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Close Support Fires for the Army's Objective Force 2015

Paul F. Gorman, General USA (Ret)
Richard P. Diehl

June 2003
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IDA Paper P-3765
Log: H 03-000417

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PREFACE

This paper was prepared in response to a task titled Future Combat Systems (FCS) Joint, Interagency, Multinational (JIM) Capabilities Analyses for the Defense Advanced Research Projects Agency/Tactical Technology Office.

The authors are grateful for the comments of Tom Garrett, Brad Hosmer, and John Smith, who reviewed the paper.

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CLOSE SUPPORT FIRES FOR THE ARMY'S OBJECTIVE FORCE 2015

A Study Prepared in IDA to Assist the DARPA-Army Program Manager for Objective Force with his Choices for FCS Increment 2

In May 2003 the U.S. Army will seek the approval of the Defense Acquisition Board to acquire the initial version (Increment 1) of Future Combat Systems (FCS), a Defense Advanced Research Projects Agency (DARPA)/Army/Industry-developed systems of systems that incorporates a wide range of innovations from manned and unmanned fighting vehicles to networked command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR). If approved, FCS first-unit-equipped (FUE), a brigade equivalent, would be fielded in 2008, with initial operating capability (IOC) of a division equivalent in 2012. Between 2012 and 2015, the Army plans to field a total of four more FCS-equipped division equivalents, termed units of employment (UE), each comprising three brigade equivalents, or units of action. In the Army's view, by 2015 these five FCS-equipped units within its Objective Force, while constituting a minority among the Army's combat formations, would ensure that the National Command Authority (NCA) has significantly more capabilities for force projection than the present force can provide (see Appendix A, The Objective Force 2015). The Army's goal is thus to transform its Active and Reserve Components so that its Objective Force can be described as follows:

- *Jointly interdependent*—structured to exploit Joint, interagency, and multinational capabilities;
- *Expeditionary*—manned, trained, and equipped for operational maneuver at strategic distances;
- *Aware*—sure of the locus of all its combatants and well informed of friends, foes, and neutrals;
- *Lethal*—capable of discriminate supporting fires synchronized with dominant maneuver;
- *Survivable*—able to combine awareness, agility, and sustainability into relative invulnerability.

FUE for FCS Increment 2, the first of successive upgrades that will bring into the Objective Force technologies judged too immature for inclusion in the preceding increment, plus capabilities that were unknown or overlooked, will be in FY12. IOC for Increment 2 is set for FY14. This paper, the first of four for the DARPA-Army Program Manager for Objective Force, focuses on "Lethal"—fire support for the Objective Force in 2015. For FCS Increment 2, we recommend alternatives to the provisions for fires envisaged for FCS Increment 1, especially those that pertain to the role of Close Air Support (CAS). The Unit of Action of Increment 1 may include self-propelled 155 mm howitzers and 120 mm mortars that, together with requisite ammunition and trucks, will entail significant airlift for strategic and operational maneuver and add materially to the tactical signature of the unit. This structure presents two questions for Increment 2:

- Should the Objective Force should depend more on missiles rather than organic cannons and mortars?
- How should the Unit of Action organic weapons be supplemented with joint fires?

The original concepts for FCS did not include cannons or mortars for indirect fires, but rather relied on DARPA's NetFires for line-of-sight (LOS), beyond-line-of-sight (BLOS), and near-line-of-sight (NLOS) missions (see Appendix B, The Original FCS Concept). In 1999, DARPA and the Army's Training and Doctrine Command (TRADOC) partnered to present to Vice Chief of Staff Army (VCSA) a unit of a future ground combat system (FGCS) structured around networked C4ISR linked to the global information grid (GIG) that would reduce sensor-decider-shooter latency, would be highly mobile and austerely manned, and would have robotics throughout. NetFires, Army aviation, and U.S. Air Force CAS would provide FGCS fire support. That notional unit was to be equipped with digital radio frequency tags (DRaFTs) that could interact with staring ground moving-target indicator (GMTI)/synthetic aperture radar (SAR)/ interferometric SAR (IFSAR) to furnish precise location of Joint, interagency, and multinational elements within radar coverage, one of the essential elements of information for CAS. When the FGCS was presented to General Keane, the briefer considered it germane that during Desert Storm, U.S. corps commanders, because they were uncertain of the exact whereabouts of their foremost troops, did not use many of the sorties allocated for "flow CAS" in the daily Air Tasking Order (Appendix E, pp. E-5–E-6.)

New stand-off weapons and targeting techniques being developed by the U.S. Air Force and U.S. Navy neatly complement NetFires, as do growing capabilities for exploiting the joint radar environment for precision targeting and for managing target

information efficiently within joint networks (see Appendix C, Stand-off Missile Systems and Joint Targeting). These developments could increase the lethality of FCS, diminish the need for organic cannons and mortars within units of action, broaden opportunities for joint interdependence, and enhance the Objective Force's expeditionary character and render it more survivable. Relevant Concept of Operations (CONOPS) are a close fit with TRADOC's stated requirements for the Objective Force (see Appendix D, Proleptic Examples).

Both the Army and the Air Force are doctrinally committed to CAS. Although there has been some acrimony over CAS incidents in Afghanistan, the public debates have focused more on fixing blame than on fixing the CAS system (see Appendix E, The Anaconda Controversy). The facts are that both services seem to share a common doctrinal vision for the future. If there is an issue, it rests on the control measures adopted by the Air Force to guard against fratricide, reflected in its CAS doctrine, and manifested in its substantial investments of manpower and materiel to execute its CAS missions (see Appendix F, Doctrine for Joint CAS).

It is possible that progress with Blue Force tracking already evident can be improved upon and extended to Joint, interagency, and multinational tracking, and thereby enable close support fires by stand-off missiles.

The structure for the brigade-equivalent Unit of Action that will be presented to the Defense Acquisition Board (DAB) incorporates, at this writing, the following manning and major equipment: in bold face are structural elements for NLOS fire support—indirect fires:

Total Personnel	2,499
No. Manned AFV	382
Personnel for Organic NLOS Fires	264
No. Manned Trucks for Organic NLOS Fires	91
No. Manned AFV for Organic NLOS Fires	45

The personnel and equipment for NLOS fires constitute 10.6 percent of Unit of Action manning, but 19.4 percent of the weight for airlift.[1] Further, FCS Increment 1 procures terminally guided projectiles for the 120 mm cannon for BLOS (projectiles launched from mounted combat systems with sufficient range and precision to strike

1 Estimated ramp weight of combat loaded vehicles. Total "essential combat weight" is 9,408.16 short tons. Of that weight, 1,822.825 short tons is NLOS weapons, trucks, and ammunition.

targets not in view of the firing vehicles), and expensive guided projectiles for the NLOS 155 mm howitzers and the 120 mm mortars (see Appendix G, FCS Increment 1 Structure).

By upgrading and supplementing NetFires and by using Army aviation to exploit Joint loitering missiles for close supporting fires, risks accepted with FCS Increment 1 can be mitigated, and FCS Increment 2 can be assured of higher lethality, rendered more expeditionary, and provided with more robust C4ISR and enhanced survivability. NetFires Increment 2 can be better able to service targets in proximity to the Unit of Action—whether LOS, BLOS, or NLOS—and to deliver effects for which no provisions now exist. As important, Increment 2 Apache and Comanche could employ U.S. Air Force and U.S. Navy weapons now in development that attack from standoff ranges, especially those that can loiter to strike within the Unit of Action fire support coordination line (FSCL).

Within the time frame of FCS Increment 2, dropping ordnance from manned high-performance fighter-bombers per present CAS procedures can be replaced by precision missile attack of targets proximate to Unit of Action, so that CAS can and should evolve to Joint provisions for close support fires within the FSCL of the Unit of Action commander. In particular, the Tactical Air Control System (TACS) can be simplified—the current human-centric, training-sensitive CAS [Tactical Air Control Party (TACP), terminal attack controller (TAC), forward air controller (FAC), enlisted terminal attack controller (ETAC)] can give way to a robust, low-latency, network-centric system amenable to automation—and manned fighter aircraft need not be equipped for CAS within the envelopes of forward-deployed hostile man-portable air defense (MANPAD)/short-range air defense (SHORAD) weapons. FCS Increment 2 should field a pervasive, persistent radar environment around the Unit of Action that furnishes a dynamic FSCL to a coherent Joint battle command and control (C2). Pivotal to that Joint battle C2 will be a Joint, interagency, and multinational tracking system (JIMTS) that plots within the FSCL(s) all friendly entities on the ground or in the air and a Joint C4ISR system to control all close support fires there: fires and fire-delivered effects impacting close to the Unit of Action, whether from organic weapons or from weapons from any of the four service components assigned to the Joint Force commander (see Appendix H, Joint Battle Command and Control and Conclusions).

Therefore, recommend that Program Manager Objective Force:

(A) Assign priority for FCS Increment 2 to funding the following:

1. Accelerated, improved, and extended NetFires, not only for direct support fires for Unit of Action, but also to respond to Joint, interagency, and multinational battle C2:
   - To rationalize Unit of Action transportation and handling by providing for pallets, cranes, and remote delivery by air landing or air drop, and by helicopter insertion of container launch unit;
   - To precede Unit of Action maneuver for combat upon arrival;
   - To detect, identify, and track targets collaboratively with Joint, interagency, and multinational ISR;
   - To provide immediate post-strike damage assessment;
   - To suppress, blind, deceive, or delay an enemy;
   - To emplace sensors, obstacles, or electronic-warfare apparatus within FSCL;
   - To perform three-dimensional maneuvers in close terrain and to deliver discriminate lethal effects (e.g., Mini-NetFires, Metal Storm).
2. Extend the current Command Post of the Future program into an Interactive Commander's Interface (ICI) for Joint, interagency, and multinational battle C2 that is capable of synchronizing Joint fires and maneuver and conducting collaborative engagement.
3. As a risk-reduction measure, a GMTI radar/processor pallet for the Blackhawk helicopter per the Communications-Electronics Research Development and Engineering Center (CERDEC) proposal that is capable of providing GMTI/SAR/IFSAR, radio relay, and signals intelligence above a ground unit, thereby developing software and communications for the ICI.
4. A medium-altitude, long-endurance C4ISR robotic rotorcraft (e.g., A–160):
   - To position GMTI/SAR/IFSAR, radio relay, and SigInt above each Unit of Action linked to the ICI;
   - To paint a dynamic FSCL around the Unit of Action to enable use of Joint standoff weapons;
   - To ensure Unit of Action awareness of nearby friendly, hostile, and neutral entities;
   - To deconflict the airspace within the Unit of Action FSCL;
   - To enhance the survivability of Joint, interagency, and multinational personnel and platforms;
   - To facilitate deployment, logistic support, and system maintenance.
5. A robust JIMTS linked to the ICI:
   - Based on DRaFT; support the initiative of Director, CERDEC, to experiment with "DRaFT-Lite" prototype tags and airborne GMTI;

- Tags supplemented by redundant active jamming Global Positioning System (GPS), Inertial Navigation System (INS), signal-time-of-arrival, altimeters, and other 3–D geopositioning.

6. A high-altitude, long-endurance (HALE) unmanned aerial vehicle (UAV) for communications relay and electronic warfare (EW) (e.g., GPS pseudolite).
7. Develop Army adaptations, with Joint battle C2, of the following systems (Appendix C):
    a. Low-cost autonomous attack system (LOCAAS) for launch of Army helicopters;
    b. Affordable weapon system (AWS) for launch from containers on palletized loading system (PLS) trucks;
    c. Affordable moving surface-target engagement (AMSTE), for use with Army GMTI radars;
    d. Cursor-on-target, for use throughout Army C4ISR.
8. Experiments that validate evolution from CAS to CFS (e.g., at DARPA's FCS C2 test bed at Fort Monmouth).

(B) Analyze the impact of Joint fires for adroitly implemented Joint, interagency, and multinational battle C2 and close support fires from beyond the FSCL upon the Army's ability to reduce organic structure for BLOS and NLOS fires in the FCS Increment 2 Unit of Action, and propose restructuring the Unit of Action accordingly.

(C) Through Director, Objective Force Task Force, propose that JCS instruct the Commander, Joint Forces Command (JFCOM), as Chair of the Functional Capability Board for Joint C2:

1. To devise a C4ISR architecture for close support fires—including JIMTS and Interactive Commander's Interface for Joint battle C2—and to work with the Joint Requirements Oversight Council (JROC) to ensure that service requirements for components within that architecture are met in time to be incorporated into FCS Increment 2.
2. To conduct analyses of a JTF with four service components in which units of action of an Army UE supported by an Air Expeditionary Force are dependent upon Joint fires rather than BLOS and NLOS fires from organic cannons and mortars.

GLOSSARY

3–D	three dimensional
AAA	Antiaircraft Artillery
AADC	Area Air Defense Commander
AAFARS	Advanced Aviation Forward Area Refueling System
AAGS	Army Air Ground System
AAN	Army After Next
ABCCC	Airborne Battlefield Command and Control Center
ABCS	Army's Battle Command System
ACO	Airspace Control Order
ACR	Armored Cavalry Regiment
AFARN	Air Force Air Request Net
AFSS	Advanced Fire Support System
AFV	Armored Fighting Vehicle
ALO	Air Liaison Officer
AMMPGM	Advanced Miniature Multi-Role Precision Guided Missile
AMSAA	U.S. Army Material Systems Analysis Agency
AMSTE	Affordable Moving Surface Target Engagement
AO	Area of Operations
AOA	Analysis of Alternatives
AOC	Aerospace Operations Center
ARNG	Army National Guard
ARV	Armed Robotic Vehicle
ARV-A (L)	Armed Robotic Vehicle Assault (Light)

ASB	Army Science Board
ASOC	Air Support Operations Center
ATACMS	Army Tactical Missile System
ATACS	Amphibious Tactical Air Control System
ATAS	Air-to-Air Stinger
ATO	Air Tasking Order
ATR	Automated Target Recognition
AWACS	Airborne Warning and Control System
AWS	Affordable Weapon System
BATS	Brilliant Anti-Armor Submunitions
BCD	Battlefield Coordination Detachment
BCIS	Battle Command Information System
BCOTM	Battle Command on the Move
BCS	Battle Command System
BDA	Battle Damage Assessment
BFA	Battlefield Functional Area
BFT	Blue Force Tracking
BLOS	Beyond Line of Sight
BOS	Battlefield Operating System
BVR	Beyond Visual Range
C2	Command and Control
C2I	Command, Control and Intelligence
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
CAOC	Combined Air Operations Center
CAS	Close Air Support
CECOM	U.S. Army Communications Electronics Command

CIC	Combat Information Center
CID	Commander's Interactive Display
CLU	Container Launch Unit
COE	Common Operating Environment
COG	Center of Gravity
COLT	Combat Observation and Lasing Team
CONOPS	Concept of Operations
COP	Common Operational Picture
CoT	Cursor on Target
CPOF	Command Post of the Future
CROP	Common Relevant Operating Picture
CS	Combat Support
CSAF	Chief of Staff Air Force
CSAR	combat search and rescue
CSS	Combat Service Support
CTAPS	Contingency Theater Automated Planning System
DAB	Defense Acquisition Board
DARPA	Defense Advanced Research Projects Agency
DASC	Direct Air Support Center
DMPI	Desired Mean Point of Impact
DPICM	Dual Purpose Improved Conventional Munitions
DraFT	Digital Radio Frequency Tag
DRB	Division Ready Brigade
DS	Direct Support
EHF	Extra High Frequency
EO	Electro-optical
ERMP	Extended Range Multi-Purpose

ES	Electronic Support
ETAC	Enlisted Terminal Attack Controller
EW	Electronic Warfare
FAC	Forward Air Controller
FAC (A)	Forward Air Controller Airborne
FAFV	Future Armored Fighting Vehicles
FBCB2	Force XXI Battle Command Brigade and Below
FCS	Future Combat System
FGCS	Future Ground Combat System
FLOT	Forward Line of Own Troops
FMTV	Family of Medium Tactical Trucks
FOPEN	Foliage Penetrating
FSB	Forward Support Battalion
FSCL	Fire Support Coordination Line
FSCM	Fire Support Coordination Measure
FSE	Fire Support Element
FTTS	Future Tactical Truck System
FUE	first unit equipped
GFAC	Ground Forward Air Controller
GIG	Global Information Grid
GMTI	Ground Moving Target Indicator
GPS	Global Positioning System
HALE	High Altitude Long Endurance
HAVEQUICK	Aircraft UHF-AM Transceiver with anti-jam capability
HEMTT	Heavy Expanded Mobility Tactical Truck
HF	High Frequency
HIMARS	High Mobility Artillery Rocket System

HMMWV	High Mobility Multipurpose Wheeled Vehicle
HTARS	HEMTT Tanker Aviation Refueling System
IADS	Integrated Air Defense System
ICI	Interactive Commander's Interface
ICV	Infantry Carrier Vehicle
IFF	Identify, Friend or Foe
IFSAR	Interferometric SAR
IMINT	Image Intelligence
INS	Inertial Navigation System
IOC	Initial Operating Capability
IR	Infrared
ISR	Intelligence, Surveillance and Reconnaissance
IUGS	Internetted Unattended Ground Sensors
JAAT	Joint Air Attack Team
JAOC	Joint Air Operations Center
JDAM	Joint Direct Attack Munition
JFCOM	Joint Forces Command
JIM	Joint, Interagency, Multinational
JIMTS	JIM Tracking System
JOA	Joint Operating Area
JROC	Joint Reqirements Oversight Council
JSHIP	Joint Shipboard Helicopter Integration Process
JSOW	Joint Stand-off Weapon
JSTARS	Joint Surveillance Target Attack Radar System
JTF	Joint Task Force
JTRS	Joint Tactical Radio System
LAM	Loitering Attack Missile

LHS	Load Handling System
LOC	Line of Communications
LOCAAS	Low Cost Autonomous Attack System
LOS	Line of Sight
LS	Launch System
LSI	Lead Systems Integrator
LZ	Landing Zone
MACCS	Marine Air Command and Control System
MALE	Medium Altitude Long Endurance
MANPAD	Man Portable Air Defense
MASINT	Measurement and Signature Intelligence
MCO	Major Combat Operations
MCS	Mounted Combat System
MEDEVAC	Medical Evacuation
METL	Mission Essential Task List
MLRS	Multiple Launch Rocket System
MNS	mision needs statement
MS	Mission Support
MTI	Moving Target Indicator
MUM	Manned-Unmanned
NAI	Named Area of Interest
NBC	Nuclear, Biological, Chemical
NCA	National Command Authority
NLOS	Non Line of Sight
NTACS	Navy Tactical Air Control System
OAV	Organic Aerial Vehicle
O&O	Operational and Organizational

OP	Observation Post
OPCON	Operational Control
OPSEC	Operational Security
OPTEMPO	Operational Tempo
ORD	Operational Requirements Document
PAM	Precision Attack Missile
PGMM	Precision Guided Mortar Munition
PLS	Palletized Loading System
POL	petroleum, oil, lubricants
RF	Radio Frequency
RSTA	Reconnaissance, Surveillance and Target Acquisition
SA	Situational Awareness
SADARM	Search and Destroy Armor
SAM	Surface to Air Missile
SAR	Synthetic Aperture Radar
SASO	Stability and Support Operations
SEAD	Suppression of Enemy Air Defense
SEMA	special electronic mission aircraft
SHORAD	Short Range Air Defense
SIGINT	Signals Intelligence
SINCGARS	Single Channel Ground and Airborne Radio System
SUGV	Small Unattended Ground Vehicle
SOF	Special Operations Forces
SORC	Statement of Required Capabilities
SOTAC	Special Operations Terminal Attack Controller
SOTAS	Stand-Off Target Acquisition System
SPINS	Special Instructions

SSM	Surface to Surface Missile
STS	Sensor-to-Shooter
SU	Situational Understanding
SUOSAS	Small Unit Operations Situational Awareness System
TAC	Terminal Attack Controller
TACC	Tactical Air Command Center
TACP	Tactical Air Control Party
TACS	Theater Air Control System
TACON	Tactical Control
TADIL-J	Tactical Digital Information Link (Link 16)
TAGS	theater air-ground system
TBMCS	Theater Battle Management Core System
TRADOC	Army's Training and Doctrine Command
UAV	Unmanned Aerial Vehicle
UE	Unit of Employment
VCSA	Vice Chief of Staff Army
VTOL	vertical takeoff and landing
WIN-T	War-fighter Information Network-Tactical
WWW	World Wide Web

APPENDIX A

THE OBJECTIVE FORCE OF 2015

APPENDIX A

THE OBJECTIVE FORCE OF 2015

On 12 October 1999 the Chief of Staff of the Army, General Eric K. Shinseki, announced the Army Vision, which set goals of deploying a brigade-sized unit anywhere in the world within 96 hours, a division-sized unit in 120 hours, and 5 divisions in 30 days. Integral to those deployments was the requirement that deployed units be capable of fighting upon arrival and of sustaining themselves for 3 to 7 days.

The Vision was an attack upon "Transformation" with three axes of advance: (1) Legacy Force sustainment and recapitalization, (2) Objective Force research and development, and (3) Interim Force fielding of Brigade Combat Teams. As Figure A-1 shows, these axes were to merge into the Objective Force.

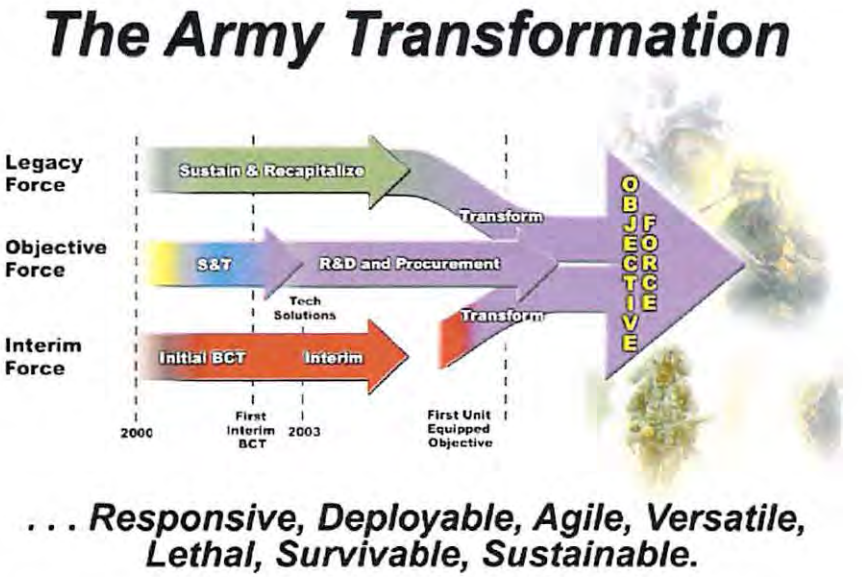

Figure A-1. Army Transformation

From that Vision came almost immediately a program to field an "Interim Force" equipped with a wheeled armored fighting vehicle (AFV); this has since evolved into a plan for six Stryker-equipped Brigade Combat Teams. In early 2000, the Army and DARPA executed a Memorandum of Agreement to partner to develop a "system of systems" initially called the Future Ground Combat Systems (FGCS). The name was later

changed to the Future Combat Systems (FCS), since the "system of systems" embraced more than just ground systems (see Appendix B for the evolution of concepts from 1996–1999). DARPA was then working on a number of technologies that it believed could be developed and transitioned to the Army to actualize FCS.

After urgings from Chief of Staff Army to accelerate its progress, the size, nature, and timing of the eventual Objective Force has gradually emerged. The date of "First Unit Equipped Objective" (diagram above), originally set at 2012, was advanced to 2008, and an extraordinary management team was put in place. In 2000, the Army formed an Objective Force Task Force, headed by Lieutenant General John Riggs. It further assigned acquisition responsibility for the Increment 1 version of the FCS to the Program Executive Office for Ground Combat Systems, headed by a major general. Within that office, a brigadier general has been assigned and chartered to act as the Program Manager for FCS Increment 1. DARPA accepted assignment of an Army officer to serve as the DARPA Program Manager for the Objective Force.[1] Soon after the DARPA-Army partnership was formed, DARPA entered into agreements with four contractor teams, each of which was to study the FCS concept and develop an innovative structure to enlarge upon it. Those teams were also to develop the rudiments of a development program and acquisition strategy. An acquisition strategy was published on 20 April 2001. In a solicitation released by DARPA in November 2001 to seek proposals from contractor teams vying to serve as a Lead Systems Integrator, FCS was described as follows:

> The Future Combat Systems (FCS) program is a joint effort of the Defense Advanced Research Projects Agency (DARPA) and the Department of the Army. The Army, as the Nation's predominant land component, must be capable of responding to the range of combat and non-combat operations/missions enumerated within Joint Vision 2020. FCS is the centerpiece for the Army's Transformation program. FCS is envisioned to be a "system of systems," designed to permit the Army to be dominant across the full spectrum of military operations outlined in Joint Vision 2020.[2]

In March 2001, DARPA and Boeing Corporation entered into an 845 Other Transactions agreement under which Boeing would serve as that Lead Systems Integrator (LSI) for the Concept and Technical Development phase with an option to continue into a

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1 The position, originally designated Program Manager FCS, was eventually redesignated the broader, more time-extensive Program Manager for the Objective Force.

2 FCS Solicitation PS02-07, Released 23 November 2001, Proposals were due on 17 January 2002.

System Design and Development phase. The option was dependent in part upon an affirmative Milestone B decision by the Defense Acquisition Board authorizing continuance of the program into System Design and Development. The LSI contractually agreed to perform numerous integrative functions, including development of many of the various documents and plans required by the DoD 5000-series acquisition regulations for a Milestone B decision review.

In the meantime, TRADOC had been working on concepts of operations and materiel requirements for the Objective Force. On 6 November 2001, TRADOC published its Pamphlet 525-3-91, *The United States Objective Force, Tactical Operational and Organizational Concept for Maneuver Units of Action.* This Pamphlet, a draft Mission Needs Statement (MNS), and a draft Statement of Required Capabilities (SoRC) were included as annexes to the LSI solicitation. Though the title of the TRADOC document would indicate that it included an organization for a Unit of Action, it did not; but it did include a relatively detailed description of its CONOPS.

In the spring of 2002, the Army Materiel Systems Analysis Agency (AMSAA) published its *Future Combat Systems Unit of Action Systems Book, AMSAA Version 1.2.* That AMSAA product described a variety of materiel envisioned as constituting the equipment for a Unit of Action; it was designed to support the Analysis of Alternatives (AoA) to be conducted by AMSAA. An AoA is required for a Milestone B decision review.

On 22 July 2002, TRADOC Pamphlet 525-3-90/O&O, *The United States Army Objective Force, Operational and Organizational Plan for Maneuver Unit of Action* appeared. This document presented an organization for the Unit of Action comprising 2,145 to 2,245 personnel and including a variety of light-armored platforms for various purposes, earlier described in the AMSAA *Systems Book* (above). On 25 November 2002, Change 1 to TRADOC Pamphlet 523-3-90 was released, changing the organization for the Unit of Action. The number of personnel increased to 2,499; the change also listed 12 different types of light-armored vehicles plus a new 6-ton truck system, the Future Tactical Truck System (FTTS), in several configurations.

On 20 December 2002, AMSAA updated its *Future Combat Systems Unit of Action Systems Book, Version 1.5.* That book describes the threshold systems for Increment 1 of FCS and the objective systems for Increment 2 and later. On 8 December 2002, Director of the Army's Objective Force Task Force issued the "final draft" White Paper, *The Objective Force in 2015.* It stated,

> In 2015, the Objective Force is the Nation's offensively oriented, JIM, interdependent, combined arms precision maneuver force that employs revolutionary multi-dimensional operational concepts enabled by technology. The Objective Force brings a campaign quality to the Joint fight, ensuring long term dominance over evolving, sophisticated threats with asymmetric capabilities on a non-contiguous battlefield against an adaptive enemy.

The White Paper describes the Objective Force of 2015 as containing "5 Units of Employment, 15 Units of Action, 6 Stryker Brigade Combat Teams (SBCTs), 2-1/3 Digital Division Corps, and a combination of heavy, light, and specialty forces brigades (airborne, air assault, Special Forces), USAR units, and 4 Multi-Functional ARNG Divisions."[3] However, the White paper also asserts that the Army plans

> to field brigade sets of equipment at the rate of three Units of Action (UA) and one Unit of Employment (UE) per year until we complete Transformation. Given the UE fielding timeline of 18 months, there will be 6 UAs and 2 UEs in fielding (non-mission capable) at any one time. The Objective Force provides us the traditional heavy-force campaign overmatch, rapid and flexible SBCTs, and full spectrum precision maneuver Objective Force UEs and UAs.

A more detailed description of the Objective Force, as currently planned, is included in Appendix G. The Army's expectation is that "Transformation" will be achieved by 2030.

Each of the cited documents envisages the Objective Force as versatile, able to sense and respond with alacrity. TRADOC's operational and organizational (O&O) plan for the Objective Force Unit of Action (Pamphlet 525-3-90), Chapters 1 and 2, sets forth CONOPS for Joint and ground-combat operations by the Objective Force, structured and equipped "to see first, understand first, act first, and finish decisively." Although there are numerous other descriptors for the Objective Force of 2015, its qualities can be captured with five broad terms, as follows:

Expeditionary. It must be smaller and lighter than traditional combat organizations, be austerely manned, and be equipped with complementary systems that can be deployed and supported by air over intercontinental distances. It must be able to accomplish more strategically and operationally with less: operational maneuver at strategic distances.

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3 *The Objective Force 2015,* 8 December 2002, p. 1.

Aware. It must rely upon a pervasive, persistent surveillance regime, networked across traditional Service boundaries to provide to all Joint participants a common relevant operating picture of unprecedented reliability, especially relative to Blue and Red situational awareness. Broadband communications that admit no Service distinctions must tie that network together.

Lethal. It must be capable of striking targets to kill or neutralize within seconds of identification, and it must be able to deploy weapon systems capable of engaging, hitting precisely, and destroying any adversary from the outer limits of the Unit of Action/UE area of influence to within line of sight (LOS). It intends to destroy the adversary beyond LOS using ordnance for beyond-line-of-sight (BLOS) and non-line-of-sight (NLOS) engagements. For any adversary that is able to maneuver to within LOS ranges, the networked fires system shall detect the enemy, engage the enemy with precise munitions within seconds, and decisively finish that enemy.

Survivable. Survivability depends upon (1) protection derived from improved, network-enabled information and knowledge management and information systems; (2) technological innovations to defeat any adversary's threat measures and counter-measures (e.g., chemical and kinetic energy munitions, electronic detection and jamming, and entry-denial systems); (3) platform agility and active defenses designed as a trade-off for heavy armor; (4) dramatically more efficient sustainability; and (5) reformed personnel policies and training systems.[4]

Jointly Interdependent. The Army must rely upon nonorganic assets provided by other Services and Defense agencies to carry out operational maneuver at strategic distances and sustained land combat in support of national objectives. That inter-dependence extends far beyond traditional notions of supporting-supported relationships, especially for fire support. As the White Paper posits, "In 2015, the Objective Force is an integral component of the Joint Force. It is organized, manned, equipped and trained as a JIM force, possessing common overarching doctrine, integrated training, commonality and interdependency/interoperability."[5]

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4 Objective Force White Paper, p. ii: "The Transformed Army is not just new systems; it is completed, holistic revolution in organizations, training, materiel, leader development, people and facilities (DOTMLPF). The Objective force represents not only a change in our operational Army, but also a change in our institutional Army. It will be Soldiers, not technology, that realize the campaign qualities of America's Army, the Objective Force."

5 Ibid., p. 2.

Specifically, the Objective Force

- integrates, transfers, and partners capabilities throughout the Joint Force with speed and audacity;
- strengthens the ability of the U.S. to deter, preclude, and limit conflict escalation by providing a multidimensional campaign quality threat to any potential adversary;
- provides the Joint Forces Commander the precision maneuver tool complementing precision engagement capabilities and creating the synergistic effect of precision strike throughout the Joint Operations Area;
- *enables Joint fires by empowering the maneuver commander to accurately focus all available destructive fires;*
- contributes through the Objective Force Joint C4ISR architecture to the common operating picture, transforming data into knowledge, thereby by massing Joint capabilities;
- provides operational-level information superiority to the Joint Forces Commander, enabling him to gain and maintain operational initiative;
- provides the essential capability to achieve a decisive victory through the control of terrain, people, and resources without resorting to indiscriminate destruction.

From any perspective—strategic, operational, or tactical—elimination of latencies in the sensor-decider-shooter cycle is the salient feature of FCS. Its ground-combat platforms will be lightly armored vehicles that can be deployed within the time lines established by the Army Vision by both inter-theater and intra-theater airlift. Those vehicles are to be highly agile and reliable and have extended operating ranges—they are to arrive in theater ready to fight 24/7 with a reduced need for traditional pauses for refueling and rearming. The FCS force will have several types of robotic aerial vehicles with sophisticated sensors, on-board processors, and communications. Aerial robots will dwell continuously over the ground elements, providing persistent surveillance and communications relay. FCS will feature a network of computers linked by communications devices, with both omnidirectional and directional antennas and with varying waveforms, including those with low probability of detection and antijam characteristics. This network is to be integrated across the battlespace and will be tied seamlessly to all Joint, interagency, and multinational participants. C4ISR within the Unit of Action—organic, from the UE or from Joint or national agencies—must be designed to expedite maneuver and fires.

The FCS-enabled Unit of Action relies upon alacrity and fires instead of the traditional overmatch systems of the Cold War era. The Army's Operational and Organizational Plan[6] for the Objective Force describes how the FCS-enabled Unit of Action achieves overmatch:

> The UA builds lethal overmatch through a new combat power formula. In the past, combat battalions relied on Maneuver, Firepower, Protection and Leadership as the formula for Combat Power: CP=M+F+P+L. However, in the UA, situational understanding derived from real-time, accurate Information raises combat power exponentially: $CP = ((M+F+P)(L))^{Information}$. The strengthened ability to see and comprehend the relevance of the environment permits the UA to seek the advantage aggressively, employ combat skills, execute battle command, and fight collectively to win sequential and simultaneous engagements. This is a combined arms force with the ability to provide mutual support and cooperative engagement between platoons, companies, and battalions. Also built into the organization is *the ability to employ lethality from external sources.* Structurally, and through the network, sensor-shooter relationships begin at the platform level and exist throughout the formation, providing the UA the ability to accurately direct effects internally or from supporting UE forces and joint assets. *This ability to cooperatively engage targets with tactical, operational, and strategic level assets will be accomplished in seconds rather than minutes.* [italics added] (pp. 3-1 to 3-2)

Describing the required capabilities for the Unit of Action when engaged in tactical operations in urban terrain, the O&O states, "ISR must be networked with direct access to the full array of LOS, BLOS, and NLOS fires, Army and Joint, with sensor-to-sensor links that *receive fire support in seconds.*" [italics added] (pp. 6–8)

Time, then, the Army hypothesizes, is the *critical determinant of both tactical success and force survivability.*

The Army CONOPS for the Objective Force is predicated on what it refers to as the "quality of first":

> Historically, uncertainty about enemy and friendly conditions on the battlefield often dictated cautious movements to contact. US forces lost both time and resources developing the situation while in contact, followed by the initiation of decisive action at a time and place which was not necessarily that of the commander's choosing. UA capabilities break

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6 Change 1 to TRADOC Pamphlet 525-3-90, *The United States Army Objective Force Operational and Organizational Plan*, 25 November 2002.

> this paradigm...The UA has the wherewithal to develop the situation before, during, and after contact, affording leaders and soldiers unprecedented situational dominance with revolutionary competencies and capabilities. The UA operates within a new tactical paradigm based upon the quality of first: the ability to see first, understand first, act first, and act decisively."[7]

"Seeing" means not only detecting, classifying, recognizing, and identifying enemy forces but also knowing where friendly forces and neutrals are on the battlefield. Seeing includes automated cueing. It also includes awareness of environmental influences on operations—terrain, weather, and population implications. Overall, "seeing first" permits Objective Force leaders to know, think, and understand several steps ahead of the enemy—a measure of relative timing. "Understanding first" is the recognition of the enemy's patterns that stems from the maneuver commander's contextual comprehension, aided by the use of automated predictive analyses, filters, and fusion of information and data. "Understand first" enables commanders at all levels to apply fires, fully integrated with maneuver, to achieve success before, during, and after tactical engagements. "Act first" connotes using the foregoing to seize and to maintain the initiative, establishing overwhelming dominance through massed lethal effects—meaning the combination of all elements of combat power applied at the right time and place. "Finishing decisively" means controlling the tempo of tactical operations, denying the enemy freedom of action, destroying the enemy's ability to fight, and enforcing the Joint Forces Commander's desired end state.[8]

Traditionalist cynics have argued, and will continue to argue, that the FCS is too light: no 16- to 22-ton vehicle can slug it out and win against the 70-ton tanks that potential adversaries have in their inventories or that they could export to rogue states. That argument, grounded in Industrial Age, Cold War thinking, is colored by the perception that Objective Force battles will be fought in the same mode as World War II or Desert Storm tank battles. And, in an LOS duel, one lightly armored FCS platform against one 70-ton tank might have a low probability of survival. Increment 1 FCS platforms will be able to survive a direct hit from up to a 14.5 mm projectile, with add-on armor they can be protected against munitions up to 30 mm. Substantial advances in passive defenses may occur over the next decade, so that FCS Increment 2 (and later

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7 Ibid., pp. 4-1 and 4-3.

8 Ibid., Chapter 4.

iterations) might outfit an AFV to defeat large-caliber kinetic-energy penetrators.[9] Available active-protective systems (APS) and electromagnetic armors can defeat large-caliber chemical-energy munitions, particularly rocket-propelled grenades. It is also true, given the range of existing and prospective anti-armor weapons, that even a 70-ton tank does not have assured passive defenses. Nonetheless, an FCS AFV will be no match one-on-one against a legacy main battle tank.

On the other hand, operating an FCS platform within a formation, and that formation within a credible C4ISR system, changes the odds. Simply put, the FCS platform's probability of survival will then be higher because the *formation* will be aware of the enemy, able to fix his exact location, and fire first with precise munitions with a high probability of kill.

The 15 Units of Action within the 2015 Objective Force are being designed for the Information Age. A Unit of Action can expect to be assigned an Area of Influence[10] with up to a 75-kilometer[11] radius—almost 18,000 square kilometers. The objective is to destroy the adversary in other than a toe-to-toe, one-on-one battle, so that the lighter, more agile force survives in the end. The Army describes survivability as:

> the ability to combine systems, tactics, operations and processes that afford optimum protection to deployed Army forces. The UA seeks to leverage technology, tactics, and processes to achieve survivability overmatch while employing lighter platforms, in terms of weight, to achieve responsiveness, agility, versatility lethality, mobility, and sustainability. It uses SU [situational understanding] with lethality and speed, in conjunction with active and passive protection capabilities to achieve survivable forces. *For the UA, survivability is more than armor protection to platforms; it is a holistic and layered approach that emphasizes defeating all enemy weapons effects against all FCS systems before impact. The survivability concept for the UA is to destroy the enemy first and don't be detected, acquired, hit, or penetrated.* [italics added][12]

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9 Realistically, to be included within the Objective Force of 2015, any technological invention that will appear in that force must have completed development and been deemed ready for production by 2012, at the latest.

10 "An area of influence is a geographical area in which a commander can directly influence operations by maneuver or fire support system normally under the commander's command and control...." p. 4-6, ibid.

11 See Figure 4-1, p. 4-7, ibid.

12 TRADOC Pamphlet 525-3-90, pp. 4-76–4-77.

The mechanism to achieve the "holistic and layered approach" and to "destroy the enemy first" without being "detected, acquired, hit, or penetrated," is a concept known as "networked fires." Networked fires is expected to change the dynamics of indirect fire support:

> Networked Fires is a system of systems that will provide future commanders real-time capability to apply full dimension effects solutions across the battlespace. It is fully integrated and interdependent with Army, joint, multinational, and interagency sensors; effects-generating systems and capabilities; and information technology systems. Networked Fires is a purpose-oriented, execution-focused, networked capability optimized to provide a broad range of lethal and non-lethal effects against enemy decisive points and centers of gravity in concert with maneuver and support operations. It enables the commander to dynamically apply fires and effects, on demand, to any echelon, in support of combined arms and joint operations in any operating environment.
>
> Teaming by ISR and indirect fire systems dispersed throughout the battlespace and by small tactical units fully integrated with maneuver is critical. The requirements for such a capability must be achieved by a system of systems framework. It is critical that an enabling, integrated networked fires system-of-systems solution, leveraging a wider set of capabilities including sensors, command and control, and attack means from Army, Joint and multi-national forces, be pursued to provide the operational capability required today and in the future...
>
> Networked fires is a component of the battle command system and supporting communications architecture. It is a triad of relevant sensors, effects capabilities, battle command tools and communications capabilities available across the UA which enables dynamic application of lethal and non-lethal destructive and suppressive effects to achieve the commander's tactical and operational objectives...Networked...fires are fully integrated from theater to platform, allowing it to rapidly establish, alter, and terminate linkages to all relevant sensors and LOS, BLOS, NLOS, external and Joint systems with a wide set of lethal and non-lethal effects.[13]

As Figure A-2 shows, networked fires is one of the keys to Objective Force tactical lethality and survivability. The accompanying text points out that from maneuver platoons rearward throughout the Unit of Action are organic weapons that can fire BLOS and NLOS to provide precision effects at extended ranges. "Missiles-in-a-box"—a reference to DARPA's NetFires program—provide the capability of delivering precision

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[13] TRADOC Pamphlet 525-3-90, p. 4-63.

missiles [Precision Attack Missiles (PAM) and Loitering Attack Missiles (LAM)]. Combined-arms battalions also employ missiles-in-a-box to set the conditions for company engagements. Finally, the brigade has organic NLOS howitzers and mortars in addition to the capability to employ missiles-in-a-box. All echelons have *direct* access to Army and joint fires through networked fires.

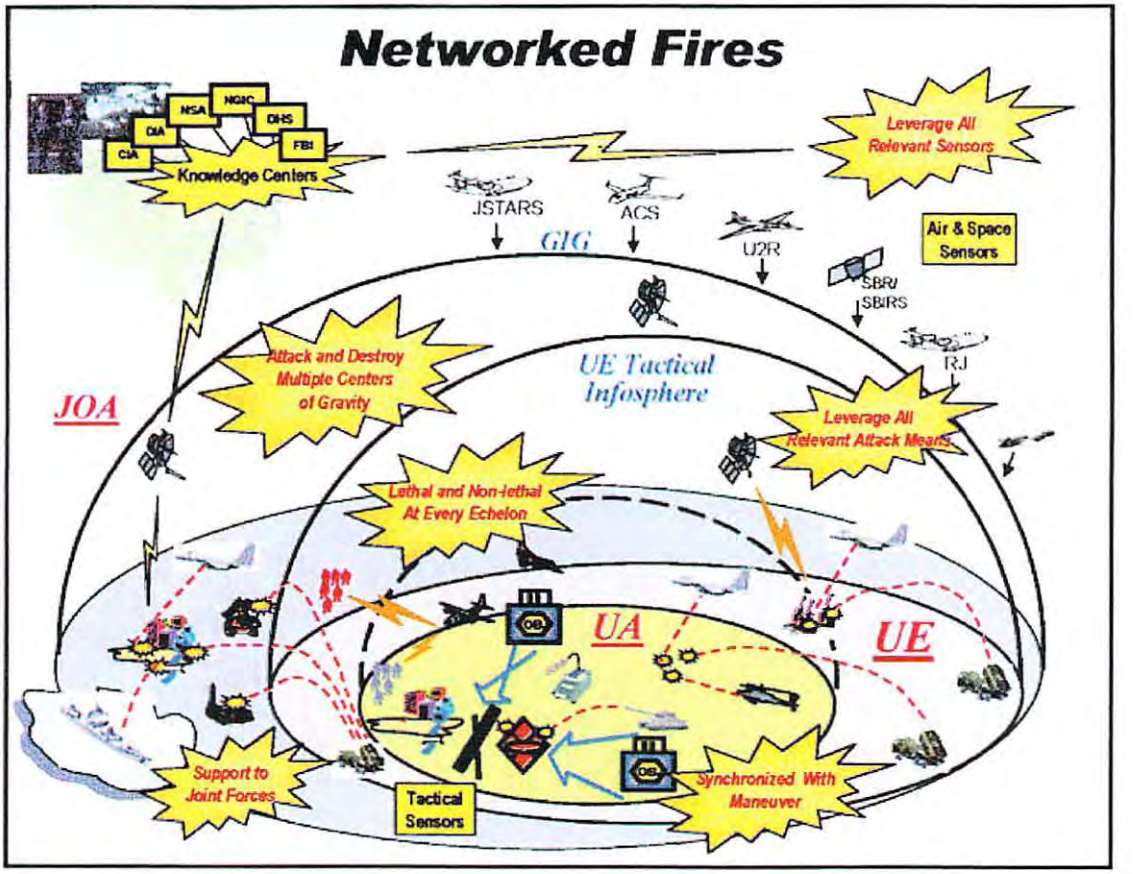

Figure A-2. Networked Fires (Source: Pamphlet 525-3-90)

A. HOWITZERS AND MORTARS WITHIN UNIT OF ACTION OF THE OBJECTIVE FORCE

The organizational design for the Objective Force Unit of Action includes eighteen 155 mm howitzers and twenty-four 120-mm mortars. Those weapons are to be moved about on lightly armored vehicles with a hybrid-electric drive, recuperative turbine engine, and in-chassis motors that provide power to a band-track suspension system. Both are to be 22 tons combat loaded. The howitzer carrier is to be 18 tons in the deployed configuration, and the mortar carrier will be 16 tons. The howitzer carrier will

carry 24 rounds of ammunition with propellants and fuses in the threshold configuration, 48 in the objective configuration. The howitzer is required to do the following:[14]

> NLOS Cannon respond to fire mission in 20 (T), 15 (O) sec for target within 30 deg of vehicle centerline. [3293]
>
> NLOS Cannon respond to fire mission in 45 (T), 30 (O) sec for target outside 30 deg of vehicle centerline. [3293]
>
> NLOS Cannon respond to fire mission when moving in 30 (T), 20 (O) sec after stop. [2205]
>
> NLOS Cannon compute firing data; provide limited fire direction for battery. (O) [2760]
>
> NLOS Cannon fire 6 (T), 10 (O) rounds per min for on-board ammo. [2175]
>
> NLOS Cannon have minimum range of 4 (T), 3 (O) km for low-angle indirect fire. [2169]
>
> NLOS Cannon fire 30 (T), 40 (O) km. [2173]
>
> NLOS Cannon fire current ammo with CEP 0.55% of range within 30 km. (O) [2172]
>
> NLOS Cannon munitions use widespread technology. (O) [3393]
>
> NLOS Cannon engage and destroy aerial targets. (O) [3313]
>
> NLOS Cannon fire current and developmental ammo. (O) [2197]
>
> NLOS Cannon verify projectile, fuze, propellant before ramming. (O) [2198]
>
> Similarly, the 120 mm mortar is required to do the following:[15]
>
> NLOS Mortar respond to fire mission in 30 sec when emplaced, 60 sec when moving. (O) [1700]
>
> NLOS Mortar move 750 m from firing position in 90 sec (T), shoot on the move (O). [1701]

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14 Extracted directly from page 3-28, *Army FCS UA Systems Book Version 1.5,* 20 December 2002; (T) means Threshold version; (O) means objective version.

15 Ibid., p. 3-22.

NLOS Mortar have semi-autonomous (T), autonomous (O) fire control. [2225]

NLOS Mortar have autoloader to handle current and developmental 120mm mortars. (T) [2227]

NLOS Mortar fire in any direction. (O) [2229]

NLOS Mortar fire LOS for self-defense up to 500 (T), 1000 (O) m. [2221]

NLOS Mortar fire MRSI, 12 rounds impacting within 4 sec. (O) [2215]

NLOS Mortar sustain 8 (T), 10 (O) rounds per min. [2216]

NLOS Mortar fire maximum of 16 (T), 24 (O) rounds in 1 min. [2278]

NLOS Mortar engage targets out to 8 km. (O) [2224]

NLOS Mortar fire developmental rounds out to 12 (T), 15 (O) km; and fire future rounds (O). [2725]

Both of these ground-to-ground fire-support systems are to fire current ammunition as well as the precision munitions now under development—the Excalibur for the howitzer and the Precision Guided Mortar Munition (PGGM) for the mortar. In Operation Anaconda, Coalition Joint Task Force participants used a combination of 120 mm, 81 mm, and 60 mm mortars. Table A-1 compares current ammunition for these mortars and 155 mm howitzer projectiles:

Table A-1. Mortar and Howitzer Comparison

Munition	Projectile Weight	Weight: Explosive Charge	System Maximum Range
60 mm Mortar	3.07 lb	0.42 lb (6.72 oz) of Comp B[a]	1,650 m
81 mm Mortar[b]	7–10 lb	1.29-2.10 lb of Comp. B	5,608 m
120 mm Mortar[c]	20–29 lb	10 lb of TNT	7,500 m
155 mm Howitzer	95–98 lb	14.5 lbs of TNT—15.5 lb of Comp. B	18,100–22,000 m—30,000 m w/RAP

a AMC Pamphlet 700-3-3, "Logistics, Complete Round Charts," Headquarters, U.S. Army Materiel Command, 30 November 1985.

b FM 23-90, 1 March 2000, Chapter 4.

c FM 3-06.11, 28 February 2002, Chapter 7, and FM 23-90, 1 March 2000, Chapter 7.

The explosive charge within a 60 mm mortar high-explosive round is slightly larger than that within an M61 fragmentation grenade (6.72 ounces vs. 5.5 ounces of Composition B explosive). The Army's Field Manual 71-123, *Tactics, Techniques and*

Procedures in Support of Heavy Brigade Operations, points out that the disadvantages of mortars are (1) they are easily detected, (2) they are not as precise as howitzers, (3) they are affected greatly by strong winds, (4) they have short range, (5) they have a long time of flight, and (6) they can carry only a limited amount of ammunition.

FM 71-123 lists the disadvantages of field artillery: (1) howitzers are area-fire weapons; (2) point-target engagements require guided/homing projectiles (i.e., Copperhead, which only comes in a 155 mm configuration and is not a part of the howitzer's basic load); (3) guided/homing projectiles (Copperhead) are available in limited quantities; (4) howitzers are not suited for a direct fire role; and (5) howitzers have a limited ability to mass fires on moving targets.

Appendix C of FM 6-20-30, *Improved Artillery Munitions,* further describes the vulnerability of the Copperhead munitions: (1) weather conditions limit the performance of the laser designator, (2) the laser designator and the operator are vulnerable to ground fires, (3) the laser designator operator must track the target continuously over the last 13 seconds of flight of the projectile, (4) performance is dependent upon effective radio frequency communications between the laser designator operator and the artillery fire direction center, (5) the laser designator signal can be detected, and (6) success depends upon reflected energy. Table A-2 provides comparative statistics on the effectiveness of various mortar and 155 mm howitzer rounds.

Table A-2. Number of Rounds for 30-percent Damage

Type Round	Max. Range	Tank Target	APC Target	ADA Gun Target	Commo Van (Soft) Target
120 mm HE PD	5 km	3,348	1,074	138	30
120 mm DPICM	5 km	954	210	546	66
81 mm HE PD	5 km	8,268	1,548	378	54
155 mm H PD	15 km	708	516	180	78
155 mm DPICM	15 km	504	348	468	36

The figures in the table were derived by the U.S. Army Materiel Systems Analysis Agency (AMSAA), using their CCTC Model (Unclassified). For each munition shown, these comparative figures represent, the number of rounds that must be fired to achieve 30-percent damage to the targets shown (30-percent casualties or material

damage is the definition of "destruction" in FM 105-5-1).[16] As these figures show, the harder the target, the less effective mortars are. But conventional rounds for mortars, even 120 mm mortars, were never designed to engage hardened or elusive targets. The same is true for howitzer rounds.

As mentioned above, the Army is developing an Excalibur round for the 155 mm howitzer and a Precision Guided Mortar Munition (PGMM) for the 120 mm mortar. Those munitions are among the required capabilities of the FCS 155 mm NLOS cannon and the 120 mm mortar. The XM982 Excalibur is actually a family of global positioning system/inertial measurement/precision-guided projectiles. Cost estimates for initial production will be at least $35,000 per round for the first 100,000. They are to have a 37 to 40 km range. There will be a Dual Purpose Improved Conventional Munition (DPICM), a Sense and Destroy Armor (SADARM) projectile, and a Unitary (Bunker Buster) projectile. These munitions will begin fielding sometime between fiscal year 2007 and 2010. Like the Copperhead howitzer round, the 120 mm mortar PGMM is a laser-guided munition. It is expected to extend the range of the mortar to 12–15 km within the capabilities listed for the mortar in the *FCS UA Systems Book Version 1.5*. The cost per PGMM round is forecast to be $15,000. The first unit is to receive the PGMM in fiscal year 2007.

In earlier versions of the Unit of Action design, an Army rocket system called the High Mobility Artillery Rocket System (HIMARS) was included within the Unit of Action. HIMARS is 5-ton truck-mounted version of the Multiple Launch Rocket System (MLRS) that has been fielded within the Army's heavy divisions for years. HIMARS accommodates one pod of six M26/M26A1 rockets; the MLRS can mount two pods. HIMARS can mount one medium-range Army Tactical Missile System (ATACMS); MLRS can mount two. The area covered by one rocket containing DPICM bomblets is nearly 20 percent of a square kilometer. Both systems have on-board fire control that can launch rockets within seconds of a call for fire. The difference in the two systems is mobility, as HIMARS will be transportable on C130-type aircraft. HIMARS will be found at the Unit of Employment level and should be made available to a deployed Unit of Action. The HIMARS rockets have a range of 32 to 45 km. The ATACMS rocket has a range of 300 km. Soon to be fielded are improved rockets that will have a circular error probable of 5 m, with a deflection error of 2–3 mrad.

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16 "When referring to the effects of field artillery fires, a target out of action permanently, or 30% casualties or material damage. Destruction requires large expenditures of ammunition and is prohibitive unless using improved conventional munitions or 'smart weapons.'"

The missiles within the system referred to within the Unit of Action O&O as the NLOS Launch System are called NetFires, a DARPA technology demonstration program that is in the process of transition to the U.S. Army Aviation and Missile Command for system design and development, with a projected introduction into Increment 1 of FCS within the 2008–2010 time frame. NetFires is a vertical-launch, soft-launch technology borrowed from a Navy development. The missile is 7 inches in diameter and has a very high probability of first round hit. Currently, there are two types of missiles, the loitering attack missile (LAM) with 150 km range or 50 minute loiter time, and the precision attack missile (PAM) with a 40 km range. The LAM will have 5 pounds of explosives within its warhead; the PAM will have 25–28. The warheads will have GPS/INS guidance, the capability to communicate in-flight so a LAM can update and redirect PAMs toward elusive targets, and protection against jamming. Although the current development program has not concentrated upon the development of a container round to emplace sensors, drop illumination flares, or carry other lethal and nonlethal payloads, that need is recognized. Each container launch unit (CLU) is configured at the factory to hold 15 missiles plus the fire-control computer and communications to fire and control the missiles. The CLU will be sealed at the factory and will remain in that sealed container until the missiles are fired. This simplifies packaging and handling from factory to firing unit.

Table A-3 presents another set of statistics derived by AMSAA to compare the effectiveness of various 155 mm projectiles; rockets fired by the MLRS and its lighter sibling, HIMARS; and NetFires missiles. These statistics are the results of simulation runs by AMSAA using its GENESIS and ARTQUICK models. "Destruction" in these simulations is not merely 30-percent casualties or material damage shown in Table A-2. In this case, destruction means a mobility or firepower kill—the weapon system is nonfunctional. The threat is an armored division containing, among other capabilities, 325 tanks, 54 self-propelled artillery pieces, and 4 Air Defense Missile Launchers. The end condition for the simulations was destruction of 50 percent of the tanks, artillery, and air-defense missiles.

