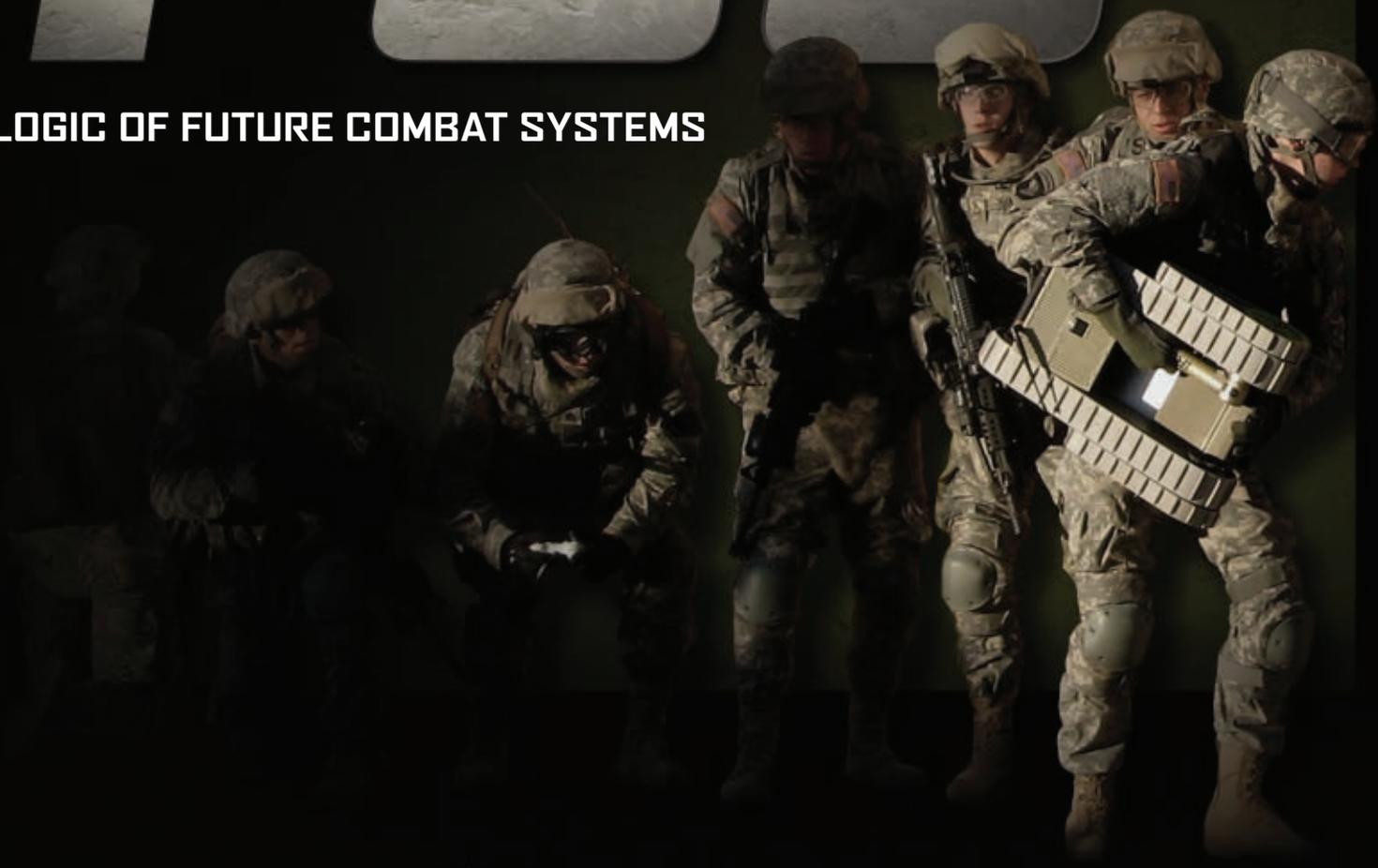


FCS

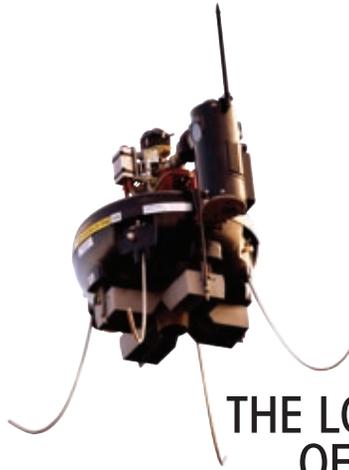
THE LOGIC OF FUTURE COMBAT SYSTEMS



FINDINGS IN BRIEF

- The Army's Future Combat Systems (FCS) program is a family of ground combat vehicles and unmanned reconnaissance aircraft tied together by a high-capacity wireless network. It is the centerpiece of Army modernization efforts, consuming about four percent of the service's budget over the next two decades.
- The need for a network-enabled family of combat systems is driven by the emergence of new threats and the increasing sophistication of more traditional threats. The new threats include unconventional challenges such as terrorists and insurgents, while the traditional threats mainly involve conventional forces that have become more potent due to the growing availability of precision munitions, advanced sensors, digital communications and weapons of mass destruction.
- Future Combat Systems was conceived to bolster Army combat capabilities across the full spectrum of potential military challenges. Using new technologies, embedded training and agile tactics, FCS enables soldiers to stay connected in combat, detect and destroy threats faster, protect themselves more effectively, and project power wherever it is needed on short notice.
- The core elements of FCS are 14 different combat systems united by a shared network, organization and concept of operations. Because they are linked together via a resilient and versatile network, soldiers equipped with FCS capabilities will enjoy unprecedented situational awareness and operational flexibility, permitting them to achieve combat objectives more efficiently while risking as few lives as possible.
- Future Combat Systems is the essential next step beyond resetting existing equipment so that soldiers can be prepared for the fights of the future. If it is not implemented as planned, more soldiers will die due to lack of adequate awareness, agility and protection, while the Army will have to spend a similar amount of money on less effective responses to the emerging threat.

This report was written by Dr. Loren Thompson of the Lexington Institute staff as part of the Institute's continuing effort to analyze military technology requirements and acquisition practices.



