AUSA BACKGROUND BRIEF

Army Issue:
DIGITIZATION AND THE MODERN BATTLEFIELD

PURPOSE

This paper discusses the key role of digitized communications in the Army's concept of fully integrated operations on the modern battlefield. Horizontal integration of information nodes involves the exchange of real-time information and data to establish friendly force dominance of enemy forces. With heavy reliance on computers and satellite transmissions, command and control, data, surveillance, targeting and weapon system information capabilites will be converted to digital networks. Digitization will increase the volume, speed and accuracy of radio transmissions.

Digitization of the battlefield is a major combat multiplier in the conduct of warfare in an era of a smaller Army and shrinking resources. The use of digital data networks will allow much information now transmitted by voice radio and synchronized manually to be transmitted and updated automatically and simultaneously to the computer screens of unit commanders and staffs dispersed throughout an expansive battlefield. Conversion to digital communications is an imperative if the Army is to maintain technological superiority on future battlefields.

ISSUE

The need is for a horizontally integrated battlefield network of information nodes using leading-edge technology. This network is identified by the Army as the "digitized battlefield." It is central to the emerging operations doctrine and to the future modernization and development of information, communications and weapon systems.

Maintaining and retaining technological superiority in military operations will require a continuing, systematic approach to the development of a fully digitized battlefield. The Army goal of a digitized battlefield is the focus of Army modernization and resource decisions.

BACKGROUND

One of the important means to technological superiority on the battlefield is the exploitation of information to permit field commanders to outthink, outmaneuver and outshoot the enemy on a real-time basis. The objective is a fully integrated operation where the commander has the information

necessary to develop intelligence, synchronize the maneuver of forces and optimize the employment of weapons throughout the width and depth of the battle area.

The information technology and processes which will do this involve the digitization of command, control, communications, computers and intelligence (C^4I) information systems across the spectrum of combat, combat support and combat service support capabilities. The result is the digitized battlefield, the military counterpart of the civil sector's future "information highway" of interactive data communications.

The Digital Revolution

Day-to-day use of commercial radio has made AM (amplitude modulation) and FM (frequency modulation) transmissions of voice and music commonplace phenomena. These familiar modes of radio signal modulation involve the conversion of a continuously variable (analog) signal into a different signal form which can be transmitted. Modulation is necessary for the transmission of multiple signals which have the same basic frequency range (i.e., voice). By shifting each basic signal to another frequency (modulation), numerous signals can be transmitted and received over a wide range of designated frequencies without interference.

We have also — perhaps unknowingly — become ever greater users of a seemingly revolutionary form of modulating voice or music analog signals by converting them to digital transmission. Digital modulation involves a process of encoding a continuous analog signal into a discrete or discontinuous signal. The process involves the assignment of "binary" codes consisting of a series of discrete "on" (one) or "off" (zero) pulses to represent a measure of the basic signal. The measuring process involves "sampling" the amplitude of the continuous signal at microsecond intervals and transmitting a digital code to represent the amplitude. The same process applies to the transmission of data other than voice, for example written messages where digital codes represent letters and numbers.

Though digital transmission has been feasible for a number of years, the early investment in analog systems to transmit sound was far too great for major changeovers, particularly in the telephone industry, where telephone lines were analog. This has all changed in the last fifty years with the invention of the transistor and advent of the microcomputer chip. The need to transmit digitized voice, video and data over radio frequencies and between computers linked by analog telephone lines has led to the modulator-demodulator (modem) to convert digital signals to analog signals, the introduction of the fiber-optic "telephone line" (which can transmit large amounts of digital signals) and vastly improved radio transmission and retransmission capabilities of earthbound sites and satellites. These events and other technological innovations, which make it possible to transmit many digital signals simultaneously over the same frequency, have given rise to demands for better and faster ways to transmit greater volumes of voice, graphics, video and data by wire, radio, optics and other means.

Digital communications include encoded voice signals, data processing, telegraphy, telemetry, and forms of modulation to transmit graphics, pictures and video. Digital modulation allows the time intervals between pulses to be filled with different signals. The result is a vastly increased capability

to transmit a large volume of data. Digital coding is also less sensitive to noise, interference from adjacent frequencies, signal distortion and fading, and has greater transmission efficiency. With these advantages, digitization of the battlefield will result in near real-time exchange of information among units.