The sensor-fused munition shown for the 155 mm cannon is the Excalibur round. These figures show the comparative effectiveness of the various systems that will support the Unit of Action of the Objective Force of 2015. They are important for three reasons: (1) they reflect the effects of the diverse probabilities of first round hit of the various munitions; (2) they vividly show the difference in effects of precision munitions when

Table A-3. Number of Rounds to Engage Typical Targets in a Threat Tank Division

Weapon and Round	Threat (total) Tanks (325)	SP Arty (54)	Air Def (4)
155 mm Howitzer			
DPICM	73,123	702	26
Unitary HE	11,735	1,530	10
Sensor Fused	3,250	108	18
MLRS			
DPICM	22,749	162	6
PGM	650	81	4
NetFires			
PGM	325	54	4

compared to nonprecision munitions; and (3) they give an indication of the number of projectiles that a Unit of Action would have to carry and expend against such a threat. The third factor appears to be adequate rationale to support the hypothesis that reliance upon nonprecise munitions may prove to be disastrous in a high-intensity 24/7 fight using howitzers and mortars.

To elaborate, we can estimate ammunition requirements, basing them on expenditure rates for similar systems—today's 155 mm howitzers and 120 mm mortars. The AMSAA-derived expenditure rates within FM 101-10-1/2 do not relate to a 24/7 type of operation envisioned for the Unit of Action; ST 101-6, however, factors combat intensity into the consumption equation. The computations below should be at least a rough indication whether the transportation assets shown within the Unit of Action structure could conceivably accommodate self-sustainment. If those assets are insufficient to handle Class V requirements, transporting additional classes of supply using the same limited assets is impossible.

Ammunition for the major caliber weapon systems—120 mm LOS/BLOS cannon on the Mounted Combat System (MCS), which will deliver indirect, BLOS fire support; 155 mm NLOS howitzer; and 120 mm NLOS mortar—can be aligned to the expenditure rates shown in Chapter 1 of ST 101-6. Shown below are the required supply rates for heavy-intensity combat as provided in OPLOGPLN 1.30. These rates should be somewhat close to the requirements that a firepower-intensive Unit of Action will experience in a 24/7 conflict:

- Each mobile gun system should be expected to fire 191 rounds (6.54 short tons) on the first day of the attack and 192 (6.57 short tons) on the second and third days.
- Each 155 mm NLOS cannon should be expected to fire 214 projectiles (18.26 short tons) on the first day and 172 projectiles (14.68 short tons) on days 2 and 3.
- The 120 mm mortars should each be expected to fire 108 rounds (2.16 short tons) the first day and 59 rounds (1.18 short tons) on days 2 and 3.
- The amount of ammunition needed in those identified categories amount to 2,028.36 short tons.

The MCS will be able to carry 43 rounds, the 155 mm howitzer carrier 24, and the 120 mm carrier 48. That represents 139.32 short tons of the 2,028.36 short tons required. Vehicles other than the weapons carriers will have to upload and carry that Class V tonnage (1,889.04 short tons) if the Unit of Action arrives with sufficient Class V to sustain itself for 3 days of intense combat as the Army Vision provides. The Future Tactical Truck System—Mission Support within the Unit of Action is to provide the Class V uplift capability. That truck is to be a medium tactical vehicle in a 6-ton class; it is to have a gross vehicle weight of 15 tons with a 6-ton load. Thus, to accommodate just the Class V requirements of the three indirect fire systems shown, 315 FTTS trucks will be required within the Unit of Action. Of the 204 such trucks within the Unit of Action, only 85 are available to carry ammunition, and 36 of those are trucks that are carrying a 2,700-pound NLOS Launch System (NetFires) CLU.[17] Thus, the total potential Class V truck uplift capacity within the Unit of Action is 456 short tons.[18] Even if the expenditure rates shown were off by a factor of 4, there still would not be enough truck capacity to satisfy just the Class V requirements.

The main reason for this shortfall is that force designers are attempting to develop an organizational design that is small, compact, and deployable within 96 hours. The root cause of their problem, however, is reliance on three types of traditional ordnance. First, the120 mm LOS cannon is also to perform as an indirect-fire (BLOS) support system whether or not sufficient munitions are on hand for that purpose. Second, the force envisions a 155 mm howitzer on a light AFV that is supposed to be able to attain ranges and precision beyond the M109A6 Paladin (at a much higher cost per round). Finally, the

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17 TRADOC Pamphlet 525-3-90, Chapter 3, Change 1.

18 This assumes that weight not cubic volume is the key constraint.

force relies on the 120 mm mortar, which as the effectiveness statistics show, is ineffective against both hard and fleeting targets except with the expensive PGMM. The Unit of Action relies upon its fire-support system for its survivability. These weapon systems should be purged from the organization in favor of more precise, efficient, sustainable systems such as NetFires coupled with standoff joint fires.

APPENDIX B

THE ORIGINS OF THE FCS CONCEPT: 1996–1999

APPENDIX B
THE ORIGINS OF THE FCS CONCEPT: 1996–1999

In the spring of 1996, TRADOC, as part of its long-range planning process, then known as "Army After Next" (AAN), sponsored a conference on global trends portending change. Invitees included a number of prominent futurists (e.g., the Tofflers). Among the technologists asked to attend was the director of DARPA, who, after listening to sociological speculation for an hour or so, decided that he could contribute little and prepared to depart. General Hartzog, the TRADOC commander, tried to persuade him to stay, but failing that, urged him to provide DARPA's view of what technologies might be brought to bear by the Army before the AAN timeframe, 2016 or so.

The General's request led to a DARPA study that held sessions throughout the summer of 1996. Its conclusions were eventually briefed to General Hartzog in October. The study group—a panel of retired officers and business executives—presented a briefing with hyperlinks that enabled auditors to roam freely through a wide range of topics under the headings of Planning, Capabilities, and Technologies (see Figure B-1).

For example, the "Problem?" button linked to 11 charts that addressed (1) why land forces should be committed, (2) gave a historical perspective, and (3) discussed implications of Desert Storm for technology. Figure B-2 shows six of the charts.

Concerning "rapidly deployable artillery," the study group concluded that it was imperative for the Army to take better advantage of long-range fires from the U.S. Air Force and the U.S. Navy and from sea-based Army missiles such as MRLS and ATCMS. The group was particularly impressed with Major General Robert H. Scales's book *Firepower in Limited War* (1994), in which he observed that, for effective fires, time was of the essence:

> Even in the Gulf War...the intelligence system consistently came up short. All of the range, precision, and lethality that a firepower system brings to the battlefield cannot be fully exploited unless the eyes of the system can isolate the most lucrative targets within a target array, then pinpoint those targets within a space smaller than the killing radius of a weapon, and deliver the weapon before the target moves or goes to ground.

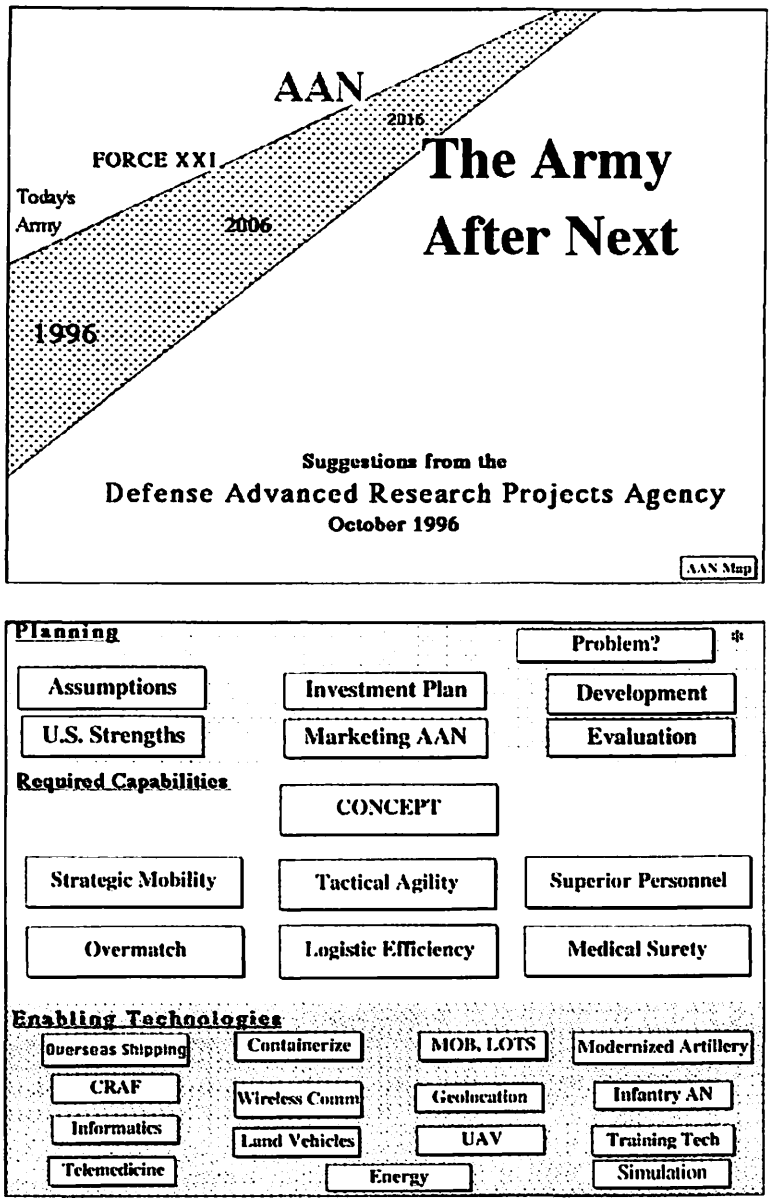


Figure B-1. Army After Next Title Slide and Hyperlinks

> To the infantryman seeking to kill the enemy, the source of ordnance exploding to his front is irrelevant. He must receive the most effective munition when and where he needs it. He must be able to mix firepower from all sources and apply all fires in concert....

The study group found two interesting projects underway in DoD Science and Technology (S&T). The first was at the Army Research Laboratory. The "Integrated Soldier Engagement System" is a concept in which the individual soldier is a node on a network of weapon systems distributed by various means in weapon pods around the

Why commit land forces?

- ☒ To **deter** the use of violence for political purposes
  - Evidence U.S. determination
  - hearten allies
- ☒ To **control** territory and people
  - Forestall or redress aggression
  - Destroy or neutralize hostile forces
  - Separate combatants
  - Conduct humanitarian operations
- ☒ To **secure** bases for air and sea forces
- ☒ To **discriminate** in using firepower
- ☒ To **win** conclusively
  - Delay, disrupt, or deceive hostile forces
  - Enable decisive fires and dominant maneuver

Desert Storm

- Army shipped 2.2 million tons dry
- 60% total was ammo, mainly artillery
- Army returned 1.6 million tons dry
- Not clear what was fired at enemy
- USAF delivered 70,000 tons of ordnance; 40 tons of fuel per ton delivered

Desert Storm

500 ship loads
9,000 aircraft loads

Delivered +3,000,000 tons

12,400 tracked vehicles
114,000 wheeled vehicles

38,000 containers
350,000 tons of ammunition

Need:
Brilliant logistic management

Lighter, smaller, more fuel-efficient vehicles

More accurate, responsive, close support fires

The Current Division

~ 17,000 men (~ 2,000 tons)
~ 5,000 vehicles (~1,500 tracked)
~ Over 100,000 tons combat loaded
~ 2,500 tons per day of all classes of supply, spares, and consumables

- *Tactical mobility high*
- *Strategic mobility low*
- *Logistically burdensome*

The Make-Weights

- Armored and tracked vehicles (65%)
  - — Tanks, IFV
  - — Artillery
  - — Engineer vehicles
  - — Provisions for sustaining same
- Fuel and dry cargo lift fleet (~ 20%)
- Artillery ammo (~ 50% resupply)
- Fuel (~ 25% resupply)

Possible Technology Interventions

- √• Develop rapidly deployable artillery
- √• Lighten the AFV fleet
- √• Reduce manpower in combat theater
- • Deliberately align Army with commercial thrusts
- √• DARPA Technology Can Assist

Figure B-2. Linked Charts (See Figure B-1)

battlefield, capable of responding to his calls for fire. The second, a DARPA seedling project called "Deployable Firepower System," is containerized artillery, or "rockets in a box." The study group noted that using the DARPA approaches, it would be possible to put wings on a powered missile to extend its range, so that it could fly an indirect path to its target and even circle over it before making a diving attack. The group's conclusion was that DARPA should develop a system for close, responsive fires from autonomous, distributed, unmanned containers containing both ballistic and nonballistic missiles, with calls for fire optimized for optimum responsiveness sensor/observer-to-target. Target worth and tactical urgency, as well as Prob(hit) and Prob(kill), would drive system cost effectiveness. The DARPA seedling project became a formal program under the title of Advanced Fire Support System (AFSS), renamed "NetFires" in 2000.

In the spring of 1997, the Army held an Advanced Warfighting Experiment at the National Training Center, Fort Irwin, California, an event involving a "digitized" brigade that produced a large store of data on contemporary mechanized warfare and C4ISR. Members of the AAN study group were permitted to examine certain of these data to ascertain how frequently lucrative targets presented themselves and for how long. The results of initial analyses attracted the attention of the Army Science Board (ASB), which invited more extensive examinations of the NTC data, including comparison of these data to the experience of the 2d Cavalry during the battle of 73 Easting (Desert Storm, February 1991), for which IDA had extensive data. The results of the analysis for the ASB have been published in the in Army Science Board 1998 Summer Study Final Report, March 1999, Appendix M, "The Military Worth of Loitering." Appendix M includes the following information:

EXECUTIVE SUMMARY

- Direct firefights among AFV are usually of short duration: 15 minutes or less.
- Formations of AFV on the move present dense target arrays that usually persist for less than ten minutes.
- A non-ballistic missile with loiter time of up to 15 minutes would be useful for the following:
  - Extending the control of US AFV (range, lethality) by exploiting sights, laser range finders, and BCIS
  - Covering to the front or flank of AFV on the move
  - Synchronizing maneuver with direct and indirect fires
  - Foreclosing having to disclose position by muzzle flash

— Engaging transient targets identified by collaborative sensors

Artillery that depends on ballistic projectiles, being inherently heavy and vulnerable, is usually held to the rear by land combatants, and its *modus operandi* necessitates elaborate communications and procedures to nominate targets and to coordinate their engagement. Requests for fire being passed rearward consume some eight minutes at each echelon involved. As information technology flows into the force, its ability to prosecute even transient targets improves. Yet ballistic projectiles, whether shells or missiles, have difficulty in hitting moving targets, or in providing close support to swiftly maneuvering friendly forces. Cruise missiles able to dwell for a period over a target seem more apt for the information age, and more advantageous for future battlefields.

Moreover, in looking ahead to the period post 2010, the ASB anticipates both much more powerful sensors, and much tighter sensor to shooter linkages. Hence, several concepts being explored by the Tactical Technology Office of DARPA seemed highly relevant to the ASB study. These include several sensor and sensor control programs ...and, importantly, the Advanced Fire Support System that enables a very short time-span from sensing a target, to deciding to destroy it, to delivering the lethal munition. This study assumes advanced sensor systems and fire support organic to the battalion echelon, directly under the control of the battalion commander. The study ... concluded that non-ballistic, boost-launched missiles would benefit synchronization and heighten lethality for the reasons cited [above], and that ability for such missiles to loiter over a target area for up to fifteen minutes would suffice.

Appendix L, "Fire Support," while lauding Crusader as "an almost quantum leap in traditionally implemented tube artillery," also suggested future improvements for that system:

> There could be dramatic improvements that derive from two sources—the nature of Battle Force air-mode operations, and the possibilities resident in the combination of electromagnetic launch means and non-ballistic rounds....What does EML add to Crusader? The answer is caliber independence and efficiency. When these are coupled with rear ballistic (powered flight) projectiles, dramatically different performance emerges.

At the same time, the report urged the Army to consider converting its MLRS from ballistic missiles to nonballistic (cruise) missiles.

The report noted that the Army's 155 mm howitzer has a muzzle energy of about 10 MJ, which is achieved at the cost of $250 for propellant. Any of several electromagnetic launch designs, driven by diesel fuel, could achieve the same muzzle energy for $0.50. Were all 155 mm converted to electromagnetic launch, the propellant savings would be at least $80 million per year. A 10 MJ system could also launch larger munitions, such as a nonballistic missile with the capability to fly to the target area and loiter. A nonballistic missile offers several technical advantages over a ballistic missile: (1) less

fuel, by weight and by volume, is required; (2) lifted bodies are more fuel efficient than ballistic bodies; thus, they have greater range; (3) fossil fuel is less expensive than rocket propellant; and (4) "from loitering locations, delivery trajectories can be employed to optimize the performance of terminal seekers and guidance" and to deliver munitions with greater lethality than is in general possible from ballistic trajectories.

The principal advantage of loiter is enabling and enhancing synchronization in engagements. Referring to Appendix M, the ASB author noted that AFSS missiles can achieve the loiter time recommended—up to 20 minutes—if they fly out at subsonic speeds (200–250 m/sec), and then loiter at lower speeds (50–100 m/sec).

The analyst then computed the daily resupply for an F–16 wing dropping CBU bomblets, 72 aircraft at 2 sorties per day each, and then similar data for improved MLRS and electromagnetic launch Crusader firing munitions that deliver equivalent effects (as measured by bomblets dropped) on target. From the point of view of a logistician, the nonballistic missile systems look fairly efficient; the F–16, of course, is a much more versatile weapon system, and would be in theater for other reasons than just to deliver CBU bomblets (see Table B-1).

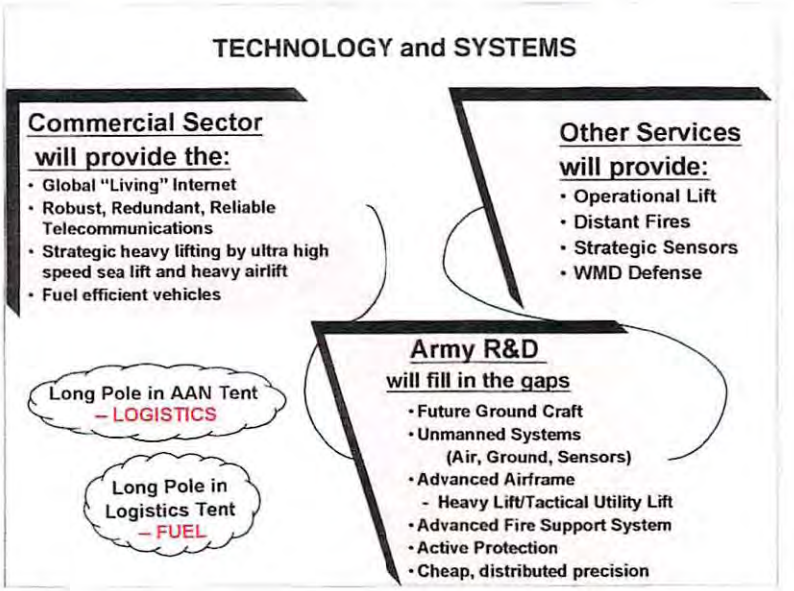
Table B-1. Daily Resupply of Fuel and Ordnance for Equivalent CBU Bomblet Delivery

Launch Platform	Resupply per day (tons)	Personnel	Weight (excludes A/C)
F–16 Wing (144 sorties)	1,300	2,000–2,500	4,000 tons
MLRS (Loitering BM)	570	132	2,400 tons
EM Crusader (Loitering BM)	390	600	3,300 tons

In February 1998, Major General Robert Scales, then Commandant, U.S. Army War College, spoke at the Chief of Artillery's Senior Fire Support Conference at Fort Sill, Okla. Scales, an artilleryman and an authority on the subject of fire support (he is the author of *Firepower in Limited War*), told the conferees that to modernize their branch, they had to accept order-of-magnitude reductions in weight and cube in their delivery systems, in footprint or presence in the zone of close combat, and in the elaborate bureaucracy that had grown up for the planning and coordination of fires. To meet these objectives, he advocated moving promptly toward precision munitions delivered from dispersed platforms and allowing small maneuver units to identify and designate targets, so the forward artilleryman becomes a decision-maker. Referring to the fire-support bureaucracy, he reported that every layer therein costs 8 minutes per fire mission and that these delays proceeded from process and indecision rather than technology. Indeed, he offered data to show that as automation had been applied to the

process, latency had increased. Scales recommended remedies: "decentralize; touch a [fire] mission only once; designate, illuminate target at lowest level (platoon? squad?); aim for one shot/one kill; no worst-casing, safe-siding; near perfect target-munition fit."

Looking to the future, Scales predicted that artillerymen could anticipate help from the information revolution that would be useful across the entire spectrum of war: coalition connectivity, situational understanding, ability to coordinate nearly simultaneously a vast array of disparate events, and ability to eliminate friendly fire incidents. His prescience on technology is shown in the following charts:



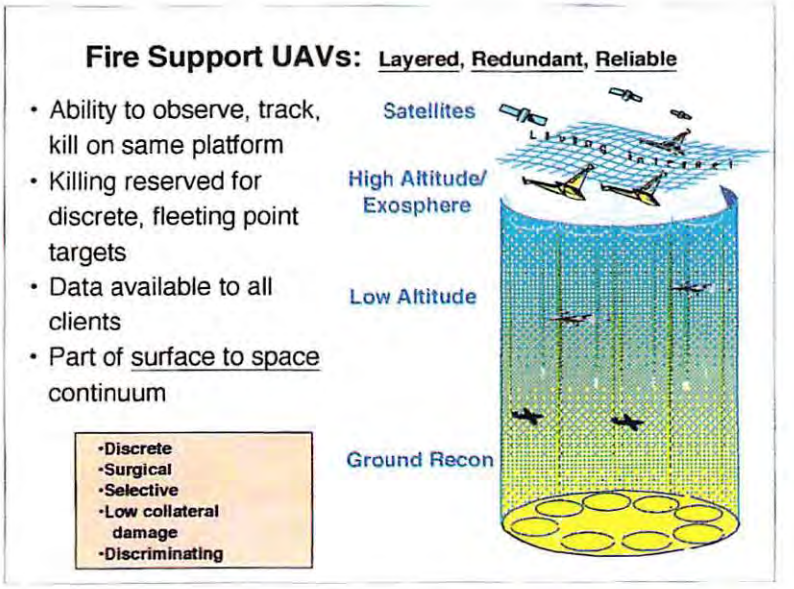
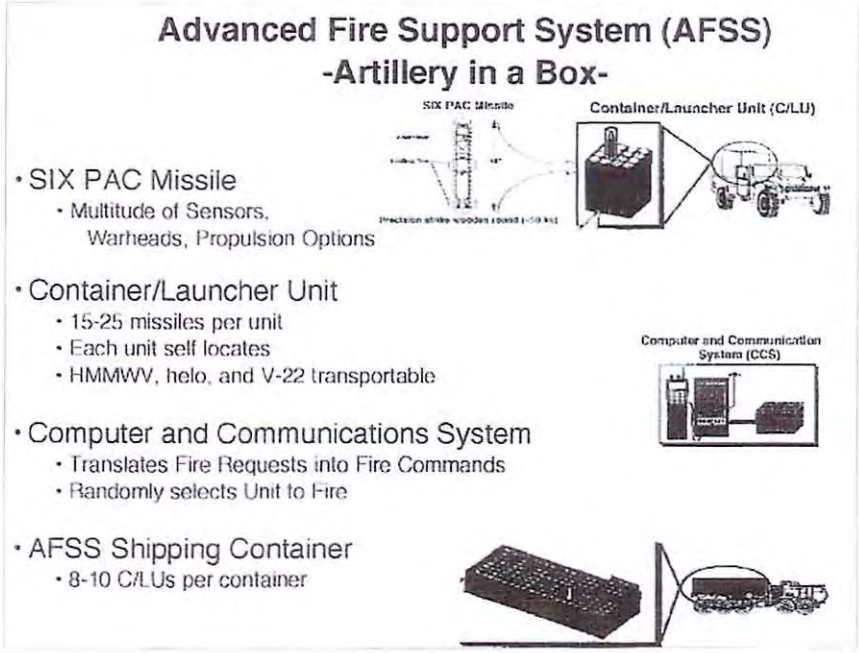


Figure B-3. Information Revolution and Its Effects on the Army

He particularly emphasized DARPA's AFSS, but cautioned against reaching too far, too fast:



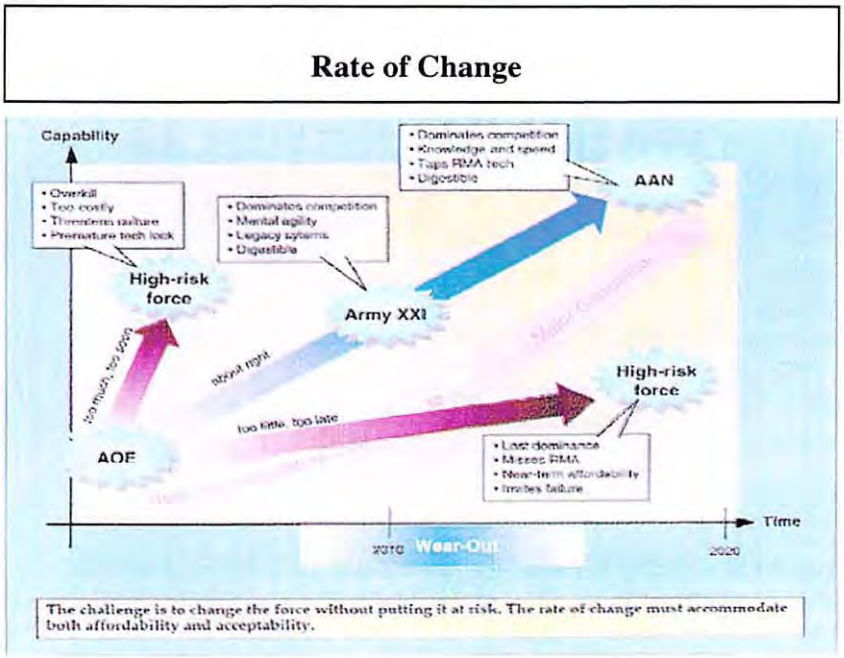


Figure B-4. AFSS

In the spring of 1999 Lt Kern, MILDEP to the Army's Acquisition Executive. approached Dr. Frank Fernandez, the Director, DARPA, with a proposal for a joint study for the future Army, what LtG Kern described as "lightweight, lethal, survivable, multi-mission ground forces." The Director agreed to share costs to determine a course leading

to true innovation. In June DARPA, with Army concurrence, set up a Senior Advisory Group to assist the joint study chair, Larry Lynn, the previous Director of DARPA. Senior Advisory Group members included two former DARPA directors, five retired general officers, the Director of the Joint Advanced Warfighting Program, and two former industrial executives, both then chairing ASB Summer Studies. Among the government advisors to the Senior Advisory Group were senior TRADOC officers.

The Senior Advisory Group soon concluded that to actualize LtG Kern's guidance, the Army needed not a future combat vehicle, but a system of systems centered on networks (C4ISR), along with a Concept of Operations (CONOPS) predicated upon collaboration at all echelons. By October a report on this system of systems, called Future Ground Combat Systems (FGCS) was ready. The FGCS was ready to be fielded within "multi-mission combined arms teams."

The report of the Senior Advisory Group envisioned FGCS-equipped units capable of acting as a strategic covering force. The Senior Advisory Group stated that the first purpose of such a force would be deterrence, given that the United States could

- Suddenly enter the theater of war with a sea-air-land Joint Force when and where it chooses,
- Use mass effects—OPTEMPO, fires, maneuver—to dominate hostile centers of gravity and, ultimately, to win decisively.

Key to such deterrence would be evident readiness to control territory and population, to forestall or redress aggression, to establish peace, to support the rule of law, and to conduct humanitarian operations. A *ground* combat system is essential to (1) secure bases on land for air and sea components of the joint or combined force and to support all joint, interagency, and multinational elements; (2) discriminate in using firepower amid noncombatants; and (3) terminate conflict on terms most favorable to the United States.

The thrust of the program proposed by the Senior Advisory Group was to develop an early-entry force with enhanced unit performance and mission robustness, instead of one or more armored fighting vehicles (AFV) designed to overmatch a perceived threat AFV. The Senior Advisory Group recommended the following:

- Build for strategic mobility, exploiting all available air and sealift
- Adopt CONOPS based on collaboration and network-centric materiel

- Discriminate by experimentation among technology choices and CONOPS NLT 2005[1]
- Extract from FGCS materiel that can be retrofitted to the remainder of U.S. Land forces to boost their effectiveness and to enable interoperation.

> Hence, the SAG proposes that the Army (1) combine strong technology thrust with vigorous conceptual reform, and (2) illuminate its choices with analyses and experiments in FYs 2002–2005 to insure that such a combined thrust will exert upward leverage on capabilities across the entire range of possible Army missions.

The Senior Advisory Group cited Army Science Board data to generalize about strategic mobility:

> (1) commercial air freighters will constitute the bulk of lift available in 2020, and (2) the "sweet spot" for vehicle weight to exploit lift potential is 10 tons. Hence, the FGCS ought to include light combat vehicle(s) able to be deployed anywhere in the world within hours, capable, as compared with today's land forces, not only of strategic and tactical mobility, but significantly improved lethality and survivability. But the SAG hastens to add that survivable, lethal, light vehicles are improbable without much improved self-protection and much more capable C4ISR, integrated with robots, within a tactical network.

The following two charts, and the entire following page, are extracted from the Senior Advisory Group's report (see Figure B-4).

The Army leadership accepted the concepts advanced by the study group. The Army and DARPA executed a Memorandum of Agreement to partner to develop FGCS [the name was later changed to the Future Combat Systems (FCS), because the system of systems embraced more than just ground systems]. Early in 2000 the Army held an "Industry Day" at TACOM to announce the start of the new program. Since then the FCS has been oriented principally toward ground vehicles. An FCS Senior Advisory Group chaired by Larry Lynn was formed with a number of members who had participated with him in the original study.

The FCS Senior Advisory Group regularly reported to LtG Kern (or his replacement) and to LtG Riggs its concern that the FCS program was platform-centric, not "collaboration-centric" or "net-centric," as originally conceived, and that DARPA's programs were being slighted by contractors who were listening carefully and responding

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1 At the time, the program was aimed at the Army After 2010.

to Army proponents for armored vehicles, guns, and projectiles for guns. In many ways, this thrust was understandable. The DARPA programs were, per Agency policy, risky endeavors, technologically immature, whereas the Army leadership was pressing the program management to put an FCS-equipped unit into the field. Moreover, Army proponents could be expected to be skeptical of proposals to abandon ordnance, structures, and CONOPS that had produced overwhelming success on the battlefield in favor of innovations with which no one had combat experience and, in some cases, for which there existed no analytical models.

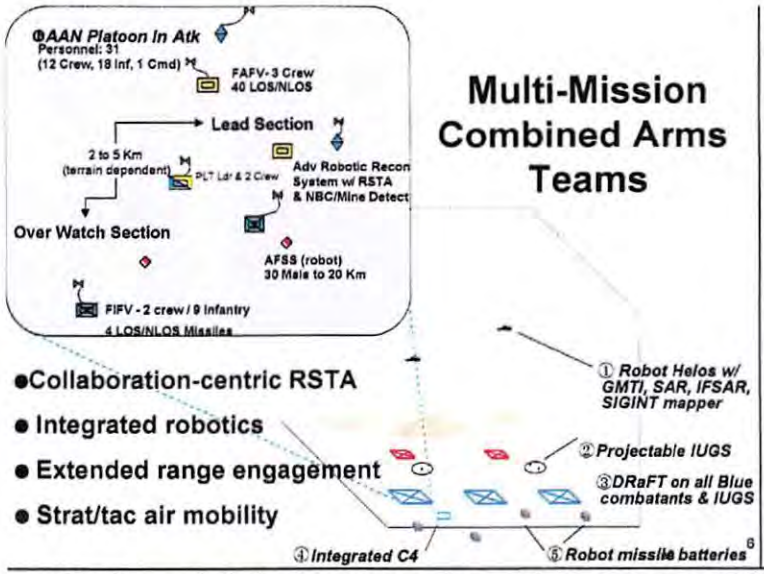
CONOPS Enablers

- *Distributed, integrated force* of teams with a mix of unmanned and unmanned systems, *light* (extensive reach-back, automation, low-weight vehicles, high fuel efficiency), *lethal* (precision munitions and effective suppressive ordnance), and *survivable* (teamwork and interactive protective systems.
- *Organic C4ISR at every echelon* linked directly to weapons, particularly those enabling engagement beyond line of sight.
- *Highly automated, self-actualizing C3 system* that assures situational understanding and prompt execution of tactical decisions.
- *Configured for air mobility:* moving overseas using commercial transmodal equipment and civil air freighters, and able to be deployed and sustained within the theater by C–130 (or comparable airlifters).
- *Punch and endurance* beyond that of today's heavy force, capable of forcing entry and of gaining and maintaining operational and tactical initiative.

FCGS-Based CONOPS

	2000	Post 2010
Force Structure	"heavy" or "light"	combined arms
Construct	duel; overmatch	win at extended range
OPTEMPO	diurnal spikes	relentless
Venue	mono-plane	3-dimensional
Close Battle RSTA	"higher" + eyes	ISR layers all echelons
Indirect Fires	latency	linked sensor-shooter
Manpower	intensive	robot-assisted
AFV	crew + platform	network with robots
C3	TOC	distributed, automated
Mobility: strategic	DoD lift; RSOI	all lift; fight on arrival
Mobility: tactical	control zone; secure LOC	control enemy CGs; mass effects; sustain from the air

(cont'd.)



Multi-Mission Combined Arms Teams

- Collaboration-centric RSTA
- Integrated robotics
- Extended range engagement
- Strat/tac air mobility

Illustrations of "Collaborative-Centric" Approach

- Enable individual soldiers/FAFVs with distributed functionalities so that they are organized around the team C3 (RF Tag, acoustic sensors, etc.)
- Strength of the soldier/FAFV is found in the distributed architecture of the team (shared knowledge, response)
- Strength of the team is provided through fusion of its several functionalities (e.g.: soldier/FAFV as a sensor element, organic RSTA)

Similarly at every echelon:
"Fractal Fighting Force"

right 6

The diagram (left chart) portrays an advanced force structure and CONOPS based on DARPA programs already underway that, if successful, will add significantly to both Blue situational awareness (SA) — that is, Blue's knowing precisely the location of Blue combatants — and Red SA — that is, Blue's knowing where Red is. DARPA programs are depicted in the "cube":

① The Hummingbird 160 (Robotic Rotorcraft or RR) mounting a CECOM Ground Moving Target Indicator/Synthetic Aperture (GMTI/SAR). This aircraft is designed to take off, land, and navigate autonomously, using GPS guidance. It has a design ceiling of 9+ kilometers, and a design endurance of 48 hours, with speeds of up to 140 knots. Its GMTI will operate in the k$_u$band, have a range of 20 km, and a circular error probable less than ten meters.

② Internetted Unattended Ground Sensors (IUGS), acoustic, seismic or imaging sensors that can be precisely positioned by air-drop or by ordnance (missiles or projectiles).

③ DRaFT (Digital Radio Frequency Tags) that will be provided to all Blue combatants so that the GMTI radar aboard the RR can collect the current location of each Blue combatant — dismounted or vehicle crew— and "read" IUGS.

④ A Commander's Interactive Display (CID) with automated terrain analyses, a portable, flexible, color computer-display enabling a commander to view highly accurate map-based data, or other graphics, that enables him to operate anywhere on the battlefield independent of any particular platform or location.

⑤ Advanced Fire Support System (AFSS), containerized missiles ("rockets in a box") of ~20 km range with GPS guidance and a range of lethal warheads. AFSS fire units are positioned by higher headquarters to support a subordinate command, and the latter exercises radio control of when the missiles shall be fired, and what targets they will engage.

⑥ The plan inset upper left is from TRADOC's AAN study, and depicts a platoon of 2 sections: 2 future armored fighting vehicles (FAFV), each with RSTA robots; and 2 future infantry fighting vehicles, also with RSTA UAV. The leader operates from a UAV-equipped vehicle, and controls 2 AFSS robots.

The force is internetted, and is capable of extended range engagement as well as direct fire. In the AAN force structure sketched, a "battalion" would consist of several teams like that in the "cube", and would report to division —a structure that could eliminate an echelon of current maneuver C3, and several echelons of combat support C3. The chart on the right emphasizes that **a team is a system of manned and unmanned systems; larger units are a team of teams.**

Figure B-4. Senior Advisory Group Report—Extracts

Here is a chart used by the FCS Senior Advisory Group to describe the C4ISR environment in which FCS should operate and without which few of its desired characteristics were attainable. Note the primary access on the left to a rich radar environment connected to FCS by DRaFT and broadcast and on the right to the GIG. *There are redundant provisions for Blue Situational Awareness: DRaFT, GPS, radio multilateration, and INS; these should be a requirement for FCS Increment II.*

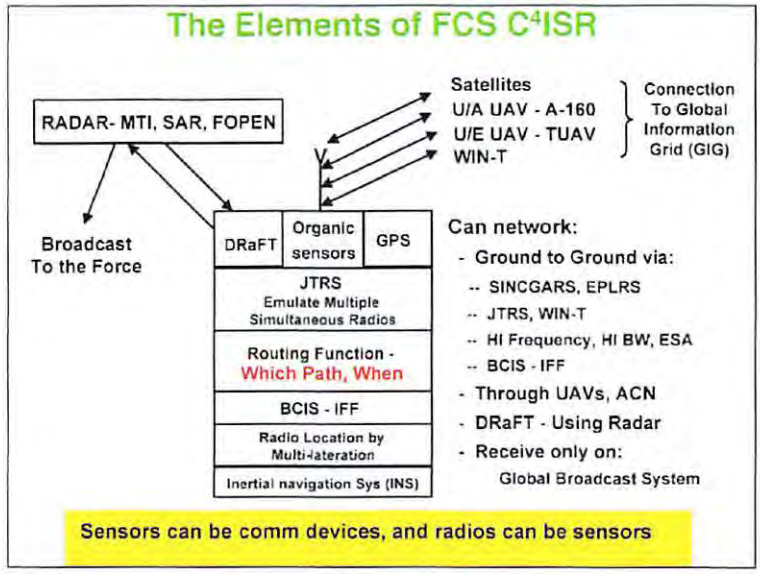
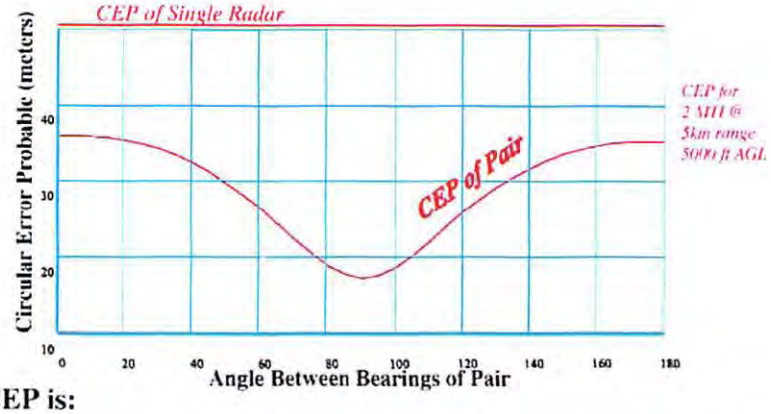


Figure B-5. C4ISR Environment

With respect to C4ISR, the original FCS concept had unit pairs of medium-altitude (>15 k) long-endurance (>24 hr) UAVs flying overhead. The UAVs would preferably be rotorcraft rather than fixed wing. DARPA's program with Frontier Aviation to develop the A–160 Hummingbird seemed a proper fit: its characteristics were vertical take-off with 300 lb, 40-hours endurance, self-deploying to expeditionary ranges, and an ample ceiling. These represent genuine technological progress. However, the A–160 may not reach a maturity level sufficient to warrant its being included among the systems selected for FCS Increment I. *FCS Increment II should ensure full exploitation of A–160 technology.*

The preference for collaborating pairs of radars came from the Army's experience with its SOTAS system in the late 1970s and early 1980s (SOTAS was a progenitor of the USAF E8 JSTARS). SOTAS radars demonstrated higher accuracy when collaborating, with optimal performance when the look angles were orthogonal (see Figure B-6). Note that this is the essential principle of the current AMSTE program (see Appendix C).

Accuracy of Collaborating Pair of MTI



- **CEP is:**
  - **a. ~ independent of altitude; at max range ~ 25 meters @ 90°**
  - **b. reduced ~ .7 by flying pairs in parallel**
  - **c. reduced ~.5 to ~.25 as ∠ bearings approaches 90°**
  - **d. even less if GPS/INS error is offset by benchmark DRaFT**

Figure B-6. Collaborating Pairs of Radar

The A–160 also offers the FCS network an airborne communication relay and EW vantage point, since it has enough space and power to support multiple electronic packages and is large enough to accommodate antennae. (Although a payload has not yet been integrated, CECOM is flying a LYNX GMTI/SAR mounted on a Blackhawk helo, a surrogate for network experimentation.)

One import of the radar environment is targeting by the supported unit commander within range of his radar (or within constraints imposed on him by a higher commander, but evident on his radar display). The best imagery analyst is the commander. As a brief to the FCS Senior Advisory Group noted, "He who commands fires and movement must be advantaged by IFSAR-generated elevation data, by constant radar watch, and by pixel change detection."

To take advantage of this increased awareness, the system of systems needed highly responsive fires directly under control of "he who commands fire and movement." DARPA proposed "rockets in a box," or NetFires, a lethality advance that promised precision effects within seconds of the decision to attack by fire. Early analyses indicated that in kills per ton-in-theater, NetFires held a 6:1 advantage over conventional 155 mm howitzers and required only one-eighth the personnel. Overall system costs were correspondingly much lower. NetFires was to be capable of LOS, BLOS, and NLOS engagements and to act on command virtually autonomously.

Tracking Red SA for Targets

Target tracking and Recognition:

- Is contextual: the more the Red SA, the lower the interpretive error; hence, feed processed sensor data to commander of maneuver and fires elements
- Improves with DTED
- Is facilitated by staring sensors and automated change-detection
- Warrants multiple platforms with redundant GMTI/SAR/IFSAR/SIGINT to maintain persistent RSTA for the FCS unit

Figure B-7. Tracking Red Situational Awareness for Target

In the original FCS design, NetFires (robotic missile batteries) furnished fire support for the maneuver unit and emplaced its internetted, unattended ground sensors. It remained under direct control of the maneuver commander. DARPA set out to demonstrate two forms of missile. The first, a fast precision-attack missile (PAM) on wireless command, would soft launch from a sealed container, ignite its main engine, then dash out to the target, guided by a combination of GPS, in-flight target-location updates, and terminal seeker, to hit accurately with a 28 lb warhead. The second, a loitering attack missile (LAM) from the same container that traded speed and payload for range, was equipped with a ladar with automated target recognition (ATR), a 5 lb top-attack warhead, and communications to guide a PAM. NetFires is a bold departure from conventional Army cannons or mortars, in that it can precisely strike when and where the maneuver commander directs without any call for fire. No personnel are dedicated to manning guns, handling ammunition, or manning fire-direction centers. NetFires container launch units (CLU) need not be located within any specific organization: they are a commodity that can be issued to any unit, carried on most vehicles, and even deposited anywhere within range, its munitions tasked to respond to the maneuver commander without his being responsible for the CLU. (Further information of NetFires is presented in Appendix C.)

NetFires System Concept and Attributes

Extended range NLOS fires for Future Combat Systems

- **Containerization and platform independent launch**
  - Substantially reduces logistics burden, weapons support and total costs
  - Substantially expands operational flexibility - unmanned remote fires
- **Enhanced missile performance and operational flexibility**
  - Extended range (>40km)
  - Allows single system to substitute for multiple systems
- **Non-line-of-sight and lock-on-after-launch capabilities**
  - Engages both stationary and moving targets
  - Integrates well with a networked targeting system
- **Continuous "hunter/killer" munition capability**
  - Low latency - organic system
  - Loitering plus attack

Lethal **Affordable** **Integratable**

Figure B-8. NetFires Concept

One of the five DARPA technologies briefed to General Keane in 1999 by the FGCS Senior Advisory Group was the Commander's Interactive Display (see Figure B-9), a portable wireless "battleboard" for the maneuver commander in the FCS maneuver unit. So equipped, no matter where on the battlefield he chose to position himself, the commander could synchronize fires and maneuver and react quickly to fleeting targets. DARPA did pursue a program termed Command Post of the Future (CPOF), initially focused on a Tactical Operations Center, but more recently on a collaborative decision aid for a commander of a mobile ground-combat unit. Although CPOF elicited much interest when demonstrated to several of the Stryker Brigade Combat Teams (SBCT), it has been perceived as a leader-development mechanism, or training aid, rather than an operational C2 system. It now appears that neither DARPA nor the Army will fund further development, even though flexible computer displays and highly compact storage devices are now on the technology horizon. NetFires and joint supporting fires alone would seem to warrant the Army's furnishing each forward leader such a display for his Common Relevant Operating Picture. Indeed, *a Commander's Interactive Display ought to be a mandated component of the Joint Battle Command and Control System.*

Commander's Interactive Display (CID)

- Blue SA: locate, track, identify, and access status of U.S combatants in zone
- Red SA: locate, track, classify enemy forces, building all-source file on each
- Locate and interpret reports from mines, UGS, and GMTI/SAR radar
- Map and display SA as individuals or units showing locus or center of mass, or portray "see, sense, shoot"
- Collect spot DTED 4; prepare and present automated terrain analyses
- Target and synchronize NetFires, manage target deconfliction, post strike assessment, and re-supply
- Enable broad-band comms with over-head comm relay
- Support force-on-force training and operational rehearsal, with AAR

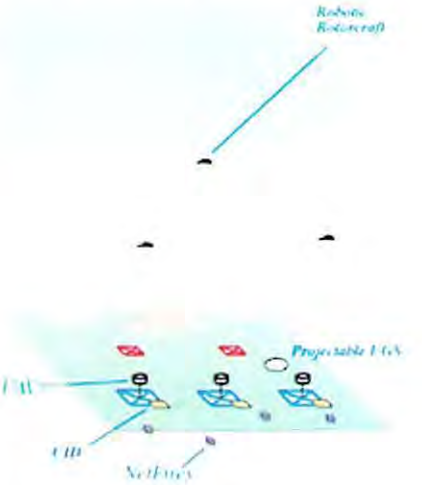


Figure B-9. CID

Another of the five technologies briefed to General Keane by the FGCS Senior Advisory Group was Digital Radio Frequency Tags (DRaFT). Any commander's visualization of the disposition of his unit is pivotal to his employment of fires. The Army's under-utilization of allocated CAS sorties in Desert Storm was a direct consequence of commanders not knowing precisely where friendly forces were located. Imprecision in Blue situational awareness will surely constrain use of Joint fires. The FGCS Senior Advisory Group advocated development of DRaFT and deployment of a tag to all Joint, interagency, and multinational elements within any FCS-equipped unit's radar coverage, for the radar could not only "see" the tag, but also report its geographic location and identity.

The present DARPA program seeks to build and test prototypes capable interacting with X-band radar and Ku-band radar. The prototypes will be the size and shape of a hockey puck, but heavier; if the radar tests prove the design sound, further development could lead to much smaller sizes. The current requirements for DRaFT include not only combat identification, but also data exfiltration from sensor fields, including imagery, and two-way messaging. These features add significantly to the complexity and cost of each tag. *One objective for Increment II should be a chip-level DRaFT capable of responding to an Army radar, including FOPEN, with a design-to-cost objective under $100.*

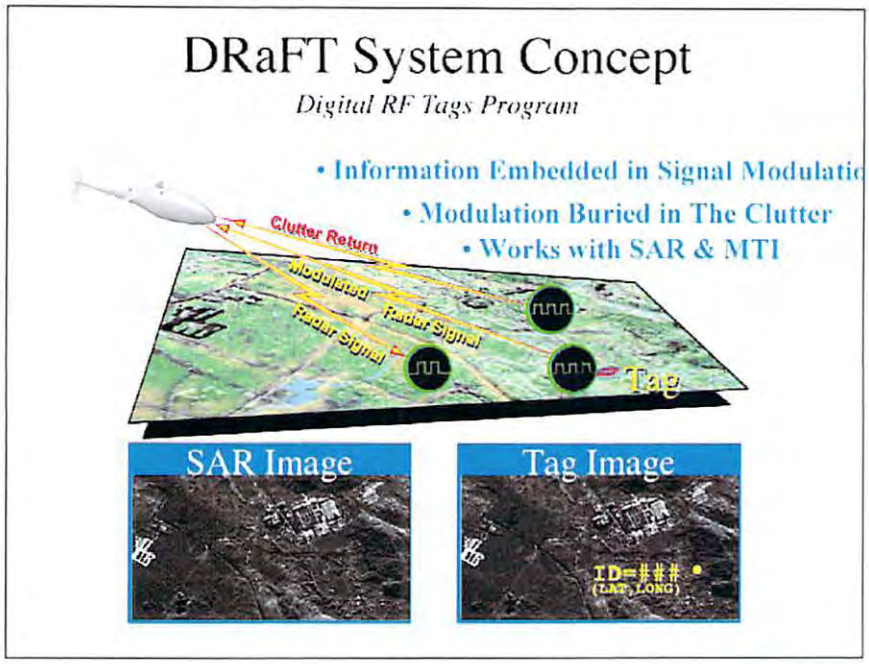


Figure B-10. DRaFT

The Director of the Army's Communications Electronics Research and Development Center is currently pursuing an initiative to narrow the requirements for DRaFT, thereby focusing development on "DRaFT-Lite," a one-radar (Ku band), affordable version.

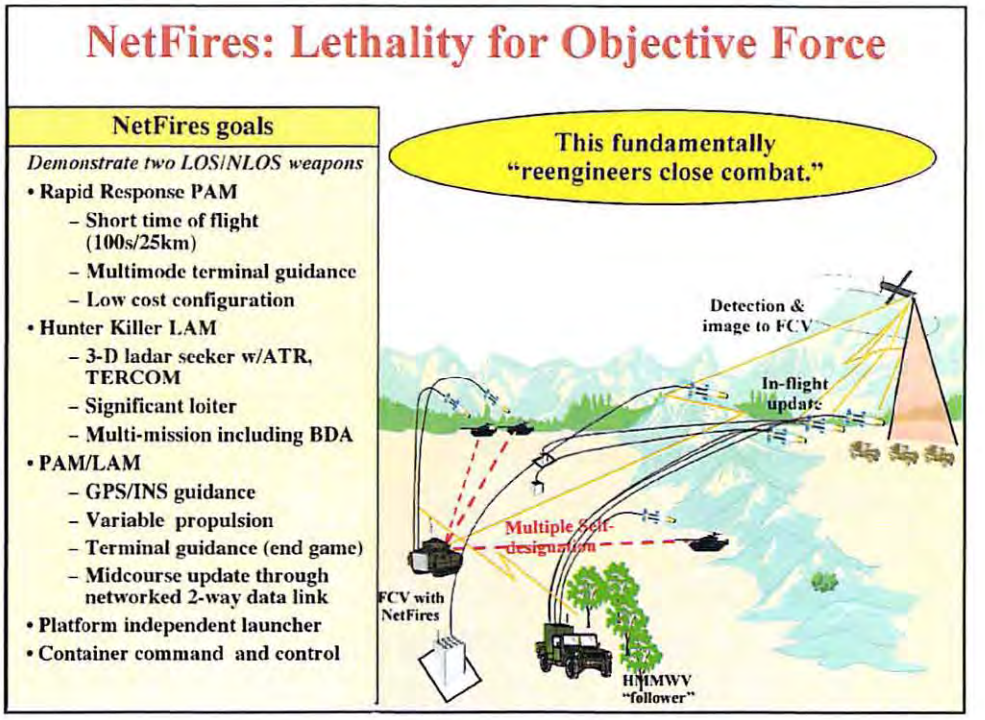
APPENDIX C

STAND-OFF MISSILE SYSTEMS AND JOINT TARGETING

APPENDIX C
STAND-OFF MISSILE SYSTEMS AND JOINT TARGETING

ARMY MISSILE SYSTEM: NETFIRES

What the Unit of Action O&O refers to as the *Non-Line-of-Sight Launch System* is known in DARPA as "NetFires." NetFires is a DARPA technology demonstration program being transitioned to the U.S. Army Aviation and Missile Command for system design and development for introduction into Increment 1 of FCS. NetFires is a containerized, vertical-launch, soft-launch technology borrowed from a Navy development. The missile is 7 inches in diameter and has a very high probability of first round hit. NetFires currently has two types of missiles: the loitering attack missile (LAM) with 150 km range or 50-minute loiter time and the precision attack missile (PAM) with a 40 km range. The LAM will have 5 pounds of explosives within its warhead; the PAM will have 25–28 pounds. The warheads will have Global Positioning System/Inertial Navigation System (GPS/INS) guidance, the capability to communicate in flight so a LAM can update and redirect PAMs toward elusive targets, and protection against jamming.

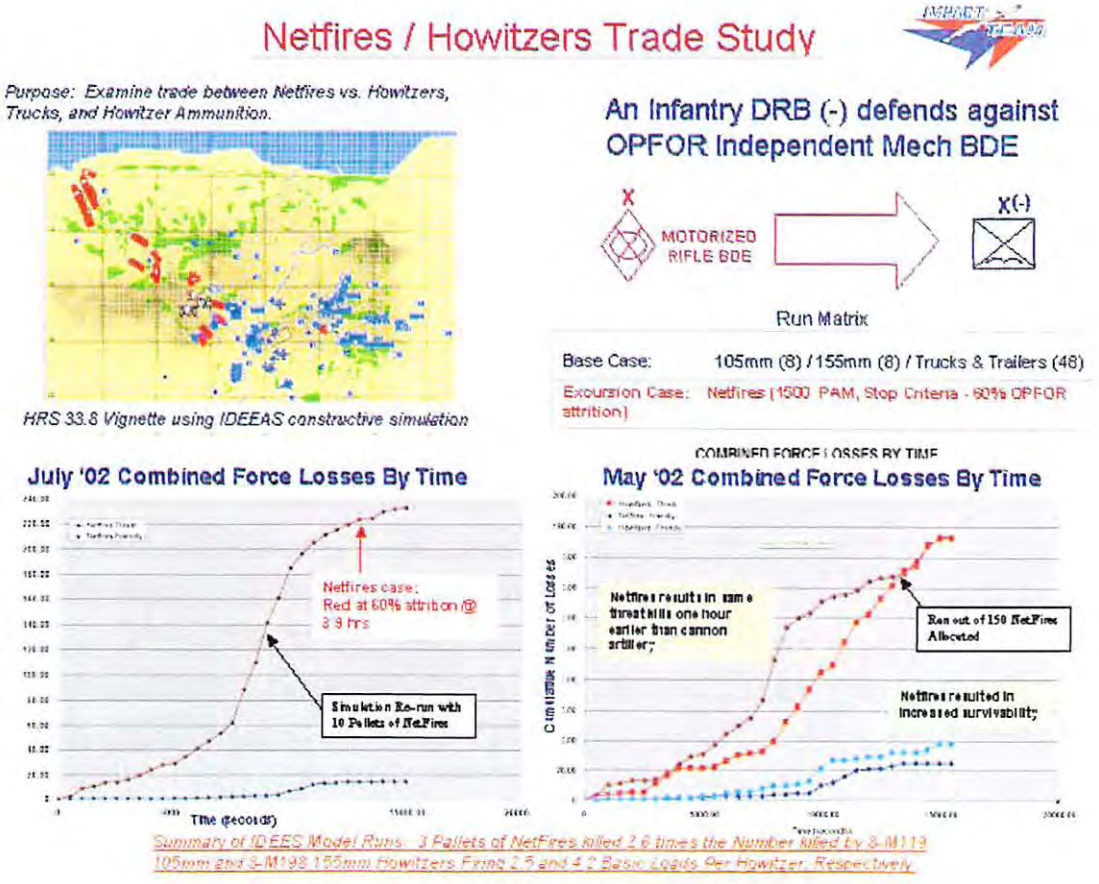


NetFires, the "rockets in a box" technology envisioned as an alternative to cannons and mortars, dates back to 1996. It was also a part of the FGCS concept briefed to the Vice Chief of Staff Army (VCSA) in 1999. The original concept featured carrying container launch unit (CLU) on a variety of vehicles, including the high mobility multi-purpose wheeled vehicle (HMMWV). Although the concept of having a highly precise missile system spread across the battlefield was attractive, the 2,700 pound weight of the missile CLU meant that it likely required a crane for loading. The Unit of Action concept incorporates 60 NetFires CLU into its non-line-of-sight (NLOS) Battalion. Twenty-four are to be carried on 12 Future Tactical Truck System (FTTS)–Mission Support trucks within the 15 man NLOS Launch System (LS) Platoon in the NLOS Battalion headquarters battery. The other 36 are to be carried on 36 FTTS–Mission Support vehicles found in the 3 cannon batteries (12 trucks per battery). The truck drivers of the FTTS–Mission Support trucks found in the batteries are also members of the 18 cannon crews, and the 6-ton FTTS–Mission Support on which the NLOS LS/NetFires CLU is carried doubles as an ammunition carrier for cannon ammunition (see Appendix G). Each CLU is still estimated to weigh approximately 2,700 pounds. That will necessitate equipping the FTTS–Mission Support truck with a crane, which could weigh as much as 1.1 tons. That leaves little room for conventional cannon ammunition.

