Order Code RL32888

CRS Report for Congress

The Army's Future Combat System (FCS): Background and Issues for Congress

Updated July 1, 2008

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Prepared for Members and
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Summary

The Future Combat System (FCS) is the U.S. Army's multiyear, multibillion dollar program at the heart of the Army's transformation efforts. It is the Army's major research, development, and acquisition program consisting of 14 manned and unmanned systems tied together by an extensive communications and information network. FCS is intended to replace such current systems as the M-1 Abrams tank and the M-2 Bradley infantry fighting vehicle. The FCS program has been characterized by the Army and others as a high-risk venture due to the advanced technologies involved and the challenge of networking all of the FCS subsystems together so that FCS-equipped units can function as intended.

The FCS program exists in a dynamic national security environment which could significantly influence the program's outcome. The Administration has committed the United States to "the Long War," a struggle that could last for decades as the United States and its allies attempt to locate and destroy terrorist networks worldwide. Some question if FCS, envisioned and designed prior to September 11, 2001 to combat conventional land forces, is relevant in this "Long War" where counterinsurgency and stabilization operations feature prominently. The FCS program has achieved a number of programmatic milestones and is transitioning from a purely conceptual program to one where prototypes of many of the 14 FCS systems are under development. With a variety of estimates on the total cost of the FCS program, questions have been raised about FCS affordability. In 2007, citing the impact of past budget cuts, the Army restructured the program from 18 to 14 systems. In June 2008, primarily in response to both congressional and Department of Defense (DOD) concerns about getting FCS technologies to forces in the field sooner and overall program affordability, the Army restructured the program again. Under this current restructuring, the Army will instead focus its FCS equipping efforts on Infantry Brigade Combat Teams (IBCTs) as opposed to heavier FCS BCTs.

The overall FCS program is in a variety of developmental phases, with some technologies on the verge of being fielded to units and others still under development with varying degrees of success. The 110th Congress, in its appropriation, authorization, and oversight roles may wish to review the FCS program in terms of its projected capabilities and program costs. This report will be updated as the situation warrants.

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Issues for Congress

The Future Combat System (FCS) is the Army's multiyear, multibillion-dollar program at the heart of the Army's transformation efforts. It is the Army's major research, development, and acquisition program for the foreseeable future and is to consist of 14 manned and unmanned systems tied together by an extensive communications and information network. FCS is intended to replace such current systems as the M-1 Abrams tank and the M-2 Bradley infantry fighting vehicle. The Army's success criteria for FCS is that it should be "as good as or better than" the Army's current force in terms of "lethality, survivability, responsiveness, and sustainability."[1]

The primary issues presented to 110th Congress are the capabilities and affordability of the FCS program, and the likelihood, given a myriad of factors, that the Army will be able to field its first FCS-equipped brigade by 2014 and eventually field up to 15 FCS-equipped brigades. Key oversight questions for consideration include the following:

- What is the impact of the June 2008 program restructuring on the 15 FCS BCTs?
- The programmatic, budgetary, and operational impact of the Army's June 2008 program restructuring.
- The increasing role of lead systems integrators in FCS program management.
- Possible radio spectrum and satellite problems.

The 110th Congress's decisions on these and other related issues could have significant implications for U.S. national security, Army funding requirements, and future congressional oversight activities. This report will address a variety of issues including the program's timeline, budget, program management issues, current program developmental progress and challenges, and FCS's relevance in the current and potential future security environments.

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[1] Government Accountability Office (GAO) Report "Defense Acquisitions: Improved Business Case is Needed for Future Combat System's Successful Outcome," GAO-06-367, March 2006, p. 2.

Background

FCS Program Origins

In October 1999, then Chief of Staff of the Army (CSA) General Eric Shinseki introduced the Army's transformation strategy which was intended to convert all of the Army's divisions (called Legacy Forces) into new organizations called the Objective Force. General Shinseki's intent was to make the Army lighter, more modular, and — most importantly — more deployable. General Shinseki's deployment goals were to deploy a brigade[2] in four days, a division in five days, and five divisions in 30 days.[3] As part of this transformation, the Army adopted the Future Combat System (FCS) as a major acquisition program to equip the Objective Force.[4]

This transformation, due to its complexity and uncertainty, was scheduled to take place over the course of three decades, with the first FCS-equipped objective force unit reportedly becoming operational in 2011 and the entire force transformed by 2032.[5] In order to mitigate the risk associated with the Objective Force and to address the near-term need for more deployable and capable units, the Army's transformation plan called for the development of brigade-sized units called the Interim Force in both the active Army and the Army National Guard. Some of these seven brigade-sized units,[6] known as both Interim Brigade Combat Teams (IBCTs) or Stryker Brigade Combat Teams[7] (SBCTs), have served in Iraq.[8]

General Shinseki's vision for the FCS was that it would consist of smaller and lighter ground and air vehicles — manned, unmanned, and robotic — and would employ advanced offensive, defensive, and communications/information systems to "outsmart and outmaneuver heavier enemy forces on the battlefield."[9] In order to

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[2] According to Department of the Army Pamphlet 10-1, "Organization of the United States Army," dated June 14, 1994, a brigade consists of approximately 3,000 to 5,000 soldiers and a division consists of approximately 10,000 to 18,000 soldiers.