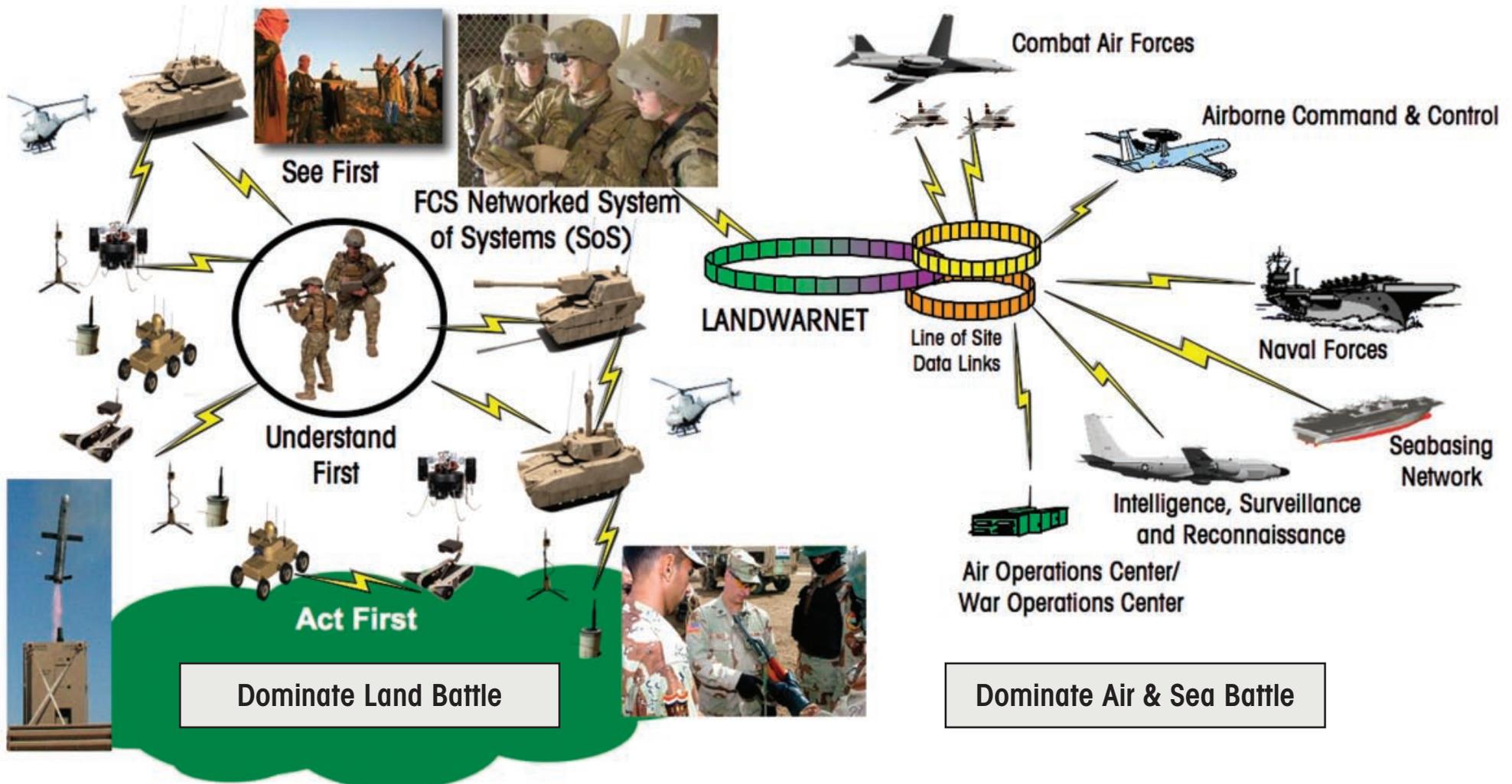
THE LOGIC OF FCS

America's Army has begun the most far-reaching modernization of its warfighting capabilities in forty years. Called the Future Combat Systems, or FCS, the program is designed to reshape the Army so it can respond quickly and decisively to emerging threats. It does this by adapting new technology to the demands of the future battlefield, and then adjusting tactics and training to make maximum use of the capabilities the new technology delivers.

FCS DOMINATES ACROSS THE SPECTRUM OF CONFLICT

Soldiers Conducting Network Enabled Land Warfare

Network Enabled Air and Naval Operations



At the heart of the FCS concept is a wireless network that links each soldier to all the capabilities of the joint force, enabling unprecedented gains in battlefield awareness, precision, protection and agility. But unlike other networking initiatives begun under the banner of transformation, Future Combat Systems has been shaped by the lessons of combat in Iraq and Afghanistan. The capabilities it provides are needed today, and the program has already begun delivering new warfighting tools to soldiers.

This report explains the basic logic of Future Combat Systems, detailing how the program would enable each soldier to achieve combat objectives more safely and successfully. It also describes how FCS would improve functions performed far from the battlefield, such as training and logistics. The report consists of four parts:

- An examination of the emerging threats that made FCS necessary.
- An exposition of how FCS uses new technology to address those threats.
- An explanation of why specific elements were included in the final FCS design.
- An exploration of how soldiers equipped with FCS will be better able to fight and win.

Future Combat Systems is not a traditional weapon system, it is a framework for waging war in a period of rapid and unpredictable change. It assumes that the individual soldier will

remain at the center of land warfare for the foreseeable future, and therefore seeks to equip that soldier with competencies and capabilities that would have been impossible in an earlier time. The fact that the Army believes this can be accomplished for barely four percent of its budget over the next two decades is a testament to the potential of new technology and the skill of American soldiers.

CHANGING THREATS CREATED THE NEED FOR FCS

During the 20th Century, democracy was threatened by three great waves of danger. Imperialism caused World War One. Fascism caused World War Two. Communism caused the Cold War. In each case, dictators tried to harness the industrial might of their nations to halt humanity's long march to freedom. They were defeated because western democracies were better at developing and employing new tools of war, from tanks to submarines to bombers to ballistic missiles.

