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Force XXI Battle Command Brigade and Below-Blue Force Tracking (FBCB2-BFT). A Case Study in the Accelerated Acquisition of a Digital Command and Control System during Operations Enduring Freedom and Iraqi Freedom

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The purpose of this project is to provide a process for accelerated acquisition in support of contingency operations. The objective of the project is to recreate and document the events surrounding the fielding of FBCB2-BFT during Operations Enduring and Iraqi Freedom, and to produce a document that provides an analysis of actions taken, the obstacles that were overcome and the acquisition policy that applied to the situation in order to rapidly acquire, produce, train and field a useful solution to fulfill an urgent and valid operational need. In 2002, while conducting the Global War on Terror, the US Army determined that combat on an asymmetric battlefield, consisting of a complex operational environment as well as an increased geographic battlespace, required improvements to the current command and control capability available to the force. PM FBCB2 determined their system could fulfill the need by taking the current FBCB2 system and adjusting it to meet the new operational need. Given the constraints regarding time, funding, and technical feasibility PM FBCB2 diligently worked with multiple organizations and agencies in order to provide a useful solution for friendly forces in Operations Enduring Freedom and Iraqi Freedom. In the 12 months prior to 21 March 2003 (G-Day Iraqi Freedom), the Army undertook an enormous effort to develop, produce, provide system training, and field FBCB2-BFT. The FBCB2-BFT initiative was successful due to the synchronization of four interrelated and supporting components; 1) a technically mature system, 2) user representative acceptance, 3) senior leadership support, and 4) a funding stream.

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The purpose of this project is to provide a process for accelerated acquisition in support of contingency operations. The objective of the project is to recreate and document the events surrounding the fielding of FBCB2-BFT during Operations Enduring and Iraqi Freedom, and to produce a document that provides an analysis of actions taken, the obstacles that were overcome and the acquisition policy that applied to the situation in order to rapidly acquire, produce, train and field a useful solution to fulfill an urgent and valid operational need. In 2002, while conducting the Global War on Terror, the US Army determined that combat on an asymmetric battlefield, consisting of a complex operational environment as well as an increased geographic battlespace, required improvements to the current command and control capability available to the force. PM FBCB2 determined their system could fulfill the need by taking the current FBCB2 system and adjusting it to meet the new operational need. Given the constraints regarding time, funding, and technical feasibility PM FBCB2 diligently worked with multiple organizations and agencies in order to provide a useful solution for friendly forces in Operations Enduring Freedom and Iraqi Freedom. In the 12 months prior to 21 March 2003 (G-Day Iraqi Freedom), the Army undertook an enormous effort to develop, produce, provide system training, and field FBCB2-BFT. The FBCB2-BFT initiative was successful due to the synchronization of four interrelated and supporting components; 1) a technically mature system, 2) user representative acceptance, 3) senior leadership support, and 4) a funding stream.

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LIST OF ABBREVIATIONS, ACRONYMS, SYMBOLS

AAE	Army Acquisition Executive
AAR	After Action Review
ABCS	Army Battle Command System
ACAT	Acquisition Category
ACTD	Advanced Concept Technology Demonstration
AFATDS	Advanced Field Artillery Tactical Data System
AIS	ABCS Information Server
AMDWS	Air and Missile Defense Workstation
APM	Assistant Program Manager
APS	Army Pre-positioned Stocks
AR 71-9	Army Regulation 71-9 Material Requirements
ASAS	All Source Analysis System
ATD	Advanced Technology Demonstration
AWE	Advanced Warfighting Experiment
BCS3	Battle Command Sustainment Support System
BCT	Brigade Combat Team
BCTP	Battle Command Training Program
BDI	Balkan Digitization Initiative
BFA	Battlefield Functional Area
BFT	Blue Force Tracking
BOS	Battlefield Operating System
C2	Command and Control
C3	Coalition Staff Operations and Training Officer
CCS	Command Center Server
CENTCOM	Central Command
CFLCC	Coalition Forces Land Component Command
CIB	Controlled Image Base
COA	Course of Action
COTS	Commercial off the Shelf
CP	Command Post
CPX	Command Post Exercise
CTIS	Combat Terrain Information System
CTSF	Central Test Support Facility
DAE	Defense Acquisition Executive
DCX	Division Capstone Exercise
DMTC	Digital Master Trainer Course
DoD	Department of Defense
DTED	Digital Terrain Elevation Data
DTRACS	Defense Transportation and Control System

EECP	Early Entry Command Post
EIS	Enhanced Information System
EPLRS	Enhanced Position Location Reporting System
EXFOR	Experimental Force
FBCB2	Force XXI Battle Command Brigade and Below
FCS	Future Combat System
FRP	Full Rate Production
FY	Fiscal Year
G3	Deputy Chief of Staff for Operations and Training
G8	Deputy Chief of Staff for Programs
GCCS-A	Global Command and Control System-Army
GIG	Global Information Grid
GPS	Global Positioning System
GUI	Graphic User Interface
HTI	Horizontal Technology Insertion
IMETS	Integrated Meteorological System
IMTF	Information Management Task Force
IOT&E	Initial Operational Test and Evaluation
ISYSCON	Integrated System Control
IVIS	Inter-vehicular Information System
JCIDS	Joint Capability Integration and Development System
LAN	Local Area Network
LRIP	Low Rate Initial Production
LUT	Limited User Test
MCS	Maneuver Control System
MDAP	Major Defense Acquisition Program
MILSPEC	Military Specification
MNS	Mission Needs Statement
MTS	Movement Tracking System
NTC	National Training Center
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
ONS	Operational Needs Statement
OODA	Observation, Orientation, Decision, Action
OPFOR	Opposing Force
OPNET	Operator New Equipment Training

PM	Program Manager
PMO	Program Management Office
PEO C3S	Program Executive Office Command, Control, and Communications Systems
PEO C3T	Program Executive Office Command, Control, and Communications Tactical
POM	Program Objective Memorandum
SA	Situational Awareness
SATCOM	Satellite Communications
SBCT	Stryker Brigade Combat Team
SETAF	Southern European Task Force
SFOR	Stabilization Forces
SINCGARS	Single Channel Ground and Airborne Radio System\
TAIS	Tactical Airspace Integration System
TF XXI	Task Force Twenty One
TI	Tactical Internet
TOC.	Tactical Operations Center
TRADOC	Training and Doctrine Command
TSM	TRADOC System Manager
TTP	Tactics Techniques and Procedures
ULMC	Unit Level Maintainers Course
USAREUR	United States Army Europe
VPN	Virtual Private Network
WAN	Wide Area Network
WRAP	Warfighter Rapid Acquisition Program

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I. INTRODUCTION

A. PROBLEM STATEMENT

The Department of Defense (DoD) Acquisition process for major weapon systems can be characterized as extremely directive and set-piece based on the multiple activities, gates, documents, and review boards that must be conducted while striving to develop and manufacture a new materiel solution.

Given this type of regimented operating environment, this case study attempts to identify the conditions which must be present and what methods may be utilized in order to accelerate the fielding of a much needed materiel requirements. The authors have limited the scope of the question specifically to an Acquisition Category (ACAT) ID program; however parallels may be drawn for lower priority requirements.

Analysis of this case study reveals that four independent, yet interrelated, components were necessary in order to provide the Force XXI Battle Command Brigade and Below-Blue Force Tracking (FBCB2-BFT) capability in support of Operations Enduring and Iraqi Freedom. The absence of any one of these components could have potentially led to the inability to successfully provide this capability. Although these four components were revealed during this case study, the authors believe that these same criteria apply to any program attempting rapid acquisition in support of contingency operations.

Figure 1 portrays the four components required to conduct acquisition and fielding in support of contingency operations and include the following:

- The presence of a relatively mature technical solution to solve an identified capability gap.
- The presence of a User Representative that is a willing to accept a temporary solution in the short term while the Program Management Office (PMO) continues to mature the system to the desired endstate as outlined in the Operational Requirements Document (ORD) or the Capabilities Development Document (CDD).
- The presence of supportive military leadership, which includes not only the individual Service Chief but also the Combatant Commander.

- The presence of a funding stream that is sufficient to provide the initial capability in the short term and if necessary the ability to request and receive supplemental funding in order to sustain the effort.

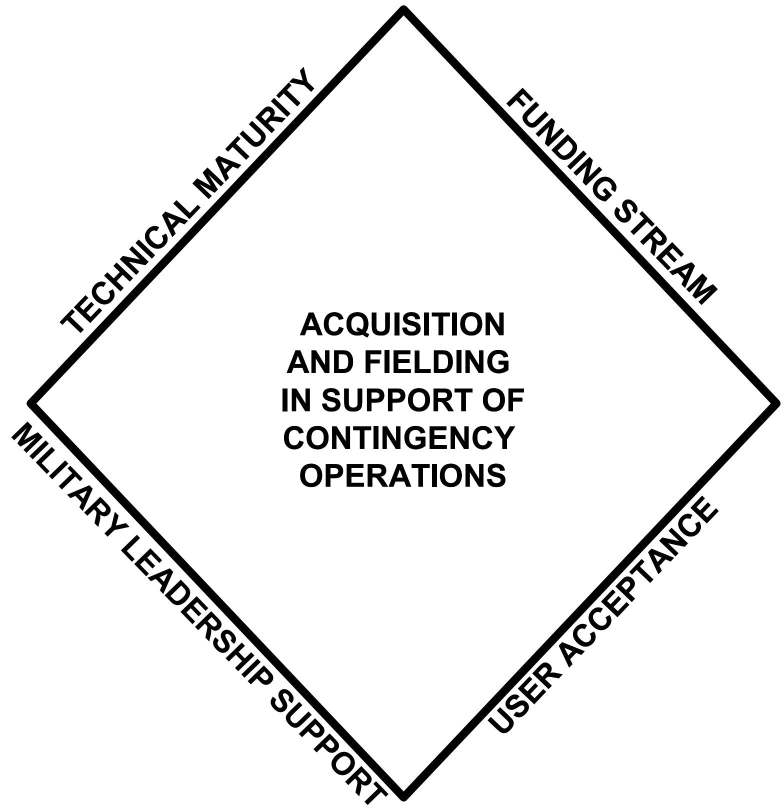

Figure 1. The Principle Components of Rapid Acquisition in Support of Contingency Operations

B. THE PURSUIT OF INFORMATION DOMINANCE

> Know the enemy and know yourself, in a hundred battles you will never know peril. When you are ignorant of the enemy but know yourself your chances of winning or losing are equal. If ignorant of both your enemy and yourself, you are certain in every battle to be in peril.
>
> —From Sun Tzu's The Art of War

> The general unreliability of all information presents a special problem: all action takes place, so to speak, in a kind of twilight,…like fog. War is the realm of uncertainty; three quarters of the factors on which action in war is based are wrapped in a fog of greater or lesser uncertainty…The

> commander must work in a medium which his eyes cannot see, which his best deductive powers cannot always fathom; and which, because of constant changes, he can rarely be familiar.
>
> —From Carl von Clausewitz's *On War*

Throughout history, military leaders have recognized the key role of information as a contributor to victory on the battlefield. In order to understand how information affects one's ability to perform military operations it is necessary to think in terms of three distinct domains; the physical domain consisting of the natural environment in which the senses are dominant, the information domain consisting of data, information systems, and documented knowledge, and the cognitive domain which consists of situational awareness, assessment and understanding.[1] As such, the pursuit of information superiority and information dominance has long been an objective of the world's armies. Over time, technological advances have provided the capability to reduce the "fog of war". Figure 2, Three Distinct Domains, depicts how technological innovation introduced over time has provided the ability to transition from one domain to the next. The US Army's digitization initiative has provided the vehicle to enter into the cognitive domain and help reduce the fog of war on the modern battlefield.

[1] Alberts, David S., Garstka, John J., Hayes, Richard E., Signori, David A., *Understanding Information Age Warfare.* Command and Control Research Program Publication Series, August 2001, p. 10.

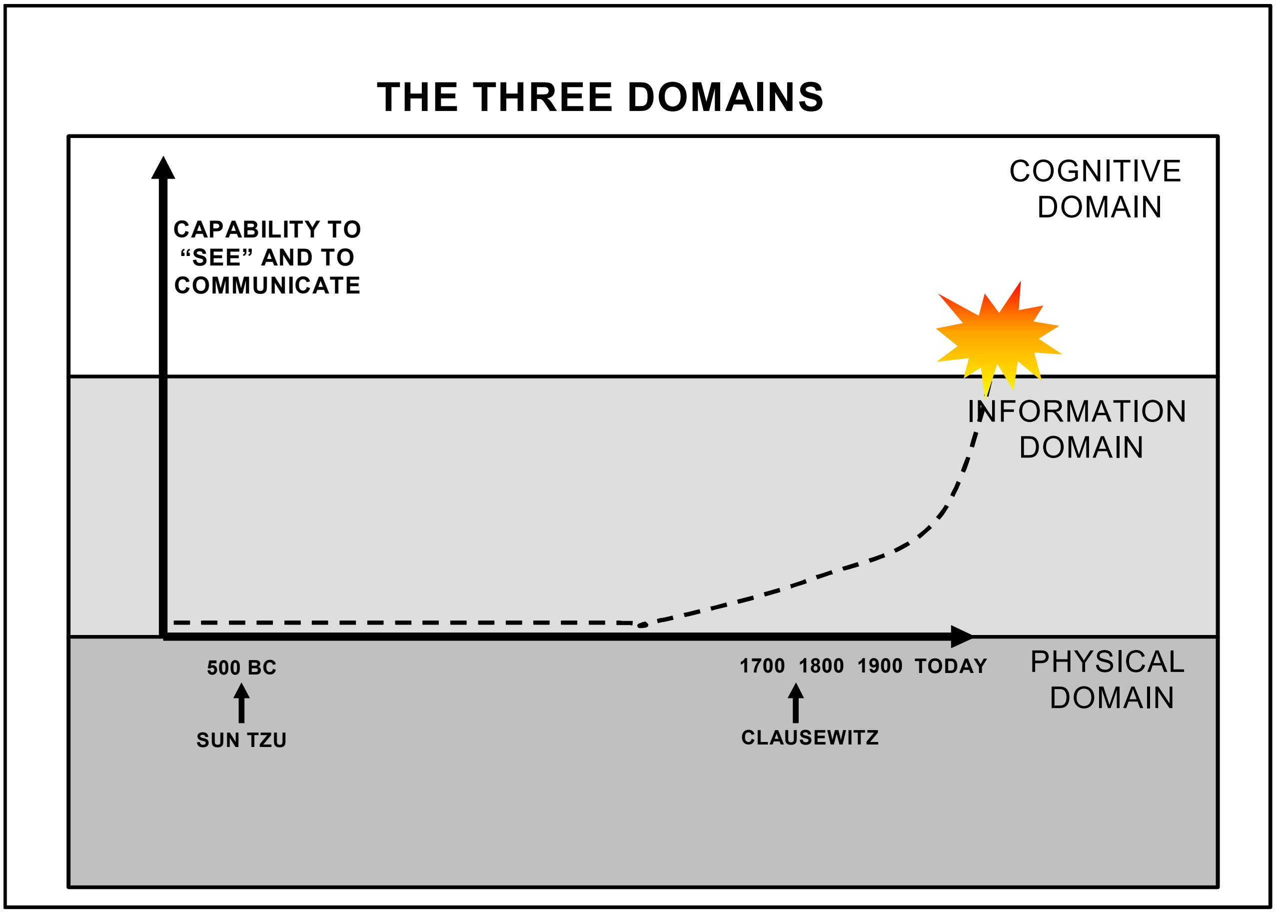

Figure 2. Three Distinct Domains Chart (After: *Understanding Information Age Warfare* p. 40.)