[3] Frank Tiboni, "Army's Future Combat Systems at the Heart of Transformation," Federal Computer Week, February 9, 2004.

[4] James Jay Carafano, "The Army Goes Rolling Along: New Service Transformation Agenda Suggests Promise and Problems," *Heritage Foundation*, February 23, 2004, p. 5.

[5] Bruce R. Nardulli and Thomas L. McNaugher, "The Army: Toward the Objective Force," in Hans Binnendijk, ed. Transforming America's Military (National Defense University Press, 2002), p. 106.

[6] The Army currently plans to field six active and one National Guard Stryker Brigade Combat Teams.

[7] The Stryker is the Army's name for the family of wheeled armored vehicles which will constitute most of the brigade's combat and combat support vehicles.

[8] Annex A (Modular Conversion) to Army Campaign Plan, Change 2, September 30, 2005, p. A-1.

[9] The following description of the early stages of the FCS program is taken from Frank (continued...)

initiate the FCS program, General Shinseki turned to the Defense Advanced Research Projects Agency (DARPA), not only because of its proven ability to manage highly conceptual and scientifically challenging projects, but also because he reportedly felt that he would receive a great deal of opposition from senior Army leaders who advocated heavier and more powerful vehicles such as the M-1 Abrams tank and the M-2 Bradley infantry fighting vehicle. In May 2000, DARPA awarded four contracts to four industry teams to develop FCS designs and in March 2002, the Army chose Boeing and Science Applications International Corporation (SAIC) to serve as the lead systems integrators to oversee certain aspects of the development of the FCS's 18 original systems. On May 14, 2003, the Defense Acquisition Board[10] (DAB) approved the FCS's next acquisition phase and in August 2004 Boeing and SAIC awarded contracts to 21 companies to design and build its various platforms and hardware and software.

The FCS Program

Program Overview[11]

The Army describes FCS as a joint (involving the other services) networked "system of systems." FCS systems are to be connected by means of an advanced network architecture that would permit connectivity with other services, situational awareness and understanding, and synchronized operations that are currently unachievable by Army combat forces. FCS is intended to network with existing forces, systems currently in development, and systems that will be developed in the future. The FCS is to be incorporated into the Army's brigade-sized modular force structure.

Structure. FCS Brigade Combat Team (BCT) units would include the following:

- Unattended ground sensors (UGS);
- Two classes of unmanned aerial vehicles (UAVs);
- Three classes of unmanned ground vehicles (UGVs): the Armed Robotic Vehicle - Assault (Light) (ARV-A-L), the Small Unmanned Ground Vehicle (SUGV), and the Multifunctional Utility/Logistics and Equipment Countermine and Transport Vehicle (MULE-T);
- Eight types of Manned Ground Vehicles (MGVs);
- The Network; and

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[9] (...continued)
Tiboni's Army's Future Combat Systems at the Heart of Transformation.

[10] The Defense Acquisition Board (DAB) is the Defense Department's senior-level forum for advising the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L)) on critical decisions concerning DAB-managed programs and special interest programs.

[11] Information in this section is taken from the Army's official FCS website [http://www.army.mil/fcs/overview.html].

- The individual soldier and his personal equipment and weapons.

The FCS is to serve as the core building block of the Army's Future Force. FCS-BCTs are to consist of:

- Three FCS-equipped Combined Arms battalions (CABs);
- One Non-Line-of-Sight (NLOS) Cannon battalion;
- One Reconnaissance, Surveillance, and Target Acquisition (RSTA) squadron;
- One Forward Support battalion (FSB);
- One Brigade Intelligence and Communications company (BICC); and
- One Headquarters company.

For a more detailed description of FCS subsystems, see **Appendix A**.

Capabilities.[12] According to the Army, the FCS Brigade Combat Team (BCT) will be designed to be:

- Self- sufficient for 72 hours of high-intensity combat;
- Self- sufficient for seven days in a low to mid-intensity environment;
- Able to reduce the traditional logistics footprint for fuel, water, ammunition, and repair parts by 30% to 70%;
- Sixty percent more strategically deployable than current heavy BCTs; and
- Able to operate across larger areas with fewer soldiers.