Today, both the threats that endanger democracy and the technologies that define warfighting have changed. The possibility of conventional combat with other industrial powers persists, but in addition a diverse collection of new enemies has emerged -- suicide bombers, insurgents, weapons traffickers, cyber-terrorists -- who use unconventional tactics to subvert freedom. All of the enemies, new and old, benefit from the availability of technologies like cell phones and the internet that enable them to carry out mass murder while eluding detection or direct combat.



Robotic vehicles are heavily used by U.S. forces in Iraq to clear buildings, search for roadside bombs and in general keep soldiers out of dangerous situations. The prototype Small Unmanned Ground Vehicle shown in this FCS exercise will provide a robotic system that is more portable and versatile than those in use today.

To a greater degree than in the past, today's adversaries operate on the ground rather than in the air or on the seas. They hide in cities and mountains and jungles, where their movements are nearly impossible to track using remote sensing devices. The only way they can be found and defeated is to confront them on the terrain they have chosen, employing better tools and tactics to win over local people while gradually wearing the enemy down.

As the world's leading practitioner of land warfare, America's Army faces two fundamental challenges in preparing for this rapidly changing landscape. First, it must field a force that can survive and win in places where all the traditional features of a battlefield -- front lines, enemy formations, secure areas -- are missing. The elusive adversaries that inhabit such settings will often be indistinguishable from noncombatants and will employ methods utterly at odds with the laws of war. Yet the Army must exhibit restraint and sensitivity if it is to win the support of civilians who are the key to victory.

Second, the Army somehow must posture itself for unconventional warfare while still being prepared to cope with the high-intensity aggression likely to be mounted by other industrialized countries. Many of the foreign militaries the Army might have to fight in the future will possess killing systems more lethal than anything it has faced in the past, including nerve gas, pathogens and even nuclear weapons. The unpredictability of combat in a world where traditional threats are more potent and non-traditional threats are more numerous convinced Army leaders a new approach to warfare was needed.

