STRATEGY RESEARCH PROJECT

FIRE SUPPORT IN THE ERA OF THE ARMY AFTER NEXT

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ABSTRACT

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The Chief of Staff of the Army has specified that the Army must begin planning now to remain a viable force in the year 2025. That Army force, the Army After Next, will need robust fire support to defeat the anticipated threats. This paper describes the Army After Next methodology and how that was derived from Joint Vision 2010 and Army XXI. The anticipated threat is outlined, as is how many visionaries see the structure of the Army After Next. The fire support requirements are detailed and compared with the current technologies available. Feasible fire support alternatives are described with emphasis on joint fire support capabilities. Recommendations are rendered on providing fire support to the early entry forces, the focus of the Army After Next.

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INTRODUCTION

What are the appropriate fire support systems for the Army After Next (AAN)? The Army must determine what systems are most useful and then sell those requirements to the force. More importantly, the Army must convince the Department of Defense and Congress to accept and fund the programs to make them a reality. Programs with new capabilities in supporting future scenarios are usually glamorous and more likely to be accepted than older existing programs. With the Army's lack of Congressional support and funding, the Army must be prepared to settle for something, although not optimal, rather than risk getting nothing at all. There is concern about the appropriate roles and missions of each of the services (and branches) and what types of fire support each service should provide. The type of platform and munitions should logically follow from the roles and missions. However, there are many factors to consider when selecting the best suite of fire support systems for the Army After Next.

The type of fire support is a major consideration. How much of the fire support should be non-lethal? What types of non-lethal fires should be resourced...smoke, illumination, stun, anti-radiation, etc. Should the majority of the munitions be anti-armor, anti-personnel, air defense, conventional high

explosive, or multi-functional? Is there still a need for high volumes of fire? Will the majority of the fire be in support of close combat, deep operations, counter-fire, or interdiction? Understanding the purpose of fires will assist our development since certain platforms are more conducive to a particular type of fire support than others.

Range, accuracy, and rate of fire have always been driving factors in the design of fire support systems. It has always been desired to defeat the enemy at the greatest possible range. In the past, accuracy was inversely proportional to range. The advent of precision guidance now provides us the ability to pin-point munitions at any range. Even precision guided munitions have several choices: guided munitions that are guided by a designator or inertial guidance; smart munitions that autonomously search, detect, and attack; and brilliant munitions which identify and engage specific targets. Most fire supporters believe that an area fire weapon is needed to provide a high volume of close continuous fires to the future force and that is normally provided by cannon artillery. Rockets have tremendous surge capability and superior range, so the rate of fire is not as critical. The key is that the force must have seamless

battlespace coverage, that is, continuous coverage from close combat to the maximum range.

The logistical and personnel requirements for each system are important. The planners are intent on not permitting the logistical tail to wag the dog. As we continue to lighten the early-entry forces, we cannot afford systems with large ammunition and fuel requirements. In addition to the raw tonnage of fuel and ammunition, there must be equipment to unload and transport these supplies. The next conflict may not occur in a country with an existing logistical infrastructure as during Operation Desert Shield. Most Army personnel requirements are described in terms of personnel "manning" the systems. Several fire support systems such as naval gunfire/rocket systems and fixed wing aircraft are difficult to determine. Most future fire support systems reduce or eliminate the required manpower to save force allocation and budget. Another consideration is the additional personnel required to accomplish sustained (24-hour) operations. Several unmanned systems are being examined for this reason.

Can the United States objectively select the best fire support systems to accomplish the AAN fire support requirements? Each service is tenaciously guarding its "share" of the defense

budget. All the services appear eager to expand their influence and increase their roles (and share of the budget). Budget and cost may be the bottom line in the final analysis. Most Congressmen know exactly what each new or existing fire support system means to their constituency in terms of jobs and economics. There will be much compromising and lobbying before reaching the final AAN fire support structure.

ARMY AFTER NEXT METHODOLOGY

The Chief of Staff of the Army (CSA) created the Army After Next program in February 1996 to establish a long-range view of the Army's future. The CSA tasked TRADOC to spearhead the effort and submit annual overviews of the AAN efforts. The CSA's tasking focused on two requirements: to connect Force XXI to the long-term vision of the Army and to ensure that the vision drives the research and development programs.[1]

The CSA also desires to strengthen Army support of the joint operational concepts espoused in Joint Vision 2010 and to achieve new levels of effectiveness as the land component member of the joint warfighting team.[2] With the world's emerging unpredictability, the Army must be prepared for a wider range of threats. The force must be able to employ combinations of technology in varying levels of intensity to address this wide

range of threats. The key force multipliers in the year 2025 will be information management and precision guided weapons. Some of the trends anticipated by the year 2025 include the use of space as an operational-level asset and more emphasis on urban warfare. Procurement cycles are expected to be reduced and information technology will be emphasized.

The vision of the Army After Next can be summed up as encouraging leaders to think outside the box. The three imperatives to be emphasized in the Army After Next are smaller, lighter forces with increased lethality; increased speed of deployment; and successful application of information technology. The Army of 2025 must be extraordinarily capable and adaptable for use at the lower end of the conflict spectrum. Operations will shift from linear sequential operations to simultaneous distributed operations.

The senior Army leadership is obligated to keep our programs closely linked with the future programs of the other armed services and to consider multinational operational requirements. We must maintain and expand the full spectrum capabilities and dominance required in Joint Vision 2010.