FCS Program Timeline

FCS is currently moving towards the System of Systems Preliminary Design Review (PDR) now scheduled for February 2009. The PDR is described as "a multi-disciplined technical review to ensure that a system is ready to proceed into detailed design and can meet stated performance requirements within cost, schedule, risk, and other system restraints."[13] Despite the Army's June 28, 2008, decision to significantly restructure the FCS program "to accelerate FCS deliveries to Infantry Brigade Combat Teams (IBCTs),"[14] Army officials have stated that "the core program has not changed in terms of its time lines."[15]

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[12] Information in this section is taken from the 2007 Army Modernization Plan, March 5, 2007, pp. 8-11, and FCS Brigade Combat Team 14+1+1 Systems Overview 14 March 2007, at [http://www.army.mil/fcs/whitepaper/FCSwhitepaper07.pdf].

[13] "Glossary of Defense Acquisition Acronyms and Terms," Defense Acquisition University, Fort Belvoir, VA, 12th ed., July 2005, p. B-121.

[14] U.S. Army News Release, "Army to Accelerate Future Combat Systems Deliveries (FCS) to Infantry Brigade Combat Teams," Army Public Affairs Office, Washington D.C., June 26, 2008.

[15] Ann Roosevelt, "FCS Needs No New Funds to Accelerate, Officials Say," *Defense Daily,* (continued...)

2009 "Go or No Go" Review.[16] In 2006 Congress directed that after the February 2009 FCS System of Systems Preliminary Design Review (PDR), that DOD conduct a FCS Milestone Review to assess (1) if warfighter's needs are valid and can best be met through the FCS program; (2) whether the concept of the program can be developed and produced within existing resources; and (3) should FCS continue as currently structured, continue in a restructured form or; (4) be terminated. A specific date in 2009 for this review has not yet been established.

Program Schedule. Prior to the Army's June 2008 restructuring, the FCS program was operating under the schedule depicted below:

FCS Program Schedule[17]

Event	Date (FY)	Event description
Systems of Systems Preliminary Design Review (PDR)	2009	A technical review to evaluate the progress and technical adequacy of each major program item. It also examines compatibility with performance and engineering requirements.
FCS Milestone "Go or No Go" Review	2009	A DOD review established by Section 214, P.L. 109-364 to determine if the FCS program should continue as planned, be restructured, or be terminated.
Critical Design Review (CDR)	2011	A technical review to determine if the detailed design satisfies performance and engineering requirements. Also determines compatibility between equipment, computers, and personnel. Assesses producibility and program risk areas.
Design Readiness Review	2011	Evaluates design maturity, based on the number of successfully completed system and subsystem design reviews.
Milestone C	2013	Milestone C approves the program's entry into the Production and Deployment (P&D) Phase. The P&D Phase consists of two efforts — Low Rate Initial Production (LRIP) and Full Rate Production and Deployment (FRP&D). The purpose of the P&D Phase is to achieve an operational capability that satisfies the mission need.

[15] (...continued)
June 27, 2008.

[16] For information in this section see P.L. 109-364, John Warner National Defense Authorization Act for Fiscal Year 2007, Section 214.

[17] MG Charles A. Cartwright and Mr. Tony Melita, Future Combat Systems (Brigade Combat Team) Defense Acquisition Board In-Process Review, June 13, 2007, p. 4.

Event	Date (FY)	Event description
Initial Operational Capability (IOC)	2015	IOC is defined as the first attainment of the capability to employ the system as intended. (Part of the P&D Phase).
Full Operational Capability	2017	The full attainment of the capability to employ the system, including a fully manned, equipped, trained, and logistically supported force. (Part of the P&D Phase).

Note: Event descriptions in this table are taken from the Defense Acquisition Acronyms and Terms Glossary published by the Defense Acquisition University, Fort Belvoir, VA, 12th ed., July 2005.

Program Schedule Concerns. The Government Accountability Office (GAO) has monitored of the FCS program since its inception. One of GAO's continuing program schedule concerns is that:

> FCS design and production maturity are not likely to be demonstrated until after the production decision is made. The critical design review will be held much later on FCS than on other programs, and the Army will not be building production-representative prototypes to test before production. The first major test of the network and FCS together with a majority of prototypes will not take place until 2012. Much of the testing up to the 2013 production decision will involve simulations, technology demonstrations, experiments, and single system testing.[18]

GAO suggests that because testing occurs so close to the production decision, that problems identified during testing will need to be resolved during the production phase, which historically is the most expensive phase in which to correct problems.[19]

March 2008 GAO Reports[20]

Section 211 of the FY2006 National Defense Authorization Act (P.L. 109-163) requires GAO to report annually on a variety of aspects of the FCS program. In recent reports and testimony GAO recommended:

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[18] United States Government Accountability Office (GAO), Testimony Before the Subcommittee on Air and Land Forces, Committee on Armed Services, House of Representatives, "Defense Acquisitions: Future Combat System Risks Underscore the Importance of Oversight," GAO-07-672T, March 27, 2007.