HOW FCS TECHNOLOGY HELPS SOLDIERS

Future Combat Systems was conceived to prepare each soldier for the full spectrum of future conflict, from peacekeeping to counter-insurgency to conventional combat. It does this by integrating technology, training and tactics in a posture that provides each warfighter with unprecedented agility and awareness. The core of the system is a resilient wireless network that ties together all friendly forces in a war zone, enabling them to share information and capabilities. The network will enable closely coordinated maneuvers by manned and unmanned vehicles that afford far greater survivability and firepower than the cold war systems currently dominating the force.

The Army does not harbor any illusions that technology can take the place of the human element in warfare. The goal of FCS is to harness new technology in support of soldiers, so that they can apply their skills and imagination unhampered by lack of information or chores best left to machines. For example, wide-area surveillance is performed by unmanned aerial vehicles and searches of dangerous places like tunnels is conducted with small robots, tactics already tested in Iraq and Afghanistan (where 4,000 robots and 1,000 unmanned aerial vehicles are in use today). The FCS design uses new technology to support four basic goals: connection, detection, protection and projection.

CONNECT-DETECT-PROJECT-PROTECT



Connection is the most fundamental goal, because it is lack of communication among soldiers that creates the confusion and mistakes practitioners call “the fog of war.” FCS equips each soldier and vehicle with redundant links to all the other friendly forces in the war zone, so there is no doubt about where friendly forces are. Every soldier will share a common operating picture created by fusing together observations from hundreds of different places in the battle area. This pervasive connectivity will permit the force to coordinate its maneuvers much more precisely, maximizing effects against enemies while minimizing the fratricide caused by friendly fire.

Detection of elusive adversaries quickly is a second goal indispensable to the survival and success of U.S. forces. The connectivity provided by the FCS network allows each warfighter to generate reconnaissance for the whole force, because observations can be processed and shared at the speed of light. In addition, the entire battle area will be filled with low-cost sensors, many of them unattended, that can collect and fuse telltale signs of enemy presence -- from the sound of boots to the heat of engines to the electrical emissions of cell phones. Information collected by other military services and intelligence agencies will be continuously fed into the Army’s network and integrated with soldier reconnaissance in a composite picture that is easily interpreted. Unpleasant surprises will still occur, but they will be less frequent and less fatal.

Protection of U.S. forces against a wide range of conventional and unconventional kill mechanisms will be engineered into every FCS vehicle, and into the equipment and body armor every soldier uses. The Army has learned the lesson of Iraq that well-defined front lines are a thing of the past, so FCS provides each soldier