Although the current development program has not been focused on the development of a container round to emplace sensors, drop illumination flares, or carry other lethal and nonlethal payloads, that need should be addressed by FUE Increment 2. Each CLU is configured at the factory to contain 15 missiles, the fire-control computer, and wireless communications. The CLU will be sealed at the factory and will remain sealed until the missiles are fired. This simplifies packaging and handling from factory to firing unit.

NetFires is significantly more lethal than conventional howitzers firing ballistic projectiles. An analysis performed by the U.S. Army Aviation and Missile Research, Development, and Engineering Command in Huntsville, Ala., in May 2002, using U.S. Army Materiel Systems Analysis Agency published performance parameters, looked at the effects of introducing 10 NetFires CLUs (150 missiles) to supplement the fire-support assets of an airborne brigade, deployed in this simulation with eight 105 mm and eight 155 mm howitzers. The opposing force was a motorized rifle brigade. The simulation end conditions were either 5 hours of simulation run time or 60-percent attrition of the opposing force. As the curves from May 2002 show (lower right graph), all 150 NetFires missiles were expended. NetFires missiles were determined to be valuable contributors to

the fight; however, those simulation results did not explicitly compare howitzer effectiveness to NetFires effectiveness. The same simulation scenario was rerun in July 2002. The base case was established as the same eight 155 mm howitzers and eight 105 mm howitzers, again with 1,500 rounds of ammunition for each set of howitzers (3,000 total). The excursion case was run with 1,500 NetFires missiles, arrayed on pallets of 10 CLU each, instead of the howitzers; the same simulation end conditions applied. The graphs on the lower left of the figure reflect the July results. In the base case, the airborne brigade, supported by howitzers only, was overrun 4.2 hours into the simulation. The excursion case stopped at 3.9 hours because the NetFires missile array had destroyed 60 percent of the opposing force's armored vehicles. Note that these simulation runs did not address the impact of a LAM (inadequate models) or the comparative deployability of the brigade, with 16 guns, 48 trucks and trailers, and 3,000 rounds of ammunition, versus the brigade with 10 pallets of 150 missiles each. Nor did it compare the personnel costs: 100+ for the howitzers, ~12 for NetFires. Put another way, 65 tons-in-theater of NetFires accomplished more than 300 tons-in-theater of howitzers. Note also that while the howitzers were allowed FireFinder radar cues, NetFires was not so advantaged.

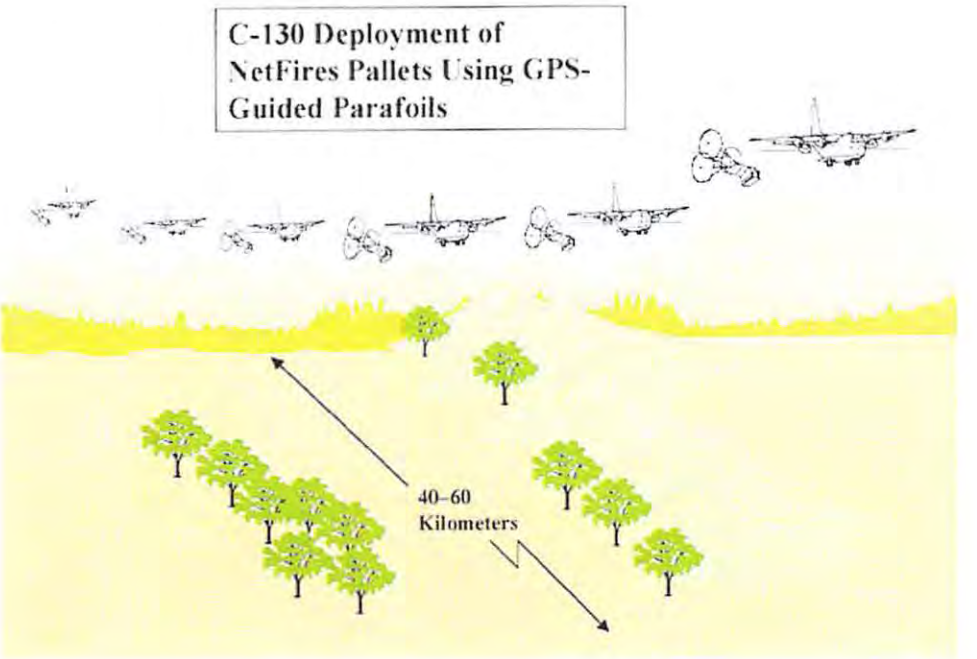


This scenario illustrates the advantage of NetFires for massing effects against an emergent target set: the CLU can be air dropped, air landed, or parachuted anywhere within range of the action, and NetFires is ready to engage upon landing without either a vehicle-carrier or personnel. Increment 2 NetFires should be configured to support "operational maneuver at strategic distances" and to prepare landing zones for a tactical airmobile maneuver. The Army Science Board Summer Study of 2002 described such an action, as follows.

The Army has within its inventory a palletized loading system (PLS) flat rack that measures 8 feet by 20 feet. The PLS is a 16.5-ton vehicle with a load handling system (LHS) on the rear. The truck backs up to a PLS pallet, hooks on to the pallet with a hook that is a part of the LHS, and drags the pallet onto the truck using rollers on the bed, similar to commercial Dempsey dumpster systems. The LHS locks the pallet in place during movement. *These pallets are air-droppable.* They can be loaded separately on C–130 aircraft without the need for special material-handling equipment. The point is that 10 NetFires CLU—150 missiles—will fit on one PLS pallet. Further, both the Heavy Expanded Mobility Tactical Truck (HEMTT) (13-ton, C–130 air transportable) and an 8-ton version of the 5-ton cargo version of the Family of Medium Tactical Trucks (FMTV) have successfully tested an LHS that can heft the 1-ton pallet. Although the weight of the loaded pallet will be about 15 tons, such a pallet could be precision air-dropped by parafoil. None of the new trucks now being considered for the Unit of Action can pick up a load that heavy. The existing HEMTT can carry 8 CLUs— 120 missiles—plus the pallet. The issue FMTV truck can carry 4 CLUs—60 missiles—plus the pallet. The Army did not include a palletized truck within the Unit of Action design.

An additional feature of the palletized concept for NetFires is automated networking of the fire-control computers once deployed, whether inserted by parafoil ahead of the ground forces, on the bed of a truck, or on the ground after having been off-loaded from the truck. Although the NetFires CLUs within the NLOS LS concept are to be configured and sealed at the factory, the concept that the Army has developed for the Unit of Action fails to describe what the command-and-control mechanism is to employ these missiles or to network the fire-control computers on-board each CLU. A palletized configuration could take packaging to a new level of efficiency. The NetFires CLUs themselves would be manufactured and sealed at the factory, then assembled on standardized pallets for shipment to Army depots. Because the pallets fit inside ISO containers, they could be stored and stacked in a depot in such a container. Upon deployment, they could either be

Forcible Entry Prior to Troop Arrival

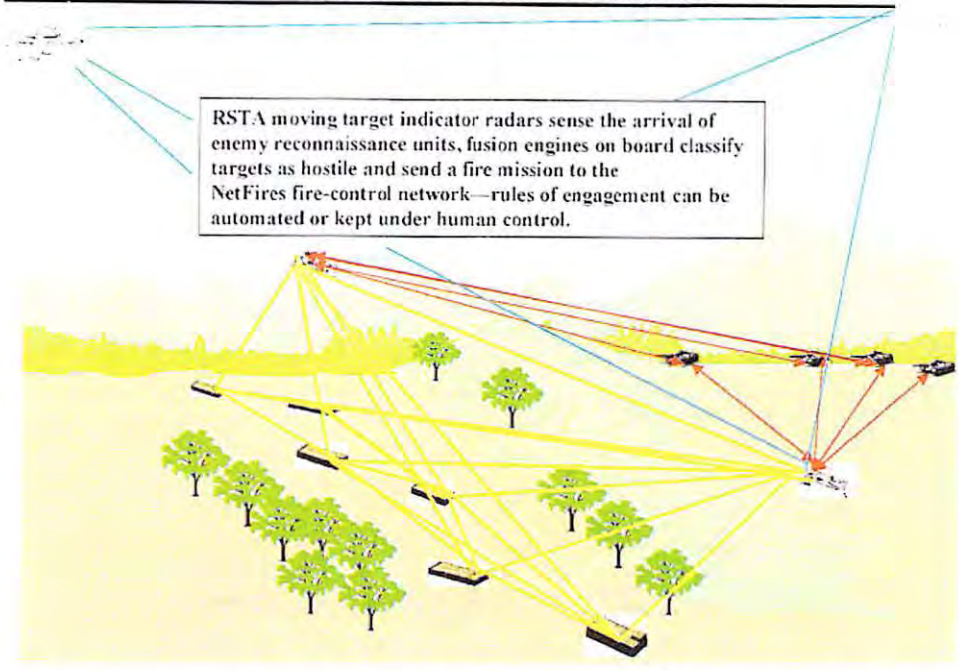


shipped in that container or removed for deployment more in concert with the Objective Force concept—using the LHS on trucks rather than material handling equipment and dedicated personnel to handle and rehandle the loads. Perhaps most important, the pallets could be configured at the factory with antennas integral to the pallet configuration, so that long-range backbones to connect distant fire-control computers could be linked via high-frequency or satellite links. Linkage of networked pallets and CLUs to the Joint battle command and control would be via the backbone frequency that connects the routers of that network of networks (see Appendix H).

Bulk-loaded pallets enable a number of new and promising CONOPS. One such is a concept for NetFires support of strategic or operational maneuver, using this precision LOS–BLOS–NLOS system as a precursor networked array of firing platforms operating semi-autonomously, under remote human control. Each NetFires CLU contains a communications/computer capability that permits CLUs ganged on ISO pallets to form a self-actuating, self-maintaining, self-repairing, large-scale radio frequency (RF) network. Further, each pallet can be air dropped to a fairly precise position with commercially available, GPS-steerable parafoils. NetFires has an automated fire-control system. Because of the 40 km range of the PAMs and the 150 km range/50 min loiter time of the LAM, an interlaced indirect-fires delivery system can be established by deploying NetFires pallets over extended distances and then connecting the on-board

fire-control computers through an RF network. Humans would preset the rules of engagement for the system before deployment.

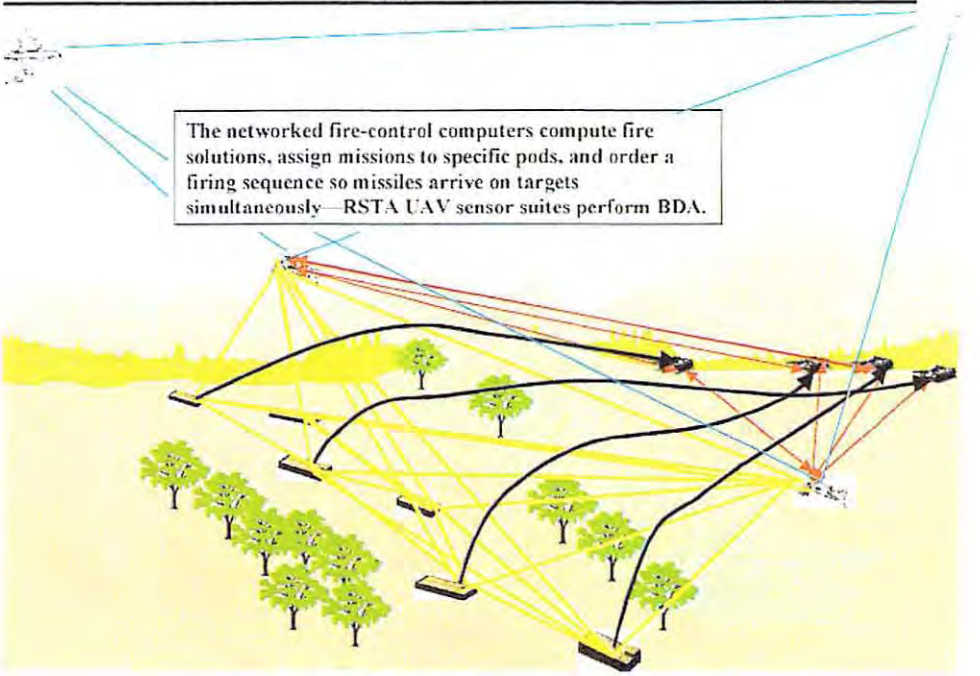
RSTA UAVs Sense, Classify, and Initiate Fire Mission



Following pallet touchdown, the RF network would be automatically established to connect the fire-control computers within the NetFires array, each CLU becoming a node within the network. Anticipated is a high-frequency (HF)-based, low-bandwidth network to enable the fire-control computers to operate as an integrated system over extended distances. The HF radios will seamlessly connect to a higher bandwidth radio(s) on board each pallet, which in turn connects the fire-control network into the global network that will connect all of the components/systems of the force.

Long-dwell, autonomous, unmanned aerial vehicles (UAVs), with collaborating on-board sensor systems, would then enter the battle area, establishing and functioning as the initial nodes within a high-bandwidth, RF-enabled command and control network, again without human involvement except to preset the rules of engagement. The radio configuration within the command-and-control tube of the NetFires CLU will permit the seamless connection of the long-range, HF-based fire-control subnetwork to the high-bandwidth command and control network.

Fire Control Computers Integrate Fire Mission Among Networked Firing Units

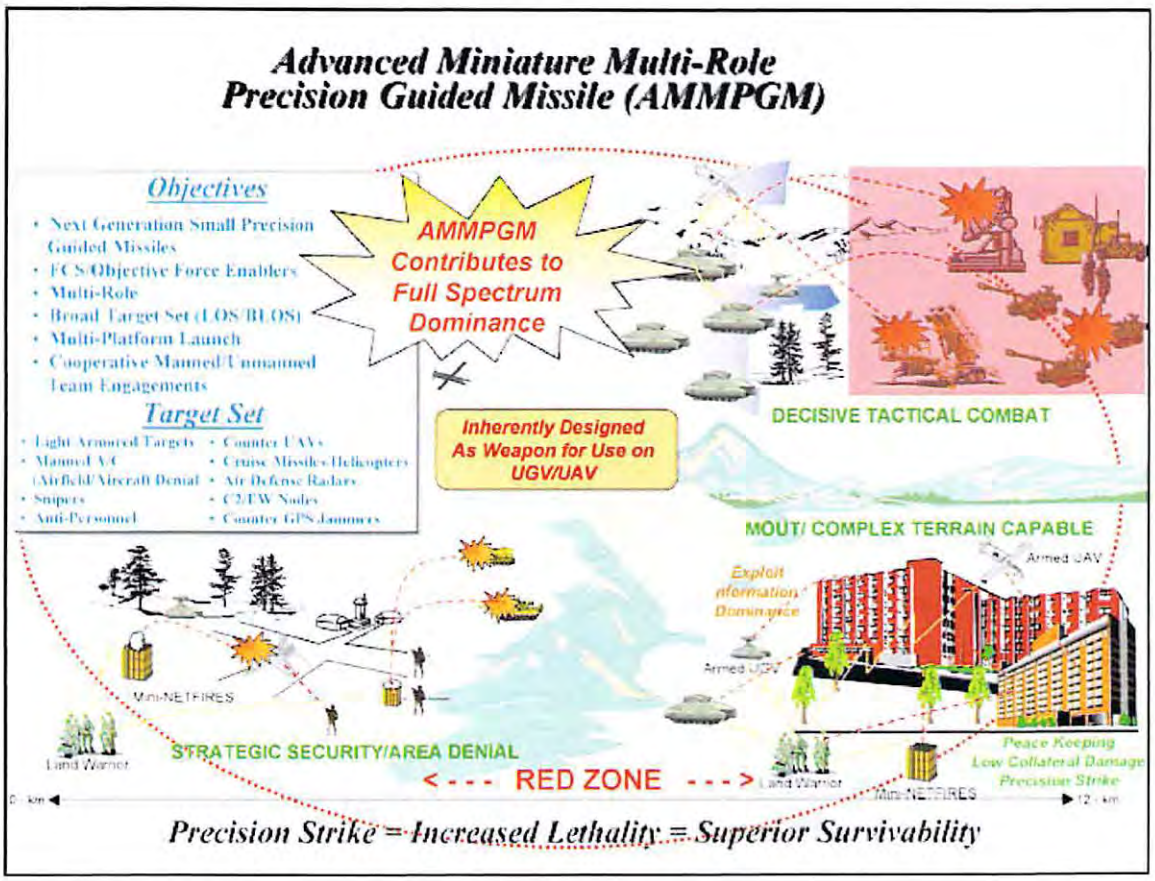


There is no technical reason why available or soon-to-be-available high-bandwidth radios cannot connect humans in remote locations with the sensors or the fire-control network. Human involvement would be executive command and control of the remote network, important to coordinating all joint fire support. As the radars of the UAVs sense hostile targets, on-board automated target recognition (ATR) engines classify the targets. If those targets are deemed hostile, a fire mission is sent to the NetFires fire-control computers over the high-bandwidth RF network. Based upon the preset rules of engagement, fire-control solutions are computed using the low-bandwidth HF communications linkages, and firing platform assignments are made between the NetFires fire-control computers over that HF-enabled fire-control subnet. Again, executive human control is preserved throughout the process. The Increment 2 NetFires system should be a network-centric design, with the networked fire-control computers providing an integrated fire-control solution.

The NetFires system can assist executive control by automating such functions as calculating times of flight from different pallet arrays to achieve simultaneous engagements of spread target arrays; controlling LAM to PAM hand-offs; cross-leveling of missile expenditures among the pallets of the array; confirming preset rules of engagement; leveraging the extended range of the missile system by interweaving fires laterally across the battlefield rather than in a traditional linear fashion; and performing other

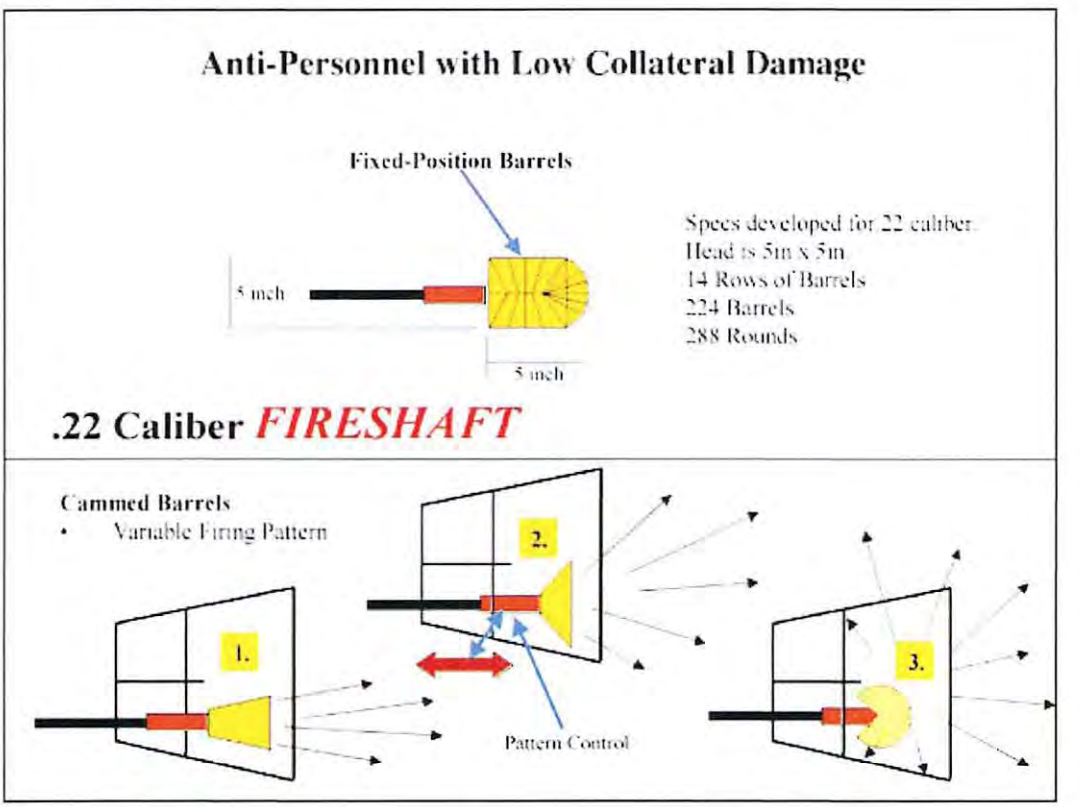
automated tasks, such as cueing the reconnaissance, surveillance, and target acquisition (RSTA) UAVs to perform damage assessment. Such a network-centric result is not attainable from 20th century indirect-fire platforms. Although automated networking of C4ISR capabilities will be part of the Future Combat Systems, all components of the Objective Force of that force could benefit from this approach, starting as early as 2007.

ARMY MISSILE SYSTEM: MINI-NETFIRES



The U.S. Army Aviation and Missile Research, Development, and Engineering Command has developed a concept it terms AMMPGM—actually, an off-shoot of a helicopter program to use stabilized 2.75 in. rockets with modern seekers—to launch vertically from CLUs similar to those of NetFires. AMMPGM is a smaller, more agile missile used to handle missions traditionally assigned to mortars and to perform horizontal maneuvers for attacking targets in cities or caves in close terrain. The smaller missile is to have a range of 15 km. The Army has shown little interest in the program, dubbed Mini-NetFires. The importance of it is threefold: (1) It flies more slowly and turns in shorter distances than LAM or PAM; (2) It can be maneuvered freely in three dimensions; and (3) It is more accurate and timely than mortars, and it has many more angles of

attack. Its slower speed and ability to turn and dive make it more discriminate in restrictive areas, such as urban terrain, where precision engagements are generally dictated by rules of engagement that make collateral damage unacceptable. Cannon and mortar projectiles were not designed to that end, including Excalibur and PGGM. The nonsymmetrical flight path that the missile traverses will, with the proper designation or seeker, permit the missile to fly into caves (see Appendix D, Annex 3); into specific entry points of buildings; and, with electronic warfare (EW) seekers, to home in on RF emissions emanating particularly from restrictive terrain. As with NetFires, this missile system should come equipped with an on-board fire-control computer for automated fire direction and network operations, RF radios to serve as the backbone for the local area network and to connect that network to the Joint battle command and control network, and antennas to permit those connections.



One concept for Mini-NetFires would be warheads equipped with MetalStorm, a DARPA munition that packs small projectiles within short barrels and electrically fires these in a very short burst. This munition has very discriminate effects for urban applications. In effect, Mini-NetFires could project a squad's worth of firepower through the window of a building's upper story.

AIR FORCE MISSILE SYSTEM: LOCAAS

The Air Force's capability to provide accurate and timely stand-off weaponry is growing. At Eglin Air Force Base the Air Force is testing its Low Cost Autonomous Attack System (LOCAAS), an affordable (approximately $63,000 per vehicle), air-launched cruise missile. In the figure, the Program Manager is shown holding a 30 × 48 in. LOCAAS developmental model.[1] LOCAAS is a low-cost ladar sensor (the same sensor used on the Army's LAM), coupled with a multimode warhead and a turbojet-powered maneuverable airframe. It can detect and identify its target and accordingly configure its warhead as a long-rod penetrator, an aero-stable slug, or fragments (for soft targets) and then attack with high accuracy. It has 30 minutes of endurance, enabling standoff attack (90+ miles), searching for targets within an area of 85 km^2, and automatically matching its ladar imagery to on-board data, which include air-defense systems and interdiction targets of significance to ground forces. Each missile is 30 in. long, has a 40 in. wingspan, and weighs less than 100 pounds. Maximum loading of LOCAAS for USAF aircraft is as follows:

Number of LOCAAS per Type Aircraft

Platform	F–16	F–15E	F–22	JSF	B52	B–1	B–2
LOCAAS	16	20	16	16	64	120	192

LOCAAS could potentially loiter over an area and be called down within seconds by ground commanders for vertical strike. Fighter-bombers loaded with the LOCAAS would lend any Air Tasking Order the flexibility to deal with situations like that in Desert

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1 V. Loeb, "Bursts of Brilliance," *Washington Post Magazine*, December 15, 2002, p. 6 ff. See also www.fas.org/man/dod-101/sys/smart/locaas.htm

Storm, when Apaches, constrained by an arbitrary coordination line, watched impotently while Iraqi armor columns escaped (see Appendix E, Annex 3). One LOCAAS-laden B–52, or a flight of three F–15Es deployed with LOCAAS, could have had a devastating effect upon that adversary. LOCAAS could be modified for close support fires (CSF) to accommodate situations like those that arose during Operation Anaconda (see Appendix D, Annex 3). That is, it could respond to laser designation or to transmission of target coordinates, with provisions made for network transmission of its imagery for ground verification of its target and approval of its warhead configuration. Joint, interagency, and multinational friendlies located near the intended impact by a Joint Combat Identification System (JCID) could automatically divert the strike.

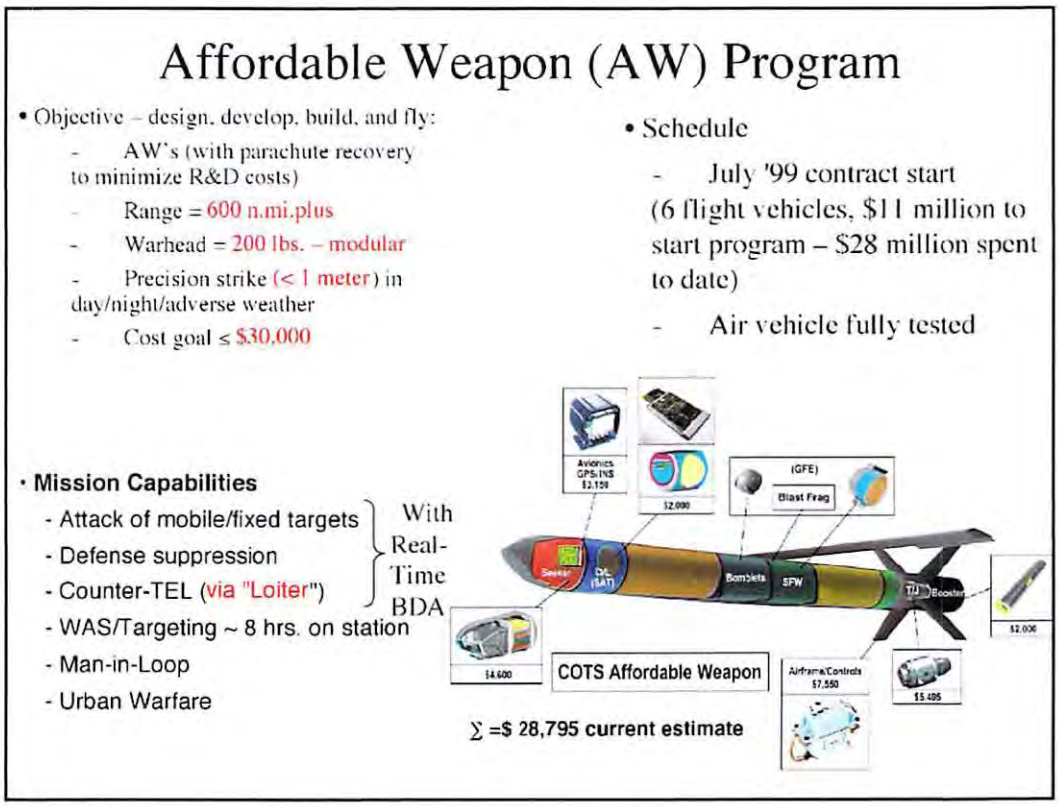
LOCAAS appears to be a system sufficiently powerful to warrant the Army's co-developing a CSF variant for launch from Army attack, utility, or heavy-lift rotorcraft. Such a common program will not only benefit commonality and reduce per-unit costs in production, but also will simplify Class V aerial platform resupply. The use of Service-centric munitions makes little sense in a sustainment-sparse theater when common stock-piles could be jointly established, managed, and distributed on an inter-Service basis.

NAVY/MARINE MISSILE SYSTEMS: AWS

Another promising system is a Navy/Marine program for a long-range, long-dwell missile designed specifically to provide low-latency direct support to ground units. The system is known as the Affordable Weapon System (AWS), in part because it currently uses a standard MK 125 blast-fragmentation warhead, and in part because the contractor developing the missile—Titan Corporation—is maximizing the use of available commercial off-the-shelf components to minimize the overall per-unit cost of the missile. Titan refers to the system as a loitering UAV with a 200-pound payload that can fly to extended ranges and remain overhead and ready for hours. It forecasts a per-missile cost of $40,000.

The missile in its prototype configuration is 12 feet long. The weapon is to be delivered from the production line, packaged in a standard 8 × 8 × 20 ISO container. Each container will carry 20 affordable weapons. Launch rails and launch electronics are simple and integral to the box. To fire the missiles, the front and rear doors are opened at the deck edge. They are then loaded with GPS waypoints. The inboard end of the container is elevated 45 deg, and the missile is fired across the platform. The platform might be a surface combatant, a littoral support ship, a standard container ship, or a barge. The missile, once launched, deploys its wing, climbs to 8,000–10,000 feet, and enters a safety corridor headed toward the supported unit. As the rounds exit the ingress corridor, they proceed to loiter at preset GPS coordinates in the vicinity of that unit.

The AWS program has completed 10 successful launches. It is now ready for live-fire demonstrations and transition out of the science and technology (S&T) phase directly into a 28-month limited-rate, initial-production/operational test and evaluation phase beginning in fiscal year 2004. The contractor estimates that 30 months after completion of the limited-rate, initial-production/operational test and evaluation phase, the first 2,000 missiles could be produced and delivered.



The AWS is not merely a missile with an extended loiter time. As it is currently configured, it is launched by a booster that separates from the missile 4 seconds after it is

launched. Upon launch, a 10 ft wing rotates into position orthogonal to the missile body, locks in place, and thereafter provides the aerodynamic lift and flight control for the missile, which is powered by a small (several pounds) turbojet engine, fueled by standard JP–8 fuel. As stated above, in its current configuration the missile is a container for the modified MK–125 warhead. That same container can accommodate up to five standard precision top-attack munitions as well as other munitions types, such as Dual Purpose Improved Conventional Munitions (DPICM) or Search and Destroy Armor (SADARM) munitions. On the drawing board is a ducted-fan engine version that the contractor estimates will increase the range of the missile to up to 5,000 nmi or the loiter time up to about 7 days. Also being considered is a contractor's concept for in-flight refueling of the loitering missile. This would be accomplished by a semi-autonomously or autonomously controlled unattended aerial vehicle that could be recovered after the refueling operation. Such a system could keep loitering missiles above supported ground units for weeks or months.

The Marine concept for using the AWS features the launch of several of these missiles to provide close support to a ground unit. Once launched, the missiles will fly to a preprogrammed coordinate(s); report their location and ID to the ground controller; and thereafter enter a fuel-conserving orbit stack, each at a different altitude. They will begin to loiter within a designated racetrack orbit until called upon by a controller—ground or air—to drop the munitions contained within the missile on a designated target(s). The number of weapons in each stack can be determined by the target-servicing rate of each supported unit. With 6 hours of fuel on board, the AWS can fly 280 nmi and orbit for 4 hours. A simple LOS video data link can show the ground controller a missile's target before final attack release. In the nose of the missile is an electro-optical/infrared sensor connected by LOS and satellite data links to any of a variety of potential controllers—a ground unit, a helicopter, a fixed-wing fighter, cargo aircraft, the launch ship, or a command and control ship. The current operational concept features the release of the on-board munitions, which will home in on the target in a variety of ways, including laser designation, differential GPS coordinates, or during-flight target sensing from systems such as Brilliant Anti-Armor Submunitions (BATS), with the missile itself continuing to loiter above for damage-assessment purposes. That concept would allow the missile to fly thereafter to a designated spot to be recovered, to attack the target with but part of the munitions on-board, and to resume the attack on its designated target, if the initial attack did not achieve its desired effects.

The Navy/Marines are developing in parallel a fast littoral ship for support of over-the-shore operations. That ship could carry up to 940 of these AWS missiles in standard ISO containers. The deck hatches of the littoral ship would be opened, the missiles fired as demanded, and the hatches then closed. Such a packaging concept will facilitate ship loading, missile storage, control, and handling, and rapid deployability.

These missiles could be mounted on PLS trucks to provide CSF to Army or Marine Corps ground units. The missiles may eventually carry payloads that are today "Army" munitions. A 5,000 nmi range, which the ducted-fan system promises, makes proximity to a littoral region unnecessary, particularly given the missile in-flight refuel option. These missiles could be launched from distant staging areas before the deployment of Objective Force units into theater to loiter above planned entry points, and they would be available from entry onward to provide close support fires to, and reconnaissance for, the deploying force. The on-board data links would be accessible to the ground commanders wherever they may be, whether in CONUS before deployment, in a staging area, on-board Air Force strategic or operational airlift aircraft, or on the ground in-theater.

Further, the packaging concept for the AWS, particularly the 8 ft × 8 ft CONEX configuration, allows it to be deployed using standard PLS 8 ft × 20 ft pallets on a heavy expanded mobility tactical truck (HEMTT)[2] equipped with an LHS. Each 8 × 8 CONEX container will accommodate 16 AWS missiles; each such container will weigh approximately 5 tons. Two containers plus the 1 ton pallet will weigh 12 tons. The LHS-equipped HEMTT has a capacity of 13 tons. Deploying these missiles from the deck of a truck or from a pallet off-loaded from that truck is conceivable, if either the Army or the Marines choose to have both a general-support ground capability ashore and a general-support reinforcing Navy littoral capability offshore.

The truck-mounted configuration of the AWS may not be necessary if Navy littoral ships carrying 940 missiles each are anywhere within the theater. The Army's stated requirements for the Objective Force's networked fires system are (1) *seamless information/knowledge management operations*, (2) *delivery of lethal and/or non-lethal fires within seconds not minutes or hours*, and (3) *effective control by supported ground force commanders*. The emerging Army, Air Force, Navy, and Marine missile systems

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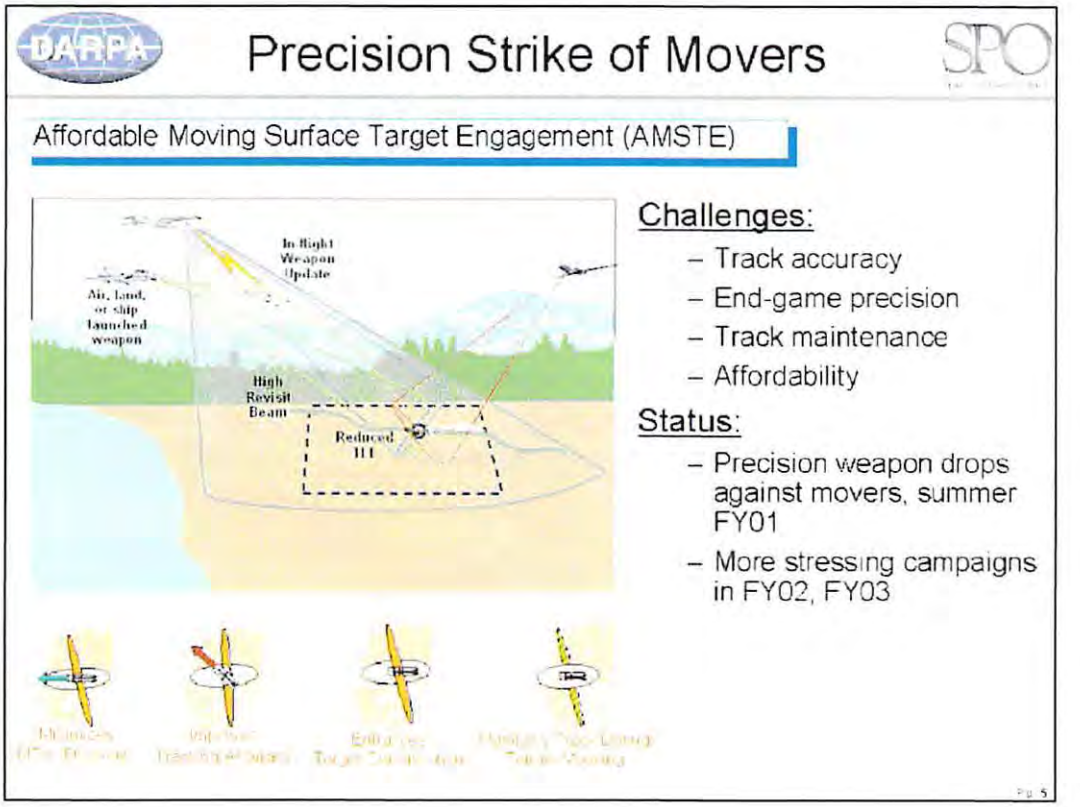
2 The HEMTT is a proven truck within the Army's inventory. It, along with the PLS, is the ammunition resupply workhorse of the Army's tactical truck fleet. The HEMTT is air deployable in a C–130 class aircraft. It would satisfy the Army's expeditionary requirements and provide double the payload capacity of the FTTS.

described above, in addition to being precise and affordable, are being developed with separate, distinct, redundant capabilities to meet each of those requirements.

JOINT TARGETING SYSTEM: AMSTE

Another program that Air Force Research Laboratories are developing in concert with DARPA and the Navy is the Affordable Moving Surface Target Engagement (AMSTE) system. This is an all-weather, netted system of systems that uses two or more multilaterated, geo-registered airborne ground moving target indicator (GMTI) radars to increase the precision of ground targeting. It requires the ability to maintain threat tracks from nomination through engagement and provide fire control updates to weapons in flight. The beauty of the system is that it uses slightly modified standard seekerless munitions within the Air Force inventory, and those munitions are launched from air-frames at altitudes and stand-off distances outside the range of threat air-defense systems. The system includes a multihypothesis tracker to fuse multiple radar tracks and maintain a common relevant operation picture in a moving tactical situation.



Originally, Raytheon and Northrop Grumman were competing for a contract to develop a follow-on AMSTE system prototype to be used for an end-to-end capstone demonstration, including battle management functions, in a large-scale Service exercise.[3] Both contractors were successful in landing munitions within the established 10-m circular error probable. Raytheon was the first to demonstrate the efficacy of the concept. From an F–14D aircraft at 20,000 ft altitude and at a stand-off distance of 6 miles, Raytheon launched two JDAM munitions—actually inert Mk-84 bombs—at the second and third vehicles within a five-vehicle column. It used antijam, ultrahigh frequency links to update the launched munitions with in-flight corrections. Those bombs required less than a minute to travel to designated targets and hit within 10 m. That same day Northrop Grumman launched a Raytheon-produced Joint Stand-off Weapon (JSOW) from an F/A–18D aircraft flying at 30,000 ft altitude, at a stand-off range of 35 miles; the data link for in-flight corrections used Link 16. The weapon traveled the 35 miles in about 5 minutes and scored a direct hit on a remotely controlled moving M60 tank. Accurate location data and maneuvering velocity of the target were gathered and maintained by bilaterated radars on an E–8C Joint STARS and a Northrop Grumman BAC 1–11 test-bed aircraft carrying a fourth-generation AESA F–35 prototype Global Hawk MP–RTIP radar.[4] Shown below is a depiction developed by Northrop Grumman of a Nominal

AMSTE Nominal Architecture

3 Northrop Grumman subsequently won the down-select competition to proceed into Phase II.

4 K.B. Sherman, "AMSTE Reaches New Milestones with Stand-off Weapons," January 2003.

System Architecture for AMSTE. Note that the Northrop Grumman architecture features the use of not just Air Force and Navy fixed-wing platforms, but also Army attack helicopters. This "system of systems" is logical and reasoned. However, note that in-flight corrections are made over a radio-frequency linkage. The Army has not embraced Link 16, though the Comanche helicopter will be equipped with hardware that will permit it to send and receive data over that data link. This is a system that can benefit all services.

ARMY AVIATION: EXPLOITING LOITERING MISSILES

The FCS-equipped Unit of Action will have organic to it long-dwell unmanned aerial platforms with GMTI radar, SAR, and interferometric SAR, as well as on-board processing and communications. Such a cross-cueing package of radars would be invaluable to the accuracy of the AMSTE as it tracks adversary targets operating in various terrains and stop-and-go postures, especially for air interdiction targets in proximity to surface forces. AMSTE has the potential to transform CSF into a low-latency system fulfilling requirements for networked fires within the Objective Force of 2015 (see Appendix H). Further, it would not require a change to either the Joint Air Targeting Order or the Air Force and Navy battle-management systems. CAS "proximity" need no longer be defined in the mold of a 200 mph, 500 ft altitude pass by an A–10 dropping dumb bombs within several hundred meters of friendly troops. Fixed-wing aircraft will be able to stand-off outside of the threat of adversary air-defense systems and out of the path of Army loitering missiles/UAVs and other noncentrally controlled airspace users, a "win-win" situation. Army, Navy, and Air Force radars can operate on different bands and still contribute to multilateration. What is essential is that in-flight communications links be compatible.

Army aviation is a key element within the Unit of Action structure providing 12 RAH–66 Comanche helicopters and an assortment of UAVs (see Appendix G). The RAH–66 Comanche provides a manned reconnaissance capability to the range of the Unit of Action's area of influence and beyond. The Unit of Action can expect to receive additional aviation support from the UE—additional Comanches; Longbow Apaches; UH–60 Blackhawks in cargo, transport, and EW models; and CH–47 Chinook helicopters. Taken together, Army aviation will:[5]

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5 See the Annex to this appendix, pp. C-1-4 and C-1-5.

- Operate in the ground regime as a component of the combined arms Unit of Action team;
- Expand the battlefield in space and time by extending the range at which fires can be concentrated on the enemy;
- Perform combat, combat support, and combat service support functions, including reconnaissance, security, mobile strike, vertical maneuver, close combat, maneuver sustainment, control of fires, command and control, and electronic warfare;
- Provide depth and verticality to the maneuver battlespace with unmanned, manned, and manned/unmanned teaming.
- Be integrated into the combined-arms team down to the level in which it will be employed;
- Operate within the same planning time lines as ground-maneuver elements.

Joint Publication 3-09 provides[6]

> Maneuver and fires are complementary functions which are essential to achieving the JFC objectives. Maneuver is the movement of forces in relation to the enemy to secure or retain positional advantage, usually in order to deliver or threaten delivery of fires in order to accomplish the mission. The principal purpose of maneuver is to gain positional advantage relative to enemy COGs [centers of gravity] in order to control or destroy those COGs...Through maneuver, the JFC concentrates forces at decisive points to achieve surprise, psychological shock, and physical momentum. *Successful maneuver requires fires and movement. Fires neutralize, destroy, and suppress enemy forces and disrupt enemy maneuver, which permits the maneuver of friendly forces. Fires may be used separately from or in combination with maneuver to neutralize or destroy the enemy*...[emphasis added]

Army aviation doctrine states, "Aviation, as a maneuver force, is the third-dimension centerpiece of the land force."[7]

Army aviation resources, particularly the Comanche and Longbow Apache helicopters and tactical UAVs, are the only assets organic to the Unit of Action and UE organizations that can cover the extended battlespace that the Objective Force can expect to be assigned by the Joint Force Commander (JFC). As the Army's aviation operational

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6 Joint Publication 3-09, *Doctrine for Joint Fire Support*, dated 12 May 1998, p. I-6.

7 See Annex to this appendix, p. C-1-2.

principles provide,[8] "Aviation units conducting tactical operations are given *maneuver objectives rather than individual targets* [emphasis added]." The RAH–66 Comanche helicopters operate teamed with Apache attack helicopters—the Comanche will be equipped with a Longbow radar and can serve as the reconnaissance part of the tandem. However, that same Longbow radar can be an integral part of the AMSTE (see above) multilateration scheme. Even in Increment 1, the Comanche will be capable of operating within the structure of that emerging Air Force system because it is equipped with a data-link capability to operate with Link 16, SINCGARS, and HAVEQUICK.[9] Thus, the Comanche crew will be able to send and receive Link 16/TADIL–J messages as well as SINCGARS/HAVEQUICK Joint Variable Message Format messages. The Comanche will be equipped with aided target detection and classification software, tactics expert functional software, sensor-fusion algorithms to turn sensor data obtained by forward-looking infrared (FLIR) and radar into usable information, target-threat management software, and multifunction displays to show the common relevant operating picture and to coordinate and synchronize fire and maneuver.

Uses for Comanche helicopters—and Apaches after the UE is deployed—can be expanded immensely if the concept of Joint fires, "fires produced during the employment of forces from two or more components in coordinated action toward a common objective,"[10] changed to "fires produced during the employment of forces from two or more components in integrated application of fires onto a common objective." The Comanche helicopters of the Unit of Action and fighter/bomber aircraft of the Air Force or Navy may be the only manned aerial assets in theater in the initial critical stages of deployment of a Unit of Action. This is the time that the ground force will be most vulnerable (even though ground systems are to be able to fight within 30 minutes after arrival). There appears to be no reason why those 12 Comanche helicopters in the Unit of Action cannot operate with Air Force and Navy fixed-wing aircraft and Marine AWS missiles the same as they would when teamed with missile-carrying Apaches.

There is another reason why the use of Army aviation in a Joint context makes sense. Ammunition and fuel for Army helicopters forward deployed under traditional notions of warfare are not normally considered serious constraints because traditional

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8 Ibid, p. C-1-5.

9 The ARC 164 (HAVEQUICK) is an aircraft UHF–AM multichannel transceiver providing a frequency hopping or antijamming capability.

10 Joint Publication 3-09, p. I-1.

forces do not face the same expeditionary time and self-sustainment objectives—96–120 hours to deploy anywhere in the world carrying enough of all classes of supply, including ammunition and fuel, for 3 days of intense 24/7 combat—that are central to the Unit of Action and UE portions of the Objective Force. The Aviation Service Troop of the Unit of Action Aviation Detachment has within it only 10 FTTS–Mission Support 6-ton capacity trucks. Four of those trucks are devoted to maintenance operations and to carrying prescribed load list parts. Two of those trucks are to carry ammunition, and the remaining four are for petroleum, oil, and lubricants. The Unit of Action is to be equipped with two AAFARS and two HTARS refueling systems (see Appendix G). The 12 Comanche helicopters are to have an operating range of 262 nautical miles (485 km) using internal fuel tanks (260 gallons) and 1,260 nautical miles (2,333 km) with self-deployment tanks (1,180 gallons). The Comanche will be able to use the same JP–8 fuel that Air Force and Navy fixed-wing aircraft use.[11] That commonality will relieve some of the Class III stress on the Unit of Action Aviation Detachment, at least during the critical initial-entry phase. To use the 12 Comanche helicopters as weapons platforms that must fly back and forth to refuel/rearm points will quickly stress to ability of the force to resupply those valuable assets using available 6-ton trucks. Using the Comanche to control the firing and post-launch correction of munitions launched from Air Force/Navy manned platforms or to direct loitering AWS missiles onto targets that present themselves keeps Comanches on station longer and optimizes the helicopter's 2-hour endurance capacity.

JOINT TARGETING: CURSOR-ON-TARGET

One of the "glitches" that developed in the targeting chain in Afghanistan was the handoff from target analyst to decider to shooter, a process that required repeated hand-entering of target location and other target-relevant data requisite for calculating the Desired Mean Point of Impact (DMPI). General John Jumper, Chief of Staff Air Force (CSAF), observed that an F–15 pilot, by placing his radar cursor on a potential target, had a machine that performed all the requisite calculations for him: target altitude, heading, airspeed, type of target, and best intercept course. The CSAF wanted a system capable of producing a DMPI that avoided stovepipe, system-specific techniques; integrated all relevant information; and operated swiftly and reliably. The Air Force Electronic Systems Command tasked MITRE engineers to propose a solution.

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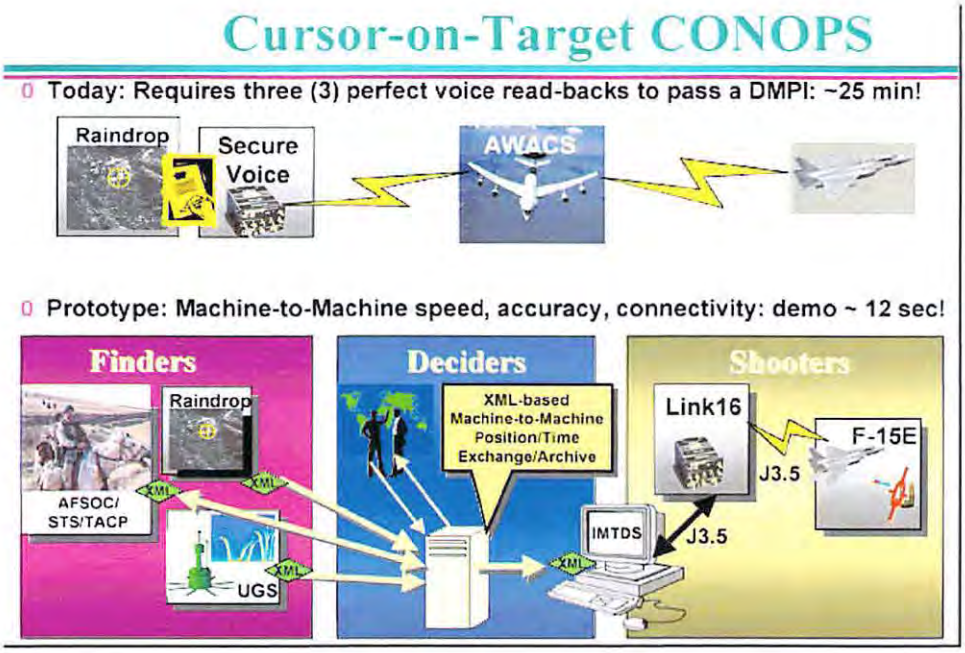
11 RAH–66 Comanche Operational Requirements Document.



The system then in use in Afghanistan passed DMPI data by secure voice from a target source to an AWACS, and then again from the AWACS to a fighter-bomber. Each forwarding involved reading the target coordinates three times and correct "read-back" by the recipient. Then the receiving delivery crew had to apply the data to its weapon and maneuver for its launch. In all, this process often consumed more than 20 minutes, and human errors demonstrably could be fatal.

MITRE engineers put together a laboratory experiment using actual communications. They demonstrated the capability to pass targeting data automatically from "finders," which could be imagery, a laser designation, or a "ring" from an unattended ground sensor. The nominated target was automatically passed to a "decider," who, if he approved, passed it automatically to an aircrew for attack. Central to the process was generation of the original "finder" message in XML format, which ensured that it could be data rich, yet very short, and therefore very fast.

Upon successfully demonstrating their system—which they refer to as Cursor on Target (CoT)— it occurred to the engineers that what they had come up with had much broader implications than DMPI applications. In the first place, the XML message was a network-centric solution, the power of which actually increased with the number of subscribers to the service. In the second place, XML suited alike the analyst who wants details and has time and the warrior who needs only minimal information and cannot tolerate delay. In effect, each XML message was an index of information pertinent to one object or incident.

Aha! Insight!
Many Tactical Data Needs are Very Similar!

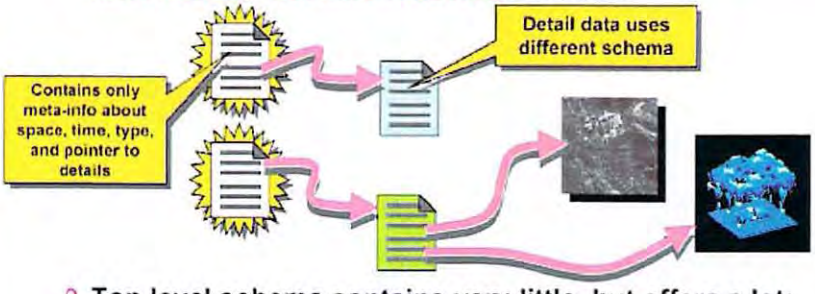
- Similar exchange of time-sensitive position info is crucial for
  - Blue-force tracking
  - Spot reports
  - Air space deconfliction
  - Unattended sensor monitoring
  - Sensor queuing
  - Real-time targeting
  - Materiel management
  - ...

- Network power increases rapidly with the number of users
  - Want all users to have potential access
- Technology exists for extensible machine-to-machine meta-data tagging

MITRE

A Common Format?
But That's Not Possible!

- It is if we make extensive use of XML for *simple, extensible, hierarchical, machine-readable* schemas



- Top level schema contains very little, but offers a lot:
  - *<position>* - actually a "volume" of space
  - *<time>* - actually an "interval" of time
  - *<type>* - { *observation* | *capability* | *tasking* | *reservation*}
  - *<details>* - URL (or embedded) next level of detail

MITRE

Thus far the MITRE CoT team has interfaced their system with two Air Force mission planning and coordination systems, three communications links, three target mensuration systems, a map display system (Falcon View), and a full set of USAF Special Operations Forces (SOF) equipment. The team's report points out that CoT does not attempt to meet all requirements, but it does provide the most important information for most systems (position, time, type, URL for more info). Its simple standards work with old as well as new systems. Connectivity costs grow proportionate to number of users, not the square of that number. Moreover, it can be readily and quickly reconfigured to meet unforeseen requirements or new missions. Because MITRE serves with all of the four services, it is in a unique position to address joint issues like CoT.

BLUE FORCE TRACKING

The employment of weapons, however precise, in proximity to U.S. or allied troops demands knowledge of the troops' exact position. To enable CAS and other close support fires, control forces, or assist their navigation, the Army has fielded in CENTCOM an extensive system for locating in real time the elements of the deployed force. Termed Blue Force Tracking (BFT), the system augments the usual service and joint communication means with military and commercial satellites and transponders, and it seeks to keep track of individual air or ground vehicles and small dismounted units. The Joint Forces Command has designated the Army to be its Executive Agent for combat identification and tracking, and the Army has turned to MITRE for assistance in evolving BFT into a more capable and versatile system. MITRE engineers have set forth these tenets for the eventual BFT design: BFT should

- be a family of systems tailorable to various types of force structure and force missions.
- be undergirded by robust communication and navigation means that can surmount hostile jamming and efforts to deny service, hence militarized vs. commercial systems, A/J antennae, GPS, and redundant navigation for urban/subterranean operations
- be seamlessly interoperable across the services: robust, scalable, secure, and long range.
- be cost effective by capitalizing on the convergence of sensors, navigation means, and communications
- Employ radio-frequency tags for situational awareness where GPS or communications may be inadequate and for low cost, for low probability of

intercept/low probability of dtection, and for exploiting the persistent sensor environments forecast for FCS and other modernizing forces.

- Provide information management that tailors distributed information to need, reduces the system initialization burden, and exploits Web services and XML.

TOWARD JOINT INTERDEPENDENCE

Joint Vision 2010 and Joint Vision 2020 advocate close cooperation among the armed services, and it is evident that when such cooperation occurs, there is effectiveness beyond the reach of any one service alone. In Kosovo 1999, more than 3,000 air sorties dropping 14,000 weapons destroyed only 52 Serbian ground combat systems.[12] During the Gulf War (1991) the 44-day air campaign destroyed 799 Iraqi tanks; the 96-hour ground campaign destroyed 1,865.[13] The *Gulf War Air Power Survey*, 1993, found that units on the ground accounted for more than 75 percent of Iraqi combat forces destroyed during Desert Storm. In short, the record indicates that for decisiveness, collaboration by air and land forces is essential.