[19] Ibid.

[20] Information in this section is taken from Government Accountability Office (GAO) reports GAO-08-408, "Defense Acquisitions: 2009 is a Critical Juncture for the Army's Future Combat System," and GAO-08-409, "Defense Acquisitions: Significant Challenges Ahead in Developing and Demonstrating Future Combat System's Network and Software," March 7, 2008 and GAO-08-638T, Testimony Before the Subcommittee on Air and Land Forces, Committee on Armed Services, House of Representatives, "Defense Acquisitions: 2009 Review of Future Combat System is Critical to Program's Direction," April 10, 2008.

- That the 2009 DOD FCS Milestone Review be scheduled in a manner where it would be both "well-informed and transparent";

- That objective and quantitative criteria be established that the FCS program will have to meet throughout the remainder of the program;

- That DOD identify viable alternatives to FCS as currently structured that can be considered if FCS fails to meet the criteria established for the 2009 FCS Milestone Review; and

- That the oversight implications of the Army's decision to contract with lead system integrators Boeing and Scientific Applications International Corporation (SAIC) for early production of FCS spin outs, the Non-Line-of-Sight Cannon (NLOS-C) and low rate production of the core FCS program be fully examined.

According to GAO, the Department of Defense has agreed to establish evaluation criteria for the 2009 FCS Milestone Review and finalize these criteria at the 2008 Defense Acquisition Board review.

Selected FCS Program Issues

The Army's June 2008 FCS program restructuring will likely result in a variety of programmatic issues. There are a number of ongoing program issues that will be relevant not only to current efforts to equip IBCTs with FCS technologies, but also if the Army chooses to pursue the eventual fielding of 15 FCS BCTs.

2007 Program Restructuring. In early 2007 the Army citing "the effects of budget reductions [by Congress] over the past three years, and the fiscal guidance for future years [DOD]," reduced the scope and delayed the schedule of fielding the FCS.[21] The major element of this restructuring was eliminating Class II and III UAVs (company and battalion-level UAVs, respectively) and deferring the Armed Robotic Vehicle - Reconnaissance, Surveillance, and Target Acquisition until the Army builds its FY2010 Program Objective Memorandum (POM).[22] The Army also separated the Intelligent Munitions System (IMS) from the FCS program, but will produce IMS under another program. This restructuring reduced the FCS program from 18 to 14 systems. In addition, the Army slowed FCS procurement to the rate of one brigade per year starting in 2015, meaning that it will take until 2030 to field all 15 FCS-equipped brigade combat teams — a five-year delay to field the last FCS brigade. The Army has also reduced the number of FCS technology "spin outs" to current forces from four to three — with the first spin out planned to start in 2008. However, the Army will increase the number of brigades receiving spin out technologies from three to six brigades.

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[21] 2007 Army Modernization Plan, March 5, 2007, p. 8.

[22] Information in this section is from Ashley Roque, "Army Retools FCS to Address Congressional, Service Budget Cuts," *Inside the Army*, February 12, 2007.

The Army maintained that this restructuring would save the Army $3.4 billion over the next six years, but will "put at risk our ability to reach the full tactical and operational potential envisioned for FCS."[23] While the Army may have believed that reducing the cost of the FCS program by decreasing it from 18 to 14 systems would make FCS less contentious in terms of overall cost, some suggest that while "stretching out" the FCS program will likely decrease yearly FCS production costs, it also means that the Army would need additional funds to keep FCS production lines open longer.[24]

2008 Program Restructuring. On June 26, 2008, primarily in response to both congressional and Department of Defense (DOD) concerns about getting FCS technologies to forces in the field sooner and overall program affordability, the Army restructured the program. In an official press release, the Army announced the restructuring, characterizing it as an effort "to accelerate FCS deliveries to Infantry Brigade Combat Teams (IBCTs)."[25] The Army now plans to field the following technologies to 43 IBCTs during the 2011 to 2025 time frame:[26]

- Tactical and Urban Unattended Ground Sensors.
- Non-Line of Sight (NLOS) Launch System (NLOS-LS).
- Network Kits for High Mobility, Multi-Wheeled Vehicles (HMMWV).
- Class I Unmanned Aerial Vehicles (UAVs).
- Small Unmanned Ground Vehicles (SUGVs).
- Ground Soldier Ensemble, a soldier worn command and control system for dismounted soldiers modeled on the Army's Land Warrior System.