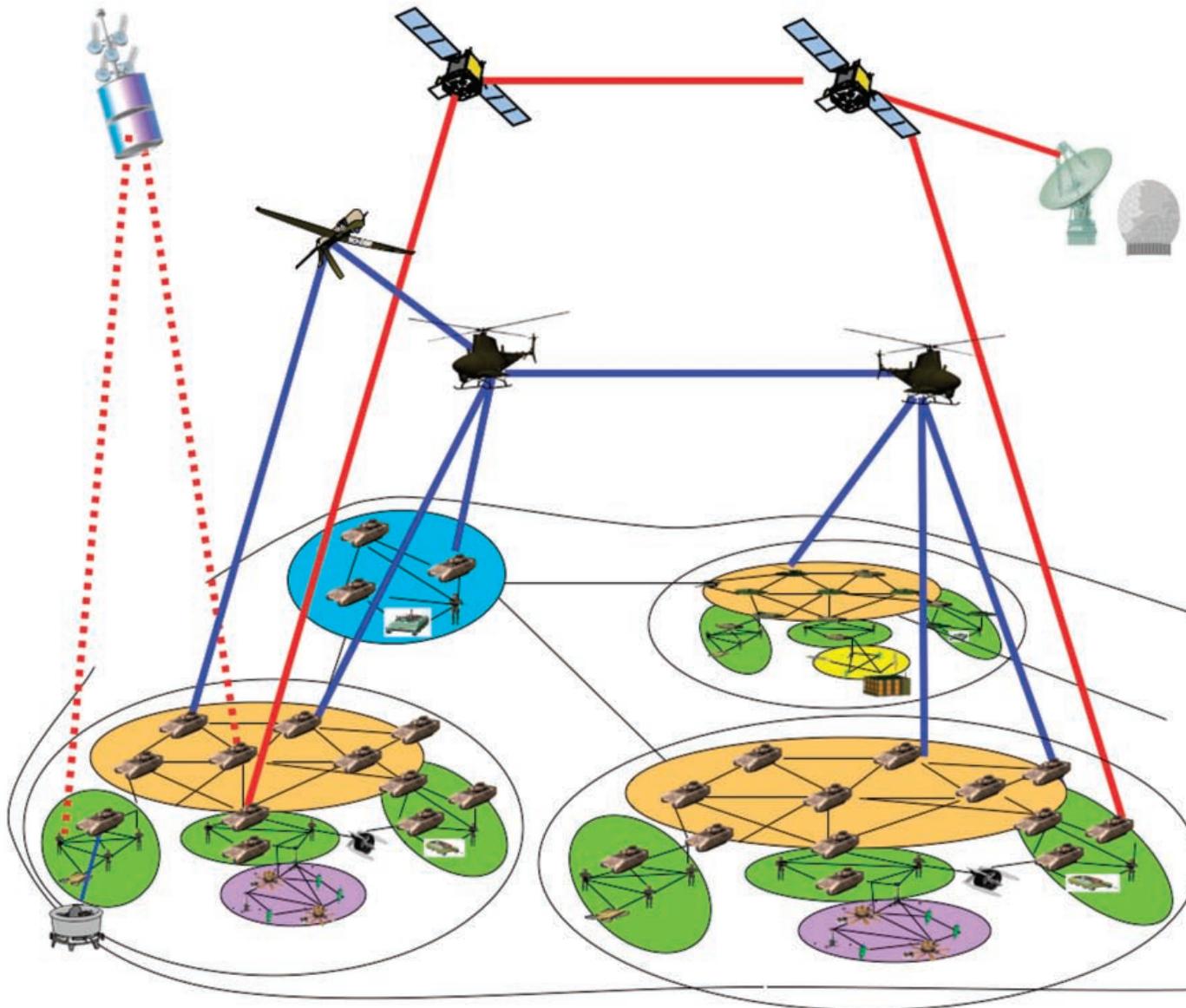
with passive and active defenses far greater than those found in existing fighting systems. For instance, every manned vehicle in the FCS design will provide 360-degree protection against machine guns, rocket-propelled grenades, anti-tank weapons, improvised explosive devices and even the electromagnetic pulse of a nuclear bomb. Not only will the vehicles have better armor, greater agility and enhanced awareness of threats, but they will carry defensive weapons that can detect and intercept incoming projectiles.

Projection is the ability to move forces to remote locations quickly, a goal that has been central to the design of FCS from its inception. Rapid deployment has always been a challenge for U.S. forces because of the long distances from America to the rest of the world, and the advantages of improved transportation like cargo jets have been undercut by the growing weight and logistical requirements of the modern Army. Future Combat Systems addresses the challenge of fast projection by greatly reducing the weight of vehicles, the requirements for skilled manpower, and the volume of supplies that must be moved. The whole force becomes easier to move, and supply problems are further reduced by a network that continually monitors warfighter needs.



FCS unattended sensors will monitor enemy movements in cities and remote terrain without requiring U.S. soldiers to be present.

A ROBUST, RESILIENT COMMUNICATIONS NETWORK



Space Layer

- Commercial SATCOM
- Wideband Global System (WGS)
- Advanced EHF (AEHF)
- Mobile User Objective System (MUOS)

Aerial Layer

- Unmanned Aerial Vehicles (UAV)
- Joint Tactical Radio System (JTRS)
- Warfighter Information Network-Tactical (WIN-T)

Terrestrial Layer

- Joint Tactical Radio System (JTRS)
- Warfighter Information Network-Tactical (WIN-T)
- Soldier Radio Waveform (SRW)
- Wideband Networking Waveform (WNW)

The challenge of sustaining a fast-moving force in the field deserves further discussion, because logistics has often proven to be the Achilles Heel of armies in the past. Future Combat Systems has been designed to greatly reduce the maintenance and support burdens associated with protracted operations in places like Iraq. An FCS brigade combat team will be able to sustain itself at a high operating tempo for three times as long as one of today's heavy brigades while only fielding a third as many support personnel due to smart design and operational concepts. Today's combat vehicles require an hour of maintenance for every two hours of operations, but FCS will raise that ratio to one maintenance hour for every 20 operational hours by using common parts across the fleet, simplifying repair tasks, and anticipating problems before they arise. A typical FCS brigade will save \$1.5 billion per year in support costs compared with today's units, so the program will quickly pay for itself in reduced fuel, parts and personnel outlays.

THE CORE ELEMENTS OF FCS

The information revolution has spawned hundreds of innovations potentially relevant to the conduct of land warfare. The Army and its contractors had to sort through these innovations to determine which offered the most leverage in future combat, and how they could be integrated into a flexible, resilient force posture. It was decided early on that the basic fighting unit of the future should be a brigade combat team rather than the bigger, more cumbersome divisions of cold war years (a cold war brigade typically consisted of over 10,000 troops organized in three brigades).