II. BACKGROUND

A. THE UNITED STATES ARMY IN TRANSITION

The late 1980’s and 1990’s comprised a period of unprecedented rapid and fundamental change. The computer industry experienced dramatic leaps forward in the areas of computing power, processing speed, and Random Access Memory development while simultaneously reducing both physical size and cost. Concurrently, the information technology (IT) industry and the Army were developing processes and software applications to capitalize on these advancements.

The implosion of the Soviet Union signaled the end of the Cold War in July 1990, and the United States found it increasingly difficult to justify a large standing army with substantial forces forward deployed and postured to fight a conflict whose time had passed. The political environment within the United States called for the downsizing of the military as a whole and the repositioning of a substantial amount of forces to the continental United States.[2]

US Army leadership believed that employment of emerging technological advances in the areas of information technology could serve as a force multiplier and would somewhat compensate for the reduction in Army force structure brought on by the end of the Cold War. The Army digitization plan capitalizes on the acquisition of current and emerging technologies in order to create an environment where friendly forces can dominate. Army digitization initiatives would soon develop new systems and improve existing systems within each Battlefield Functional Area (BFA). The overall goal would be to aggregate them into an interoperable network-centric force. The vision of this initiative was to improve the situational dominance of the US Army on the modern battlefield for the foreseeable future.

Situational dominance can be defined as applying lethal and non-lethal effects with unprecedented precision across the spectrum of military operations. Situational

[2] Gargan, John J. To Defend A Nation: An Overview of Downsizing and the U.S. Military. M@n@gement, Vol. 2, No. 3, 1999, pp. 225-226.

dominance is attained through the ability to collect, analyze, distribute and act on information pertaining to the battlefield. Situational dominance facilitates increased operational tempo, dispersed operations, synchronization of forces, accelerated orders dissemination, application of massed and precision effects, automated logistics, reduction in fratricide, and the ability to operate within the enemy's decision making cycle.

Before significant restructuring activities and digitization implementation could take place in the Army, the nation of Iraq invaded neighboring Kuwait on August 2, 1990. Following a prolonged six-month deployment and build up of forces in the Middle East by the United States and coalition partners, the Iraqi army was forcibly removed from Kuwait in February 1991. At the conclusion of hostilities the United States Army conducted a detailed analysis of its performance, which set the stage to launch its future Force XXI initiative.

One of the most powerful tools available to the United States military is the effective use of the After Action Review (AAR). The AAR is the mechanism through which detailed information pertaining to a specific event can be gathered and analyzed. The purpose of the AAR is to capture what happened, why it happened, how to sustain exposed strengths and improve on identified weaknesses. [3] Following Desert Storm, AARs confirmed that weapon systems such as the M1 Abrams Tank, M2 Bradley Fighting Vehicle, M270 Multiple Launch Rocket System, AH64 Apache Helicopter, and the Patriot Missile System, which had been developed and fielded for a potential conflict in Europe against the Soviet Union, received high marks for their survivability, mobility, and lethality. However, the AARs determined that effective Command and Control systems were still lacking. It was apparent that to improve our warfighting capability a rapid and reliable information networks was necessary to enable the Army to better project the force, protect the force, gain information dominance, shape the battlespace, conduct decisive operations and sustain the force.

The resulting product of this introspection was the Army's roadmap for future digital transformation. The Army began its process of transformation with a detailed

[3] US Department of the Army. Training Circular 25-20 A Leader's Guide to the After Action Review. September 1993, p. 1.

three-pronged vision and process called Force XXI. This plan detailed the method by which it would convert from a Cold War army into a force projection army. The three prongs consisted of 1) redesigning the operational Army, 2) redesigning the institutional Army and 3) integrating information age technologies into the force.[4] Of particular interest to the Army leadership was how to leverage current and future technologies to solve the information problem. Over the next several years multiple studies and experiments were conducted to demonstrate the potential that insertions of information technology could have on the nature of warfare. Each BFA pursued the development of a system that would solve their individual problems.

B. THE EVOLUTION OF FORCE XXI

Much preparatory work by the Training and Doctrine Command (TRADOC) Battle Laboratories preceded the Army's formal launching of Force XXI. Between September 1992 and April 1994, TRADOC conducted a sequence of experiments and simulations to examine the emerging digitization concept. In the first of these experiments held in the fall of 1992, planners conducted live simulations with an M1A2 tank platoon from the 1st Cavalry Division in a field experiment at the National Training Center (NTC) Fort Irwin, California.[5] The M1A2 tanks contained a crude, by modern standards, developmental system called the Inter-vehicular Information System (IVIS)[6]. IVIS provided the capability for tank crews to "see" each other on an automated map overlay and share information. Constructive and virtual simulations followed at the Army's National Simulation Center at Fort Leavenworth in December 1992. A March 1993 experiment posed live simulations with a mini-combined arms team, followed in July that year by live simulations with a company-team at the NTC.[7]

1. Advanced Warfighting Experiment I

These preliminary field experiments led to the first of the TRADOC led Advanced Warfighting Experiments (AWE) in April 1994. Labeled Desert Hammer VI,

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4 https://atiam.train.army.mil/soldierPortal/atia/adlsc/view/public/6272-1/pam/525-5/toc.htm (November 15, 2005).

5 http://www.globalsecurity.org/military/agency/army/force-xxi.htm (November 15, 2005).

6 http://www.globalsecurity.org/military/agency/army/force-xxi.htm (November 15, 2005).

7 Ibid.

the experiment took place during a normally scheduled unit rotation at the NTC. The purpose of this initial AWE was to examine the impacts of a battalion task force equipped with digital communications across each Battlefield Operating System (BOS). In simulated and instrumented battle against the NTC's opposing force (OPFOR), a battalion task force from the 24th Infantry Division (Mechanized) was equipped with rudimentary digitized displays of position locations and communications that allowed forces to receive near-real-time information during the battle. The Advanced Concept Technology Demonstration (ACTD) hardware elements were leveraged from Commercial off the Shelf (COTS) solutions and the software applications at this stage contained very limited functionality. Although imperfect in this first trial, Desert Hammer in effect proved the principle of platform and Tactical Operation Center (TOC) digitization.[8]

Based on the initial successes of AWE I the US Army decided to initiate the FBCB2 program in May of 1994. The Office of the Secretary of Defense designated Force XXI Battle Command Brigade and Below (FBCB2) as an ACAT III program in October of 1994.[9] By the end of 1994, Army planners had outlined a series of AWEs to lead up to AWEs in 1997 to examine a digitized brigade labeled Task Force XXI, followed by a digitized division labeled Division XXI.

2. Task Force XXI

One of the lessons learned from the AWE I was that the experimental force failed to have ample time to train and that too much new equipment had been fielded for soldiers to become proficient. Army leadership recognized that the process of implementing digitization in the Army would require the commitment of a dedicated experimental force (EXFOR). As identified in AWE I, the experimental force required constant exposure to digitization in order to become proficient. In December 1994, the Army designated the 2d Armored Division, which was subsequently redesignated as the 1st Brigade 4th Infantry Division (Mechanized) in January 1996, as the EXFOR.[10] This organization would be the world’s first digitized brigade. This analog organization would

8 http://www.globalsecurity.org/military/agency/army/force-xxi.htm (November 15, 2005).

9 US Army Office of the Program Manager, FBCB2. “Firepower 2000 Artillery Symposium” (2000).

10 http://www.globalsecurity.org/military/agency/army/force-xxi.htm (November 15, 2005).

convert to a digital organization through a deliberate fielding process. This process would include insertion of multiple digital systems across each Battlefield Functional Area (BFA) in order to support their individual missions. Through a series of information age technology insertions, intensive exercises and culminating Advanced Warfighting Experiments the Army planned to experiment, refine concepts and validate new technologies that would transform the warfighting capability of the Army.[11]

3. Army Battle Command System

Occurring simultaneously with the conduct of these early experiments was the development of the Army Master Digitization Plan (AMDP). One element of the AMDP was the establishment of the Army Battle Command System (ABCS). ABCS is a system of systems that provides the overarching architecture for the digital network. The goal of ABCS is the effective horizontal and vertical integration of the individually developed BFA systems. In some cases the names of these individual systems have evolved over time. The current name for each ABCS system is provided. ABCS is composed of the following systems;

a. Global Command and Control System-Army (GCSS-A)

The Army component of the Joint Global Command and Control System (GCCS). GCCS-A is the Army's strategic, tactical and theater command and control system. GCCS-A provides a common picture of Army tactical operations to the Joint and Coalition community, while facilitating interoperability of systems with the Army Command.

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

Provides an integrated command and control system that extends horizontally across all Battlefield Functional Areas (BFAs) and vertically from individual squad/platform to brigade/regimental headquarters. It also provides a seamless, holistic battle command capability to leaders of all combat, combat support, and combat service support units performing missions across the operational continuum at the tactical level of war.

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[11] Hanna, Mark. *Task Force XXI: The Army's Digital Experiment.* Strategic Forum #119. Institute for National Strategic Studies National Defense University. July 1997, p. 1.

c. Advanced Field Artillery Tactical Data System (AFATDS)

Provides a digital fire support planning and execution tool.

d. Air and Missile Defense Workstation (AMDWS)

Provides situational awareness of air defense artillery battlespace.

e. All Source Analysis System (ASAS)

ASAS is the ABCS intelligence fusion system that provides a timely, accurate, and relevant picture of the enemy situation to warfighters. It provides combat leaders all source intelligence to support visualization of the battlefield and so support more effective conduct of the land battle.

f. Battle Command Sustainment Support System (BCS3)

Provides the Logistics Common Operating Picture (LCOP) to commanders in a map-centric display.

g. Combat Terrain Information System (CTIS)

Through the use of the Digital Terrain Support System (DTSS) units are provided with automated terrain analysis, terrain database management, and graphics reproduction in support of intelligence preparation of the battlefield, command and control terrain visualization, and weapons and sensor systems.

h. Tactical Airspace Integration System (TAIS)

The TAIS provides automated support for Army Airspace Command and Control (A2C2) and Air Traffic Services (ATS) operations. TAIS provides automated and digitized A2C2 planning, coordination, and execution of the third dimension of Army battlespace.

i. Maneuver Control System (MCS)

The MCS provides commanders and staffs the ability to collect, coordinate, and act on near-time battlefield information and graphically visualize the battlefield. The MCS integrates information horizontally and vertically to provide the common picture of friendly and enemy unit locations. As the primary automated tool for commanders and staffs from corps to battalion level, it is relied on to provide the Common Operational Picture, decision aids, and facilities for development and dissemination of plans and orders.

j. Integrated Meteorological System (IMETS)

Provides commanders at all echelons with an automated tactical weather system that receives, processes, and disseminates weather observation forecasts, battlefield visualization, and weather effects decision aids to all BFAs.

k. Integrated System Control (ISYSCON)

Provides network initialization. Provides critical network configuration to enable Unit Task Reorganizations. Provides situational awareness of communications networks. ISYSCON provides ABCS to FBCB2 linkage.

l. ABCS Information Server (AIS)

Provides infrastructure services used by the other BFAs including: alerts, messaging, communications, and address book. Provides an integrated AIS server which acts as an information hub, providing critical data to the BFAs.[12]

The benefit of the successful development of ABCS, as envisioned, would be an integrated digital capability across all Battlefield Functional Areas. This capability would provide both horizontal and vertical interoperability between the various command and control system components. This would provide the ability to exchange common information pertaining to the battlespace in reduced time. Figure 3 represents a graphical depiction of the ABCS Network. ABCS systems are depicted on the outer ring adjacent to the information these same systems provide. The inner portion of the circle represents the communication paths these systems use to exchange information. Situational dominance is attained through the effective collection and distribution of battlefield information across the force.

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[12] GlobalSecurity.Org. Army Battle Command System. Available from http://www.globalsecurity.org/military/systems/ground/abcs.htm (November 15, 2005).

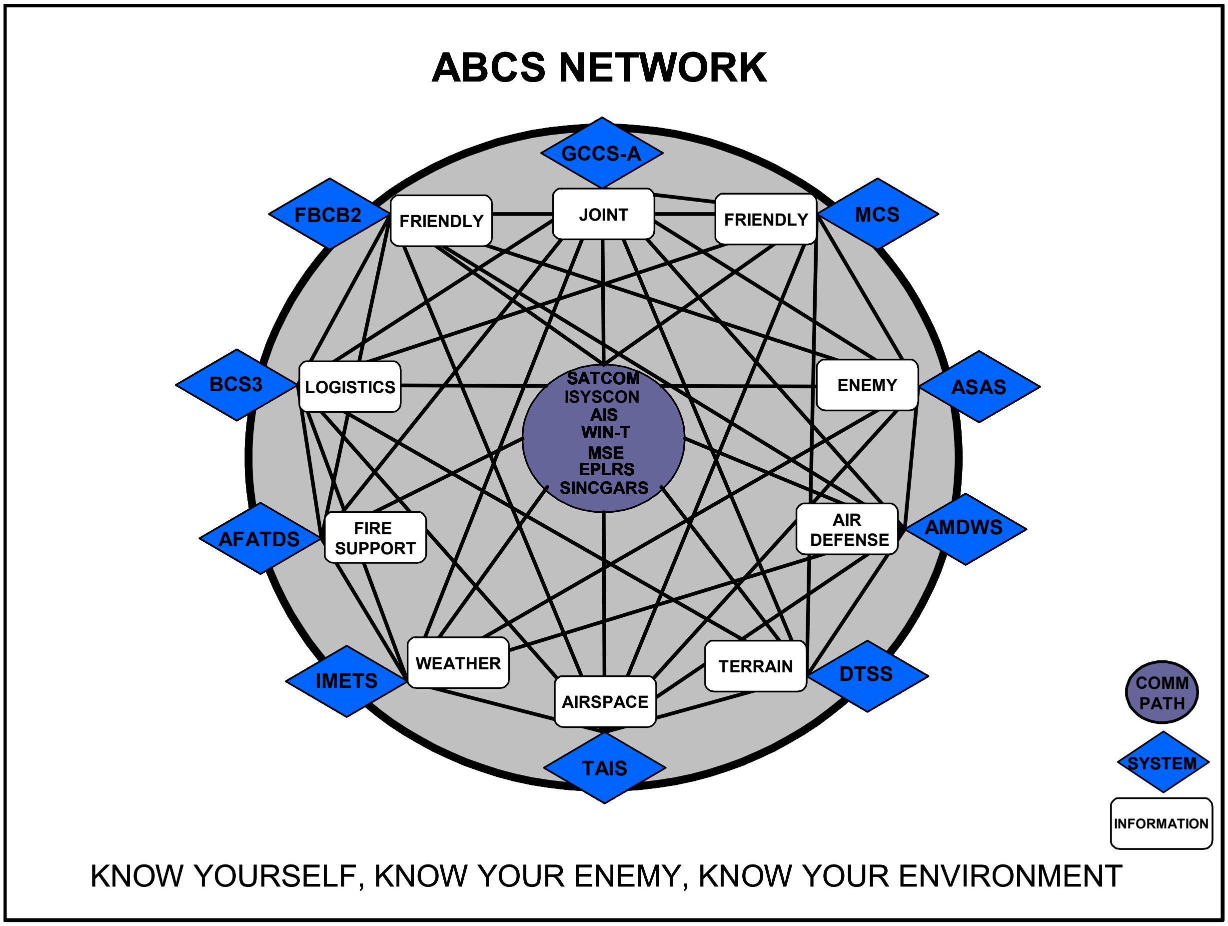

Figure 3. The Army Battle Command System Network (After: http://peoc3t.monmouth.army.mil/Mission.html (November 3, 2005))