Digital Integration of Army Systems

New technological developments, new weapon systems and upgrades to existing weapon systems will make it possible for ground units to dominate the modern battlefield. Military applications of digitized communications in an era of limited resources principally involve upgrades to the information components of existing weapon systems to optimize integration and sharing of information while denying similar capabilities to a potential enemy. Changing weapon systems from analog voice, video and data transmissions to digital coding is an essential part of the process to expand the real-time information available to field commanders. Because information systems are increasingly satellite dependent, inherent in this concept is the protection of friendly satellites from destruction or jamming, as well as antijamming protection for the information network in support of the battlefield commander.

The goal of attaining an integrated battlefield — and winning the information war — involves intelligence, electronic warfare (EW), command and control, and counterintelligence. It is a concept that will guide the development, acquisition and use of weapon systems. To win the information war, the ground commander must be able to see and hear the enemy with sensors; disrupt and deny the enemy information with EW systems; and maneuver forces and firepower using C^4I systems.

C^4I systems are key to the integrated battlefield because they capitalize on digital capabilities. C^4I includes: a communications architecture which permits commanders to move freely and act with precision; automation and communications support for intelligence dissemination and targeting; and automation for sustainment forces. Integrating C^4I and weapon systems permits commanders to have a common picture and understanding of the battlefield situation, including friendly and enemy unit locations, using data from the global positioning system (GPS). The ability to remain linked to command posts, intelligence sensors and subordinate commanders by satellite provides the commander great flexibility of action. Some special features of digitized C^4I include:

- satellite broadcasts of intelligence, weather and other important information direct from the broadcast source to users;

- integration of common user systems — radios, telecommunications and data communications — throughout the operational area; and

- connecting sustainment bases to the battlefield to provide updated resource information to logisticians and field commanders.

Space systems are key to the whole concept of the integrated digital battlefield. The Army, of all the services, is probably the greatest potential user of total products from space. Satellites, and

particularly the GPS (used during Desert Storm), have had a profound impact. Future battlefield information systems will demand effective and adequate support from space systems.

The Digitized Battlefield

The Army's visualization of the digitized battlefield portrays a ground force operating in a combined arms, joint task force setting. The integrated ground force C^{4}I and weapon systems information network would operate as an integral part of the joint network of land, air and sea forces and in turn would be linked to a global network. The digitized battlefield will support rapid, decisive placement of combat power in the right place and at the right time to overwhelm and destroy enemy forces.

To deny the enemy battlefield information, sensors, information processing, data distribution, electronic countermeasure and electronic counter-countermeasure systems are employed. Systems are employed to gather threat information, process it and transmit it around the battlefield, while denying threat forces the same capabilities. Sensors that locate and identify targets, intelligence fusion systems, command and control systems, fire control systems, smart munitions, and other systems deny threat forces the capability to locate and attack U.S. forces.

In digitizing battlefield systems, a network interlinks weapon systems, aerial platforms, surveillance, and communications systems, allowing the exchange of vast amounts of information. Communications networks transfer data between each battlefield functional area — combat, combat support and combat service support.

Some Army systems have made the transition to digitization, and others are in process. Emerging technological developments will capitalize on digital information systems which, when achieved, will provide the following capabilities on an integrated basis:

- responsive command and control to all echelons, providing rapid exchanges of orders and graphics;

- global positioning;

- data distribution;

- broadcast communications for intelligence, weather and other types of information directly from broadcast sources to users;

- intelligence dissemination;

- rapid and synchronized targeting;

- electronic fixes on enemy and friendly locations; and

- shared situational awareness.

How Will the Digitized Battlefield Operate?

Visualize a widely dispersed battlefield where the C^4I systems of combat, combat support and combat service support organizations are interconnected to share digitized information vital to the outcome of the battle. Upgraded mobile weapon systems are operating on and above the battlefield: the M1A2 Abrams tank, and M2A3 Bradley infantry fighting vehicle; M109A6 Paladin 155mm self-propelled howitzer; AH-64 Apache attack helicopter, AH-1 Cobra attack helicopter and OH-58D Kiowa Warrior armed reconnaissance helicopter (the latter two aircraft slated to be replaced by the RAH-66 Comanche); UH-60 Black Hawk helicopter equipped for command and control; unmanned aerial vehicle (UAV); Joint Surveillance and Attack Radar System (Joint STARS) aircraft; and other ground and air vehicles performing combat, combat support and combat service support missions.

To link the weapon systems through an information-sharing network, ground vehicles are equipped with an Inter-Vehicular Information System (IVIS) which can transmit and receive real-time battlefield data automatically through vehicle-mounted SINCGARS (single channel ground and airborne radio systems). Digital electronic map display screens, integrated into each weapon system, are updated automatically to provide real-time self, friendly and enemy locations. Forward units' ability to share this information on friendly and enemy locations reduces fratricide and contributes significantly to the ability of the ground force to execute swift and decisive maneuvers and employ firepower more effectively.