Future Combat Systems has been designed around the anticipated warfighting needs of tomorrow's brigade combat teams. Not only will it fully equip a select portion of the Army's brigades, but it will provide connectivity and awareness to all the other brigades in the force to fashion a truly unified fighting force. Eventually the entire active and reserve-component force will be equipped with FCS technology, but in the near term the main thrust of development has been focused on the brigades that will be equipped with the full range of new systems, beginning early in the next decade.

Many of the new systems are being deployed to the current force in Iraq and Afghanistan as they become available, but the overall FCS concept cannot be grasped without delineating the core elements that a fully modernized brigade would contain. The Army sometimes uses the shorthand of 14+1+1 to describe these core elements, meaning that there are 14 new warfighting systems plus a network plus the soldier, with the soldier being at the center of the whole scheme. If an FCS brigade combat team were a living being, then the individual soldier would be its brain, the network would be the connective tissue integrating all of the appendages, and the 14 warfighting systems would be the arms, legs and sensory apparatus with which the soldier perceives and shapes the battlefield.



An unmanned Multifunctional Utility/Logistics & Equipment (MULE) vehicle designed for use in infantry and air assault operations.



The Fire Scout unmanned aerial vehicle will enable combat units to view contested areas from above with a variety of sensors. Recent combat experience has demonstrated a need for aerial surveillance systems that can be used quickly by troops under fire.

The FCS network is sometimes described as the central element in the overall design, but that is only true in an engineering sense. The real central element is the individual soldier, because it is unlikely that machines could ever take the place of seasoned warfighters in applying experience, judgment and imagination to the dynamic demands of combat. In the FCS concept, the network and the various warfighting systems it connects are simply extensions of the individual soldier, designed to support his needs and execute his decisions.

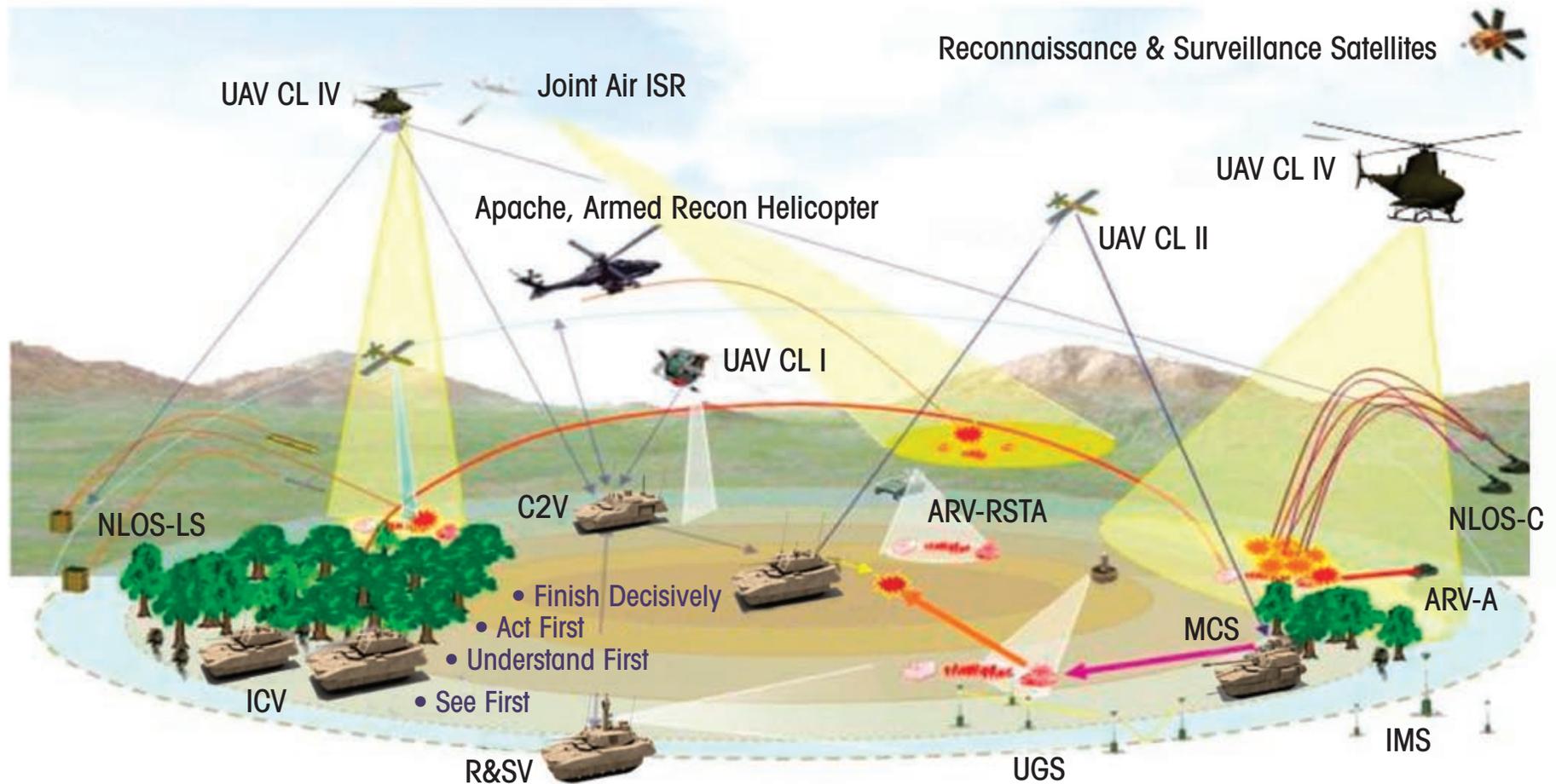
However, that is no easy task on a modern battlefield, and the network that provides the “glue” for Future Combat Systems is a multi-layered system far surpassing the capabilities of any existing warfighting network. Among other things, the FCS network must support:

- A common operating picture for all soldiers in the war zone.
- A resilient communications link for warfighters on the move.
- A command mechanism for close coordination of dispersed forces.
- A planning environment for de-conflicting diverse missions.
- A fusion system for quickly integrating and sharing vital intelligence.

The challenge of performing these and other chores is made much harder by the need to withstand enemy attempts to destroy or subvert the network. The Army rejects the notion of “network-centric” warfare because it minimizes the human dimensions of combat. But service leaders do want to transition to a “network-enabled” posture in which warfighters enjoy all the benefits of new information technology in terms of connectivity, awareness and protection. That requires providing each soldier with network access that is reliable, resilient and robust even in the face of severe aggression such as the use of nuclear weapons.

The 14 warfighting systems included in each FCS brigade combat team will consist of eight types of manned ground vehicles and a variety of unmanned systems such as reconnaissance drones and battlefield sensors. The eight manned vehicles are next-generation armored systems using a common chassis that are designed to provide greatly enhanced deployability and protection while reducing logistical burdens in the war zone. Like existing armored vehicles, the FCS manned ground vehicles will perform a range of functions from precision firepower to infantry transport to tactical reconnaissance, but they will be much lighter than current vehicles -- without sacrificing survivability. They will also be much easier to repair and maintain. Most of the sensors in the FCS network are carried on these vehicles.

FCS SENSOR CAPABILITIES



- Every sensor & vehicle is a node on the network
- Tactical to national sensors linked in near real time

Layered, networked sensors provide location and identification for threat activities

The six unmanned warfighting systems include two aircraft used for reconnaissance and surveillance, unattended ground systems for monitoring enemy movements and providing tactical firepower, and robotic vehicles that can free soldiers from highly dangerous or routine tasks. The unmanned aircraft would enable soldiers at the platoon and brigade levels to conduct airborne reconnaissance of the ground without having to rely on manned aircraft. The unattended ground systems would permit warfighters to detect and respond to hostile actions in the clutter of cities and jungles without having to leave personnel in exposed locations. The robotic vehicles would improve on systems already in use in Iraq and Afghanistan for probing minefields, searching buildings, and delivering supplies.

FCS IN ACTION

The real value of Future Combat Systems resides not in its advanced technology or innovative operating principles, but in the way it answers the key questions that any soldier in combat must pose. Where are my friends? Where is the enemy? How do I defend myself? How to I defeat my foe? When soldiers are under fire and lives are being lost, those are the first questions they ask. FCS is designed to provide the right answers fast -- not just to commanders, but to every friendly soldier in the combat zone.

Where are my friends?

Each vehicle and dismounted soldier will carry a networked global positioning device that continuously informs other friendly forces of their precise location and movements. In addition, all

troops will be connected by a flexible, resilient communications system that allows them to share what they see, what they hear, and what the sensors they carry are detecting. These observations are instantaneously fed into a system that integrates, interprets and displays all relevant information in a "common operating picture" available to every vehicle in the force. Not only will this constantly updated picture report where each soldier is, but it will combine local observations with the reconnaissance of other joint sensors such as unmanned aircraft circling overhead and satellites. FCS thus will pierce the "fog of war" more effectively than any other combat network in history, and share its benefits with individual soldiers at the speed of light.

Where is the enemy?

