Force XXI Battle Command Brigade-and-Below (FBCB2)

"Where am I?"

"Where are my buddies?"

"Where is the enemy?"

The senior leadership of the Army formulated the hypothesis that if battlefield commanders and their staffs had the answers to these questions and other critical information, they could make better tactical decisions, and make them faster. To test this hypothesis, the Army embarked on a rigorous and demanding methodology – the Task Force XXI Advanced Warfighting Experiment (TF XXI AWE). This nine-month process of force-on-force field experimentation and evaluation culminated in a "digitized" training event held at the National Training Center in March 1997.

"Digitization of the Battlefield"

Information technology equipment (e.g., computers, secure radios, packet routers, etc.), software, and related training were all combined into a system called "Force XXI Battle Command Brigade-and-Below "

(FBCB2). Provided to a brigade-sized combat team, this system delivered unprecedented, focused, and accurate near-real-time information to every member of the team:

• To provide "situational awareness". Task Force XXI proved that BLUE /RED (air/ground, Army/joint) locations could be provided, and that such information is of great value to the warfighter.

• To provide a common view of the battlespace to combat arms, combat support, and combat service support elements. FBCB2 proved that it can work for the entire 1st Brigade Combat Team (1st BCT), and that there is value in sharing common data across all members and branches within the 1st BCT. Providing FBCB2 to all of the elements of the 1st BCT facilitated coordination and teamwork. Indeed, it is clear that the benefits of digitization are applicable to everyone in the combat team, not just for the

combat and combat support arms; digitization provides significant benefits to the combat service support elements in the form of more accurate and timely logistics, and a near-real-time view of personnel / logistics supply status.

• To improve the decision-making process. Situational awareness – especially when integrated with active combat identification – reduced fratricide. Situational awareness also increased the effectiveness of the 1st BCT; the 1st BCT was able to decide and to act/react faster than the Opposing Force (OPFOR). With the ability to make timely decisions, the 1st BCT was able to engage decisively the OPFOR by massing appropriate fires and/or forces quickly in the right place at the right time, without having to commit the 1st BCT reserve to every action.

The Task Force XXI soldiers showed that they can learn to use the digitization equipment and software, and use it to increase their unit's combat power through better and quicker decision-making. Through the introduction of information technology, the cumulative effect resulted in decisively reducing the "fog of war".

TRW, as the Army's prime contractor for Force XXI Battle Command Brigade-and-Below, provided the hardware (computers and installation kits), software, data bases, installation, training, and maintenance for the Task Force XXI Advanced Warfighting Experiment. The results were spectacularly successful, validating the Army's hypothesis: information technology does improve the effectiveness of the land-combat team. The Army now has the data it needs to guide its vision to "digitize" the Army in the early 21st century.

Many new ideas and products were tried during Task Force XXI, but the centerpiece of the entire activity was the hardware and software constituting Force XXI Battle Command Brigade-and-Below ("Appliqué") system. More than 1,000 Appliqué systems operated simultaneously during Task Force XXI, demonstrating their unique capability to gather and distribute critical combat information to soldiers, units, and battle commands in near-real-time through the use of its revolutionary new communications system, the "Tactical InterNet".

Displayed on a digital map background with associated battlefield symbology, the TRW-provided Appliqués and Tactical InterNet combined to deliver near-real-time situational awareness, allowing each wheeled vehicle, tracked vehicle, helicopter, fixed-wing aircraft, and dismounted soldier so equipped to "see" friendly and known enemy forces.

TRW is proud to have led the Army's contractor team in validating the Army's vision of "digitizing the force". The TRW / Army team is already at work using the lessons learned during the Task Force XXI AWE process to make Force XXI Battle Command Brigade-and-Below a reality, for the Army's Interim Digitized Division, for an initial Digitized Corps, and for the complete force of the future.

