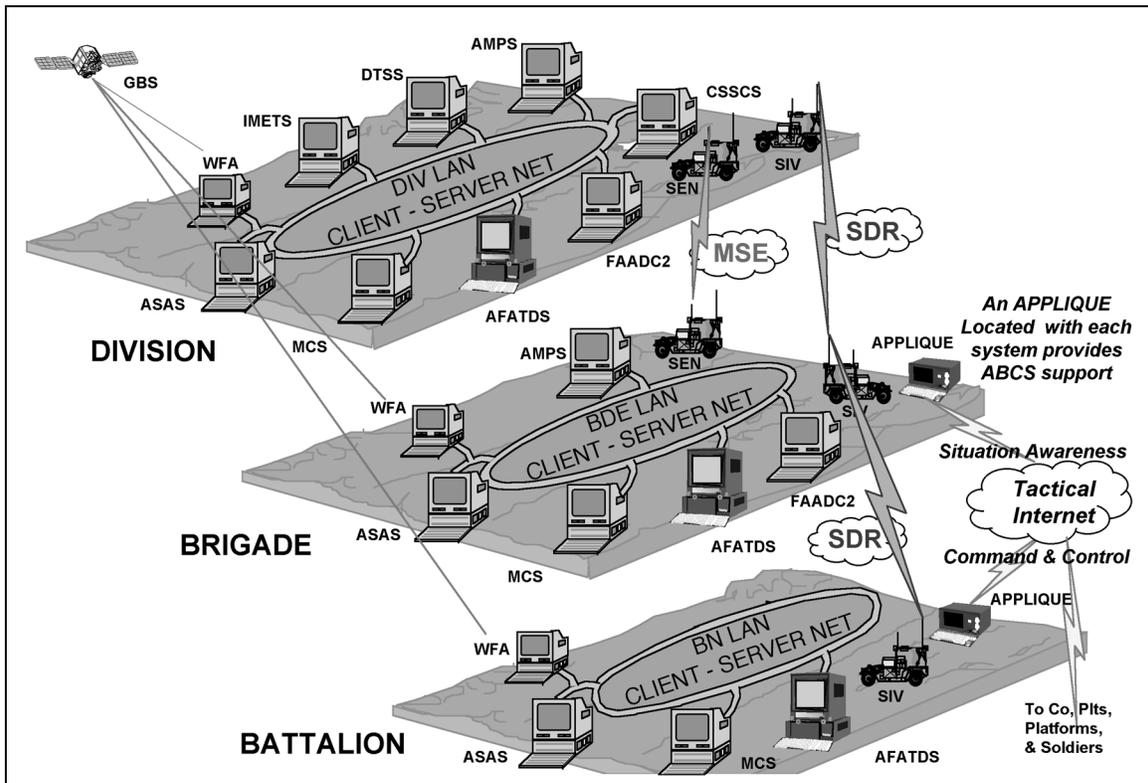


BATTLEFIELD DIGITIZATION



DIGITIZATION INTRODUCTION

The Army's program for Battlefield Digitization is a vast and complex web of computers, radios, and routers intended to provide the means for improved command and control on future battlefields. DOT&E placed "Battlefield Digitization" on oversight in 1995, and will monitor the development and fielding of the entire system-of-systems until overall performance, interoperability, and the procedure for upgrades has been demonstrated. Battlefield digitization is truly a "systems of systems," and the components should be integrated into the force together, evaluated together, and to the extent possible, acquired and updated together. The system-of-systems approach for Digitization is challenging from both a technological and management perspective, but is necessary for the Army to achieve their Digitization goals.

DOT&E interest stems not only from the extraordinary magnitude and complexity of this program, but also from its potential to improve combined-arms effectiveness and joint and coalition interoperability. This potential has been explored in several large-scale Advanced Warfighting Experiments (AWEs) that have accelerated the delivery of digital technologies to operational users. Based on the insights from these AWEs, and the expected effectiveness improvements, the Army has reduced the number of maneuver companies in each heavy division by 25 percent. The dynamics of a changing force structure, in concert with significant equipment modernization and evolving tactical procedures, challenge the acquisition and test communities to ensure that systems demonstrate enhanced military capability prior to fielding.

Early on, the Army conceived that effective Digitization AWEs would require large-scale, system-of-system events culminating at the National Training Center to examine prototype systems in the most operationally realistic environment. The Force XXI Central Hypothesis states in unambiguous and operational terms what the benefits of Digitization will be: improvements in lethality survivability and operational tempo. Additionally, new processes were implemented via creation of the Experimentation Force, the Experimentation Force Coordination Cell, and the Central Technical Support Facility at Ft. Hood, TX, to execute, manage, and optimize the experiment. The Army has reaped many good insights and supported acceleration of numerous programs through these experiments, and confirmation events for the programs comprising the Digital Battlefield must follow a similar path.