The integrated, layered reconnaissance system made possible by networked sensors enables soldiers to "see first, understand first, act first." Manned and unmanned sensors will be scattered across and above the battlefield in a seamless web that can see through darkness, clouds, smoke and electronic interference. There will be multiple perspectives on every event, so that geography imposes no limitations on soldiers in grasping what is happening. All of the actions of possible enemies will be tracked in exquisite detail, and then displayed in a form that is easy to act on. Reconnaissance inputs can be easily manipulated by friendly forces to highlight or retask specific sensors, and then the findings can be quickly shared with other units. Few enemies will be able to escape detection by this pervasive network, and fewer still will enjoy the kind of situational awareness U.S. forces possess during every moment of combat.



The Non-Line-of-Sight Cannon developed for the FCS program will provide high rates of precision fire on an easily-deployed vehicle. It will be much easier to sustain in the field than existing artillery due to reduced logistics requirements and simplified maintenance procedures.

How do I defend myself?

Superior situational awareness is a key feature of the protection afforded each soldier by Future Combat Systems, but it is only the beginning. FCS technology provides a spectrum of active and passive counters to enemy attacks ranging from stronger armor and greater agility to electronic countermeasures and an “active protection system” that detects and intercepts incoming projectiles before they impact on vehicles. Vehicle designs have been formulated to provide the best protection available against improvised explosive devices, anti-tank weapons, rocket-propelled grenades, machine gun fire and even such exotic killing mechanisms as nerve gas and nuclear effects. In addition, unmanned systems will be used in place of soldiers on some missions where there is a high danger of exposure to attack. Many FCS force protection innovations will be infused into legacy vehicles as the new technology is fielded, but there is no way that older vehicles can be made as safe as new-design systems incorporating all of the latest technology.

How do I defeat my foe?

Comprehensive networking of friendly forces will enable carefully synchronized maneuvers that enemies cannot match. When combined with detailed, timely situational awareness under the most trying battlefield conditions, American soldiers will be able to use the precision lethality delivered by FCS firepower to maximum effect. Most of the manned ground vehicles and all dismounted soldiers will be equipped with weapons that far surpass existing devices in precision, reach, rates of fire, reliability and maintainability. In addition, soldiers will have the option of employing unmanned killing systems operating on or above the

battlefield. The effectiveness of Army weapons will be further enhanced by the ability to deploy them quickly, and then support them in the field with an agile, highly accurate logistics system. The end result is a spectrum of firepower options that will permit tailored effects against any adversary while minimizing adverse consequences for noncombatants.

THE BOTTOM LINE: FCS IS THE BEST SOLUTION

No single program can solve every problem the military faces. Funding will always be limited, the future will always be unpredictable, and new technology is no substitute for well-trained troops or inspired leadership. But within the constraints that limit all military initiatives, Future Combat Systems seems to offer the best solution to emerging Army needs. Not only can it cope with the full range of prospective threats and contingencies, but it leverages areas in which America has unique advantages -- from the sophistication of its sensors to the initiative of its soldiers. FCS would not be a good match for the conscripted military of a foreign dictatorship, but its design speaks directly to the intelligence, discipline and values of America’s all-volunteer force.



FCS battlefield sensors will greatly enhance the situational awareness of soldiers, bolstering survival rates.

Within that framework, there are five key points about Future Combat Systems that explain why it is likely to remain the centerpiece of Army modernization for the foreseeable future:

- Without the improvements in agility, awareness and protection delivered by FCS, many soldiers are going to die unnecessarily on future battlefields as emerging threats mature.
- FCS technology is already making a difference on today's battlefields, because new capabilities are being fielded as they become available in response to needs identified by soldiers in Iraq and Afghanistan.
- The price-tag for fielding FCS over the next 20 years represents barely four percent of projected Army spending during that period, and will enable the service to avoid the cost of maintaining many legacy systems.
- If FCS is scaled back, a similar amount of money (or more) will need to be spent on alternatives, since cold war systems are overdue for replacement and cannot cope with emerging dangers.
- FCS isn't just the centerpiece of Army modernization, it also enables other facets of improvement by providing the concepts, capabilities and systems that will define the entire future Army.

Thus, the Army has no practical alternative to proceeding with Future Combat Systems. It is the only integrated solution to future warfighting needs that fits within the framework of feasibility and affordability constraining all military efforts. A whole generation of Army leaders have stressed the importance of the capabilities that FCS will deliver, and now the operational needs statements being generated by soldiers in Iraq and Afghanistan confirm that those capabilities are indeed required in the field as soon as possible. Whatever challenges the future may hold for America's warfighters, Future Combat Systems is the closest thing the Army has to an answer.



FCS lightweight aerial reconnaissance systems can be easily carried and controlled by troops in the field.

Printed in the United States of America
April 2008



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