4. Advanced Warfighting Experiment II

One objective of Task Force XXI was to explore whether a smaller digitized force with properly integrated doctrine and technologies could attain increases in lethality, operational tempo and survivability. Task Force XXI was the first effort to integrate tactical radios with commercially based routers, thus providing a networking capability at lower echelons to rapidly share common situational awareness.[13] AWE II, conducted in 1997, focused on establishing the terrestrial based hardware infrastructure while

13 Alberts, David S., Garstka, John J., Hayes, Richard E., Signori, David A., *Understanding Information Age Warfare.* Command and Control Research Program Publication Series, August 2001, p. 257.

individual software solutions continued to be developed. TF XXI FBCB2 enabled platforms were equipped with Version 1 COTS, Version 2 Ruggedized COTS, and Version 3 Military Specification (MILSPEC) hardware systems and were only able to interface with other similarly equipped systems.[14] On these systems the initial version of FBCB2 software was hosted. FBCB2 provided the ability to share friendly situational awareness down to the individual vehicle level, improve command and control, and for the first time, demonstrate that time-sensitive information could be shared horizontally rather than having to follow the traditional chain of command path.[15]

The EXFOR for the Task Force XXI AWE II consisted of an armored battalion, a mechanized infantry battalion, a light infantry battalion, and various support units. The EXFOR contained 873 ABCS digitized and networked platforms.[16] The maneuver battalions consisted of M1A1 tanks and M2A2 Bradley Fighting Vehicles equipped with various appliques. The EXFOR's light infantry battalion contained 186 individual dismounted soldier systems. A battalion of M109A6 Paladins provided field artillery support and was enabled with AFATDS, and the Aviation Task Force consisted of eight AH-64A Apaches, two AH-64D Apache Longbows, and eight OH-58 Kiowa Warriors.[17]

The EXFOR prepared for the AWE at Fort Hood by conducting platoon, company, and battalion collective training, as well as a culminating brigade exercise that took place in December of 1996.[18] During this training, a significant amount of time was dedicated to the mastery of the hardware and software that digitized and networked the platforms. An undesirable consequence of this focus on new hardware and software was a decrease in the time available for basic combined arms collective training.[19]

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[14] US Army Office of the Program Manager, FBCB2. "Firepower 2000 Artillery Symposium" (2000).

[15] Ibid.

[16] Alberts, David S., Garstka, John J., Hayes, Richard E., Signori, David A., *Understanding Information Age Warfare.* Command and Control Research Program Publication Series, August 2001, p. 257.

[17] Alberts, David S., Garstka, John J., Hayes, Richard E., Signori, David A., *Understanding Information Age Warfare.* Command and Control Research Program Publication Series, August 2001, pp. 257-258.

[18] Ibid.

[19] Ibid.

As part of the system of systems approach to ABCS, Task Force XXI demonstrated the power of networking multiple sensors and rapidly turning sensor data into useful information.[20] The division Analytical Control Element (ACE) received battlefield information from maneuver unit spot reports and various Army and Joint sensor platforms. Analysts used the All-Source Analysis System (ASAS) to correlate this information into a coherent, timely enemy picture.[21] This enemy picture was used to update the Common Operational Picture (COP) not only at the TOC but also down to the individual vehicle level. For the first time, soldiers at the platform level equipped with FBCB2 could see what was happening around them.

During the AWE, the EXFOR conducted a total of eight missions against the opposing OPFOR. Of the eight missions executed, three were similar to missions conducted by non-digitized forces during a normal training rotation. The five remaining missions were developed to validate digital warfighting concepts. During these five unique missions the EXFOR was dispersed over a larger than normal area of operations.

The performance of the EXFOR's network during the AWE was limited by hardware and software problems.[22] These limitations were due in part to the use of COTS technology that was not rugged enough to withstand the rigors of a simulated combat environment as well as a slowly evolving software application operating over an even less robust network infrastructure. Specifically, the message completion rate for digital message traffic was under 30 percent.[23] The results from the individual battles, if stated in terms of victory or defeat, were similar to the observed results in most analog unit rotations at the NTC. However, one of the key observations made by the EXFOR was the value of increased Blue situational awareness that resulted from the use of the tactical

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[20] Alberts, David S., Garstka, John J., Hayes, Richard E., Signori, David A., *Understanding Information Age Warfare.* Command and Control Research Program Publication Series, August 2001, pp. 257-258.

[21] Ibid.

[22] Alberts, David S., Garstka, John J., Hayes, Richard E., Signori, David A., *Understanding Information Age Warfare.* Command and Control Research Program Publication Series, August 2001, p. 257.

[23] Ibid.

internet (TI).[24] Approximately 75 percent of platoons were visible at the battalion command post.[25] Although the results of the test did not meet desired expectations, enough information was collected to support the continued development of a more robust communications infrastructure that could support larger scale operations and materialize into what the army had envisioned. This increased positional location capability facilitated by FBCB2 was used by combat support units to find the vehicles they needed to rearm and refuel, as well as mark and avoid minefields and chemical strike areas.[26] In addition, shared positional information helped artillery units see with some certainty the location of the friendly forces, which assisted them with clearance of fires.[27]

FBCB2 continued to demonstrate progress in the evolution of both hardware and software solutions. The results of the AWE and other analysis provided enough positive evidence for the Army to conduct a Milestone I/II review. The Milestone II decision was approved given the conditions that the Operational Requirements Document and Test and Evaluation Master Plan were completed quickly. Program Executive Office Command and Control Communication Systems (PEO C3S) designated FBCB2 an ACAT II program in November 1997.[28]

Between the years 1998 and 2000 several additional test events occurred which coincided with the release of new and improved hardware solutions as well as newer versions of FBCB2 software. Limited User Test 1 (LUT) was held in August of 1998. An improved combination COTS and Ruggedized hardware system was provided which hosted FBCB2 software Version 2.1. In 1999, FBCB2 software version 3.2 was released. Software version 3.2 provided initial security functionality, improvements in speed and

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24 Alberts, David S., Garstka, John J., Hayes, Richard E., Signori, David A., *Understanding Information Age Warfare.* Command and Control Research Program Publication Series, August 2001, p. 257.

25 Ibid.

26 Ibid.

27 Alberts, David S., Garstka, John J., Hayes, Richard E., Signori, David A., *Understanding Information Age Warfare.* Command and Control Research Program Publication Series, August 2001, p. 258.

28 US General Accounting Office. Battlefield Automation. Acquisition Issues Facing the Army Battle Command, Brigade and Below Program GAO/NSID-98-140. June 1998, p. 6.

reliability to C2 messaging, enhancements to mapping and overlay products, enemy picture management, line of sight tool, range fan tool, improved navigation functionality as well as Unit Task Organization capability.[29]

During 2000, a Force Development Test and Evaluation as well as Limited User Test 2 were conducted. Limited improvements in hardware were now available as well as additional improvements to the previously released FBCB2 software Version 3.2 These improvements included improved security functionality, MCS, ASAS, and AFATDS interfaces, the introduction of a Mission Data Loader (MDL) which served as a portable media device to transfer larger size files from platform to platform, an on screen keyboard, reduced start up and shut down time, and a message distribution mechanisms.[30]

5. Division Advanced Warfighting Experiment

The U.S. Army conducted a Division AWE at Fort Hood, Texas in 1997, with the objective of determining the warfighting effectiveness of a digitized division-sized force. This Division AWE was held over a nine day period with elements of the 4th Infantry Division conducting a Battle Command Training Program (BCTP) Command Post Exercise (CPX). This exercise differed from previous exercises in that it was conducted largely through the use of the Corps Battle Simulation, which is a computer assisted wargame.[31] The focus of the exercise was the command and control of digitized forces. All units smaller than brigade command posts were simulated.[32] The division and brigade command posts were deployed in the garrison area of Fort Hood and connected via radio and landline links.[33] Although this AWE only simulated the desired architecture, it still provided enormous feedback on where improvements to the architecture as well as individual system interfaces were needed.

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29 US Army Office of the Program Manager, FBCB2. “Firepower 2000 Artillery Symposium” (2000).

30 US Army Office of the Program Manager, FBCB2. “Firepower 2000 Artillery Symposium” (2000).

31 Alberts, David S., Garstka, John J., Hayes, Richard E., Signori, David A., *Understanding Information Age Warfare.* Command and Control Research Program Publication Series, August 2001, p. 259.

32 Ibid.

33 Ibid.

The Division AWE Wide Area Network (WAN) architecture employed at Fort Hood was up to 48 times faster than the WAN developed for Task Force XXI.[34] Additionally, the Local Area Networks (LAN) inside each Division AWE command post had improved over those used in Task Force XXI. This augmented network supported additional applications such as video teleconferencing and higher volume, faster data transfers.[35] The network also supported previously used network applications, such as exchanging formatted messages, client-server operations, and web-based operations.[36]

As in Task Force XXI, the application of ABCS systems enabled commanders and their staffs to understand the battlespace with higher levels of clarity and act on that information with increased speed. Improvements within software applications and in the effectiveness of the network contributed to the EXFOR achieving and sustaining situational awareness and information dominance over the OPFOR.[37] As a result, the EXFOR was capable of conducting distributed, non-contiguous operations over an extended battlefield. As the enemy attempted to maneuver, the EXFOR was able to locate and track the enemy's most critical forces and bring massed, destructive fires on them.[38] The subsequent close fight allowed cohesive, mobile EXFOR brigade combat teams (BCTs) to engage and defeat the disrupted and attrited OPFOR units.[39]

Despite numerous problems along the lines of those discussed previously such as software interoperability problems, and the need for adequate training on new command and control systems, the following improvements relative to the results of previous warfighters command post exercises were observed:

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[34] Alberts, David S., Garstka, John J., Hayes, Richard E., Signori, David A., *Understanding Information Age Warfare.* Command and Control Research Program Publication Series, August 2001, p. 259.

[35] Alberts, David S., Garstka, John J., Hayes, Richard E., Signori, David A., *Understanding Information Age Warfare.* Command and Control Research Program Publication Series, August 2001, p. 258.

[36] Ibid.

[37] Ibid.

[38] Ibid.

[39] Alberts, David S., Garstka, John J., Hayes, Richard E., Signori, David A., *Understanding Information Age Warfare.* Command and Control Research Program Publication Series, August 2001, p. 259.

- Operational tempo: division-level plan development time was reduced from 72 hours to 12 hours, making a six-fold increase in Operational Tempo (OPTEMPO) possible.
- Speed of calls for fire: time required for processing calls for fire was reduced from 3 minutes to 0.5 minutes, again a six-fold increase in the potential for bringing fire assets to bear, with increased potential lethality as well as potential for saving friendly lives and improving the pace of battle or friendly OPTEMPO.
- Planning time for deliberate attacks at the company level was cut in half, from 40 to 20 minutes. Substantial improvements in OPTEMPO and the ability to operate within the adversary's Observation Orientation Decision Action (OODA) loop were therefore demonstrated.[40]

The Division AWE validated the ABCS concept and strengthened the argument for significant resourcing in order to field this system of systems concept. In light of the emerging importance of FBCB2 to not only the Army but to the Department of Defense' military strategy, as well as the significant program cost increase, FBCB2 was designated an ACAT ID program in November 1999.[41] In 1999 a Low Rate Initial Production (LRIP) Decision was obtained in order to produce a total of approximately 9000 improved ruggedized hardware systems manufactured by two separate hardware manufacturers.[42] The production of the total quantities would be phased over a number of years. The two companies selected were Litton Corporation and Paravant Incorporated.[43] The initial purpose of this LRIP was to produce FBCB2 hardware in support of the upcoming DCX as well as the ABCS system of systems IOT&E scheduled for 2001. The second purpose of the LRIP was to validate the production capabilities of both Litton and Paravant in advance of selecting a sole source hardware provider.

Based on lessons learned and user feedback from previous exercises, FBCB2 software version 3.3 was developed. This version of software would be available for the Division Capstone Exercise (DCX). FBCB2 version 3.3 would provide full system

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40 Alberts, David S., Garstka, John J., Hayes, Richard E., Signori, David A., *Understanding Information Age Warfare.* Command and Control Research Program Publication Series, August 2001, p. 259.

41 US Army Office of the Program Manager, FBCB2. "Firepower 2000 Artillery Symposium" (2000).

42 Ibid.

43 Ibid.

security, improved message reliability, interfaces with CSSCS as well as AMDWS, embedded training capability, improved network management, Laser Range Finder integration, as well as call for fire messages.[44]

6. Division Capstone Exercise

The Division Capstone Exercise (DCX) was conducted in April 2001, at Fort Irwin, California. The purpose of DCX I was to demonstrate and assess the 4th Infantry Division's mechanized and aviation brigades' ability to contribute decisively to an III Corps' land campaign counteroffensive.[45] One of the principle goals of the DCX was the demonstration and assessment of ongoing ABCS digitization and equipment modernization programs. FBCB2 hardware and software had continued to develop and for this exercise two hardware solutions had been fielded. The two versions were produced by Litton and Paravant, respectively. These hardware solutions operated FBCB2 software version 3.3. The DCX Blue Force (BLUEFOR) was composed of approximately 7,500 soldiers in two Brigade Combat Teams (BCTs) consisting of elements of the 2nd and 4th Brigades of the 4th Infantry Division.[46] The DCX OPFOR consisted of NTC OPFOR elements fighting with their traditional home field advantage.[47]

The 2nd BCT comprised a heavy force of three battalions containing three companies each equipped with state-of-the-art M1A2 System Enhancement Program (SEP) Abrams tanks and M2A3 Bradley Fighting Vehicles.[48] One of the battalions was composed of three tank companies; another, two tank companies and one infantry fighting vehicle company; and the third, one tank company and two infantry fighting

[44] US Army Office of the Program Manager, FBCB2. "Firepower 2000 Artillery Symposium" (2000).