Software

Based on layered applications connected via a "software backplane" and built-in evolutionary increments, starting with a "software architecture skeleton", the version 1 software used at the Task Force XXI AWE proved that situational awareness could be provided to a large, mobile force, communicating over the Tactical InterNet. Moreover, it demonstrated that the FBCB2 software architecture is suitable for the digitization mission and the evolutionary introduction of additional capabilities, while providing the near-real-time performance and reliability required by the mission. New functions providing support for all elements of the combat team are already in progress for future versions of the software, based on the "lessons-learned" of the Task Force XXI AWE process.
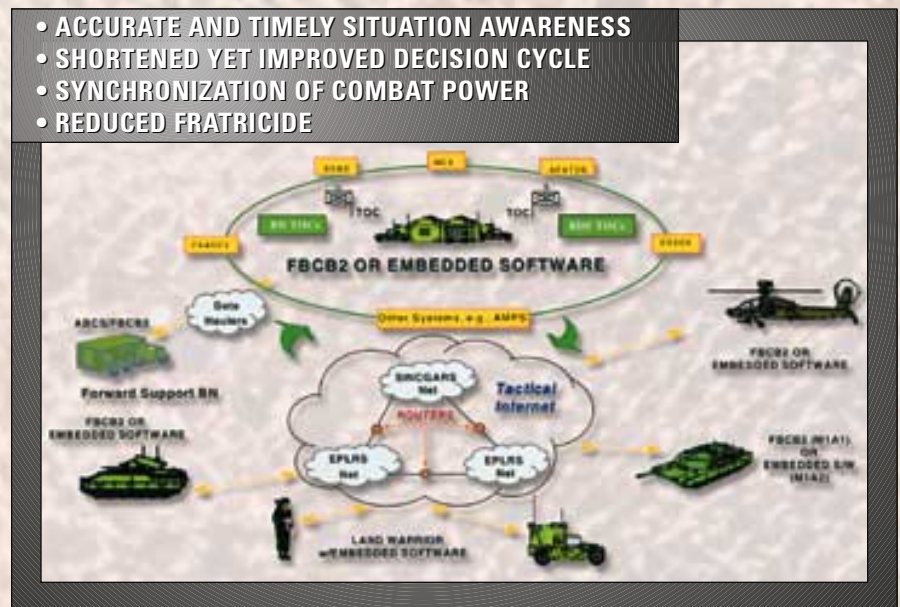
TRW's techniques of layering, isolation, encapsulation, and modularity made the FBCB2 software flexible and re-hostable. Six different computers were used during the Task Force XXI AWE process, and portions of the software (most notably, the variable message format [VMF] message parser) were used in 10 other systems. This flexibility and re-hostability have also made possible another key benefit: the unification of the Army's strategy for digitization with its plan for weapons platform modernization, particularly for the ABRAMS main battle tank, the Apache helicopter, the BRADLEY fighting vehicle, and the CRUSADER artillery vehicle, among others.

A segment of the FBCB2 software, termed "Embedded Battle Command" (EBC), will be integrated directly into on-platform embedded computers in these modern weapons platforms. These (EBC-equipped) platforms are provided access to the FBCB2 variable message format, situational awareness, command-and-control, and Tactical InterNet functionality, simultaneously guaranteeing their inter-operability with the "appliquéd" fleet of platforms. A proof-of-concept implementation of this important software module has been completed and demonstrated.

Technical Architecture

FBCB2 was the first large-scale software system to be built in compliance with the new Army Technical Architecture, a "building code" for complex software systems, since adopted as a joint standard. Military-specific devices (such as the SINCGARS SIP radio and the EPLRS data radio) were integrated under a set of commercial protocol standards,

- ACCURATE AND TIMELY SITUATION AWARENESS
- SHORTENED YET IMPROVED DECISION CYCLE
- SYNCHRONIZATION OF COMBAT POWER
- REDUCED FRATRICIDE

Example Appliqué Installation

- V2 Computer
- Laser Range Finder
- Radio
- Driver's Display
- Pos/Nav
- BCIS
- Vehicle Intercom
- Cautions/Warnings

which proved to aid significantly in the system-level integration of the more than 1,000 Appliqué systems that took part in Task Force XX. Improvements to the selected protocol suite are already in evaluation for future versions of the FBCB2 / Tactical InterNet system-of-systems.