ANTICIPATED THREAT

It is difficult to predict who or what the threats will be by the year 2025. Clearly the anticipated threat spectrum must first be defined before we start designing a force to control and defeat it. Several senior military leaders have expressed concern that we have lost the art of threat analysis, that some of the difficulty in obtaining an accurate threat projection is that the experts are afraid to be wrong. Although most believe that there will not be a competitor equal to the United States (peer competitor), a major military competitor is a distinct probability.

Few individuals will make a firm prediction as to what the world will be like in 30 years, given what has happened in the past 30 years. The rate of political change is increasing in response to economic and demographic factors. The international arena will continue to be dominated by state-to-state relations. Non-national entities will exert more influence on the traditional states, but will not replace them. The political actions of states will adapt to accommodate less traditional factors. As they adapt to the new environment and conditions, several nations or unions will develop the industrial base and technologies nearly equal to those of the United States. These

and others will possess armies with modern warfighting equipment.[3]

STRUCTURE OF THE ARMY AFTER NEXT

The Army is now in a great process of change and is testing and experimenting with many new systems in a series of Army Warfighting Experiments (AWEs). It is expected that, by the year 2010 when Army XXI will be a reality, the Army will have achieved a cultural and technological metamorphosis. The Army of 2010 will be a knowledge-based force, balanced across the traditional imperatives and possessing a clarity of observation, degree of decentralization, and pace of decision unparalleled in the history of warfare.[4] It is expected that the Army After Next program will provide the future Army with the speed and physical agility to complement the mental agility of Army XXI.

A series of futuristic war games was conducted to attempt to frame the strategic and operational issues likely to influence conflict in 2025. All the games were free play exercises with an active and unfettered opposing (Red) force. The principal finding of the war games on the tactical and operational levels was that speed of maneuver proved to be the most important factor contributing to battlefield success.[5] Battlefield knowledge contributed to speed, although the exact relationship is yet to

be determined. Blue forces could engage more rapidly than the Red forces, achieve results quicker, and re-engage the enemy elsewhere. Speed was the dominant factor at the strategic level. This increased speed had a political impact by complicating the National Command Authority's ability to form coalitions and choose deterrence or other responses. Strategic speed introduced forces into the theater faster and often deterred the Red Force's planned aggression.

Emerging lessons of the war games indicate that success on the future 2025 battlefield will require forces with a robust surface-to-space continuum, interdependence, split-based operations, hybrid forces, and outstanding leaders. AAN forces must be able to utilize Unmanned Aerial Vehicles(UAVs) and space vehicles for intelligence, communications, and fire support. The robust use of the surface-to-space continuum, the high ground of the 21st century,[6] will permit a reduction in the size of the force close to the enemy. Reach-out communications, fire support, and intelligence, in addition to just-in-time and just-what's-needed logistics, will permit split-based operations with many support functions housed hundreds of kilometers from the enemy.

Near-simultaneous campaigns across the theater will be emphasized in 2025. These operations go beyond joint to the interdependent level. It is envisioned that the Army of 2025 will be a hybrid force; the war games examined an AAN early arriving force and an Army XXI strategic force. These forces complemented each other well in the war games. The challenge will be to meld these complementary forces to keep unrelentless pressure on the enemy.

The war games demonstrated an increased reliance on expeditionary forces. The diffusion of threats and the budgetary constraints will cause the United States to maintain fewer forces, but have them strategically mobile to counter threats in a wide variety of locales. Many experts expect AAN expeditionary forces to comprise about 30% of Army forces, much like our light forces (Airborne, Air-assault, Light, Mountain, and Ranger) today. The other 70% would be the heavier follow-on forces of the Army XXI variety. There are several terms used for the two types of forces. The term early entry forces will be used instead of the Army After Next, light, Global Scouts, expeditionary, preemptive or battle ready forces; and the term follow-on forces will be used for the Army XXI, heavy, or campaign forces.

The Army's target acquisition capabilities will increase to fulfill the need for increased knowledge. Although ground sensors will improve, the greatest source of targeting information will come from overhead systems. The command and control of this force will be a challenge. The Army will cultivate mature, highly experienced, technically and tactically proficient leaders, capable of withstanding higher levels of stress. Technology will force a re-evaluation of the way the Army commands and controls its forces.

ARMY AFTER NEXT FIRE SUPPORT REQUIREMENTS

Every senior military leader who has seen combat emphasizes the use of fires. Fires should always be used to soften up or defeat the enemy before any maneuver forces are put at risk. These fires used to equate to Field Artillery fires and the Field Artillery was indeed the greatest killer on the battlefield. A revealing quote by General William E. DePuy is, "I honestly concluded at the end of World War II, when I soberly considered what I had accomplished, that I had moved the forward observers of the artillery across France and Germany."[7] Most leaders realize that fires today are more than Field Artillery. A successful leader will use all available fire support to accomplish the mission, minimizing friendly casualties.

Many experts advocate taking a systems approach to fire support. The fire supporter should focus on effects. He must ensure that he understands the joint task force or maneuver commander's fire support guidance and then provides the desired effects. It should make little difference which fire support platform delivers the effects, as long as the end-state is achieved.