[45] Alberts, David S., Garstka, John J., Hayes, Richard E., Signori, David A., *Understanding Information Age Warfare.* Command and Control Research Program Publication Series, August 2001, p. 265.

[46] Alberts, David S., Garstka, John J., Hayes, Richard E., Signori, David A., *Understanding Information Age Warfare.* Command and Control Research Program Publication Series, August 2001, p. 265.

[47] Ibid.

[48] Ibid.

vehicle companies.[49] Supporting the operations of the 2nd BCT were an M109A6 Paladin field artillery battalion, an engineer battalion, and a forward support battalion. The 4th BCT consisted of a battalion minus of AH-64D Longbow Apache attack helicopters, a battalion minus of UH-60 Blackhawk helicopters, two troops of OH-58D Kiowa Warrior reconnaissance helicopters, and an aviation support battalion.[50] The DCX also evaluated several new brigade organizational structures, including a Brigade Reconnaissance Troop (BRT), three company battalions, forward support battalions, and organic engineer assets.[51]

Leveraging the increases in situational awareness enabled by the networking of the digitized force, the 4th Infantry Division's two BCTs proved to be more agile, had greater precision and were able to be more adaptable to changing situations.[52] In comparison with the Task Force XXI AWE, the BLUEFOR that participated in the DCX appeared to have developed and mastered new Tactics Techniques and Procedures (TTP), which enabled it to leverage the power of the network to significantly increase its warfighting effectiveness.[53]

PM FBCB2 continued to develop and refine software functionality. FBCB2 software version 3.4 would be available for the scheduled 2002 IOT&E. Its specific improvements would include full network management, improvements to night operation capability, as well as improvements to the mapping interface between FBCB2 and MCS as well as ASAS.[54] Figure 5 depicts the evolution of FBCB2 Hardware solutions that supported each of the field experiments and exercises. Figure 6 depicts the current

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[49] Alberts, David S., Garstka, John J., Hayes, Richard E., Signori, David A., *Understanding Information Age Warfare.* Command and Control Research Program Publication Series, August 2001, p. 265.

[50] Alberts, David S., Garstka, John J., Hayes, Richard E., Signori, David A., *Understanding Information Age Warfare.* Command and Control Research Program Publication Series, August 2001, p. 265.

[51] Ibid.

[52] Ibid.

[53] Alberts, David S., Garstka, John J., Hayes, Richard E., Signori, David A., *Understanding Information Age Warfare.* Command and Control Research Program Publication Series, August 2001, p. 265.

[54] US Army Office of the Program Manager, FBCB2. "Firepower 2000 Artillery Symposium" (2000).

FBCB2 Applique Hardware components that comprise the FBCB2 system in a terrestrially equipped organization. Figure 7 depicts the architecture of a terrestrially equipped FBCB2 organization. Figure 8 depicts the Graphic User Interface (GUI) as viewed by an FBCB2 operator. This GUI has been relatively consistent from this point to the currently fielded software version.

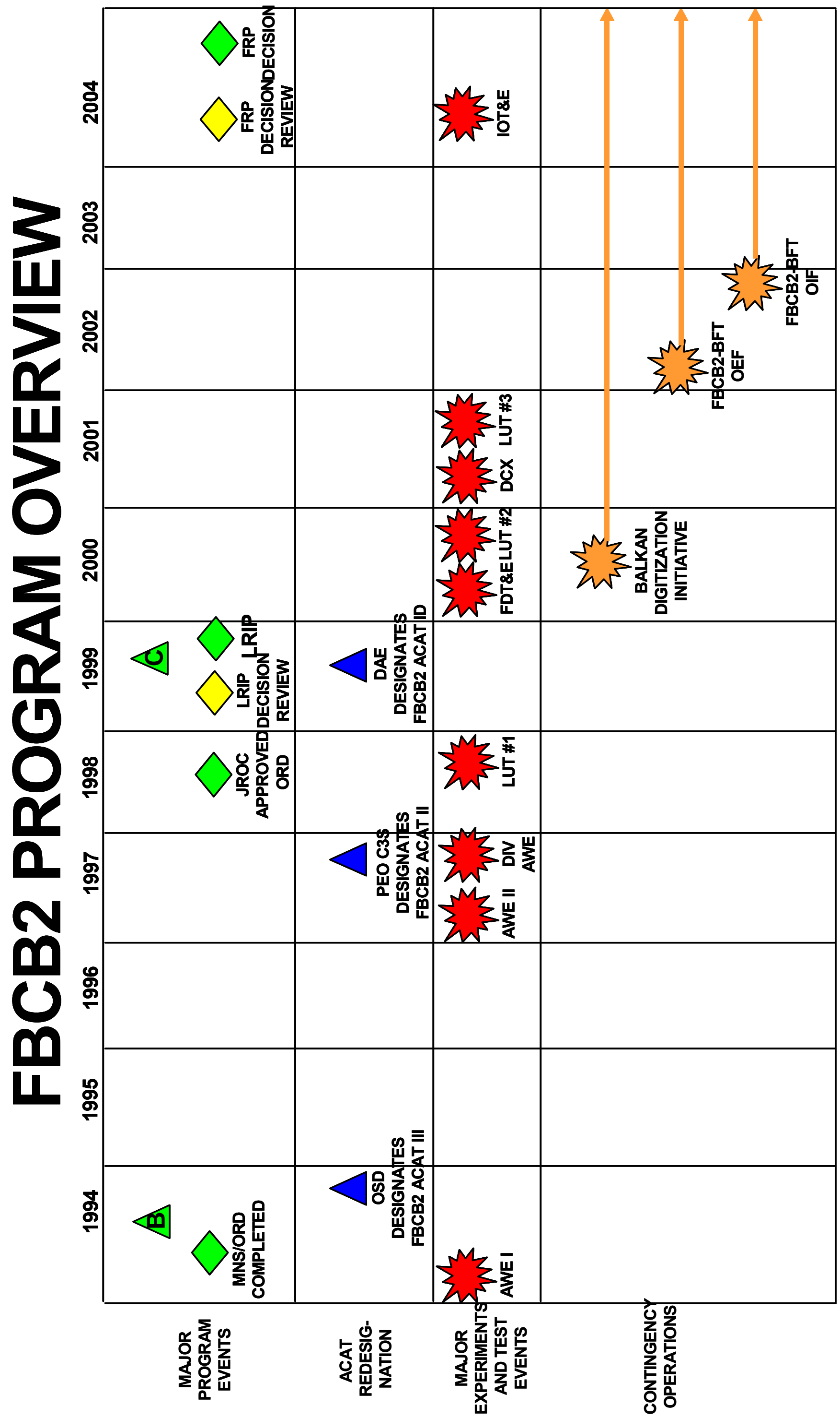

Figure 4. FBCB2 Program Overview.

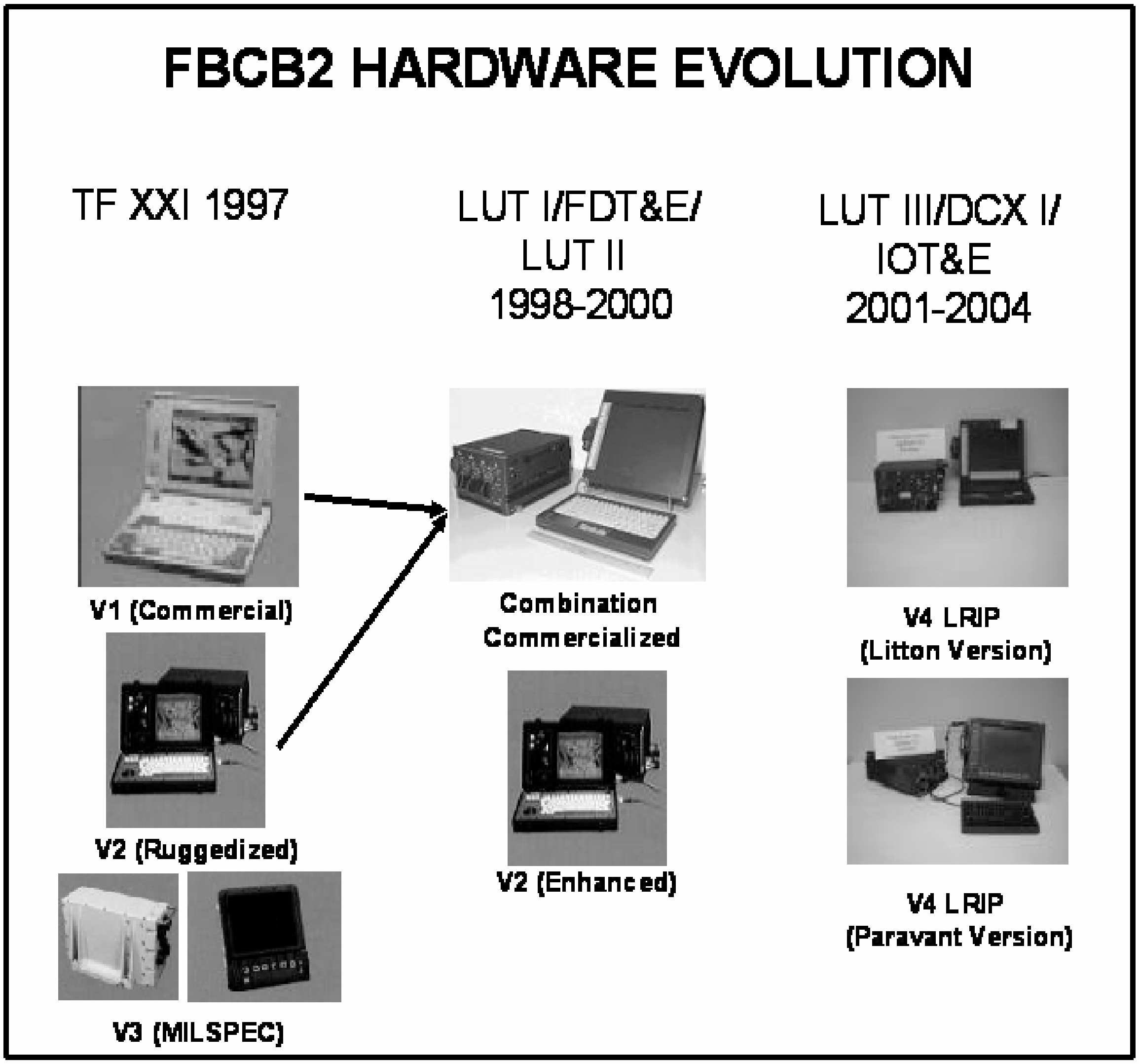

Figure 5. Evolution of FBCB2 Hardware (After: Artillery Symposium Briefing (2003))

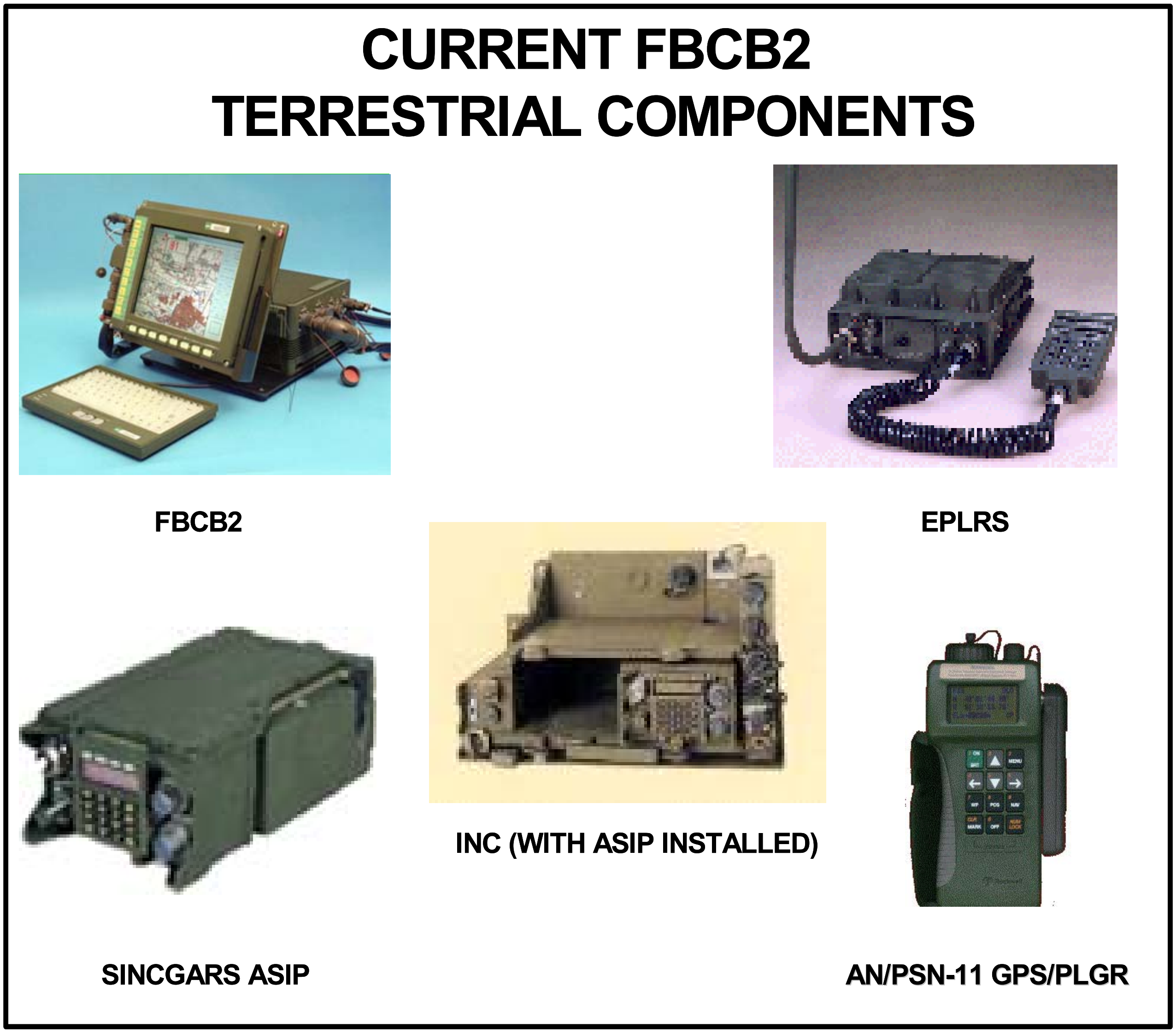

Figure 6. Terrestrial Based FBCB2 Components
(From: FBCB2 Image from **www.people.com.cn/ GB/junshi/1079/2156634.html** (November 3, 2005)
EPLRS Image from **www.terec.gatech.edu/ rocs.html** (November 3, 2005),
SINCGARS Image from **www.acd.itt.com/ sincgars.htm** (November 3, 2005),
PLGR Image from **www.usni.org/ resources/GPS/gps.htm** (November 3, 2005),
INC Image from FBCB2 Training Support Package (November 3, 2005))

