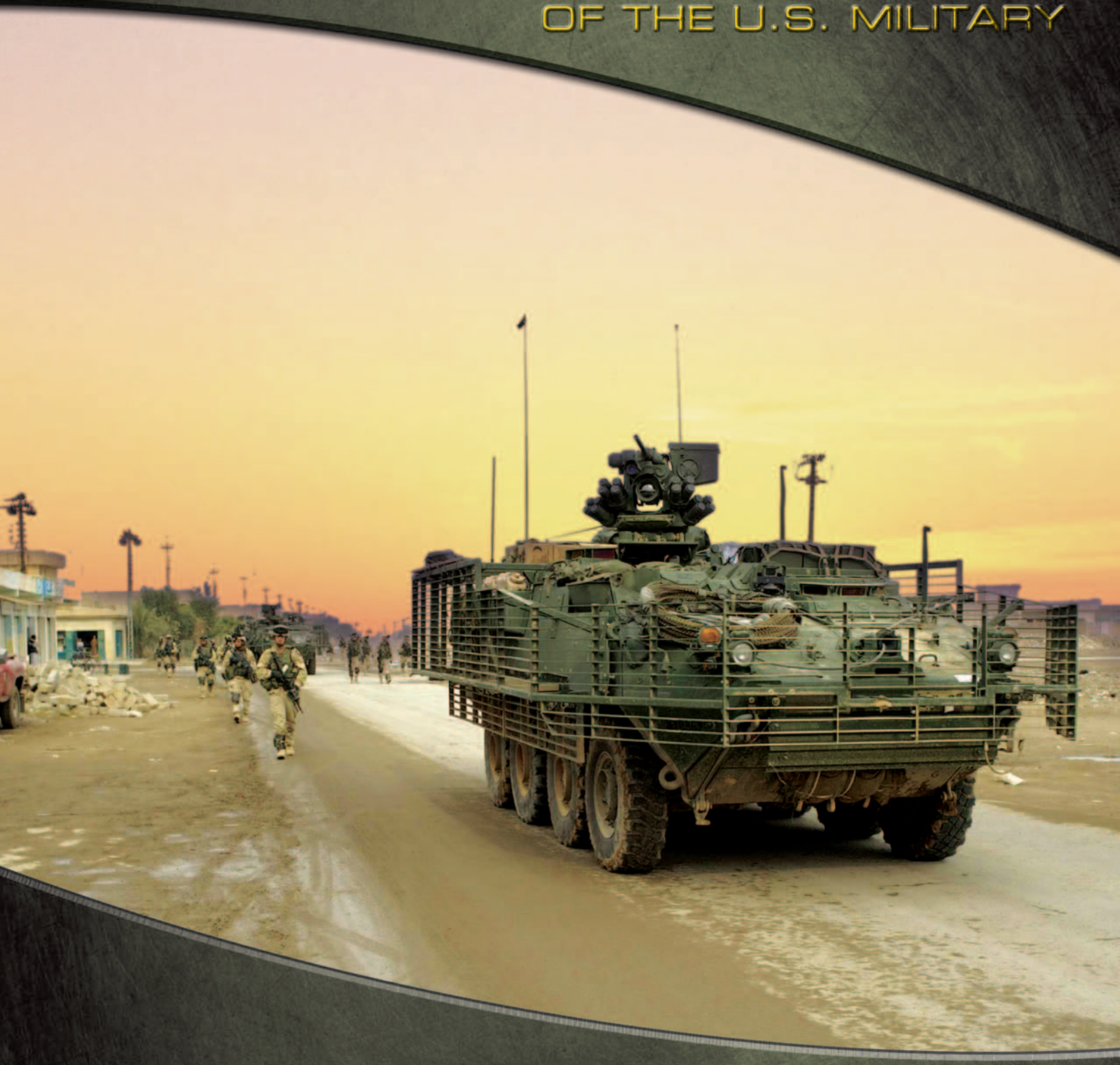
# MEDIUM ARMOR

## AND THE TRANSFORMATION OF THE U.S. MILITARY



Lexington Institute

Cover: A Stryker of the 3rd Brigade,
2nd Infantry Division, near Samara, Iraq.

# EXECUTIVE SUMMARY

The war in Iraq has made one fact clear: the U.S. Army and Marine Corps need units organized around medium armor. Light forces and vehicles are maneuverable but lack force protection and striking power. Traditional heavy forces, while providing excellent protection, are strategically ponderous, logistically expensive and largely inappropriate for peacekeeping missions. Had more medium armor been available in Iraq, American lives could have been saved.

The United States Army is poised not only to transform itself but, potentially, to write an entirely new chapter in the history of warfare. It hopes to accomplish this feat by redesigning itself into an expeditionary force capable of projecting significant land power rapidly and over long distances. One of the defining goals of defense transformation is to deploy a major warfighting force anywhere in the world within ten days, fight and win decisively in thirty days and reset the force for another contingency within another thirty days (the 10-30-30 construct). To do this, the Army must get lighter while becoming more mobile, digital, survivable and lethal. It must learn to exploit information, to operate as part of a joint force and to create new organizations and operating concepts.

One step in this process is to create a more rapidly deployable medium-weight capability in the current force. The Army did so by acquiring a wheeled vehicle, the Stryker, which would be more readily transportable than existing heavy armor and better protected than light vehicles. With ten variants, the Stryker will equip at least six Brigade Combat Teams (BCTs).

Another step is the restructuring of existing Army divisions into more modular formations based on a Unit of Action (UA). The goal is to use existing equipment and manpower to both expand the number of combat brigades in the Army from the current 33 to as many as 48, and simultaneously create brigade-size maneuver UAs that are more deployable, agile and flexible than existing brigades. Maneuver UAs plus other UAs specialized for strike, reconnaissance, support and maneuver enhancement can be organized into larger Units of Employment (UE) in any combination necessary to support a Combatant Commander's needs.