The advent of standoff precision weapons such as AWS and LOCAAS will probably coincide with the fielding of NetFires and its derivatives. AMSTE, CoT, and BFTS indicate that it ought to be possible to develop a joint, precise, reliable, and swift system for controlling such weapons systems.

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12 Draft RAND report, "Disjointed War: Military operations in Kosovo, 1999."

13 Joint Intelligence Team Survey

APPENDIX C, ANNEX 1

ARMY AVIATION DOCTRINE

EXTRACT FROM FM 1-100 ARMY AVIATION OPERATIONS, DATED 21 FEBRUARY 1997*

FUTURE DOCTRINE

This edition of FM 1-100 is written to carry Army aviation forward to the turn of the century. Our vision lies beyond the turn of the century, however. As this manual is being drafted and staffed, we are concurrently developing the new concepts that will evolve into the doctrinal foundation for the *next century*. This is a dynamic period of innovation and change.

Our leap-ahead reconnaissance and attack aircraft—the RAH-66 Comanche and AH-64 Longbow Apache—are realities. We know their current capabilities, and can envision the future potential they bring to the *future battlefield*. We are developing future doctrine based on those capabilities. At the same time, the research and development community and industry continue to create the enabling technologies-the digital communications and other linkages—we need to fight these systems to their fullest potential. The *future battlespace* will be fluid, high tempo, and nonlinear. The traditional battlefield framework of deep, close, and rear operations will become increasingly convoluted and ambiguous.

To maintain continuity with other capstone Army doctrine, this edition of FM 1-100 will continue to refer to close, deep, and rear operations; however, in the near future, a more viable framework may be simply close and extended operations. On the *nonlinear/non-contiguous battlefield of the future*, we must be prepared to conduct seamless, simultaneous operations in all directions.

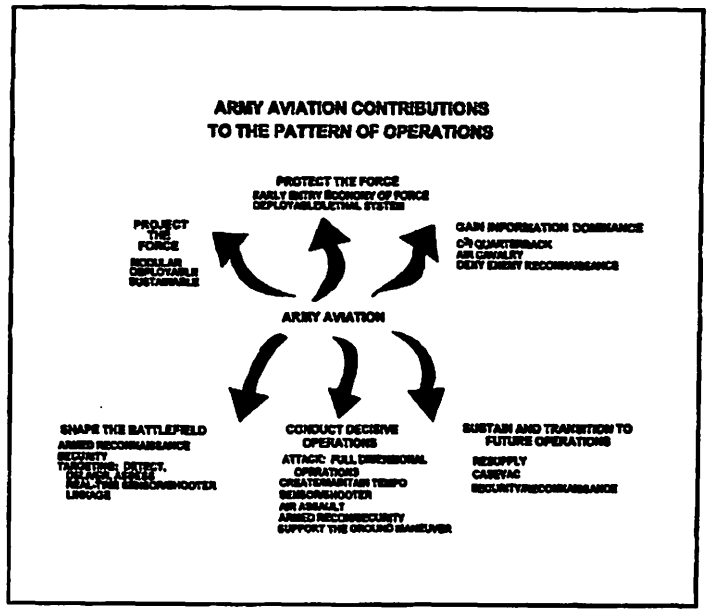
Army operations will be conducted in the context of an ever-changing world. No longer can we model the force and develop our doctrine against one known threat, or even counter the capabilities of a number of known potential adversaries. Instead, we must develop and retain the warfighting capability to win decisively across the spectrum of operations with minimum friendly casualties. This is domination-based warfare-massing not only our forces, but total lethal and nonlethal effects, throughout the battlespace to dominate any potential adversary. *Army aviation is uniquely suited to these challenges.*

The Apache and Comanche fully exemplify the inextricable linkage between maneuver and fires. With unmanned aerial vehicles (UAVs) to extend their range and coverage-digitally cued by the Joint Surveillance Target Attack Radar System (JSTARS), Army airborne command and control system (A^2C^2S) UH-60 Black Hawks, and other ground-based command posts—these aircraft provide commanders with real-time intelligence and situational awareness. They maneuver throughout the depth of the battlespace to deliver precision fires with devastating lethality.

Shaping Army aviation for future operations is more than merely delivering lethal fires ...it is more than killing enemy tanks and artillery.. .it is, instead, creating a new synergy—a total integration into what is termed a *pattern of operations*. (The subsets of the pattern are depicted in italics to indicate that they are *emerging doctrinal* terms.)

* Online, Available: http://www.adtdl.army.mil/cgi-bin/.atdl.dll/query/download/FM+1-100, 14 May 2003.

Our future Aviation units will be modular and deployable. They will provide joint force commanders with a lethal and flexible force to rapidly deploy from the continental United States (CONUS), or abroad, to any theater. Deployment will be by strategic air or sea lift, self-deployment, with a maritime force aboard aircraft carriers, or by any combination of those means.



No other force can match Army aviation's ability to rapidly *project the force* and build combat power in an immature theater. Once on the ground, we become the principal means to *protect the force* as the other ground forces continue to deploy and flow into the initial lodgement. This is best exemplified by the initial days and weeks of Desert Shield as aviation units quickly deployed to Saudi Arabia and became the principal combat power for the initial covering force.

Throughout the future fight, Army aviation will be at the forefront of *gaining information dominance.* The Comanche and Longbow Apache, coupled with UAVs and the A²C²S UH-60, form a team that becomes, in effect, the command, control, communications, and intelligence (C³I) key facilitator for the *future battlefield.* We can eliminate the enemy's reconnaissance, attack his command and control (C²), and gather intelligence, while providing security for our own intelligence and C² systems. Digitally cued by JSTARS and other airborne and ground sensors, our future aircraft will add a new dimension of precision economy of force. Concurrently, these missions also contribute to Army aviation's key role in *shaping the battlespace.*

By conducting armed reconnaissance and security missions with real-time, sensor-to-shooter linkages, Army aviation can rapidly confirm the enemy's intentions, disrupt his tempo, deny his freedom of action, and get into his decision cycle. The ultimate in shaping the battlespace is to preclude the necessity for conducting decisive operations. We can sustain the tempo of the fight, attacking with depth and simultaneity throughout the battlespace. At a time and place of our choosing, we will initiate decisive operations in conjunction with maneuver ground forces to complete the destruction or defeat of enemy forces.

We will sustain the force and transition to future operations with combat support and combat service support provided by our UH-60 Black Hawk and CH-47 Chinook aircraft, and by air assaulting forward-operating bases from which follow-on combat operations can be conducted. We will also continue to provide the reconnaissance, security, and attack helicopter support to sustain the fight and protect the force as we prepare for follow-on operations.

Army aviation must adapt quickly to the inevitable changes that affect our mission. Our doctrine, tactics, techniques, and procedures must reflect those changes and be responsive to the needs of our units in the field. We encourage your comments and ideas as we develop our collective vision for shaping the future of Army aviation.

CHAPTER 1

INTRODUCTION TO ARMY AVIATION

There is "the enduring reality of the unknown and the uncertain; not just across the Atlantic and Pacific, but in all regions of the world that continue to harbor danger and turmoil; regions where crisis will occur when least expected." To meet this reality, contingency forces "provide global crisis and contingency response capability across the spectrum of conflict from counterinsurgency to major conventional conflict."

General Colin Powell
A Critical Analysis of the Gulf War

1-1. PURPOSE

The purpose of our capstone doctrine is to capture the essence of Army aviation and those principles upon which it is employed across the range of military operations.

1-2. STRATEGIC REALITIES

a. Recent events have underscored the uncertainty of these times. The post Cold War period has placed unprecedented operational demands on the Army. Civil disturbances, disaster relief, humanitarian and peacekeeping operations, and the threat of lesser regional contingencies punctuate the need for a trained and ready contingency-oriented Army. Amidst these global demands, domestic change and fiscal constraints broaden the challenge.

b. This era also confirms the application of high technology in future warfare. Weapons with the *"effects of massed forces"* are available to any nation possessing hard currency. Precision munitions, digital communications, and position location equipment promise to change the face of future battle.

c. The physical and intellectual dimensions of battlespace urgently demand intuitive and versatile leaders supported by agile battle staffs and well-trained soldiers. Mobility, agility, simultaneity of effort, lethality, increased battle tempo, and space-age logistics must dominate the Army's restructuring initiatives and investment decisions.

1-3. ARMY'S RESPONSE

a. The Army has responded to this new environment with continental United States (CONUS)-based contingency and reinforcing forces and some forward-deployed units. Total Force initiatives are underway among the Active and Reserve Components to give broadened meaning to the doctrine development of a trained and ready Total Army, capable of decisive victory. Force restructuring initiatives are being implemented to

leverage high technology for a downsized force. Modernization decisions are focused on projecting and sustaining the force, protecting deployed forces, winning the information war, conducting precision strikes, and dominating the maneuver battle. The result is a combined arms team that leverages all dimensions of the ground regime.

b. Aviation, as a maneuver force, is the third dimension centerpiece of the land force. Reconnaissance, attack, utility, and cargo helicopters complemented by special operations forces (SOF), fixed-wing and medical evacuation (MEDEVAC) aircraft, and air traffic service (ATS) units, comprise our contribution to the fight for a global Army. While the range of military operations demands readiness for a wide range of employment, warfighting is our mission and we cannot lose sight of this obligation.

1-4. A VISION

a. As we look toward the next century and the pivotal role of Army aviation across the full range of military operations, it is imperative that we have a vision—a concept that will serve to guide our collective thought and actions—as we look to the future (Figure 1-1).

b. Although we emphasize and have soundly demonstrated our versatility and proficiency in stability and support operations (SASO), Army aviation's primary focus remains with combat operations. That focus on warfighting is guided by immutable principles that have stood the test of time and the trials of war.

AVIATION VISION

AVIATION IS THE RELEVANT FORCE FOR THE 21ST CENTURY PROVIDING COMBAT, COMBAT SUPPORT, AND COMBAT SERVICE SUPPORT CAPABILITIES ACROSS THE SPECTRUM OF FULL-DIMENSIONAL OPERATIONS. ITS INHERENT VERSATILITY, MANEUVER ADVANTAGE, AND WARFIGHTING EFFECTIVENESS WILL INFLUENCE ALL DIMENSIONS OF THE FUTURE BATTLESPACE. HIGHLY MOTIVATED AVIATION SOLDIERS, EQUIPPED WITH MODERN SYSTEMS AND TRAINED TO WORLD CLASS PROFICIENCY, WILL PROVIDE COMMANDERS AT ALL LEVELS AN EXPONENTIAL INCREASE IN LETHALITY, THE LEADERSHIP TO HARNESS THE TECHNOLOGICAL REVOLUTION OF THE DIGITAL BATTLEFIELD, AND THE ABILITY TO ACHIEVE DECISIVE VICTORY.

Figure 1-1

1-5. AVIATION OPERATIONAL PRINCIPLES

Mission planning and execution are driven by general principles that apply and go beyond the principles of war and the tenets of Army operations. These general principles are as follows:

a. Aviation operates in the ground regime.

(1) This cardinal principle defines aviation's role as an element of landpower. Aviation is a component of the combined arms team, not the air component of the US Army.

(2) Aviation's primary mission is to fight the land battle and to support ground operations. Aviation is comprised of soldiers, not airmen, and its battlefield leverage is achieved through a combination of reconnaissance, mobility, and firepower that is unprecedented in land warfare.

(3) Aviation greatly enhances the commander's ability to apply four fundamental principles of war—maneuver, mass, surprise, and economy of force.

b. Aviation expands the battlefield in space and time at each echelon.

(1) Expansion of the battlefield is necessary to enable the commander to seize the initiative at a critical point in the battle. Aviation expands the ground commander's battlefield, principally in space and time, by extending the range at which direct fires and observed fires can be concentrated on the enemy; and by expanding his reconnaissance and surveillance envelope beyond the effective range of other systems.

(2) Aviation expands battlespace at each echelon to which it is assigned or attached—providing a capability where none previously existed or enhancing existing capabilities. Aviation allows commanders to achieve the effects of mass without massing weapons systems.

c. Aviation performs combat, combat support (CS), and combat service support (CSS) battlefield functions (Figure 1-2).

(1) Aviation's greatest contribution to battlefield success is the ability it gives the commander to apply decisive combat power at critical times, virtually anywhere on the battlefield. This may be direct fire from aviation maneuver units or the insertion of overwhelming infantry forces or artillery fires, delivered into combat via air assault. This versatility is the very essence of Army aviation.

(2) CS missions support ground combat operations. These operations include air movement; command and control (C^2); ATS; electronic warfare; close in fire support; support by fire; combat search and rescue; and aerial mine delivery. The primary function of these missions is to support combat elements in contact with the enemy.

(3) Aviation performs CSS functions in support of units throughout the entire area of operations. Aviation units enhance the commander's battlespace through rapid delivery of supplies and personnel and aeromedical evacuation.

d. Aviation is concentrated at division and corps level.

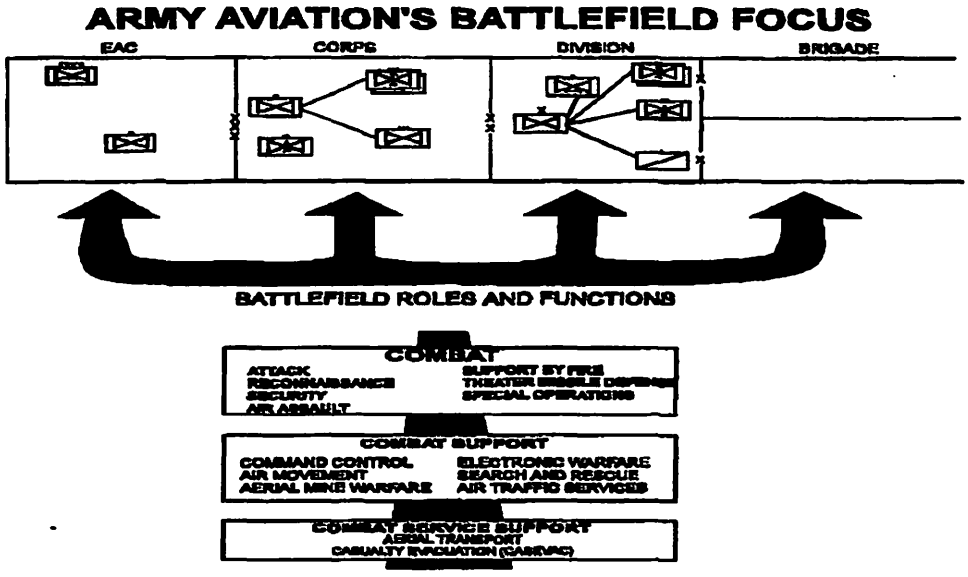


Figure 1-2

(1) The corps aviation brigade may operate directly for the corps commander or be placed under operational control (OPCON) of a subordinate division. The corps commander can task organize other corps assets, especially division aviation units, under the command of the corps aviation brigade or task the corps aviation brigade to support an armored cavalry regiment (ACR).

(2) The aviation brigade may also be tasked to be a covering force headquarters when augmented by ground forces. The corps aviation brigade conducts attack and reconnaissance operations to find, fix, and destroy enemy forces; it also conducts security, air assault, C^2, and air movement operations throughout the corps area of operations (AO).

(3) The corps aviation brigade plans, coordinates, and executes aviation operations in support of the corps scheme of maneuver. It can be expected to operate anywhere in the corps area.

(4) The division aviation brigade conducts all aviation combat, CS, and CSS missions (except ATS and fixed-wing operations) in support of the division scheme of maneuver. The primary mission of the division aviation brigade is to find, fix, and destroy enemy forces within the division area. The division aviation brigade can accomplish this mission as an aviation-pure or task-organized force.

(5) Combined arms battles and engagements are fought by brigades and divisions. Division is the lowest level at which all of the combined arms are normally integrated.

(6) The combination of infantry, armor, and aviation is a habitual association at the division level. All three arms are required for operations, in depth, throughout the course of battle. Therefore, combat aviation must be primarily assigned to, and employed by, divisional aviation brigades, just as infantry and armor battalions are assigned to, and employed by, their parent brigades.

(7) Aviation forces fight as units and must be given unit missions. Aviation units conducting tactical operations are given maneuver objectives rather than individual targets.

e. Aviation units are integrated into the combined arms down to the level at which they will be employed.

(1) The division aviation brigade is the primary level of integration. The brigade commander is responsible for the operation of all divisional aviation; he will normally command and integrate additional aviation units attached or under OPCON from corps.

(2) When aviation units are placed under OPCON of the other maneuver brigades, they normally will be on a mission basis and tailored or task organized with assets from brigade and/or division. A liaison detachment should be placed at the ground brigade command post to improve synchronization and responsiveness, especially in changing tactical environments.

f. Planning times for aviation and ground maneuver elements will be the same.

(1) Aviation units conduct deliberate planning within the same time parameters as the other maneuver elements. Airspace coordination, route clearances, and weather updates complicate the task for aviation staffs; however, for effective combat operations, the standard is the same.

(2) Both ground and air mission planning times can be reduced when plans are carefully integrated, effective liaison occurs, and standing operating procedures (SOPs) are optimized.

1-6. BATTLEFIELD OPERATING SYSTEM

The battlefield operating system (BOS) is comprised of the major functions performed on the battlefield. These functions facilitate the integration, coordination, preparation, and execution of successful combined-arms operations to successfully execute Army operations (battles and engagements) and accomplish military objectives directed by the operational commander. They include *intelligence; maneuver; fire support; mobility, countermobility,* and *survivability; air defense; logistics;* and *battle command* (Figure 1-3).

ARMY AVIATION CONTRIBUTION

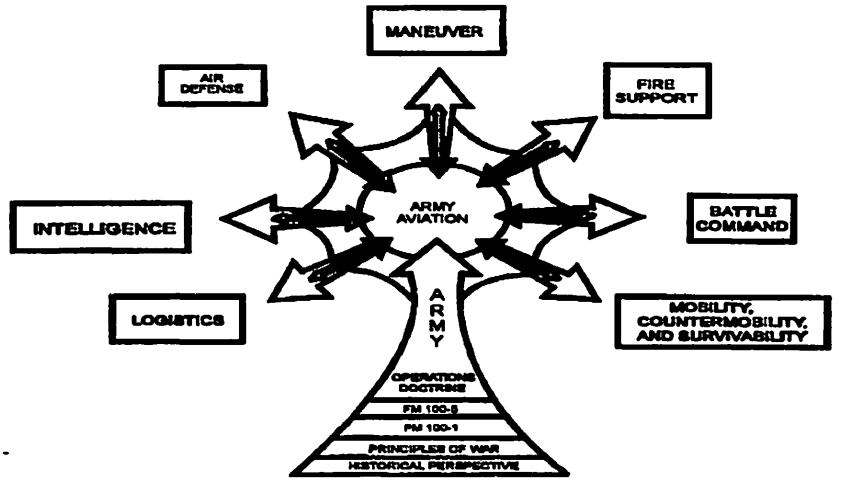


Figure 1-3

Commanders use the BOS to integrate and coordinate these functions to synchronize battle effects in time, space, and purpose. Army aviation contributes to all BOS functions addressed in the following paragraphs:

a. ***Maneuver.***

(1) Maneuver is defined as *"Employment of forces on the battlefield through movement in combination with fire, or fire potential, to achieve a position of advantage in respect to the enemy in order to accomplish the mission."*

(2) During decisive operations, Army aviation's mobility and firepower make it a dominant force—a force that can gain and maintain contact; destroy the enemy in depth; attack decisive points at the tactical and operational levels; and allow him no safe haven in which to reorganize, rearm, or recover.

(3) Attack helicopter units give the commander a force that can rapidly build devastating firepower at any point on the battlefield.

(4) Army attack helicopters can support the close fight by securing an armored or mechanized force's flanks-providing aerial fires, target acquisition, and reconnaissance. They can also attack decisive points and critical targets hundreds of kilometers (km) deep in the enemy's rear area simultaneously.

(5) By destroying follow-on forces, C^2 nodes, and logistical supply assets before they can be employed against friendly forces, aviation can significantly influence tomorrow's close fight.

(6) Deep operations require precise synchronization of both lethal and nonlethal assets; aviation performs not only maneuver, but supports other maneuver forces with fires and maneuver. Since this is true, aviation commanders are accustomed to massing effects on the battlefield. We can rapidly mass effects; then just as rapidly shift our focus to a new main effort. This flexibility and versatility are paramount to decisive operations.

(7) UH-60 Black Hawk and CH-47 Chinook units also play a pivotal role in combat operations. The means to project a forward-operating base across hundreds of kilometers allow the friendly force commander to define the battlespace, control it, and engage the enemy at a time and place of his choosing.

(8) UH-60 Black Hawk and CH-47 Chinook units can rapidly move dismounted troops, artillery, and antitank weapons anywhere on the battlefield to attack targets; seize critical terrain; or cut off an enemy's retreat so he can be destroyed in place.

b. ***Intelligence.***

(1) Intelligence is the product resulting from the collection, analysis, and dissemination of all available information that is immediately or potentially significant to military planning and operations.

(2) The commander drives intelligence by specifying what his intelligence and targeting requirements are; and requiring his intelligence BOS to provide the intelligence he needs, in the format he can use, in time to support his decision-making process.

(3) The commander's priority intelligence requirements (PIRs) will drive this process. The tasks required to properly integrate intelligence into aviation missions present a challenge for aviation commanders at every level. Primary intelligence tasks are—

- Provide indications and warnings.
- Perform intelligence preparation of the battlefield.
- Perform situation development.
- Perform target development and support to targeting.
- Support force protection.
- Perform battle damage assessment (BDA).

(4) Aviation augments intelligence collection by providing reconnaissance, early warning, target acquisition, electronic support (ES), and BDA.

(5) Army aviation also assists the intelligence effort by conducting missions to attack the enemy's command, control, and intelligence (C^2I) systems; and by conducting missions to protect friendly C^2I.

(6) Army aviation provides the commander with near real-time intelligence throughout his battlespace with its attack and cavalry aircraft and special electronic mission aircraft (SEMA). In fact, with the OH-58D Kiowa Warrior and AH-64 Apache, a single combat system can find, fix, and observe or destroy enemy assets across the depth of the battlefield.

(7) Aerial exploitation battalions (AEBs) exist in most Army corps; they provide an organic deep look capability for the corps commander, focusing on second-echelon forces that can influence the fight greater than 72 hours into the battlespace. The Guardrail Common Sensor can provide targetable communications intelligence (COMINT) and electronic intelligence (ELINT) on enemy targets as far as 300 km away. Besides Guardrail, Airborne Reconnaissance Low (ARL) provides all-source imagery and signals intelligence throughout the range of military operations.

(8) At the division and armored cavalry regiment, the EH-60 Quickfix is an important SEMA asset for conducting intelligence and electronic warfare (IEW). The EH-60A (Quickfix) and the follow on EH-60L (Advanced Quickfix) provide the commander with signal intelligence and electronic jamming capability using the advantage of aviation mobility.

(9) Intelligence is critical to the successful conduct of aviation operations—particularly deep operations. Army aviation units often require joint, theater-level intelligence support; joint and echelon above corps (EAC) assets must be integrated into the aviation collection plan. This is particularly vital to engagement area (EA) planning and development. The intelligence links necessary to *"see"* an EA must be emplaced in a timely manner and continuously monitored.

(10) Another critical area that requires the same level of detailed planning and joint/EAC support is joint suppression of enemy air defense (JSEAD). JSEAD is more than planning artillery fires. It is a synchronized plan that integrates all available lethal and nonlethal joint assets into an operation concentrating on dismantling the enemy's entire air defense (AD) network—not simply isolating and suppressing or destroying specific weapons. This more thorough approach requires continuous and detailed intelligence collection and assessment.

c. ***Fire Support.***

(1) Fire support operations are conducted throughout the wide range of military operations. Fire support includes the delivery of conventional and smart munitions by

armed aircraft, land- and sea-based fire systems, and electronic warfare (EW) systems against ground targets. Operations often hinge on carefully planned integration of fires.

(2) Army aviation, as a maneuver force, contributes to fire support operations by acquiring targets; providing laser designation; adjusting indirect fires; and providing command and control to artillery units. Aviation units also contribute to fire support by engaging targets with close in fire support and conducting support by fire missions.

(3) The EH-60 Quickfix mission contributes to fire support by providing *"electronic"* fires in the form of signal jamming and electronic deception. FM 100-5 states *"when developing the concept of operation, tactical commanders should consider EW assets the same as they do artillery."*

d. ***Air Defense.***

(1) Across the wide range of military operations, commanders at all echelons are faced with an increasingly capable air and missile threat. Today's widespread technological advances are challenging the maneuver commander in his execution of air and ground maneuver. All commanders can expect the enemy to violently contest the use of the airspace at any level of conflict with an extensive array of weapon systems.

(2) The air dimension of the battlefield must be effectively controlled by disrupting, degrading, or deceiving enemy air defenses. Suppression of enemy air defense (SEAD) prevents effective fires on friendly forces. Thus, Army aviation and tactical air assets can maneuver into the depth of the enemy to weaken his ability and will to fight.

(3) SEAD and JSEAD are major functional areas that affect the operations of all combined arms actions. Commanders at operational and tactical levels must coordinate and allocate a balance of resources (direct, indirect, electronic attack) to SEAD/JSEAD. Aviation commanders must be involved in recommending and developing SEAD and JSEAD priorities. As evidenced in Desert Storm, Army aviation not only may be a benefactor of SEAD/JSEAD operations, we also may be called upon to provide SEAD/JSEAD fires at the strategic, operational, and tactical levels of war.

(4) AD operations are performed by all members of the combined arms team; however, ground-based air defense artillery (ADA) units execute the bulk of the force protection mission. AD operations protect the force by preventing enemy aircraft, missiles, and remotely piloted and unmanned aerial vehicles (RPV/UAV) from locating and attacking friendly forces.

(5) Army aviation assists AD units by conducting theater missile defense (TMD) attack operations and contributing to short range air defense (SHORAD). Army aviation units conduct deep operations to attack threat missile components, such as launch platforms; command, control, communications, computers, and intelligence (C'I) nodes; missile stock infrastructure; and UAV launch facilities.

(6) Army aviation can attack these targets when they are stationary or on the move. In certain environments, Army aviation can execute these missions without the benefit of sensor/eyes on target or a precise grid coordinate. Army aviation assets may also be called upon to intercept and destroy enemy helicopters and UAVs that pose a threat to friendly forces.

e. ***Mobility, Countermobility, and Survivability.***

(1) Mobility operations preserve the freedom of maneuver. They include breaching enemy obstacles; increasing battlefield circulation; improving existing routes, or building new ones; providing bridge and raft support for crossing rivers; and identifying routes around contaminated areas.

(2) Army aviation contributes to the mobility and survivability of the force by overcoming both man-made and natural obstacles. Aerial reconnaissance elements identify obstacles in the path of advancing forces and search for bypass routes or safe crossing sites. This precise information saves valuable time and helps the force continue to move unimpeded.

(3) Aviation forces also provide security during obstacle-emplacement or crossing operations by rapidly moving troops and supplies to secure obstacle locations or crossing sites.

(4) Countermobility missions hinder enemy maneuver. Aerial delivered mines can be employed to emplace tactical minefield; reinforce existing obstacles; close lanes, gaps, and defiles; protect flanks; and deny the enemy AD sites. Aerial delivered minefield can also be employed for flank protection of advancing forces and for operating in concert with air/ground cavalry units on flank guard or screen missions.

(5) Survivability operations protect friendly forces from the effect of enemy weapons systems and from natural occurrences. Hardening of facilities and fortification of battle positions are active survivability measures. Deception, operational security (OPSEC), and dispersion can increase survivability. Nuclear, biological, and chemical (NBC) defense measures are also key survivability operations.

f. ***Logistics.***

(1) Logistics entails the essential capabilities, functions, activities, and tasks necessary to sustain all elements of operating forces in theater at all levels of war.

(2) Aviation assists in providing basic sustainment operations for the Total Force. Aviation forces may support major maneuver forces, CS elements, or major CSS elements for the maneuver force.

(3) Aviation cargo and utility assets may perform force sustainment as well as support aviation-specific sustainment requirements. However, air movement is a

relatively inefficient means to transport heavy supplies and equipment and should be reserved for the support of major operations in which air movement is essential for success or in situations where emergency resupply is vital for mission accomplishment.

g. ***Battle Command.***

(1) Battle command functions are performed through an arrangement of personnel, equipment, communications, and procedures employed by a commander to plan, direct, coordinate, and control forces and operations to accomplish a mission.

(2) Battle command is the art of battle decision making; leading; and motivating soldiers, and their organizations, into action to accomplish missions. Battle command consists of visualizing the current state and the desired end state for an operation. It includes deciding how to get from one state to the other at the least cost to the soldier.

(3) Battlefield visualization lies at the center of battle command. It is a continuous process that commences before an operation and continues through achievement of the desired conclusion to that operation.

(4) Visualization of the battlefield requires use of operational tools derived from science and technology. These operational tools provide the commander with near real-time information on the current situation. Situational awareness includes knowing the disposition of friendly forces, enemy forces, noncombatants, the environment, and the terrain.

(5) Army aviation—with its reconnaissance and security assets and SEMA platforms-can assist the force commander by providing accurate information in virtually all environmental conditions and throughout the full spectrum of conflict.

(6) Reliable communications are central to both battle command and battle control. Effective battle C^2 requires reliable signal support systems to enable the commander to conduct operations at various tempos. Army aviation has the capability to provide highly mobile C^2 command posts to commanders at the brigade, division, corps, and EAC levels. The communications suites in these C^2 aircraft are compatible with the force's command post mission.

(7) In addition, by using its ATS assets, aviation supports the A^2C^2 mission; it aids in the regulation, integration, and deconfliction of the flights of both Army aircraft and Joint Service aircraft as well as UAV.

1-7. TRAINING AND READINESS CHALLENGES

a. Global realities require that Army aviation be prepared for employment throughout the entire range of military operations. Several factors present unique challenges to commanders concerning the conduct of training and readiness:

(1) Long overseas deployments on short notice will be the standard.

(2) Threat forces will probably outnumber early deploring US forces and may have technological parity in some weapons systems.

(3) Early deploying forces must be mobile, lethal, survivable, and sustainable upon arrival.

(4) Integrating Army National Guard and Army Reserve forces into operations at all levels.

(5) Maintaining readiness while undergoing major force restructuring.

(6) Harnessing increased situational awareness provided by digitization.

(7) Maintaining troop morale/equipment in spite of wide range of missions.

(8) Conducting realistic training and deployments while complying with environmental regulations.

(9) Maintaining readiness with decreased home station OPTEMPO and increased frequency of deployments.

b. Seldom, if ever, will military operations be conducted by a single service. The Army will act as part of a joint or multinational force in future operations. Complementary contributions of every component add to the effectiveness of the Total Force. Aviation possesses inherent characteristics that guarantee it will play a significant, if not unique, role throughout the range of military operations (Figure 1-4).

STATES OF THE ENVIRONMENT	GOAL	MILITARY OPERATION		EXAMPLE
WAR	Fight and Win	WAR	COMBAT	Large-scale combat operations... Attack Defend
CONFLICT	Deter War and Resolve Conflict	STABILITY AND SUPPORT	COMBAT / NONCOMBAT	Strikes and raids Peace enforcement Support to insurgency Antiterrorism Noncombatant NEO
PEACETIME	Promote Peace	STABILITY AND SUPPORT	NONCOMBAT	Counterdrug Disaster relief Civil support Peace building Nation assistance

The states of peacetime, conflict, and war could exist all at once in the theater commander's strategic environment. He can respond to requirements with a wide range of military operations. Noncombat operations might occur during war, just as some stability and support operations require combat.

Figure 1-4

1-8. FORCE PROJECTION

a. Force projection—a key element of power projection—is the ability to rapidly alert, mobilize, deploy, and operate anywhere in the world. As with Operations Just Cause and Desert Shield, force projection operations usually start as a crisis response; may require light, armored, or special operations forces; and may be either opposed or unopposed.

b. Aviation units deploying into a theater must be prepared for both offensive and defensive operations. If the threat is minor, it may be possible to enter directly into offensive operations as in Operation Just Cause. Against a formidable opponent, it may be necessary to assume a security mission or a defensive posture while forces are sufficiently built up to ensure success in offensive operations as in Operation Desert Storm.

c. Placing combat aviation forces in the early entry phase offers the ground commander a force that can provide reconnaissance, security, and C^2 over great ranges, in depth, at night; and increase his security capability during the critical phase of force buildup.

d. The presence of armed helicopters in the initial force package may deter the threat or interrupt his decision cycle long enough for additional friendly forces to arrive. If the entry force must conduct forcible entry operations to obtain a lodgement or secure the force against an aggressive threat, attack helicopters can place powerful direct fire capability in the hands of the ground commander.

e. Assault and cargo helicopters can rapidly move personnel, equipment, and supplies across great distances rapidly expanding the AO. SEMA and other fixed-wing platforms efficiently perform a wide range of intratheater reconnaissance and passenger transport missions even further enhancing the flexibility and versatility of our force.

1-9. JOINT OPERATIONS

a. Joint operations are the integrated military activities of two or more service components—Army, Navy, Air Force, Marine Corps—of the US military.

b. US joint forces must overcome joint operational and logistical differences. Complementary contributions of every service's forces add to the effectiveness of the Total Force.

c. Army aviation forces will continue to operate as part of the Army forces to a unified command, a specified command, or as part of a subordinate joint force.

d. The aviation force commander advises the joint task force commander on the capabilities, limitations, planning, and execution of aviation operations to support the joint contingency mission.

NOTE: Joint operations does not imply that planning must occur exclusively within high echelon staffs. *Joint air attack team (JAAT)* strategy evolved through direct team-level

interaction with US Air Force (USAF) pilots. Refinements in joint electronic combat tactics are occurring through direct coordination between Quickfix, at the platoon level, and the USAF squadron that conducts the airborne EW mission *"Compass Call."* This type of creative interaction between service forces should be encouraged by all commanders.

1-10. MULTINATIONAL OPERATIONS

a. Multinational operations involve diplomatic-military actions between two or more agencies, with armed forces of two or more nations to achieve the strategic end state; alliances or coalitions can be formed to carry out these actions.

b. Army aviation must be prepared to conduct multinational operations with the air, land, and naval forces of allied governments.

c. Combatant commanders face numerous challenges when planning and conducting multinational operations. Each participant brings its own unique capabilities and limitations to the operation. Commanders must not only consider cultural and language differences, but also differences in equipment, doctrine, and logistics.

d. The key to success in multinational operations is matching capabilities with missions and aggressive liaison between forces.

e. Army aviation forces will normally operate as part of the US Army component during multinational operations.

f. The aviation commander will advise the Army component or allied force commander on the capabilities, limitations, planning, and execution of aviation operations.

APPENDIX D

PROLEPTIC EXAMPLES

APPENDIX D
PROLEPTIC EXAMPLES

Pro •lep •sis (pro lep´sis) *n., pl.* **–lep´ses** (sez) the describing of an event as taking place before it could have done so, the treating of a future event as if it had already happened —**pro • lep´tic** *adj.*

—*Webster's New World Dictionary*

We should try to tell each other stories about how we expect to use technology in the future to give our fighters an advantage...

—*Director, DARPA, December 2002*

We never do the CONOPS, which tells how we are going to integrate up, down, and sideways, before we start talking about programs...if we don't start talking about how we fight, before we start talking about what we're going to buy to fight with, we're never going to achieve what the secretary of defense is trying to achieve.

—*CSAF, 20 November 2002*

Here are four "stories" about battles that U.S. forces may fight in the period 2012–2015.

- Annex 1, *The Defense of Fombler's Ford*, is set in the Balkans, and is a retelling of the British military classic from the Boer War, ca. 1901.
- Annex 2, *The Battle of Baachen*, describes combat aftermath in urban terrain, and echoes the circumstances of the fighting in Aachen, Germany, October, 1944, where the 26th Infantry under Colonel Jeff Seitz captured the city against odds of 1 attacker against 5 defenders.
- Annex 3, *Operation PYTHON*, engages some of the same principals who faced the challenges of Operation Anaconda in the high mountains of Afghanistan, 2002, with a similar mission.
- Annex 4, *Operation MONTANA*, takes place in a tropic jungle setting in circumstances patterned after those of the battle of Ap Gu, Vietnam, April 1967.

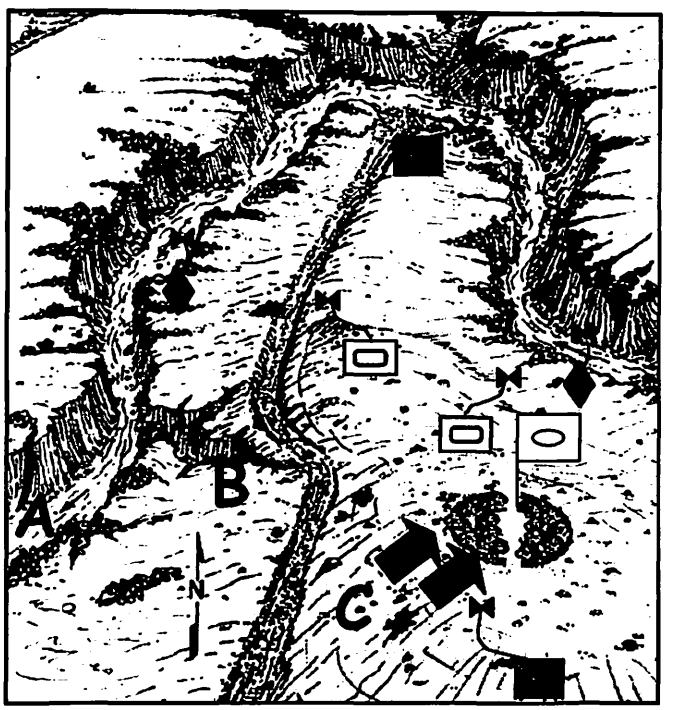
While based on actual circumstances of a past combat, in these proleptic essays both protagonists have been advantaged by technology insertions over the years, and both

are actors in a worldwide crisis, such as that portrayed for the Army's strategic war game at Carlisle Barracks, Pennsylvania, in the spring of 2002.

APPENDIX D, ANNEX 1

THE DEFENCE OF FOMBLER'S FORD

The Defence of FOMBLER'S FORD



A few experiences in the field defence for detached posts which may prove useful in our next war

Prepared with a salute to
Major General Sir E.D. Swinton
K.B.E, C.B,, D.S.O.
Inventor of the tank, and author of
The Defence of Duffer's Drift

The Defense Advanced Research Projects Agency
Program Manager, Command Post of the Future
Program Manager , Future Combat Systems

THE LESSONS OF DUFFER'S DRIFT*

1. Do not put off taking your measures of defence till the morrow, as these are more important than the comfort of your men or the shipshape arrangement of your camp...

2. Do not in war-time show stray men of the enemy's breed all over your camp, be they never so kind and full of butter, and do not be hypnotised, by numerous "passes," at once to confide in them.

3. Do not let your sentries advertise their position to the whole world, including the enemy, by standing in the full glare of a fire, and making much noise every half-hour.

4. Do not, if avoidable, be in tents when bullets are ripping through them; at such times a hole in the ground is worth many tents.

5. With modern rifles, to guard a drift or locality does not necessitate sitting on top of it (as if it could be picked up and carried away)...

6. It is not enough to keep strange men of the enemy's breed away from your actual defences, letting them go free to warn their friends of your existence and whereabouts—even though they should not be under temptation to impart any knowledge they may have obtained...

7. It is not business to allow lazy men (even though they be brothers and neutrals) to sit and pick their teeth outside their kraals whilst tired soldiers are breaking their hearts trying to do heavy labour in short time...

8. When collecting the friendly stranger and his sons in order to prevent their taking information to the enemy...do not forget also to gather his wife and his daughter, his manservant and his maidservant (who also have tongues)...

9. Do not forget that, if guns are going to be used against you, a shallow trench with a low parapet some way from it is worse than useless, even though the parapet be bulletproof ten times over...

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* Online. Available: http://www.adtdl.army.mil/cgi-bin/atdl.dll/misc/duffers-drift/duffers-drift.htm, 5 June 2003.

10. Though to stop a shrapnel bullet much less actual thickness of earth is necessary than to stop a rifle bullet, yet this earth must be in the right place. For protection you must be able to get right close under the cover...

11. For a small isolated post and an active enemy, there are no flanks, no rear, or, to put it otherwise, it is *front all round.*

12. Beware of being taken in *reverse;* take care, when placing and making your defences, that when you are engaged in shooting the enemy to the front of your trench, his pal cannot sneak up and shoot you in the back.

13. Beware of being *enfiladed.* It is nasty from one flank—far worse from both flanks.

14. Do not have your trench near rising ground over which you cannot see, and which you cannot hold.

15. Do not huddle all your men together in a small trench like sheep in a pen. Give them air.

16. As once before—cover from sight is of often worth more than cover from bullets.

17. To surprise the enemy is a great advantage.

18. If you wish to obtain this advantage, *conceal* your position. Though for promotion it may be sound to advertise your position, for defence it is not.

19. To test the concealment or otherwise of your position, look at it from the enemy's point of view.

20. Beware of convex hills and dead ground...

21. A hill may not, after all, though it has "command," necessarily be the best place to hold.

22. A conspicuous "bluff" trench may cause the enemy to waste much ammunition, and draw fire away from the actual defences.

PREFACE*

In 1903 there appeared in the United Service Magazine in Great Britain an essay on small unit operations entitled "The Defence of Duffer's Drift," under the pseudonym of Backsight Forethought. The author, Ernest D. Swinton, was a captain of Royal Engineers aged 35 who had recently spent three years in South Africa during the war with the Boers. Swinton's efforts there to visualize tactical options for subordinates catalyzed his inventing the "Dreamdorp paradigm": a sequence of dreams in which an officer progressively discovers how to devise a concept of operations based on the verities of terrain and enemy capabilities, to lay aside self indulgence, and to forego misguided concern for troop welfare.

Swinton set forth the rules for the dream sequences as follows:

> Upon an evening after a long and tiring trek, I arrived at Dreamdorp. The local atmosphere, combined with a heavy meal, is responsible for the following nightmare, consisting of a series of dreams. To make the sequence of the whole intelligible, it is necessary to explain that, though the scene of each vision was the same, yet by some curious mental process the totality was totally new to me, the locality was totally new to me, and I had an entirely fresh detachment. Thus I had not the great advantage of working over familiar ground. One thing, and one thing only, was carried on from dream to dream, and that was the vivid recollection of the general lessons previously learnt. These finally produced success....

Swinton, after a tour in France early in World War I, served on the secretariat of the Committee of Imperial Defence, and was foremost among those responsible for the tank's being introduced as a weapon system.

Ernest Swinton's *"Duffer's Drift"* has been through many editions, in many languages, the world over [Amazon.com carries it today!]. Concerning its continuing relevance, the views of Field-Marshal Wavell, in 1949 Colonel of the Black Watch Regiment, remain pertinent. Wavell wrote in a forward for a new edition of that year:

> If the up-to-date young officer asks scornfully what he can possibly learn from the tactics of the Boer War nearly fifty years ago, I can only advise him to read and then inwardly digest some admirable precepts of common sense...If after studying this little work, an officer decides that he has learned nothing, I can only recommend him to apply for employment in an Administrative branch of the War Office, for he will certainly be a danger to his troops in the field.

In that the terrain and the enemy remained constants, the lessons Backsight Forethought of *Duffer's Drift* had to learn depended upon only one variable: his concept of operations (CONOPS). *Fombler's Ford* introduces a descendant, Backsight Forethought VI, who is leading a small conventional task force centered on state-of-the-art main battle tanks. Posted as a picket during an offensive operation in "yet another war in the Balkans," he encounters a combined arms team of American allies that is organized around advanced information technology in the form of ground and air robots, layers of organic sensors for reconnaissance, surveillance, and target acquisition (RSTA), and organic robotic fire support for engaging targets out to 20 kilometers. The "Dreamdorp gene" of the Forethoughts then obtrudes with a dream sequence that enables him to understand how that American technology enables wholly new CONOPS. In short the Forethought of the 21st Century progresses through his lessons with both CONOPS and technology as variables.

The military history of the 20th Century establishes that adapting CONOPS simultaneously with the development of advanced weapon systems —radical evolution— is both very difficult and very rare.

The history of the tank is instructive. Great Britain led in development of armored fighting vehicles, and Colonel J.F.C. Fuller of the Royal Tank Corps proposed a brilliant concept of operation for the campaign of 1919: strike deep with massed tanks to decapitate German command and con-

*This article was published in AUSA's ARMY magazine, Vol. 50, No.7, July 2000, pp. 27-42.

trol. But Field Marshal Haig and virtually all other generals of the British Army of the era believed that tanks should be dispersed among infantry formations to assist their advance. Fuller's concept was often reexamined during the interwar years, but the Royal Tank Corps entered World War II committed to the concept of tactical support for infantry. So also were the tanks of the French Army, despite the arguments of DeGaulle and others to the contrary. In contrast, Germany supported Guderian's plan for radical evolution: combine advanced technology into a system of systems —e.g., not only armored fighting vehicles, but also radio communications, signals security, and attack aviation — into an integrated mobile force capable of decisive operational maneuver. In 1940 the tanks of England and France were quantitatively and qualitatively superior to Germany's, but Guderian's concept —labeled by the media of the time as "blitzkrieg"— was proved distinctly superior. N.B., in 1920 the Congress of the United States legislated that the maximum rate of advance of a tank should not exceed that of an infantryman, and that while American armor pioneers experimented with "combat cars" during the 1930s, the vaunted American armored division was not fielded until after 1939, and George C. Marshall's becoming Chief of Staff of the Army while the German juggernaut crushed the Polish army. Even then, the American concept of tank destroyers as an independent arm proved dysfunctional in North Africa, and had to evolve amid the following campaigns of 1943 and 1944.

The major American successes with radical evolution have mainly been achieved by services other than the Army. The U.S. Navy after World War II, constrained by arms control treaties that limited naval tonnage, initially built emulations of the Royal Navy's battle cruisers — smaller, faster, more lightly armored battleships with large guns — despite battle outcomes showing that these were vulnerable when employed using conventional fleet CONOPS. Then a group of determined reformers with support from high ranking admirals transformed the U.S. Navy by introducing a CONOPS centered on the aircraft carrier and carrier-borne aviation, a system of systems the efficacy of which was first demonstrated during the 1930s in war games at the Naval War College.

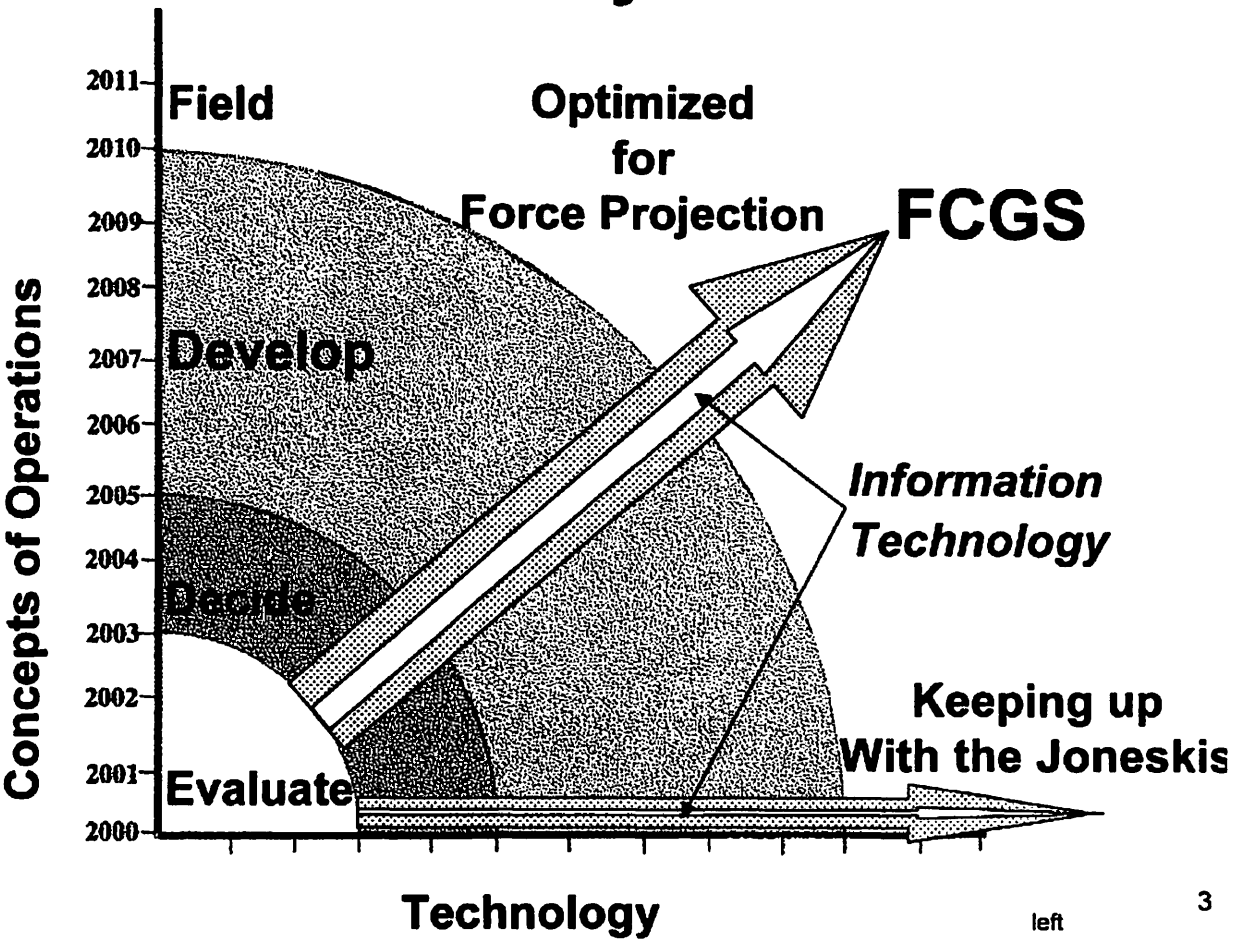
In the first decade after World War II, the Navy and the Air Force developed the strategic triad with wholly new technology and new CONOPS. Faced with unprecedented threats, these services fielded new technology apace with compatible doctrine and force structure, all directed "top down." The only comparable Army reform was the Howze Board's airmobile force, designed for the nuclear battlefield, that became the mainstay of U.S. Army Vietnam during the war in Southeast Asia.

Today the United States Army faces a choice between conventional and radical evolution: it is now a force projection force with worldwide missions requiring strategic and operational mobility, and tactically decisive overmatch as well. Yet the Army is finding increasing difficulty in adapting the forces and weapons acquired during the Cold War to its current and prospective missions, and is facing severe constraints on its funds for modernization.

Recently a study conducted under the joint auspices of the Army's Acquisition Executive and the Director of the Defense Advanced Research Projects Agency presented this chart among its findings and recommendations:

> The Army believes that it must make a decision in the period FY 2003 to 2005 on **what** to develop and **how** to develop for that portion of its materiel that will be modernized for the Army After 2010. Its options are indicated on the following chart by the two arrows.
>
> • The lower arrow portrays thrusting into the future using the Army's existing practice of developing platform-centric weapon systems. It is the more narrow of the two because R&D costs will be higher per weapon system, and development (assuming continuing budgetary strictures) correspondingly constrained. Thus, for example, fielding a new U.S. tank to overmatch a foreign tank equipped with a 152mm gun and advanced armor. The accelerating progress of technology will no doubt underwrite such a significant improvement in tank lethality and survivability, perhaps even assure that any new Army weapon system will **overmatch** that of any potential adversary.

Toward the Army After 2010

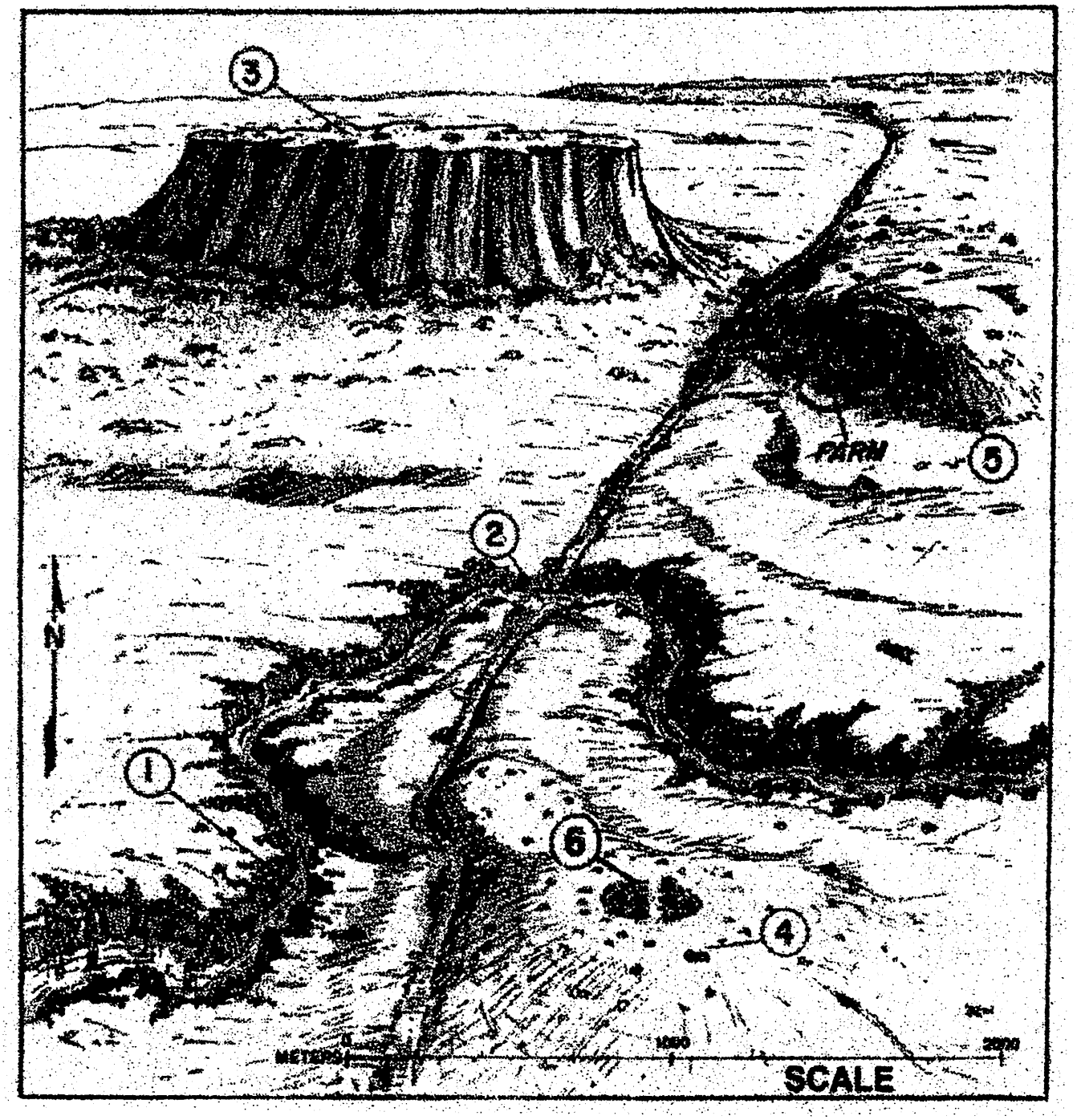


Only marginal changes in present Army concepts of operations will be necessary for the lower arrow.

• However, as the upper arrow indicates, if DARPA leads the thrust with determined exploitation of information technology — what the SAG termed a "collaboration-centric" or "network-centric" approach — and if the Army resolutely changes its concepts of operations apace, Future Combat Systems (FCS) fielded for 2010 and after will provide strategically and tactically agile forces for force projection. Further....there will be numerous opportunities to extract technologies from FCS developments that, when applied to legacy combat systems, will constitute apt modernization: significant improvements in combat effectiveness and useful life.

But what do Future Combat Systems look like and how do they operate? There follows a vision of a U.S. Army unit that might be the product of ten years of radical evolution. *The Defence of Fombler's Ford* employs the Dreamdorp paradigm to introduce Lt. B. Forethought VI and the reader to FCS CONOPS within reach of nascent technology that can be fielded by 2012.