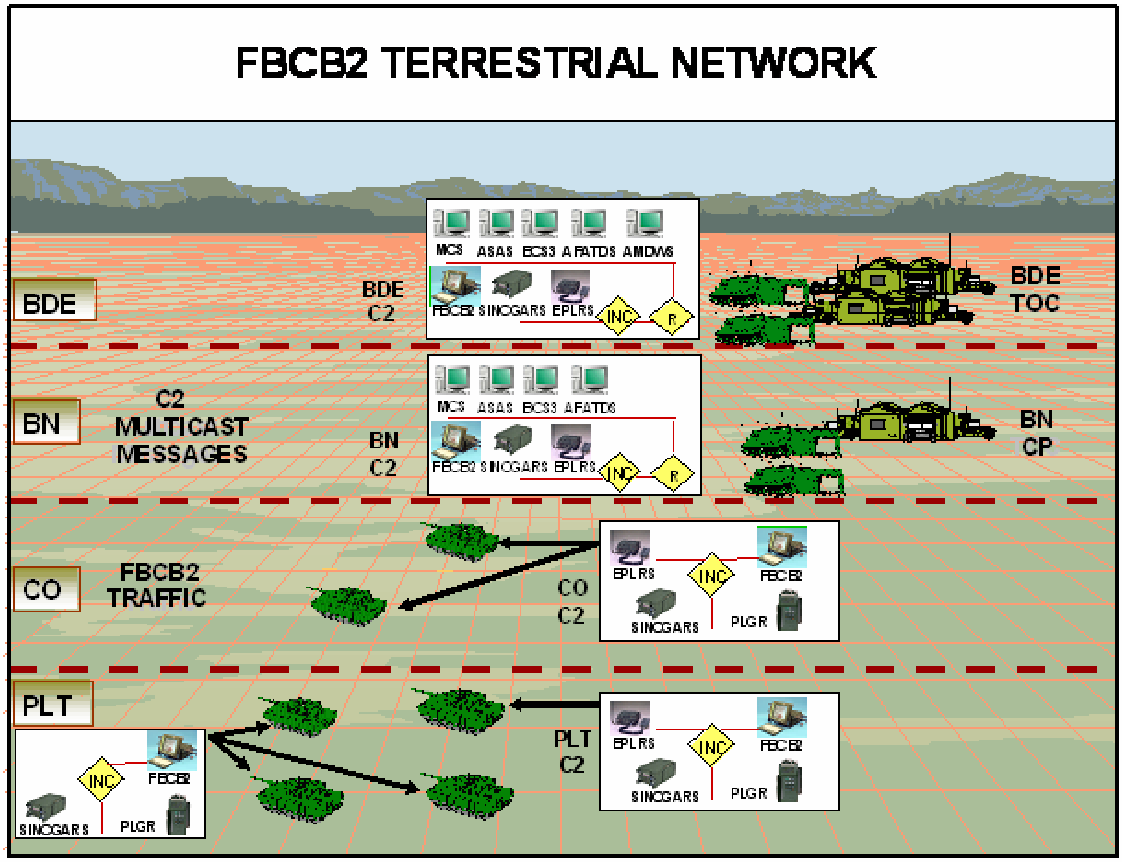

Figure 7. FBCB2 EPLRS Based Architecture (After: FBCB2 Training Support Material (2005))

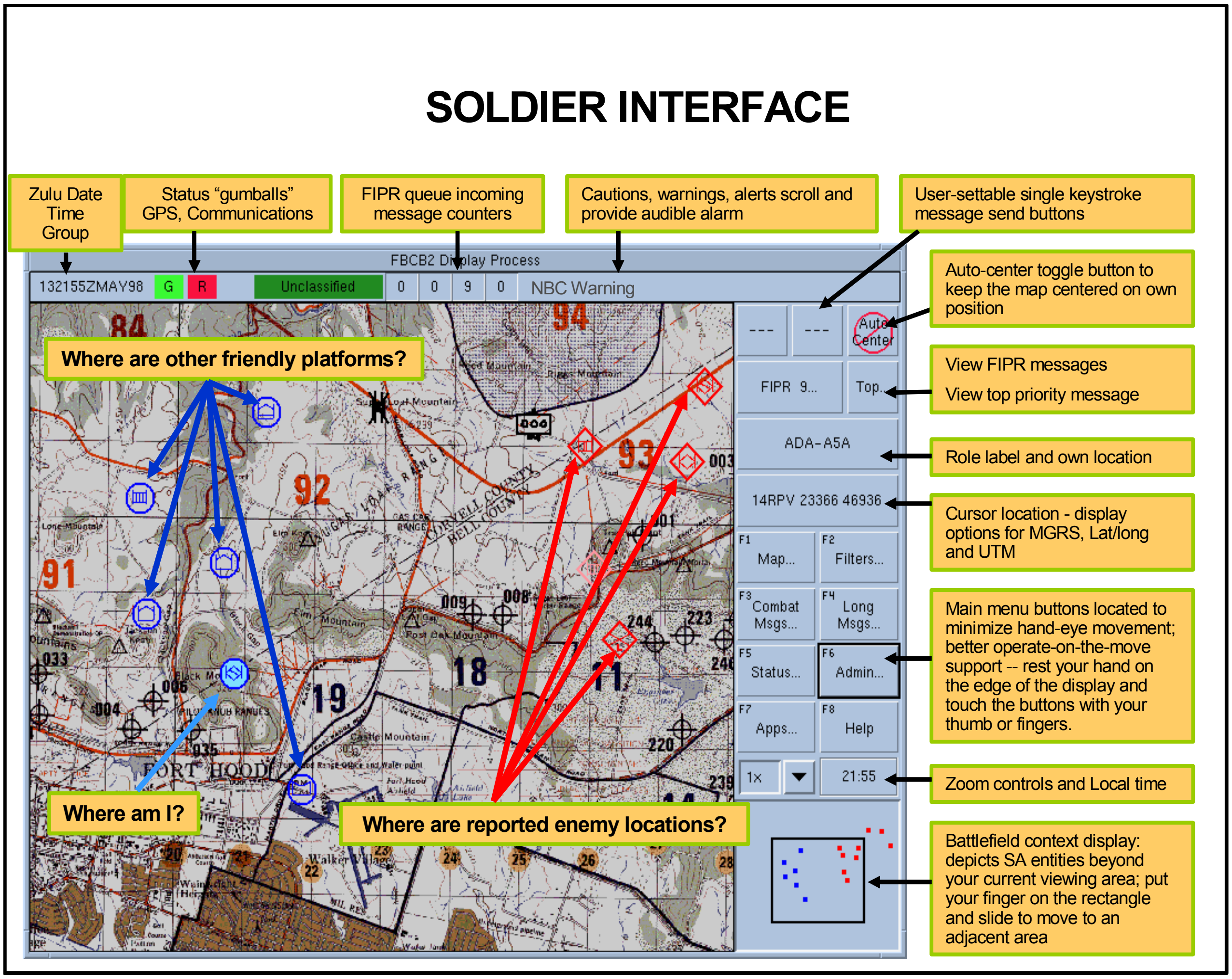

Figure 8. FBCB2 Soldier Interface (After: TSM XXI Army Knowledge Symposium Briefing (2003))

C. THE BALKAN DIGITIZATION INITIATIVE

Events occurring simultaneously with the development of FBCB2, although unknown at the time, would have a major impact on the future of digital command and control. The Balkan Digitization Initiative (BDI) is the Program Executive Office Command, Control, and Communication Systems (PEO C3S) response to a 1998 request from the Commander, United States Army Europe (USAREUR) to enhance the capabilities of the Stabilization Force (SFOR) in the Balkans.[55] The first site surveys were conducted late in 1998 in order to gain an accurate picture of the requirements and the desired endstate.[56] USAREUR provided funding for the initial functionality in July of 1999. The purpose of BDI was twofold; provide situational awareness (SA) to peacekeeping/peace enforcement patrols and to send position location information to the Global Command and Control System (GCCS) for inclusion in the Common Operational Picture (COP) maintained at USAREUR Headquarters.[57]

Due to the extremely restrictive terrain associated with the Balkan region and the unavailability of Enhanced Position Location Reporting Systems (EPLRS), a satellite-based solution was developed to solve the communication problem. QUALCOMM was the contractor selected to implement BDI.[58] The proposed solution was developed based on a similar system used in the commercial trucking industry. BDI can be divided into four distinct but interrelated components; satellite hub, USAREUR Headquarters, tactical headquarters, and vehicular systems.[59]

QUALCOMM installed the satellite hub, known as the Network Management Facility, in Mannheim, Germany in March of 2000.[60] This facility would be capable of

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55 Robinson, B., Troxell, R.K., *The Balkan Digitization Initiative*. Military Communications Conference, 2001. MILCOM 2001. Communications for Network-Centric Operations: Creating the Information Force. IEEE Volume 2, 28-31 October 2001, p. 775.

56 Ibid.

57 Ibid.

58 Ibid.

59 Robinson, B., Troxell, R.K., *The Balkan Digitization Initiative*. Military Communications Conference, 2001. MILCOM 2001. Communications for Network-Centric Operations: Creating the Information Force. IEEE Volume 2, 28-31 October 2001, p. 775.

60 Ibid.

providing coverage for all systems in Bosnia and Kosovo conducting peacekeeping and peace enforcement operations. The system employed a Ku-Band satellite solution in order to pass information. The Network Management Facility was also connected to various command and control centers over the Army's Non-secure Internet Protocol Router Network (NIPRNET) through an encoded Virtual Private Network (VPN).[61]

BDI, at the platform level, incorporates a suite of commercial hardware known as Fieldworks/Kontron, which hosts a limited functionality Force XXI Battle Command Brigade and Below (FBCB2) Version 3.1 software, the AN/PSN-11 Precision Lightweight Global Positioning System Receiver (PLGR) and a Ku-Band satellite transceiver.[62] The resulting product was renamed Enhanced Information System (EIS) and has been installed on approximately 600 vehicle platforms.[63]

Within each battalion task force headquarters, one each located in Bosnia and Kosovo respectively, a Command Center Server (CCS) and an Enhanced Information Server (EIS) were installed.[64] The CCS utilized QUALCOMM provided OmniTRACS QTRACS software and the EIS utilized the current version of FBCB2 software.[65] The CCS facilitates communications between the command centers, the satellite hub, and the individual vehicle platforms. The EIS aggregates the position location reports of individual vehicle platforms and passes this information to the CCS, which broadcasts it to all operational systems. Data brokers are connected to secure networks through the use of trusted guards and provide worldwide dissemination of the information through web browsers. EIS software provides the capability to maintain a vehicle's own position location, maintain the vehicle locations of other EIS equipped vehicles, compose, send

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61 Robinson, B., Troxell, R.K., *The Balkan Digitization Initiative*. Military Communications Conference, 2001. MILCOM 2001. Communications for Network-Centric Operations: Creating the Information Force. IEEE Volume 2, 28-31 October 2001, p. 775.

62 Ibid.

63 Ibid.

64 Ibid.

65 Robinson, B., Troxell, R.K., *The Balkan Digitization Initiative*. Military Communications Conference, 2001. MILCOM 2001. Communications for Network-Centric Operations: Creating the Information Force. IEEE Volume 2, 28-31 October 2001, p. 775.

and receive text messages, and maintain battlefield geometry information through the use of graphic control measures displayed on digital overlays.[66]

Lastly, QUALCOMM installed a Command Center Server at the USAREUR Headquarters, located in Heidelberg, Germany.[67] This system provides position location information to GCCS-A for inclusion in the COP.[68] This information represents the various patrol locations in both Bosnia and Kosovo. On 11 January 2001, BDI successfully transmitted ground force position information to the GCCS Common Relevant Operational Picture.[69] Figure 9 depicts the satellite architecture of the Balkan Digitization Initiative. Figure 10 provides a view of a BDI equipped vehicle. Although the implementation of BDI was successful in its own right, the true impact of the BDI technical solution would not be realized until the start of Operations Enduring and Iraqi Freedom.

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66 Robinson, B., Troxell, R.K., *The Balkan Digitization Initiative*. Military Communications Conference, 2001. MILCOM 2001. Communications for Network-Centric Operations: Creating the Information Force. IEEE Volume 2, 28-31 October 2001, p. 775.