Beyond the Stryker Brigades and the restructuring of the current force, the Army is planning to create a Future Force that will consist of relatively smaller, lightweight UAs capable of rapid deployment and a high operational tempo with significantly reduced logistical support structure. The centerpiece of the Future Force is expected to be the Future Combat System (FCS). The FCS is more than a single weapons platform and will serve more than one kind of warrior. It is an array of up to 18 platforms, manned and unmanned, ground and airborne. It is envisioned as a network-centric "system of systems" centered on a common vehicle chassis. The Army has declared that it wants the first FCS-equipped UA by 2014.

The initial draft of this paper was written by Dr. Daniel Gouré and Kenneth A. Steadman.

# INTRODUCTION

The Bush Administration came into office determined to transform the United States military. It believed that the military of the 20th Century was not well equipped, organized or postured to meet the threats of the 21st Century. These threats would emerge suddenly and in new places. Potential adversaries would employ techniques and technologies intended to deny the United States access to regions of interest and the sea approaches to them. These adversaries might also acquire weapons of mass destruction with which to threaten U.S. allies and forward-deployed forces and possibly even the homeland. To meet these threats, the Bush Administration concluded, U.S. forces would have to be projected farther, faster and with greater striking power when they arrive. With these facts in mind, President Bush argued that the United States needed:

> ...a future force that is defined less by size and more by mobility and swiftness, one that is easier to deploy and sustain, one that relies more heavily on stealth, precision weaponry and information technologies.

The experiences of Afghanistan and Iraq appeared to confirm the Bush Administration's belief in the wisdom of transformation. Secretary of Defense Donald Rumsfeld described the plan to transform the U.S. military thus:

> Over the next decade, a portion of the force will be transformed. It will serve as a vanguard and signal of the changes to come. **Ground forces will be lighter, more lethal, and highly mobile. They will be capable of insertion far from traditional ports and air bases and will be networked with long-range precision-strike systems.** Naval and amphibious forces will be able to overcome anti-access and area-denial threats, operate close to an enemy's shores, and project power deep inland. Aerospace forces will be able to locate and track mobile enemy targets over vast areas, and in combination with land and sea forces, strike them rapidly at long ranges without warning. The joint force will be networked in order to conduct highly complex and distributed operations over vast distances and in space. [Emphasis added]

The vision of a transformed military was given added impetus by the events of September 11 and the subsequent need to project U.S. military power far inland to the capitals of Afghanistan and Iraq. The successful campaigns to overthrow the Taliban in Afghanistan and Saddam Hussein in Iraq made use of advances in a range of technologies — including information systems, precision weapons, stealthy aircraft and unmanned aerial vehicles (UAVs) — to fight a new kind of war.

In Iraq, both the Army and Marine Corps found the need for more armor. In particular, the need arose for what can be called medium-armor units, those with armored vehicles heavier than the Humvee and even M-113, but lighter than the Abrams tank or Bradley

## *ON THE CHARACTERISTICS OF ARMORED VEHICLES*

*What is the distinction between light, medium and heavy armor? Most simply, the designation of armored vehicles or military units as light, medium or heavy is a reflection of their weight. Traditionally, the combat roles of armored vehicles have been a function to their weight. Lighter vehicles tended to operate in support of other, often heavier, forces, serving as scouts or battlefield transports. Heavier vehicles were those that had the most armor and generally the heaviest armaments. Heavier vehicles tended to serve as mobile artillery platforms, assault guns or, in the case of main battle and heavy tanks, as counter-armor platforms. Tanks and infantry fighting vehicles (IFV) dominated the modern conventional battlefield.*

*The designation of units as light or heavy is largely a reflection of the degree of their mechanization, particularly the number of tanks and IFVs they possess, but also artillery and support vehicles. U.S. divisions designated as heavy possess large numbers of both unarmored and armored vehicles including Abrams tanks and Bradley IFVs. Armored and mechanized divisions are heavy divisions. The 101st Air Assault division is unique because of the large amount of rotary aviation it possesses, making it a heavy division in terms of total weight. Light divisions have little mechanization and virtually no armored fighting vehicles. Airborne, infantry and light infantry divisions are considered light. Similarly, armored cavalry brigades are considered heavy units while infantry, ranger and airborne brigades/regiments are considered light units. Heavy armored units have been viewed as the decisive force in modern conventional warfare.*

*Traditionally, forces of different weights, with different degrees of mechanization, had distinct primary missions. Light forces were considered the best for quick-response, forced-entry missions and to support heavy forces that, in turn, used a combination of decisive maneuver and firepower (sometimes referred to as shock) to defeat hostile ground forces. The United States has concentrated most of its heavy armored divisions in a single "counter-attack" Corps.*

*So-called medium-weight vehicles and units such as the Stryker brigades and, in the future, the FCS Unit of Action (UAs), represent a departure from the traditional understanding of light and heavy forces. This is less because of the weight of such vehicles per se and more because of the missions they will perform. Strykers and manned FCS vehicles will be somewhat heavier than standard unarmored or lightly armored vehicles; but they will be much lighter than traditional heavy armor. More important, Stryker brigades will operate in the space between traditional light and heavy forces with deployability closer to that of light forces but with maneuverability, survivability and firepower more akin to that of heavy forces. As part of the joint force Stryker brigades will be able to enhance both its maneuver and firepower capabilities by exploiting distributed sensors and joint fires. FCS UAs, exploiting even greater connectivity, sensor capability and long-range firepower than that available to the Stryker brigades, could virtually eliminate the distinction between light and heavy forces, operating seamlessly across much of the mission spectrum.*

fighting vehicle. As the 3rd Infantry Division's after-action report notes, while "tanks were effective against most enemy direct-fire targets, they were overkill in many cases." This was particularly the case in stabilization operations. But on the noncontiguous, nonlinear land battlefields of the future, lighter, agile forces with substantial firepower and force protection features will be needed to rapidly respond to a fluid environment, defeat enemy skirmishers, seize and control key terrain and police the area.