FOMBLER'S FORD



(1) Ogenchornya River
(2) Ford
(3) Nichevo Mountain
(4) Dobroy Hill
(5) Starry Hill
(6) Dobroy Villiage

Sir Backsight Forethought

Outside the family, none of the Forethoughts ever talked about what they called the "Dreamdorp gene." Fellow officers of the British Army during the century past had assumed them born with tactical genius, for each Forethought manifested an uncanny ability to anticipate and to counter any foe, no matter how wily, no matter how advantaged by numbers or materiel. But the Forethought tactical acumen was less innate than acquired: each Forethought in turn had carefully guarded the truth, the anguished nocturnal experiences by which his tactical perceptiveness had been acquired. Each had risen through the ranks amid increasing respect and acclaim, and earned a painting on the wall of the ancestral home wearing full regimental regalia in the rank of general officer. And each had taught his son to anticipate serial nightmares on the eve of battle, dreams often terrifying, usually fraught with frustration and fear, but always crucially instructive — the very substance of the tactical genius for which the Forethoughts were renowned.

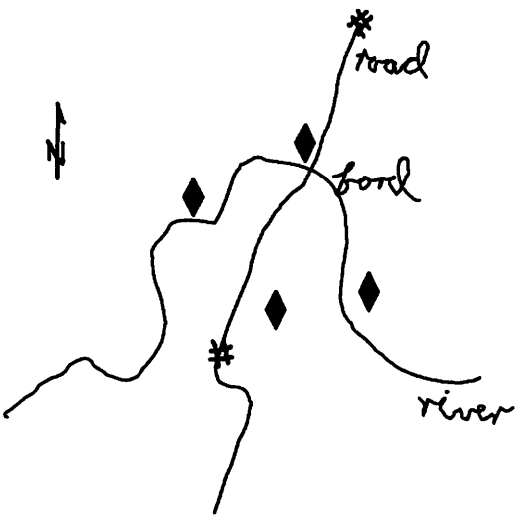
Lieutenant N. Backsight Forethought, the sixth of that name, was in a quandary. It was in the year 2012, amid yet another war in the Balkans, and he was in his tenth day on his first independent mission. Each time he had turned in at night , BF — as his friends called him— thought to himself that <u>this</u> was the eve of battle. With his platoon of tanks of the 1/6th Hussars and an attached section of infantry, BF had been ordered to block the main road to Urbanograd at a place where it traversed a shallow on the Ogenchornya River. He had seen to it that his dispositions took maximum advantage of the reach and power of his four main battle tanks, each of which was well sited and camouflaged artfully, and that his infantry soldiers were well dug in, ready to protect the tanks against RPG stalkers. But no enemy had appeared to test his defence. Though he had heard on his radio reports of British attacks to the east and to the west, at Fombler's Ford there had been only tense days of peering into the distance. Not even farmers or refugees put in an appearance. It was, as

Sergeant Higgins, his infantry sergeant, put it," Bloody Balkan boredom." Worst of all, BF's sleep had been dreamless.

It was late in the afternoon, and the men were beginning to prepare their tea. Forethought was called to the radio for a message instructing that a platoon of an American "battle team" was on the way to relieve his force at the ford. He was thereupon to rejoin his squadron. He acknowledged with a mixture of relief and dismay. He both dreaded and yearned for nocturnal experiences like those of his progenitor in South Africa early in the previous century. Was he to return to his unit both untested and unenlightened? Could it be that the "Dreamdorp gene" had forsaken his generation?

BF posted a pair of infantrymen on the south side of abandoned Dobroy Village to watch for the Americans approaching up the road from Urbanograd. He was somewhat taken aback when, just at dusk, the Yanks arrived unannounced, landing by air beside the village amid a great whomping and billows of dust. Out of all that commotion there had emerged nine pitifully small, unimpressive vehicles and some thirty soldiers, some accoutered as armored vehicle crewmen, most as infantry. Seven of the vehicles seemed to be lightly armored, and mounted what appeared to be armament. When BF reported their arrival, his commander ordered him to dispatch his force under his Platoon Sergeant to rejoin the troop at Checkpoint Zulu on the outskirts of Urbanograd, but he was to remain behind himself until the following morning to insure that he passed on to the arriving Americans all that he had learned about the position.

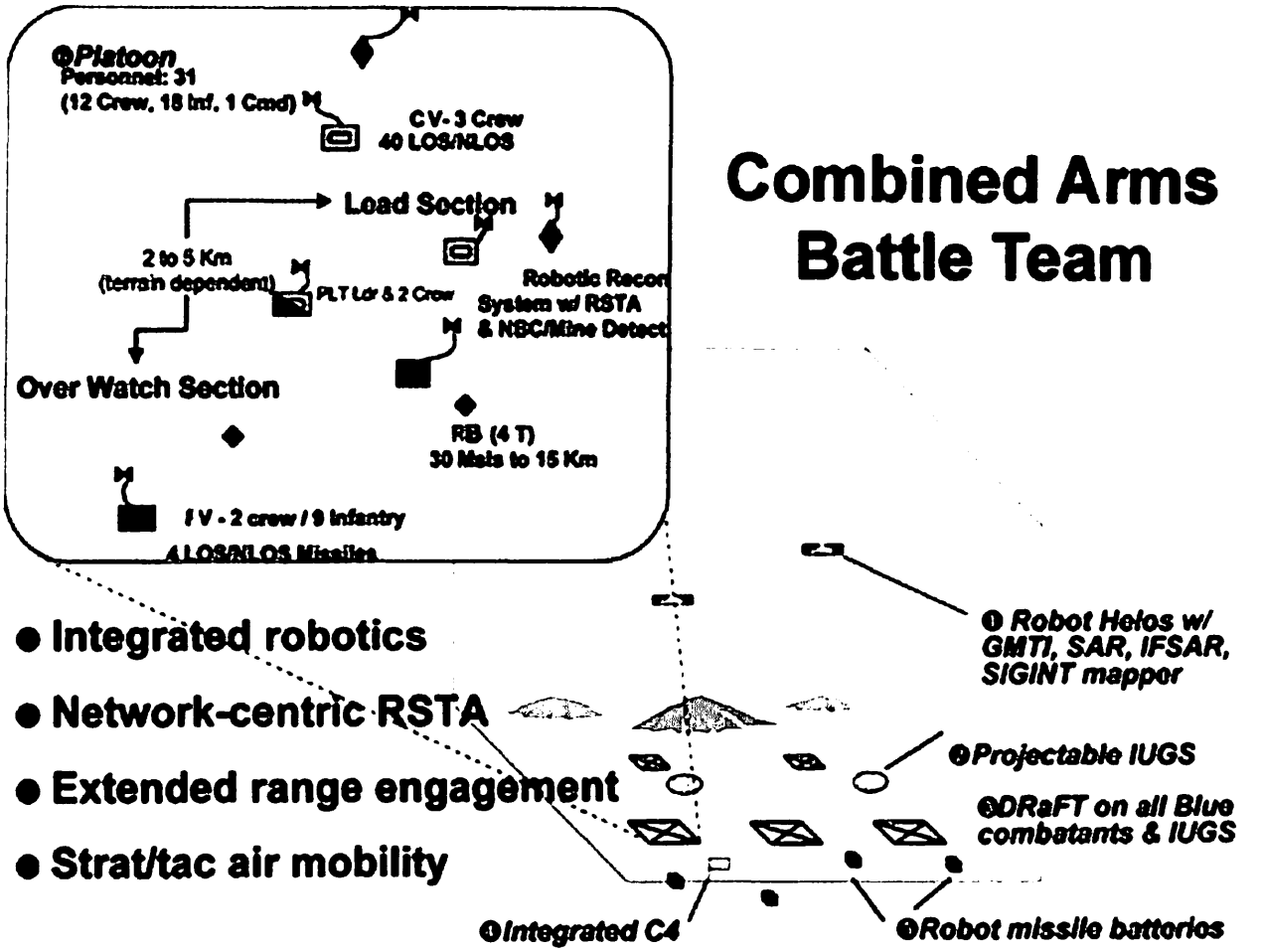
The American commander was a youngish captain with a Slavic surname, and an assurance BF considered entirely unwarranted by his meager force. BF was not unfamiliar with Americans, for his father, who had been a graduate of Leavenworth, and had trained in the field with American units in Germany, had told him that they put great store in briefings, range cards, and like formalities. BF forthwith launched into a brief that included a sketch that he had drawn on the back of his map case to support an explanation of what he called his "lozenge defence," a site for a tank on the north, east and west across the river to guard the ford on the three main avenues of approach, each site surrounded by craftily-concealed infantry to foil sneak teams armed with shoulder-fired rockets. The foremost tank covered the north roadblock. His own tank was at the southern apex of the formation, in overwatch on the north slope of Dobroy Hill, so that no matter which approach enemy armor chose, there would be at least three tanks bearing, with a reserve of one; his tank could also move to cover the southern road block.



BF also provided Captain Maltzoff (for that was the Yank's name) with an overlay of the artillery concentrations that had been plotted on his front and flanks, on which he had noted the frequency and call sign of his supporting artillery battery. He warned the Captain that it took nearly ten minutes to summon a volley from that battery, but confessed that he did not know whether artillery support would be forthcoming for the Americans. He had assembled guides, each bearing a range card for one of the three positions across the river, so that a relief in place could proceed smoothly even after dark.

Captain Maltzoff was duly attentive and properly grateful, but seemed quite disinter-

ested in BF's plan, stating that he would choose his own positions and provide for his own fires. He explained that BF was being relieved by one platoon of a Battle Team, an organization relatively new in the U.S. Army. He showed BF a chart to explain what was in a Battle Team.



1. **Synthetic Aperture Radar (SAR), Interferometric SAR (IFSAR), and a Signals Intelligence (SIGINT) mapper**
2. **Internetted Unattended Ground Sensors (IUGS) that can be fired into position by missiles or artillery.**
3. **Digital Radio Frequency Tags (DRaFT)**
4. **Integrated Command, Control, Communications, and Computer (C4)**
5. **Robotic missiles or Rockets-in-a-Box (RB)**
6. **Platoon of a Battle Team cosisting of five manned and 4 unmanned vehicles**

BF was completely nonplussed by the chart, and remained silent. Captain Maltzoff then urged BF to get his troops underway as soon as possible. Somewhat huffily, BF complied. It soon became dark, and as the last British vehicles clambered onto the road headed south toward Urbanograd, Thompson, his driver, appeared with an invitation to join Captain Maltzoff for supper. Thompson told him that the American captain had directed him to set

up BF's bedroll beside his own. Thompson then led him to a canvas lean-to in back of one of the peculiar American vehicles. Inside, Captain Maltzoff was contemplating a large glowing map. He invited BF's attention to some blue specks toward the bottom, remarking that his platoon was making good time. Then BF remembered the American apparatus that had been bolted to all Hussar vehicles at the beginning of the month. So that's what those were, radios for reporting the location of each and every British vehicle, and no doubt posting targets on the enemy's map as well!

BF asked whether there was not some hazard in having his vehicles broadcasting where they were located. The captain looked puzzled, but replied that they were not broadcasting; to the contrary, what BF was seeing were returns from digital radio frequency tags transmitted within radar returns, which had a very low probability of detection. That explanation left BF more mystified than ever, but he decided not to inquire further into a matter on which the Yank seemed so certain.

Maltzoff showed him on the map how he had arrayed his own force on Dobroy Hill. BF was appalled: the ford was wide open, virtually uncovered, and some of the American vehicles were huddled pusillanimously in or behind the village. He started to say something, thought better of it, accepted a proffered field ration and a cup of coffee, and sat down on a jerry can to eat. Captain Maltzoff, however, sensed his disapproval, and touched his map several times, saying here's where your tanks were: the grey shading is generated by the display's terrain analyzer using high-fidelity digital terrain data collected this afternoon. You can see what your tanks were actually covering; you can see that there's a lot of dead space out there. Here's our defense: this area is what we can see — that is, what we can observe with our eyes and optics — and here's our direct fire range fans. The green shading is the coverage of our on-vehicle radar. The area around the ford was indeed well-covered with shadings. BF was fascinated at the facility with which Maltzoff had summoned that information, and would liked to have asked more questions, but the Captain seemed more interested in telling him about his unit's trip from the United States in a commercial air freighter some twelve hours earlier. He did keep an eye on his map's changing weird patterns and moving specks, and from time to time interrupted his discourse to bark a command at the screen, or to finger what seemed to be its controls. The meal over, Captain Maltzoff suggested BF get some sleep, saying that at first light they would together have a walk around the area.

BF fell asleep soon after he crawled into his bag.

First Dream

He heard Thompson's voice telling him that OP Number 4 had enemy in sight.

He emerged from his tent into the previous morning. There were his tanks in his "lozenge defence", their turrets active, the tank commanders out of the hatch, binoculars trained northward. He could see no sign of an enemy, but suddenly there was a sharp explosion, and the turret of his right flank tank flew through the air, landing top down thirty meters away. BF ran for his own tank, but even as he climbed aboard he heard another explosion, and saw smoke and flame rising from the left flank. As he donned his helmet he heard a radio net in chaos: jamming interspersed with shouts and curses. Over the intercom Chadwick, his gunner, calmly reported gunflashes azimuth 0060 mils, range 4500. BF was astounded: the enemy was sitting up the road, well out of range, killing off his tanks like sitting ducks. He commanded back into defilade and move right, but even as his tank lurched to the rear a third column of smoke arose to his front. He saw Higgins, his infantry section sergeant, running toward him, stopped him, and signaled him to mount up. The ford was lost; they

would have to pull back....

BF woke with a shout. It was so real, so vivid! He had been whipped without a chance to fight by an enemy with clearly superior tanks! He became aware of Maltzoff sitting beside the glowing map, quizzically regarding him. BF told the captain about the dream, and warned him that the events therein might be more than a mere nightmare. Maltzoff chuckled and said that was quite possible that there were enemy out there. His glint detectors had located a suspected OP on Nichevo Mountain, and his SIGINT mapper had detected transmissions from both the OP and from the farm under Starry Hill. Moreover, he said, there were indeed enemy tanks to the north, six of the very heavy Panslav IV type, with a 152-mm gun that could range 5 kilometers. But, he said, these had been tracked, and they were coiled fourteen kilometers away, apparently refueling. It was not yet clear that they were headed for Fombler's Ford. Astonished, BF asked how he knew about the tanks. Maltzoff replied that he had detected possible enemy targets moving south, and that his battalion had deployed acoustic and seismic ground sensors that automatically classified the targets as Panslav IV tanks. At the moment the battalion was watching and a waiting to see what else would come into view so that they would know more about enemy capabilities and maybe intentions.

Watching? Watching how? asked BF. Maltzoff explained that early the previous morning, even before his troops had arrived in the theater, four pairs of radar-equipped robotic rotorcraft had taken station high above the battalion's zone, each pair of moving target indicating (MTI) radars able to pinpoint to an accuracy of twenty five meters anything that moved within a circle of forty kilometers diameter. A pair of these had been positioned over Fombler's Ford an hour before his team had landed, and remained in direct support of Maltzoff. Whatever these robot aircraft detected was automatically fused with information from ground sensors and other intelligence, and posted to Maltzoff's map. The static cluster of red symbols near the top of the map was the coiled Panslavs. But, asked BF, how long can these robot rotorcraft stay? Maltzoff replied that each pair would be on station 24 hours or so, but would be relieved by another pair. The aircraft could stay aloft for more than forty hours, but they were based well out of the country, where civilian contractors maintained them.

Ah, said BF, the enemy has French shoulder-fired air defence guided missiles and machine guns. Won't they be shot down? Not likely, said Maltzoff. These birds are all composite materials, with a low radar cross-section. They fly at 20,000 feet or so, well above MANPADS and guns, and the enemy could not shoot them down unless they brought forward their more sophisticated SAMs. Our Air Force would enjoy getting a crack at those.

At that moment there was a crisp radio voice transmission reporting that the Panslavs had been identified as the advance guard of an enemy tank battalion, the main body of which was moving south some 35 km distant. Maltzoff's team was to be ready to strike the coiled advance guard in twelve minutes. Maltzoff acknowledged the instruction, and touched his "map' several times.

POP-WHOOSH! POP-WOOSH! BF flattened himself on the ground.

Maltzoff grinned, and told BF that was outgoing: soft-launched rockets being dispatched to loiter over the Panslavs. Minutes passed; the radio erupted: "Execute now!" Maltzoff touched the red symbols, which one by one then changed to orange. Maltzoff watched intently until the last flickered orange, then turned back to BF with a smile. That, he said, writes off the Panslav threat, so go back to sleep.

Not until you tell me what happened, BF replied. Maltzoff explained that among the vehicles he had brought in were two RBs — Rockets-in-a-Box, mounted on unmanned trucks — that tamely followed his CV (Combat Vehicle, referring to the one to which the lean-to was attached). The RBs would typically be one terrain feature or a specified distance to the rear of the CV. He commanded these robots directly from his battle map, in this case launching a salvo of ten "Lima Mikes" —loitering missiles — to a point overhead the Panslavs of the advance guard, ready to plunge downward at his command. One remaining missile carried sensors for BDA, he added.

BDA? asked BF. Battle Damage Assessment, Maltzoff explained. BDA makes sure that the missile salvo destroys all the targets, and that none are struck more than once. The BDA is signaled to me here by the red-to-orange shift in the enemy symbols. His battalion commander had timed Maltzoff's attack to coincide with a similar deluge on the main body, so that the entire enemy battalion had been ambushed by fire and destroyed in a matter of minutes; the deep attack was probably by Divarty, and by Apache Longbows, or both.

Suddenly there was a loud whirring and the tent flapped wildly. Again BF was startled until Maltzoff informed him that a robotic rotorcraft has just delivered a container of replacements for the expended missiles, an automated procedure.

BF could remember vaguely reading about RBs and robotic rotorcraft in a professional journal, but he never imagined that sort of hi-tech magic could reach a battlefield so soon. Shaking his head in wonderment, he pulled his sleeping bag up to ponder these matters, concluding that they conveyed the following lessons:

1. **Sitting in the same positions for ten days conserves enemy ammunition, for he will be sure to know where to shoot for a first-round kill.**
2. **Defending a place by defeating an approaching enemy with distant fires is clearly preferable to having to count on outshooting him in tank-on-tank duels — especially if his guns outrange your own.**
3. **Knowing what your force can see and what it can shoot, and what it cannot see or cannot shoot is *sine qua non* for sound tactical decisions.This is the minimum requirment for a C4 system.**
4. **Relevant technology enables a commander to change his concept of operations, and makes his force man-for-man, vehicle-for-vehicle, more survivable and more lethal.**

Then BF drifted off, and he found himself in another dream.

Second Dream

It was again the previous morning, and he was in his own tent, but beside him there was Maltzoff's glowing map, his own tanks plotted thereon, showing that they had been repositioned to hull defilade positions on Dobroy Hill. Somehow he now knew how to use that map, and it told him that the radar robots were overhead, and that his RBs were ready to fire. He looked at the symbols for the suspected enemy observation post on Nichevo Mountain, and for the radio at the farm to the right front. He stepped to the door of the tent to train his binoculars first on the one, then the other. There was nothing to be seen. He went back to the map. There were no other red symbols anywhere on it.

Then a thought struck him like a lightening bolt. Those radars overhead detected movements. To be invisible to the radar all the enemy had to do was to remain stationary. Supposing an enemy force had been in position to his front hiding for the last ten days? Those radars could not detect

them!

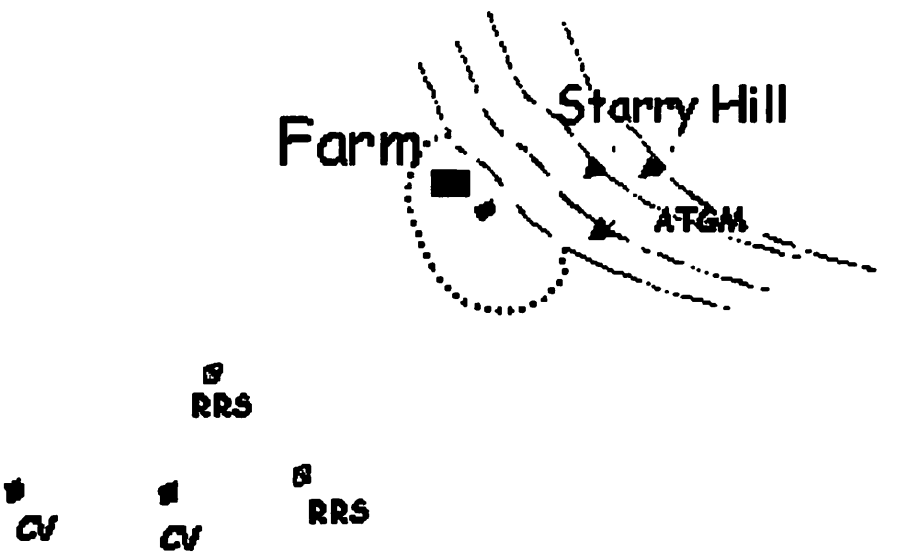
BF promptly ordered a mounted combat patrol consisting of one tank with an infantry squad on the rear deck to proceed to the farm to find and eliminate whatever enemy might be there. He called for artillery to smoke the OP on Nichevo Mountain. Within a half-hour the smoke rounds began falling, and the patrol moved out. BF went to the turret of his tank, and laid the glowing map on the open hatch cover, while Chadwick carefully laid his gun on the farmhouse. It turned out that BF's hunch was on the mark: the farm was an enemy strongpoint. As the patrol approached there was bright flame and backblast from an enemy anti-tank launcher, and a wire-guided missile flew out to stop the patrol tank in its tracks. Chadwick fired at the farmhouse, causing a secondary explosion and much smoke. A second guided missile crashed into the right flank tank in the lozenge. BF shouted in his microphone that they were in the woods behind the farm. There was a third flash behind the farm, and BF was engulfed in searing flame.....

Again BF awoke with a shout, startling Captain Maltzoff. BF related his unhappy adventure with the patrol, and asked how Maltzoff would guard against such misfortune. Maltzoff immediately said that BF was quite right to be concerned about enemy in hide positions, where the MTI would not be effective. But he said, if the MTI had the effect of causing the enemy to suppress maneuver, it would afford a distinct advantage to Allied forces. Careful preparation of the battlefield would preferably begin long before Allied forces deployed, precisely so that enemy maneuver elements could be tracked to their hide positions, and dealt with while in them by fires or a combination of fire and movement.

But what if that doesn't work? Or they deceive you? asked BF. Well, said Maltzoff, we would approach a position where we expected there might be enemy in hiding with a robotic recon vehicle out front. I have two of these: for deception each looks just like a manned combat vehicle, but it has no crew, just a load of RSTA and an APS.

WRIST-AH? AY PEE ESS? asked BF. Yea, said Maltzoff, RSTA means sensors for Reconnaissance, Surveillance and Target Acquisition, and APS means Active Protection System. And I would never send a single vehicle on a mission like this. I would send at least my lead section: two manned CVs (combat vehicles), and two RRS (robot recon systems). Let's say the enemy decides to fire on the lead recon robot as it approached. I'll use my white-board to show you what would have happened.

Here is the Farm and the slope of Starry Hill above it. Hidden in the brush up on the hill are three tube-launched wire-guided anti-armor missile systems manned by persons with presumably hostile intent, because our first warning of their presence is backblast from a missile launch. Then the following sequence of events occurs.

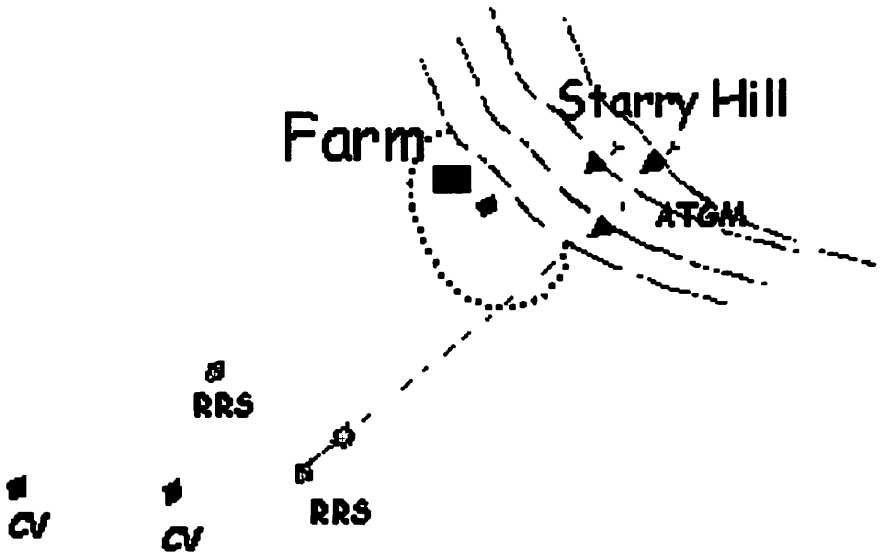


First, the APS on the RRS (Robotic Recon System) detects the flash,

reports position of the firer on the network, and slews its APS radar onto same, which then predicts the trajectory of the incoming round. At the precisely correct micro-second, it fires an intercepting missile that destroys the incoming missile. Debris, of course, scars up the RRS, but it is armored for that purpose.

Second, the hostile backblast is also detected by the APS on the other three vehicles, and communicated over the network to the processor aboard the CVs, which plots the location of the firer, and presents the team commander an option to fire back. He toggles "fire", and his CV launches a missile to kill the enemy shooter.

Third, all four vehicles scan for other enemy optics on the hillside, and any glint detected causes a line-of-sight missile automatically to fire.



- Two US CV mounting APS, each with a Robotic Recon System also mounting APS, encounter a hidden Red ATGM.
- Red ATGM fires at lead US RRS; APS engages and fragments incoming round
- APS sensors autonomously plot position of firer, then discharge missile to destroy RED ATGM
- US CVs and RRSs search vicinity for other enemy optics (using netted Glint-Q, 1st pulse of former STINGRAY), find both remaining ATGM, fire missiles to destroy them
- **Concepts: (1) to protect, deter; (2) teamwork; (3) network-centric exploitation of layered sensors**

Glint detection? interrupted BF. I guess I should have asked about that before.

Right, said Maltzoff, glint detectors are netted low power lasers that sweep the sector from which enemy fire might come looking for reflections from enemy optics, like gunsights. When a reflection off an optic is received, the network can automatically dump a missile right on the source of the glint. It all happens in microseconds, and usually the enemy never knows what hit him.

Why didn't you shoot at the OP on Nichevo that you located with a glint detector? asked BF. Well, said Maltzoff, you remember I said "suspected OP". It might have been an innocent civilian looking through glasses and talking on a citizen band radio. We had received no fire from there, and our rules of engagement foreclose our firing unless we are sure that there is hostile intent. That was true of the radio signals from the farm. We could not be sure it was an enemy radio. For insurance, I preplanned a massed RB strike to respond the instant there was any hostile action from there.

It is all so automatic, said BF. Why have any humans involved at all?

Maltzoff laughed and said that although sensors and robots were very swift, they were

often poor thinkers. They could not make the judgement calls required by the rules of engagement, and otherwise could not cope well with the unexpected. He always provided for control of robots by human intelligence. What makes it all work, he said, is the network: sensors and processors interconnected by communications, men and machines literally cooperating, all responsive to the commander. We call it a "collaboration centric force".

By that time, BF's mind was reeling. He lay down again, and mulled the lessons he had just learned.

5. **To send a single tank on any mission, even if accompanied by infantry, is a futile gesture. Teams — preferably networked and automated teams — are clearly more capable, and the more distributed their capabilities, the better.**
6. **The more different types of sensors there are available in a team, the surer it will be that the commander will know what he is facing, and the better able he will be to make the correct tactical choices.**
7. **Automate liberally, but preserve human control. Provisions for protecting non-combatants or otherwise restraining the use of force —rules of engagement — can be preserved within the framework of a highly automated force.**
8. **Technology enables not only new concepts of operations, but new ways to organize military units. Robots can replace many men in the zone of highest hazard.**

BF dozed off again. A strange thing happened: he had another dream.

Third Dream

Once again BF awoke on the dawn of the previous day full of confidence that now that he knew about RBs, the RRS, glint detection and the rest of the American magic, the enemy could present no serious threat to Fombler's Ford. The glowing map was clear of all red symbols, his RRS were on watch to the front, and his own tanks were hidden within or behind Dobroy Village. His robotic rotorcraft were on station, and reporting neither enemy movement nor enemy signals.

It was a beautiful day; the birds were singing, and the bees were humming. Thompson was frying some bacon that he had been hoarding for the final day at the Ford, emitting a most inviting fragrance. Then he remembered his grandfather's telling him that anytime he diverted attention from his responsibilities as a leader to enjoying the delights of nature, or to satisfying the urging of human appetite, he was inviting disaster. He could almost hear the gruff voice: "Just when you think that your military matters are entirely in hand, and that you can spare time for self indulgence, that is exactly when you will face your most dire threat. That is when you must raise your alertness to its highest level, and that is when you must anticipate the worst."

But what could possibly befall this fine platoon of the 6th Hussars, their tanks the more formidable now that they were aided by the latest American technology? He walked around a bit: the infantry OP was on the alert, scanning to the north; his tanks were fueled, armed and ready; his RBs were in position, ready to fire. He went back to his tent and checked his map: it was comfortingly devoid of threatening symbols. Perhaps, he thought, grandfather was simply uninformed of the potential of technology, and that had he known about collaborative-centric forces, networks, robots, sensors and processors, he might have been a bit more human.

BF had just begun to relish his first mouthful of Thompson's bacon when there was much shouting to his rear, and scattered rifle shots. Some sentry with the wind up, he supposed, set down his plate, and called on the radio for Sergeant Higgins. "I'm here, sir," said Higgins immediately behind him. BF turned around to find a very crestfallen Higgins, hands behind his head, in front of five bearded men in dirty, ragged garments brandishing Kalishnikovs. These prodded Higgins and BF to the village square, where soon all of his command joined them. None were seriously hurt, but

all were thoroughly apprehensive at the prospect of captivity under the surly brigands that were now in charge of Fombler's Ford. One leering thug berated them in broken English, bragging about a stealthy approach up the riverbed from the south, and a swift envelopment of Dobroy Hill...

When he awoke this time BF uttered a sigh of relief that he would not have to face his grandfather in the Great Beyond after so grievous a tactical miscarriage.

What is it now? Maltzoff asked. BF told him about the guerrillas that had with stealth and guile countered all the American technology, rendered useless the robotic rotorcraft and the glint detectors, and preempted possibilities that the RBs or the RRS could be used against them.

Ah, said Maltzoff, again you have anticipated a serious threat. We worry a lot about how to deal with attacks by hostile infantry, especially irregulars that can pose as non-combatants. Part of the answer is to exclude all locals from our sensitive areas such as command posts or key terrain features, like this ford. This enables us to surround ourselves with various types of sensors capable of providing early warning of attempts at infiltration, of detecting the presence of weapons or explosives, and of intercepting infiltrators with fires or movement. If we have to pass refugees, we can do so with them under tight control.

Well, said BF, all that sounds good, but what have you in place here and now to prevent the loss of Fombler's Ford to a scruffy lot of bandits?

Maltzoff turned to his glowing map, and caused it to present symbols representing what he referred to as "sensor fields". These were put in yesterday evening as your vehicles were forming for their march south. Mostly these IUGS were laid from helicopters, but we did supplement with rocket-emplaced, and hand- emplaced sensors. We can, if need be, fire in entire sensor fields with RB missiles. Moreover, each of my CVs, and IVs (infantry vehicles), and both of my RRS have on board a tethered unmanned aerial vehicle that carries aloft a small, foliage-penetrating MTI radar capable of detecting a moving human at a range of 3 to 5 kilometers. What we do is try to position our sensor fields on the most likely avenues of approach, and then back them up and extend our coverage with our radars. The MTI radars on our robotic rotorcraft at high altitude have some capability against humans on foot, but for close-in protection we have the additional layers of RSTA I have just described.

BF was puzzled. How can a sensor know the difference between a farmer carrying an axe and a guerilla with an assault rifle? Maltzoff replied that in individual cases the answer is that only an imaging sensor could discriminate. He showed BF three sensor fields laid along the road, one in the defile to the north, one 800 meters beyond the north roadblock, and one 1000 meters from the south roadblock. In both of these fields there are imaging sensors so that we can have a look at what's coming — that's particularly important when refugees are on the road. IUGS have proved most useful in alerting us to the presence of off-road groups in which all parties carry large metal objects, when and where such a presumably armed group would constitute a threat to a sensitive area. Usually this awareness requires a large number of sensors of various types spread over quite large areas.

BF thought a moment, and opined that such measures must be very costly, and would probably pose difficult problems for communications: batteries, antennae, and all that.

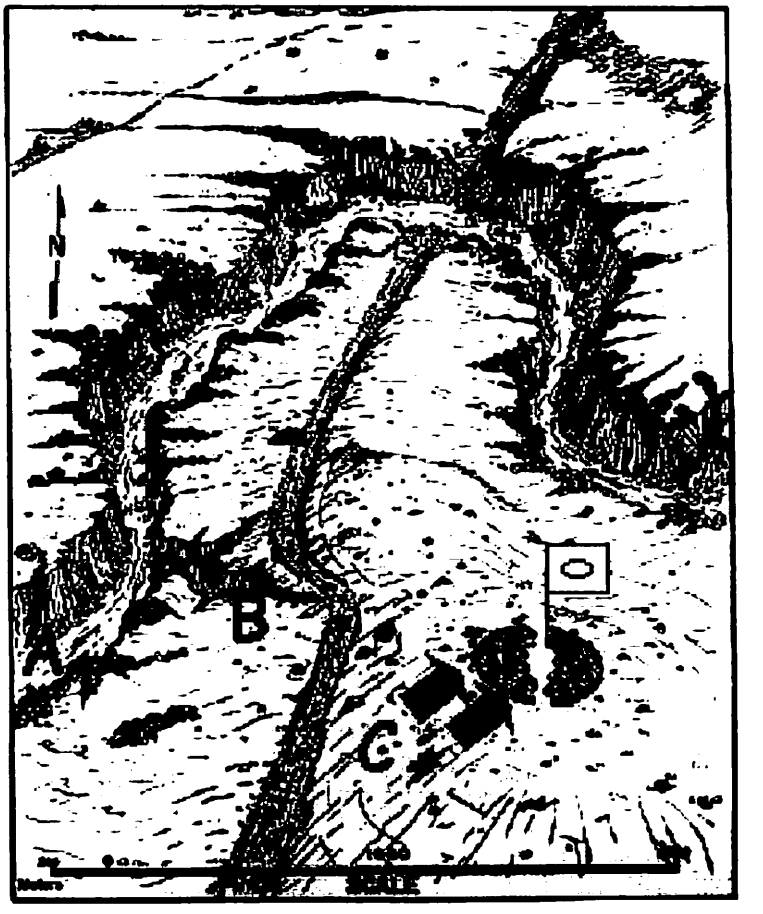
Maltzoff grinned and said that takes us back to your first question about digital radio frequency tags, which can interact with the MTI radar overhead, or with our close-in, tethered MTI radars, to network sensors with processors that interpret and combine the

data with information from other sources. A digital radio frequency tag can be a very small, very low power device, readily combined at chip level with an acoustic, seismic, magnetic, or video sensor. Moreover, these can now be made so cheaply that they are disposable.

BF asked Captain Maltzoff if they could "wargame" a hypothetical guerrilla attack on the Fombler's Ford position. Maltzoff proposed that BF play the role of guerrilla commander, devise an attack plan, and he would then show him on the map what would have happened to the attackers.

BF immediately described an attack based upon what he had heard during his dream from the guerrilla in the village square. We have been observing the British for ten days. We know they are least alert in the early morning after the sun is up. We will advance on the Ford not from the north, for which direction they expect us, but from the south, where their security is least. And we will advance in column up the riverbed at night [**A**] so that their aircraft cannot observe us. When we reach the gully west of Dobroy [**B**] we will close up, and prepare for the attack.

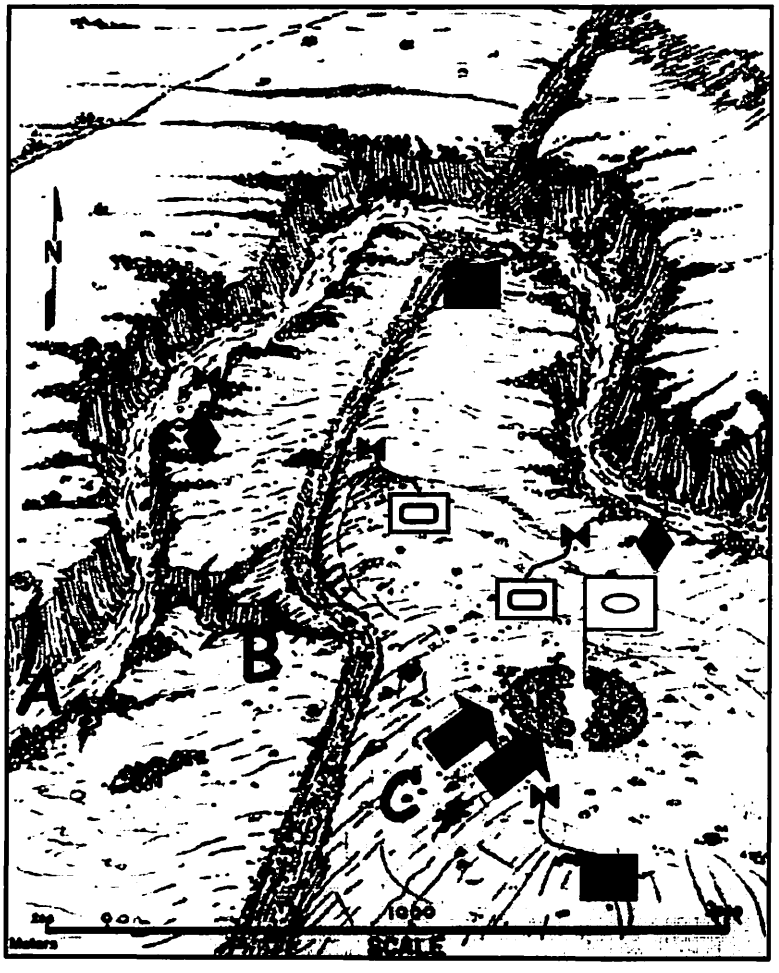
While it is still dark we will hide ourselves amid the boulders and brush on the southwest slope of Dobroy Hill [**C**], formed into two assault groups, one to envelop Dobroy Village from southwest to northeast, the other to envelop west to northeast. The signal to attack will be given when it is certain that the British are at their ablutions and their breakfasts.



Not bad work for a hasty plan, said Maltzoff. Truthfully, we had discounted an approach up the river bed from the south because of the steep banks and the deep and swift water — you would be marching up stream, you know. But we did identify that gully **B** as a way into our position, and placed a field of sensors in there that included what we call "nettles," tiny DRaFT that look like natural nettles and cling to clothing like the real thing. These make the wearer stand out in the beam of our radars, and mark him as an infiltrator. In any event, as you can see, our main defenses against dismounted infiltration is internetted unattended ground sensors and our close-in layer of radar coverage. Your attack, Mr. Guerrilla, would walk into a trap.

Let me show you again how we've laid out our defenses for the hours of darkness. Mainly we positioned our vehicles to take full advantage of their on board radars, surrounding ourselves with radar overage. I planned the position using this display: (here

Maltzoff fingered the glowing map, and shaded patterns appeared) It shows me the coverage of the radars on our vehicles. Note how the gaps stand out. I can then fill in the gaps by changing the position of the vehicles, or by using additional IUGs. Remember that if need be I can emplace sensors with RB. You should also recall that in the overhead robotic rotorcraft I have an option of using the radar as SAR, or in an imaging mode — it takes longer to generate an image, and one trades off area surveillance for point knowledge, but being able to image a column of vehicles well down the road is often the best way to know what's coming, and to avoid shooting into a group of tractors hauling loads of refugees. Here is the way the defense here at Fombler's Ford looks.



I have placed an IV near the ford in case we have to filter refugees at the north road-block, used our RRS on the flanks, and put the CV's on the saddle north of Dobroy Village. The other IV is down here south of the village overwatching the southern road-block. At daybreak we'll hide the CVs in the village, but this night-deployment is what your attack would have run into. I suspect that we would have picked up your column near **A** with the left flank RRS, and classified you thoroughly when you got into the sensor-covered gully, **B**. When you came up toward the road, I could have moved one CV and one IV to cover **C**, and confronted you with very superior firepower, all aimed through night vision devices much better than yours. Or I could have struck into the gully with anti-personnel RB missiles. In my judgment, your attack would have had little chance of success.

BF was disappointed in himself, for rather than approval, he felt chagrin at that outcome. In any event, he thanked Maltzoff, perhaps a bit too profusely, and went back to his sleeping bag. Well, he thought, there are lessons in all that:

9. **The enemy has many deadly options, and the proper leader spends all his waking moments trying to anticipate and to foil these. Guard against habit and indulgence, for to lapse into either broadens the enemy's opportunities.**
10. **Night and day dispositions should be different, so that the enemy's ability to observe by day never compromises security during hours of darkness.**
11. **When defending a convex hill, remember that the slopes are dead space, and must be controlled lest they provide an avenue of approach into your vitals.**
12. **Sensors expand significantly the ability of a small force to control ground, and to**

do so with discrimination. With proper technology, a platoon can do the work of a conventional company, and a small combined arms team can do the job of a conventional battalion.

His went from waking to dream in what seemed to be seconds....

Fourth Dream

It was just after daybreak, but he knew that he was in a secure position, surrounded with sentience, and equipped to respond to detected threats with either fire or movement or both. Then his interactive map showed activity in the vicinity of Starry Farm. First reported observations were of civilians, including children, gathering near the barn of the farm. From the barn there emerged a school-bus like vehicle. Subsequent observations reported the people loading into the bus, and onto a farm wagon drawn by a tractor. The two vehicles moved slowly out onto the road, the bus leading, and turned in direction of the ford. BF ordered infantry to man the road block, prepared to screen the people.

Then he remembered that there had been radio transmission from that farm, and anti-tank missile positions behind it. Suppose this were just a ruse? Suppose that bus was filled with guerillas ready to shoot his infantry, and rush his lead tank? Suppose that this ruse was but an overture to a larger attack from the flanks or from the south? Minutes passed. The bus approached the road block. BF alerted his infantry to be prepared to fire, and launched several loitering missiles from his RB, targeted on the bus/tractor convoy. But he was prepared to redirect the missiles to rain destruction upon attack from any direction.

Suddenly it occurred to him that he had set up a circumstance for the sort of major "incident" against which his squadron commander had sternly cautioned. The bus stopped at the road block, and women and children began to dismount from both vehicles, and to crowd forward in front of his infantrymen. Then there were dark figures running from the vehicles into the underbrush. They've got guns! said his radio. There were shots. His forward tank fired. The bus exploded in a ball of fire. What could the enemy possibly hope to gain by such an attack? The answer struck BF like a thunder-clap: they wanted us to shoot!

He awoke and sprang to his feet. Maltzoff was asleep in his bedroll, and a sergeant was on watch at the glowing screen. BF leaned over and shook the captain awake. I've just had another dream, he said. I think they are going to stage an "incident" here. How's that? asked Maltzoff groggily.

BF recounted his dream. The captain appeared to be puzzled, but urged that they wait until daybreak, when they could talk it over while they walked the terrain. He lay back, and after a bit, BF did the same.

The sergeant woke them, summoning them to the map. It was still dark. A column of three vehicles, identified by sensors as non-military, had emerged from behind Nichevo Mountain and was proceeding south toward the road block. The roadblock confirmed reports from SAR and video sensors that the vehicles appeared to be flatbeds carrying non-combatants. In a running account, the sergeant in charge at the roadblock, tension evident in his voice, reported the trucks' stopping and a large number of women and children swarming forward against the barbed wire entanglements in front of the obstacles.

Then the sergeant at the map interjected that there was a flight of four helicopters twenty-six kilometers to the northeast, closing rapidly toward the Ford. BF asked how he knew that, since the MTI radar range was only twenty kilometers. Maltzoff replied that all his combatants —both men and vehicles— carried networked audio sensors, forming a wide aperture sonic array capable of locating and classifying aircraft signature sounds at a

great distance. He pointed to his helmet lying beside the map, and told BF that his own sensor was embedded in its cloth cover. The MTI radar was now cued to confirm the altitude and direction of the flight once it flew into coverage, and to conduct IFF (indentification friend or foe — if they were friendly, they would have DRaFT).

The noncom at the road block interjected that the women were trying to dismantle the barrier wire, and would not heed warnings. He requested permission to fire warning shots. The helos were now visible on the glowing map, and the symbols were red. They had crossed the ten kilmeter range circle the sergeant had posted, and he remarked that they were about three minutes away..

BF suggested politely that the road block was in no immediate danger, but that the whole force was threatened by the attacking aircraft. Captain Maltzoff thanked him, and launched RB missiles — antiaircraft homing missiles, he said.

The road block was on the air again, reporting that some of the children had already crawled through the obstacles, and were running around in front of his machine guns. BF again spoke up to recommend that the captain use his glint detectors on the trucks. Maltzoff barked orders. Within a minute or so a CV reported that it had a return from a large optic in the cab of the front truck.

What does it mean, mused Maltzoff. BF quickly responded that the glint was probably from a TV camera poised to collect footage of Americans shooting down innocents. Maltzoff promptly signaled his missiles to attack the four helos, now flying nap of the earth masked by Nichevo Mountain, reiterated his order to the road block to hold fire, and dispatched his lead team of two CVs and two RRS to reinforce the infantry at the road block, and to capture or neutralize whomever was in the cabs of the trucks.

Within an hour some fifty women and children were gathered under guard near the Ford eating breakfast, waiting for trucks to carry them to Urbanograd. Six men, whose ragged clothes and unkempt beards seemed incongruous with their highly sophisticated video equipment, had already been evacuated by helicopter to the city. SAR from the overhead MTI confirmed four enemy attack helicopters downed on the north side of the mountain. Maltzoff shook BF's hand, thanked him for his help and urged that he snatch some sleep while it was still dark.

There were new lessons, thought BF:

13. **Measure threat by time, not distance. The most dangerous is not the most proximate, but the one that can strike first. Assign priority for action accordingly.**
14. **In the age of worldwide television coverage, an enemy with a TV camera and an opportunity to provoke an indiscretion may cause much more damage than one with a lethal weapon.**
15. **Networking vehicles and men into a sonic sensor array seems a splendid idea, for wherever they go, no matter how fast they move, awareness of their surroundings travels with them.**
16. **Anti-aircraft defenses that can attack well beyond on line of sight endow a ground unit with significantly better survivability.**
17. **Timelines for a small unit on the forward edge of the battle area are very short indeed. Having organic RSTA and organic firepower, and an ability to "clear" ones own fires is far better than having to request support from distant units.**
18. **Presence on the ground, with human intelligence, eyes and ears, is crucial whenever non-combatants are encountered, and discrimination in the use of violence is therefore dictated.**

Fifth Dream

This time when BF fell asleep, he found himself in a different sort of dream. Gold braid and red flashes abounded, and he was quite the center of attention. There was a huge gong on a splendid ribbon about his neck, and his colonel was urging him forward through the splendid company, and bade him kneel. There was a gentle rap on his shoulder, and voice said "Arise Sir Backsight Forethought."

But it was only Captain Maltzoff, waking him for one last look at Fombler's Ford.

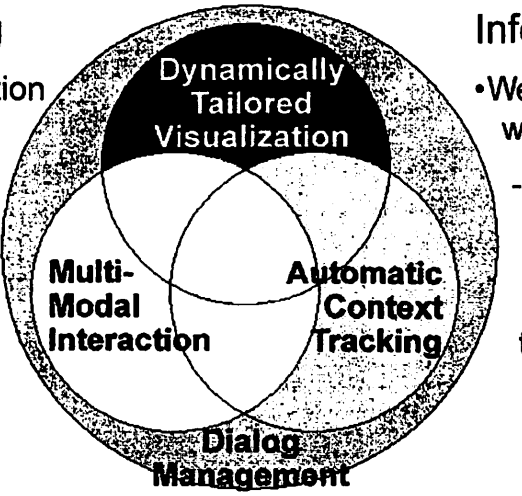
Lessons of Fombler's Ford

1. Sitting in the same positions for ten days conserves enemy ammunition, for he will be sure to know where to shoot for a first-round kill.
2. Defending a place by attacking an approaching enemy with distant fires is clearly preferable to having to count on outshooting him in tank-on-tank duels — especially if his guns outrange your own. The measure of success is not overmatch in a duel, but overmaatch in an engagement.
3. Knowing what your force can see and what it can shoot, and what it cannot see or cannot shoot is *sine qua non* for sound tactical decisions. This is the minimum requirement for C4 system.
4. Relevant technology enables a commander to change his concept of operations, and makes his force man-for-man, vehicle-for-vehicle, more survivable and more lethal.
5. To send a single tank on any mission, even if accompanied by infantry, is a futile gesture. Teams — preferably networked and automated teams — are clearly more capable, and the more distributed their capabilities, the better.
6. The more different types of sensors there are available in a team, the surer it will be that the commander will know what he is facing, and the better able he will be to make the correct tactical choices.
7. Automate liberally, but preserve human control. Provisions for protecting non-combatants or otherwise restraining the use of force —rules of engagement — can be preserved within the framework of a highly automated force.
8. Technology enables not only new concepts of operations, but new ways to organize military units. Robots can replace many men in the zone of highest hazard.
9. The enemy has many deadly options, and the proper leader spends all his waking moments trying to anticipate and to foil these. Guard against habit and indulgence, for to lapse into either broadens the enemy's opportunities.
10. Night and day dispositions should be different, so that the enemy's ability to observe by day never compromises security during hours of darkness.
11. When defending a convex hill, remember that the slopes are dead space, and must be controlled lest they provide an avenue of approach into your vitals.
12. Sensors expand significantly the ability of a small force to control ground, and to do so with discrimination. With proper technology, a platoon can do the work of a conventional company, and a small combined arms team can do the job of a conventional battalion.
13. Measure threat by time, not distance. The most dangerous is not the most proximate, but the one that can strike first. Assign priority for action accordingly.
14. In the age of worldwide television coverage, an enemy with a TV camera and an opportunity to provoke an indiscretion may cause much more damage than one with a lethal weapon.
15. Networking vehicles and men into a sonic sensor array seems a splendid idea, for wherever they go, no matter how fast they move, awareness of their surroundings travels with them.
16. Anti-aircraft defenses that can attack well beyond on line of sight endow a ground unit with significantly better survivability.
17. Timelines for a small unit on the forward edge of the battle area are very short indeed. Having organic RSTA and organic firepower, and an ability to "clear" ones own fires is far better than having to request support from distant units.
18. Presence on the ground, with human intelligence, eyes and ears, is crucial whenever non-combatants are encountered, and discrimination in the use of violence is therefore dictated.

Speed up Situation Awareness
Technology Options

Information Filtering

- Human/System Interaction is a dialog
- Every visualization is an answer to a query
  - Explicit query
  - Implicit query



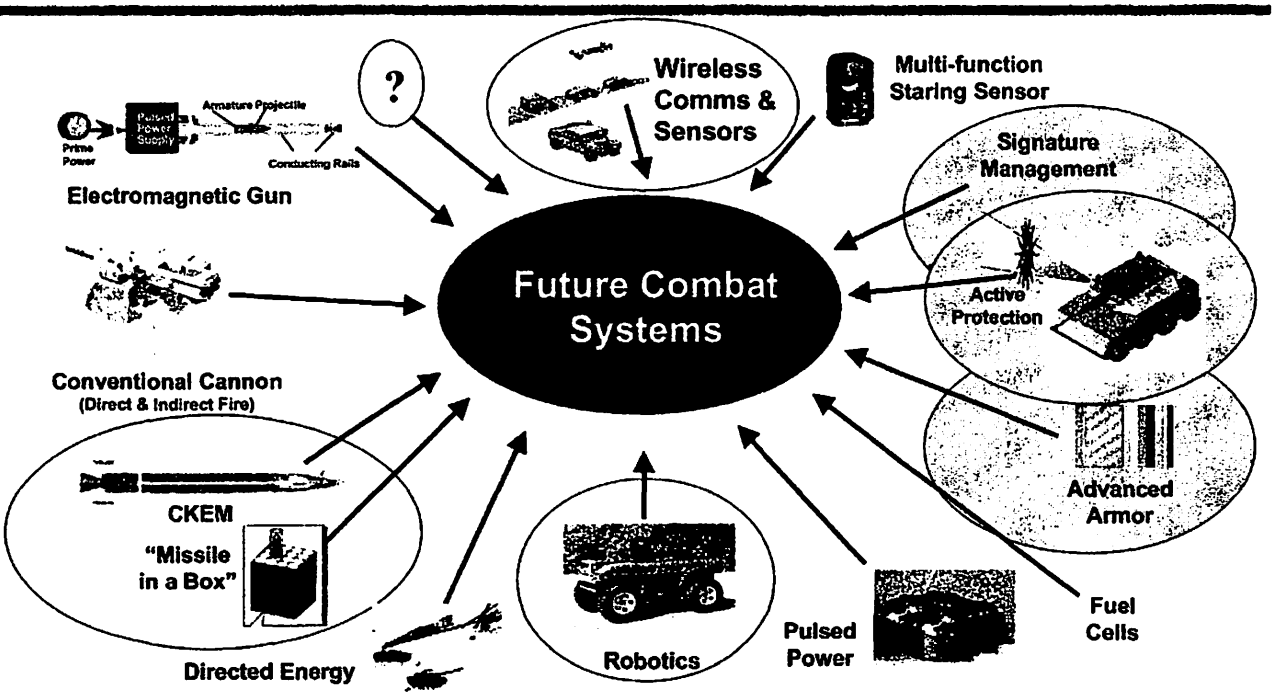
Information Transfer

- We are at the mercy of the wiring of our brains
  - Optimize throughput by tuning presentation to the perceptual channels and expert models of the brain

The goal of CPOF is to shorten the commander's decision cycle to stay ahead of the adversary's ability to react.

System Technology Options
Future Combat Systems

Draw From the Fullest Range of Technology Options



Army Science Board Recommended Concentration Areas

DARPA Senior Advisory Board Recommended Concentration Areas

COMMAND POST OF THE FUTURE — A DARPA PROGRAM

APPENDIX D, ANNEX 2

THE BATTLE OF BAACHEN
CENTCOM, OCTOBER 2015

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CENTCOM, OCTOBER 2015

It was cold, dark, and malodorous, but the Americans sitting around the table were in an ebullient mood that reflected neither the place nor the dreary field rations sitting before them. Baachen[1] had fallen to JTF 11, and beneath the terrace on which the door-cum-table had been set up, a ragged column of POWs plodded along, herded by soldiers of the Big Red One with weapons at the ready.

Colonel Jeff Seitz of the 26th Infantry, the tactical commander in that sector, had invited to lunch the American press contingent—two female reporters and one male reporter—that had been covering his operation. Sitting at the head of the table, warming his hands on hot coffee in his canteen cup, he was relaxed and confident as he invited their questions.

The tall female reporter spoke up first: "Well, Colonel, the U.S. Army hasn't always been this lucky in urban fighting. I remember a book by Charles Whiting called *Aachen, Bloody Aachen*, that reported that this division and your regiment paid dearly for its success in that city. And after that came Hue and Mogidishu. How can you explain what happened here? Were we just lucky in picking the right enemy?"