67 Ibid.

68 Ibid.

69 Ibid.

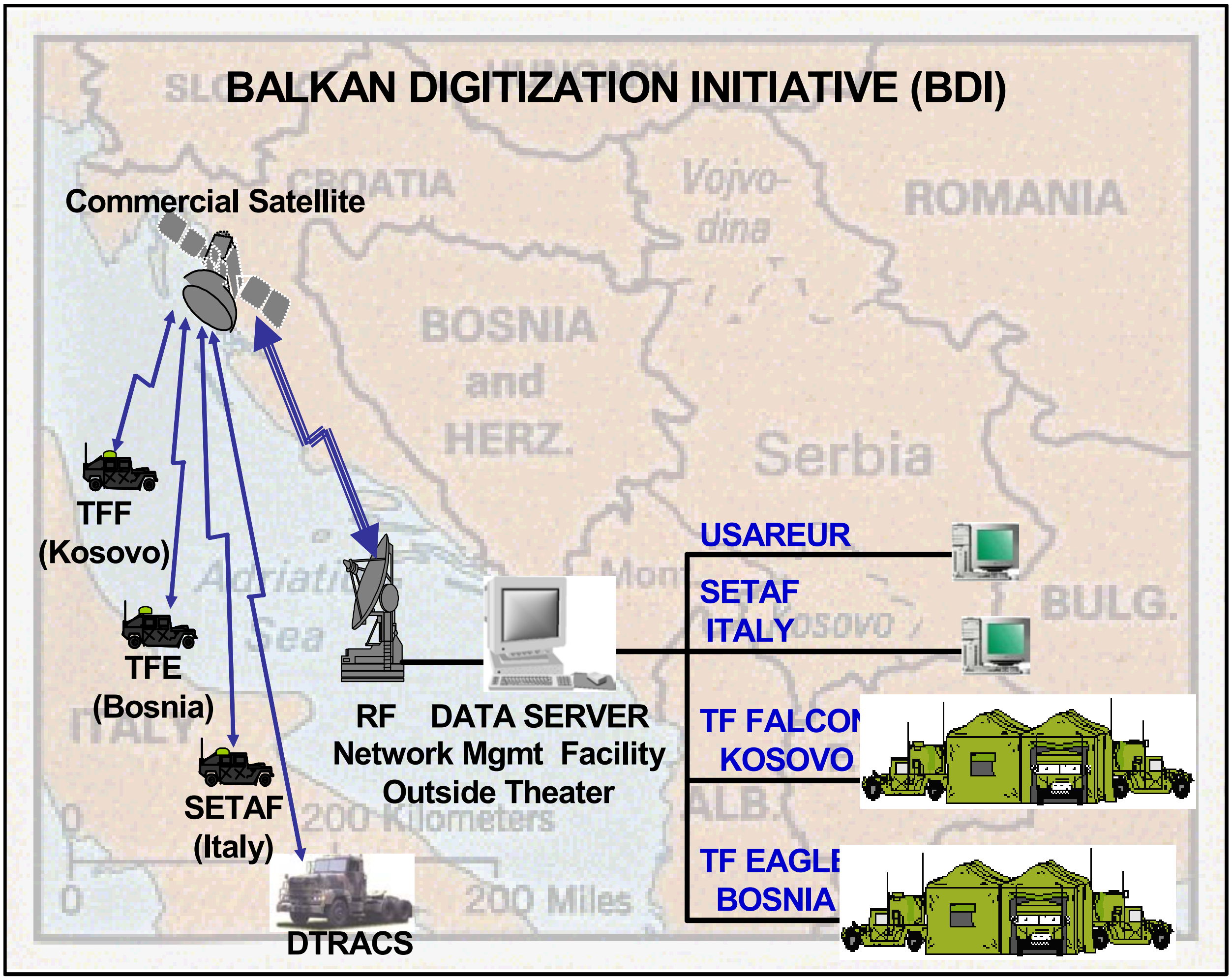

Figure 9. Balkan Digitization Initiative Architecture (After: TSM XXI Army Knowledge Symposium (2003))

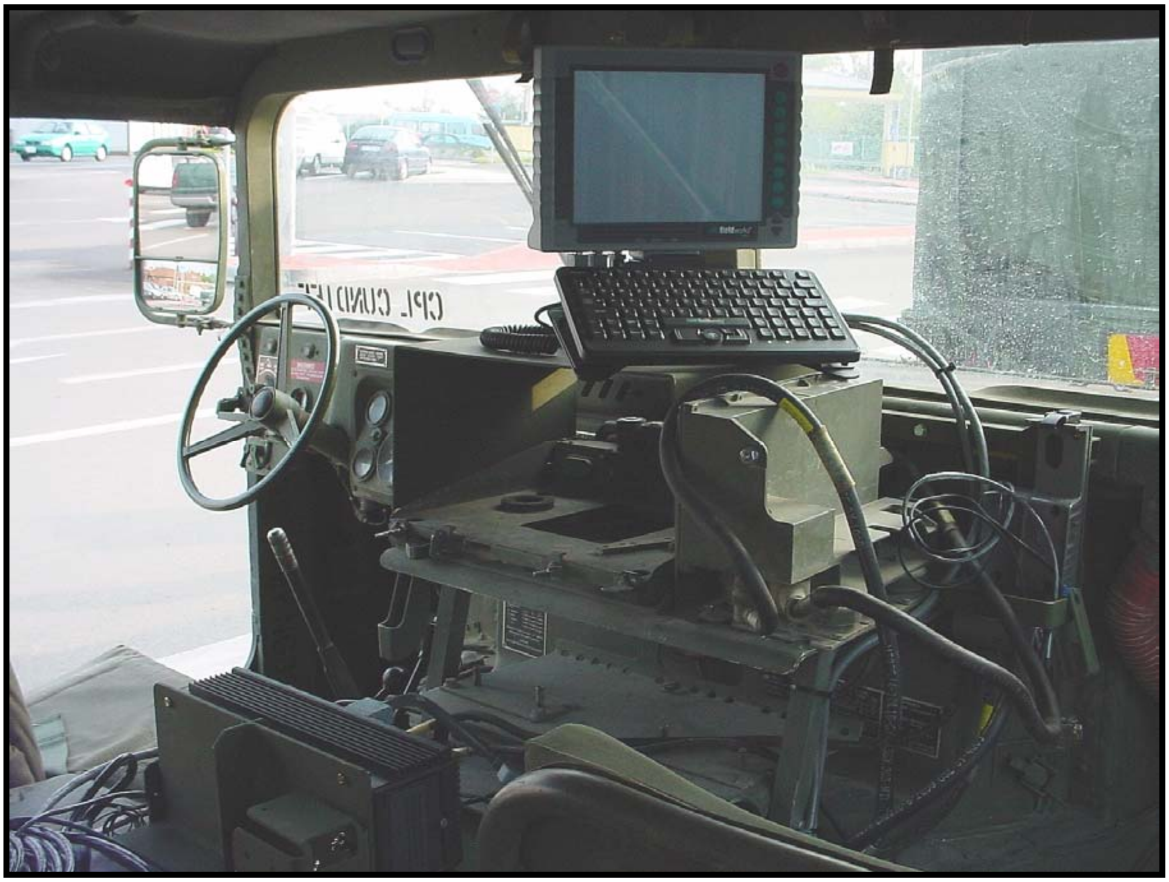

Figure 10. Balkan Digitization Initiative Components (After: TSM XXI Army Knowledge Symposium (2003))

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III. EXPLOITING THE POTENTIAL

In 2001, FBCB2 was a fully functional terrestrial based command and control system and was prepared to take part in the scheduled ABCS system of systems Gateway IOT&E. Although other ABCS systems may have faired well in a system specific IOT&E, interoperability issues associated with the ABCS architecture continued to delay the system of systems test event. The postponement of this system of systems test prevented FBCB2 from gaining the Beyond Low Rate Initial production (BLRIP) report from the Office of the Secretary of Defense (OSD) and securing the congressional authorization in support of a Full Rate Production (FRP) decision. In spite of this test delay, PMO FBCB2 continued to field FBCB2 to the 1st Cavalry Division and 1st Brigade 25th Infantry Division (SBCT) from LRIP quantities. In addition, software improvements continued to be developed and fielded.

In October 2001, the forward elements of CENTCOM and the 3rd US Army deployed to Qatar and Kuwait, respectively and quickly realized that the command and control infrastructure desired to prosecute the GWOT was lacking. As a consequence, of the perceived need for an appropriate C2 solution, CENTCOM requested technical assistance from the Army Staff.

A. FBCB2-BFT

1. Information Management Task Force (IMTF)

The initiative that culminated with the development and fielding of the FBCB2-BFT system actually evolved over time and was one of three technical initiatives to increase command and control in the theater of operations. The broad effort to support CENTCOM began in February 2002, and was threefold, as follows: 1) Correct current communications and network problems within the theater of operations, 2) Design and build a command center for the integration of all fielded ABCS Systems, and 3) Field 200 "tracking systems" within the Afghanistan theater of operations. At this point in time, the Global War on Terrorism was limited to Afghanistan. Operations within the areas of Kuwait and Iraq were based on a strategy of deterrence revolving around the enforcement of the Northern and Southern No Fly Zone and the rotational deployment of a US Army

Brigade Combat Team in exercises in Kuwait that were titled Intrinsic Action. In February of 2002 there was no plan to field a "tracking system" capability to forces deployed in Kuwait. The initial plan for the "tracking system" in Afghanistan was to employ Ku Band Fieldworks/Kontron commercial hardware and the EIS software which had already been proven during the Balkan Digitization Initiative.[70]

a. Phase One

The Assistant Program Manager (APM) for FBCB2, deployed from Ft. Monmouth, New Jersey in the middle of February 2002, with approximately 15 engineers and communications specialists for Kuwait and Afghanistan. Employing the BDI based hardware and software solution, the Information Management Task Force (IMTF) conducted installation and training within the Afghanistan area of operations. The first phase of the operation lasted approximately six weeks and was completed in late March 2002, in time for the start of Operation Anaconda.[71]

b. Phase Two

Simultaneously during phase one, an analysis of the Coalition Forces Land Component Command (CFLCC) Operations Center at Camp Doha, Kuwait was conducted. The observation was made that the CFLCC Headquarters was austere and lacked current information technology systems that would help them operate effectively. The various staff sections were organized in a system of cubicles that provided no synergy of effort. Based on these observations the decision was made to build a new command center. CFLCC took the lead for the physical construction of the command center and PM FBCB2 and his staff developed and executed the plan for the audio/video and integration of ABCS systems, which included procurement, installation and training.[72]

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70 US Army Office of the Program Manager BFT. "Email Message. FBCB2-BFT Data Request." (2005).

71 Ibid.

72 US Army Office of the Program Manager BFT. "Email Message. FBCB2-BFT Data Request." (2005).

Phase Two of the operation began immediately with the design. The IMTF acquired resources from the Army G6 for this effort. The estimated cost for the audio/video effort was between four and five million dollars. The architecture was tested at the Central Test Support Facility (CTSF) located at Ft Hood, Texas in June of 2002 with the integration of the C2 systems. The individual items were flown to Kuwait, and the new CFLCC Command Center was operational by August of 2002. Based on the success of this initial command center, a decision was made in November of 2002, to build an alternate command center at Camp Arifjan, Kuwait. This command center was operational by January 2003.[73]

c. Phase Three

Phase III of the initiative was to provide a "blue force tracking" capability within the Kuwait theater of operations and began concurrently with the first two efforts. The ability to provide this blue force tracking capability was possible because of the following initiatives:

1. In 2000, the Balkan Digitization Initiative effort in both Bosnia and Kosovo was the genesis for BFT. About 600 systems had been used with the commercial Fieldworks/Kontron and Ku Band using a reduced functionality FBCB2 software Version 3.1.[74]

2. The maturity level of FBCB2 software provided an effective Graphic User Interface (GUI), a variety of functional command and control messaging capabilities, a robust mapping capability, graphic control measure development and symbology. Finally, hardware development under the FBCB2 program baseline and procurement under LRIP provided a partial hardware solution to install.[75] The ability to leverage L-Band transceivers from a pre-existing Movement Tracking System contract was the final hardware component required to complete the system.

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73 US Army Office of the Program Manager BFT. "Email Message. FBCB2-BFT Data Request." (2005).

74 Ibid.

75 US Army Office of the Program Manager BFT. "Email Message. FBCB2-BFT Data Request." (2005).

The single best architectural decision that led to the success of BFT was the transition from Ku-Band to L-Band satellite as the choice for communications. L-Band was selected because there were commercial satellite communications available worldwide and it possessed a higher data transfer rate. With Ku-Band, there are areas of the world where the Army could potentially operate that would not have Ku-Band satellite coverage, including much of Southwest Asia. An additional attraction of the L-Band solution was the ability to install it on aviation platforms. One additional factor that led to the overall success of BFT was that the MTS program had a pre-existing contract for 40,000 L-Band transceivers which could be leveraged.[76]

Following the final decision of the FBCB2-BFT architecture, L-Band satellite providers had to be acquired. FBCB2-BFT ultimately leased service from three separate providers: Thuraya located in the United Arab Emirates, Inmarsat located in Norway, and Artemis located in Italy. The decision to lease from three providers was based on the necessity for redundancy as well as coverage. Each satellite system had particular characteristics that had to be accounted for in the software.[77] While the satellite infrastructure and operations centers made communications relatively painless for operators and units, it was also more vulnerable. If one of the nodes were destroyed or became inoperable, the entire communications network would be lost. Two operations centers had to be designed and built in order to provide redundancy and reduce risk.[78] Figure 11 depicts the FBCB2-BFT satellite architecture.

In order to make the entire system perform properly, a number of software interfaces had to be developed, tested and applied. Due to security classification protocols, an interface to GCCS-A through the Data Broker and the Radiant Mercury was required in order to receive a one way feed of friendly position reports. Due to limitations on existing bandwidth, certain messages had to be made inaccessible to users because the messages were potentially too large. An extensive amount of modeling and simulation

[76] US Army Office of the Program Manager BFT.

[77] Ibid.

[78] Ibid.

was conducted beforehand in order to determine the anticipated load on the entire system. Estimates of the number of operational platforms and expected data rates were developed in order to validate the concept.[79]

d. Mission Expansion

As the political situation between the United States and Iraq continued to become more strained throughout 2002, the potential for combat operations increased. In October 2002, the Coalition Forces Land Component Command (CFLCC) C3 (Operations), questioned why the blue force tracking capability was not being provided to all OPLAN units. Virtually overnight the requirement for BFT expanded from 150 to 1200 systems. In order to accomplish this monumental task PM FBCB2, in conjunction with TSM XXI and the CFLCC staff had to identify individual units, develop a basis of issue plan, and determine the best location to conduct installation and training. Teams of installers and trainers had to be hired, trained, and deployed in order to support this effort. Over the next two months, equipment installation and unit training was conducted in seven different countries and over 25 different states. All of the decisions surrounding this situation were driven by a fluid and indeterminate schedule that was developing as well as hardware availability.[80]

The main thrust of the PMO FBCB2's strategy was to capitalize on the current environmental conditions. The primary method by which the PMO FBCB2 sought to capitalize on the environment was to incorporate relatively mature Horizontal Technology Insertions (HTI) into the FBCB2 system and to refine and build a new communications architecture that was similar to the previous BDI initiative. This would allow the FBCB2 software to transform from a terrestrial based system to a Satellite Communications (SATCOM) based system called FBCB2-BFT. Standard FBCB2 hardware and software would be used, but an entirely new satellite transceiver and communications network had to be developed, tested, produced, distributed, and installed. The training plans for units deploying had to be modified based on time

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79 US Army Office of the Program Manager BFT. "Email Message. FBCB2-BFT Data Request." (2005).

80 Ibid.

available. Finally, the installation of systems in combat vehicles and the actual training of soldiers had to occur. All of these events would be in direct competition with other activities that the designated units already had to accomplish within their deployment timelines. Figures 12 and 13 depict the hardware components and various installation solutions of the FBCB2-BFT system.

The 2d Brigade Combat Team (BCT), 3d Infantry Division (ID) was deployed to Kuwait in September and October 2002 for Operation Desert Spring (formerly Intrinsic Action) and was the first unit to receive FBCB2-BFT. What followed was an unprecedented fielding of FBCB2-BFT systems in Army Pre-positioned Stocks (APS) and unit platforms in theater, as well as on unit platforms at home station prior to their deployment. This resulted in simultaneous installation of more than 1,000 systems on three continents, spanning six countries, including 20 states within the United States, and involving more than a dozen Army, Joint, and Coalition formations.

Throughout this process, over 4,000 soldiers were trained. The system was provided to the 3d ID (M); 1st Armored Division; 101st Air Assault Division; 82d Airborne Division; 2d Light Cavalry Regiment; 3d Armored Cavalry Regiment; 173d Airborne Brigade; 3d Brigade, 4th ID (M); 75th Exploitation Task Force; 11th Aviation Brigade; 12th Aviation Brigade; 1st Marine Expeditionary Force (MEF); and the 1st United Kingdom Armoured Division, as well as selected V Corps and Coalition Forces Land Component Command (CFLCC) platforms and command posts. Installation and training sites ranged from the comfort and convenience of unit motor pools and staging areas in the Continental United States and Germany, to the austere conditions of company-level forward operating bases found along Afghanistan’s border with Pakistan.