It is necessary for the fire supporters of all services to achieve the next level of jointness, which some are calling interdependence. All fire supporters and fire support systems must be able to communicate with all systems in common language. The current definition of joint Fire Support out of Joint Pub 3-0 is "Joint fire support include those fires that assist land and amphibious forces to maneuver and control territory, populations, and key waters. Joint fire support can include the lethal or destructive operations of close air support (by both fixed- and rotary-wing aircraft), naval gunfire, artillery, mortars, rockets, and missiles, as well as nonlethal or disruptive operations such as EW (Electronic Warfare)."[8]

Non-lethal fires will play a bigger role in the Army After Next as the need to neutralize enemy sensors, optics, and communications becomes increasingly important. The ability to

deliver incapacitating mechanisms will increase in importance. One of the great concerns in the year 2025 will be urbanization because of the difficulty engaging targets in an urban environment. Advances in precision fire will enhance the military's ability to engage specific targets and limit collateral damage. The AAN fire supporter must master all available fires to meet the maneuver commander's fire support guidance. The future fire supporter will become an effects manager.

The Army After Next forces will have many versatile means to attain the desired effects on target. Many, to include the Field Artillery Center, advocate the use of an Effects Control Center (ECC) to quickly analyze the target acquisition information and the available firing units to determine the best means to achieve the desired effects. This Center would most likely be located with the maneuver command and control cell. The ECC would, with the help of computer technology, prioritize the targets according to the maneuvers commander's fire support guidance. The ECC would allocate the most efficient fire support asset to engage each target, while preventing unnecessary multiple engagements of the same target. The Advanced Field Artillery Tactical Data System (AFATDS) is perhaps the fore-runner of the future ECC.

There is concern among the different services about what fire support resources are available below the CINC or Joint Task Force Commander level. The other services will not voluntarily offer up any resources to the Land Component Commander, although they are supporting Joint Staff demonstrations on a concept similar to the ECC. The Joint Continuous Strike Environment (JCSE) Advanced Concept Technology Demonstration (ACTD) runs from FY97 to FY01. The goal could succinctly be summed up: right weapons, right time, right targets. The demonstration included automated target prioritization, continuous weapon availability monitoring, optimized target pairing, and near real time airspace deconfliction. The demonstration has been a huge success so far with all services participating, which bode well for the future capabilities of ECCs.[9]

The focus of AAN fire support will be on precision rather than mass. The proliferation of cheap precision guidance systems in warheads will ensure that fire support assets hit where they are aimed. The guidance systems may be Global Positioning System (GPS) based to ensure the round lands at an exact location or sensor based so that a round hits an identified target. All the services are making huge strides in this area today and it is

expected that by the year 2025, one round equals one kill will definitely be a reality.

The improvements in ammunition precision, lethality, and range should reduce the need for huge amounts of rounds to be used in preparations and counterfire. There will still be targets of opportunity and large volumes of fire may be needed in demonstrations or shows of force. However, most of the shock action and devastation of the ground shaking with large amounts of smoke and dust will be replaced with large numbers of individual vehicles being destroyed simultaneously at long ranges. The fire supporter must be cognizant of new and different factors such as longer times of flight, air space considerations, and the location of loitering overhead systems.

THE IMPACT OF TECHNOLOGY ON FIRE SUPPORT

The Army and the Field Artillery Center have commendably improved old and fielded new systems over the past 30 years. The Multiple Launch Rocket System (MLRS), the upgraded M109 Self-Propelled Howitzer (Paladin), the Army Tactical Missile System (ATACMS), and the work on the Crusader are a few of the success stories. The Field Artillery has a modernization plan to keep these legacy systems viable through the extended planning period. The big question is whether these legacy systems are adequate for

the AAN timeframe. It is extremely difficult to bring a new concept or technological change out of the laboratory and field the system. Once the concept is identified and approved, the biggest issue is the affordability of the system.

CANNON TECHNOLOGY

Currently the active Army employs two towed howitzer systems, the M119(105mm) and the M198(155mm). The 105mm howitzers are used in all of the airborne, air assault, mountain, and light divisions. The howitzer can be easily air-dropped, air assaulted, or strategically moved aboard Air Force aircraft because of its light weight (4100 pounds) and reduced size. The M198 is much heavier (15,700 pounds) and takes up more space, but can fire the entire family of 155mm munitions. The United States Marines and several Army units are equipped with the M198. The M198 is also capable of airdrop and air assault operations.

The future towed cannons are the Lightweight 155 (LTWT 155) and the Future Direct Support Weapon (FDSW). The LTWT 155 is a joint acquisition venture of the Army and Marines. The major advantages are that it is about half the weight and fires twice as fast as the M198. The LTWT 155 has an attached computer and up-to-date electronics and will be fielded in five years. The LTWT 155 is a good general support weapon, but does not meet all

of the light forces' direct support requirements. The FDSW meets all the direct support requirements, has information dominance, and has a common carriage for either the 105mm or 155mm tube. The FDSW will be fielded in 2011.

The standard howitzer for our heavy forces is the M109 series, 155mm Self-Propelled Howitzer. The upgraded M109A6 Paladin has an increased range of 30 kilometers (assisted). The Paladin can operate in a semiautonomous mode because of its onboard ballistic computer, position/navigation system, automatic gun positioning and digital communications. The Paladin is noted for its "shoot-and-scoot" tactics, which means it can displace immediately after firing a mission. It can deliver fires within 60 seconds of receiving subsequent fire missions with first round fire-for-effect accuracy. All of the active duty self-propelled howitzer battalions and sixteen Army National Guard battalions will be equipped with the Paladin by the year 2001.