The Marine Corps made extensive and successful use of their Light Armored Reconnaissance units equipped primarily with the wheeled LAV-25 (Light Armored Vehicle) which carried a 25mm cannon to protect convoys, fight irregulars and patrol their sector of Iraq. The 1st Marine Division's after-action report concluded that with some important upgrades, such as a heavy gun/mortar capability, these units "can be the most lethal, versatile forces on the battlefield."

Medium-armored vehicles have proven their value in the fight to stabilize Iraq. Light vehicles such as Humvees are vulnerable to small-arms fire and improvised explosive devices. Heavy armor provides excellent force protection but it is difficult to maneuver in urban terrain. Medium armor provides enhanced force protection as well as mobility. The Stryker brigade deployed to northern Iraq in late 2003 is successfully policing an area that previously required an entire regular division.

The experience in Iraq has taught the United States an important lesson, which is that this country needs to enhance its ground forces. Most immediate is the need for better force protection. In addition to providing up-armored Humvees, the military is acquiring a significant number of the specially designed Armored Security Vehicle, once deployed only with military police units. More generally, there is a need for a broader spectrum of forces and capabilities to include medium armor, tactical unmanned aerial vehicles and a common operating picture of the battle space.

President Bush and Secretary Rumsfeld were not the first to recognize the need for a more strategically mobile and tactically agile Army. Former Chief of Staff General Eric Shinseki began the process of making the Army more mobile, and hence relevant to the conflicts of a new era. Following the overly long deployment of Apache helicopters to Kosovo in 1998, the Army's leadership recognized the need for fundamental change. The Apaches arrived so late and were encumbered by so much heavy equipment that the aircraft played no constructive role in the outcome except to give the Army a black eye for its lack of responsiveness. This event led General Shinseki to set as an objective that a transformed Army be able to deploy a full brigade anywhere in the world within 96 hours, a full division in 120 hours and five divisions in 30 days. In order to meet this objective, General Shinseki made the decision to invest in a family of medium-armored vehicles, the Stryker, and create six medium-weight brigades that could be transported by aircraft such as the C-130.

The current Chief of Staff, General Peter Schoomaker, has gone even further in his effort to make the Army more effective and efficient. Under his guidance, the Army is undergoing a near-total restructuring, moving away from the old hierarchy of brigades, divisions, corps and armies to a more flexible modular structure based on so-called Units of Action. The Army's goal is to create 43 (and possibly 48) UAs from the current Army force structure that maintains only 33 brigades. Drawing on the assets of current brigades, divisions and even corps, the UA will be the smallest combined-arms unit in the Army. The maneuver UAs will be more capable than current brigades and could operate without reliance on augmentation by higher echelons. Maneuver UAs plus other UAs specialized for strike, reconnaissance, support and force protection can be organized into larger Units of Employment (UEs) in any combination necessary to support a Combatant Commander's needs.

The Army also has decided to change how it operates as part of the joint force. The Army intends to reduce its reliance on organic fire support and rely more heavily on joint fires provided by the other Services. Similarly, Army fires assets will be able to conduct fire missions in support of the theater campaign or the operations of other elements of joint and combined forces.

The Army faces tremendous challenges in meeting the goals of becoming more expeditionary, flexible and relevant to the needs of the Combatant Commanders. Its existing equipment, organization and doctrine did not support the vision of its own leadership, much less that being put forward by Secretary Rumsfeld and President Bush. The current active Army consists of six heavy divisions and two light divisions. There are two unique active divisions, the 82nd Airborne and the 101st Air Assault Division. The 82nd is a light infantry division with the strategic mobility to be deployed within hours of notification. The 82nd is the current early or forced-entry force. With its strategic mobility it is capable of seizing an entry point for more tactically mobile and survivable forces to arrive. The 101st, with its many helicopters, can almost be characterized as a heavy division. It is not strategically mobile, but is unique because its helicopters give it unprecedented tactical mobility.

The Army also maintains two Integrated Divisions, the 7th Light Infantry and the 24th Infantry (mechanized). Both are composed of an active duty headquarters and three enhanced Separate Brigades (eSBs). The eSBs are provided with the best equipment available to the National Guard and are better trained than the Guard's other combat units and ready to be deployed with minimal training and processing time. Several of the light brigades are scheduled for deployment to Bosnia, Kosovo or Afghanistan.

Currently only the Ready Brigade of the 82nd Airborne Division can deploy within the 96-hour timeframe. The Airborne brigades deployed in Alaska and Italy could also meet this deployment timeline. It would take between 10 and 15 days to deploy even a light brigade from another active division. The Ready Brigade can seize an entry point, but the Army has no strategically mobile armored forces to rapidly reinforce the Ready Brigade.

Today the United States is certainly capable of assembling the air, ground and sea forces to accomplish a decisive victory in a relatively short time. But deployment of those forces, especially ground forces, would not be swift and the ground forces would not be able to attack upon arrival in theater. Today's ground forces, as even the Army acknowledges, are too heavy, take too long to deploy and require too much logistical support to fit President Bush's or Secretary Rumsfeld's vision of the future. Making the Army strategically mobile so that it can operate as an integral part of a transformed U.S. military is a demanding task, but one that must be successfully accomplished.

