# IMPROVED BATTLE TRAINING THOUGH FBCB2 COMMUNICATIONS LINK WITH MILES 2000

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## ABSTRACT

Digitizing support and combat forces is the means by which the US Army will continue to maintain information dominance capability on the battlefield. However, only when it is used appropriately and efficiently will information dominance translate to force dominance. The digitized Army therefore requires digitized training. Together, the Force XXI Battle Command Brigade and Below (FBCB2) system and the Multiple Integrated Laser Engagement System (MILES) 2000 provide vital tools that permit combat training centers and home stations to train troops in the conduct of digitized warfare, as well as to impart an understanding about the employment of information dominance to affect force dominance.

Currently, combat training facilities employ large numbers of human observers to collect and process truth data for entities involved in training exercises. The MILES 2000 family of training instrumentation gear provides direct fire engagement truth data. However, this data must be manually collected from each unit and centrally processed to support after action reviews.

With the integration of a MILES 2000 communications interface into FBCB2, digitized training facilities can now make timely, far better use of truth data available during training exercises. Collection of unit and engagement truth data can now occur in real time, making it immediately available for processing and redistribution. This data is both generated and collected autonomously - simultaneously reducing the observer staffing and freeing up these observers to teach vital combat skills and to point out shortcomings as they occur.

This paper addresses recent FBCB2 enhancements that provide MILES 2000 interface capability. Digitized training process improvements resulting from the MILES 2000 interface are highlighted.

## PRIMARY AUTHOR'S BIOGRAPHY

Calvin Lombard is a systems engineer for TRW's Simulation and Training Systems Business Area in Orlando, Florida. He has been involved in various simulation and integration activities during his 6 years with TRW, including: integration of FBCB2's Embedded Battle Command (EBC) into M1A2 SEP main battle tanks at General Dynamics, Principle investigator for Smart Munitions Virtual Hotbench internal research project, force-on-force engagement modeling using CASTFOREM and ALWSIM, and supporting analyst for various signature suppression technologies for improving combat vehicle survivability. Calvin received his MS in Physics from Michigan State University and his BS in Physics from University of New Hampshire.

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## I. INTRODUCTION

Digitizing combat and support forces is the means by which the US Army will continue to maintain information dominance capability on the battlefield. However, only when it is used appropriately and efficiently will information dominance translate to force dominance. The digitized Army therefore requires digitized training. Together, the Force XXI Battle Command Brigade and Below (FBCB2) system and the Multiple Integrated Laser Engagement System (MILES) 2000 provide vital tools that permit combat training centers and home stations to train troops in the conduct of digitized warfare, as well as to impart an understanding about the employment of information dominance to affect force dominance.

Currently, combat training facilities employ large numbers of human observers to collect and process truth data for entities involved in training exercises. The MILES 2000 family of training instrumentation gear provides direct fire engagement truth data. However, this data must be manually collected from each unit and centrally processed to support After Action Reviews (AAR).

FBCB2 is a militarized computer running software that manages generation, dissemination, and display of digital command and control messages as well as situational awareness data. FBCB2 maintains a database to correlate the user's role with tactical internet routing information. FBCB2 disseminates Joint Variable Message Format (JVMF) messages over the tactical internet via an Internet Controler (INC) interfaced with either EPLRS or SINCGARS radios. FBCB2 provides password and role based security features, Unit Task Organization and Reoganization (UTO/R) tools, and commanders graphical intent tools.

With the integration of a MILES 2000 communications interface into FBCB2, digitized training facilities can now make timely, far better use of truth data available during training exercises. Collection of unit and engagement truth data can now occur in real time, making it immediately available for processing and redistribution. This data is both generated and collected autonomously - simultaneously reducing the observer staffing and freeing up these observers to teach vital combat skills and to point out shortcomings as they occur.

This paper addresses recent FBCB2 enhancements that provide MILES 2000 interface capability. Digitized training process improvements resulting from the MILES 2000 interface are highlighted.

## II. CURRENT TRAINING PROCESS LIMITATIONS

While MILES 2000 is a highly capable training engagement system that meets its major operational requirements, limitations based on the current use of the system and in processes used to train soldiers during live exercises are evident. This paper addresses these limitations and reports on training process improvements obtainable through use of a communications interface between FBCB2 and MILES 2000 on the training battlefield.

### Non Real Time Data Collection

MILES 2000 and other tactical engagement training systems are designed to collect exercise event data experienced by individual participants and store it locally until downloaded to a central facility. Local engagement data is generally downloaded at the end of exercises, which may be days after the events occurred. This delayed collection has led to errors in pairing identification, as well as insufficient fidelity to adequately rebuild the course of events for effective learning during after action reviews. Non real time collection and analysis of engagement data also provides opportunity for participant cheating – he knows that battle outcomes will not be assessed and events will not be tracked until end of exercise.