The Crusader is expected to be the dominant system providing precision fires to the heavy forces in the close fight. The Crusader is one of the first combat vehicles specifically designed for the future information-dominated battlefield. It will have the mobility and speed equal to the maneuver fighting vehicles, with an increased firing range to 50 kilometers. The

automated ammunition handling will reduce the crew size to three personnel while increasing the rate of fire. The Crusader will have its own Crusader Resupply Vehicle that can auto-transfer fuel and ammunition.

The Field Artillery Center is making great progress is improving artillery ammunition. The Crusader will use Modular Artillery Charge System (MACS), which can be auto-loaded and will be compatible with all 155mm systems. There will be no unused powder resulting in a 20% logistical reduction. There is a new extended-range Dual Purpose Improved Conventional Munitions (DPICM) round that will range 50 kilometers with the Crusader. The Sense and Destroy Armor (SADARM) has two top-attack, fire and forget submunitions per 155mm projectile which destroy self-propelled artillery and other armored vehicles.

Although not current cannon technology, several other initiatives include longer range mortars and the use of tanks (advanced fighting vehicle) with smart munitions. The Precision Guided Mortar Munition Advanced Technology System in development now (1995-2001) will give the early entry forces an organic, indirect hard target capability. The munition doubles the range of the 120mm mortar with increased accuracy. One requirement for the Advanced Fighting Vehicle (AFV) is to deliver indirect fire.

Technically that is a current capability, although most tankers would not want to depend on it.

ROCKET AND MISSILE TECHNOLOGY

The Multiple-Launch Rocket System (MLRS) is the current rocket system employed by the United States. The tracked launcher carries two rocket pods and can fire rockets one at a time or ripple fire all twelve to a range of 32 kilometers. The MLRS rockets are free-flight artillery rockets armed with DPICM. The MLRS launchers employ shoot and scoot techniques to minimize vulnerability to counterbattery fire. The High Mobility Artillery Rocket System (HIMARS) is a lightweight version of the MLRS on a 5-ton vehicle and is C-130 transportable. The HIMARS functions exactly like the MLRS, but carries only one rocket or missile pod.

Many ammunition improvements are in development for the MLRS systems as shown in Table 1. The Extended Range Rocket for MLRS (ER-MLRS) will carry improved DPICM submunitions and range out to 45 kilometers. The Guided MLRS Rocket (GMLRS RKT) will be equipped with inertial guidance for control and greater accuracy. It will range more than 60 kilometers. The MLRS Smart Tactical Rocket (MSTAR) will be a fire and forget rocket that can engage soft or hard, stationary or moving, and hot or cold targets. It

will also have a range greater than 60 kilometers. The greater stand-off range increases the survivability of the force and the greater accuracy requires less ammunition.

MRLS ROCKETS

Model	Range	Ordnance	Schedule	Improvement
MLRS	32 km	644 M77 DPICM	Current	
ER-MLRS	45 km	518 XM85 DPICM	IOC FY99	Range
ERG-MLRS	60-70 km	518 XM85 DPICM	IOC FY04	Guidance
MSTAR	60-70 km	518 XM85 DPICM	IOC FY08	Fire and Forget

Table 1. Multiple-Launch Rocket System Munitions.

The Army Tactical Missile System (ATACMS) is at the center of the Army's precision strike modernization effort. It is a quick response, all-weather capable, long range weapon system. Two ATACMS can be fired from each modified multiple-launch rocket system launcher. The Block I and IA systems are ideal for attacking soft targets such as command and control centers, logistics elements, air defense systems, and surface-to-surface missile sites with Anti-Personnel/Anti-Materiel (APAM) submunitions. The Block II and IIA systems will be fielded with the Brilliant Antiarmor (BAT) submunitions used to attack armored targets. The ATACMS Block II w/BAT can attack moving armored formations. The ATACMS Block IIA w/BAT P3I will have preplanned

product improved BAT submunitions that seek and kill stationary cold vehicles or moving hot vehicles. The ATACMS Block XB will be capable of ranging 499 kilometers with increased accuracy, carrying the APAM warhead to destroy stationary, soft targets.[10] ATACMS characteristics are shown in Table 2.

ATACMS MISSILES

Model	Range	Ordnance	Schedule	Improvement
Block I	165 km	950 M74 APAM	current	
Block IA	300 km	310 M74 APAM	IOC FY98	range
Block II	140 km	13 BAT	IOC FY01	anti-armor
Block IIA	280 km	6 BAT	IOC FY03	range
Block XB	499 km	TBD APAM	IOC FY04	inertial guid.

Table 2. Army Tactical Missile System Munitions.

ADVANCED TECHNOLOGY

Several believe more resources must be devoted to advanced technology such as the electric rail gun, electro-thermal-chemical (ETC) propulsion and laser or directed energy. The electromagnetic launch (EML) or electric energy gun (EEG) technology was originally considered for placement in the future Army tank and Navy warships. The EEG could launch Navy projectiles 400 nautical miles or more. The EEG requires no propellant and would greatly reduce the logistical tail and improve safety. However, several problems such as hardened electronics and shell ablation must still be solved. The biggest drawback is that the required power supply is enormous. The Army

has almost given up on the concept and the Navy estimates that the power requirements would be equal to the ship's propulsion.[11]

Several countries have been working on electro-thermal-chemical (ETC) propulsion for a number of years. It is a promising concept for a hyper-velocity gun, needing one hundredth of the electric rail gun pulsed power requirements. The ETC technology gives modest gains in velocity, but significant increases in throw-weight. There are safety issues because of some instability in the burning of the plasma, but several are being resolved by using a dense propellant bed.[12]

The use of directed energy as a fire support system is really speculative. The FAC talks about loitering munitions and the use of space vehicles to detect and destroy enemy targets. Directed energy is being considered for the active protection of the Advanced Fighting Vehicle and as a component of the theater missile defense system. Directed energy as a fire support system remains to be proven.