## TOWARD A STRATEGICALLY MOBILE, TACTICALLY AGILE, HIGHLY LETHAL ARMY

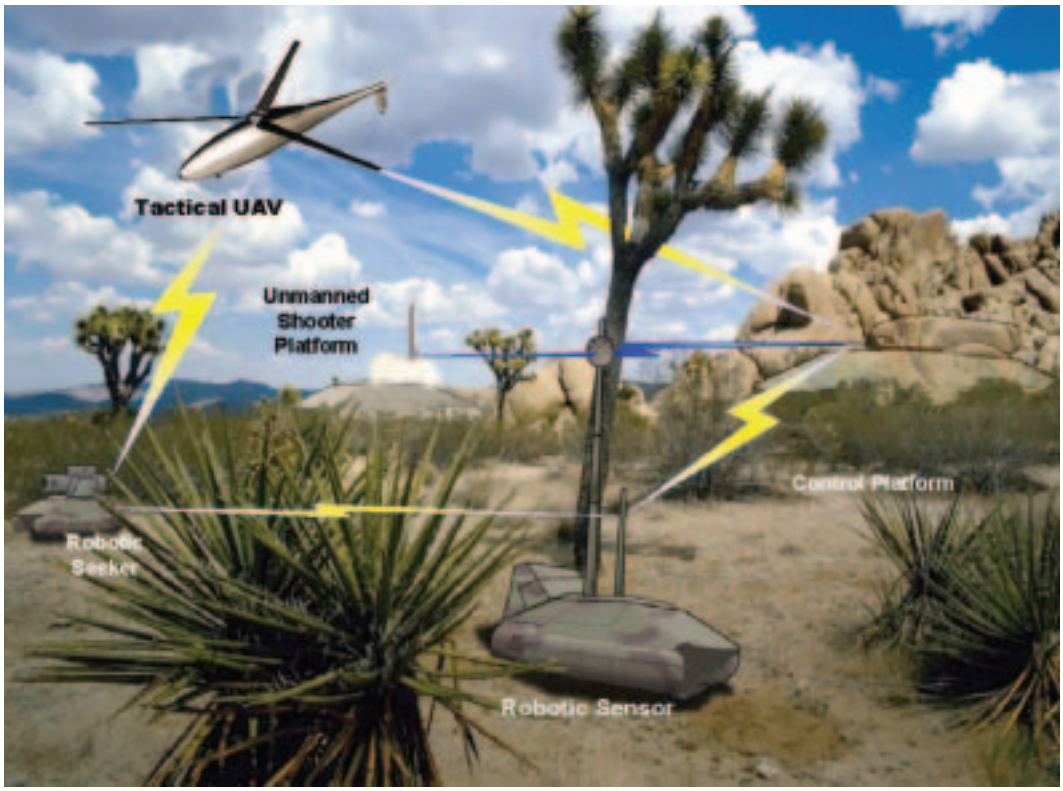
In order to transform itself, the Army must address the problem of weight. Put most simply, the heavier the total weight of Army units and platforms, the more difficult it is to move. In order to make its units more deployable, the Army must balance the competing demands for reduced weight, enhanced tactical mobility, lethality and survivability on the battlefield. To first order, there is a tradeoff between weight and survivability, on the one hand, and mobility, on the other hand. Heavier armored vehicles are more survivable than lighter ones and may have enhanced lethality insofar as they are able to carry heavier armament and more ammunition. U.S. ground forces must be sufficiently light so as to be strategically deployable and tactically mobile. Tactical agility provides the ground forces with the advantage of swift maneuverability against the adversary. They must also have sufficient survivability and lethality to fight and win on the modern battlefield.

Since World War I, gaining and maintaining superior tactical agility on the battlefield has been a constant goal of the Army. It was the reason for motorizing and mechanizing the Army of World War II and the rationale behind the adoption of the helicopter after the Korean War. Throughout the last century, and still apparent today, is the Army's willingness to even sacrifice firepower if it will gain the advantage of tactical agility.

Survivability also is a vital consideration for the Army. The battlefield has become more lethal with fire-and-forget weapons, long-range precision munitions (both bombs and artillery) and the proliferation of man-portable anti-tank and anti-vehicular weapons such as the Rocket Propelled Grenade (the RPG-7 is capable of penetrating 12 inches of steel). The M1A2 Abrams tank and the M2 Bradley Infantry Fighting Vehicle have the armored protection to provide a relatively high degree of battlefield survivability, as was shown during Operation Iraqi Freedom (OIF), and the tactical mobility to maneuver rapidly on the battlefield. However, units equipped with these platforms are difficult to deploy strategically and require tremendous logistics support. The Army desires to retain that tactical mobility, battlefield survivability and lethality while it strives for strategic mobility.

The United States is in the forefront of a radical transformation of ground forces, one that will result in heavy forces becoming lighter than they are currently and lighter forces becoming, in effect, medium-weight forces. A first step in that transformation is the creation of medium-weight combat brigades built around a new fighting vehicle, the Stryker. It is intended to be a bridge between light infantry and the heavy-armored force. The Army plans to field at least six Stryker brigades, possibly more.

A second step is the reorganization of existing formations to both increase overall deployable combat power and to make the Army more strategically relevant and operationally agile. This change to a modular force structure based on UAs and UEs initially will involve little in the way of new equipment, except for enablers such as advanced surveillance systems, UAVs and communications equipment. It will involve organizational changes and



new concepts of operation. The first division to be reorganized is the 3rd Infantry Division (ID). The second division to be restructured will be the 101st Airborne. Over the next several years, six other active component divisions will undergo a similar process of modularization.

The third step in Army transformation is to begin creating the future Army, the so-called Future Force, with its Future Combat System. The FCS is not one platform, but a mix of manned vehicles, robots and unmanned aerial vehicles. It is expected that the Future Force will look very different from the current Army organization and will operate according to a new doctrine. At least initially, it is probable that the FCS will reequip existing modular UAs. However, once FCS capabilities are deployed in significant quantities, it is possible that other organizational arrangements will be undertaken.

A final step in this transformation is to change the capabilities of the individual soldier and the relationship between the soldier and his vehicles. The Future Force Warrior (FFW) programs hold forth the possibility of a radical transformation in the effectiveness of the individual soldier. The Army has traditionally developed armor vehicles pretty much independent of its soldier system programs. As the Army continues to fight in more untraditional environments, including heavily urbanized terrain, these individual developments need to be once again treated holistically as part of a system-of-systems.