### Manpower Intensive Data Collection

Operational deployment commitments, coupled with armed services and contractor personnel reductions, have placed a premium on personnel available for normal day to day duties as well as the preparation for and participation in training exercises. Adverse impacts on morale and effectiveness have resulted from the OPTEMPO created by these commitments. New training systems have established goals of reducing the number of required role players, easing the burgeoning observer/controller (O/C) workload, and increasing the automation and interoperability of the training system components in order to provide more effective training opportunities.

Currently, training engagement systems such as MILES 2000 stores all unit event data on each individual instrumented platform until downloaded by a technician using a hand-held data collection device. In the case of MILES 2000, this download interface is an infrared LED port, requiring the technician to be very close to the instrumented unit. Downloaded data is then carried to the training facility's analysis center for insertion into the AAR generation computer and software system. Live training exercises typically involve hundreds (sometimes thousands) of instrumented participants covering the gamut from soldiers to vehicles. Downloading data from each individual participant in a one-on-one manner is very time consuming. Occasionally, these participants are difficult to locate and may be relatively long distances from the central analysis facility.

### Uncorrelated Situational Awareness at Tactical Operation Centers

In addition to the training received by exercise combatants equipped with MILES gear, the commanders in the Tactical Operation Center (TOC) also receive training in the use of situational awareness (SA) data from the Advanced Battlefield Command Systems (ABCS), as well as the employment of troops, equipment, and supplies.

SA data is collected by combat participants and is otherwise known as perceived truth. Conclusions leading to tactical decisions, safe lanes of advancement, appropriate targeting, etc. are only as good as the observations that have been correlated by the ABCS systems, i.e., FBCB2 coordinated through All Source Analysis System (ASAS).

Training exercises require adequate collection and use of real ground truth data to assess and correct combat participants' use of their equipment and SA data. In the future, soldiers and commanders must develop adequate digital battlefield skills to make effective use of their advanced battle systems. In order to provide opportunities to effectively train soldiers and commanders in these skills, exercise ground truth and perceived SA data must be correlated in near real time to allow teachers opportunity to effect learning events for their trainees, and thus avoid negative learning that leads to formation of adverse habits.

In recent years, the push to achieve data correlation and system interoperability between simulation and training systems, and go to war C4I equipment has met with marginal success. Interfacing FBCB2 with MILES 2000 is a good step in the right direction. In this manner the inherent strengths of the go to war ABCS systems can be leveraged to improve live training facility capabilities.

### No Automated Real Time Correlation of Area Effects

Area effects on the battlefield such as mines, chemical and biological hazards, and other dangerous areas are of ever increasing concern. Training soldiers on the discovery, marking, and reporting of these areas is of paramount importance during live exercises. FBCB2 and other C4I devices have automated capabilities for communication of area effects in the form of SA overlays, while MILES and other training engagement systems still rely on time consuming and subjective observation and communication by OCs. Interfacing FBCB2 with MILES begins to tap the potential for improvement in automated coordination of area effects ground truth during training exercises.

## III. IMPROVEMENTS AFTER INTERFACING FBCB2 WITH MILES 2000

As more field units become equipped with FBCB2, a MILES 2000 to FBCB2 interface can be employed to overcome many of the training limitations identified above.

### Near Real Time Feedback from Trainers to Trainees

Perhaps the most significant benefit achievable by an FBCB2 to MILES 2000 interface is the opportunity to collect real time MILES engagement events at a central facility, and provide instant feedback to the trainees involved in the exercise. For example, tank crews could be informed that their main gun rounds were consistently near-missing their targets to the left. This might indicate a crosshair or MILES laser misalignment. Currently, near miss events are registered by targeted units, but no external reporting mechanism is activated. Blinking beacons are activated only for kill events. This means the shooter never has any idea that his shot was anything but a bad miss. There is no indication that his miss may be due to crosshair or laser misalignment rather than faulty firing preparation. Interfacing FBCB2 with MILES 2000 provides a mechanism by which near miss data can be disseminated very quickly during the battle to observer controllers to assist them in training their students while the opportunity for hands on learning exists.