Seitz smiled, and said, "One thing you can be sure about: this win was not luck. For one thing, the leaders of the bad guys included some men who were very capable and well experienced with urban in-fighting. They elected to use a tactic they calculated would cause us maximum grief: they took the advice of former Chechen veterans, dispersed their fighters throughout the city in small four to six man teams, and prepared to contest us building by building, block by block, neighborhood by neighborhood, never massing force. They relied on their superior knowledge of the city, on ambushes and deceptions, on mines, booby traps, rocket propelled grenades, and shoulder fired antiaircraft weapons. They aimed to bleed us grievously. You may recall that 15 or 20

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1 Gen. (Ret.) Paul Gorman, "MOUT in Aachen, 1944," Online, Available: http://cpof.ida.org/MOUT-Aachen-1944.pdf, 5 June 2003; see also J. Votaw and S. Weingartner, eds., *Blue Spaders, the 26th Infantry Regiment, 1917–1967*, Cantigny First Division Foundation, Wheaton, Ill., 1996, pp. 85–88.

years ago such tactics defeated the Russians in Chechnya on two occasions, and required the Russians ultimately to reduce the rebel capital to rubble. We did some damage here in Baachen, but far less than the Russians found necessary in Grozny. Moreover, our troops knew what they had to do to counter the enemy's tactic, and they did it right. We did not resort to brute force. We attacked selectively, and only for high-payoff targets. We did not fall into the attrition trap. When we attacked a building, we almost always attacked from the top down, using small flight vehicles to lift soldiers to the rooftop. There was little element of chance in the outcome. These guys—" he gestured toward the POWs, "thought they had us exactly where they wanted us, impaled on a stake before world opinion. But it turned out that it was their commanders on the stake, not us.

"I agree that fighting in cities has not been the strong suit of our Army. In 1944 Aachen was a tough fight, at long odds—five defenders against one U.S. attacker—but we won. In that battle, as in this one, we won not because of special urban training or exclusively because of our equipment. We won in large part because our soldiers had been working together for years: Today, as then, we are teams of trusted comrades, and we are individually and collectively very good at fire and movement. And we are so because we are in an Army that has learned from its shortcomings, not only in the past battles you mentioned but also in every single operation it conducts, in peace and in war. In this outfit, every day in combat is a day in training. Those prisoners that you see down there are evidence of 'lessons learned.'"

The reporter with the white beard shot the next question: "But Colonel, with all due respect, here you have asserted control over a city ten times bigger than Aachen, and you have done it with fewer troops. What's the magic, Colonel? There has to be some lever operating here that has not been available in the past."

Seitz sipped his coffee while he considered his reply.

"Lever...leverage. I would propose there were at least three leveraging decisions in the past 15 years within the Department of Defense. The first was a decision in 2003 to accelerate a brace of maturing DARPA information technology programs—mostly intended for the Army's Future Combat Systems, a 2010++ acquisition—to be procured and fielded to raise the readiness of the total force for urban contingencies like we faced here. Not all technology marches to the same drummer, and advances in the field of information technology proceed much faster than those for military platforms and weapons. I don't want to flood you with nomenclature and acronyms, but you may remember that the accelerations included the A–160 Hummingbird; the Digital Radio

Frequency Tags, or DRaFT; and NetFires. To these DARPA added advanced communications to support tactical and operational networks in an urban environment. These DARPA investments paid off big time for JTF 11 here in Baachen.

"The second was the decision in the same year to transform the Army personnel system by abandoning individual replacements for units of the combat arms in favor of supporting readiness by stabilizing units for 3 years, and revitalizing the combat arms regimental system. The intent was to have combat units that could benefit from the same sort of accumulated professionalism and trust that distinguished this unit's predecessor in 1944, an outfit whose soldiers who had been training together more than 4 years, and fighting together from North Africa, through Sicily, France, and Belgium. Any infantry fight is tough, but any infantry veteran will tell you that if you have to go into battle, join a unit that knows how to work together, fight together, and win even in tough fights. Ours is just such a unit!

"There was, in my opinion, a third decision of equal import: to transform the method of leader development in the services. The armed forces of the U.S. had developed during the 20th century a professional education system second to none in the world, a school structure for periodic education of its leaders. But that structure required that officers and NCOs transfer from their unit to resident schooling, upon completion of which they were almost never returned to the unit they had left. Moreover, resident training not only failed to benefit a unit, but it was service specific and rapidly became outdated by the constant flux in technology and doctrine, especially joint doctrine. The decision was to adopt best commercial practices for joint continuing education in all the services, and to use a blend of Internet-based distance learning coupled with in-unit mentoring, plus short joint exercises in the schools. That transformed service-particular leader development into lifelong joint learning, assuring more competent officers and NCOs. We have been able to grow our own leaders right in our units to the advantage of cohesion, pride, and overall effectiveness.

"Without those decisions, I doubt if the outcome that you have seen here in Baachen would have been possible."

"But Colonel, so far you have been talking your unit and just Army. What was joint about this operation?" The reporter was clearly looking for an angle on inter-service rivalry.

Seitz waved his hand toward the lowering sky. "This was a joint, three-dimensional attack from the outset. We were absolutely dependent on national agencies

and the U.S. Air Force. We learned what we needed to know about this place mainly from up there. We entered from up there. We were supported by fires from up there. We were sustained from up there." Then he said, pointing to the POWs, "Those guys down there are being marched to a pickup zone to be airlifted into a POW cage. We will leave the same way. All four services cooperated to bring off this operation."

This prompted the short female reporter to interject: "But how exactly did all those DARPA things make this operation, however joint, different from those in the past?"

Seitz again paused, cup to lip, thinking through what he could say about DARPA systems.

"Let's start with the A–160 Hummingbird. That is an unmanned aircraft that you have not seen because it is based out of theater, and flies in to loiter above the city 24 hours per day, high up where you can't see it or hear it. Each Hummingbird has an endurance of more than 24 hours, and it carries radar and other sensors that stare down at our battlefield, an on-board queuing capability to optimize the sensor selection for a specific target, an on-board fusion capability to sort out false alarms and to detect and classify targets, plus communication gateways to connect the ISR local network on which the bird operates directly with me and my commanders, reporting changes in friendly or enemy dispositions. The gateway capability also allows the bird to instruct airborne munitions what targets to attack and to guide them to where they should hit. The Hummingbird also has a communications suite on it that proved useful for maintaining our ability to communicate among ourselves and with our higher headquarters, transmitting national-level intelligence to us automatically through the Department of Defense global grid. I want to emphasize that the A–160 is closely netted with the radars, sensors, and radios of all elements of JTF 11, contributing information to them, and profiting from what they knew. Close in to my troops, my fire-support coordinator orchestrated those fires, but when he designated a target, notice was automatically provided to all commanders in the vicinity, on the ground or in the air. Unless some other unit objected, the target was struck. We never lacked for fire support, and most weapons that we used were not Army, but came rather from Air Force, Navy, or Marine platforms. I can tell you that we did not care where the fires came from, or who delivered them. What we liked was the responsiveness of the effects. The whole process from designating a target to ordnance upon it took seconds, instead of the tens of minutes we used to require for conventional artillery or mortars. That direct sensor-to-shooter linkage

permitted us to successfully engage very transient or fast-moving targets and also permitted us to minimize collateral damage.

"Next I mentioned DRaFT. Digital Tags are, as their name suggests, small, chip-equipped ID cards on the person of our soldiers, and on our vehicles, that interact with our overhead radars—of whatever service—to assure identification and location of friendly forces and to de-conflict the airspace. Moreover, they are cheap enough, and sufficiently secure, to warrant distributing them widely throughout allied or aligned forces, and thereby to help prevent fratricide, and to facilitate collaboration with fires and maneuver. You should understand that these tags in effect send a message embedded in the radar return to the Hummingbird, so they are a form of communication.

"NetFires. You've heard us talking about LAMs and PAMs. Those names refer to Loitering Attack Missiles and Precision Attack Missiles, both of which arrive on the battlefield prepackaged in small containers—"rockets in a box"—that I am certain you have seen around here. These boxes are commodities that can be assigned to any service, and have proved to be useful to pilots and infantrymen alike. We also brought in with us mini-NetFires, missiles tailored for urban combat, smaller and more agile, but able to precisely strike where ordnance was needed with either lethal or nonlethal effect. More important, both the Air Force and the Navy hung the sky overhead with a virtually inexhaustible supply of loitering missiles for backup. Each of these missile systems relies on networking technologies that allow the loitering missiles to pass data to what could be dozens of precision-attack missiles fired to engage specific targets within the target area. These in-flight data exchanges permit in-flight reprogramming to make even the most elusive target vulnerable as never before, even in the restrictive city canyons."

She was not convinced: "We were told you used robots."

"We did indeed," Seitz responded. "But our robots do not look like R2D2. The A–160 is a robot helicopter that automatically flies a course set for it by GPS waypoints. The LAM is a robotic cruise missile. We used many small autonomous aircraft, ducted fans that look like flying saucers, and are also robotic. On the ground we used small crawlers to precede our troops, but these were usually tele-operated by a soldier, less autonomous than the unmanned aerial vehicles."

The reporter shook her head. "But how did all that stuff help you in finding the small groups of enemy lurking in alleys and side-streets? What did your equipment have to do with those prisoners down there? How did you affect them? Why did they give up?"

Seitz smiled, and told her that she was asking the right questions.

"Knowing precisely where all our own assets were at any given point in time was the most important information I needed for planning and executing operations to attack or neutralize the enemy. Actually, the digital tags plus the Hummingbird radar usually told me what I needed to know—a secure passive method that requires no telltale radio signals from the troops on the ground. Moreover, given all the aircraft and missiles flying through the air space over the city, the tag-radar combination gave us a way of deconflicting the air traffic. I should also note that our position-location system had redundant backup to take care of the possibility that enemy would try to jam GPS, or that our troops would lose the GPS signal when they were in buildings or underground. All of my troops carried GPS plus inertial navigation devices that allowed my leaders to know where every soldier was located in three dimensions: locus not only in what building, but also in what room on what floor. On top of that, we can position any of our radios on people, missiles, or aircraft by timing its signals on the network."

She was still puzzled: "But knowing where your guys were located couldn't help you unless they had eyes on a target, and it seems to me that the enemy was doing everything he could to deny you that advantage. How did you counter elusive ambushers? What kind of pressure did you bring to bear on the guys with Kalishnikovs and RPGs?"

"Our eye in the sky, the radar aboard the Hummingbird, can see enemy as well as friendly, can detect motion, and on command, send us an image of an object as small as four inches. But we had other ways of looking into the streets and alleys." Seitz stood up, walked around to where she was sitting, and pointed to a building across the street. "Look over there at the corner of that building. Do you see that object sitting on the ledge?"

She stood up to sight along his arm." You mean that blocky thing at the end of the wire?"

"That's it," Seitz said. "What you are looking at is a ducted fan, one of the small unmanned aerial vehicles that enabled us to see what was happening in the streets. That perched UAV acts as the terminus for an ADDR, an air deployed rope. The rope is actually a fiber optic cable with small sensors embedded along its length. The UAV snaked across the building tops, unreeling its cable, and as it approached the cable's end, it perched up there where it could power the sensors and transmit what they were detecting on the streets up to the Hummingbird. There, ADDR information could be integrated with what the radar was seeing on its own, then sent to us on the ground. If I told one of my leaders to clear a given area, the first thing he would do, using the Hummingbird and ADDR, is to establish continuous observation over the streets there.

One technique we found useful was to patrol up and down the streets above the ADDR cables with another UAV, a larger and noisier bird, in the hopes that the enemy would shoot at it, especially with an RPG. If they did, they provided us a demonstration of hostile intent and a precise location, so we could shoot back then and there with a LAM or a PAM, and take the shooters out."

"Didn't you sacrifice a lot of UAV doing that?"

"We lost a few," Seitz said, "But for that baiting mission we used faster birds with active protection against attacking rockets, For example, these carried means to detect and attack the rocketeer's optical sight even before he could engage, and could fire a small, on-board gun-type system, called "MetalStorm," that could shoot apart with a cloud of bullets any rocket that came up at it. The birds we lost were shot down by lucky shots from assault rifles."

This brought male reporter back into the conversation. "Colonel, we have heard that you had major problems communicating because enemy jamming disrupted your network. Is that true?"

Seitz chuckled. "You take enemy propaganda too seriously. There was plenty of enemy jamming all right, and we did everything we could to convince him that it was working. But he was attacking the frequencies that we had been using for training and operational rehearsal. When we came in here, we kept up dummy traffic on those same nets, and he obliged us by attacking there while we transacted our real business on networks elsewhere in the electronic spectrum, at higher frequencies and with different waveforms very resistant to jamming, and with low probability of intercept. Moreover, we used highly directional antennae at low power that made it even more difficult for him. The upshot was that he was only a minor nuisance for our tactical communications—our local area networks and command grids, with our reconnaissance, surveillance, and target acquisition means, formed a robust network that never let us down.

"Another technology that proved invaluable was a DARPA system that allowed us to plug into the electrical sockets of the buildings we were in. We took in gadgets that looked like nightlights or those plug-in air fresheners. By plugging in one of these gadgets to wall sockets, soldiers on each of the floors could talk to each other without having to use their radios. Then when they left the room, they could set the gadget to sense if someone or something was entering the place behind them. There was a larger unit with more smarts that could process all the sensor data on several floors, or in a whole building, send notice of the intrusion to my commanders through our local area

command network, and even indicate whether it was the enemy or neutrals. We used a similar scheme to transmit among buildings using the electrical power lines and telephone wires that remain in place even after buildings were heavily damaged. Even though the electrical and telephone grids had switches and transformers, DARPA figured out a way to sense where active connections could be established between a sender and receiver, and to route their traffic without relying on wireless transmissions. This means of connecting sensors and fighters over the existing wire infrastructure proved to be highly effective and secure. The enemy commanders never figured that out."

"OK, let's say you hoodwinked them, and you got control of the streets. But what good did that do? Couldn't they just stay in the buildings, or even go underground?"

Seitz smiled. "They could and they did. But that's what we wanted them to do, because our overall concept was to segment the city, set up a tightly controlled zone, and then strike selectively therein. Within our NetFires system, we had missiles designed to deliver sensors that could home in on transmitters like active cell phones, and we made extensive use of imitative deception and selective jamming. Although the enemy operated dispersed and decentralized, he had a command system, and he did from time to time communicate among the combatant groups, and send messages outside the city."

"But how did you know where a key commander was located? How did you know where and when to strike?"

Seitz replied that he could not comment on all the sources and methods used for those purposes, but that he was cleared to talk about what led to the capture of "Commander Abdul."

"Commander Abdul, as you know better than I do, built up a worldwide audience as spokesman for the dictator, Ahmad Kazek. In the information-warfare phase of this operation, Abdul has been the most prominent symbol of resistance here, and the prime motivator for these chaps marching past us. Every day, around eleven in the morning, Commander Abdul had been making a long bombastic radio broadcast to the world in which he used half-truths and outright lies to report to Ahmad Kazek about Abdul's triumphs here in Baachen. Each broadcast was carefully coordinated to boost morale among his small units within the city, and to lend credence to propaganda disseminated outside the city by World Wide Web broadcasts of video segments and "interviews" with locals. One of the JTF's missions was to shut down Commander Abdul.

"One way the JTF accomplished that mission was to intercept Abdul's Internet traffic, including the videos he tried to send out. For Abdul to disseminate his message,

he had to get to an access point that allowed him to put his traffic onto the World Wide Web. We intercepted the traffic, and substituted our own. I am sure that you have seen or heard of some of the results. It does not take long to discredit someone in the eyes of the world when the truth is substituted for absurdities. I cannot tell you technically how this was done. But you can judge for yourself whether it worked.

"However, finding and eliminating Abdul turned out to be easier said than done, because while it seemed certain that Commander Abdul was, as he claimed, in Baachen, he moved several times each day, and he always used antennae for his broadcasts that were remote from the site from which was speaking. However, two days ago the Air Force caused a number of significant acoustic events—specially orchestrated explosions—to occur during his scheduled broadcast, events that his microphone picked up, and transmitted to the world as background noise. Since we knew when and where those events occurred, it was a relatively simple matter to calculate where he and his microphone were located, and before he finished his broadcast, our strike force pounced on him. As you know, we were successful; he died of wounds after we got to him.

"JTF operations against other local commanders produced 4 out of 5 similar successes: what in effect happened is that we decapitated the planned resistance, and it collapsed.

"There followed 24 hours of eerie quiet, broken by our intensive psyops campaign, and our occasional strikes on small detachments trying to move out from cover. Then we began to see white flags, and the start of the POW parades."

The tall female reporter asked whether he believed this approach would work in other urban contingencies, against other enemies.

Seitz replied that he was certain that every circumstance would dictate a unique response, but that U.S. forces finally had in place joint policies, training, and materiel that encouraged him to believe that it could defeat any enemy on urban terrain as decisively as his troops had defeated those of Commander Abdul.

"But," he said, "the evolution of measures and countermeasures will require us to continue to learn operationally, and to press persistently for technological advantage. The secret of future victory—as it has been here in Baachen—is simply superior information enabling our adaptation to new reality."

A major came up with a paper in hand to which Seitz turned his attention, his demeanor signaling that the lunch and the interview were at an end.

APPENDIX D, ANNEX 3

OPERATION PYTHON

APPENDIX D, ANNEX 3
OPERATION PYTHON

EUCOM, NOVEMBER 2015

Major General Bentley had every reason to be concerned about his mission. Within a month of assuming command of his division, EUCOM had directed implementation of OPLAN PYTHON,[1] an attack on the terrorists holed up high on Mount Ararat who had caused the crash of two international passenger flights, one carrying a U.S. Ambassador and his family. In many respects, PYTHON resembled ANACONDA, the attack on Taliban and al Qaeda in the Shah-e-Kot Valley of Afghanistan in 2002, only in this case the LZs were at a higher altitude, and the quarry even higher. For that reason, and with the approval of CINCEUR, he had invited General Hagenbeck, USA (Retired) to assist in reviewing the plans for PYTHON. In ANACONDA, aside from the terrain, enemy mortars were Hagenbeck's main problem; but the terrorists on Ararat targeted by PYTHON had not only mortars, but also late-model French and Russian ordnance: sniper rifles, machine guns, recoilless rifles, man-portable air defense weapons, night vision optics and weapon sights, and anti-helicopter mines. Moreover, they were well dug in along an irregular, snow-covered ridge operating from a nexus of underground bunkers and under-snow communication tunnels. Their number obviously included technicians with equipment capable of meaconing[2] the civilian aircraft and jamming their GPS.

The Turks wanted to use artillery to support PYTHON, but Bentley had told them there was neither the lift to get their guns in range or to keep them supplied, nor infantry to be spared for protecting one or more firebases. Bentley asked his Fire Support Coordinator, Lt. Col. Dave Meade, a savvy Marine well versed in the Joint Fire Support

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1 Cf. R. Grant, "The Clash About CAS," *AIR FORCE Magazine,* January 2003, pp. 54–59. Also, MGen. F.L. Hagenbeck, "Afghanistan: Fire Support for Operation Anaconda," R.H. McElroy, and P.A. Hollis, eds., and LtC C.F. Bentley, "Afghanistan: Joint and Coalition Fire Support in Operation Anaconda," *Field Artillery*, HQDA PB6–02–4, Sep–Oct 2002, pp. 5–14.

2 Meaconing—"A system of receiving radio beacon signals and rebroadcasting them on the same frequency to confuse navigation. The meaconing stations cause inaccurate bearings to be obtained by aircraft or ground stations." (JCS Pub 1, 1987)

System, to lay out for him and General Hagenbeck the provisions being made to insert PYTHON's 400-man allied ground force, to support and sustain them as they closed with the terrorists, and to extricate their casualties and eventually, the entire force.

Meade began by pointing out that altitude would impair the efficiency of the aircraft and of the men, and would raise the hazards faced by the wounded. There was also a prospect that weather would be a factor: high winds, blowing snow, and very cold nights. Bentley impatiently urged him to proceed with the plan for fires to cover the landing.

"Well, sir, as you know, we have already begun to position the C4ISR[3] for the landing. Immediately upon receiving the EUCOM warning order, we stationed a HALE[4] aircraft over the objective area both to provide continuous SIGINT collection, and to serve as a pseudolite to counter enemy GPS jamming. Yesterday we began 24 × 7 staring MALE[5] surveillance that has already significantly upgraded our targeting information.

"Per your guidance, General Bentley, the landing force will be organized into nine assault platoons, with three platoons to be retained in airborne reserve. Beginning at L – 12 hours we will paraglide in three CLUs[6] of NetFires[7] per platoon, and we plan to keep two C-130s aloft from L-hour until L + 24 with supplemental CLUs to be inserted as required. I would point out that for every platoon, at least one CLU will be equipped with the Mini-FireFinder, so that in the event the enemy has recourse to indirect fire, the platoon will be able to counterfire immediately, with precision.

"Last night a UCAR[8] accurately dropped three fiducial digital tags[9] on the ridge, so that any of the cooperating GMTI/SAR/IFSAR[10] maintaining surveillance of the target

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3 C4ISR—command, control, communications, computers, intelligence, surveillance and reconnaissance.

4 HALE—High Altitude Long Endurance; in this instance, "high altitude" is above 50,000 feet and "long endurance" is more than 1 week.

5 MALE—Medium Altitude Long Endurance; in this instance, "medium altitude" is above 18,000 feet and "long endurance" is more than 1 day.

6 Container Launch Unit, a prepackaged container of 15 missiles, each of which launch from the CLU on wireless command from the supported unit; a component of NetFires.

7 NetFires is a system for providing fire support to a maneuver unit within a radius of 40 km of a CLU using either a PAM (Precision Attack Missile) or a LAM (Loitering Attack Missile).

8 UCAR—Unmanned Combat Armed Rotorcraft.

9 A passive marker on the ground visible to friendly radar, the geo-location of which is precisely surveyed, used to correlate sensor imagery to the ground.

areas can have precise geo-registration for guiding the incoming missiles and for coordinating the fires with the infantry attacks. Any time we have helicopters within range of known enemy positions, and certainly while the troops are being inserted, we will suppress using Joint Air-to-Surface Standoff missiles and sensor-fused weapons optimized for attack of weapon crews. We plan to alternate these strikes with a low flyover by a UCAR, under cover of two loitering LOCAAS[11] missiles, to provide BDA,[12] and to induce enemy air defenders to attack. The UCAR will be provided with active defenses and can call down a loitering LOCAAS on any enemy MANPAD[13] foolish enough to try to engage. If the enemy air defenders do not bite, the LOCAAS will be redirected to contingency targets, and these will initiate the next round of suppression. Just before troop insertion, UCARS accompanying the lift birds will launch OAVs,[14] one per platoon, to provide surveillance of the latter's objective. The OAVs will carry IR and glint-detection sensors, so that even weapons under overhead cover can be detected slant-range and attacked by a LOCAAS or a PAM.

"For suppression of known enemy positions during troop insertion, we've arranged for a B–52 strike along the ridge, a flight of LAMs for BDA, and a rack of Navy AWS for restrike or targets of opportunity. In back of that we'll have a B–52 with LOCAAS and JDAM on station throughout the operation.

"At L-hour, each assault platoon will be landed as close to its objective as the terrain permits, and each will move to it objective by the most expeditious route, with the intent of simultaneous assaults."

Hagenbeck, theretofore silent, interjected: "Close Air Support, CAS. What about CAS? What is the role for the fighter bombers?"

Meade nodded. "General, what I have just described is what we refer to as CSF, close support fires, and they will be delivered precisely where want them, closer than we could ever have effected with piloted aircraft, with better coordination between ordnance delivery and friendlies than we could ever have had absent our staring radars and digital

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10 GMTI/SAR/IFSAR—a type of radar useful for C4ISR. The acronym stands for Ground Moving Target Indicator/Synthetic Aperture Radar (for imaging detected movers)/Interferometric SAR (for detecting elevation).

11 Low Cost Autonomous Attack System, a GPS-guided, LADAR-homing, air-launched cruise missile with endurance greater than 30 minutes.

12 BDA—bomb damage assessment, evaluation of strike effectiveness.

13 MANPAD—man-portable air defense, typically a shoulder-fired heat-seeking rocket.

14 OAV—organic aerial vehicle, a small unmanned air vehicle under control of a ground unit.

tags. Technology has enabled us to meet the requirements for continuous air-ground coordination and tight control of the air vehicles that has heretofore been the central prerequisite for CAS. We have traded the advantages of piloted aircraft for a combination of high confidence in blue positional location[15] and precision weaponry. We know where our people are, we can see where the enemy is, and we are confident that our weapons will strike what we target. As for the role of manned fighters, they are just one more weapon system platform, delivering stand-off weapons."

The old General was not persuaded; he turned to Bentley: "I am sort of surprised at you. You know that you can't suppress with precision weapons. Just as soon as the explosions stop, the enemy will be out of their holes and dropping rounds down mortar tubes. It's air overhead that keeps their heads down."

Bentley replied calmly: "General, I believe that we can suppress with precision weapons provided we keep close watch on the objective area. We will be able to detect any motion near those holes, because we will have overhead multiple radars and loitering attack missiles with ladar. I will also tell you, close hold, that we have a FOPEN-equipped MALE, and we can detect the bad guys moving in their snow tunnels.[16] Sir, I think you and I agree that suppression depends on inducing a high expectation of imminent wounding or death. I think we can get those expectations up pretty high, and keep them up."

Hagenbeck grunted, stared at his feet for a moment, then said: "It seems to me that this plan is like Montgomery's thrust into Holland in 1944: his was a bridge too far, yours is a ridge too far.

"You plan to use stand-off weapons to subdue an enemy that has clearly demonstrated ability to deceive sophisticated civil air navigation equipment, and to interfere with GPS. What makes you think he hasn't figured out how to bamboozle Air Force standoff weapons as well? You are relying on high-tech to get infantry into a very high place, where the advantages will surely rest with the guys who are fighting from prepared positions on terrain they know much better that your troops. Your infantry will have to climb to close, and every foot upwards at that height will exact a toll in energy and determination. And I can tell you from experience that at that altitude anyone who

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15 Situational awareness includes knowing where all friendly elements (blue) are located and being well informed of the location of enemies (red).

16 FOPEN—foliage-penetrating radar; this can produce sensing of reflected energy not only through foliage, but also through other forms of light concealment opaque to light.

starts bleeding from a wound or an injury will need immediate medical attention, because up there the Golden Hour for casualty evacuation shrinks to minutes. And how in hell are you going to synchronize those distant fires? Isn't one of your platoons likely to arrive at its objective and get pounded by missile launched a half hour earlier? What have the technologists fielded to offset those disadvantages?"

Meade was ready with answers: "General, we expected this to be a tough assignment, and we have selected weapons and trained units we believe can meet the challenges. On enemy EW, some of the early arriving weapons will pepper the ridge with EW countermeasure pods.[17] Actually, we would like them to turn on their emitters so that we can precisely pinpoint their location, and attack them.

"To help the assault force, we have picked LZs, or better, fast-rope insertion points that minimize the climbing tasks. As to the enemy's prepared positions, they are indeed an advantage, but they are also a liability in the sense that their preparations have made it easier for us to detect where they are, and to ascertain how they are built. They have even been using stoves up there, making it easier for our IR. Knowing that, each platoon leader has picked a range of weapons, tactics, techniques and procedures specific for his mission, taking into account the difficulties of terrain, and the particulars of the enemy's fortifications. We calculate that our information advantages, coupled with coordinated fires and maneuver, will be decisive."

"On controlling fires, our radar automatically paints an FSCL[18] on the CROP,[19] so that as FSCOORD for operation, missile crossing the FSCL will have to be cleared by me. I'll be aboard the joint airborne command post, and I'll work that synchronization very carefully. Mainly, I'll stack up incoming missiles above the ridge, where they are just seconds away from strike when and where we want them to hit."

Hagenbeck persisted: "OK, let's take one platoon as a case in point: this platoon lands as planned, maneuvers as planned, assaults as planned, and accomplishes its mission as planned. But not all platoons are similarly successful, and there are firefights underway within earshot on either side. This platoon I'm talking about had 1 KIA and 3 WIA, and it now has 14 POWs. Ammo is short all around; unfrozen water is all but consumed. How do you expect to get that platoon back into action?"

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17 EW—electronic warfare.

18 FSCL—Fire Support Coordination Line.

19 CROP—Common Relevant Operating Picture.

Bentley responded to that question: "I've made arrangements for a half-dozen high-altitude SAR[20] birds to be made available for MEDEVAC, and these will bring with them some of the new smart litter-lifters, those ducted-fan ground-effect vehicles that permit one solider to steer a well-monitored casualty to the PZ. All of our soldiers will be equipped with TSC devices; the wounded will be closely monitored and given supplemental doses of TSC as required. And of course, all the troops will be wearing bio-sensors monitoring their vital signs—one safeguard against hypothermia—and all will have bio-active undergarments to staunch any flow of blood.

"What are these 'TSC devices'?" asked Hagenbeck.

"Sir," Bentley answered, "they're the small portable devices for administration of *trans sodium crocetinate*, the new oxygen enhancement drug developed by the military. When self-administered through the pocket inhaler, TSC helps counteract the effects of the low oxygen levels that will otherwise debilitate our soldiers at this altitude. And in the event of hemorrhagic shock from a wound, the drug extends the "golden hour" and buys us time to complete necessary evacuations."

"God, I wish we'd had that in the Shah-e-Kot Valley in '02," Hagenbeck said.

"Yes, sir. It improves the men's physical performance, and can help save their lives if they're wounded. Just having it in their gear helps their morale as they go into action."

"Now, what about resupply," Hagenbeck asked.

"Sir, we'll be counting on cruise missiles air-launched from utility helicopters, guided into landing right on the objective. I've seen these work: a soldier puts out a small transponder exactly where he wants the drop, and the missile does a Mars-lander set-down, guiding itself right on top of the transponder, using a parachute to decelerate, and an air-bag to mitigate the shock of landing. Each can deposit up to 200 pounds."

General Hagenbeck remarked that he'd like to see that demonstrated and then asked Meade to tell him more about the "mini-FireFinder." Meade responded that the walls of a CLU for NetFires—4 by 4 by 6 feet, and self-erecting upon landing— had been embedded with a conformal steerable antenna, and one of the stowed munitions had been replaced with a processor/power-supply capable of precisely locating the point of origin of any ballistic projectile and autonomously targeting it with a PAM. In default

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20 SAR—search and rescue.

setting, the CLU would fire before the incoming projectile landed. As his troops approached the objective, the platoon leader could change that setting to "fire on command."

Hagenbeck was silent for a long moment. "What I am hearing is that this will be an Army-only show. You won't have any TACP[21] or even any ETAC.[22] Is that prudent?"

Bentley answered: "General, there is no functional need for Air Force personnel on the ground. We have worked the TTPs together in joint training. We will have all the Air Force support that we need, and we can get a lot more in a hurry. We will, of course, have Turks with us, and we will insert some intel guys; from start to finish the outcome will depend upon JIM[23] teamwork."

Hagenbeck shook his head slowly. "Where was all this stuff when we needed it in Afghanistan? I sure hope it works for you. Anyways, I know that General Bentley would not have confidence in it unless he had seen it work. And Colonel Meade, I know your commander agrees with me that the key role in this operation will be played by the infantry: robot aircraft and missiles, radar and ladar, stand-off this and loitering that, all that goes for naught unless the infantry is able to clean those bastards out!"

Bentley's feedback from Hagenbeck's reports to EUCOM was that the old general was uniformly supportive, enough so that when PYTHON struck with overwhelming success and minimal losses, he was able to say, "I told you so."

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21 TACP—Tactical Air Control Party, assigned to an Army unit to control CAS.

22 ETAC—Enlisted Terminal Attack Controller, a USAF NCO trained and equipped to accompany a small Army unit for the purpose of conducting precision CAS.

23 JIM—oint, interagency, multinational.

APPENDIX D, ANNEX 4

OPERATION MONTANA
PACOM, DECEMBER 2015

APPENDIX D, ANNEX 4
OPERATION MONTANA
PACOM, DECEMBER 2015

It is a long way from Fort Drum to Singapore in more ways than just travel time, but Colonel D.R. Golosov, commander of the 32d Infantry Regiment, used the time to rehearse details of OPLAN MONTANA[1] that had heretofore been withheld from his staff. They conferred in his palletized CP in the USAF transport, surrounded by communications and displays that linked him with the JTF command network and with his subordinate commanders enroute in other aircraft.

He began by reiterating that their unit's task was nothing less that the classic infantry mission: to close with and to destroy the enemy. In this case the enemy was the main fighting force of the Movement for Independent Sumatra (MIS), which had unleashed attacks on whole villages and towns so barbaric that the world had become outraged. The United Nations had overwhelmingly approved a Security Council resolution calling for intervention by an armed force to restore the peace. But as nations moved to form a force, the MIS had massed its troops and committed what the media labeled "the Rape of Palembang," sacking the city as thoroughly as Genghis Khan might have, then withdrawing into the jungle-covered mountains to the southwest of the city, their Internet spokesmen and radio broadcasters defying the UN to come after them. So, Golosov said, the mission entailed finding, fixing, and defeating a wily, ruthless, and well-equipped opponent that was expert in information and jungle warfare on the battleground of his choosing: steep terrain covered with a dense triple-canopy jungle. "How shall we go about finding the enemy?" he asked.

Golosov answered his own question: "We will not search for him unless we have to, but instead, we'll try to induce him to come in search of us. The Joint Force Commander's central stratagem is to deceive the MIS commander by having us pose as a unit so evidently weak and inept that he will be enticed into attacking us in the

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1 Cf. J. Votaw and S. Weingartner, eds., *Blue Spader, The 26th Infantry Regiment, 1917–1967*, Cantigny First Division Foundation, Wheaton, Ill., pp. 213–227. For the commander's perspective on Ap Gu, see Alexander Haig's personal account: A.M. Haig, Jr., *Inner Circles*, Warner Books, New York, 1992, pp. 174–179.

expectation of inflicting heavy American casualties and of humiliating and deterring the UN, thereby bringing about a withdrawal by the UN, as its force in Somalia had been withdrawn two decades earlier.

"I remind you that U.S. forces will be among the first on scene—PACOM already has a carrier battle group with an ARG off-shore. The MEU will seize the airfield at Palembang, so that we can air land with C–130s out of Singapore. 2d and 3d Battalions will initially be attached to the UN force, commanded by Lt. General Prakit that will secure the city, reopen the port, and assist international relief organizations and whatever may be left of civil government to undertake humanitarian assistance. The Regiment-minus, under my command, will immediately conduct an airmobile assault into rice fields around the village of Pembak, 95 miles to the southwest of Palembang, in the foothills of Mount Dempo, elevation 10,364 feet. Our ostensible mission will be a reconnaissance in force to find the MIS stronghold so that Prakit's force can then assault it. Our actual mission will be to convince the MIS commander that we are so incapable that we present to him an opportunity he will be unable to refuse."

Golosov paused, and looked around: "This will not be easy. The Indonesian Army tells us that much of the rural population in that region is sympathetic to the MIS cause, and most are apparently willing to provide information to MIS operatives, if not more active forms of support. I am told that the Indonesian Army stopped patrolling in this area over a year ago because of mines, booby traps, and ambushes staged by local guerrillas. We are counting on MIS sympathizers to act as the eyes for the MIS main force. We are going to present them an eyeful, an American unit that is trying to search MIS, but cannot because of internal crises.

"Patrolling dense jungle, searching for an elusive foe, is arduous, time-consuming, and very risky, especially if the area is contested by skilled irregulars. The last time the U.S. Army operated in the jungles of Southeast Asia, in Vietnam, the commander of the 1st Infantry Division, General William DePuy, reported that combing the jungles for small guerrilla units resulted, on the average, in about two enemy casualties per battalion day in the field. But if he could bring to battle the enemy main force, regiments manned by North Vietnamese, enemy losses were three times greater—six per day on average. So DePuy maneuvered battalions, and even companies or troops into the path of enemy regiments. What would then happen was that his troops would brace themselves for a stiff defense supported by a lavish concentration of artillery and Close Air Support. In short, he set up a firetrap baited by a temptingly small unit.

When the enemy took the bait, the outcome was invariably extensive enemy carnage against relatively few American losses.

"My study of DePuy's tactics taught me an important lesson, but my concept of operation here is different from his in one important respect: DePuy induced his enemy to attack a strong defense, whereas my intent is to draw the MIS main force into a well-structured ambush, and after that ambush has been sprung, to attack to sweep the kill zone."

His S–4 then spoke up: "Sir, per your guidance we will be carrying only one mortar per company, and the ammunition we've requested is mainly flares and smoke. Will we have CAS for the ambush?"

Golosov nodded to his fire support coordinator, and the artilleryman took the floor: "In this operation our fires will be closely integrated with extensive supporting C4ISR and precision joint fires. I have extensively worked the plans with our naval LnO, Lt. Gleason, and I believe that we will have available ample scheduled fires to deal with a force of four to six infantry battalions, with additional support on call. I was told not to plan for use of the mortars in the ambush."

The S–4 looked quizzically at Golosov. "Why carry them in at all, sir?"

Golosov smiled and remarked that that as far as he was concerned, the Army could send the last of the mortars off to its proliferating museums; but since the 32d still had some, he wanted the MIS commander to be informed by the village "eyes" that our indirect fire support was limited to three 120 mm auto-loading mortars. Then he said sternly, "This concept of operations hinges on deception, so I want absolutely no chatter outside this group about the fact that the mortars are actually window-dressing. The story that I want conveyed to the MIS commander is that we are few in number, poorly armed, plagued with sickness, short on ammunition and food, and completely ignorant of his force. To bring that about, we'll be doing some pretty dumb things, and the men will ask plenty of questions. That's OK, so long as all you tell them is that we're under UN orders now, and as this Regiment has always done in the past, we're just following orders. Let me go over the role that each of you will play while we are around that village, waiting to see if the enemy will take the bait.

"I'll begin with signals: we will have two nets, one secure for all real traffic, and one unencrypted net, on which the Sig O will repeatedly complain to Palembang that our encryption devices are inoperable in the tropical damp. That net would include stations in Palembang, and our hope is that the MIS interceptors are every bit as good as the

Indonesian Army says they are, and that every word we transmit will get to the MIS commander. All of you will have a role to play in acting out our story, and I want you to use that open net with convincing sincerity and appropriate angst. I want you to convey that you are under stress, you need help, and that you are impatient, perhaps desperate, that the REMFs in Palembang can't produce what we need. I want the S–2 and the S–3 to patrol as the OPLAN dictates, using the secure net for actual C2, but every other night or so I want you to stage a "lost patrol" scenario on the unsecured net, complete with the patrol leader's reporting their secure mode out, and requesting help, and us firing a machine gun straight up or popping flares with the mortars so that the patrol can get a homing azimuth."

One by one, the Colonel went around the staff, suggesting to each what he or she might do to assist the deception. For example, Golosov instructed the doctor to set up a tent with a large Red Cross on it that would represent the unit's infirmary. He was also to open a clinic in the village, assisted by Indonesian Army medics, and to do what he could to provide real medical assistance to the villagers. But in addition, he was to have his Indonesian colleagues instruct the citizens that they were to stay away from the infirmary because the Americans had brought in with them a virulent sickness. After a day or two, he was to let it be known that American patients were dying. There was then to be staged helicopter evacuations of body bags (filled with sand bags). The doctor's mission was to act out a dreadful epidemic that was seriously sapping the unit's strength, and to consult with doctors in Palembang over the unsecured net about appropriate countermeasures. Those doctors were to report that because of the epidemic, General Prakit had foreclosed bringing the unit back to Palembang, where public health measures were tenuous at best.

When Golosov finished the last of such scenarios, the group was somber. The S–1 blurted that he, for one, did not like the idea of being bait in a trap. The Colonel grimaced and remarked that the captain might like less an indefinite tour in a green hell just below the Equator, because one option open to MIS was simply to lie hidden in the mountains and wait out the UN force.

In any event, the transloading in Singapore went smoothly, as did the air landing in Palembang. The following morning the lead company of the Regiment (-) secured that LZ at Pembak, and the rest of 1st Battalion and the Regimental Headquarters, with one company of Indonesian infantry attached, followed in company serials, the operation complete by late afternoon. By the next day Operation MONTANA was in full swing: the infirmary was erected, and the medical clinic "downtown" had been opened (at first the Indonesian medics had to sweep the village for a few sullen or fearful patients, but before

long, there was a crowd of children gathered at the door, and volunteer patients, all women, began to come forward). Golosov inspected the security around his command post daily and focused his attention on patrol plans and ISR reports. He instructed his subordinates to "look busy," establish an evident routine, and to follow it daily. From time to time, a litter party was to carry a "patient" to the infirmary (where each got a day of rest until he was sent back to his unit after dark). On day three, there began the grim enactment of evacuating "body bags."

Four days after landing, his S–2 came to him to report that the previous evening, he had requested the MALE overhead to track the village postman, a scar-faced ancient with a rickety bicycle and a document from the Indonesian government proclaiming him a member of its postal service. That afternoon that worthy had approached the Indonesian Army checkpoint on the road out of the village, and after some discussion, he was searched for weapons, and allowed to proceed with his "mail." The A–160 traced him some 30 kilometers to a road junction, where he was met by a motor vehicle. After a short interval, the bicycle rider continued toward his announced destination to the northeast, while the motor vehicle turned around and drove rapidly northwest, toward the mountain. Golosov directed the S–2 to commence 24/7 surveillance along that road.

Three days later Golosov staged a "firefight" in the jungle, within hearing but well out of sight of the village. The doctor was recalled from the clinic with a loud announcement that one American patrol had ambushed another, and that there were 6 dead and 12 wounded. Two hours later a column of litters with bloody and bandaged "patients" (with moulage wounds) emerged from the jungle and were carried in full view of the villagers to the infirmary. A noisy helicopter evacuation of the "dead and wounded" ensued, and the radios crackled incessantly.

The next day the postman was again passed through the checkpoint. His rendezvous with the motor vehicle took place as before, but this time the vehicle was tracked for 40 kilometers along the road as far as it extended, and then up a ravine under the jungle canopy for several hundred meters. The S–2 wanted to send in UCAR with low altitude OAVs to scout the ravine, but Golosov pointed out that this might alarm their quarry and prompt them to find a new hideout. The better course was to pepper the ravine with sensors to conduct a MASINT[2] assessment. That led to a silent overflight of the

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2 MASINT—Measurement and Signature Intelligence, entailing the collection of scientific and technical intelligence obtained by analyzing holistic data from a given site (size, angle, spatial, wavelength, time, modulation, plasma, hydrometric) derived from internetted mini-sensors. These are disguised as

ravine during the night in which it was sown with hundreds of internetted microsensors, over 90 percent of which lodged in trees, but all of which began to collect minute information on what was happening from moment to moment on the surface. A HALE, now positioned over the ravine, polled the sensors about every 20 minutes, and gradually, the MASINT analysis took shape. The following morning Golosov was briefed from the carrier task force that there were probably 100–400 humans in the ravine, occupying an encampment that stretched along a stream for about 1,000 meters. There was a center of activity that coincided with most of the electronic emissions, judged to be a command center.

The S–2 said he would turn the latter location over to the FSCOORD,[3] but Golosov vetoed him: "No, to the contrary, we want to watch it. If the Indonesian estimates are accurate, we have located only a small part of the MIS force. Tell the MASINT analysts that my EEI[4] are, all ASAP: 'Where is the rest of the MIS force?'; 'Is any MIS element preparing to move?'; 'If they are moving, which direction?'; and 'What force remained in the original location?' Also, since we now have a sensing that MIS likes to camp in ravines and to use vehicles for liaison with the guerrillas, select some other likely locations nearby for MASINT treatment—SIGINT DF will probably help, but you will no doubt have to look for low-power emissions, probably from commercial CB-type radios or cell phones."

The next night five additional ravines were sown. There was another hit: a formation about the same size as the first was located 3 kilometers to the southwest. SIGINT also fixed two repeater stations atop interposed ridges. Golosov directed his S–2 to keep searching, but to do so very cautiously lest the search flush the quarry.

Within 36 hours, early in the evening, the S–2 interrupted Golosov's supper with a report that both the known MIS camps are astir. Within minutes another report followed indicating that both units were in fact moving, both southward. Golosov immediately ordered his ambush to be set up.

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naturally occurring life-forms (e.g., dead birds) and report acoustic, electro-optic, infrared, and radio-frequency sensor data, as well as human bio-sensor data, such as an effluvium from human waste.

3 FSCOORD—Fire Support Coordinator.

4 EEI—Essential Elements of Information: "The critical items of information regarding the enemy and the environment needed by a particular time to relate with other available information and intelligence in order to assist in reaching a logical decision." *U.S. Military Glossary,* Online, Available: http://usmilitary.about.com/library/glossary/e/bldef02240.htm, 12 June 2003.

The ambush was based on three concentric rings of layered sensors around the village of Pembak. The outer ring consisted of SIGINT HALEs above cooperating FOPEN GMTI MALEs, collaborating to detect and to report on the location, speed, and direction of persons moving in the jungle. The second and third rings consisted of pre-sown sensor fields, to be thickened as the azimuth of the enemy march became evident, and as he closed the range to Pembak. Up until that point, Golosov had withheld his OAV to deny the enemy forewarning that he had such robots, but he intended to use these in the third ring, up close, for exploiting data from the innermost sensors and providing precise targeting for his NetFires missiles.

Golosov's decision to lay out the ambush in full circle was fortuitous, because when the enemy started toward him, he did not know where all the MIS elements were located, or what direction they would come from. In any event, the outer ring detected an additional column from a different direction, and the extended plots of all three converged on Pembak. MIS had taken the bait!

Golosov's staff alerted the elements of the Joint Task Force tasked to support the ambush. All across the JTF area of operation, units moved into position and prepared to fire, and commanders watched their CROP to follow the enemy's progress toward Golosov's unit. From all indicators, the enemy was unaware that he was being tracked: there were a few cryptic intercepts of messages from column to column, apparently reports of reaching preordained checkpoints or other coordination measures. It was nearly two o'clock in the morning before the first enemy column entered the second ring, by which time the enemy transmissions had become more numerous, evidently to urge all to increase speed.

Golosov gave the order to launch his 2d and 3d battalions, waiting loaded in helicopters in Palembang. They were led to Pembak by several flights of empty helos, intended to pick up his 1st Battalion.

When all three enemy columns were within the second ring, but before any of them had met, Golosov requested the JTF to launch its missiles. Fast littoral fire support ships were positioned one off each coast of Sumatra, each ship carrying more than 900 of the AWE cruise missiles. These were fired from 8 × 8 foot containers holding 16 of the 12-foot missiles. The missile had an engine that gave it a range of thousands of nautical miles, or 2 to 3 days of loiter time. For Golosov's ambush, 300 missiles were flown to loiter overhead the second ring, the first-arriving arranging themselves in three columns, each to fly an azimuth 180 degrees from that of one of the target sets: linear arrays of

personnel concealed by jungle foliage. Golosov's plan called for near-simultaneous attack rolling down the enemy columns from front to rear, with a substantial reserve of loitering missiles for second or third strikes, depending upon BDA. Each missile was armed with the 175 pound Mark 125 warhead fused to burst for optimal fragmentation against personnel out to 300 meters range.

Immediately after the first of the AWE strikes, there were to be LZs cut into the jungle at the head of each enemy column by a GPS-guided, parachuted container bearing a USAF 15 ton fuel-air explosive. Golosov went aloft in his airborne command post to observe the strikes, and reported in his AAR that they were "textbook perfect." He sent in his UCARs for BDA, and based on what he saw, decided on a second AWE strike to be followed by attacks along each enemy column by UCARS and an Apache Longbow company. Insertion of his three battalions would follow, each to sweep a kill zone, each with a USAF AC–130 in direct support, able to identify friendlies from glint tape visible atop their helmets.

There was a modicum of muddle at the PZ for his 3d Battalion, but otherwise the operation went like clockwork. As Golosov had expected from SIGINT DF, the enemy command groups were found toward the head of each column, and the Indonesian Army confirmed the identity of each commander—all KIA. What little resistance his troops encountered was almost immediately eliminated by the USAF gunship overhead. There were over 100 POW taken, and some 600 corpses counted. U.S. casualties were one KIA from a hand grenade and seven WIA.

In an important sidebar action, during the strikes Golosov's S–2 had located the Pembak guerrillas massed in an assembly area south of the village, presumably waiting to join in the MIS assault. His FSCOORD laced that force with a deluge of PAMs that continued until imagery from a LAM overhead confirmed that all motion had ceased. Afterwards the Indonesian Army unit from Pembak reported 32 dead males, all armed, in that vicinity.

After the AAR at Palembang with General Prakit and the JTF commander, Golosov shipped his mortars to the Army Museum at Fort Belvoir, accompanied by imagery from Montana, and a description of the vital role the mortars had played in the victory.

APPENDIX E

THE ANACONDA CONTROVERSY

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According to the January 2003 issue of *AIR FORCE Magazine*, "Nothing has sparked friction between the Air Force and the Army like Close Air Support...[Operation Anaconda] the two week campaign during March 2002 touched off a major Army-Air Force imbroglio...what made the Army mad about CAS also went to the heart of the Army's future transformation concepts."[1]

Close Air Support (CAS), as formally understood among DoD, NATO, and the IADB, is "air action against hostile forces which are in close proximity to friendly forces and which require detailed integration of each air mission with the fire and movement of those forces."[2] That understanding differentiates CAS from "interdiction," defining the latter as "air operations conducted to destroy, neutralize, or delay the enemy's military potential before it can be brought to bear effectively against friendly forces at such distance that detailed integration of each air mission with the fire and movement of friendly forces is not required." The core of the criticism leveled at CAS in Afghanistan (e.g., that by Major General Hagenbeck and his fire-support coordinator, Lt. Col. Bentley) was the latency involved in "detailed integration." The former said that for responsive fires, "the ground force needs a highly lethal, all-weather indirect fire capability organic to the force," and the latter said that "every light infantry division needs an AC–130 squadron."[3]

For solutions, Grant urged provision for CAS in Army transformation:

> The need for good fire support is beyond dispute, but blaming the Air Force for Army shortcomings is not the way to transform. The Army itself has an obligation to evaluate its plans for lighter forces and equip them to

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1 R. Grant, "The Clash About CAS," *AIR FORCE Magazine,* January 2003, pp. 54–59. Rebecca Grant, a contributing editor of the magazine, has worked for RAND, Sec AF, and CSAF. Ms. Grant wrote the article in response to articles in *Field Artillery*, published by the Department of the Army, Sep–Oct 2002. HQDA PB-02-4, pp. 5–14.

2 Definitions of CAS and interdiction are from *Dictionary of Military and Associated Terms*. JCS Pub. 1. 1 June 1987.

3 Grant, p. 59.

defend themselves until CAS arrives. Anaconda showed the risks of doing otherwise.

If the Army of the future is to fight successfully in a large, distributed battlespace, in must understand the basics of CAS—what it is, and what it isn't. No air force in the world can guarantee the safety of an infantry unit inserted in tough terrain without proper "organic fires," as the Army would say. The lighter, faster Army forces of the future still have to be able to defend themselves for a minimum period and cope with the unexpected. CAS will remain a sacred obligation for airmen—but heavy reliance on it rarely is the preferred way to win wars.

CAS: WHAT IT HAS NOT BEEN

On the record, CAS has seldom exerted a profound influence on campaign outcomes, having usually been accorded a lower priority than interdiction. Wick Murray has judged that CAS was a sideline for the Luftwaffe in Hitler's victories of 1939–1941, the JU–87 Stuka dive-bomber notwithstanding.[4] During the American drive across Europe in 1944–1945, U.S. Army Air Corps operations often thought of as "CAS" were typically either armed reconnaissance (e.g., within the "pockets" at Falaise and Mons) or massive preparation for a ground attack from a fixed position (e.g., the breakout on the Cotentin Peninsula or the attacks on Aachen or the Hürtgen Forest). *AIR FORCE* holds that allocation of sorties to CAS probably peaked statistically during the Korean War, but in that war, on an average day during 1950–1953, Fifth Air Force assets allocated to CAS for the Eighth Army were only 13 percent (96 sorties). The 1st Marine Air Wing, in direct support of the 1st Marine Division 1950–1953, flew 118,000 sorties, of which one-third were CAS missions.

Even when the ground battle in Korea was most intense, CAS allocations changed little. In October 1952, truce talks broke down. From 6–15 October, Chinese ground forces attacked in the center of the UN line, mainly in the western sector of Eighth Army's IX Corps, north of Chorwon. In mid-October, in conjunction with massive naval and airborne feints, the Eighth Army went on the offensive in eastern IX Corps northeast

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4 Contemporary soldiers need to be reminded that in 1940, when the Army Chief of Staff exercised full authority over the Air Corps, General Marshall had to borrow Navy dive Bombers from Admiral Stark to replicate the Stuka-threat for the Louisiana Maneuvers, since the Artillery branch had a long-standing agreement with the Air Corps that the latter was not to operate within range of the former's guns. In 1940 the U.S. Army Air Corps had for CAS neither doctrine, nor tactics, techniques, or procedures (TTP), nor even suitable aircraft. Moreover, requests from ground units for air support of any sort had to be passed up the ground chain of command, across to the air task force, and then down to the flying squadrons.

of Kumwha, launching the U.S. 7th Infantry Division and two Korean regiments into attacks on well-fortified mountain positions. Late in October, the Chinese attacked positions of the USMC 1st Division. Air operations were particularly intense—24,000 sorties during the month—but of these, only 3,000 (12.5 percent) were CAS missions. Of the 3,600 sorties flown by USMC aviators, 1,300 (36 percent) were categorized as CAS missions. For CAS in Korea, the most demanding month of the war was its last, June 1953, when the Chinese mounted massive assaults on the South Koreans to compel them to accept a truce, but even then, only 50 percent of missions flown were CAS.[5]

The Vietnam War, because of the air campaigns over Laos and North Vietnam, and because of the priority to interdict forces on the Ho Chi Minh Trail, did not involve a higher percentage of CAS sorties. That war ushered in the use of gunships for CAS missions. In addition, there were B–52 strikes that were arguably CAS. But it was certainly true that when tactical necessity required massed fires, CAS proved to be invaluable. In April 1967, Alexander Haig, later Secretary of State, then commanding 400 soldiers of 1st Battalion, 26th Infantry, deep in War Zone C northwest of Saigon, described the battle of Ap Gu, in which his unit was attacked by a crack enemy force that outnumbered his troops by "at least six to one." He reported that while his unit was well supported by all artillery within range, it was 114 sorties of CAS, plus a B–52 strike within 2 km, that "broke the spine" of the enemy assault.[6] The attack began at the beginning of morning twilight; final details of the air support had been coordinated the previous evening, including Haig's approving position of the B–52 "box."

During Operation Desert Shield, CENTAF conducted several months of strikes while coalition ground forces were postured in theater, during which time ARCENT commanders could nominate targets to aid their planned offensive. CINCCENT had set as an objective for these fires 50-percent attrition of Iraqi armor and artillery. A three-sided controversy developed: CENTAF felt that ARCENT estimates of strike effectiveness understated the accomplishments of its aircrews, while Washington analysts believed that both ARCENT and CENTAF were overly optimistic. The ARCENT estimates proved to be relatively sound. During the course of the war, ARCENT submitted 3,067 targets for the Air Tasking Order (ATO), of which 1,241 were flown. Another 1,582 targets were submitted to CENTAF. BGen John Smith, USA (Ret.), who

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5 Grant, p. 56. Other data on the Korean War have been derived from the Web sites of the historians of the U.S. Air Force, Army, and Marine Corps.

6 A.M. Haig, Jr., *Inner Circles*, Warner Books, New York, 1992, pp. 178–179.

commanded an intelligence unit located next to an airfield, tells of his CENTAF liaison officer passing a plot of moving targets through the airfield fence to an A–10 squadron sitting on strip alert; the squadron promptly took off and within minutes struck the targets. Overall, while there was controversy over interdiction, ARCENT commanders were pleased with USAF General Charles Horner's scheme for CAS:

> His innovative technique called for preplanned CAS, nicknamed "flow CAS" by CENTAF. With the number of aircraft at his disposal, Horner saw that the most efficient method of employing sorties to support the ground forces in contact with the enemy was to push them forward at regular intervals. Under the control of the airborne command and control center (ABCCC)—the equivalent of a flying "tactical CP" for the Air Force—the sorties would check in with air liaison officers (ALOs) at each corps to see if the units on the ground had targets. If they had none, the CAS missions would divert to interdiction missions under ABCCC. Horner's decision made sense and ground commanders saw that it would be inherently more responsive than keeping aircraft and crews on standby.[7]

Once Desert Storm got underway, CAS accounted for 6 percent of all sorties flown.[8] Many of the sorties launched as "flow CAS" were not employed by ground commanders and were diverted by the ABCCC to other missions. The ARCENT corps commanders, LtGen Luck and LtGen Franks, "were continually frustrated by their inability to influence target selection for the ATO [a 72 hour cycle]...