Additionally, the 4th Infantry Division and 3rd Brigade (SBCT), 2nd Infantry Division were deployed to the OIF theater with the terrestrially based EPLRS FBCB2 version of the system.

To incorporate this new capability into the receiving units, the TRADOC System Manager (TSM) XXI provided briefings to senior commanders and staffs, developed and distributed an FBCB2 user’s Tactics, Techniques, and Procedures (TTP) pocket guide, and provided over-the-shoulder training to units at home station and in theater. These Key Leader Briefings and TTP handbooks contributed to understanding the system's capabilities and limitations. New equipment training consisted of three courses; an abbreviated Operator's New Equipment Training (OPNET) course with eight hours classroom instruction; a Digital Master Trainer's Course (DMTC) with eleven days of classroom instruction; and a Unit-Level Maintainer's Course (ULMC) with three days of classroom training.

2. FBCB2-EPLRS and FBCB2-BFT Differences

Currently, Army units are using two FBCB2 baselines: the original EPLRS radio-based FBCB2 (FBCB2-EPLRS) found in III Corps units (4th Infantry Division and 1st Cavalry Division) and Stryker Brigade Combat Teams (SBCTs), and the recently developed satellite communication (SATCOM)-based FBCB2-BFT. The two baselines are not fielded to the same density. An FBCB2-EPLRS-equipped division had approximately 2,600 systems, whereas an SBCT has approximately 700 systems, practically one on every platform. Therefore, the Blue Force Common Operational Picture (COP) is very complete. In comparison, an FBCB2-BFT-equipped heavy division during Operation Iraqi Freedom was issued approximately 150 systems. The FBCB2-BFT equipped division distribution only provided systems to key leader platforms down to company level, primarily in maneuver units. Additionally, select C2 nodes ranging from maneuver battalion command posts to the CFLCC Headquarters and the Early Entry Command Post (EECP) were also equipped. Thus, the Blue COP in these units, although useful, was less comprehensive than in Force XXI units.

In FBCB2-EPLRS-equipped units, radio-based communications rely on a denser fielding of systems and good dispersion of platforms throughout the area of operations to maintain network integrity. Wide dispersion and line-of-sight limitations between vehicles affect the terrestrial-based radio network and the effectiveness of Situational Awareness and C2. FBCB2-BFT literally breaks the line-of-sight barrier with its satellite link. Distance, dispersion, and line-of-sight between vehicles are much less of a problem. FBCB2-EPLRS is accredited to process both unclassified and secret information. It can be operated in either an "unclassified" or a "secret" mode using individual or unit password access. This capability is required to connect to the secret-high ABCS. Thus, FBCB2-EPLRS is interoperable with the tactical operations center (TOC) ABCS systems. Currently, FBCB2-BFT is not encrypted or accredited to process secret information, because of the commercial satellite link and therefore, it is not currently interoperable with the TOC ABCS systems. However, it does provide a one way feed of Blue locations to the Army-level Global Command and Control System-Army (GCCS-A) through a "trusted guard," which populates the "secret" COP and disseminates the blue picture back down through TOC systems to brigade level. The information passed over SATCOM is encrypted, however, it has not been "Type 1" communications security certified and, therefore, is not authorized to process secret information. This shortcoming has been identified as being critical and currently solutions are being researched to correct this deficiency.

The update rate for FBCB2-EPLRS position reports is time and distance triggered and is set for every five minutes or 100 meters. For FBCB2-BFT, this update rate is set at five minutes and 800 meters for ground platforms, and every one minute or 2,300 meters for air platforms. A server collects these platform-position reports and transmits a network-wide message, with position updates, every 5 minutes for ground and every minute for air.

Both systems provide leaders the ability to see and manage reported enemy situational awareness (Red SA); however, correlated enemy SA via the TOC All-Source Analysis System is not possible with FBCB2-BFT due to the lack of ABCS interoperability. While there are some differences between the two versions of FBCB2, many of the capabilities are identical. Some of the most valuable tools found in both systems are the navigational and map tools. Both systems use Global Positioning Systems (GPS) for platform location, which updates continuously in real-time. Both systems have the same mapping capability to load a variety of military mapping products or imagery backgrounds with underlying Digital Terrain Elevation Data (DTED). Maps on both systems are scalable and possess a zoom-in and zoom-out capability. Both versions have the ability to create, save, analyze, and send routes to other platforms. Both systems have point-to-point and circular line-of-sight terrain analysis tools. Lastly, both systems can be locally or remotely challenged and destroyed, if compromised, by erasing the computer hard drive.

B. RESULTS

> I fought in combat with a very good digital battle command system that had some minor problems. Based on my experience, I am convinced that digital battle command is the key to success in current and future conflicts. We need to embrace digital battle command and recognize its importance in twenty-first century warfighting.
>
> — LTC John W. Charlton,
> Commander, Task Force 1-15 Infantry, 3ID (M)

> You are focused [With FBCB2-BFT]. You have just reduced layers of friction, and the fog of war is why units lose. This is simultaneous, real-time synchronization. It reduces the friction of war about a hundredfold.
>
> — CPT Stewart James, Commander,
> A Company, 2d Battalion, 69th Armor

FBCB2-BFT provided Operation Enduring Freedom and Iraqi Freedom commanders and units a remarkable capability that greatly enhanced their combat effectiveness. FBCB2-BFT enabled the ability to navigate under limited visibility conditions, to move rapidly over great distances and synchronize unit movement, and to communicate both vertically and horizontally over extended distances. Unit Commander's initial confidence in the system varied. It is difficult to embrace a new system and discard tried and true practices with which they and their units were familiar and confident. In some cases, units were forced to accept, and came to rely on, FBCB2-BFT when traditional equipment and accepted practices proved insufficient during the campaign. During Operations Enduring Freedom and Iraqi Freedom, the level of FBCB2-BFT's effectiveness and individual unit "digital learning curves" varied after receiving the system. Units that quickly embraced the new technology and placed command emphasis on its training and employment, benefited early on in the campaign. Others that either received the capability late in the fielding process or did not quickly embrace it, were forced to adjust during the conflict.

The most lauded capability was the Blue SA. The Blue SA picture provided to commanders and command posts significantly enhanced battle and unit tracking, and greatly reduced frequency modulation and tactical satellite radio traffic. This gave unit leaders more confidence when making tactical decisions and more time to focus on fighting the enemy. Despite the five minute icon update latency, commanders, particularly at higher levels, were better able to track the execution of their intent and synchronize the movement of their forces with FBCB2-BFT. Commanders and units at every level viewed the exact same blue picture throughout the entire war in near real time. This is the first time since the Napoleonic Era that commanders were able to "see" their forces on the battlefield.

Map and navigational features provided by FBCB2-BFT helped unit's move and maneuver from the Kuwaiti border to Baghdad in record time. Many BFT users stated that they stowed their paper maps in the bustle rack of their vehicle shortly after Line of Departure (LD). Operations Iraqi Freedom units were provided numerous digital maps, covering the entire country of Iraq at multiple scales. These in included five meter Controlled-Image Base imagery (CIB), 1:50K and 1:250K scale military maps, and Digital Terrain Elevation Data (DTED) maps — all changeable with a touch of a button.

Armed with these digital maps and the presence of a GPS-generated "own" icon, FBCB2-BFT users could navigate and maneuver their forces without having to stop and switch map sheets and replace graphics, which are also computer generated and scalable with the map background. Many soldiers claim that if it were not for FBCB2-BFT, they could not have navigated through the almost-zero visibility conditions caused by dust storms early in the campaign.

The opinion that FBCB2-BFT reduced fratricide is also a common theme in feedback from the users in combat units. Anti-fratricide has never been a component of FBCB2, especially in the context of such a thin fielding and the five minute latency of platform positions. However, due to the increased SA of commanders and their staffs, a reduction in the numbers of Blue-on-Blue incidents appears to have been a secondary effect. FBCB2-BFT was also used in the clearance of indirect fires and to facilitate link-ups between units, which did occur between the 3d Infantry Division and 1st Marine Division in An Nasiriyah and Baghdad.

Despite many complaints about satellite bandwidth limitations, the C2 and email-like messaging capabilities were still very effective. This was particularly true for the Combined Joint Task Force 180 forces that were located at fixed sites spread across great distances in the rugged terrain of Afghanistan. Operating under extremely poor line-of sight conditions, FBCB2-BFT provided units with an extremely reliable back-up communications mechanism and a means to keep routine administrative and logistics traffic off the very limited tactical satellite voice frequency. The messaging capability did the same for units in the Iraqi theater on the road to Baghdad. These units passed critical C2 information, fragmentary orders, and overlays over great distances with great success. This is especially important considering that maneuver and logistics elements were separated, at times, by hundreds of kilometers. One of the chief complaints from FBCB2-BFT users is that the system was fielded too thinly among their units. The primary reason for this thin fielding was the limited availability of hardware and time. The Army was forced to develop the "thin" distribution plan based on approximately 1,000 systems already available through LRIP in the timeframe allocated.

C. THE FUTURE OF FBCB2-EPLRS AND FBCB2-BFT

Perhaps the greatest limitation of BFT was its limited distribution.

— 3 ID (M) Operation Iraqi Freedom After Action Report

Prior to the war in Iraq, FBCB2-EPLRS was projected for upgrades in capability and user functionality. Since the onset of Operations Enduring Freedom and Iraqi Freedom and the development of FBCB2-BFT, the program has drastically expanded; reaching units that were never projected to receive a digital capability or that were not scheduled for fielding until the arrival of the Future Combat System (FCS). User feedback from Force XXI units, the SBCTs, and Operations Enduring Freedom and Iraqi Freedom units continue to assist in guiding FBCB2 combat and material developers to improve the system. Among these issues to be considered for development for future implementation are: increased bandwidth or lifting the 576-byte message size limitation; adding a print capability for maps, overlays, messages, and orders; enhanced overlay construction tools; increased drag-and-drop style functionality; enhanced email-like messaging capability; and a more user-friendly data base. Operation Iraqi Freedom has also reinforced the need to fulfill a pre-existing ORD requirement for a handheld material solution with the same functionality found in FBCB2-BFT for dismounted operations. There are a number of handheld prototypes under development; however, none yet have fulfilled the capabilities requirement. Recent technological advances have allowed for reducing the size and weight of the handheld prototype and producing a product that does not excessively increase the weight of the individual soldier's load. The solution must have FBCB2 software to be truly interoperable with the platform-based FBCB2-BFT systems. Additionally, the requirement to bring SA and navigation tools to the pilots of rotary wing aircraft has been reinforced.

Software improvements for FBCB2 are currently being developed and fielded. The first software improvement was originally designed to fix current software shortcomings found in the SBCTs, but has significantly expanded to incorporate user feedback as well as faults identified during Operation Iraqi Freedom. Major improvements that will affect both FBCB2-EPLRSand FBCB2-BFT-equipped units are: L-Band and EPLRS two-way SA interoperability; hierarchical database for FBCB2-BFT units; and increased message size for C2 messages and overlays.

TSM XXI has led an effort known as FBCB2 Key Leader Option (KLO) to expand the original fielding plan of FBCB2-BFT down to platoon leader and platoon sergeant levels in virtually every active and reserve component division in the U.S. Army. With Modularity this places approximately 2,200 FBCB2-BFT systems in a standard armor or mechanized division and approximately 1,800 in light infantry divisions. KLO also allocates approximately 3,000 systems to Special Forces, Civil Affairs, Psychological Operations, and Ranger battalions. The KLO Fielding Plan was approved by G3 and the CSA, Headquarters, Department of the Army (HQDA), April 2003 and resourced by G8, HQDA in the 2005-2009 Program Objective Memorandum (POM). Digitization across the breadth of the Army is necessary to maintain information superiority and achieve information dominance over our potential adversaries. Capabilities, such as FBCB2-BFT and similar technologically advanced war fighting systems enabled mission success in record time.

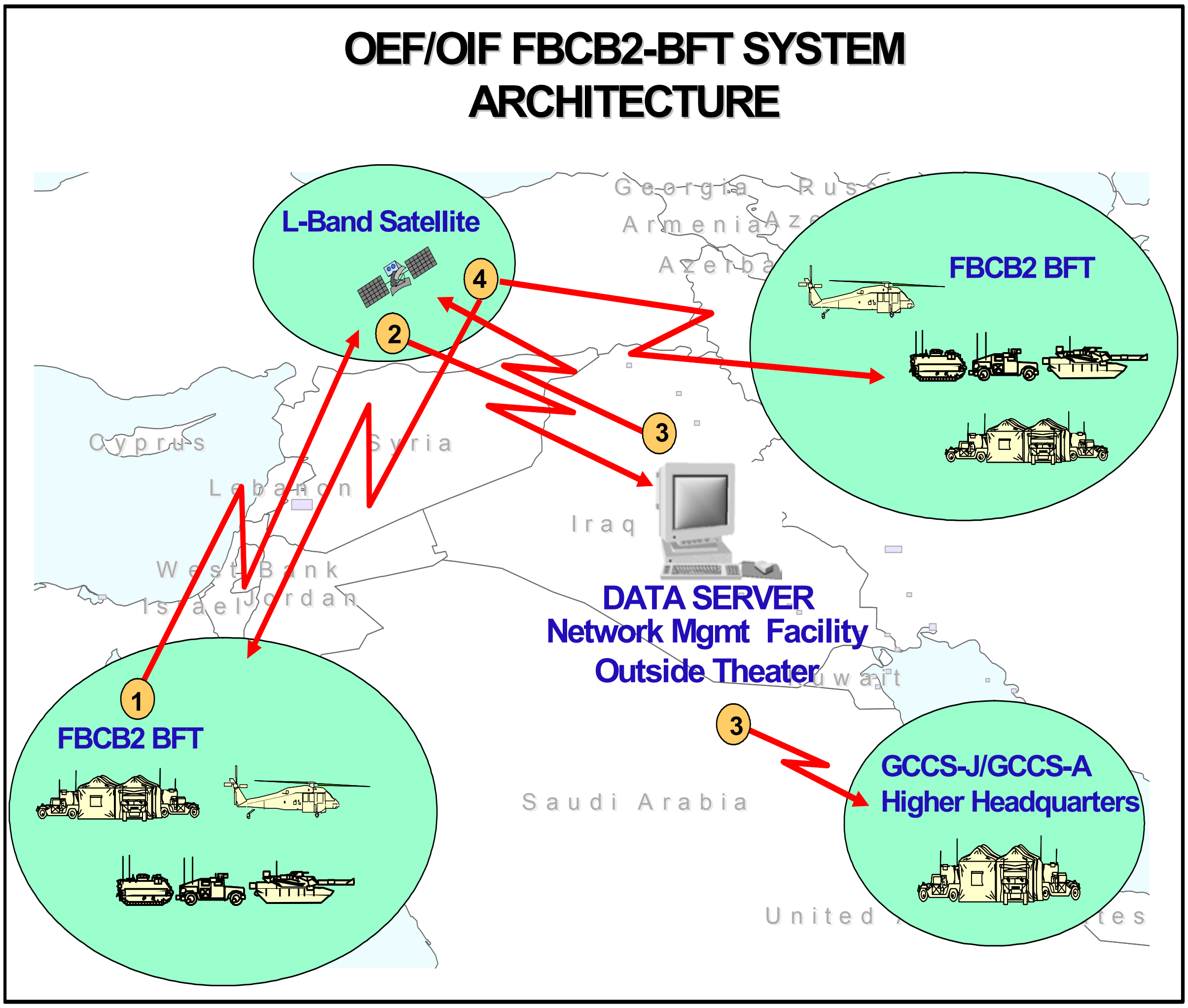

Figure 11. FBCB2-BFT Architecture (After: TSM XXI Army Knowledge Symposium (2003))