Another example for which real time feedback would be especially useful is for target selection. Even when killed units activate an external beacon light, there is no indication of which unit killed the target. This pairing data is currently not available until the exercise is over and data has been downloaded and analyzed. In the heat of a dense conflict there may be multiple shooters that an observer could conclude made the kill. Therefore, if specific target selection decision making was a critical skill for a particular exercise, there is no objective mechanism to measure a trainee's performance until after the exercise concluded. Interfacing FBCB2 with MILES 2000 provides a mechanism by which pairing data can be disseminated very quickly during the battle to observer controllers to assist them in training their students in real time.

**Reduced O/C Workload Reduces Cost of Training Exercise**

The ability to automate the collection and storage of MILES events greatly reduces the manpower required to physically move from vehicle to vehicle and download that data after an exercise has completed. This reduced manpower requirement helps reduce the cost of the training exercise in both time and resources. Event data collected as the exercise progresses can be reduced immediately. Significant events can be highlighted and incorporated into AAR segments while fresh on the minds of the training staff. AARs could be held in a much more timely manner keeping the exercise fresh in the minds of the participating soldiers and observers, thus providing additional training benefit.

**Improved Training to TOC Commanders**

The FBCB2 to MILES 2000 interface provides engagement pairing and kill data that can be made available to observer/controllers in the TOCs for providing improved situation training to the commanders. For example, TOC personnel's use of unit status reports, or lack thereof, can be directly correlated with MILES' kill data in near real time. TOC personnel performance can be assessed as the exercise progresses, rather than having to wait until the AAR at the conclusion of the exercise.

**Future Potential Area Effects Correlation in FBCB2**

Upgrades can be integrated into FBCB2 to effectively account for emplaced mine truth data. This would allow training with regards to minefield breaching operations and SA observation and guidance. When a platform's position as measured by GPS passes within a certain distance from an active mine the platform is killed by sending an event notice to MILES for kill processing. MILES would then assess engagement impact on the unit and pass appropriate kill codes through FBCB2 back to the central analysis facility.

**Secondary Improvements**

During analysis of the training benefits of the FBCB2 to MILES interface, several secondary improvements were identified. While not specifically aimed at reducing existing training deficiencies, these are areas that provide avenues for future improvement. MILES 2000 is currently meeting its requirement of capturing 500 events during a training exercise. While not a noticeable limitation in currently sized events, the possibility exists that events could be lost due to rollover after the initial 500 events are recorded. The real time archiving of MILES events through FBCB2 eliminates this potential limitation.

This work has prototyped a Training/Simulation mode in FBCB2, which could be used to extend its capability in the future. The FBCB2 to MILES interface now provides an initial standalone FBCB2 embedded training capability, whereby FBCB2 provides functionality directly supporting training exercises. Further enhancement FBCB2 embedded training would allow a soldier working at an FBCB2 console to send out messages, acknowledge other messages, examine the battle situation, and build and disseminate engagement plans while he may or may not be interacting with another FBCB2.

## IV. INTERFACE DESIGN AND IMPLEMENTATION

FBCB2 is a go to war advanced battle system undergoing continuous development to implement planned enhancement and capability upgrades. As yet, FBCB2 does not inherently provide training range support for purposes of live training commanders and soldiers. FBCB2 does provide embedded training help screens, but this capability is limited only to single user, situation independent learning. Therefore, FBCB2 software had to be modified to demonstrate its inherent potential for supporting live training exercises through communications with tactical engagement training systems. MILES 2000 was chosen as the training engagement system for this demonstration because MILES 2000 is currently and will likely remain the most prolific system employed at the primary combat training centers. Limited modifications were made to both MILES 2000 and FBCB2 to generate a proof of principle demonstration capability.

The FBCB2 computers being fielded to the first digitized division and beyond incorporate a number of serial port devices for communicating with platform and other external systems. RS-232, RS-423, and USB ports are all supported. However, all RS-232 and RS-

423 ports have already been dedicated to specific platform systems. The solution identified for long term integration of a MILES serial communication port was to tie MILES into the USB port, which is hot pluggable by nature. For purposes of this demonstration project, it was decided to limit the scope of MILES interface redesign by reusing one of FBCB2's RS-423 ports.

Two significant processing threads were added to FBCB2 for this project. The first was an asynchronous communications process designed to download event data from MILES into the FBCB2 computer, form JVMF compliant messages, and transmit them to another FBCB2. The Free_Text JVMF message was chosen as the simplest standard mechanism to transmit the MILES data.

Due to the inherent data content limits of the Free_Text JVMF standard, messages can contain only a limited number of MILES events. Therefore, the data downloaded from MILES must first be parsed into acceptable event parcels. A fielded capability will likely involve a more robust solution by building a new JVMF message type for training event data or by using a binary data transfer approach strictly within the FBCB2 application itself.