> Frustration with the rigidity of the air support system increased as the ground war began, [An arbitrary grid-line restriction between CENTAF and ARCENT] imposed by CENTCOM air planners kept the [U.S. Army] 11th Aviation Brigade [Apache] helicopters [conducting a deep attack] from preventing the escape of Iraqi armor. [The ATO had assigned the area east of the 20 grid to F–111s, who were to drop four laser guided bombs every 20 minutes; but that area was flooded with fleeing Iraqi AFV—far more than 4 targets per 20 minutes]. As a result, the coalition was unable to exploit the synergy of deep attack with unique ability of the Apache helicopters to kill large numbers of moving targets at night in conjunction with integrated airpower attacks...
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> The "flow" close air support system worked quite well in practice. The A–10 in particular was devastating once the ground war began and once

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7 R.H. Scales, *Certain Victory*, OCSA, U.S. Army, Washington, 1993, p. 189. Produced in TRADOC, this book is a compendium of lessons learned, the Army's official After Action Review (AAR).

8 Grant, p. 56. The author notes that during Desert Storm, the USMC extended its definition of CAS to encompass all air sorties within 5 miles (8.3 km) of the FEBA.

> the aircraft dropped low enough to provide effective 30 mm cannon support. However, CAS seldom descended below 10,000 feet due to still effective Iraqi antiaircraft defenses. Nor did CAS fly closer than 5 kilometers to friendlies because the armored forces were moving too quickly for FACs [Forward Air Controllers] to work with any less separation...The fear of further aerial fratricide caused most ground commanders to employ [CAS] very cautiously if they used it at all. In any case, the weather was so bad that most tactical aircrews could not see to bomb accurately. Most significantly, the presence of organic aerial firepower in the form of Apaches and Cobras lessened greatly the traditional Army reliance on close-in delivery of tactical airpower...As in past wars, once tactical aircraft arrived over the battlefield, pilots provided supporting fires to advancing troops with great tenacity and skill. The task for the future will be to shorten the ATO cycle and streamline the system of control between air and ground forces so that pilots can get to the battlefield more quickly, and once on station, keep track of the swirling, fast paced battle below.
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> Problems with procedure and philosophy, however, should not diminish the fact that in Desert Storm the United States raised the excellence of joint warfare to an unprecedented level of competence. In land combat, the term "joint" centers almost exclusively on the integration of ground and air combat forces. In years to come, the single most distinguishing characteristic of joint land combat will be the presence of aerial vehicles from every Service and in support of every battlefield function. It is essential that all aerial and ground platforms, regardless of the Service of origin, be blended together into an effective, seamless striking force.[9]

The essentiality of an "effective seamless striking force," evident as it may have been to the Army in 1992, was not recognized by the Army in 1999, when NATO undertook military action to halt Slobodan Milosevic's heavy-handed campaign that was destroying villages and wantonly killing in Kosovo. One issue stood out: whether to incorporate Army Apache attack helicopters in the air campaign against the Serbians. Clark agreed with U.S. Army commanders in Europe that "Apaches would be useful, perhaps vital in strengthening the fight against Serb forces in Kosovo":[10]

> The Americans favored a strategic air campaign; the European militaries were more ready to move in on the ground. I was in the center, trying to make both options work...

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9 Scales, pp. 287–290, 369–370.

10 W.K. Clark, *Waging Modern War*, Public Affairs, New York, 2000, 2002, pp. 319–321.

> It seemed that we would have to win without the Apaches. On May 18 [1999] President Clinton commented publicly that the Apaches probably wouldn't be used, suggesting that the risk to the pilots would be too great...Particularly damaging was a May 20 story in *Inside the Pentagon*, personally attacking Jay Hendrix [U.S. Army commander of V Corps] and claiming, among other accusations, that he would not allow the Apache sorties to appear on Short's [LtGen, USAF, Commander, NATO Air South] Air Tasking Order. The article was apparently based largely on an E-mail sent by a disgruntled Air Force officer several weeks previously...A staff officer's misunderstandings, communicated without perspective to friends in other units, suddenly surfaced to make news weeks after it had been written, after the problems it addressed, if real then, had been corrected.
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> The perceived vulnerability problem—that the Serb's SA–7 antiaircraft missiles could shoot down the Apaches—was not borne out by analysis. Flying low at night up narrow valleys and through the mountains, moving in small formations, the Apaches would present a fleeting target to any Serb gunner. Nor was it clear that the Serbs even had night capabilities with these launchers. Anyway, the Apaches had defensive systems...
>
> An Army assessment team [invited by Clark to examine the Apache problem] overlooked all the joint support available, ignored the superb targeting process that Jay Hendrix had put in place, and discounted the value of striking Serb forces. While complimentary of the crews, the Army seemed to have no confidence in its own Apache weapons system in the most likely conditions in which it would be useful. I simply didn't agree..."

In Afghanistan, CAS for the first time played a major role in the campaign. Nonetheless, for Anaconda, General Hagenbeck limited preparatory CAS to one strike, requested hours before inserting some 1,200 soldiers into mountainous terrain. To support maneuver from the LZ, he relied on 26 mortars—120 mm, 81 mm, and 60 mm—that were to be lifted in with his troops.

> But I will tell you that the trade-off I would have had to make the first day would have precluded me from using 105s. In that terrain, my choice would have been either to airlift in soldiers with their mortars, or 105s...To sling a 105 underneath a CH–47 and try to set it down in very rugged terrain, to include slinging in the ammo after it, would have been very difficult and dangerous.[11]

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[11] Robert H. McElroy with Patrecia Slayden Hollis, ed., "Afghanistan: Fire Support for Operation Anaconda," *Field Artillery*, September-October 2002, p. 6.

In any event, the infantry were inserted into an Al Qaeda killing zone in a valley where a decade earlier the Soviet Army had conducted an assault only to be driven back with 2,000 casualties.

> The battle didn't begin as planned....There was some bad weather, and intelligence information was imperfect: There were more Al Qaeda and Taliban in the area than expected, and some were in or near the locations at which the Americans were set down by their helicopters. American soldiers were pinned under heavy fire—some forty were wounded during the first days of the battle. Apache attack helicopters and strike aircraft were brought into the battle. Two Special Forces transport helicopters were seriously hit, and eight Special Forces troops were killed.[12]

The enemy had fixed mortar baseplates, and tended to use the guns in direct lay, LOS; the tube was carried into a cave whenever there was air overhead. The cave entrance then became a potential target for a precision weapon. Almost at once, CAS request nets became clogged. MG Hagenbeck stated that:

> ...Precision munitions were most effective against...fixed targets...But for the first three or four days, we faced "fleeting" targets. By the time the AWACS [airborne warning and control system aircraft] handed a target off, the Air Force said it took 26 minutes to calculate the DMPI [desired mean point of impact] which is required to ensure the precision munition hits the target. Then the aircraft had to get into the airspace management queue. It took anywhere from 26 minutes to hours (on occasion) for the precision munitions to hit the targets...
>
> We have a huge procedural and training issue we've got to work through with our Air Force friends. Because of the complexity of their precision munitions, they will not shoot JDAMs without either a GFAC [ground forward air controller] or ETAC [enlisted terminal attack controller] calling them in. There were not enough GFACs and ETACs in their inventory to support every ground maneuver element...this war became platoon fights separated by distances in very rugged terrain with too few ETACs to go around.

CAS was also limited by weather and LOS visibility. In that fight, CAS had been neither a satisfactory substitute for organic fire support nor a source of immediate help in coping with an unexpected tactical emergency. This operation calls into question both the lessons of Desert Storm and the feasibility of current Army doctrine, as set forth in Field Manual 3-0, *Operations* (June 2001):

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12 Clark, p. xxiii.

> Air Force air platform support is invaluable in creating the conditions for success before and during land operations. Support of the land force commander's concept for ground operations is an essential and integral part of each phase of the operation. Air Force strategic and intratheater airlift, directed by US Transportation Command, supports the movement of Army forces, especially initial-entry forces, into an AO. Air assets move Army forces between and within theaters to support JFC objectives. Fires from Air Force systems create the conditions for decisive land operations. In addition, the Air Force provides a variety of information-related functions—to include intelligence, surveillance, and reconnaissance-that support land operations...The effectiveness of air interdiction and close air support depends, to a large degree, on integrating land maneuver with the joint force concept of operations.

LtC Bentley attributed the shortcomings of joint fire support to the 36 hours involved in coordinating the ATO, and while he conceded, "the ATO was the best mechanism available to coordinate the hundreds of human and mechanical pieces involved in getting air on station," he held that it was inflexible and "not well-suited to support a nonlinear, asymmetrical battlefield." The ATO includes allocated sorties for contingency CAS, plus provisions for diverting strikes for tactical emergencies or targets of opportunity. The problem in Anaconda lay less with the availability of sorties for CAS than with the lack of provisions for employing CAS, especially difficulties in coordinating strikes once CAS was available. Yet CAS by both fixed- and rotary-wing platforms ultimately wrested the initiative from Al Qaeda and enabled the ground force to move to control the objective area. Bentley holds that "Every light infantry division needs an AC-130 squadron. These platforms should be available for all light infantry training and military operations around the world."[13]

CAS: WHAT IT OUGHT TO BE

Anaconda teaches an old lesson: as practiced from World War II to the present, integration of CAS with ground maneuver requires direct coordination between the ground commander and the supporting weapon systems, and it usually requires exchanges of personnel to ensure that fire support from the air is tightly synchronized with forces on the ground. As MG Hagenbeck observed, there is work to be done to facilitate the requisite joint interactions. "Facilitate" could mean to integrate more Air Force personnel into Army units. But it could also mean technology interventions to obviate the need for those Air Force personnel and provide fail-safe measures against

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[13] Grant, p. 13.

friendly-fire incidents. The speed and uncertainties of contemporary warfare, and the imperative for cohesive teams and mutual trust among ground combatants, favors the latter course of action. Moreover, for force projection, the newly expeditionary Army will need fire support from platforms of great range and endurance to actualize the Army's intent to conduct "operational maneuver at strategic distance," and it will need flexibility and volume of fire to support "dominant tactical maneuver" within theater. But expectations that these would or could be integral to Army units are fatuous: for the foreseeable future, Air Force resources for basing, directing, and air-to-air refueling pertinent platforms will remain compelling reasons for that service to provide those forms of fire support to the Army.

Operation Anaconda demonstrated that the three essential conditions of the Objective Force's networked fires concept are unattainable using today's CAS system. In the Anaconda debate there has been little discussion of how to modernize CAS. It is now time to evolve CAS from its current human-centric methods to a network-centric mode amenable to automation, albeit with provisions for exceptional human control. Ground forces do not care where their fire support comes from, provided it is both timely and effective. All ordnance, whatever its origin, intended to strike near troops on the ground should be under a common joint schema. Therefore, we recommend that the services:

> Drop the term Close Air Support (CAS), which connotes aircraft-delivered fires, in favor of a more generic concept: Close Fire Support (CFS). CFS would embrace all forms of fires, and all forms of effects delivered by air platforms, missiles, or projectiles. A key objective of FCS Increment II should be a C4ISR network capable of managing all fires (and fire-delivered effects) impacting close to ground forces.

APPENDIX E, ANNEX 1

CLOSE-AIR SUPPORT AND THE MODERN WARFIGHTER

APPENDIX E, ANNEX 1
CLOSE-AIR SUPPORT AND THE MODERN WARFIGHTER

Maj. Gen. David H. Huntoon, Jr.*

The opening days of the Korean War represent the nadir of American readiness in the post-World War II era. American ground formations were generally untrained in tactics above the company, and air-to-ground integration was practically nonexistent before actual combat. Most regiments had no radio that could talk to the U.S. Air Force aircraft operating overhead. They had no tactical air control party (TACP) working with them, no way to speak from the ground to the air to call off or direct attacks. The result was chaos, a situation that was not uncommon that deadly summer. This is not surprising considering that at the beginning of the North Korean attack there had been a grand total of one TACP trained and equipped to talk to aircraft conducting close air support in all of South Korea.

The Army and the Air Force had gone their separate ways between the end of World War II and the beginning of this new, come-as-you-are kind of war, and now the bill for that divorce was coming due. In those intervening years not only had the Army atrophied to a point at which the ground forces of the Far East Command were nearly unrecognizable as a combat element, the Air Force had let their support elements waste away as well until there was but a single unit in all of Japan, the 620th Aircraft Control and Warning Squadron, that could control attacking aircraft in the close air support mission.

Flash forward 51 years to the same Army and the same Air Force, again operating more than 10,000 miles from home in an austere environment with little in the way of indirect fire support. This time, however, things were different. The Army arrived, in force, and stacked up above, waiting patiently for their turns in the queue, were our winged brothers-in-arms from the Air Force, the Marines, and the Navy. The results

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* Maj. Gen. David H. Huntoon, Jr., is the Director of Strategic Plans and Policy in the Office of the Deputy Chief of Staff, G–3. He is a graduate of the U.S. Military Academy. Copyright© 2003 by The Association of the U.S. Army. Reprinted with permission.

demonstrated something that we sometimes forget; for all of our squabbles, for all of our sometimes frustrating parochialism and interservice rivalry, over time, our armed forces have demonstrated an ability to do something that few other military institutions have successfully accomplished over the course of history. It is an ability that frightens our adversaries. The American armed forces have the capacity to learn. We've learned how to conduct close air support; we've learned how to make it efficient. What we're now struggling with is how to make it perfect—an admirable goal, but one which sometimes needs context.

Throughout history, if it worked, Americans kept it. If they saw something some other army did better, they copied it. If it did not work, the Americans dropped it or changed it as soon as possible. What we saw in the air over Afghanistan last year was a perfect example of that phenomena. We saw things that worked, things that didn't work, changed some things on the spot and called back to the rear for fixes to others. In a word, we learned. We are still learning.

So it was that this past January the senior leadership of both the Army and the Air Force came together at Carlisle Barracks for another in an annual series of "Warfighter" talks. Four-star (and some select three-star) generals from both services got together, behind closed doors, and talked frankly and face-to-face about how we interact. This is among our greatest strengths. Topics at this conference ranged from UAV development to lift requirements to Apache deep strike integration to Joint Close Air Support, all areas where the Army and the Air Force find themselves periodically engaged in more friction than is best for either service. For several days our most experienced officers, entrusted with the power to make real and substantive changes, met and talked about how to get better in areas where the United States is already the world leader.

APPENDIX F

DOCTRINE FOR JOINT CLOSE AIR SUPPORT

APPENDIX F
DOCTRINE FOR JOINT CLOSE AIR SUPPORT

In a speech 31 January 2002 at the National Defense University, the Secretary of Defense urged the services to stop playing safe: "Put aside the comfortable ways of thinking and planning, take risks and try new things so that we can prepare our forces...we need rapidly deployable, full integrated joint forces capable of reaching distant theaters quickly, and working with our air and sea forces to strike adversaries quickly, successfully, and with devastating effect."

For the Army, close air support (CAS) provided by the U.S. Air Force has been the usual form of Joint fires, defined in Joint Pub 3-09 as: *"Fires produced during the employment of forces from two or more components in coordinated action toward a common objective."*[1] Neither service is entirely comfortable with CAS.

In structuring its Objective Force, the Army has sought to provide organic resources for all close fires, apparently assuming that (1) these would require a 24/7 response capability which would be impossible for the weather-sensitive Air Force; (2) CAS was in any event too complicated and too slow to deal with the sort of fast-moving battles envisioned for Future Combat System (FCS); and (3) Air Force support was a scarce resource, likely to be off pursing missions of priority higher than CAS. For its part, the Air Force regards CAS as a nonnegotiable obligation, one difficult to meet, but one for which it must be ready.[2]

Current CAS procedures dictate observation of the CAS aircraft by experts on the scene, and this requirement appears inappropriate for either joint fire support or for the networked fires of the Army's Objective Force. There are at least two conditions for revising the current system:

> A way of precisely ascertaining the position of all friendly forces proximate to any proposed strike, preferably a semi-automated system capable of handling multiple strikes simultaneously.

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1 Joint Publication 3-09, *Doctrine for Joint Fire Support*, 12 May 1998, p. v.

2 See Annex 2 for excerpts from relevant USAF doctrine.

A means for synchronizing air strikes with maneuver that can be invoked by a fast-moving surface force without breaking stride or waiting for a TAC-trained observer to take control.

Within FCS are mechanisms that could meet both conditions. First, digital radio frequency tags (DRaFT) read by over-watching radar(s) can portray friendly positions on the Common Relevant Operating Picture (CROP). Second, cruise missiles loitering over potential targets, seconds away from a hit on the enemy and under control of the maneuver commander, facilitate the close coordination of fires with maneuver. The Air Force, Navy, and Army are investing in long-endurance cruise-missile systems capable of loitering for a long time. (See Annex C.)

The FCS Unit of Action (UA) could add to the CROP a Fire Support Coordination Line (FSCL), so that any strikes across that line would have to be coordinated with the surface commander. He could either approve the strike or, for a missile capable of loitering, wait until he needed it. This would mean that any responsibility for fratricide would devolve to the ground commander, but he carries that burden for all close support fires, from whatever source.

Field experiments should be conducted to establish whether automated Blue situational awareness and loitering missiles can substitute for manned aircraft and Air Force controllers with the supported surface unit. *"As with all new systems, however, reliability and compatibility must be proven before new sensors or weapons are employed, especially in the CAS environment."*

Joint fires can obviate the need for an expeditionary UA to carry all its firepower on its own vehicles, reduce the numbers of soldiers it needs to deploy, and enable it to move faster and further with fewer image intelligence (IMINT) and signals intelligence (SIGINT) telltales. The price: better command, control, communications, computers, intelligence, surveillance, and radar (C4ISR) and better links with the Joint Forces Commander's fire-support subsystems.

The Army's capstone doctrine manual discusses CAS less extensively than its Air Force counterparts. The premise of Army doctrine for "unified action" is *synchronization*. As it prescribes close interaction among its branches and services—combined arms—so it enjoins a joint synergy, holding that the strengths of each service component combine to overcome the limitations or reinforce the effects of the other components, creating military power more potent than the sum of its parts.

As a joint operational partner, the Army regards the Air Force first among equals: "Air Force air platform support is invaluable in creating the conditions for success before and during land operations...Air assets move Army forces between and within theaters to support the JFC objectives. Fires from Air Force systems create the conditions for decisive land operations. In addition, the Air Force provides a variety of information-related functions (including ISR) that support land operations. The Army expects to support the Air Force in return, citing contributions that can be made to Air Force missions such as counterair, interdiction, theater reconnaissance, and surveillance by Army aviation, air defense, military intelligence, and field artillery. But, "the effectiveness of air interdiction and close air support depends, to a large degree, on integrating land maneuver with the joint force concept of operations."

Joint doctrine defines two forms of support that are based on proximity: mutual and close support. Close support is defined as: *"The action of the supporting force against targets or objectives that are sufficiently near the supported force as to require detailed integration or coordination of the supporting action with fire, movement, or other actions of the supported force."* The Army looks to the JFC to establish the conditions within which that integration and coordination can proceed smoothly. JFCs and multinational force commanders normally establish areas of operation (AOs) for their subordinates. Within these AOs, land and naval force commanders are normally supported and commanders synchronize maneuver, fires, and interdiction.

The Army manual quotes Joint Pub 0-2: "Unless limited by the establishing directive, the commander of the supported force will have the authority to exercise general direction of the supporting effort. General direction includes the designation and

prioritization of targets or objectives, timing and duration of the supporting action, and other instructions necessary for coordination and efficiency."

Synchronizing maneuver with interdiction is especially important "to impose dilemmas on the enemy." Integrating joint fires requires the development and full understanding of and strict adherence to common maneuver control measures and FSCMs (Fire Support Coordination Measures). Land and amphibious force commanders establish within the boundaries of their AOs Fire Support Coordination Lines (FSCL). FSCLs facilitate the expeditious attack of surface targets of opportunity beyond the coordinating measure. An FSCL applies to all fires of air-, land-, and sea-based weapons systems using any type of ammunition. "Short of an FSCL, the appropriate land or amphibious force commander controls all air-to-ground and surface-to-surface attack operations. Since attacking targets from beyond an FSCL involves danger of fratricide, air strikes short of the FSCL—both close air support and air interdiction—must be under *positive or procedural control* (for example, by forward air controllers or tactical air control parties) to ensure proper clearance of fires." The FSCL enables that coordination necessary to mass effects. "Achieving complementary and reinforcing effects requires synchronization, initiative, and versatility."

The premise of U.S. Air Force doctrine for CAS is *effectiveness*. Of several categories of applications of aerospace power, "counterland," involves the missions of air interdiction (AI) and CAS, both conducted to attain and maintain a desired degree of superiority over surface operations by the destruction or neutralization of enemy surface forces. Counterland may be conducted with or without Army forces, but when friendly ground forces are present, counterland tends to be more effective at greater distances from the ground battle, where fratricide is not an issue and the enemy may be more vulnerable.

CAS, the use of aerospace assets to directly support the ground force, is flown against targets that are in proximity to friendly forces. "Proximity" means within range of BLOS and NLOS weapons organic to the surface force and therefore requires detailed integration between CAS missions and its fire and movement. "While CAS is not considered the most efficient mission for aerospace power, in critical ground combat situations it may be the most effective. Control of close air support is performed by Air Force personnel attached to the ground units being supported, working closely with their Army counterparts. *Tactical control of CAS always remains with the air component commander, not the ground commander."*

CAS is viewed as a surge capacity for servicing surface targets, and it seems to be particularly relevant to FCS-equipped units with fighting vehicles having relatively light armor: "In general terms, CAS should only be used when the surface force cannot handle the enemy with organic firepower. This makes the requirement for CAS greater with light forces, such as airborne or amphibious units, and less for heavy units such as armored divisions...*CAS produces the most focused but briefest effects of any counterland mission; by itself, it rarely achieves campaign-level objectives. However, at times it may be the more critical mission by ensuring the success or survival of surface forces...* Although there is no single category of targets most suitable for CAS application, mobile targets and their supporting firepower (in general) present the most immediate threat to friendly surface forces and thus are prime candidates for consideration. This is especially true when supporting light forces...since they are not able to bring as much organic heavy firepower into battle as heavier mechanized or armored units.

CAS is particularly important to offset shortages of surface firepower during the critical landing stages of airborne, air-mobile, and amphibious operations by friendly forces. But again, CAS should complement, not be a substitute for, fires from the force on the surface. *"The ground commander should use his organic firepower whenever possible before calling in requests for CAS."*

But what comes through from USAF doctrine, loud and clear, is that:

> The task of CAS is to provide selective and discriminating firepower, when and where needed, in support of surface forces. It provides the surface commander with highly mobile responsive, and concentrated firepower, enhances the element of surprise, is capable of employing munitions with great precision, and is able to attack targets which are inaccessible or invulnerable to surface fire.

APPENDIX F, ANNEX 1

UNITED STATES ARMY DOCTRINE

Extract from HQ, Dept. of the Army, FM 3-0, Operations, June 2001

[text omitted]

CONDUCT OF UNIFIED ACTION

2-15. In unified action, Army forces synchronize their actions with those of other participants to achieve unity of effort and accomplish the combatant commander's objectives. The capabilities of joint, multinational, and interagency partners can expand strengths, compensate for limitations, and provide operational and tactical depth to Army forces.

JOINT OPERATIONS

2-16. Joint operations involve forces of two or more services under a single commander. Land operations and joint operations are mutually enabling—land operations are inherently joint operations. Joint integration allows JFCs to attack an opponent throughout the depth of their AO, seize the initiative, maintain momentum, and exploit success. Effective joint integration does not require joint commands at all echelons, but does require understanding joint synergy at all levels of command. Joint synergy extends the concept of combined arms synergy familiar to soldiers. The strengths of each service component combine to overcome the limitations or reinforce the effects of the other components. The combination of multiple and diverse joint force capabilities creates military power more potent than the sum of its parts.

> *Unless limited by the establishing directive, the commander of the supported force will have the authority to exercise general direction of the supporting effort. General direction includes the designation and prioritization of targets or objectives, timing and duration of the supporting action, and other instructions necessary for coordination and efficiency.*
>
> JP 0-2

2-17. JFCs often establish supported and supporting relationships among components. They may change these relationships between phases of the campaign or major operation or between tasks within phases. Each subordinate element of the joint force can support or be supported by other elements. For example, the Navy component commander or joint force maritime component commander (JFMCC) is normally the supported commander for sea control operations; the joint force air component commander (JFACC) is normally the supported commander for counterair operations. Army forces may be the supporting force during certain phases of the campaign and become the supported force in other phases. Inside JFC-assigned AOs, the land and naval force commanders are the supported commanders and synchronize maneuver, fires, and interdiction.

THE OTHER ARMED FORCES

2-18. Through Title 10, US Code (USC), and DODD 5100.1, Congress has organized the national defense and defined the function of each armed service. All US armed forces—Army, Air Force, Navy, Marine Corps, Coast Guard—and special operations forces (SOF) are required to provide globally responsive assets to support combatant commanders' theater strategies and the national security strategy. The capabilities of the other armed forces complement those of Army forces. During joint operations, they provide support consistent with JFC-directed missions.

Air Force

2-19. Air Force air platform support is invaluable in creating the conditions for success before and during land operations. Support of the land force commander's concept for ground operations is an essential and integral part of each phase of the operation. Air Force strategic and intratheater airlift, directed by US Transportation Command, supports the movement of Army forces, especially initial-entry forces, into an AO. Air assets move Army forces between and within theaters to support JFC objectives. Fires from Air Force systems create the conditions for decisive land operations. In addition, the Air Force provides a variety of information-related functions—to include intelligence, surveillance, and reconnaissance—that support land operations.

2-20. Support from Army forces made available to the JFACC for tasking—including Army aviation, air defense, military intelligence, and field artillery—is invaluable in accomplishing portions of the counterair, interdiction, theater reconnaissance, and surveillance missions. Such missions may support operations directed by the land component commander or JFC. The effectiveness of air interdiction and close air support depends, to a large degree, on integrating land maneuver with the joint force concept of operations. Land force commanders understand that defeating enemy air and space capabilities is necessary to ensure freedom of action on the ground.

Navy and Marine Corps

2-21. The Navy and Marine Corps conduct operations in oceans and littoral (coastal) regions. The Navy's two basic functions are sea control operations and maritime power projection. Sea control connotes uninhibited use of

designated sea areas and the associated airspace and underwater volume. It affords Army forces uninhibited transit to any trouble spot in the world.

2-22. Maritime power projection covers a broad spectrum of offensive naval operations. Those most important to Army force operations include employment of carrier-based aircraft, lodgment by amphibious assault or maritime pre-positioned deployment, and naval bombardment with guns and missiles. Naval forces establish and protect the sea routes that form strategic lines of communications for land forces. The Navy provides strategic sealift vital for deploying Army forces. Army forces cannot conduct sustained land operations unless the Navy controls the sea. Additionally, naval forces augment theater aerospace assets and provide complementary amphibious entry capabilities.

2-23. The Marine Corps, with its expeditionary character and potent forcible entry capabilities, complements the other services with its ability to react rapidly and seize bases suitable for force projection. The Marine Corps often provides powerful air and ground capabilities that complement or reinforce those of Army forces. When coordinated under a joint force land component commander (JFLCC), Army and Marine forces provide a highly flexible force capable of decisive land operations in any environment.

Coast Guard

2-24. The Coast Guard is an armed force under the Department of Transportation. It has a statutory civil law enforcement mission and authority. Army forces support Coast Guard forces, especially during counterdrug interdiction and seizure operations. When directed by the president or upon a formal declaration of war, the Coast Guard becomes a specialized service under the Navy. The Coast Guard and Navy cooperate in naval coastal warfare missions during peace, conflict, and war. During deployment and redeployment operations, the Coast Guard supports force projection. It protects military shipping at seaports of embarkation and debarkation in the US and overseas. The Coast Guard supports JFCs with port security units and patrol craft.

2-35. **Support.** Joint doctrine establishes support as a command *authority*. Commanders establish it between subordinate commanders when one organization must aid, protect, or sustain another (see JP 0-2; JP 3-0). Under joint doctrine, there are four categories of support (see Figure 2-4). General and direct support describe the supporting command's focus. Mutual and close support are forms of activity based on proximity and combat actions. Army doctrine establishes four support *relationships*: direct, reinforcing, general, and general support reinforcing (see Chapter 4).

CATEGORY	DEFINITION
General support	The action given to the supported force as a whole rather than to a particular subdivision thereof.
Mutual support	The action that units render each other against an enemy because of their assigned tasks, their position relative to each other and to the enemy, and their inherent capabilities.
Direct support	A mission requiring a force to support another specific force and authorizing it to answer directly the supported force's request for assistance.
Close support	The action of the supporting force against targets or objectives that are sufficiently near the supported force as to require detailed integration or coordination of the supporting action with fire, movement, or other actions of the supported force.

Figure 2-4. Joint Support Categories

[text omitted]

CONSIDERATIONS FOR UNIFIED ACTION

2-65. Joint doctrine addresses employment of Army forces in unified action. Each operation is different: factors vary with the situation and perspectives of the participants. Unified action has military, political, and cultural considerations (see Figure 2-5, page 2-20). These considerations are not all-inclusive

but highlight factors important to effectively employing Army forces in unified action.

MILITARY	POLITICAL	CULTURAL
• Targeting • Fire support coordination • Air and missile defense • Teamwork and trust • Doctrine, organization, and training • Equipment	• Goals and objectives • National control of forces • Consensus building	• Culture and language • Communication • Media relations • Law enforcement

Figure 2-5. Considerations for Unified Action

MILITARY CONSIDERATIONS

2-66. Unified action requires commanders to consider the same military factors they consider when conducting joint operations (see FM 3-16; FM 3-16). However, participation of multinational and interagency partners adds additional layers of complexity. The following areas require additional attention from commanders and staffs of units conducting unified action.

Targeting

2-67. The JFC defines how the land component participates in the joint targeting process. JFCs may delegate targeting oversight functions to a subordinate commander or may establish a joint or multinational targeting board. The targeting board may serve as either an integrating center or review mechanism. It prepares targeting guidance, refines joint target lists, and reviews target information from a campaign perspective. It is not normally involved in selecting specific targets and aim points or in developing attack packages (see JP 3-60; FM 3-60).

Fire Support Coordination

2-68. JFCs and multinational force commanders normally establish AOs for their subordinates. Within their AOs, land and naval force commanders are normally supported commanders and synchronize maneuver, fires, and interdiction. These commanders designate target priorities and the effects and timing of fires. However, all missions must contribute to accomplishing joint force objectives.

> ***Interdiction*** **is an action to divert, disrupt, delay, or destroy the enemy's surface military potential before it can be used effectively against friendly forces.**

2-69. Synchronizing operations in land or naval AOs with wider joint operations is particularly important. To facilitate synchronization, JFCs establish priorities for execution of operations throughout the theater or JOA, including within the land and naval force commanders' AOs. Commanders assigned theater-wide functions by the JFC coordinate with the land and naval force commanders when their operations, to include attacking targets, occur within a land or naval AO (see JP 3-09).

2-70. Army force commanders recognize the enormous potential of synchronizing maneuver with interdiction. They visualize the links between operations within the land AO and joint operations occurring outside it. They identify interdiction targets outside the land AO that can help create conditions for their decisive operations. They advocate combinations of maneuver and interdiction inside and outside the land AO that impose dilemmas on the enemy. Army commanders understand the theater-wide flexibility and reach of unified air operations. When required, they support joint interdiction outside land AOs with Army assets.

2-71. Integrating joint fires requires the development and full understanding of and strict adherence to common maneuver control measures and FSCMs. To ensure timely and effective fires, JFCs develop control measures and FSCMs early and emphasize them continuously. Land and amphibious force commanders may establish a fire support coordination line (FSCL) within their AO to facilitate current and future operations, and to protect the force (see JP 3-09). The FSCL is an FSCM that is established and adjusted by land and amphibious force commanders within their boundaries in consultation with superior, subordinate, supporting, and affected commanders. FSCLs facilitate the expeditious attack of surface targets of opportunity beyond the coordinating measure. An FSCL applies to all fires of air-, land-, and sea-based weapons systems using any type of ammunition. Coordination of attacks beyond the FSCL is especially important to commanders of air, land, and special operations forces.

2-72. Forces attacking targets beyond an FSCL must inform all affected commanders in enough time to allow necessary action to avoid fratricide, both in the air and on the ground. In exceptional circumstances, the inability to conduct this coordination does not preclude attacking targets beyond the FSCL. However, failure to coordinate increases the risk of fratricide and may waste limited resources. Short of an FSCL, the appropriate land or amphibious force commander controls all air-to-ground and surface-to-surface attack operations. For example, air strikes short of the FSCL—both close air support and air interdiction—must be under positive or procedural control (for example, by forward air controllers or tactical air control parties) to ensure proper clearance of fires. This control is exercised through the operations staff or with designated procedures.

2-73. The FSCL is not a boundary. The establishing commander synchronizes operations on either side of the FSCL out to the limits of the land AO. The establishment of an FSCL does not create a "free-fire area" beyond the FSCL. When targets are attacked beyond an FSCL, the attacks must not produce adverse effects forward, on, or to the rear of the line. Attacks beyond the FSCL must be consistent with the establishing commander's priorities, timing, and desired effects. They are deconflicted with the supported headquarters whenever possible.

Air and Missile Defense

2-74. The area air defense commander (AADC) establishes rules of engagement and assigns air defense missions for operational-level air and missile defense assets. Army force commanders communicate their requirements through the JFC to the JFACC and AADC when developing air and missile

defense plans. When the JFC apportions ARFOR assets, including operational-level assets, to the air component for counterair missions, they are generally placed in direct support to the air component. Normally, Army corps retain control of organic air defense units. The JFC may designate the joint or multinational air component commander as the AADC.

Teamwork and Trust

2-75. In unified action, commanders rely upon rapport, respect, knowledge of partners, team building, and patience. Commanders build teamwork and trust in a joint or multinational force in many ways. They and their staffs should establish a direct, personal relationship with their counterparts. Commanders must establish and maintain a climate of mutual respect. They should know their partners as well as they know their adversary. Team building is essential. It can be accomplished through training, exercises, and assigning missions that fit organizational capabilities. Building teamwork and trust takes time and requires the patience all participants. The result is enhanced mutual confidence and unity of effort.

Doctrine, Organization, and Training

2-76. National and service military doctrines vary. Some doctrines emphasize the offense, others the defense. US Army doctrine stresses rapid, agile operations based on exercising disciplined initiative within the commander's intent. When determining the units best suited for particular missions, commanders must be sensitive to doctrinal differences and their consequences. In dealing with joint and multinational forces, commanders must remember that doctrine and organization are closely linked. Removing part of a service's or nation's force structure may make it unbalanced and make it fight in a way not supported by its doctrine and training. Adjusting a component's force structure, if authorized, must be done with extreme caution. Commanders also need to understand the training level of participating forces. All armies do not have the same training resources. A battalion-sized unit from one country may have different capabilities than one from a different country. Commanders must understand that not all organizations are the same.

Equipment

2-77. Different equipment and technologies may result in a mixture of systems in a joint or multinational force. The modernization levels, maintenance standards, mobility, and degree of interoperability of different partners will probably vary. Commanders of a joint or multinational force may have to compensate for significant technological differences among its components. Incompatible communications, unfamiliar CSS needs, and differences in vehicle cross-country mobility can pose difficulties. Some multinational partners may use systems similar to enemy systems, making measures to preclude fratricide vital. However, one nation's capabilities may reduce another's vulnerabilities. Commanders position units and assign command and support relationships to exploit interoperability and complementary capabilities.

COMPLEMENTARY AND REINFORCING EFFECTS

4-104. The services and the various arms within Army forces complement each other by posing a dilemma for the enemy. As the enemy evades the effects of one type of action, he exposes himself to destruction by another. This leads to enemy paralysis, destruction, or surrender. A tactical example of complementary effects is suppressing a defender with indirect fires while maneuvering to envelop and destroy him. If the enemy attempts to move to meet the threat, he risks destruction from the fires. If he remains in place to survive the fires, he risks being encircled and trapped.

4-105. *Complementary* capabilities protect the weaknesses of one system or organization with the capabilities of another (see Figure 4-8). For example, tanks combine protection, firepower, and mobility. However, they are vulnerable to mines, antiarmor missiles, concealed infantry, and restricted avenues of approach. They are particularly vulnerable in urban areas and dense vegetation. Therefore, commanders combine tanks, infantry, and engineers into combined arms teams and task forces. The infantry maneuvers on terrain where armor cannot and eliminates concealed threats to the tanks. The engineers clear obstacles, restoring the mobility of the armor. Unhindered by small arms fire, the armor maneuvers to deliver devastating firepower to

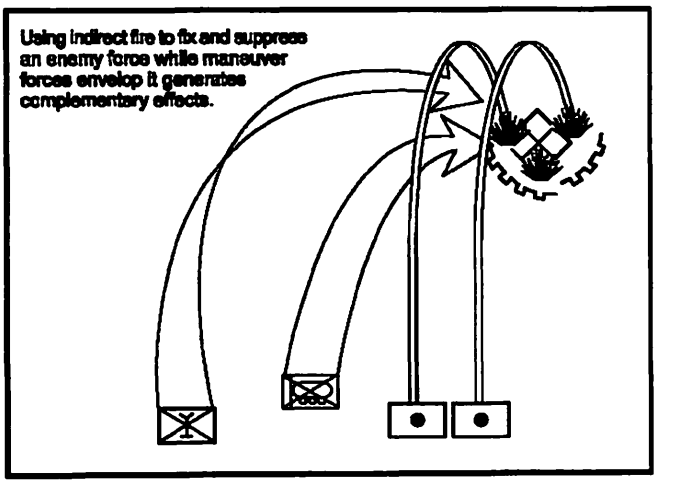
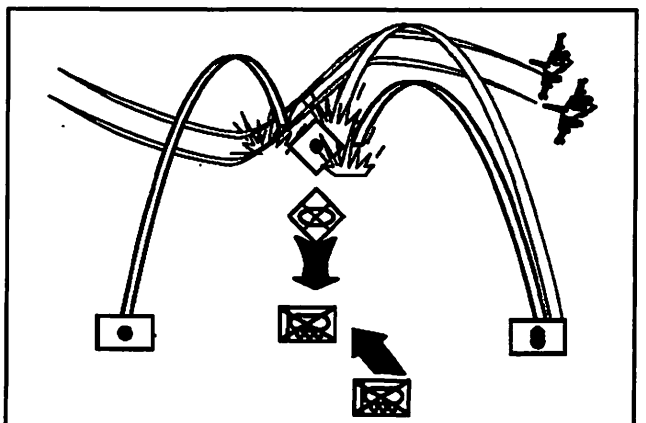


Figure 4-8. Complementary Effects

support the infantry and engineers. CSS units support, providing the capabilities that the mix of systems requires.

4-106. At the operational level, the capabilities of the services complement each other. This situation provides JFCs with a wide range of options and confronts enemies with difficult dilemmas. Army, Navy, Marine, and Air Force aircraft engage targets that degrade enemy capabilities. Space, airborne, and land-based sensors monitor enemy reactions. Pilots and aviators use this information to refine and sharpen strikes. Ground forces maneuver, seize terrain, and destroy enemy forces. If the enemy attempts to meet the ground maneuver, he leaves his protected areas and exposes himself to the full weight of air power and long-range missiles. He is then even more vulnerable to the effects of maneuver. If the enemy attempts missile strikes on US air bases and lodgments, theater missile defenses, supported by space systems, intercept the weapons. As US ground forces maneuver, they overrun enemy air defenses, air bases, launch areas, command posts, and CSS units, eliminating both tactical and operational threats and rendering the enemy's situation hopeless.

4-107. Army forces and those of the other services *reinforce* each other when they combine the effects of similar capabilities (see Figure 4-9). Commanders reinforce to achieve focused, overwhelming effects at a single point. When massed, different types of field artillery systems, such as howitzers and missiles, reinforce each other. Aerial fires have similar effects and can reinforce indirect fires. In a similar manner, commanders reinforce maneuver elements to guarantee superiority at the decisive time and place.



Combining the firepower of similar systems produces reinforcing effects. In this case, friendly counterfire, reinforced by air strikes, overwhelms enemy field artillery while maneuver units reinforce the defender.

Figure 4-9. Reinforcing Effects

4-108. Achieving complementary and reinforcing effects requires synchronization, initiative, and versatility. Synchronized action is the basis for complementary and reinforcing effects. Commanders focus systems in space and time to generate synergy that increases effects. The initiative of leaders combines units and systems in the fluid circumstances of action, often in the absence of orders. Confronted with a constantly changing situation, leaders develop new combinations of systems and pose new dilemmas for the adversary. Properly combined, these effects produce asymmetries that the joint force uses to achieve theater objectives.

APPENDIX F, ANNEX 2

UNITED STATES AIR FORCE DOCTRINE

Extract from *Air Warfare*, Air Force Doctrine Document 2-1, 22 January 2000, pp. 10–12

[text omitted]

Counterland

Counterland involves those operations conducted to attain and maintain a desired degree of superiority over surface operations by the destruction or neutralization of enemy surface forces. The main objectives of counterland are to dominate the surface environment and prevent the opponent from doing the same. Counterland can either be accomplished in direct or indirect support of large-scale ground operations, or can be carried out with minimal or no friendly ground forces in the area. When friendly ground forces are present, counterland tends to be more effective at greater distances from the ground battle where fratricide is not an issue and the enemy may be more vulnerable. In the latter case, counterland operations may represent the bulk of overall theater strategy. *The ultimate expression of this doctrine is the "decisive halt" in which the enemy is both stopped short of reaching their objective, which may be to*

engage friendly ground forces and/or take territory, and destroyed or disrupted to such a degree that continued fighting is no longer possible. Missions that are used to perform counterland are air interdiction (AI) and close air support (CAS).

- **Air interdiction** is a form of aerial maneuver that destroys, disrupts, diverts, or delays the enemy's surface military potential before it can be used effectively against friendly forces, or otherwise achieve its objectives. Typical targets for AI are lines of communication, supply centers, command and control nodes, or fielded forces. *Air interdiction planners typically look for targets that leverage the available air assets by creating significant disruptions of the enemy through attacks on relatively few targets.* Direct attack of fielded forces, one vehicle or artillery battery at a time, is possible but tends to be a less efficient use of aerospace power. Air interdiction is either performed as part of an overall theater-wide interdiction effort, which typically aims to isolate all or part of the battlefield from its source of support and reinforcement, or as a more local effort in response to the needs of ground combat. Whenever AI is flown in the vicinity of ground operations, the two achieve the greatest results when the efforts are integrated.

- **Close air support** is the use of aerospace assets to directly support the ground force. CAS is flown against targets that are in close proximity to friendly forces; that proximity requires detailed integration between CAS missions and the fire and movement of surface forces. In this context, forces in "close proximity" are close enough to engage one another with organic weapons such as artillery. Enemy forces that are not within this range are more properly the targets of AI rather than CAS. *Long range weapons that do not bring a pre-*

The A-10 Thunderbolt II, commonly known as the "Warthog." A-10 pilots earned a deadly reputation with Iraqi ground units during Operation DESERT STORM. Iraqi prisoner of war (POW) debriefs revealed that they feared only the B-52 strikes more than the ubiquitous A-10.

ponderance of fire to the battlefield, such as tactical ballistic missiles, are not used to set the maximum distance of "close proximity." While CAS is not considered the most efficient mission for aerospace power, in critical ground combat situations it may be the most effective. Control of close air support is performed by Air Force personnel attached to the ground units being supported, working closely with their Army counterparts. *Tactical control of CAS always remains with the air component commander, not the ground commander.*

In general terms, CAS should only be used when the surface force cannot handle the enemy with organic firepower. This makes the requirement for CAS greater with light forces, such as airborne or amphibious units, and less for heavy units such as armored divisions.

Extract from *Counterland*, Air Force Doctrine Document 2-1.3, 27 August 1999, pp. 35–46

CHAPTER THREE

CLOSE AIR SUPPORT

CAS produces the most focused but briefest effects of any counterland mission; by itself, it rarely achieves campaign-level objectives. However, at times it may be the more critical mission by ensuring the success or survival of surface forces.

AFDD 1

CLOSE AIR SUPPORT OBJECTIVES

CAS provides firepower in offensive and defensive operations, day or night, to destroy, suppress, neutralize, disrupt, fix, or delay enemy forces in close proximity to friendly ground forces. For CAS to be employed effectively, it should be applied against targets that present the greatest threat to the supported friendly surface force. Almost any enemy threat in close proximity to friendly forces on the modern battlefield is suitable for CAS targeting. However, indiscriminate CAS application against inappropriate targets decreases mission effectiveness, increases the risk of fratricide, and may increase the attrition of attack aircraft to an unacceptable level. Although there is no single category of targets most suitable for CAS application, mobile targets and their supporting firepower (in general) present the most immediate threat to friendly surface forces and thus are prime candidates for consideration. This is especially true when supporting light forces, such as airborne or amphibious units, since they are not able to bring as much organic heavy firepower into battle as heavier mechanized or armored units. *CAS provides the surface commander with highly mobile, responsive, and concentrated firepower. It enhances the element of surprise, is capable of employing munitions with great precision, and is able to attack targets that are inaccessible or invulnerable to surface fire.*

The success of both offensive and defensive operations depends on massing effects at decisive points, and not diluting them across the entire battlefield. Normally there are many more targets for CAS than can be attacked by the available air assets. As a result, CAS should be focused in those critical areas where friendly surface forces lack the organic firepower to handle the situation themselves. The centralized command and control of CAS employment are essential to allow the mass-

ing of its effects where needed most. This may often be beyond the troops-in-contact range, as CAS missions operating there will have reduced risk of fratricide and enemy forces destroyed or delayed there are often kept from engaging friendly surface forces. Surface commanders should properly prioritize and focus the firepower of apportioned and allocated CAS at decisive places and times to achieve their objectives. *Distributing CAS among many competing requesters dilutes the capability of those assets and will result in less rather than more air support to ground forces.*

Effective actions to gain air superiority and to interdict an enemy can limit the flexibility of those forces, deny their reinforcement, and enhance opportunities for friendly commanders to seize the initiative through offensive action. Close air support can enhance the offensive by providing the capability to deliver a wide range of weapons, massed or distributed as necessary, and by creating opportunities to break through enemy lines, protecting the flanks of a penetration, or preventing the counter-maneuver of enemy surface forces. Defensive requirements to blunt an enemy offensive may also dictate the need for close support. CAS can protect the maneuver and withdrawal of surface forces, protect rear area movements, or create avenues of escape. CAS aircraft may also be used to provide escort and suppressive supporting firepower for air mobile and airborne forces, and to conduct surveillance and security for landing forces, patrol, and probing operations. *All of these benefits of CAS must be weighed against the other, potentially more effective, uses for CAS-capable assets such as AI or even strategic attack. The ground commander should use his organic firepower whenever possible before calling in requests for CAS.*

CHARACTERISTICS OF CAS OPERATIONS

Close air support is "air action by fixed- and rotary-wing aircraft against hostile targets which are in close proximity to friendly forces and which require detailed integration of each air mission with the fire and movement of those forces." (JP 1-02) Since close proximity is defined as that distance within which terminal control is required for fratricide avoidance and targeting guidance, *CAS is not defined by a specific region of the theater/JOA*; rather it can be conducted at any place and time friendly surface forces are in close proximity to enemy forces. For example, CAS can be employed in support of special operations forces operating anywhere in the JOA, as long as there are friendly troops within close proximity of the enemy forces being attacked.

CAS is not the only form of aerospace power that can support ground operations, since much of air interdiction also accomplishes that function, as can other aerospace functions. CAS is simply the name applied to air attack of enemy forces that are currently within close proximity and detailed integration distance of friendly ground forces. The distinguishing factor for CAS is the detailed C2 required to integrate air support into the ground close battle area; this also makes CAS effects much more rapid than deeper attacks which may have more overall impact on the enemy. Air operations against enemy surface forces that will engage, or be engaged by, friendly ground units in the near or distant future normally fall under air interdiction rather than close air support. *Whereas AI may provide indirect or general support through integrated planning, CAS provides direct support through integrated planning and integrated execution.*

Successful close air support requires precise teamwork between the air and ground elements.

Since close air support operates in close proximity to friendly surface units, reliable air-ground communications are mandatory. Ground terminal attack controllers normally provide targeting instructions, final attack clearance, and fratricide avoidance instructions to CAS aircraft. Airborne forward air controllers, or FAC(A)s, may also provide this capability and will normally be in contact with ground-based terminal attack controllers to determine targeting and friendly location details. *Since close air support requires the highest level of integration between air and ground maneuver, specific procedures and training are required for air and ground terminal attack controllers and CAS aircrew.*

Air operations in close proximity to friendly forces require particular emphasis on the avoidance of fratricide. CAS requires detailed planning, coordination, and training for effective and safe execution. Though occasionally the result of malfunctioning weapons, fratricide has often been the result of confusion on and over the battlefield.

Causes include misidentification of targets, target location errors, target or friendly locations incorrectly transmitted or received, and loss of situational awareness by terminal controllers, CAS aircrews, or air support request agencies. It is critical for all involved in the CAS process to realize that they can contribute to unintentional or inadvertent friendly fire incidents. *Each participant must make every effort possible to ensure friendly units and enemy forces are correctly identified prior to engagement.*

CAS should be massed to apply concentrated firepower where it is most needed by the ground commander. When applied en masse, CAS has immediate physical and psychological effects on enemy capabilities. Since available assets are usually limited, CAS is applied against targets of immediate concern to surface forces when those forces cannot produce the desired effect with organic weapons alone, when surface forces are committed without heavy organic weapons support, or when the disposition of targets prevents successful attack by surface firepower. CAS often provides more effective support to the ground force when used against enemy targets that are beyond troops-in-contact range, due to the decreased risk of fratricide and the reduced interference of CAS with organic surface fires. The task of CAS is to provide selective and discriminating firepower, when and where needed, in support of surface forces. *It provides the surface commander with highly mobile, responsive, and concentrated firepower, enhances the element of surprise, is capable of employing munitions with great precision, and is able to attack targets which are inaccessible or invulnerable to surface fire.*

CAS missions are integrated with the organic fire of surface units to achieve mutual support, increase the overall destruction of enemy forces, suppress enemy air defenses (SEAD), and to ensure air support is delivered when and where required. This detailed integration is accomplished by parallel air and surface force control systems which extend through all levels of command. These systems integrate air maneuver with surface firepower to fulfill fire support requirements as they occur and deconflict air maneuver units from surface fires. Augmentation of surface firepower by CAS can decisively contribute to surface combat success with air attacks during breakthroughs, counterattacks, defense against enemy assaults, and surprise attacks. SOF teams operating beyond the range of organic surface fires may require emergency CAS if compromised, and many combat search and rescue (CSAR) situations also require CAS. *CAS is particularly important to offset shortages of surface firepower during the critical landing stages of airborne, airmobile, and amphibious operations by friendly forces.*

Thus, close air support should be available, responsive, utilized to mass its effects, and closely integrated with the surface component commander's scheme of maneuver. The mobility and firepower of CAS can make an immediate and direct contribution to the surface battle, *but only when all players adhere to a complicated orchestration process.*

US airpower doctrine matured in North Africa, the first major test of Army Air Force doctrine in joint operations with a major ground offensive.

When the Allies invaded North Africa in 1942, US Army Air Force air support doctrine was not yet mature, and the correct USAAF doctrine that did exist was often improperly employed. The air support system as practiced called for dividing air support assets among the various ground units being supported, resulting in "penny packeting" of airpower into small, uncoordinated, and ineffective formations. The drawbacks of this system were highlighted by the poor performance of air support in the early days of the Tunisian campaign.

Building on ideas that had existed in US airpower thought since World War One and had been proven by the Royal Air Force against the Afrika Korps, the USAAF developed a system for air support that provided centralized control of supporting airpower, commanded by an airman, and decentralized execution through a system of air liaison officers who lived and fought with the US Army units they supported. This air support control system matured through the Allied advance across North Africa and into Italy, and was used to great effect in France following the Normandy landings.

The Allied airmen who perfected this system did so in the heat of battle, where lessons learned were often costly. Their developed concepts, along with other improving circumstances, had dramatic effects in North Africa. They correctly identified the key requirements of successful command and control of air support that survive to this day, which if forgotten will lead to relearning the same costly lessons all over again.

North Africa: Lessons Learned and Relearned

TYPES OF CAS REQUESTS

There are various methods of requesting close air support, depending on how fluid the situation is and how much premission intelligence on the target is available. Unlike other forms of air attack, with CAS it is very rare to know the precise target prior to takeoff. It is important to note the difference between CAS *missions* and CAS *requests*. CAS requests may change right up to the time the CAS flight lead checks in with the terminal controller, due to the changing battlefield situation, while such changes may or may not affect the actual execution timing of CAS missions. *The ground component may have a pre-identified list of CAS targets, but the fluid battlefield situation often delays to the last minute the decision as to which target's destruction or disruption is the highest priority.*

Preplanned CAS means that the aircraft flying the missions are scheduled for a particular time or time period, which normally coincides with the anticipated time when CAS will be needed most by the ground component. Preplanned CAS requests come in two categories: *scheduled* and *on call*.

- **Scheduled CAS** is the preferred method of employment because it puts the CAS assets over the area of the battlefield where they are needed most, at a preplanned time-on-target (TOT), and where a need for CAS had been established in advance. Scheduled missions will normally have a specific contact point, at a specific time, to expect handoff to a ground- or air-based forward air controller. Scheduled CAS missions are the most likely to have good intelligence on the expected type of target, resulting in a better munitions-target match. Although joint doctrine states that a specific target must be identified when requesting scheduled CAS, the reality of fluid battlefield environments makes identifying a CAS target days in advance very difficult.

- **On-call CAS** involves putting the aircraft on ground-based or airborne alert (often listed as GCAS or XCAS in the air tasking order) during a preplanned time period when the need for CAS is likely, but not guaranteed. *This is a less efficient use of CAS resources, as the assets involved may or may not actually employ against the enemy unless a backup target is provided.*

Immediate CAS requests usually result from unanticipated needs on the battlefield, often of an emergency nature, that require diverting or rescheduling aircraft from other missions. Immediate requests will re-

sult in missions that are likely to be less well planned or executed due to their hasty nature. The best way to fill immediate requests is by diverting aircraft from preplanned CAS missions that are of lower priority. The need for immediate CAS can be reduced by apportioning the proper amount of aerospace power to support the ground scheme of maneuver, based on the overall theater priorities. When immediate requests result in CAS requirements that exceed the CAS apportionment, the JFACC will either deny the lower priority requests or request additional CAS apportionment from the JFC. The decision on whether or not to increase CAS apportionment will be based primarily on the gravity of the ground situation and the contribution to theater strategy being made by the available CAS-capable assets.

Push CAS represents a proactive method of distributing close air support that differs from the standard request-driven or "pull" method. While similar in concept to other preplanned CAS missions, push CAS differs in that it is planned and often flown before the actual request for CAS is made by the supported ground component. *Push CAS missions are scheduled to arrive at a specified contact point at a specified time, normally in a continuous flow, to provide constant CAS assets available to support the ground*

P-47 Thunderbolts en route to a counterland target.

The successful DESERT STORM tactic of "push CAS" can trace its origins at least back to World War II. By 1944, the USAAF and RAF in Italy had perfected a method of flowing fighters into the CAS area on a regular, prescheduled basis. This system, known as "Cabrank" for its similarity to a line of taxicabs waiting for passengers, provided a constant flow of fighters overhead the ground controllers, then known as "Rovers." If not needed for close air support, these missions pressed on to a preplanned backup target, typically a bridge or other interdiction target of known value to the enemy. The Cabrank system was possible because of Allied air superiority and large numbers of counterland assets, and provided the ground force with very responsive air support. Cabrank response time was as little as a few minutes, while traditional CAS missions that were only scheduled in response to specific requests by the ground force might not arrive for several hours.

The Origins of "Push CAS"

unit(s) identified as the main weight-of-effort. The term push refers to the fact that CAS missions are "pushed" forward to the terminal attack controller (TAC) before the formal CAS request is made; those assets not needed for CAS will often be pushed to preplanned backup targets so the sorties are not wasted. Although not required, push CAS works best in an environment where many CAS targets are available, so the assets involved will likely have a lucrative target to employ against.