Having transitioned from experimentation to acquisition, the continued development and procurement of Digitization systems is likely to extend into the 2010 timeframe due to the number of participant systems and anticipated upgrades. The current systems under development may experience complete replacement as technology matures, or they may merely be upgraded over time, but the general concept and architecture of Battlefield Digitization is unlikely to be altered for many years. There will be a hybrid architecture—a presence of both digital and analog systems—for the foreseeable future, as different systems mature at different rates and various components of the force are equipped on different schedules.

DIGITIZATION DESCRIPTION & CONTRIBUTION TO JOINT VISION 2010

Battlefield Digitization refers to the computers, routers, and radios which comprise a vast network extending vertically from Corps down to individual platforms, and horizontally across all of the combined-arms elements of the force. It can be decomposed into two major sub-networks: the *lower* Tactical Internet that encompasses the weapons platforms and vehicles (with their associated command, control, and communications systems), and the *upper* Tactical Internet that links the Tactical Operations Centers of the force from battalion through corps.

DOT&E currently performs oversight on many of the individual systems that comprise Battlefield Digitization. Oversight systems that will operate on the *lower* Tactical Internet include Force XXI Battle Command, Brigade and Below (FBCB2) computers and software, the Enhanced Position Location Reporting System (EPLRS), and the Single Channel Ground and Airborne Radio System (SINCGARS) and Internet Controller. Oversight systems that will operate within the *upper* Tactical Internet include the Army Tactical Command and Control System components (MCS, ASAS, AFATDS, CSSCS, and FAAD C3I) and the Mobile Subscriber and Near-Term Data Radio communication systems. The Joint Tactical Radio System (JTRS) is expected to replace the Near-Term Data Radio, SINCGARS and EPLRS when it enters service, and will be a key element of the Warfighters Information Network—Tactical (WIN-T). The Command and Control Vehicle (C2V) will be the vehicular shelter that houses many of the *upper* Tactical Internet components. “Embedded Digital Platforms” include the M2A3 Bradley Fighting Vehicle and the M1A2 Abrams Tank System Enhancement Program. Each of the underlined systems is fully addressed in a separate section of the Annual Report, alphabetized under “Army Systems.”

In 2004, when the Army plans to field the First Digital Corps, each of the heavy divisions are envisioned to include approximately 2,800 command-and-control computers (FBCB2, MCS, ASAS, AFATDS, FAAD, and CSSCS) and 12,000 radios (EPLRS, SINCGARS, and Near-Term Data Radio). Although an “analog” division today includes a number of these systems (approximately 500 computers and 6,000 radios), a decade ago there were fewer than 100 command-and-control computers and 5,000 radios.

The objective Digitization system-of-systems is expected to support *Joint Vision 2010* by providing *information superiority* to the *dominant maneuver force*. Furthermore, via improved command and control, the digitized force should accrue extensive capabilities in the areas of *precision engagement, focused logistics, and full-dimensional protection*.

BACKGROUND INFORMATION

The Army initiated the Force XXI Battlefield Digitization program in 1994, with the intent to proliferate and integrate digital communications and information management technologies across the combined-arms spectrum. The Army's efforts have been demonstrated in a series of AWEs. The central hypothesis throughout Digitization experimentation has been: "If information age, battle-command capabilities and connectivity exist across all battlefield operating systems, then increases in lethality, survivability, and op-tempo will be achieved." To this end, three major events have been conducted since DOT&E began oversight of Digitization: the Task Force XXI AWE and Maneuver Control System IOT&E in 1997 and FBCB2 Limited User Test (LUT) #1 in 1998.

The Task Force XXI AWE equipped a brigade from the 4th Infantry Division with Army Tactical Command and Control Systems in its Tactical Operations Centers, and Applique hardware and software on all of its 1,600-plus vehicles. The brigade trained with the new digital equipment and supporting communication systems, among dozens of other initiatives, for about eight months, then deployed to the National Training Center for a series of force-on-force battles with a live opposing force. Due to immaturity and limited interoperability of most of the digital equipment, the degree of digital connectivity achieved during the Task Force XXI AWE was not sufficient to meet the premise of the central hypothesis, as well as unsuitable for tactical operations. The immaturity also impacted the training readiness of the unit and the development of digital tactics, techniques, and procedures. In spite of these challenges, the digitized brigade performed similarly to the non-digitized baseline brigades at the National Training Center, a result that, with follow-on constructive modeling, the Army used to support continued program acceleration for a number of key Digitization systems.