Integration

TRW's approach for managing multiple fielded configurations of complex software systems, previously proven on Army programs such as CSSCS, FAAD C2I, GBR, and STACCS, proved again that disciplined configuration management procedures combined with sound system/software engineering processes are absolutely crucial to the future of the digitized battlefield. Adhering to this proven approach for managing multiple systems, TRW integrated a dozen systems developed by several contractors (including AFATDS, ASAS, BCIS, CSSCS, EPLRS, FAAD C2I, INC, JANUS, MCS, NMT-B2, PLGR, SIMNET, SINCGARS SIP, TMG, and others) into more than a dozen mobile Tactical Operations Centers and the 1,000-node FBCB2 network. The Army has already scheduled many other systems for

integration by TRW and PM Appliqué into the digital battlefield. This approach ensures that the TRW / Army software solution for FBCB2 can grow to support not just a digitized division, but the entire digitized force, including components from other services and allies.

Hardware

TRW's responsibilities for Task Force XXI and FBCB2 extend well past software, the Tactical InterNet, system architecture for the digital battlefield and system integration. They also include a variety of hardware responsibilities, including design, development, qualification, production, and maintenance of all of the computer systems for the Appliquéd platforms; and the design, development, qualification, production, installation, and maintenance of more than 90% of the installation kits, for wheeled ground platforms, tracked ground platforms, helicopters, and some dismounted soldiers.

For Task Force XXI, TRW and our team-mates delivered more than 1,000 computers (of 6 varieties) and installed them into more than 850 platforms (of nearly 50 varieties);

we also delivered nearly 200 soldier systems. The design of these devices was proven appropriate for the intended use, as we achieved daily operational availability rates in the high 90's every day of the AWE; on most days, achieving rates of about 98%! This experience is being used to define cost-effective "next-generation" equipment that will not only provide additional performance "break-throughs", but will ensure that digitization is affordable as well as effective.

Callout labels (top, left to right):

Zulu Date Time Group

Status "gumballs" GPS, comm,etc

Cursor location w/display options for MGRS, Lat/Long, and UTM

Your role and your position

Displays Flash/Immediate/ Priority/Routine message queue counters

Warnings and alerts displayed in scrolling marquee

View top-priority messages

User-definable single-keystroke message send

Autocenter on own position

Callout labels (left box):

Map brightness and contrast controllable separate from icons and overlays

Map background can be CADRG, DTED, imagery, other standard DMA products or combinations thereof