ARMY AFTER NEXT LOGISTICS AND MOBILITY REQUIREMENTS

Force reductions and the re-positioning of forces in the Continental United States mandates that the Army re-evaluate its mobility and logistical requirements. The traditional mobility triad of airlift, sealift, and pre-positioning must be enhanced

to meet expected deployment timelines of the AAN forces. Pushing supplies to many dispersed early entry forces will be difficult. The increased knowledge capability must be utilized to efficiently manage unit movements and logical resupply.

The Army must be concerned with the strategic deployability of the early arriving forces and the follow-on forces. The early arriving forces must be the area of operations before the enemy can set; the deployment goal to the forward area is 120 hours with 48 hours being optimal. Many believe that the early arriving forces must sustain themselves for 10-14 days before being relieved or augmented by the follow-on forces. This is much more demanding than the average 75-day deployment time of our heavy divisions during Desert Shield.[13]

In order to take advantage of the increased knowledge available, the Army's forces must move tactically without delay. The future systems must have reduced weight to enhance air transportability. The Advanced Airframe (AAF) is a Vertical Take-off and Landing (VTOL) aircraft capable of carrying all models of the advanced family of vehicles (AFV) or two Advanced Fire Support Systems (AFSS). All of the vehicles in the AFV and future heavy systems (such as the Crusader) will have improved

mobility characteristics with maximum speeds of 75 mph on highways and 40 mph cross country.

The Army After Next must take an aggressive strategy in how to equip and supply the force. The Army cannot depend on "supply by saturation" and establish huge logistics bases. The logistical tail must be radically streamlined. Maximum use must be made of the enhanced knowledge, situational awareness, and transportation technologies to provide "just on time" logistics to many dispersed units.

The efforts of the Field Artillery Center and others on reducing the different types of fuses, rounds, and propellants will shrink the ammunition logistical tail. The emphasis on precision engagement and increased ranges will reduce the requirement to move large ammunition to forward locations. The increased situational awareness of ammunition by type of round will permit the logisticians to eliminate the large ammunition stockpiles and emphasize "just in time" resupply.

FEASIBLE FIRE SUPPORT ALTERNATIVES

FIELD ARTILLERY CENTER'S PLAN

The Field Artillery Center (FAC) took a proactive approach to the issue of fire support in the Army After Next. The Center expanded their four-year old Vision 2020 and published a

document, "Distant Fires," which describes the Field Artillery's vision of fire support for the Army After Next. The "Distant Fires" document describes the emerging context of future warfare and examines fires on a changing battlefield. This document reviews the relevance of current Field Artillery programs to the future and lays out a roadmap on how to get there (fire support in 2025) from the present.[14]

The Field Artillery Center is thinking ahead and being proactive in preparing to support the Army After Next. It expects that precision fires will reduce the volume and there will be no distinction between direct and indirect fires. The emphasis is changing from heavy, pre-configured platform-oriented fires to mobile, adaptive, effects oriented fires. The Center is examining the impact that these new tactics and orientations will have on fire support organizations, personnel, training, and the current modernization program.[15]

The Center is carefully reviewing the relevance of the future artillery systems. The modernization program for the follow-on-forces looks strong. The versatility and lethality of the future systems are increasing as improvements in long-range precision munitions are emphasized. All caliber of munitions are being upgraded: 155mm projectiles, MLRS rockets, ATACMS missiles, and

even some new 105mm projectiles for the near-term. The Center is proposing the creation of Effects Control Centers (ECCs) and pondering the subsequent deletions of several echelons of Fire Direction Centers. The FAC is upgrading target acquisition capabilities and increasing the use of space vehicles and UAVs. The Field Artillery Center has a well thought out plan for AAN fire support.[16]

ROLE OF ADVANCED SYSTEMS

There are several advanced systems that will give the maneuver commander additional options to destroy enemy targets. The Advanced Fire Support System is a stand-alone rocket system. The Enhanced and Advanced Fiber-Optic Guided Missiles are additional extended-range tank killers. The Line-of-Sight Antitank weapon employs leap ahead technology and will provide the early entry forces with a devastating direct fire antitank weapon.

The Defense Advanced Research Projects Agency (DARPA) is developing the Advanced Fire Support System (AFSS) which many are affectionately calling "rocket in a box." The AFSS will be a stand-alone pod of ammunition. The pod will weigh approximately 7000 pounds and be air-droppable, airlifted by the Advanced Airframe (AF), or towed by the family of Advanced Vehicles.