## THE STRYKER COMBAT SYSTEM

In 1999, the Army's Strategic Planning Guidance established a requirement to make the Army more strategically deployable. To do this, the Army leadership decided it needed to build a new generation of combat vehicles that would be more readily transportable by air to provide strategic and tactical mobility and to be survivable on the battlefield. The Army's current combat vehicles, the Abrams tank and the Bradley Infantry Fighting Vehicle are air transportable aboard the largest air-lifters, the C-5 and the C-17, but the aircraft can only accommodate one vehicle per flight. These vehicles have proven their tactical mobility and survivability, but are too heavy. Additionally, it would take more than 96 hours to deploy a brigade-sized force. The new generation of combat vehicles must be able to meet the requirements of being strategically deployable while having both tactical mobility and survivability on the battlefield.

Full-tracked vehicles can carry the armor necessary to survive on the battlefield, a requirement validated by reports that the Abrams tanks and Bradleys sustained numerous RPG hits during Operation Iraqi Freedom without significant damage to their operating capability. During the famous "Thunder Run" into Baghdad during OIF, every vehicle of the 2nd Brigade, 3rd Infantry Division, was hit by RPG fire. These vehicles, which are capable of cross-country speeds up to 40 mph, are certainly tactically mobile, but they lack the strategic mobility necessary to meet many of the new threats. Moreover, they inevitably create a large footprint and require extensive logistical support, thereby increasing their vulnerability to anti-access strategies.

Light units (airborne and infantry) were more readily deployable into a theater but possessed little in the way of tactical maneuver capability or organic firepower. During OIF, CENTCOM had to airlift heavy armored fighting vehicles into Central and Northern Iraq to enhance the limited firepower of airborne and SOF units (Special Operations Forces) that had captured key targets.

Wheeled combat vehicles, without the weight of their fully tracked counterparts, have improved to the point that they are fully capable of rapid cross-country movement. The suspension systems, tires and engines are powerful enough to allow the new generation of vehicles to rapidly traverse nearly all open terrain. Most of these new vehicles also have the capability of fording or "swimming" across water barriers, which few tracked vehicles possess.

The capabilities of the wheeled combat vehicle answered the requirement to make the force lighter and thus more strategically and tactically mobile. The selection of the Swiss designed Piranha 8X8 wheeled combat vehicle for the Army's Stryker Brigade Combat Teams (BCTs) is leading the effort. The Stryker comes in two variants: the Infantry Carrier Vehicle (ICV) and the Mobile Gun System (MGS). The ICV has been further adapted as a mortar carrier; an anti-tank guided missile (TOW) vehicle; a nuclear, chemical and biological reconnaissance vehicle; a medical vehicle; an engineer vehicle; and a command vehicle. The longer cruising range (330 miles on 53 gallons) and parts commonality will ease the logistical and maintenance burden for the BCTs. The Strykers have tires that can run either inflated or deflated to make it safer and easier to traverse surfaces ranging from deep mud to hardtop, and can run on flat tires.

Stryker ICV in the field.

The Strykers are protected by armor sufficient to withstand 14.5mm heavy machine gun fire and 152mm overhead artillery fire. A strengthened undercarriage protects the personnel inside from mines. In the summer of 2003 the first Stryker vehicles had problems with the armor not adequately protecting the crew from 14.5mm fire. This was fixed by backing the ceramic armor on the Strykers with a 3mm steel plate. Appliqué armor capable of withstanding an RPG-7 is under development and, if it passes, will be retrofitted to the initial Stryker BCT in 2004 and added to the follow-on BCTs by 2006.

All variants of the Stryker are to be connected with a digital command, control and communications and intelligence, surveillance and reconnaissance (C3ISR) system to enable all commanders to read and see the location of all friendly and enemy forces, as well as the location of fire support and air- and ground-reconnaissance systems. The same Caterpillar engine used in the Army's current medium tactical vehicles powers the Stryker. As a result, the entire fleet of vehicles will be easier to maintain.

The Mobile Gun System, the nuclear, biological and chemical reconnaissance vehicle and the fire-support vehicle are about to be fielded. The MGS will mount a 105mm gun fully stabilized to fire on the move in a low profile turret. Weight and space restrictions will limit the MGS to only 18 rounds of main-gun ammunition. It is envisioned that each Stryker BCT will have a platoon of four Mobile Guns when that system is fielded. The anti-tank guided-missile vehicle is standing in until the Mobile Gun System reaches the field.

The Stryker is approximately 22 feet long, nine feet wide, nine feet tall and weighs approximately 36-40,000 lbs unloaded and unmanned. The space and weight are well within the parameters of the C-5B and the C-17 strategic aircraft, but are pushing the limits of the C-130H aircraft. The C-130 fleet can carry a maximum of 38,000 lbs up to 1,000 nautical miles, and the Stryker approaches that ceiling. When the additional 3mm of steel backing was added to the ceramic armor it pushed the weight up to the C-130's maximum weight-carrying capacity. Currently, C-130 aircraft can only carry the Strykers in a stripped-down version. As a consequence, the vehicles will not be airlifted directly into a contested area. The Stryker has been modified to accept these changes, although reassembly of these systems has to take place on the ground before tactical operations can commence.

The current version Stryker, however, is not the final solution for the problem of strategic mobility with survivability. To protect against RPGs, "slat armor" — in essence a steel cage — will be welded to the side of the vehicles once they arrive at their destination, which will delay the time when the BCT can enter combat. The "slat" armor makes the Stryker too large to fit aboard a C-130 and it must be carried in a separate aircraft.

There is additional passive add-on ceramic armor that can be bolted to the Stryker after it arrives in the battle area to provide protection from the RPG threat and there are several other technologies under development and testing. "F"-class technology consists of a sensor and reactive explosive to detect a shaped-charge RPG warhead and deflect or destroy it by explosion before it hits the vehicle. The "EMA" or electro-magnetic armor sets off an electrical charge that diffuses and explodes a warhead before it makes contact with the vehicle. These technologies, as well as new developments in both reactive and passive armor, are being considered as enhancements to the Stryker and for the FCS.

