise's C4I C2 and SA messages. CTAFS does not monitor ground truth data from the simulation systems. CTAFS must have perfect communications for proper operation or CTAFS must be connected to the signal profiling system. The signal profiling system must provide CTAFS with access to the intended message recipients, the actual message recipients and the reasons for any communication failures. The OC may access the C4I database of any of the exercise participants either during the exercise for control and monitoring duties or the OC may use this process for the preparation and presentation of the AAR. CTAFS also includes the capability for the OC to electronically "bookmark" important C4I events so that he may come back to them at a later time. CTAFS display capabilities include all C2 messages as well as overlay and map information for the monitored and role-played entities.

two-part research project. The next step in CTAFS development is the inclusion of an expert system and additional functionality that will:

- Alert the OC to significant player digital actions or inactions.
- Automatically generate C4I AAR products, which will be available for the OC's review and editing immediately following the end of the exercise (ENDEX).
- Include embedded open-ended questions (based on user actions, TTP)
- Provide the OC with utilities for post-exercise AAR preparation, organization and presentation.
- Include OC utilities for assisting with the performance improvement process. For example, each automated AAR product will include open-ended questions, measures of performance and TTP.
- Include during-exercise information management utilities such as an on-demand Global Message Log (see Figure 2).

Current CTAFS Prototype Enhancements

The CTAFS capability to monitor VMF traffic on a LAN is complete. However, that is only part one of a

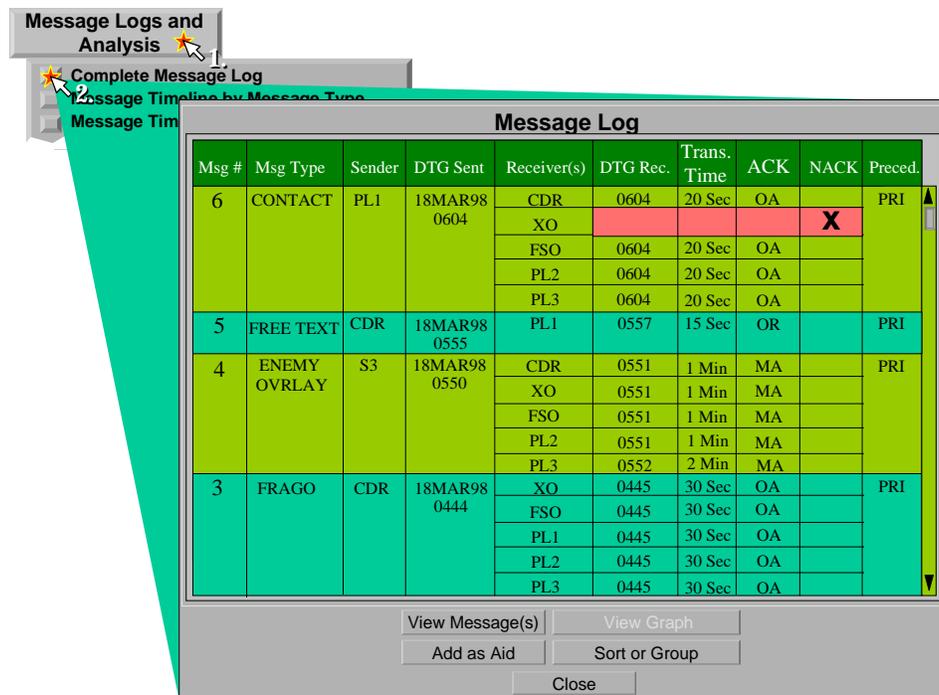


Figure 2. An OC information management utility, the Global Message Log

CTAFS will optimize the OC's during-exercise workload through information management utilities such as the Global Message Log, timelines and message statistics. All of which can be added to the AAR as AAR products (such as Plan View Displays, animations of SA data, timelines, charts, graphs and text).

The quality of the AAR is usually dependent on the expertise of the OC and very often, the OCs comments are unstructured and based primarily on subjective evaluations of player performance (Verstegen, D.M.L. & Barnard, Y, F., 1998). However, since CTAFS will provide the OC with automated AAR products and its expert system will link all of these AAR products to military measures of performance, CTAFS will supply structure, standardization and objectivity to the AAR.

CTAFS will monitor and store the exercise's C2 and SA message traffic. Then, CTAFS will use its embedded expert system to reduce OC workload and create automated AAR products. CTAFS uses "OC Alerts" to signal the OC when it identifies significant digital communications, player changes to default C4I settings,

identification of major procedural errors and disparities in shared information/situational awareness.

Various exercise events will trigger CTAFS' automated message analysis system. For example, when CTAFS detects a digital CONTACT Report, CTAFS will automatically examine the exercise history at a pre-determined time - for example 5 and 10 minutes prior to receipt of the CONTACT Report. CTAFS will then scan each of the player nodes' Enemy/Intel and Operations Overlays. CTAFS will use this overlay scan to produce an Overlay Entity List for each player. CTAFS will then compare these Overlay Entity Lists searching for discrepancies. If CTAFS finds discrepancies between these lists, it indicates a disparity among the situational perceptions of the players in the Company/Team. CTAFS will immediately alert the OC. When the OC selects the "Alert Indicator" on the CTAFS workstation, CTAFS will display the differing overlays and isolate the specific discrepancies (see Figure 3).