The Free_Text message sent by the combatants' FBCB2 contains MILES event data such as kill codes, near miss event data, weapon round identifiers, and shooter identifiers. It also contains limited unit ground truth data provided by FBCB2 to assist with more precise AAR presentation and situation analysis. This includes FBCB2 unit identification, event time, and unit location.

The serial communications handshaking protocol employed for this MILES interface is the same as is used for FBCB2 communications with the Precision Lightweight GPS Receiver (PLGR), with the exception of baud rate. The baud rate inherent to the MILES 2000 infrared download port is used in order to minimize impact to the MILES hardware design. Provisions are made for imperfect data reception by using independently calculated checksum values. When the checksum supplied by MILES does not agree with the checksum calculated by FBCB2 for any given data message from MILES, FBCB2 signals MILES to try again.

The second significant processing thread added to FBCB2 is designed to pass all MILES data received at the central control facility's collection FBCB2 to the MILES After Action Review System (MAARS) for analysis. This thread is synchronous, being activated only for received JVMF messages of type Free_Text, that contain a MILES_message key flag. When such a message is received, it is processed by the new thread in lieu of standard FBCB2 message processing. The MILES event messages are known not to contain any user or SA data and should not be made available to users via the standard FIPR queues. Instead, all MILES event data and associated unit truth data tacked on by the sending unit are stripped out of the JVMF message and passed to the MAARS system. A copy of the original Free_Text JVMF message is archived in a user_folder for later retrieval, should the need arise.

Again, in order to limit initial impact to the MILES hardware system for this demonstration project, the link to the MAARS system was an RS-423 serial link. However, a fielded solution would likely employ an Ethernet connection via LAN port. The central collection site would be collecting events from hundreds (maybe thousands) of units, both BLUEFOR and OPFOR. All this data must be extracted and passed down to the MAARS system without significant bottlenecking which would likely occur on a serial line.

Cubic Defense incorporated a few key modifications to the MILES 2000 suites for the M1A2 and M2A3 to support this interface demonstration. An RS-423 serial port was added and multiplexed off the standard infrared output port. A serial communications cable was built to connect the main controller unit to FBCB2 via the serial port. Software was added to support the MILES side of the communications interface. MAARS functionality was enhanced to accept additional truth data that FBCB2 injected into MILES event messages at each local unit. Cubic supported systems integration and demonstration development at TRW's Orlando facility.

## V. DEMONSTRATION SCENARIO

The minimal complement of force units necessary to be involved in the project demonstration was three: one to be BLUEFOR, the second to be OPFOR, and the third to collect all MILES engagement messages. The BLUEFOR unit was selected to be the aggressor and was configured to be an M1A2 main battle tank. The OPFOR unit was selected to be the target victim and was configured to be an M2A3 fighting vehicle. The central collection unit was chosen to be a brigade command group higher headquarters.

For the demonstration, each "vehicle" consisted of a six foot office table with FBCB2 surrogate computer and modified MILES platform kit, along with wireless LAN equipment used in place of military radios. Figure 1 is a block diagram depicting the three simulated unit