Figure 12. FBCB2-BFT Components (After: TSM XXI Army Knowledge Symposium (2003))

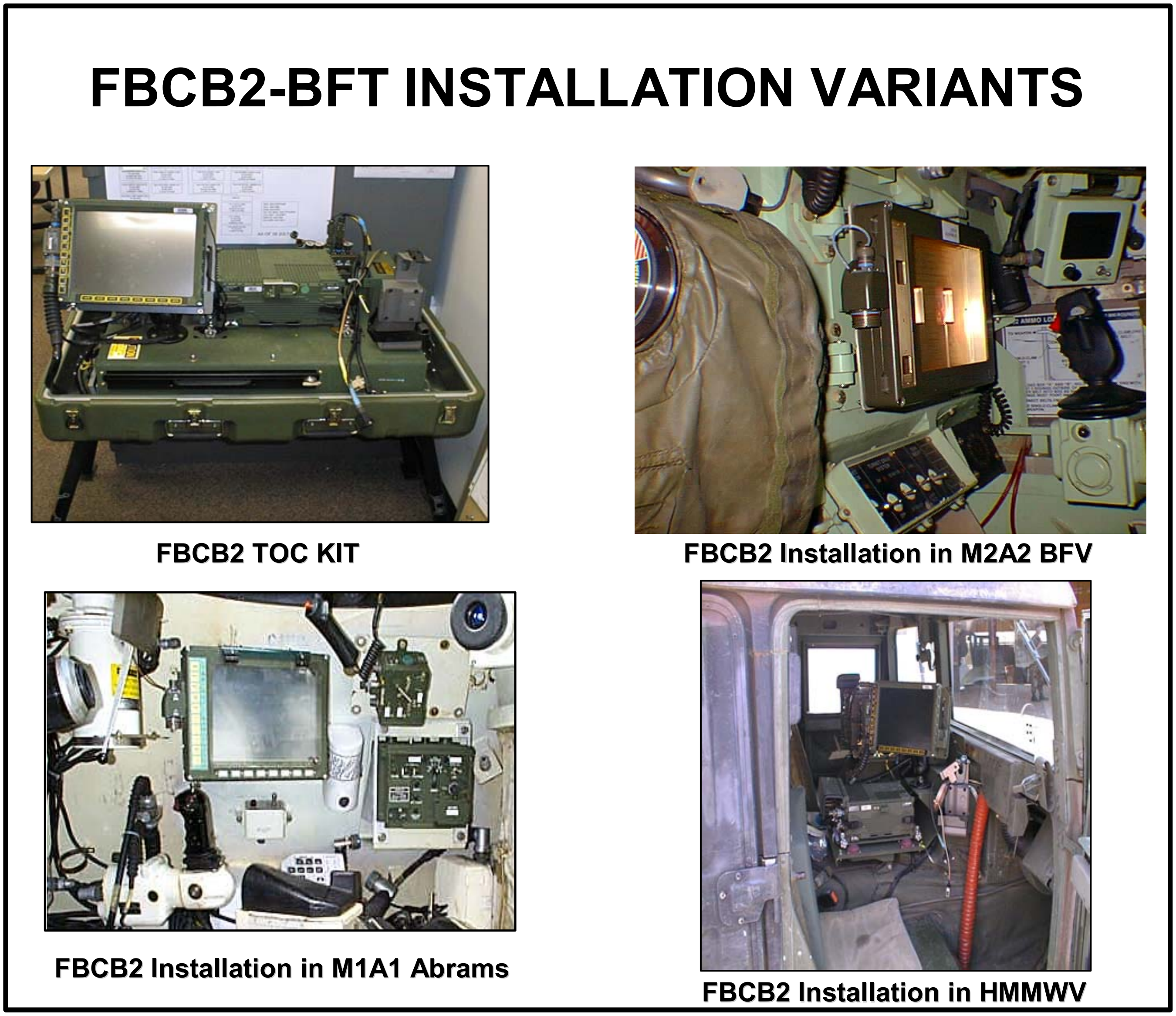

Figure 13. FBCB2-BFT Installation Variants (After: TSM XXI Army Knowledge Symposium (2003))

IV. FBCB2-BFT CONTINGENCY FIELDING CONDITIONS

AR 71-9 provides a provision for Operational Commander's to initiate the requirements determination process through the use of the Operational Needs Statement (ONS). In this case an ONS was not developed by CENTCOM so there was no formal action for the Army staff or The Training and Doctrine Command (TRADOC) to take. Furthermore, an ONS could not have been validated by the Army Staff since an ONS cannot be used for the development and/or procurement of a system or capability for which there is another valid, approved requirements document as was the case with FBCB2-BFT. By 2001, the FBCB2 program had achieved a Milestone C decision and had an approved Low Rate Initial Production (LRIP) quantity. A portion of this LRIP quantity could be leveraged towards an emerging contingency requirement. This fact coupled with three other independent, yet interrelated, components were necessary in order to provide the FBCB2-BFT capability in support of Operations Enduring and Iraqi Freedom. The absence of any one of these components could have potentially led to the inability to successfully provide this capability. Although these four components were revealed during this case study, the authors believe that these same criteria apply to any program attempting rapid acquisition in support of contingency operations. Figure 14 portrays the four components required to conduct acquisition and fielding in support of contingency operations and include the following:

- The presence of a relatively mature technical solution to solve an identified capability gap.
- The presence of a User Representative that is a willing to temporarily accept a useful solution in the short term while the Program Management Office continues to mature the system to the desired endstate as outlined in the Operational Requirements Document (ORD) or the Capabilities Development Document (CDD).
- The presence of supportive military leadership, which includes not only the individual Service Chief and the Combatant Commander but also the Undersecretary of Defense, Acquisition, Technology and Logistics (USD AT&L) or the Service Acquisition Executive (SAE) in the case of a service managed program.

- The presence of a funding stream that is sufficient to provide the initial capability in the short term and, if necessary, the necessary program support and backing to request and receive supplemental funding in order to sustain the effort.

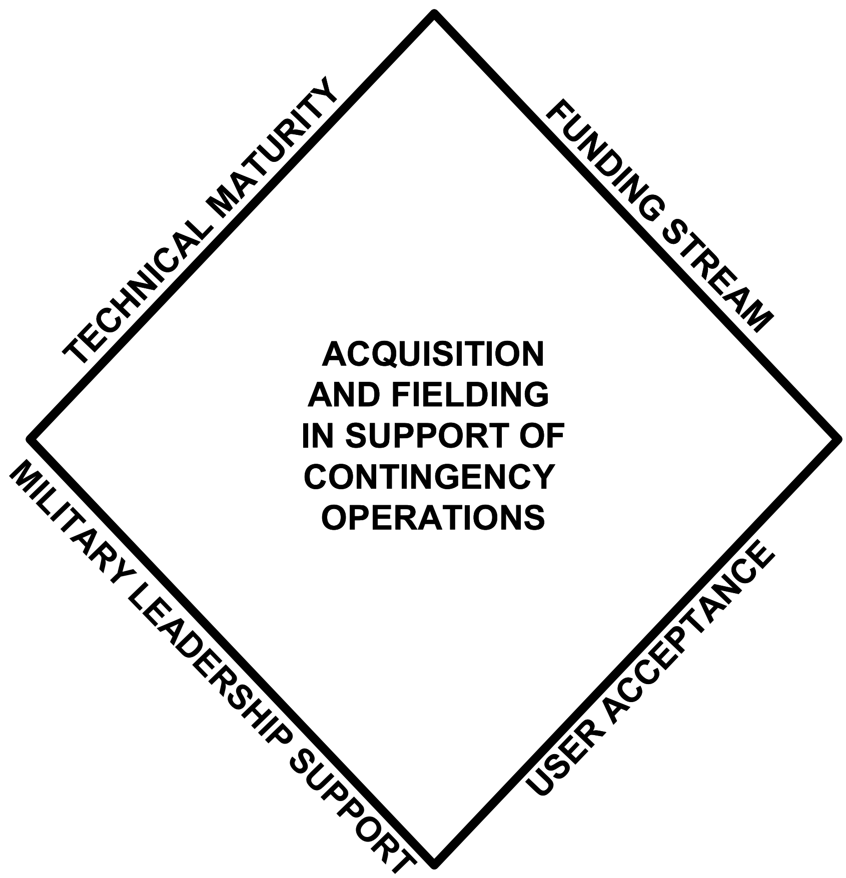

Figure 14. The Principle Components of Rapid Acquisition in Support of Contingency Operations

A. TECHNICAL MATURITY

Following eight years of system development coupled with a robust series of Developmental Test events and Operational Assessments, FBCB2 was at a point in its Acquisition Life-Cycle that a useful terrestrial technical solution was being provided to the force through LRIP. Although a formal IOT&E had not been conducted, previous Operational Assessments conducted through Limited User Tests and Advanced Warfighting Experiments suggested that suitability and effectiveness criteria would be met. The Global War on Terrorism served as a catalyst for FBCB2 to modify the system by replacing the current terrestrial components with a SATCOM solution to satisfy the warfighter's command and control requirements. In order to convert FBCB2 from a terrestrial based system to a SATCOM based system required additional testing. PMO FBCB2 was able to leverage the expertise of the Central Test Support Facility at Fort Hood, Texas, to model the planned FBCB2-BFT architecture. Using the Balkan Digitization Initiative as a baseline, the CTSF was able to validate the FBCB2-BFT concept. As a result of previous terrestrial based testing efforts, Materiel Safety Releases had been obtained for a variety of military vehicles with the M1A1 Abrams and M2A2 Bradley figuring most prominently. Additional testing had to occur to ensure that the system functionality on the M1A1 and M2A2 remained unchanged due to the addition of a satellite transceiver.

B. USER ACCEPTANCE

The TRADOC System Manager (TSM) XXI, the Army user representative, clearly understood the added value of providing FBCB2-BFT to the force. Although units would not be connected to the overarching Army Battle Command System (ABCS) structure and would not be fielded to the same density as a terrestrially equipped FBCB2 formation, increased capability could still be realized for contingency forces. TSM XXI outlined the levels of benefit gained, as follows:

- Robust mapping products
- Enhanced Situational Awareness stated in the following terms.
    - Knowing one's own location
    - Knowing the location of other FBCB2-BFT equipped platforms
    - Knowing the location of reported enemy
- Alternative means of communication

TSM XXI believed that the modification of the current Training Support Package would be sufficient in order to train soldiers to an acceptable level to use the system in combat. With enhanced capability and an executable Training Support Package as guiding principles, TSM XXI began the process of educating the leadership of the Army on the capabilities and limitations of FBCB2-BFT and provided recommendations of how to maximize this potential. TSM XXI worked in conjunction with other stakeholders to develop a Basis of Issue (BOI) plan in order to maximize the utility of the limited quantities of FBCB2 hardware available.

C. MILITARY LEADERSHIP SUPPORT

Execution of rapid acquisition in support of contingency operations required the presence of supportive military leadership, which included not only the individual Service Chief and the Combatant Commander but also the Undersecretary of Defense, Acquisition, Technology and Logistics (USD AT&L). Army leadership identified the shortcomings of current command and control capabilities and realized that a technical solution was required that supported their vision of how to prosecute the Global War on Terror. The result of this identified shortcoming was the establishment of the Information Management Task Force, which was charged with correcting current communications and network problems, designing a command and control center that integrated all ABCS systems, and fielding a blue force tracking system. Once FBCB2 was identified to address the blue force tracking capability at the theater level, the merits of the system at the tactical level became readily apparent. The senior level acceptance of the FBCB2-BFT concept, married with the TSM XXI guiding principles completed the final endorsement required to begin executing the concept. Due to the urgency of the need, the operational community was willing to accept a modified developmental system that had not completed the entire acquisition process. This support provided PMO FBCB2 the flexibility to work within the Acquisition framework. PMO FBCB2 was able to submit, with endorsement by the Army leadership, to the USD AT&L requests for waiver to exceed LRIP quantities. Additionally, the senior level acceptance of the BFT capability helped to ensure future funding.

D. FUNDING STREAM

Without the presence of a dedicated funding stream the previous three components described above are rendered virtually inconsequential. PMO FBCB2, with the support of their MDA, was able to leverage programmed dollars in the short term to provide the initial financial resources to bring FBCB2-BFT to fruition. Simultaneously, PMO FBCB2 received increased funding through the supplemental funding process. This funding provided the continuous stream required in order to sustain the FBCB2-BFT effort. Finally, Congressional Authorization and OSD direction provided an increase of funding for the ongoing war effort that allowed a diversion of FBCB2 program funding from planned expenditures within the acquisition baseline to fund and support a growing battle tracking need in both operational theaters. Initially, PMO FBCB2 funded the FBCB2-BFT initiative with programmed dollars but was able to secure supplemental funding as the BFT initiative gained momentum. The need for supplemental funding to support the GWOT was identified early. Supplemental funding is designed to "reimburse" organizations for the expenditure of their programmed funding in support of the current contingency and to assist organizations to procure items or services required to support the current contingency. FBCB2-BFT was one of the many identified priorities. These items or services are prioritized by the COCOM, individual services and OSD and ultimately approved by Congress. Through the supplemental process, PMO FBCB2 requested and received additional funding in order to continue the effort. Without the initial and continual approval to obtain financial resources to support the FBCB2-BFT initiative, an entirely different outcome may have occurred.

It is imperative that the acquisition community continually seek innovative approaches to provide needed capability to the warfighter. The FBCB2-BFT initiative was successful due to the synchronization of four interrelated and supporting components; 1) a technically mature system, 2) user representative acceptance, 3) senior leadership support, and 4) a funding stream. This paper has demonstrated that the acquisition of a system in support of contingency operations is not entirely dependent upon the adherence to the acquisition framework alone. By synchronizing the four components identified above, needed warfighting implements may be put into the hands of combat or contingency forces on an accelerated schedule.

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