The Army will begin a Preliminary Limited User Test (P-LUT) focused on infantry units at Ft. Bliss, TX, in July 2008 in lieu of the previously scheduled heavy FCS BCT Limited User Test. A formal LUT for the infantry BCT is scheduled for FY2009, and the Army hopes to "Spin Out" these technologies to IBCTs beginning

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[23] 2007 Army Modernization Plan, March 5, 2007, p 9.

[24] Ashley Roque, "Army Retools FCS to Address Congressional, Service Budget Cuts," *Inside the Army*, February 12, 2007.

[25] U.S. Army News Release, "Army to Accelerate Future Combat Systems Deliveries (FCS) to Infantry Brigade Combat Teams," Army Public Affairs Office, Washington D.C., June 26, 2008.

[26] Ann Roosevelt, "Army Tightens FCS Focus on Infantry and Current Fight," *Defense daily*, June 26, 2008; U.S. Army News Release, "Army to Accelerate Future Combat Systems Deliveries (FCS) to Infantry Brigade Combat Teams," Army Public Affairs Office, Washington D.C., June 26, 2008; and Daniel Wasserbly, "Bringing Soldiers Into the Network: Army to Align Ground Soldier Program with FCS Spin Out 1 Fielding," *InsideDefense.com*, June 30, 2008.

in FY2011. The Army will alter its overall FCS testing schedule to accommodate the IBCT FCS spin outs. Army officials plan to field IBCT Spin Out One equipment to both Active and National Guard IBCTs, based on when the units are scheduled to deploy to Iraq or Afghanistan.[27]

Non-Line-of-Sight Cannon (NLOS-C).[28] According to Secretary of the Army Geren, the Army will build only five prototype NLOS-Cs in 2008 instead of eight previously planned for due to funding cuts over the past three fiscal years. Secretary Geren said that the three deferred NLOS-Cs would be built in FY2009. The Army fielded the inaugural FCS prototype in June 2008, but program officials are still attempting to solve cooling system and power distribution issues associated with the hybrid-electric drive system which will be common across all MGVs. These NLOS-C prototypes would be used by the Army Evaluation Task Force (AETF) at Ft. Bliss, TX - the Army unit designated to test and evaluate FCS technologies.

Non-Line-of-Sight Launch System (NLOS-LS).[29] In May 2008, the Army successfully tested the Precision Attack Munition (PAM) fired by the NLOS-LS — a technology that is planned to be included in the revised Spin Out One to IBCTs in 2011. During the test, the PAM was able to strike a specified grid coordinate from approximately 40 kilometers away. The PAM is said to have a 10-meter kill radius and a 20-meter blast radius and has been described as a "mini cruise missile." Contingent on additional testing, low-rate production could begin in 2009, and the Navy also plans to acquire the NLOS-LS and PAM for integration into its Littoral Combat Ship (LCS).

Manned Ground Vehicles (MGVs) and Improvised Explosive Devices (IEDs).[30] The Army is developing a counter-IED kit that can be mounted on the 27-ton common MGV chassis for the eight FCS manned vehicles. Because of the MGV's design, it can be raised up to 36 inches off the ground, and a "V"-shaped hull can be fitted to the vehicle when it is operating in areas where IEDs are a high threat. The Army maintains that the IED kit for the MGVs will give it protection equal to or better than a Mine-Resistant, Ambush-Protected (MRAP) vehicle.

Joint Tactical Radio System (JTRS). JTRS radios are software-defined radios that are to be used to provide voice, video, and data communications to FCS ground and aerial vehicles. One of the primary benefits of JTRS is that it is intended to operate on multiple radio frequencies, permitting it to talk to certain non-JTRS radios that are expected to stay in the Army's inventory. JTRS is a joint program and

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[27] Daniel Wasserbly, "Testing Pushed Back to Next Summer: Army to Reprogram Funding in Fy 08, FY 09 for FCS Spin Out 1 Changes," *InsideDefense.com,* June 30, 2008.

[28] Information in this section is taken from Daniel Wasserbly, "Geren: Army to Cut Three Copies from FY-08 NLOS-C Production," *InsideDefense.com,* March 3, 2008 and "Army's First FCS Manned Ground Vehicle Prototype Expected in June," *InsideDefense.com,* April 7, 2008.

[29] Daniel Wasserbly, " Later Tests Will Examine PAM's Seeker: Army Testers Complete Successful FCS Launch System Flight Test," *InsideDefense.com,* May 26, 2008.