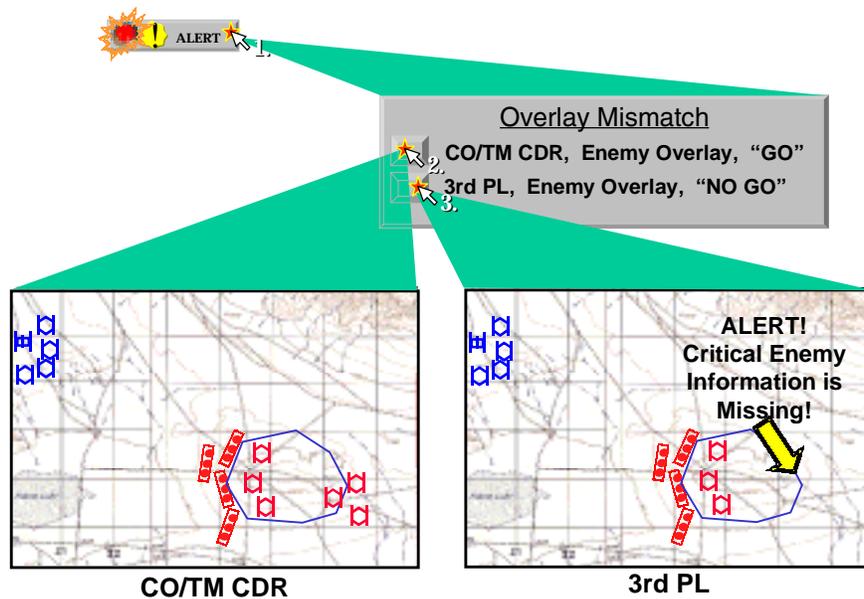


Figure 3. OC alerts and automated comparison of collective situational awareness

CTAFS will perform these automated comparisons behind the scenes, while continually monitoring exercise traffic and enabling the OC to page through player databases and control the exercise. CTAFS will also provide the OC with tools to instantly add these comparisons to the AAR.

Near-Term Upgrades to CTAFS

CTAFS' completed functionality is based on Applique Version 1.02a. However, Appliqué Version 1.02a is an

obsolete system. Consequently, we have identified and are working on two critical upgrades for CTAFS. The first is an upgrade of CTAFS' messaging system to achieve compatibility with newer versions of FBCB2. The second CTAFS upgrade includes the integration and analysis of ground truth and perceived data. CTAFS will accomplish this GT and PT integration by building on lessons learned from an earlier project called the Automated Training Analysis and Feedback System (ATAFS).

ATAFS is specifically a ground-truth system that provides near-real-time monitoring of GT exercise data and voice radio transmissions. ATAFS automates the production of GT post-event AAR learning products, and provides utilities for the presentation of these AAR products during the AAR.

ATAFS development was funded by STRICOM, the Defense Advanced Research Projects Agency (DARPA) and the Army National Guard. In addition, DARPA and the ARNG funded ATAFS' phase three developments under the Simulation in Training for Advanced Readiness (SIMITAR) Program. During CTAFS development, we have incorporated many of ATAFS' lessons learned (as published in several ARI sponsored reports). The linking of CTAFS and ATAFS capabilities will enable comparisons such as the ones illustrated in Figure 3, with the addition that after CTAFS has analyzed player perceptions, it will automatically compare them with the relevant ground truth data from the simulation system.

For example, an Enemy/Intel overlay shows the enemy situation, as the players perceive it. The GT locations are the actual locations of the enemy, as reported by the

simulation system itself. When the GT matches the PT exactly, CTAFS will only store the data. However, when GT and PT are different CTAFS will alert the OC and create visual comparisons for display.

DISCUSSION

Based on CTAFS lessons learned and known obstacles, there is still much work to be done. Here are a few CTAFS and C4I digital training discussion points.

First, there must be a more efficient way to visualize and understand C4I messages and data. During CTAFS development, we will take raw VMF and JVMF messages and translate them into graphical representations that enable the user to quickly identify the "So What" of the various digital messages, without having to scroll and click through pages of text to determine the important information. For example, when CTAFS monitors a Personnel Status Report, CTAFS will automatically compare the raw C4I data with the unit's Military Table of Organization & Equipment (MTO&E). CTAFS will then provide the OC with a graphical representation that is easily understandable and is suitable for inclusion as an AAR product (see figure 4).