There will be 24 rounds per pod or box of ammunition. The standard weapons load will be 18 fire support rounds fused with the precision guided BAT munitions with a 50 kilometer range and six air defense artillery rounds with a 30 kilometer range. The AFSS will house a C4I module that interfaces with the tactical internet. The fire direction center or ECC will remotely control firing the rockets through the tactical internet. The rounds will be allocated by the Fire Support Coordinator and terminally guided to the target by forward forces through an UAV, an AFV, or a ground emplaced controller. If each container has self location, cold launch, and remote firing, then every ship, truck, or remote site is a potential firing site. The pod will be tamper proof and have functionability sensors.[17]

The Enhanced Fiber-Optic Guided Missile (EFOG-M) is currently in the advanced technology demonstration (ATD) phase of the program. This system uses a fiber optically guided anti-armor missile with a range of 15 kilometers. This precision anti-armor weapon uses a soft launch and flies an offset route to the target area by following a series of waypoints using inertial navigation. The gunner interrupts the flight to lock onto the target and the missile flies a direct intercept course to the target. This system reduces the probability of fratricide and

minimizes collateral damage by keeping the soldier in the loop. The EFOG-M is mounted on a high-mobility, multipurpose wheeled vehicle (HMMWV) with eight missiles per launcher.[18]

The Advanced Fiber Optic Guided Missile (AFOG-M) will be a product improved EFOG-M. It is anticipated that every Advanced Fighting Vehicle (AFV) will carry two AFOG-M missiles and the missiles can also be carried on the Advanced High Mobility Vehicle (AHMV). The AFOG-M is a multi-mission engagement missile that can defeat main battle tanks, enhanced armored vehicles, rotary wing aircraft and VTOL aircraft at ranges up to 50 kilometers. The AFOG-M data and imagery are digitally linked to the tactical internet to provide BDA information.[19]

The Line-of-Sight Antitank (LOSAT) provides a leap ahead in antitank lethality and technology. It will outrange and overmatch all projected threat armor developments to include reactive add-on and active protection systems. It is a hyper-velocity kinetic energy round which results in devastating effects on the target. It will give the early entry forces increased survivability and lethality. The LOSAT will defeat bunkers and high priority hard targets at ranges of 4000-5000 meters. The LOSAT will be mounted on a HMMWV chassis and has incorporated several technology system upgrades. These

technologies include an improved target and missile tracker algorithms, forward looking infrared target acquisition system, and overwhelming lethality of the missile against armored targets.[20]

ROLE OF ATTACK AVIATION

The emphasis on air mechanization and dispersion will increase the importance of attack aviation. Although some experts recommend that the Army should replace rotary attack helicopters, current plans indicate that the Longbow Apache and Comanche helicopters will still be in the inventory in 2025. A new aircraft, termed the Advanced Attack Airframe (AAAF) should be available, whose capabilities will change the way the Army uses attack aviation. The extended weapons ranges and new tactics of combined arms deep operations will change the nature of deep strike operations and will not limit these operations to Air Force interdiction, long range artillery fires and attack aviation.

The AH-64A Apaches are being remanufactured into AH-64D Longbow Apaches. The capabilities of the Apache Longbow include multifunction displays, a precision navigation suite, an improved data modem, and processing electronics for the Longbow mast-mounted radar. The millimeter wave radar will enable the

helicopter to detect and classify targets in all weather conditions and engage them free of the many restrictions of laser designators. The Apache remanufacture program will continue to deliver Longbow Apache helicopters until the year 2008.[21]

The AH-66 Comanche is currently still in testing. The Comanche helicopter is touted to revitalize the scout-attack mission. The Comanche is an integrated armed reconnaissance system rich in sensors, processors, and digital connectivity. The Comanche is dubbed the "quarterback of the digital battlefield." It is a scout worthy of the Apache Longbow in working in high-threat environments. Computer simulations of the Joint Precision Strike Demonstration indicated a combat mix of Comanches and Longbow Apaches were three to five times as effective as an all-Apache force. On several long-range missions behind enemy lines, the Comanche ingressed and egressed without engagement. The first Comanche-equipped unit will be functional in the year 2006 and the Army is scheduled to continue to receive Comanches through 2020.[22]

The Advanced Attack Airframe is a fixed wing/tilt rotor aircraft capable of vertical takeoff and landing (VTOL). The AAAF will perform both attack and armed reconnaissance aircraft roles, the functions of the Longbow Apache and Comanche. The

AAAF will be capable of strategic deployment and tactical operations. It will have a strategic planning range of 2100 nautical miles and a tactical planning radius of 1000 kilometers. It will utilize all low signature management techniques to retard acquisition by radar, thermal and IR detectors. The AAAF will carry 16 Hellfire missiles (fire and forget), two AIM-9 Sidewinder missiles, and a turreted 30mm cannon.[23]

NAVY'S SUPPORT OF LAND COMBAT

The Navy and the Marine Corps operating doctrine is capsulated in the term, "Forward...From the Sea." The Navy is concerned that it must retain its traditional missions: sea control, power projection, deterrence, forward presence, and sea lift during a period of decreasing fiscal resources. The Navy and Marine Corps will be replacing the majority of their warfighting equipment in the next 35 years, and the Navy is examining concepts to accomplish its missions in a timely and cost-effective manner. Initiatives include examining platforms with reduced life-cycle costs and smaller crews and pursuing integrated electric drive power and propulsion systems.[24] The Navy will support the Marines (and other land combat forces) operating in dispersed units far from the sea. The Marine Corps envisions that future operations will require sea-based firepower

capable of delivering area munitions against soft targets, precision munition against hardened targets, and smart munitions against mobile or unique targets.[25]

A 1992-1994 study by the Navy, titled Sea Based Firepower, examined the current and near-term capabilities of the Navy. Each carrier sustained 60 attack sorties a day with a standard mix of weapons and ordnance. The naval gunfire (only 5"/54 with a range of 13 miles was available) had no impact on the outcome. Currently the Navy is fielding the Extended Range Guided Missile (ERGM) with much less dispersion and a range of 63 nautical miles. Now the Navy can offer the land combat forces more than just carrier support.[26] Many believe that the Navy should examine additional naval gunfire alternatives such as a 12 meter gun with a 400 mile range and electric gun technology, but it appears that the Navy will concentrate on rockets and missiles.