On the battlefield of the immediate future, target information is transmitted from a helicopter (or from a UAV or Joint STARS aircraft) to proximate ground commanders (who can use direct-fire weapons to engage the target); fire support units (where a fire support team can coordinate the indirect fire of mortars and artillery to mass fires on the target); and command and control elements (which can maintain updated intelligence information on enemy forces and friendly locations — through GPS — so as to synchronize maneuver forces and supporting fires to rapidly defeat the enemy force). At the same time, it is possible to interconnect combat and combat support units with combat service support units to continuously update expenditures of ammunition, fuel and other resources so as to facilitate timely resupply.

The integrative nature of the digitized battlefield — among deep reconnaissance elements, forward ground maneuver units, rear indirect fire systems, air support systems, command and control systems, intelligence gathering organizations and logistical support systems — reshapes the nature of combined arms task forces, which are qualitatively different from those of the past. The situational awareness of the commander will be orders of magnitude better than those which presently exist.

Modernization in Support of the Digitized Battlefield

Some of the modernization efforts ongoing (or planned) in the Army program include:

- the RAH-66 Comanche attack and reconnaissance helicopter, the centerpiece of the digital battlefield;

- the M1A2 tank equipped with the Inter-Vehicular Information System (IVIS) which displays and digitally transmits to other units map overlays, reports, and information on own location and target coordinates;

- the M2A3 infantry fighting vehicle (upgraded from the M2A2 model);

- the Apache Longbow air/ground radar for the multiple-targeting, fire-and-forget Hellfire missile system;

- a new command and control vehicle (C^2V), essential for mobile command and control on the integrated battlefield;

- the Armored Gun System (AGS) to provide support for light forces and designed to operate in the digital net; and

- the Advanced Field Artillery System (AFAS), which is designed to fire autonomously at greater ranges, thus extending the digital battlefield.

Many of the near-term improvements will be by technology insertions via upgrades to sensors and electronic warfare (EW) systems. Systems include Joint Surveillance Target Attack Radar System (Joint STARS), Unmanned Aerial Vehicle (UAV), Ground Based Command Sensor (GBCS — a vehicular mounted sensor providing key target acquisition and tracking capability at division level), Guardrail Common Sensor (GRCS — a fixed-wing communication and electronic emitter intercept and direction-finding system used at division and corps level), and Advanced Quick Fix (AQF — a tactical, heliborne communications intercept, direction-finding and electronic countermeasures system).

Important command, control and communication (C^3) systems include Army Tactical Command and Control System (ATCCS), Advanced Field Artillery Tactical Data System (AFATDS), Combat Service Support Control System (CSSCS), Forward Area Air Defense C^3 Intelligence System (FAADC^{3}I), NAVSTAR Global Position System (GPS), Maneuver Control System (MCS), Standard Integrated Command Post System (SICPS), Mobile Subscriber Equipment (MSE) and SINCGARS.

SUMMARY

Digitization is the process of integrating information systems across the battlefield using the power of the computer microprocessor and digital electronics. Coupled with satellite communications, digitization redefines the depth and breadth of the battlefield. The principal advantage of digitization is increased speed and range of data transmissions of near real-time information.

Emerging Army doctrine characterizes the superiority of Army ground forces on the integrated battlefield. In this respect, draft operational doctrine states:

Microprocessing, miniaturization, communications and space technologies have combined to permit almost real time intelligence and information sharing, distributed decision-making and rapid execution of orders from a wide variety of forces and systems for concentrated effect.

This horizontal integration of digital electronics results in a network linking weapon platforms (armor, aviation, artillery) with C^{4}I systems. The result is real-time force synchronization, shared situational awareness and the capability for swift, decisive maneuver.

A digitized battlefield will speed up the tempo of operations to outpace the enemy's decision-making cycle. Some Army systems with digital capability are already in use or in production. Future upgrades and developments will further incorporate the technology. Priority of Army research, development and acquisition (RDA) should be focused on achieving this important objective. The RAH-66 Comanche attack and reconnaissance helicopter, recently identified by Army Chief of Staff General Gordon R. Sullivan as the Army's most critical weapon modernization program, will be the centerpiece of the digitized battlefied and the capability to share information.

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(This **Background Brief** was prepared by the staff of the AUSA Institute of Land Warfare.)