Strykers are being employed in brigade-size units rather than in divisions. Heretofore, the division was the smallest unit capable of sustaining itself in combat for extended periods. By organizing the Strykers at the smaller brigade level, the Army signals that it is shifting away from divisions to smaller units. With the fielding of the first six Stryker brigades the Army is creating a new and different capability within the Army, one that possesses enhanced survivability, mobility and firepower in comparison to light forces. The Army now has a mix of heavy, medium and light forces. This is an attempt to balance the requirement for tactical mobility and survivability with that of strategic deployability.

## THE FUTURE COMBAT SYSTEMS

The follow-on to the Stryker and the Army's next generation combat system that will support the creation of rapidly deployable, highly mobile, survivable and lethal formations is the Future Combat System; the centerpiece of the Army's vision of transforming the current heavy force into a lighter, agile strategic force with unprecedented capabilities. It has been called a "family of systems" because it will incorporate integrated networks of sensors and communications into advanced combat vehicles, with increasingly lethal weapons

light enough to be strategically deployable from U.S. bases. As envisioned by Secretary Rumsfeld, the FCS, combined with a robust C3 network, Joint Fires and manned- and unmanned-aerial systems, would result in the creation of a Future Force consisting of:

> ...Combined arms forces armed with superior situational awareness (to) maneuver more easily around the battlefield and force the enemy to mass where precision engagement capabilities may be used to maximum effect....

Graphically, the FCS is depicted as a family of eight variants of wheeled-combat vehicles with the full range of combat capabilities, from infantry carriers to line-of-sight gun carriages to indirect-fire support vehicles bound by distributed intelligence, command and control and communications networks and linked with air forces or naval forces in a joint configuration to accomplish any mission. While each platform will serve a distinctive primary function, each will exploit advances in sensor and information technologies to serve as a reconnaissance, surveillance and targeting node. The common platform must be deployable on a C-130-sized transport aircraft, be 70 percent lighter and 50 percent smaller than current armored combat systems while maintaining equivalent lethality and survivability. In addition, this "system of systems" will include a variety of unmanned ground and air vehicles, autonomous (even remotely operated) indirect-fire systems and unattended sensors.

Through the integrated networks linking air, naval and the assaulting ground units, intelligence can provide "situational" awareness to allow detailed planning and execution for initial operations while the forces are moving to the objective area. Once in the objective area, persistent, networked sensors provide additional intelligence of a battle area already "shaped" by other elements of the Joint Force (e.g., Special Operations Forces, tactical aircraft, strategic bombers and deep fires). This allows the ground forces to maneuver rapidly, out of contact with the main enemy forces. Once the enemy is located, the joint commander or local commander can orchestrate networked air, naval and ground fires against the enemy force, destroying it without massing and making a lucrative target of his own forces.

If successful in developing its "leap-ahead" technologies, the FCS will form the centerpiece for the Army's Future Force. An 8X8 wheeled vehicle (a similar tracked version also has been designed) made from a combination of titanium, high-strength aluminum, polymer composites and ceramics, is reported to be superior in armor survivability to any other vehicle, yet weighs between 36,000 and 40,000 lbs. Powered by a turbine engine and drive motor it is designed for a top road speed of 75 mph, cross-country speed of more than 40 mph and rapid acceleration. The FCS MGS version may field an electromagnetic rail gun or a high-tech version of the current 120mm tank gun. In either case new munitions providing higher velocities, reduced recoil and increased lethality also are in design. Other vehicle versions will be adapted for infantry, long-range anti-tank weapons, non-line-of-sight fires, and command, control and communications. The FCS will be a significantly lighter and more mobile replacement for the current force of Abrams tanks, Bradley Infantry Fighting Vehicles and the Paladin 155mm self propelled howitzer.

One objective of the FCS program is to ensure survivability while reducing the vehicle's weight and size. The FCS program hopes to accomplish this by employing a combination of techniques. High quality, real-time tactical intelligence will provide early warning of potential threats. Aggressive signature management will limit the adversary's ability to detect and target FCS systems. Finally, a combination of passive defenses such as Electronic Warfare and the use of obscurants, and active protection systems, could reduce the likelihood of successful attacks.

The FCS family of manned systems will be linked with and be able to control a family of unmanned robotic ground vehicles and unmanned aerial vehicles, to provide the commanders and crews with remote reconnaissance, surveillance, early warning, force protection and security. "Netfires," a family of expendable missiles currently in development, will engage non-line-of-sight targets. A Loitering Attack Missile will be capable of loitering over an area while its sensors hunt for enemy forces or vehicles, then attacking with a multi-mode warhead. A Precision Attack Missile will be available to attack even more precise targets with a larger multi-mode warhead. Both weapons will have two-way data links, allowing the operators to shift areas for targeting as the battle develops.

The FCS is being designed for a reduced logistical footprint. Fuel consumption will be considerably less per vehicle than current combat vehicles and the engine systems are being designed to produce water for the crew and accompanying personnel, further reducing the logistical requirements. Sensors will warn of vehicle problems and parts commonality

Concept for an FCS IFV.

will ease maintenance. It is envisioned that the FCS, when it reaches maturity, will become self-sustaining for extended periods.

An Independent Assessment Panel for the FCS, drawn from the Institute for Defense Analyses (IDA), reviewed the current effort. IDA concluded the Army was on a logical track to reach new levels of force agility and lethality, that connectivity between systems was the critical enabler for all of the FCS systems and that the FCS "transcends any effort in memory" in contributing to the Army's transformation.

The Army identified 31 critical technologies and the IDA assessment identified seven key performance parameters for the FCS. Not surprisingly, both assessments included survivability as a critical or key factor in FCS development. IDA referred to survivability as the "key to success of the FCS concept." The Army, recognizing that "lightweight vehicles cannot be made as impenetrable as heavy-armored vehicles," is seeking to develop a range of technologies to make light vehicles more survivable. By a combination of sensor and technologies that give the vehicle crew the ability to see or sense the enemy first and the mobility to move to a position where they can fire first, the vehicle's vulnerability to the enemy is reduced. Still the IDA assessment makes it clear that the FCS vehicles "must have sufficient survivability to deal with close engagements" especially in urban areas, "the toughest scenario for FCS." Among the technologies being pursued to deal with the "close engagement" threat are a lightweight integrated composite armor, using various materials and resins, and the active protection systems that sense a high-impact round and react against it instantaneously.