A recent study, Technology for the Twenty First Century Navy, was designed to answer the question of what could be done in the future to provide the Marines (and other land combat forces) with effective firepower. A number of factors were examined to include improved propellants, explosives, sensors and guidance. One recommendation was to put ATACMS missiles aboard ships. This "marinized" version, called a NTACMS (N for Navy), will have a

range of 100-200 miles and will be capable of being launched from any surface ship or submarine equipped with Vertical Launch System (VLS) tubes. Another recommendation was that the Navy build a family of precision guided rockets. The three recommended sizes would be 5, 10, and 21 inches, capable of fitting in the 21" VLS tubes. Four 10" rockets with a range of 200-300 kilometers would fit in a 21" VLS tube, so a Aegis Cruiser (DDG) with 64 VLS tubes could launch 256 rockets before reloading (See Table 3). If the missiles were designed for cold launch, the missiles could possibly be double or tripled stacked. There are still many other issues to resolve such as coordination, target designation, weapon accuracy, etc., but the potential capabilities are almost limitless.[27]

NAVY'S FAMILY OF LAND-ATTACK MISSILES

Rocket Dia.	Length	Warhead	Range	Number	Mission
5 INCH	5-7 ft	50 lb	100 km	1024	fire support
10 INCH	10 ft	100 lb	240 km	256	interdiction
21 INCH	21 ft	400 lb	600 km	64	strike

Table 3. Family of Land-attack Missiles Characteristics.

The Navy was looking at a new ship, an "arsenal ship," so called because its sole purpose would be to carry and launch this new family of land attack missiles. Apparently the Navy has

stopped work on this ship because of fiscal constraints, although the National Defense Panel disagreed with the termination of the arsenal ship test bed.[28]

AIR FORCE'S SUPPORT OF LAND COMBAT

The Air Force will continue many of its present functions, with no potential adversary likely to challenge the United States' dominance of the skies. The Air Force will continue to provide a global deterrent against the use of nuclear weapons and keep the forward bases and air lines of communications secure. They will provide the Air Expeditionary Force (AEF) of the Joint Expeditionary Force. The Air Force must secure sufficient air space to safely project the ground forces. It will continue to use precision engagement to destroy or neutralize strategic targets. The Air Force will complement landpower by striking deep operational targets and supplement land combat units with precision fires in close support.[29]

The Air Force officers interviewed for this paper came across as very pragmatic. They were close-minded to the possibilities of doing business differently. The Air Force will support the land forces whenever necessary, but that is not their primary mission. The Air Force is not designing or designating aircraft for that specific role. The use of fast movers (Air Force

aircraft) in the close air support role has diminished over time as shown in Table 4.[30]

CAS PERCENTAGES

World War II	40%
Vietnam War	20%
Desert Storm	6%

Table 4. Percentage of Air Force Missions Committed to CAS.

The Air Force is concerned about its role in the year 2025. It seems to believe that it can win almost any battle single-handedly and then allow the ground forces to occupy the "conquered" ground. The Air Force is using the term Air Expeditionary Force (AEF) as the centerpiece of its proposed doctrine. The AEF would be specifically "tailored" for the foe and deployed to a distant airfield and begin combat operations against the threat within 48 hours. After 30 days or however long it takes, the ground forces could just occupy the ground without resistance. The Air Force is wary of the perceived infringement of its roles by the other services. One such example is the Army's "preoccupation" with deep operations with such systems as the attack helicopter and ATACMS.

The command and control of fire support are of major concern to the Air Force. Although the Air Force officers agree that they are a force provider for a Joint Task Force Commander, they

do not want a Land Component Commander to tell them how and where to use their assets. The FAC's idea of an ECC does not sit well with the Air Force unless it is under a Joint Commander. The Air Force is already developing a system to better utilize its assets. The Air Force has built upon the success of the Contingency Theater Automation Planning System (CTAPS) to work on the Theater Battle Management Core System (TBMCS). This system should reduce the sensor to shooter link and give the Air Force complete visibility on all their aircraft and weapon loads.

The aircraft to be used in the 2025 timeframe are the F-16, Joint Strike Fighter (JSF), the B-1 bomber, and the B-2 bomber. The F-16s are currently being upgraded with the Low-Altitude Navigation & Targeting Infrared for Night (LANTIRN) system to deliver ordnance during limited visibility. The Air Force is also improving their munitions. They will have a sensor fused munition similar to the Field Artillery's SADARM. A bomb will carry 40 sub-munitions vice the two in a 155mm round. An F-16 could carry four of these rounds (160 sub-munitions) and a B-1 bomber can carry 50 of these rounds (2000 sub-munitions). Another new munition is the Joint Direct Attack Munition (JDAM) which is a GPS-guided 200 pound bomb. It can also be laser or electro-optically guided. A B-2 could carry sixteen JDAM rounds

and theoretically attack sixteen distinct targets simultaneously. These improvements when combined with JSTARS and other acquisition assets mean that the Air Force can detect and engage the enemy at a much deeper range.