[30] Kris Osborn, "MGVs to Get Counter-IED Kits," *Army Times,* June 16, 2008.

therefore is not a part of the FCS program but is instead what the Army describes as a "complimentary program." JTRS is to form the "backbone" of the FCS Network and therefore of critical importance to the program's success.

JTRS Ground Mobile Radio (GMR).[31] The Boeing-led JTRS GMR team consisting of Northrop Grumman, Rockwell Collins, and BAE Systems, with support of Harris Communications, have begun initial production of the Engineering Design Models (EDMs)[32] of JTRS GMR which are to be used in FCS ground vehicles. These models are scheduled to undergo testing throughout 2008 and formal government certification and field testing is planned to begin in late 2008.

JTRS Airborne, Maritime, and Fixed (AMF) Radio.[33] A Lockheed Martin-led team consisting of BAE Systems, General Dynamics, Raytheon, and Northrop Grumman beat out a Boeing-led team consisting of BBN Technologies, L-3 Communications, Milcom Systems Corp., Northrop Grumman, and Rockwell Collins for a $766.1 million contract for the design and development of the JTRS AMF radio for ships, aircraft, and ground sites. The Lockheed Martin team will initially develop 42 engineering development models (EDMs) for small airborne platforms and destroyers and there are options to build EDMs for other weapons systems platforms.

Potential Radio Spectrum Problems.[34] One report suggests that the Army's former Assistant Secretary of the Army for Acquisitions, Logistics, and Technology, Claude Bolton, was concerned that within the next five years, the Army may not have enough radio spectrum "to allow its next-generation networked force [FCS] to work as it is being designed to." The concern is that beginning in 2010, when the Army introduces JTRS and additional technologies designed to transmit vast amount of data from soldiers, sensors, and unmanned and manned ground and aerial vehicles, the available bandwidth will become overwhelmed. To get a better appreciation for the potential problem, both the Army Science Board and RAND Corporation have been asked to estimate the Army's future bandwidth needs, and the FCS program is investigating how FCS will perform if the network is degraded by lack radio spectrum availability and network failure. Industry officials also suggest that the Army is having a hard time keeping up with information demands,

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[31] Boeing Press Release "Boeing Begins Production of Joint Tactical Radio System Ground Mobile Radios Engineering Model," January 8, 2008.

[32] Engineering Design Models (also referred to as engineering development models) are defined by the Defense Acquisition University as a production representative system acquired during the System Development and Demonstration (SDD) Phase and may be used to demonstrate maturing performance via an Operational Assessment (OA) or Operational Testing (OT) and to finalize proposed production specifications and drawings.

[33] Ann Roosevelt, "Lockheed Martin Tops Boeing for JTRS AMF Work," *Defense Daily*, March 31, 2008.

[34] Information in this section is taken from Kris Osborn "U.S. Army Faces Spectrum Crunch," *Defense News,* January 7, 2008: Sandra I. Erwin, "Army Struggling With Rising Demand for Communications," National Defense, April 2008; and Alec Klein, "Weapons Upgrade Faces Big Hurdles: Problems With Wireless Technology May Threaten Army's Ambitious Plans," *Washington Post*, April 8, 2008 .

suggesting, for example, that Army leadership has become "addicted" to video teleconferencing, one of the most bandwidth-consuming applications

Air Force's Transformational Satellite Communications (TSAT) Program. Another issue that could have an impact on spectrum availability for FCS is the Air Force's Transformational Satellite Communications (TSAT) program.[35] The TSAT is planned to be 100 times faster than current military satellites, taking advantage of the latest Internet technology to more efficiently reroute communications traffic and is expected "to provide more securely encrypted communications for FCS to prevent enemies from intercepting or jamming signals."[36] The TSAT program has suffered from delays, restructuring, and cost cuts and it seems unlikely that the first TSAT satellite will be launched in 2016 as planned and some doubt the viability of the entire program. While FCS program officials contend that they could make do with current military and commercial satellites in the event that TSAT is further delayed or cancelled, one defense expert notes to the contrary that:

> TSAT is crucial to the secure networking capabilities that underpin FCS. Given the cutbacks, if TSAT collapses, which looks like a distinct possibility, soldiers may have to rely on links that are harder to access on the move, more vulnerable to jamming and interceptions, and offer nowhere near as much bandwidth.[37]

Warfighter Information Network - Tactical (WIN-T). WIN-T is described as the Army's "communications network of the future consisting of a three-tiered architecture of orbital, airborne, and ground links that will provide connectivity to a dispersed and highly mobile force."[38] WIN-T, reportedly now expected to cost approximately $16.4 billion, is intended to permit the Army to communicate and transfer large amounts of data on the move.[39]