Strategic deployability and tactical mobility are other important considerations of the light-armored vehicle equation. Weight will continue to be the critical factor in determining if the Army's Future Force can reach the 10-30-30 goal. While both the current Stryker and the FCS family of vehicles will be strategically deployable from U.S. bases, there may be circumstances that will limit the ability of Stryker brigades or FCS units to immediately engage in combat upon arrival. For example, the FCS Non-Line-of-Sight, Beyond-Line-of Sight vehicles and mortar vehicle are expected to exceed the 20-ton C-130 weight restriction. This constraint may place the FCS force at the disadvantage of having to deploy without all of its fighting components. While FCS-equipped units would be tactically mobile, without all their firepower components such units would lack the lethality the Army hopes to bring to the battlefield. However, the Air Force is closely following the FCS development and has plans for a new Advanced Tactical Transport capable of airlifting one or two FCS vehicles (depending on which vehicles were being airlifted) 3000 nautical miles directly to an initial entry point. A High Speed Vessel is also being considered as a way of moving brigade/UA-sized units from intermediate staging bases into the combat theater within 24 hours.

Ambitious networking requirements pose another challenge to the creation of the Future Force. The aforementioned IDA assessment noted that the success of the FCS in a combat environment would be "interdependent" with external assets such as sensors and long-range fire systems. The Army will be building into the FCS vehicles the hardware/software

it developed to support the command, control, communications and ISR requirements of the Force XXI experiment and of the "Digital 4th Infantry Division." It is essential the FCS force have "connectivity" with these external assets. What continuous power requirements will be necessary to maintain 24/7 systems connectivity and how much weight this will add to the FCS vehicle, as well as the weight of the armor and the active protection system, have yet to be determined.

Recently, the FCS program was restructured. The timeline for deployment of the initial FCS UA was extended to 2014. Additional funds were provided to ensure the successful completion of the program. More significantly, every two years maturing technologies will now be "spiraled" out of the FCS development program and into the force. Among the candidate systems that will be accelerated into deployment ahead of the first FCS UA are the Non-Line-of-Sight Cannon, several UAVs, unattended ground sensors, and advanced networks.

The FCS family of systems is expected to support some major changes in how the Army goes to war. The FCS vehicles are planned to be more reliable than current vehicles, permitting a reduced logistics footprint that also permits increased strategic deployability. With a decreased logistic requirement for maintenance equipment, parts and units, and a decrease in fuel consumption and combat service support units, there can be an increase in the number of combat units deployed and in the operational tempo of the combat units. If this result occurs, it alone may be one of the most transformational changes to occur within the Army. It may not help the Army reach its 96-hour goal, but it would change how the Army goes to war.

# MEDIUM ARMOR AND THE TRANSFORMATION OF THE MARINE CORPS

The Marine Corps, too, is looking to modernize its armor force. The Marine Corps has always been an expeditionary force. Yet, it too faces an imperative to transform into a more agile, deployable and effective force. This is the reason that the Marine Corps is acquiring the V-22 Osprey. The Marine Corps must work with the Army, which provides the Marines with all their major combat service support, in the transformation of expeditionary force logistics. The Marine Corps is looking for an advanced armored vehicle capability that will enhance its deployability, mobility and flexibility.

A central element of the Marine Corps' transformation program is the Expeditionary Fighting Vehicle (EFV), once known as the Advanced Amphibious Assault Vehicle (AAAV). The EFV program is intended to provide the Marine Corps with a highly effective armored amphibious vehicle that will replace the aging Amphibious Assault Vehicle (AAV). The EFV is as transformational a system as exists, at least in the near term. In the area of strategic and tactical mobility alone, it is also a remarkable improvement over that of the AAV. Employing powerful, high-speed water jet engines, the EFV has an at-sea speed of 23 to 29 mph, about four times that of the AAV. It can also reach the shore from ships as far out to sea as 65 miles, a 20-mile improvement over the AAV. Equally important, the EFV allows for automatic transfer of engine power from the water jets to the vehicle's tracks. This allows for a smooth and rapid transition from water to cross-country movement, reducing the time spent in one of the most difficult and dangerous tasks for amphibious vehicles. The EFV's speed on land, approximately 30 mph, is almost twice that of the AAV, allowing it to keep up with main battle tanks.

Once ashore, the EFV meets all of the Defense Department's criteria for a transformational system. In addition to its high land speed, the EFV has sufficient ballistic protection to defeat rounds up to 14.5mm or fragments from 155mm artillery shells. It also has improved mine-blast protection and a nuclear, chemical and biological defense system. This combination of features alone will provide enhanced survivability.

In addition, the personnel carrier variant of the EFV has a highly lethal 30mm Bushmaster main gun in a two-man turret with digital fire control. This gun system will allow the EFV to engage and defeat lightly armored vehicles with precision fire. Situational awareness will be provided by a set of advanced sensors including a forward-looking infrared system, a laser rangefinder and a compact modular sight. Overall the EFV's speed and maneuverability will help to enable the Marine Corps' concept of expeditionary maneuver warfare, allowing for continuous forward movement from ships located over the horizon and from hostile shores all the way to inland objectives.

The EFV is also an information platform. Both the personnel and command-and-control variants will be equipped with advanced radios, a satellite link and battle computers. The command-and-control variant will have seven work stations and be able to coordinate not only the maneuver of companies and platoons, but also direct-fire support activities. The personnel carrier variant will, according to one source, have more command and control capability than the Marine Corps' current battalion-level command vehicle. Overall, the enhanced information capabilities of both EFV variants will support both more flexible independent operations and tighter linkage with other forces in joint operations.

Acquisition of the FCS could considerably strengthen the Marine Corps' land combat capabilities. The Marine Corps is studying the FCS program with the idea, first of inserting promising technologies into the EFV program and, second to acquiring some FCS capabilities as they mature.