Callout labels (bottom, left to right):
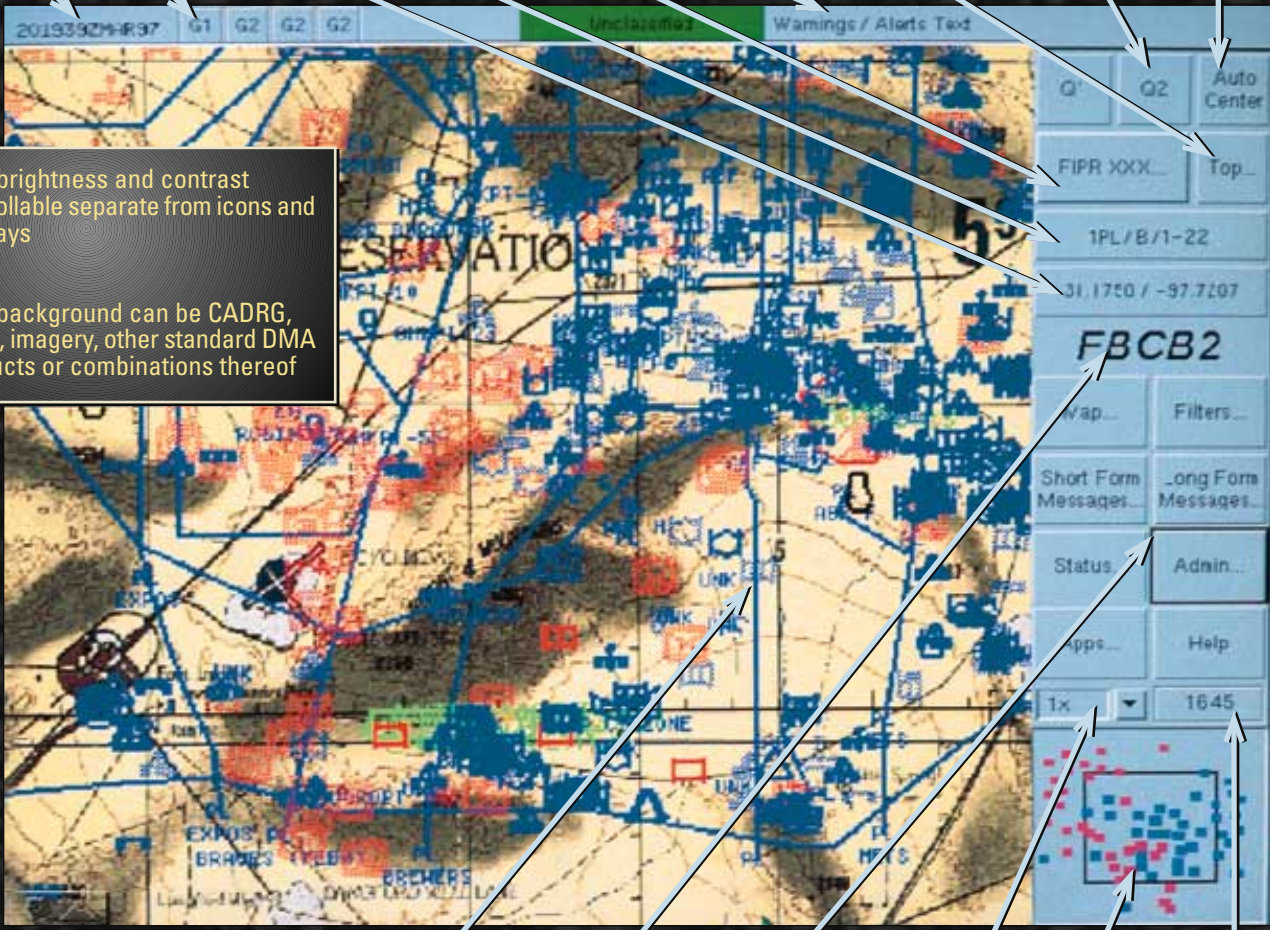
Devotes most of screen area to map

Autocenter mode (user settable) to keep the map centered on own position

Area reserved for future use; voice operations, etc

Main menu buttons located to minimize hand-eye movement; better operate-on-the-move support

Map zoom control

Battlefield context display

Local time

Screen interface text:

201939ZMHR97 | G1 | G2 | G2 | G2 | Unclassified | Warnings / Alerts Text

Q' | Q2 | Auto Center

FIPR XXX... | Top...

1PL/B/1-22

31.1750 / -97.7207

FBCB2

Map... | Filters...

Short Form Messages... | Long Form Messages...

Status... | Admin...

Apps... | Help

1x | 1645

Quote boxes (bottom):

"The EXFOR was able to be decisive without having to commit everything; Appliqué and SA are providing the commander enough information so that he knows how much to commit to each engagement."

"I've seen enough to say…this will change the way we (the Army) do business…SA is a big winner…we can fundamentally change the way we do business with Appliqué"