When a significant number of CAS assets is available, and the tactical situation dictates, a *continuous flow* system providing a constant stream of CAS missions to the contact points may be employed. This method puts CAS flights overhead at regularly scheduled intervals, keeping some flights constantly on station and ready for immediate tasking. Response times are thus reduced, but the number of sorties required is often high and the advantages gained must be weighed against the other potential uses for these assets.

CONDITIONS FOR EFFECTIVE CAS

Close air support is one of the most complex missions performed by the Air Force. The very complexity can limit the overall efficiency of CAS, but it is the only way to get air support on enemy targets in close proximity to friendly positions. Effective CAS requires proper training, equipment, and an understanding of the strengths and limitations of aerospace power. *This is why the tactical air control system (TACS) has been organized so that only airmen directly control aerospace power, even when that power is acting in support of ground combat.*

Air superiority is required for CAS missions to concentrate on the task at hand. CAS is highly demanding of aircrew situational awareness, and proper execution of the CAS mission is not normally possible while searching for, or reacting to, enemy air threats. A strong counterair plan early in the campaign will therefore enable more effective close air support. **Suppression of enemy air defenses** is part of the counterair function and is perhaps the most important aspect of air superiority to the CAS pilot. Most enemy ground forces bring some level of tactical air defense into battle; such defenses consist of antiaircraft artillery (AAA), man-portable or vehicle mounted infrared surface-to-air missiles (IR SAMs), or short-range radar guided SAMs. Depending on the enemy's integrated air defense system (IADS) and the location of the ground battle, their longer range strategic SAMs might also be a factor. This is why

indiscriminately pushing CAS missions beyond the range of organic firepower can be very dangerous; such missions will outrange ground-based suppressing fire and may fly into a much higher threat arena. Air interdiction missions are normally packaged with appropriate support assets to handle a greater SAM threat, while close air support missions typically operate in flights of two aircraft with no dedicated support. *The use of organic surface fire support such as artillery to suppress enemy air defenses for CAS aircraft represents a positive integration of air and ground component forces.*

Target marking can be accomplished through various means, including smoke rockets or rounds, laser designation, and flares. Timely and accurate marking can greatly increase the accuracy of CAS attacks and will also reduce the chances of fratricide through target misidentification. With the use of low light and infrared systems becoming more widespread, the use of marking devices in those spectra can be more effective than visible target marking, depending on how the aircrew actually acquires the target and employs ordnance on it.

Favorable weather is important to effective CAS, perhaps more so than other forms of air attack. Since identification of the target through visual or electro-optical means is usually required for target confirmation and fratricide avoidance, an undercast can often prevent CAS missions from hitting their targets. Radar-cued aiming or global positioning system and inertial navigation system (GPS/INS) tactics may allow CAS aircraft to hit stationary targets through the weather, *but questions of target coordinate accuracy and guidance reliability will have to be answered to both the air and ground component's satisfaction before this option is used.* In any case, it is the JFACC who determines what the minimum acceptable weather for CAS will be, and the air liaison officer (ALO) should advise the ground commander on what impact poor weather will have on his expected close air support. Individual controllers and aircrew must make the final call during mission execution if existing weather is above or below their mission minimums. Emerging technologies are being developed to assist in adverse-weather employment, and the partial sanctuary of poor weather may disappear, as has the sanctuary of night. Modern air-to-ground infrared (IR) systems often see better at night than during the day, and night operations can make many tactical air defense systems less effective against CAS aircraft (especially attack helicopters which are typically limited to low altitude operations).

Flexible and responsive command and control permits requests for CAS, coordinated with the appropriate agencies, to be originated at any level of command within the supported surface force or by elements of the Theater Air Control System (TACS), such as ALOs and terminal attack controllers. In MOOTW, additional restrictions may be imposed (such as a requirement to gain approval for CAS operations from foreign/civilian agencies), however, flexibility will be diminished. The interval of time between a unit's request for air support and the delivery of the supporting attack is a critical factor in CAS effectiveness. Prompt response allows a commander to exploit fleeting battlefield opportunities and to survive in a defensive situation. Launch and divert authority of scheduled CAS assets at the air support operations center (ASOC) or ABCCC level provides reduced response time. Diverted airborne aircraft from lower priority missions may also be used, however, a balance is required between the most effective use of resources and their response times. Effective command and control also enhances the ability to integrate CAS with surface operations, coordinate support, and update or warn of threats to CAS assets. The depth at which the ASOC will control operations depends a great deal on the ability to both communicate with forces and maintain situation awareness on targets, threats, and other factors. *The authority to redirect aircraft to or from missions beyond the FSCL should remain centralized at the AOC, while the authority to flow CAS assets to and from shallow AI targets short of the FSCL is often delegated to the ASOC or TACP.*

Aircrew and terminal controller skill is vital to the success of close air support. Commanders should emphasize joint training that routinely exercises CAS tactics, techniques, and procedures to maintain aircrew and controller proficiency. *Combat experience has shown that when CAS is not practiced and proficiency is not maintained a long time is spent at the opening of the next conflict relearning CAS procedures—to the detriment of friendly forces.*

CAS requires **interoperable and dependable communications** between air and surface forces. Mismatched equipment slows coordination of fire support, and lack of secure or frequency-agile radios may lead to compromised, garbled, or noncommunicated mission data. Such simple errors as having the air and ground components deploy with different codes for their communications equipment can delay the proper execution of close air support. *As with the other aspects of CAS, the only way to ensure interoperable communications in war is to conduct fully integrated exercises during peacetime.*

Flexible and responsive command and control are critical for effective employment of close air support. *The tactical employment of CAS is centrally controlled by the Air Support Operations Center (ASOC) and decentrally executed at the tactical level.* Launch and divert authority of scheduled CAS assets at the ASOC or Airborne Battlefield Command and Control Center (ABCCC) level provides reduced response time. Aircraft diverted from lower priority missions may also be used—however, a balance is required between rapid response and efficient use of limited assets. Effective command and control also enhances the ability to integrate CAS with surface operations, coordinate support, and update or warn of threats to CAS assets. The authority to re-role aircraft between mission types should remain centralized at the AOC, whereas the authority to retarget CAS and AI missions short of the FSCL normally rests with the ASOC.

Requests for CAS, coordinated with the appropriate agencies, may be originated at any level of command within the supported surface force. The procedures for CAS requests may take two forms. During low to medium intensity conflicts with a limited requirement for CAS, the ASOC may operate the traditional Air Force Air Request Net (AFARN). TACPs at any level of command may request CAS directly from the ASOC. However, during a high-intensity conflict when there are more requests than available CAS missions, the ASOC may require CAS requests to flow through the TACP at each level of command. This allows intermediate commanders to filter low priority requests (or requesting units), ensuring that only the highest priority CAS requirements are provided to the ASOC. Ground commanders at each level may thus prioritize where they have the greatest need for CAS, and employ their limited resources at the most decisive points in the battlespace. The ASOC may develop abbreviated message/request formats to speed the flow of information between C2 nodes. This also prevents the ASOC from being overwhelmed with unnecessary or low priority information.

Familiarity with the local battlefield situation is also critical to the success of CAS. When extended periods of close air support are expected, typically due to prolonged heavy ground fighting, combat effectiveness is increased when the same squadrons remain tasked to provide CAS over the same portions of the battlefield. This allows the pilots and intelligence personnel to become very familiar with the local terrain and enemy operations, as well as develop closer ties with the friendly ground units being supported. *This liaison should be strengthened through*

close contact between air and surface units whenever possible, a job that can be accomplished by the ground liaison officers (GLOs) attached to the flying units as well as the ALOs operating with the surface forces.

Extract from *Counterland*, Air Force Doctrine Document 2-1.3, 27 August 1999, pp. 47–65

CHAPTER FOUR

COMMAND AND CONTROL OF COUNTERLAND OPERATIONS

> ***Direct support of ground troops is naturally the method preferred by the immediate commander concerned, but his vision did not extend beyond the local battle. It did not consider the competing demands of individual commanders on a far flung battlefront, each of whom would naturally like to have at his disposal some segment of the Air Force for his own exclusive use.***
>
> **General Dwight D. Eisenhower**

COMMAND RELATIONSHIPS

American military power is normally employed under joint or multinational force commanders. In joint operations, the JFC normally designates a JFACC to ensure the proper application of the joint air effort within the theater of operations. The flexibility and versatility of aerospace power allows it to be employed in multiple roles against varied targets. *Since there will rarely be enough counterland-capable assets to meet all demands, a single air commander can best ensure the unity of effort required for optimum use of those assets; designating a JFACC adheres to the principle of unity of command.* The JFACC should be the Service component commander with the preponderance of air assets and the C2 infrastructure necessary to plan and conduct theater air operations. This is normally the COMAFFOR for any large-scale joint operation; however, there will be some circumstances in which the JFACC should be designated from another Service, or even an allied nation during combined (multinational) force operations. The air component commander for a *combined force* is designated the *CFACC*. The JFACC's authority, guidance, and responsibilities are assigned by the JFC and include, but are not limited to, recommending apportionment to the JFC and planning, coordinating, allocating, and tasking aerospace power based on the JFC's apportionment guidance.

The JFC establishes the specific command authority for the JFACC to fulfill assigned responsibilities. JFACCs typically exercise operational con-

trol (OPCON) over assigned and attached forces and tactical control (TACON) over (or establish a support relationship with) other forces made available for air component tasking.

The JFACC is the *supported commander* for the JFC's overall air interdiction effort and will use JFC priorities to plan and execute theater-wide interdiction operations. The JFC sets overall theater priorities, which guide air component objectives and determine the level of support that air and ground maneuver will provide each other. Based on the JFC's guidance, the JFACC will normally establish the specific priorities for theater-wide AI and will apply these priorities to air interdiction targets located both outside of and inside any surface AOs. The surface commander can determine specific targets for air interdiction or, more preferably, provide the air component mission-type instructions that allow more leeway in tactical mission planning. This way the JFACC can best determine how to support the ground commander, without knowing in advance the exact location or timing of the priority targets. *Ultimately, interdiction priorities within the surface AO are considered along with the theater-wide interdiction priorities, that are established by the JFC and guide the overall targeting process.*

The intent of centrally prioritizing aerospace power is to provide the effectiveness against all relevant targets, consistent with the theater commander's strategy. When the number of productive targets exceeds aerospace power's ability to attack them, centralized prioritization ensures that lower-priority targets are not hit first, regardless of whether they were nominated by an air or surface component. *It is important to remember that all components support the JFC's overall strategy, so there should not be great disparities between the various components' priorities for aerospace power as long as the overall task remains in view.*

Nomination of AI targets does not end when the planning cycle begins; rather, the process is flexible enough to allow for targeting inputs even beyond the ATO's execution time. Such inputs may come from any supported or supporting component and will be evaluated against theater counterland priorities and asset availability. Post-nomination target changes are normally possible but must be justified in terms of target priority. Once the ATO has entered final production, proposed changes are normally passed to the AOC's combat operations division for incorporation into tactical planning or mission execution. Further guidance on the relationship of air interdiction and surface maneuver may be found

in Joint Pub 3-0, *Doctrine for Joint Operations*, and Joint Pub 3-03, *Doctrine for Joint Interdiction Operations*.

The JFACC is normally a *supporting commander* for CAS. Priorities and intentions for both CAS and surface maneuver operations come from the JFC. The JFC apportions CAS and AI based on his overall strategy and JFACC recommendation. The JFACC then allocates sorties to the various functions, areas, and missions to support that apportionment decision and assigns CAS missions to units via the air tasking order (ATO). Surface commanders request preplanned CAS in advance of operations as part of their overall concept of operations and distribute the CAS apportionment to fill requests from those ground forces who most require air support. This distribution process is best accomplished by the air component's liaison function that accompanies ground units onto the battlefield. While the ground component commander is normally the supported commander for CAS, *direct control of CAS missions rests with the Air Force's Theater Air Control System (TACS)*.

The surface commander distributes sorties that have been allocated to CAS where his scheme of maneuver most requires them; this process is a distribution of *targets that can be attacked*, not a distribution of sorties "owned" by the ground commander (the JFACC retains tactical control over CAS through the TACS). The air-to-ground portion of the TACS is responsible for providing an air component liaison to the various echelons of ground command and terminal targeting and control that helps to ensure aerial maneuver is integrated with the ground scheme of maneuver. *The air liaison function should also guide the ground commander in the optimum distribution of CAS among his various units, keeping in mind that aerospace power is most effective when concentrated at the decisive points.*

THEATER AIR CONTROL SYSTEM (TACS)

The TACS performs centralized planning and control, facilitates decentralized execution of all air component operations, and consists of the combined AOC (CAOC) or joint AOC (JAOC) and subordinate control elements. The air-to-ground portion of the TACS, along with the air-ground control mechanisms of the various ground Services, are collectively known as the theater air-ground system (TAGS). A key function of the TAGS is to ensure aerospace maneuver is properly integrated with the ground scheme of maneuver. Figure 4.1 shows the key Air Force and Army components of the TAGS.

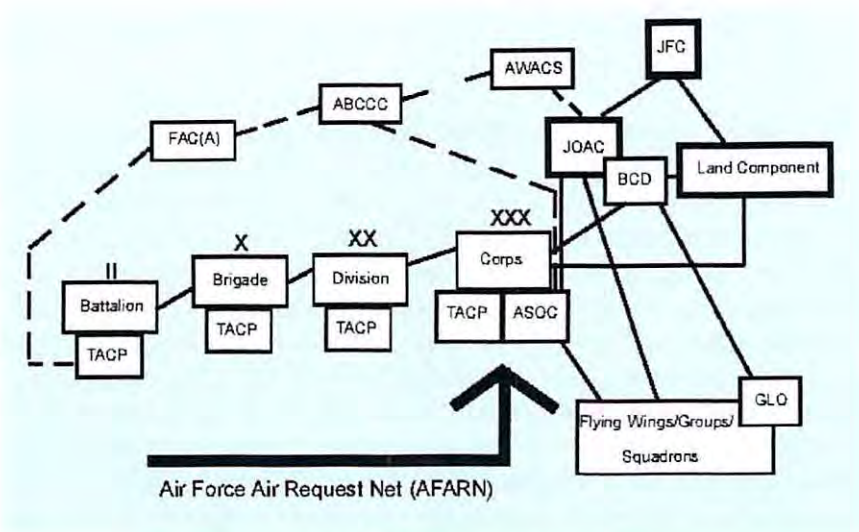


Figure 4.1. Air Force – Army TACS Connectivity

Connectivity for maritime or amphibious air support is similar, but several of the key components use different labels. The senior element in the Marine air command and control system (MACCS) is the tactical air command center (TACC), which performs similar duties at the tactical level for organic Marine aviation that the JAOC performs for the air component at the operational level. The direct air support center (DASC) is roughly equivalent to the US Air Force's ASOC that coordinates and directs aerospace support for land forces at the corps level and below, while at lower echelons of command the Marine system uses the same TACP label for air support liaisons as the TACS.

The Aerospace Operations Center (AOC)

The AOC will normally be designated the joint air operations center (JAOC) during joint operations and will be the operational command center for the JFACC. It is the means by which the JFACC exercises centralized command and control of theater air assets and turns the JFC's guidance into an air operations plan, allocating resources, and tasking forces through ATOs. Although actual theater AOC organizational structures may vary, the four basic functions performed by all large AOC's include strategy development, combat planning, combat operations, and air mobility. The JFACC employs the contingency theater automated planning system (CTAPS), being replaced by the Theater Battle Management Core System (TBMCS), to generate and disseminate the ATO, to

pass and display air target information, and to speed the flow and dissemination of other information to users in all components.

The *battlefield coordination detachment (BCD)* is the senior Army liaison element to the TACS and is located in the AOC. The BCD processes the land component's air support requests, to include air interdiction target nominations and requests for preplanned close air support. The BCD processes the ground component's target nominations and acts throughout planning and execution to ensure proper representation of ground component priorities in the overall process. The BCD acts as the primary conduit for real-time and near real-time requests for AI targeting from the ground component. Such requests flow up the Army chain of command to the highest echelon, then flow to the AOC via the BCD. It is also the BCD's responsibility to inform the various ground commanders of which nominated targets were or were not included on the target list for incorporation into the ATO and the approval status of preplanned CAS requests. This feedback loop is critical, as ground commanders must know which requested targets did or did not meet the JFC's priority requirements for air attack. During the execution process, the BCD provides current ground picture information to the AOC on both friendly and enemy ground forces.

The Air Support Operations Center (ASOC)

The ASOC is the primary control agency of the TACS for the execution of aerospace power in direct support of ground operations. *Normally aligned with the senior Army tactical level of command, the ASOC coordinates and directs aerospace support for land forces at corps level and below.* It is directly subordinate to the JAOC, and is responsible for the coordination and control of air component missions within its associated ground component's area of operation (AO). This AO typically extends to the fire support coordination line (FSCL) for actual control of mission execution, and may extend to the corps' forward boundary for planning and advisory purposes. In the latter capacity, the ASOC commander and staff advise the corps commander on CAS employment and target nominations for those AI and SEAD missions that support the ground force and that part of tactical air reconnaissance and airlift that directly supports the Army. If missions are flown beyond the range of ground-based SEAD but still in the ASOC's assigned area, the ASOC will need to coordinate for airborne SEAD from fixed- or rotary-wing assets when a threat exists. Such SEAD will almost always need to be preplanned and must include deconfliction with any friendly ground emitters in the area. As the primary coordinator for SEAD, the ASOC must have visibility of

surface-to-air threats that effect its associated component's AO to perform its mission. Air missions that do not directly support the ground component but are flown inside the ASOC's control area will normally be coordinated through the ASOC to deconflict with ground force maneuver and fires and to receive target and threat updates. The ASOC also provides fast reaction to requests for air support and is capable of assisting time-critical targeting and friendly force location information to CAS, AI, SEAD, air mobility, surveillance, and reconnaissance missions. The AOC will normally delegate launch or commit authority for alert CAS missions to the ASOC, providing a faster response time when air support is needed. The decision to delegate re-targeting authority for specific short-of-the-FSCL AI missions to the ASOC will depend on actual circumstances, including the timeliness required for getting desired effects on target. *Unless specifically delegated, however, targeting authority for all AI missions remains with the AOC.*

The ASOC director, normally the corps ALO, exercises operational control of all subordinate TACPs. The ALO is the JFACC's primary representative to the senior tactical ground commanders. Air Force ASOCs do not deploy independently, and rely on their associated ground forces for much of their logistics support. They may be tailored in size depending on the task at hand. *ASOC members must be strongly versed in Air Force doctrine and capabilities across the spectrum to include counterland, counterair, ISR, IO, and CSAR.*

Other TACS Elements

Airborne Battlefield Command and Control Center (ABCCC). The ABCCC is a key link in the C2 network for counterland operations. It is equipped with communications and battle management displays, and can act either as a self-contained airborne command post or as a relay for ground command centers such as the ASOC. *Attack aircraft hitting CAS or shallow AI targets will often communicate with an ABCCC as opposed to talking directly with the ASOC, due to radio and line-of-sight limitations.*

The Tactical Air Control Party (TACP). The TACP is the principal Air Force liaison element aligned with Army maneuver units from battalion through corps. The primary mission of corps- through brigade-level TACPs is to advise their respective ground commanders on the capabilities and limitations of aerospace power; battalion TACPs have the additional task of providing terminal control to CAS missions. The TACP provides the primary terminal attack control of CAS in support of ground

forces. In the TACS chain of command, TACPs are directly subordinate to the ASOC.

Terminal Attack Controller (TAC). A TAC is an airman experienced in air-to-ground operations who, from a forward ground or airborne position, controls aircraft in close air support of ground forces. Terminal attack controllers have the authority to direct aircraft that are delivering ordnance to a specific target. Only specially trained and certified individuals are authorized to perform this duty. TAC, a generic term applying to both enlisted and officer controllers, can include ALOs, enlisted terminal attack controllers (ETACs), FAC(A)s, special operations terminal attack controllers (SOTACs), and other trained and certified attack controllers. *Ground commanders must understand that battalion-level ALOs and ETACs are not trained as combat observation and lasing team (COLT) members, and these key C2 personnel must be carefully employed on the battlefield. The decision to send them into high-risk situations must consider the potential loss of both personnel and the capability they represent.*

The terminal attack controller is a vital link in getting close air support where the ground commander needs it the most.

Air Liaison Officer. An ALO is an aeronautically rated officer, aligned with a ground maneuver unit, who functions as the primary advisor to the ground commander on the capabilities and limitations of aerospace power. As the ground commander's expert on aerospace operations, the ALO should be given broad, "commander's intent" type of guidance so he can do the detailed air support planning with his own staff.

Forward Air Controller (Airborne). Operating from a suitable aircraft, the FAC(A) coordinates airstrikes between the TACP and CAS aircraft. The FAC(A) provides terminal control, relays CAS briefings, provides immediate target and threat reconnaissance, and marks targets for the attacking aircraft. Threats and weather permitting, the FAC(A) can

see well beyond the normal visual range of ground-based terminal controllers. The FAC(A) can perform tactical battle management by cycling the CAS flights through the target area, while prioritizing the targets in coordination with the friendly ground force. The FAC(A) normally operates as an extension of the TACP.

Airborne forward air controllers have provided increased capability to control close air support in several conflicts, and continue to be a key asset today. The FAC(A) provides increased depth and visibility for controlling CAS, and enables terminal control where it might

Killer Scout. While not a formal part of the TACS, Killer Scouts perform a similar function for AI missions that FAC(A)s provide for CAS aircraft. Killer Scout is a mission performed by some multirole fighters, and involves scouting designated target areas to locate and verify targets for, and provide some control and sequencing for, follow-on air interdiction. Capable of passing very accurate target updates to AI assets, some Killer Scouts are also capable of actually marking targets if required. Killer Scouts are also trained in cycling multiple attacking flights through the target area, and providing prioritized targeting guidance to maximize the effect of each sortie. *Killer Scouts are not trained to provide CAS terminal control, and should never be used to control attacks inside close proximity to friendly ground forces.*

AIR-GROUND COMPONENT CONNECTIVITY

Due to the nature of counterland operations, interconnectivity between the TACS and the other Service C2 networks is critical, especially when providing close air support. While the TACS is an Air Force system, a US Air Force JFACC will normally exercise command and control of his joint air assets through it regardless of the Service that provides them. When supporting the Army, the TACS must interface with the Army air-ground system (AAGS). In those cases where JFACC

air supports the Marines, the amphibious tactical air control system (ATACS) provides control through either the Marine air command and control system (MACCS) or the Navy tactical air control system (NTACS). Special operations forces normally rely on organic air support, but they also have a system in place to request CAS if needed from non-SOF forces.

AI Connectivity

All supported surface components and Services have liaisons in the AOC to coordinate nominations for air interdiction and to provide expertise on their components to the AOC for planning and execution. As previously discussed, these teams provide coordination between the air plan and the various ground schemes of maneuver. The liaison elements are instrumental in providing a knowledgeable presentation of target priority from the ground perspective, current and projected ground force positions, desired effects to support ground maneuver, and other factors that govern the integration of air interdiction and ground maneuver. These liaisons are also responsible for keeping their respective ground components informed of the capabilities and limitations of available aerospace power.

Last-minute updates to AI target nominations are normally passed through the surface component's AOC liaison (such as the Army's BCD), unless circumstances dictate that passing the request through the TACP/ASOC channel is more expeditious. AI retargeting for missions short of the FSCL can often be handled directly by the ASOC when the update comes too late to replan the mission (such as target changes after takeoff). This is possible because all missions against targets short of the FSCL normally coordinate with the ASOC or ABCCC. Unless specifically delegated, however, the ASOC cannot make AI retargeting decisions without direction from the AOC. *Establishing cutoff times for when the requested target change will be passed through one channel or the other helps to avoid confusion and leads to increased combat effectiveness.*

An increasingly important part of AI connectivity is real-time **sensor-to-shooter (STS)** information flow. Whether the data comes via voice or data link, from an unmanned aerial vehicle (UAV), a recon team on the ground, or from the E-8 JSTARS, the ability to receive real-time targeting updates is a key element in effectively targeting mobile ground forces. Effective communications between sensors, shooters, and the battle managers are critical to the immediate targeting process. Decisions, such as how much battle management authority to delegate to JSTARS, must be a

balance between the commander's intent, communications connectivity, timeliness required to strike the target and achieve the desired effect, and access to the overall air and ground picture. As with all command and control, a clear line of which C2 elements have various levels of decision-making authority must be clearly stated by the commander to avoid confusion. Another key factor in proper STS execution is to provide the right kind of information to the shooter without overwhelming him with data or choking the data pipeline. Digitized radar and electro-optical (EO) images, while costly in terms of data volume, can be very helpful in some cases to assist the shooter in correctly identifying and attacking the target. In other circumstances, however, such as when attacking rapidly moving targets, a picture that is even a few minutes old may be of limited value and unnecessary.

CAS Connectivity

At the TACP level, CAS coordination occurs between the TACP and the Army's **fire support element (FSE), S/G-3 operations staff, and S/G-2 intelligence staff.** TACPs are aligned with the FSE to ensure the proper integration of air support into the ground scheme of maneuver and to work closely with them through the execution of the battle plan. This includes requesting artillery- delivered SEAD, airspace deconfliction, target marking, and other tasks. The actual execution of CAS depends greatly on the *proximity of the target* to the terminal controller, his ability to *observe the attacking aircraft*, and the use of *reliable communications links* between all players. CAS weapons release authority comes in two levels labeled *"positive control"* and *"reasonable assurance."*

Positive control is executed under two forms known as *direct control* and *indirect control*. Direct positive control provides a higher level of targeting guidance for the aircrew and provides the greatest level of fratricide protection. Thus, positive direct control is the only method appropriate for controlling CAS in most troops-in-contact situation. Indirect control provides greater flexibility to attack targets beyond troops-in-contact range, where fratricide avoidance is less of a factor and direct control techniques may not be possible for ground-based controllers. *Where the friendly ground situation is not confirmed, troops-in-contact should always be assumed to exist.*

- **Direct control** normally requires the terminal attack controller to observe the attacking aircraft, the desired target or targets, and ensure

the aircraft is attacking the correct target and is not a threat to friendly ground forces. There may be times when the controller cannot see the attacking aircraft (due to high altitude, standoff weapons, night, poor visibility, etc.) but is in position to observe the target. In these cases, clearance to drop will be given only if the terminal controller can use other means to confirm the aircraft is attacking the correct target and has friendly positions in sight. These include, but are not limited to, confirming with a verbal description that the aircraft has friendly positions and/or the target in sight, often confirmed by a target mark (as appropriate).

- **Indirect control** is used when the TAC cannot observe the attack but a trained observer is in position to observe it and has direct communications with the terminal controller. This method still requires positive clearance to attack from the terminal controller, who may allow the fighters to execute multiple attacks once he is assured the fighters are on the correct target, friendly positions are well clear, and the initial clearance to attack is given. Indirect control is less positive than direct control, but battlefield conditions often require its use due to distance between the TAC and the target. *It must be emphasized that indirect control is not normally appropriate with troops-in-contact, due to the risk of fratricide.*

There is a gap in current joint doctrine regarding the use of CAS in beyond-visual-range (BVR) situations. Both the published definitions of direct and indirect positive control require someone other than the attacking aircrew to physically see the target, while the "reasonable assurance" level of CAS control (described below) is specifically stated not to be used as a primary form of CAS control. This creates a doctrinal sanctuary for those enemy forces that fall within the close proximity/detailed integration distance that requires them to be attacked via CAS but are outside the range where an observer or controller can physically see them and no FAC(A) is available. One method currently being employed, and only with the approval of the ground force commander, is to include as indirect positive control a method where the TAC sends the fighters to an area where targets are known to exist, and relies on the target area description from the fighters as to key terrain features, target marks, etc., to build an awareness of what the fighters are observing. Once the TAC is confident of the fighters being in the correct location they may be cleared "hot" to attack. This method differs from AI in that the TAC retains positive control of the attack throughout, and the fighters are only

cleared to attack when proper situation awareness is established for the controller on the ground. *As with other forms of indirect control, this method is not appropriate in most troops-in-contact situations.*

Emerging capabilities such as UAV datalink may allow a variation of indirect control in which the TAC observes the target through the UAV's onboard sensors and gives targeting direction and corrections to attacking aircraft via radio or datalink. This form of control would not likely be appropriate in a troops-in-contact situation, as the risk of fratricide is higher than when the TAC has visual of both the CAS aircraft and the target. Airborne forward air controllers are also increasingly equipped with night-vision systems, GPS, and laser designating equipment for more precise control of CAS in more varied environments. Real-time datalinks may lead to a common operating picture among all airborne and surface CAS players, speeding the target designation process and improving identification of friendly forces. Methods such as these will make indirect control more effective in a wider range of circumstances and may, in fact, blur the line between "direct" and "indirect" control. As with all new systems, however, *reliability and compatibility must be proven* before new sensors or weapons are employed, especially in the CAS environment. Another complication associated with developing technology is the blurring of formerly clear distinctions; for example, the term "visual" must now be specified as to whether it includes various sensors or is restricted to the "mark I eyeball" only. *It now requires more specification than just "direct" or "indirect" when discussing control of CAS; commanders must be specific in their special instructions (SPINS) and rules of engagement (ROE) on exactly which systems, sensors, and forms of CAS control are allowed under which circumstances in their theater/JOA.*

Reasonable assurance is a level of release authority that is used when conditions prevent the use of positive control. It will be used only when circumstances defined by the JFC have been met, and the air and ground component commanders concur with its use after weighing the risks involved. "Reasonable assurance" provides a clear set of guidelines for special circumstances (such as communications jamming, equipment failure, etc.); it is not intended to be used as a primary method of CAS control. Under this level of release authority, the CAS aircrew may execute their attack without positive control after ensuring that clearly specified reasonable assurance criteria have been met. *These conditions should be addressed in ROE or SPINS and must be clear-cut for both CAS aircrew and CAS controllers as to when they apply, and must come from the JFC.*

FIRE SUPPORT COORDINATION MEASURES

Various measures are used for both airspace control and fire support coordination in both **planning and executing** counterland operations. The measures help to integrate air and ground maneuver, ensure deconfliction, and identify which parts of the battlefield require specialized control procedures.

Fire Support Coordination Line (FSCL)

The purpose of the FSCL, as stated in joint doctrine, is to ensure the coordination of fire not under the surface commander's control but which may affect his current tactical situation. The land component commander typically sets the FSCL after coordinating with all affected component commanders. All attacks short of the FSCL must be coordinated with the establishing component, primarily to ensure proper synchronization and prevent fratricide. Because of this, the FSCL is often used as the forward limit of the airspace controlled by the TAGS. This mandates the various ASOCs and other TAGS components have the required connectivity to monitor not only air activity out to the FSCL but also be able to monitor friendly and enemy ground positions, surface-to-air threats, and all other key aspects of situational awareness. Likewise, when the ground component attacks targets beyond the FSCL (such as long-range ATACMS shots against high-value targets) it is required to coordinate with the air component to ensure deconfliction and prevent multiple assets attacking the same target.

Forward Line of Own Troops (FLOT)

While not a true fire support coordination measure, the FLOT is a useful planning tool that delineates the known forward trace of friendly ground forces. Joint doctrine defines the FLOT as: "A line which indicates the most forward positions of friendly forces in any kind of military operation at a specific time. The forward line of own troops normally identifies the forward location of covering and screening forces." The zone between the FLOT and the FSCL is typically the area over which friendly ground forces intend to maneuver in the near future and may also be the area within which ground force organic fires are employed. This zone is typically, though not always, the area where air operations will be executed through the TAGS (see figure 4.2).

It must be emphasized that the FSCL is primarily used to establish command and control procedures for planning and execution

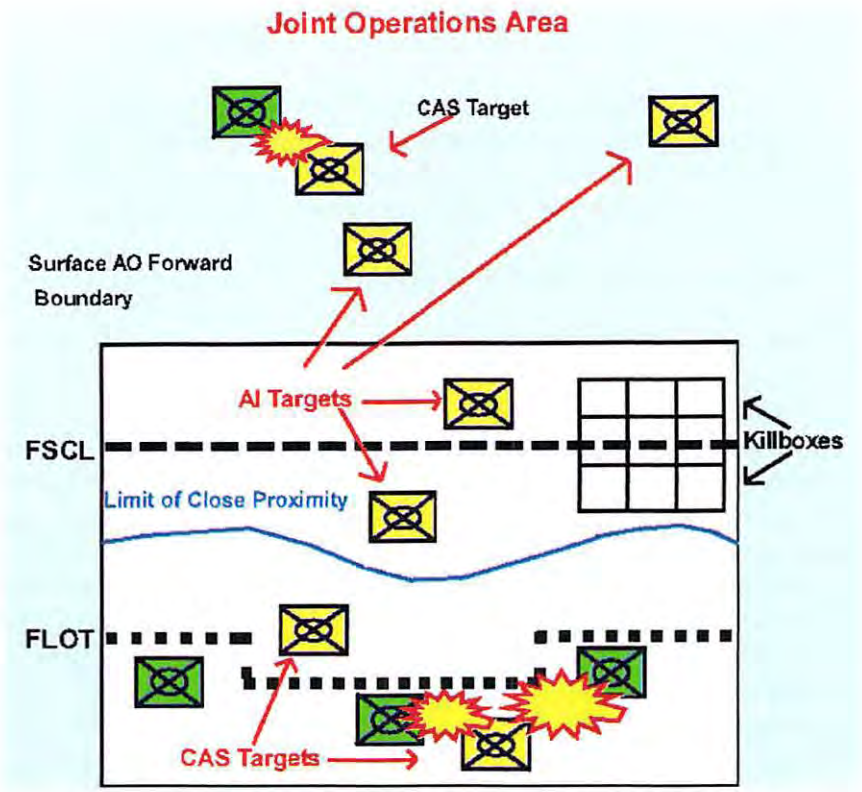


Figure 4.2. Standard FLOT/FSCL/Surface AO Relationship
(denotes troops-in-contact)

purposes; it does not define mission types. Missions flown beyond the FSCL will typically not use the TAGS, as they are beyond the distance where detailed integration is required. However, CAS missions can be flown in the portions of the battlefield beyond the FSCL when friendly troops are operating there and require support. Ground forces such as SOF teams that often operate deep should include the appropriate TAGS element for CAS control and have a liaison element at the JAOC. Short of the FSCL, all missions will typically require check in with the air-to-ground TACS while en route to the target for an update on potential targets, surface-to-air threats, and friendly troop locations. CAS missions will normally be handed off to a TAC or FAC(A) for terminal attack control. Even those short-of-the-FSCL missions that usually do not directly support the ground component, such as counterair or strategic attack, will normally contact the ASOC/ABCCC for situation updates and deconfliction while in the ASOC's airspace.

The optimum placement of the FSCL varies with specific battlefield circumstances, but typically it should be placed where the capability to produce the preponderance of effects on the battlefield shifts from the ground component to the air component. *In this way, the FSCL placement maximizes the overall effectiveness of the joint force, and each component will suffer the minimum reduction in efficiency.* To place the FSCL so deep or shallow that one component is given complete freedom to operate will usually result in the other components being so restricted that overall joint effectiveness suffers. The proper location for the FSCL may also shift from one phase of the war to the next, depending on the scale and scope of each component's contribution during that phase. FSCL placement must also take into account the ground scheme of maneuver and should be based on *anticipated,* not *current,* ground force positions at the time that the FSCL will be active. *History has shown that placing the FSCL too deep is detrimental to overall joint force effectiveness and may even provide the enemy a sanctuary from effective air attack.*

Under all but the most rapid ground maneuvers, the FSCL should normally be near the maximum operating range of organic artillery and rockets, since beyond that point most of the *"expeditious attack of surface targets of opportunity"* is accomplished by aerospace power. To facilitate a rapidly moving battlefield, a common practice is to establish *"on-call FSCLs"* in advance that can be activated as the ground force moves. In the past, establishing the FSCL along an easily identifiable terrain feature has been critical to success. Modern digitization, along with advanced navigation equipment such as GPS, has reduced the importance of this factor. When possible, however, using obvious terrain features for FSCLs can still prevent errors from happening in the heat and confusion of battle.

The FSCL is as important for planning as execution, particularly since the ATO planners must know where they will have to send their strike packages through TAGS control, where detailed integration is required, and where they will have more freedom to operate. Missions planned beyond the FSCL will normally be flown well beyond the furthest possible extent of friendly ground forces, therefore simply locating the target will be sufficient for attack. Missions attacking targets short of the FSCL will often be required to *positively identify* their targets to prevent fratricide, which can be much more difficult and time consuming. Even the use of procedural deconfliction measures short of the FSCL imparts operating restrictions not normally found beyond the FSCL. New technologies that allow for precision attack through adverse

weather, or from long standoff ranges will likewise be limited in their application when friendly ground troops are nearby. All of these factors highlight both the greater effectiveness of attacks beyond the FSCL and the need for some logical fire support coordination measures for the aerospace power planner. In those cases where the ground component commander might elect not to establish a FSCL, the air component will conceivably be able to employ "beyond FSCL" procedures right up to the FLOT. In this case, the zone where the TAGS control missions shrinks considerably. Under such conditions the JFACC would likely establish his own coordinating line at the limit of close proximity, which he would employ much like a FSCL for both planning and employment purposes. *The important point is that by not designating a FSCL the ground commander does not gain more control of counterland assets; instead it reduces the ground commander's ability to coordinate aerospace power not under his control.*

Coordination on the Nonlinear Battlefield

An emerging concept for ground warfare is the nonlinear battlefield, in which rapidly advancing ground forces occupy pockets that may have large distances of open terrain between them, occupied only by the enemy. When such advancing forces move in by air, there will likely be helicopter lines of resupply extending into the friendly rear area. Under such circumstances, the classic linear concepts such as the FSCL may need to be adjusted. *One option is to create a new fire support coordination measure, based on a standardized box, circle, or other easily employed shape, to accomplish the same task that the FSCL performs for the linear battlefield.* By drawing lines around the areas occupied by friendly troops, properly padded for both close proximity and intended scheme of maneuver, there would be large areas left available for more unrestricted "beyond the FSCL" type of air attack (see figure 4.3). This discussion presents the concept of nonlinear coordination in very simple terms, as any real example would be very complex and would require great flexibility.

This allows for more efficient air attack on nonengaged enemy ground forces, such as those at center.

A combination of the two concepts is also possible, such as when a single large advance is made from a classic linear battlefield (see figure 4.4). Here the "standard" FSCL could be used for the slower moving forces, and a localized fire support coordination measure would be created around the rapid advance.

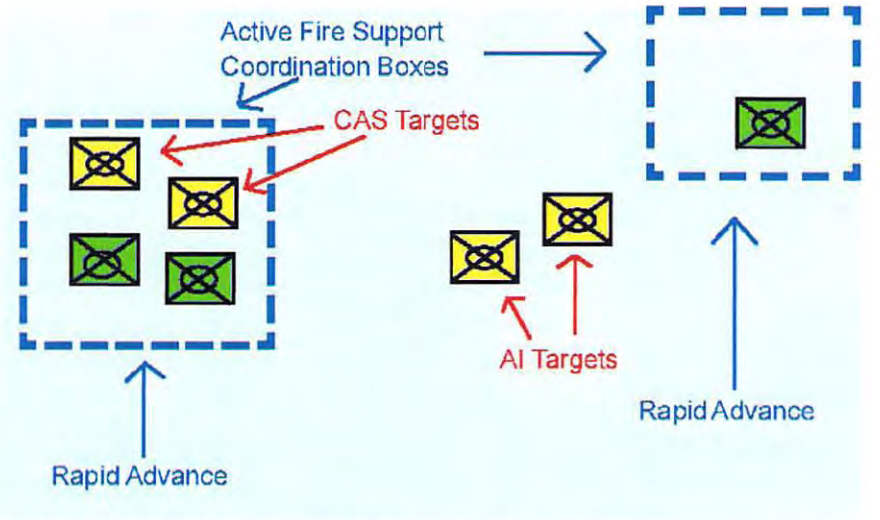


Figure 4.3. Nonlinear Fire Support Coordination Measure

This allows for the greatest freedom of ground and aerial maneuver and enhances combat effectiveness.

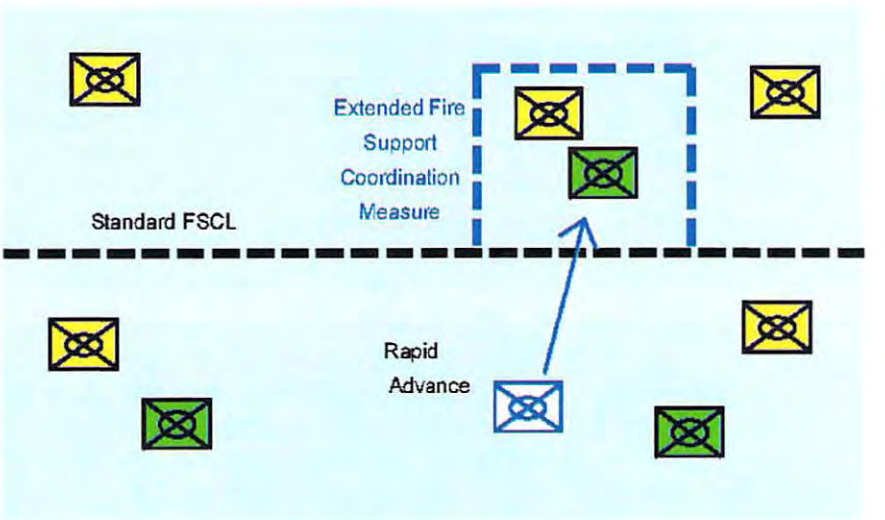


Figure 4.4 Combination of Linear and Nonlinear Fire Support Coordination Measures

AI CONTROL AND COORDINATION MEASURES

The control measures used for AI missions will vary greatly depending on the type of target attacked and whether the target sits beyond or short of the FSCL. For missions flown against preplanned targets beyond the FSCL, which normally comprises the bulk of AI, there are no special requirements for airspace control. Missions will normally check in with a command and control agency such as the airborne warning and control system (AWACS) and monitor a designated strike frequency to and from the target area for threat information and other updates. There may be other forms of AI control that apply under the following circumstances:

- **AI Short of the FSCL.** For missions against targets short of the FSCL, the theater airspace control plan (ACP), as implemented in the daily airspace control order (ACO), will normally require contact with the TAGS (typically the ASOC or an ABCCC) for ground situation updates. The plan may also require clearance into specified target areas using procedural control to deconflict with ground maneuver. The TAGS will also provide any available updates to targeting information, which provides flexibility against mobile targets right up to the actual TOT.

- **Killbox Operations.** One airspace control measure that has been used successfully in the execution of armed reconnaissance AI missions is the killbox. The killbox is defined as a generic term for airspace control measures used by the theater air control system for controlling air-to-ground operations. Killboxes are complementary to, and do not preclude or conflict with, other fire support control measures, and may be employed on either side of the FSCL. They are often employed through pre-identified map grids that are common to both air and ground components, and can be easily activated and deactivated without confusion. Killboxes provide one way to do counterland targeting in near-real-time against mobile ground forces that defy long range preplanning. The aircrew is normally given a prioritized list of target sets that reflects the desired effects of the mission and may also be provided more detailed target locations if they are available. Killboxes may be combined with sensor-to-shooter targeting data, if available. The authority to activate killboxes, whether inside or beyond the FSCL, rests with the airspace control authority (normally the JFACC); however, concurrence of the ground component is mandatory for activating any box inside the FSCL to ensure that all ground forces are clear of the designated area. Since the ASOC is deployed with the ground force

and is normally the TACS element responsible for airspace short of the FSCL, it will typically be the agency which opens and closes killboxes in that zone. An activated killbox is not usually required for missions flown beyond the FSCL, but it is simply one way of providing updated targeting information for those targets whose mobility precludes the normal planning process.

- **Airborne Alert AI.** For those circumstances in which a lucrative target has been identified and assets allocated against it, but no precise premission targeting data is available, airborne alert may be justified. This type of AI is flown much like on-call CAS and relies on some type of real- or near-real-time targeting guidance, such as the STS capability provided by JSTARS. Airborne alert can be an inefficient use of assets; if no backup target is provided then the entire mission can be wasted if the primary target fails to appear. Alert AI (often abbreviated XAI in the ATO) might be appropriate when a large enemy push is expected, but the route of advance is not clear ahead of time. It also tends to be used more when there is a lack of lucrative infrastructure targets and direct attack of enemy artillery, armored vehicles, or other ground combat forces is planned. *The use of interdiction assets to patrol for reactive attacks on enemy theater ballistic missiles has been cited as an example of airborne alert AI, although such "Scud CAPs" are correctly categorized as alert offensive counter air (XOCA) missions.*

The key to providing proper control for air interdiction lies in assessing how much flexibility will be required and which C2 assets will be in the best position to provide targeting updates in a timely fashion. For AI against nonmoving targets, very little retargeting will be done and the AOC should retain control of all missions to ensure execution remains focused on theater objectives (except where ASOC control is required for integration with ground maneuver). When the ground situation is fluid, assets such as ASOCs and Killer Scouts may need to be used more for final targeting updates. Furthermore, under such situations, flexible procedures such as armed reconnaissance and killboxes may become more useful. *There is no one best answer to command and control of air interdiction, but a flexible approach that keeps counterland operations focused where needed has proven the most effective approach.*

APPENDIX G

FCS INCREMENT I STRUCTURE

APPENDIX G
FCS INCREMENT I STRUCTURE

Future Combat System (FCS) is the centerpiece of the Army's Transformation effort, the several research and development initiatives that, taken together with the fielding of the Interim Brigade Combat Teams and Legacy Force sustainment and recapitalization, will culminate in the Objective Force (see Appendix A). The present plans for FCS are set forth in two principal sources: (1) *Operational and Organizational Plan for Maneuver Unit of Action*[1] and (2) the *Army Future Combat Systems Unit of Action Systems Book* published by the Army Materiel Systems Analysis Agency (AMSAA).[2] These documents describe the structure of FCS Unit of Action, a brigade in today's vernacular. The Army projects that the Objective Force of 2015 will have 15 of these Units of Action, within 5 organizations known as Units of Employment (UE), a higher level organization equivalent to today's division or corps.

To select technology for FCS units, the Army has used two criteria labeled "threshold" and "objective." Only *threshold* systems for FCS Increment I will be described herein; FCS *objective* equipment is that anticipated for Increments II and beyond. Timing of these Increments is tight. The AMSAA *Systems Book* reports a compressed schedule, termed the FCS "Incrementing Strategy," as follows:

> The FCS Increment 1 First Unit Equipped (FUE) date will be FY08; the Increment 1 Initial Operating Capability (IOC) will occur in FY10.
>
> The Increment 2 FUE date is FY12, Increment 2 IOC occurs in FY14. To meet these fielding dates, the Army has established specific criteria for technology selection:
>
> To support the FCS Increment 1 program, a technology must demonstrate Technology Readiness Level (TRL) 6 by FY03.

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1 TRADOC Pamphlet 525-3-90, dated 22 July 2002, and Change 1 to TRADOC Pamphlet 525-3-90, dated 25 November 2002.

2 Version 1 published in the spring of 2002; Version 1.5 published 20 December 2002. This book describes the FCS Systems and, being the document that is the foundation for the Analysis of Alternatives, a Milestone B requirement, it is generally consistent with the TRADOC operational and organizational plan.

To support FCS Increment 2, a technology must demonstrate TRL6 by FY06."[3]

Although the FCS Increment I equipment must demonstrate a Technology Readiness Level (TRL) 6 in fiscal 2003, it is the judgment of some experts that many of the technologies selected for Increment 1, particularly those in the trucks and armored fighting vehicles, will be hard pressed to demonstrate this level of readiness by the end of FY03.[4] The discussion below is based on the Army's plan.

In the current Unit of Action design, 2,499 personnel are allocated among a Headquarters and headquarters company (106), a brigade intelligence and communications company (91), three combined arms battalions (569 each), an aviation detachment (169), a non-line-of-sight (NLOS) battalion (162), and a forward support battalion (264).

Major equipment items within the organization are new types of manned and unmanned lightly armored vehicles, including

- 78 infantry combat vehicles;
- 79 command and control vehicles;
- 27 reconnaissance and surveillance vehicles;
- 54 mounted combat systems;
- 24 NLOS mortar carriers with 120 mm mortars;
- 18 NLOS cannon carriers with 155 mm cannons;
- 63 armed robotic vehicles;
- 12 RAH–66 Comanche helicopters;
- 29 FCS medical vehicles;
- 10 FCS recover and maintenance vehicles;
- 59 multifunction utility/logistics equipment (MULE) vehicles;
- 99 small unmanned ground vehicles.

There is also a new series truck named the Future Tactical Truck System (FTTS), which is to be configured in two basic versions—a 1-ton utility (FTTS–U) version and a 6-ton support version—with several variants of each. The new organization will have 64 FTTS–U command and control variants, 86 FTTS–U support variants, 204 6-ton FTTS-

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3 AMSAA, *Army Future Combat Systems Book for the Unit of Action,* Version 1.5, p. 1-4.

4 John C. Mankins, *Technology Readiness Levels—A White Paper,* 6 April 1995: TRL6 = "System/Subsystem model or prototype demonstration in a relevant environment."

Mission Support (FTTS–MS) vehicles, and 4 FTTS ambulance variants. There will be six Multimission Radars and four different classes of Unmanned Aerial Vehicles—54 Class I, 36 Class II, 12 Class III, and 2 Class IV.[5]

COMPARATIVE BRIGADE DESIGNS

A Legacy Force Armored Cavalry Regiment (ACR)[6] is an organization designed for independent missions comparable to those that will be assigned to a Unit of Action. A typical ACR has 4,193 personnel assigned as follows:

ACR (4,193)
- HQ and HQ Troop (163)
- Military Intelligence Company (167)
- 3 Armored Cavalry Squadrons (882 each)
- Aviation Squadron (586)
- Engineer Company (189)
- Air Defense Battery (199)
- Chemical Company (75)
- Aircraft Maintenance Troop (199)

The ACR fields the following:

Cavalry Squadron
- 123 M1A2 tanks
- 125 M3A2 Bradley Fighting Vehicles
- 67 M113A3 armored personnel carriers
- 27 tank retrievers (M88A1)
- 10 M2A2 Bradley Fighting Vehicles
- 6 M109A6 Howitzers

Aviation Squadron
- 16 Apache attack helicopters
- 24 aerial Scout helicopters
- 15 UH60L utility helicopters
- 3 EH60A electronic countermeasure helicopters

Other
- 39 Command Post vehicles (M577A3)
- 18 Howitzer ammunition carriers (M992A2)
- 18 Howitzer-related personnel carriers (M981A3)
- 120 mm mortar carriers (M106A2)

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5 Class I is small man-packable; Class II, employed at platoon and company level, is light enough to be carried by no more than two soldiers and is carried on infantry and mounted combat system platforms; Class III is a battalion-level unmanned aerial vehicle (UAV) found within the NLOS battalion and the reconnaissance detachments of the combined arms battalions; and Class IV is a brigade-level asset found within the aviation detachment.

6 SRC 17440L600—3d Armored Cavalry Regiment.

6 NBC Reconnaissance vehicles
6 M9 Engineer vehicles
15 armored-vehicle launched bridges (launched from M60 tank chassis)
677 trucks of various capacities

Such an organization might be capable of being airlifted inter-theater by C5 and C17 strategic airlift, but its equipment is too heavy to permit either "operational maneuver at strategic distances" as the Objective Force requires, or the tactical air mobility it anticipates. Also, it is doubtful that so heavy an organization could sustain itself without outside support for 3 days of intense combat.

The heavy brigade of the Armored Mechanized Infantry Divisions of the Legacy Force is built on the basis that all of the maneuver battalions, armor, or infantry are assigned to the division and are attached for training or operations to one of its three brigades. A brigade can command two to five maneuver battalions and typically comprises three maneuver battalions—two mechanized infantry and one tank battalion. Also in the brigade would be a slice of the divisional combat support and combat service support elements, either attached or placed in direct support. For comparison, a typical Force XXI mechanized brigade in the III Counterattack Corps might be organized for combat with 2,633 personnel:

- brigade headquarters and headquarters company (107)[7]
- brigade reconnaissance troop (49)[8]
- two mechanized infantry battalions (569 each)[9]
- tank battalion (343 each)[10]
- Paladin-equipped artillery battalion in direct support (526)[11]
- forward-support battalion (438)[12]
- an engineer company in direct support or attached (96)[13]
- a military intelligence company in direct support (36)[14]

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7 Table of Organization and Equipment (TO&E) 87042F200.

8 TO&E 17087F000.

9 TO&E 07245F200.

10 TO&E 17375F100.

11 TO&E 06365F000.

12 TO&E 63005L500.

13 TO&E 05337L000.

14 TO&E 34387F000.

So organized, the brigade has

- 45 M1A2 tanks
- 89 M2A3 Bradley Fighting Vehicles;
- 18 M109A6 Paladin Howitzer carriers;
- 18 M992A2 ammunition carriers;
- 131 assorted other tracked vehicles; and
- 422 assorted light, medium, and heavy trucks.

This organization, however, is not designed to deploy and fight as a separate brigade. It would be deployed as a part of a Force XXI division, and could expect to receive additional support from division and from corps (e.g., air-defense area coverage, artillery units in general support, and general support reinforcing, plus support from attack aviation, signal, CBR, and military police units).

A Stryker Brigade Combat Team (SBCT)[15] as it is currently designed is considerably smaller (3,079 personnel) and much lighter than an ACR. The first two IBCT formed at Fort Lewis have 798 wheeled vehicles, not only as the prime movers for the combat and combat support elements, but also to transport essential combat service support. "Stryker" is the name given by the Army to the new family of armored fighting vehicles in the IBCT. A Stryker-equipped brigade consists of the following:

- Headquarters and headquarters company (134);
- Military Intelligence Company (68);
- Two Infantry Battalions (730 Each);
- Reconnaissance, Surveillance, and Acquisition Squadron (463);
- Anti-Armor Company (53);
- Field Artillery Battalion (317), with M198 155 mm towed Howitzers;
- Engineer Company (127);
- Air Defense Battery (73); and
- Brigade Support Battalion (384).

A Stryker AFV weighs about 19 tons and has all-wheel, eight-wheel drive; top speeds in excess of 60 miles per hour; and an unrefueled range of 312 miles. There are 10 Stryker variants:

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15 SRC 47100F000—1st Brigade, 25th Infantry Division.

- Infantry Fighting Vehicle;
- Mobile Gun System with an M68A1 105 mm Cannon;
- Commander's Vehicle;
- Reconnaissance Vehicle;
- Fire Support Vehicle;
- Mortar Carrier for a 120 mm Mortar;
- Antitank Guided Missile Vehicle with an elevated TOW 2B system;
- Engineer Squad Vehicle;
- Medical Evacuation Vehicle; and
- Nuclear, Biological, and Chemical Reconnaissance Vehicle.

All are to be transportable by C5, C17, C141, or C130 aircraft.

ORGANIZATIONAL STRUCTURE OF THE FCS INCREMENT 1 UNIT OF ACTION[16]

The 106-person Headquarters and Headquarters Company is organized as follows:

Headquarters and Headquarters Company (106)
- 2 Mobile Command Group Detachments (14, 13)
- Tactical Command Post Detachment (67)
- Medical Support Section (6)
- Company Headquarters Section (6)
- 3 Infantry Carrier Vehicles (ICVs)
- 9 C2 Vehicles
- 5 FTTS–U (C2)
- 2 FTTS–U (Support)
- 2 FTTS–MS
- FCS Medical Vehicle

Brigade Intelligence and Communications Company (91)
- Headquarters detachment (6)
- Range Extension Section (22)
- Network Operations (NETOPS) Section (22)
- Analysis and Processing Section (24)
- Collection and Integration Section (17)
- 5 C2 vehicles

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16 Information in this section is extracted from Chapter 3 of Change 1 to TRADOC Pamphlet 523-3-90/O&O, *The United States Army Objective Force—Operational and Organizational Plan for Maneuver Unit of Action*, dated 25 November 2002.