## MEDIUM ARMOR AND THE FUTURE AMERICAN WAY OF WAR

There are organizational and doctrinal changes that will accompany FCS. The Initial Operating Capability (IOC) for the FCS was expected in 2010 but this date has now been slipped at least four years into the future. It is probable that elements of the FCS family of systems will be "spiraled" into the force structure. At this point it is uncertain how the Army will adapt its organization to accommodate the FCS. Initially, it is likely that the FCS will be fit into the current modular redesign of the Army. Future organizational changes are likely as the unique capabilities of the FCS are fully understood and exploited.

Since the FCS family of vehicles contains reconnaissance, infantry, direct-fire and indirect-fire weapons, it is likely the Units of Action will be organized similar to the current armored cavalry squadrons and regiments (ACRs). The ACRs have their own reconnaissance, infantry, direct- and indirect-fire elements that make them self-sufficient in battle. Current Army plans call for the conversion of eight divisions, including both heavy and light divisions into 14 FCS Brigades/UAs by 2020. The divisions include the heavy 1st Armored Division, 1st Infantry Division, 2nd Infantry Division, 3rd Infantry Division and the light 10th Mountain and 25th Infantry Divisions. But these numbers are likely to grow as the Army completes its program to create 48 modular brigade equivalents. Thus, by approximately 2020 the Active Army would be organized as follows: nine airborne or Air Assault Brigades, up to eight Stryker brigades, nine heavy brigades and 22 FCS UAs.

The Army's vision of its force structure in 2020 gives a picture of a force with a range of options for achieving the goals of rapid movement and forcible entry. There will be light brigades, brigades/Units of Action equipped with the medium-weight Strykers and FCS vehicles that can deploy either as initial entry forces or as immediate reinforcements, and heavier UAs that retain armored systems such as the Abrams and Bradley as the counterattack force.

This reorganization reflects a major shift in the Army's effort to rebalance its forces. More than half of the force will be composed of Stryker Brigade Combat Teams or the FCS UAs. This is a shift away from heavy-armored towards medium-armored forces and in the direction of light-armored forces. The FCS concept is relying not only on yet-to-be developed active armor, but also on being able to see the enemy first, to maneuver both to avoid detection and to kill the enemy first. In addition to seeing and killing first, if technology can produce an RPG-resistant armor that can be adapted for the FCS as well as retrofitted to the Strykers, this shift towards light-armored forces will be even more pronounced in the future.

General Schoomaker's proposal to reorganize divisions is a step in the same direction. If through reorganization, heavy armor forces can be made more deployable, it moves the Army a small step closer to its goal.

There is a precedent for his proposed reorganization. In the late 1950s the Army reorganized into Pentomic divisions with each division having five battle groups. The belief was that in the atomic age smaller-sized units presented less of a lucrative target for an atomic attack and that the smaller units could maneuver more easily against the enemy.

The reorganization, however, produced other overwhelming difficulties. In the 1950s communications between battle groups and division headquarters were a major problem. Lack of secure radio communications prevented rapid maneuvers, leaving battle groups uncertain of their missions and division commanders uncertain what their battle groups were doing. When the reorganization was effected, divisions simply divided the combat support and combat service support units among the battle groups. This took the function of logistical support out of the division and gave it to the battle groups. Battle groups soon found they lacked the support capacity to keep their units maintained and supplied. Most importantly, the battle groups found they did not have the artillery support they needed. Each battle group had an organic heavy mortar battery, but did not have artillery with sufficient range to support rapid or deep maneuvers. Artillery remained with the division and corps commanders who, without adequate communications, were uncertain how to employ their artillery fire to best support the maneuver of the battle groups.

Current efforts to make the Army more deployable and effective go well beyond the limited experiments of the late 20th Century. The new approach relies on advances in technology, particularly IT, that will enable both different organizational constructs and entirely new ways of conducting military operations. As a result, the Army is able to make better use of existing equipment and capabilities. The extensive exploitation of IT and other enablers permits the Army to increase the number of brigades in an active division from three to four without a reduction in their combat capability.

Much progress has been made in the past 10 years that will help the Army overcome those past problems. With secure satellite communications, commanders at all levels can be certain what their subordinate units are doing. Joint fires provided by air, helicopter and naval forces would supplement organic artillery. General Schoomaker will undoubtedly take advantage of this progress in reorganizing the Army's divisions. He may continue to find difficulties in the area of logistics. Combat support and combat service support units cannot easily be divided among smaller brigades, and existing doctrine places reliance on the division for logistical support. A Support Unit of Action (roughly of brigade strength) is being developed and will be created to take on the combat support and combat service support functions for Army operations — fires, maneuver enhancement, sustainment and aviation.

The FCS supposedly will not be troubled by the problems of the Pentomic battle groups and will represent a leap ahead in technology over the Strykers. Because their logistical and maintenance requirements will be much less, the FCS UAs will be more self-sustaining for longer periods of time. Their communications will be varied, secure and redundant. Non-line-of-sight weapons with extended ranges and precision munitions will provide fire support.

Transformation need not encompass the entire force. Secretary Rumsfeld assumes, according to his *Transformation Planning Guidance*, that only "a small portion of the force will be transformed during the early phases." This represents a "vanguard" force that can exploit new concepts and capabilities. In turn the "vanguard" force would then lead the spiral development and retrofitting of the rest of the force. No one expects either the Stryker BCTs or the FCS UAs to be as fully capable as the Army would like when the first units are deployed. The spiral development cycle of the DOD acquisition process will hopefully continue to make product improvements to the vehicles and systems until they reach their full potential. During this process breakthroughs in technology may offer opportunities to further transform not only the Future Force, but also the Stryker units and even the existing heavy force.

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1600 Wilson Boulevard : Suite 900 : Arlington Virginia 22209
tel 703.522.5828 : fax 703.522.5837
www.lexingtoninstitute.org : mail@lexingtoninstitute.org