WIN-T Increments.[40] JNN has been "rebranded" as WIN-T Increment One. The Army plans to have fielded 50% of its units with WIN-T Increment One (which began fielding in 2004 as JNN) by mid-2008. WIN-T Increment One is intended to support static headquarters. WIN-T Increment Two is intended to provide network management and the mobile portion of the system, including on-the-move satellite communication (SATCOM) and networking line-of-sight radio. Limited user testing is planned for late 2008, with a production decision possibly in early 2009. WIN-T

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[35] Alec Klein. "Weapons Upgrade Faces Big Hurdles: Problems With Wireless Technology May Threaten Army's Ambitious Plan," *Washington Post*, April 8, 2008

[36] Ibid.

[37] Ibid.

[38] Scott Nance, "Analyst: Advanced Networks to be Rumsfeld Legacy," *Defense Today*, Volume 26, Number 233, December 8, 2005, p. 3.

[39] "Army Restructures WIN-T to Meet Future Combat System Requirements," *Inside the Army*, July 3, 2006 and Josh Rogin, "DOD: Projected WIN-T Costs Soars by $2.2 Billion," Federal Computer Weekly, April 10, 2007.

[40] Information in this section is from Giles Ebbut, "WIN-T Restructuring Fuels Greater Demand," Jane's International Defence Review, December 2007, p. 17.

Increment Three coincides with FCS Spin Out Three and will further link FCS platforms with testing planned to begin in 2011 and fielding in 2014. WIN-T Increment Four is planned to consist of the Transformation Communication Satellite (TSAT) system, which will provide a more capable and protected on-the-move SATCOM system but as previously noted, some consider the TSAT program in jeopardy due to budgetary and programmatic difficulties.

WIN-T Field Testing.[41] The Army has reportedly approved the final designs for WIN-T Increments One and Two for field testing in October 2008. A General Dynamics/Lockheed Martin/BAE Systems/Harris(HRS)/L-3 Communications (LLL) team is currently building test articles for an Increment Two Limited User Test that will involve a division headquarters and two maneuver brigades. Successful testing could lead to deployment of these capabilities in 2009.

Active Protective System (APS). In March 2006, a contract potentially worth $70 million was awarded to Raytheon to develop an Active Protective System (APS) for FCS manned ground vehicles as well as the Army's current fleet of combat vehicles and potentially the Joint Light Tactical Vehicle (JLTV). The APS, divided into a short-range system for dealing with urban-type threats such as rocket-propelled grenades and a long-range system for dealing with anti-tank guided missiles, has been compared to a "mini anti-ballistic missile system." For both systems, a suite of sensors is intended to detect an incoming threat and then hit the incoming projectile with projectile of its own.

The APS program came under public criticism in September 2006 when a press report alleged that the Army rejected an Israeli-developed APS called "Trophy" for use in the FCS program, despite the system being successfully tested on U.S. combat vehicles.[42] The report further contended that the Army was favoring the APS system in development by Raytheon over the Trophy system because of "money and politics" and that U.S. forces in the field were suffering casualties because of this decision.[43] A GAO report however, maintains that there was no conflict of interest, concluding that:

> No officials from the offering companies participated in the evaluation and all offers were evaluated based on the same criteria. Four proposals were evaluated and three were determined to be comparable in terms of cost and schedule. The winner — Raytheon — was chosen on technical merit, as being more likely to meet APS requirements although its design had less mature technology.[44]

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[41] "General Dynamics, Lockheed Martin Authorized to Prepare WIN-T for Field Tests," *Defense Daily,* Vol. 238, No. 22, April 30, 2008.

[42] Adam Ciralsky and Lisa Meyers, "Army Shuns System to Combat RPGs," MSNBC.com, September 5, 2006.

[43] Ibid.

[44] United States Government Accountability Office (GAO), Report to the Chairman, Subcommittee on Air and Land Forces, Committee on Armed Services, House of Representatives, Defense Acquisitions: Analysis of Processes Used to Evaluate Active Protection Systems, GAO-07-759, June 2007, Executive Summary.