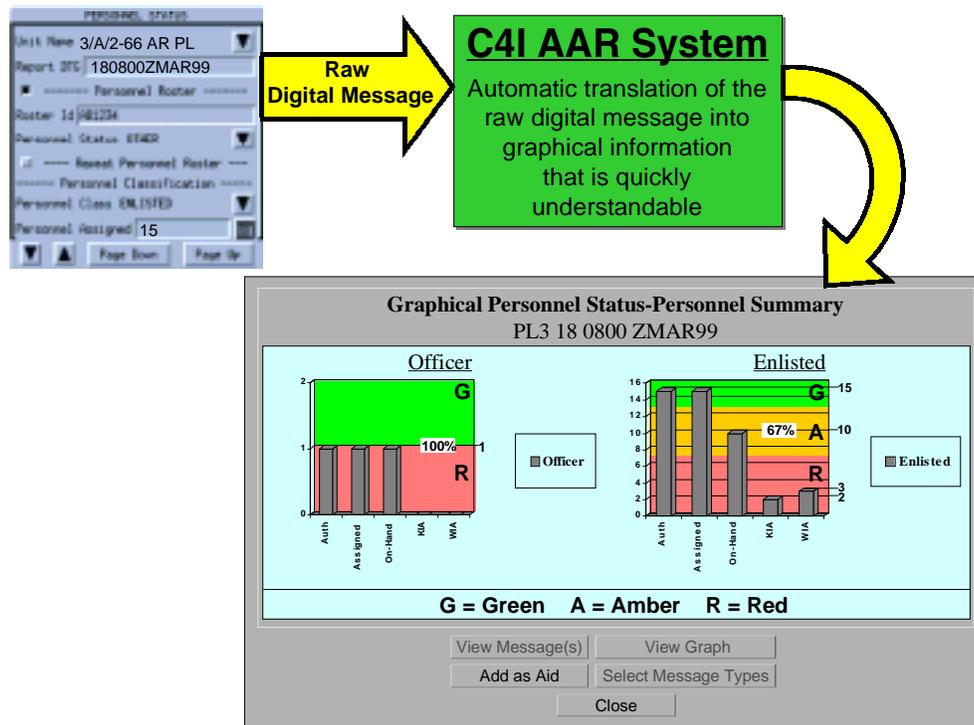


Figure 4. Automated translation of C4I data into information for instant understanding and usability

Second, we are broadcasting a call for help within the simulation community to design simulation devices and C4I systems to support AAR and training activities.

Unless signal profiling and communication modeling is built on an open architecture, AAR devices such as CTAFS will constantly have to battle with data access

challenges. For example, C4I AAR systems must know the identity of the "intended recipients" of a specific message. When exercise controllers activate signal profiling or communication models, the AAR system must also know the identity of the "actual recipients" of each specific message. When communication models prevent some or all of the intended recipients from receiving the message, the AAR system must know the reason(s) for the communication problem. AAR systems will use this information to assist the OCs with their training of proper C4I and Tactical Internet procedures.

Third, we believe there needs to be a close link between the development of digital Training Support Packages (TSPs), simulation systems and AAR devices. This will increase the chances that simulation training will be focused on training objectives, METL tasks and critical skills. In addition, this will standardize instructor support facilities and enable immediate/interactive feedback that aids in the rapid employment of the "Train-Assess-Train cycle."

Fourth, automated AAR systems such as CTAFS will bring a dramatic improvement to collective C4I training by identifying adherence to tactical and technical procedures. However, the identification/tracking of procedures does not necessarily indicate full understanding by the exercise participants. This is still the OC's job. Automated AAR systems will enable the OC to conduct greatly improved AARs and assist the OC with the interactive AAR process of determining if operators knew why certain procedures were important, while providing suggestions for how to apply those procedures to different problem domains? Unit commanders and trainers then reinforce these discoveries and lessons learned by including them in future training events.

Fifth, the linkage of live, virtual and constructive simulations on the same synthetic battlefield will further enhance the need for redesigning the training process to maximize limited resources, help soldiers learn more and gain the most benefit from simulation training events (Gourley, S.R., 1999). AAR systems such as CTAFS will be needed to support architectures such as the HITS as well as the integration of live, virtual and constructive simulations. Now is the time to think about how we are going to make that happen.

Sixth, CTAFS currently provides OCs with information such as who had access to what data when and whether or not the correct procedures were followed. That is, the OCs now knows specifically what data was available to exercise participants at any point along the exercise timeline. This enables the OC to determine how data availability affected the tactical outcome of

the battle. However, data availability is only the first step. The next critical step is the identification of the specific data that exercise participants used during the exercise and when. To do this C4I devices must provide "hooking mechanisms" to the specific button presses, mouse-clicks, etc. of the C4I operators. Then, the C4I device must send all of these operator events in near-real-time to a central AAR collection point such as CTAFS. This will provide AAR systems with a data collection mechanism that is the next-best thing to getting inside the soldier's brain. The AAR system will then perform detailed data analysis, alert the OC to critical events and create automated AAR products that start to answer the "Why" of tactical outcomes. This will complete the six W's (Who, What, Where, When, How and Why). With the answers to the six W's instantly and undeniably displayed, the OC will be free to focus the AAR almost entirely on the process of performance improvement.

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