USE OF SPACE

The U.S. Army Space and Missile Defense Command (SMDC) is tailored to support the Army efforts into space. Two of the four SMDC goals are robust integration into full-spectrum land force operations and progressive space and missile technology for land forces.[31] Currently the United States is using space for intelligence gathering, weather, mapping, terrain analysis, and communications. The SMDC recently established a Space and Missile Defense Battle Lab to experiment with and analyze future space and missile defense warfighting concepts. It is important to realize that the systems that will be operating in the 2025 time frame are being designed and built today.

The SMDC is working with the FAC to integrate the capabilities of space into fire support for the Army After Next. Two programs that the SMDC and the FAC are closely working on are the Battlefield Ordnance Awareness (BOA) effort and the Field Artillery's thrust on deep operations. The BOA program involved the advanced processing of data from infrared sensors onboard

satellites. This program employs a technology that will enable the characterization of enemy artillery activity. Space vehicles and sensors will provide critical targeting information for deep operations. Loitering munitions and space vehicles capable of delivering lethal or non-lethal fires in terms of directed energy or other ordnance may be available in the near future.

CONCLUSIONS AND RECOMMENDATIONS

The Army has many difficult decisions ahead. Although the threat has changed significantly from the Cold War era, the missions have increased while the available resources (personnel and budget) have decreased. The Army has many smart people thinking "outside of the box" and looking into the future, and they are coming up with innovative ideas. It appears that the follow-on forces will have adequate fire support with such systems as the Paladin, Crusader, MLRS, and ATACMS. I am concerned that the fire support for the early entry forces is not as well thought out. The early-entry forces are the priority element for what is currently called the Army After Next. These forces, which will be strategically deployed within 120 hours, are the lightest and in the greatest need of fire support. I recommend that the Army devote fire support resources to the following four areas, in priority: Effects Control Center,

Advanced Fire Support System, advanced decisive operations systems, and munitions improvements.

The Effects Control Center (ECC) is a sound concept and will be critical to manage and control the various fire support assets of the early entry forces in engaging multiple targets efficiently. The ECC will have visibility over all joint sensors and potential fires, to include space systems and to maximize seamless support to the maneuver commander. Building on joint demonstrations, such as Joint Continuous Strike Environment Advanced Concept Technology Demonstration, the ECC is quickly becoming a reality. The ECC must be accepted by all the services to be of maximum benefit to the early entry forces and enable the maneuver commander to communicate and direct all means of fire support, from both the Army's own systems as well as to those in space, air, or sea.

The Advanced Fire Support System (AFSS) shows a lot of promise and should be the second priority. The AFSS will house 24 rockets and range 50 kilometers. The AFSS will give the maneuver commander great flexibility in tailoring his fire support package. Most early entry force maneuver commanders will want some sort of organic fire support, but they will not sacrifice the strategic airlift to bring the heavy MLRS and

Crusader systems. The FDSW, LTWT 155, and HIMARS will give the early entry forces increased range and the ability to shoot a wide range of munitions, but will still require a great deal of strategic airlift. The AFSS offers a lightweight (7000 pounds) mobile fire support system without a manning requirement. The AFSS can be easily emplaced by air or ground and has the potential to make every transport vehicle a firing platform.

The Army must provide the early entry forces with the advanced decisive operations systems to make them a lethal entity. These systems will give the commander the ability to defeat armor and other targets at ranges in excess of 15 kilometers. The most important of these systems are the Enhanced Fiber-Optic Guided Missile (E-FOGM), the Line-of-Sight Antitank (LOSAT), and the improved 120mm mortar (Precision Guided Mortar Munition). The E-FOGM permits the commander to reach out 15 kilometers to defeat enemy armor in an indirect mode. The follow-on version (Advanced FOG-M) will range 50 kilometers. The LOSAT is a hyper-velocity kinetic energy weapon that can overmatch and outrange any known enemy armor. The LOSAT can defeat bunkers and priority hard targets at ranges up to 5 kilometers. The improved mortars will have smart munitions, digital links, and twice the range of the current 120mm mortar.

The commander could then choose the weapon systems to tailor his force based on the threat.

The emphasis on improving the accuracy, range, and capabilities of ammunition must be maintained. The improvements in miniaturizing the GPS and inertial guidance systems virtually guarantee first round fire for effect. The increase in range, particularly for the MLRS and ATACMS, will permit the commander to reach out and destroy the enemy at much greater ranges. The advances in munition capabilities, such as the smart anti-armor munitions SADARM and BAT P3I, will give the maneuver commander more options for defeating our future enemies. Sufficient funding should be devoted to improve non-lethal fires to reduce collateral damage and give the commanders more options, especially given the increased probability of fighting in urban terrain.

The Army must be prepared to deploy on short notice and be appropriately structured and equipped for a wide range of missions in the future. The Army must ensure that our forces and equipment are tested against realistic scenarios and threats. The early entry forces, the initial forces to enter the conflict, must be resourced with accurate, devastating, and responsive

fires to protect our fighting men and prosecute our nation's battles now and in the future.

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