The Maneuver Control System and Force XXI Battle Command, Brigade and Below tests both demonstrated that the Army continues to make progress towards its Digitization goals, but much improvement remains. System performance during both tests represented a significant improvement over that observed during AWEs. The friendly situational awareness information observed during the LUT was generally accurate and timely, and the improved system stability permitted soldiers to employ this information during the execution of their missions. The stability also permitted the test unit to achieve a higher state of training than the Task Force XXI unit, and furthered the refinement of digital tactics, techniques, and procedures.

DIGITIZATION ASSESSMENT

DOT&E has monitored Battlefield Digitization efforts since 1995, and will continue to do so until the Digitization hypothesis has been demonstrated and core functionality achieved. Core functionality is the minimum set of capabilities that permit the user to effectively accomplish his mission in the expected operational environment. Furthermore, core functionality should include sufficient levels of interoperability, logistics supportability, survivability, and training adequacy, such that the user would be satisfied if no additional capability were ever delivered.

In spite of the significant improvements observed during FY98 testing, the current state of Digitization capabilities is interim, with a number of critical enhancements necessary to achieve an effective and suitable capability. These include a robust network-management capability to monitor the network's health and respond to identified problems, improved interoperability with and across the Army Tactical Command and Control Systems, and the ability to allow rapid reestablishment of the network when communication/combat losses occur or a task organization change is required. All of these capabilities are to be incorporated in software that is to be delivered and tested in FY00.

The proliferation of situational-awareness information across friendly forces will result in increased emphasis on information warfare by our potential adversaries, and added challenges for security and network management capabilities. Although experimentation and testing has included only limited electronic and information warfare, these areas will receive special attention by DOT&E to ensure that both the capabilities and the vulnerabilities of Digitization are well understood and that informed acquisition/employment decisions are made. Another concern is the current focus on Digitization of heavy-division forces, which may leave unanswered issues regarding scenarios that may be more likely, such as Bosnia-type stability operations. Scenarios that may be more challenging to tactical communications—operations in urban terrain or terrain with heavy foliage—must also be examined. The digital force must demonstrate the ability to interface with analog forces (Active Army (especially aviation assets), Reserve Army, National Guard, Joint and Coalition forces).

Based on our experience, Information Technology (i.e., software intensive) systems are generally complicated, fragile in the tactical environment, and require well-trained operators and maintainers—skills that are difficult to maintain and may require extensive contractor support. Furthermore, these phenomena have been observed for Digitization systems even when software development and hardware integration have matured over several cycles of the spiral development process. We believe this is due in part to the underestimation of the challenge of employing commercial hardware and software technologies in systems subjected to the rigors of the operational environment. The excessive optimism regarding the development and integration challenges result in aggressive and unachievable schedules, with no slack for the solution of problems that have become the norm. Even when software development and hardware integration fall behind schedule, deliveries often occur on schedule, albeit with significantly reduced software functionality and poor hardware integration. This usually results in delivery of a version of the hardware/software that does not contain the full functionality originally specified for that test event, and/or which has not been adequately tested prior to operational use. This delay impacts the New Equipment Training the test unit must undergo, and undermines the effectiveness of the unit's collective training when it finally does occur. Not surprisingly, performance goals are seldom met in this schedule driven environment.

Although the aggressive spiral development schedule for introducing commercial technologies into Digitization systems has experienced significant slips in the goal of a Digital Division—originally planned for FY97—the transition from experimentation to acquisition has brought a healthy dose of discipline and adherence to established entrance/exit criteria. This has been accomplished largely via the leadership of the Army test and evaluation and user communities, who have insisted on software with required functionality and “software freezes” that prohibit last minute software drops of new functionality that is not transparent to the soldiers. This discipline permitted adequate time for individual and collective training with the functionality that had been delivered during the FY98 FBCB2 LUT, and contributed directly to the LUT's success. We are counting on the same discipline to prevail for the critical events planned for FY00—when the FBCB2 Force Development Test and Experimentation will be performed to validate Digital Tactics, Techniques, and Procedures. This test will be conducted in conjunction with the newest suite of ATCCS software (Army Battle Command System 6.X), which

provides several new capabilities. These new capabilities include the TOC Server and the Joint Common Data Base, which together promise new levels of interoperability for the Digital Battlefield.

Only when the full array of Digitization capabilities and the requisite tactics, techniques, and procedures are resident with a well-trained unit, and demonstrated in a large-scale, system-of-system event similar to the foundational AWEs, can the Army validate their Digitization Hypothesis. Accordingly, the Army's current timeline to achieve the First Digital Division in FY00 is premature when the confirmation event is not scheduled until 3QFY01. DOT&E will observe and evaluate the results of each Digitization critical-path event, and perform assessments on the progress of Digitization in Annual Reports and after selected major events.