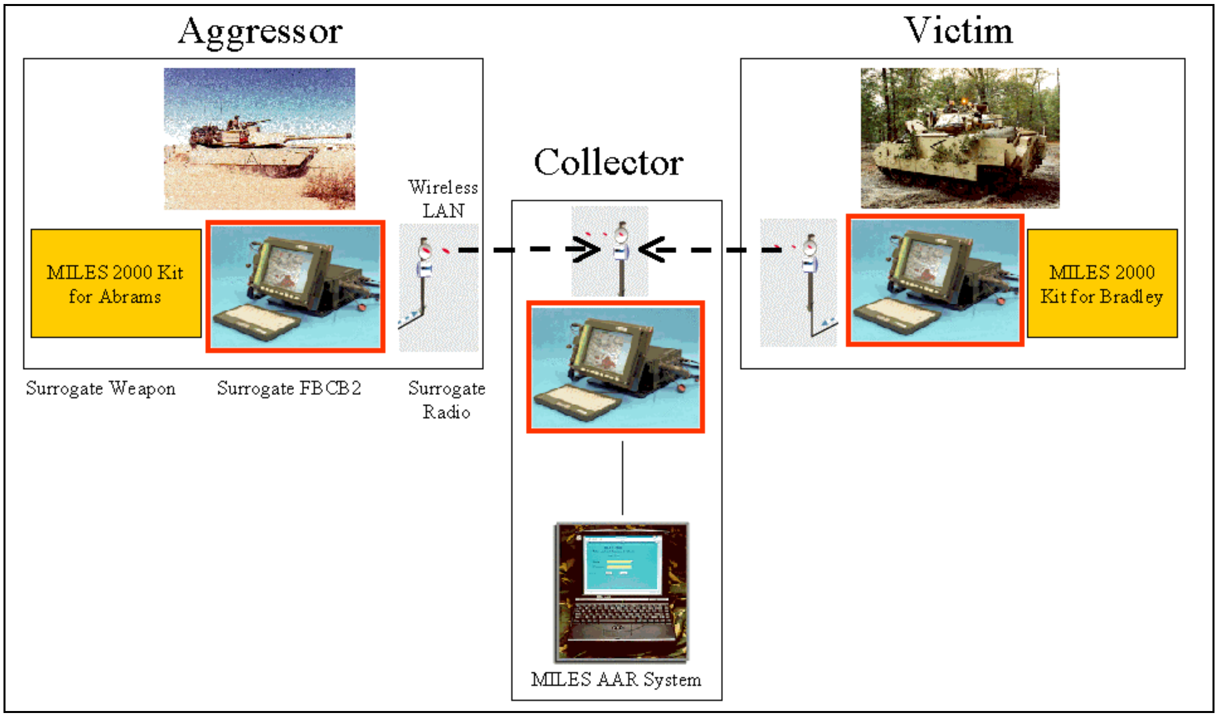


**Figure 1. FBCB2 / MILES 2000 Integration Demonstration.**

nodes. GPS devices were not used. Therefore, vehicle positions were updated manually through FBCB2's graphical user interface.

The demonstration scenario's order of events was as follows:

1) FBCB2 and MILES are activated and configured, FBCB2 establishes a tactical Internet;
2) An observer controller uses the MILES 2000 controller gun to reset both vehicles;
3) MILES passes reset events to the respective FBCB2s on each vehicle;
4) FBCB2 transmits the reset event messages to the central collection facility;
5) Central collection facility relays received reset messages to the MILES After Action Review System (MAARS);
6) OPFOR and BLUEFOR vehicles deploy through a relocation maneuver;
7) BLUEFOR unit targets OPFOR and fires;
8) BLUEFOR firing event is passed from MILES to FBCB2, which in turn transmits the event data to the collector, which in turn passes the data the MAARS;
9) OPFOR registers and processes a hit through MILES, passes hit event data to FBCB2, which in turn transmits the event data to the collector, which in turn passes the data to MAARS;
10) MAARS logs and reports the engagement activity.

Both friendly and enemy units are outfitted with MILES gear. Hence, they must also be equipped with FBCB2. Until now, OPFOR units were not outfitted with FBCB2, because threat opposing forces do not have a similar capability. However, both sides are equipped with MILES gear in order to collect pairing and event data from all combatants. Therefore, this project has expanded the role of FBCB2 appropriately such that opposition force units will be equipped with FBCB2, but only for MILES event transmission. Crew will not have access to FBCB2 capability, screens, or controls.

The FBCB2 unit designated as the combat training center's central collection site for the Free_Text messages containing MILES data had to be chosen carefully. This entity must be capable of receiving Command and Control (C2) messages and SA data from both OPFOR and BLUEFOR units, but must not disseminate ground truth data from OPFOR units to BLUEFOR units. Rather than perform the significant effort of designing a new force lay-down structure and associated FBCB2 database, an existing unit at the top of the command structure was chosen. This unit is the Command Group Higher Headquarters for the first digitized brigade. The fully objective capability would include a new unit added to the FBCB2 lay-down database specifically designated to function as the central collection point for MILES event messages.

## VI. CONCLUSION

A communications interface between tactical engagement systems, namely MILES 2000, and FBCB2 will improve the quality of collected training event data, decrease the cost of its collection, and improve the AAR turn around time. Analyst feedback can be made available in the field with little delay, providing improved teaching opportunities for the observer/controllers and improved learning opportunities for the soldiers participating in the training exercise. Observer/Controller work load will be reduced by eliminating vehicle data download tasks.

Future enhancements to this link may include additional bi-directional communications, such that OC work load is further reduced by having FBCB2 pass reset commands to MILES from the central facility. Additionally, FBCB2 can be enhanced to track ground truth data on mine emplacements and pass engagement events to MILES for kill processing when the unit has come within a specified distance of the mine, based on internal knowledge of the unit's own position. This will potentially eliminate additional OC workload and improve training reality by eliminating the need for an OC to be stationed in or near a minefield. Soldiers will not be able to cue on the presence of an OC as indication of potential danger.