The Army contends that the Raytheon system under development can detect and engage incoming projectiles from the front, back, sides, and the top of a vehicle whereas the Trophy system does not detect or engage top-down projectiles thereby creating a significant vulnerability for U.S. vehicles.[45] In addition, the Trophy system presently has a single-shot capability and once a threat is engaged from a certain direction, the vehicle is vulnerable to a second shot from that direction. The Army also believes that the Raytheon system will result in less collateral damage than the Trophy system. The Army suggests that adopting the Trophy system could provide soldiers with a "false sense of security." In late July or early August 2008, the Army plans to conduct its first full system end-to-end test of the system's short-range countermeasures.[46] The Army intends to begin full system end-to-end test of the system's long-range countermeasures in FY2010.[47]

FCS Program Budget

FY2008 National Defense Authorization Act.[48] The Conference Report to H.R. 1585 (P.L. 110-181) authorized $3.334 billion in research and development (R&D) and $99.6 million in procurement budget for FCS. This was a cut of about $229 million from the FY2008 FCS R&D budget request, but conferees fully funded the $99.6 million procurement request for "long-lead items" and for Spin Out One technologies. Conferees also transferred about $100 million of WIN-T R&D funding to procurement accounts for JNN to support the fielding WINT-T Increment One and stipulated that no more than 50% of these funds may be obligated until the Director of Operational Test and Evaluation has approved the WIN-T Increment One Test and Evaluation Master Plan and Initial Operational Test Plan.

FY2009 FCS Budget Request.[49] The Administration has requested $3.6 billion for FY2009 — with approximately $3.3 billion for R&D and approximately $300 million for procurement. Procurement funds include the manufacturing and assembly of the first six Non-Line-of-Sight Cannons (NLOS-C) to be fielded in FY2010 and FY2011 and for software and communications packages that are intended to link the FCS network to M-1 Abrams, M-2 Bradleys, and modified wheeled vehicles that will serve as surrogates for FCS MGVs during FCS initial operational tests scheduled for FY2011.

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[45] Information from this section is from an Army FCS Briefing given on September 7, 2006.

[46] Daniel Wasserbly, "Evaluating Short-Range Countermeasures: FCS' Active Protection System to Start Live Intercept Testing," *InsideDefense.com,* June 23, 2008.

[47] Ibid.

[48] House Armed Services Committee Press Release "Agreement Reached on H.R. 1585, The Fiscal Year 2008 National Defense Authorization Act Conference Report," December 6, 2007.

[49] Information in this section is taken from "The Army Budget - Fiscal Year 2009," U.S. Army News Release, Army Public Affairs Office, February 4, 2008 and Daniel Wasserbly, "Army's FY-09 Budget Includes $3.6 Billion for Future Combat Systems," *InsideDefense.com,* February 11, 2008.

FY2009 Defense Authorization Bill (H.R. 5658) Markup.[50] The Senate Armed Services Committee (SASC) has recommended fully funding the President's FCS FY2009 budget request. The House Armed Services Committee (HASC) Air and Land Subcommittee recommend $ 200 million less than the President's budget request. In addition, $33 million was shifted within the FCS program from long-term portions to near-term elements that could be fielded by 2011. Subcommittee Chairman Abercrombie stated that the $200 million reduction was:

> ... based on the need to shift funding to higher priority Army readiness needs and the fact that the FCS program, in addition to a history of delays and cost overruns, continues to operate in violation of many major Department of Defense acquisition policies, including the basic and long-standing policy requiring full and adequate testing of equipment before production begins.[51]

Mark-up language is said to include the following provisions:

- Beginning with the FY2010 Budget Request, separate funding lines for five FCS equipment classes, including manned ground vehicles, unmanned ground vehicles, unmanned aerial vehicles, unattended ground sensors, and "other FCS elements";

- A requirement for annual reports to congressional defense committees on cost growth for the program's eight manned ground vehicles, as well as an independent report - to be submitted by July 1, 2009 - on possible vulnerabilities to the FCS communications network;

- A measure that would prohibit the Army from awarding low-rate or full-rate production contracts for "major elements" of FCS to companies serving as the program's lead systems integrator.

Some members however, disagree with the mark-up reductions and provisions. Representative Saxton is said to have urged the subcommittee to "give the Army one year of stable funding in order to let the Secretary of Defense and the Army decide

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[50] Press Release, United States Senate Committee on Armed Services, "Senate Armed Services Committee Completes Markup of National Defense Authorization Bill for Fiscal Year 2009," May 1, 2008; John M. Donnelly, "Defense: House Armed Services Panel Aims at Administration's Defense Priorities," *CQ Today*, May 7, 2008, p. 11; Statement of Chairman Neil Abercrombie, Air and Land Forces Subcommittee Mark-Up of H.R. 5658, National Defense Authorization Act for FY2009, May 7, 2008; and Daniel Wasserbly, "House Panel Votes to Cut $200 Million from FCS, Boost Oversight," *InsideDefense.com*, May 7, 2008.

[51] Statement of Chairman Neil Abercrombie, Air and Land Forces Subcommittee Mark-Up of H.R. 5658, National Defense Authorization Act for FY2009, May 7, 2008.

the fate of the FCS program in 2009."[52] Other members are said to have expressed worries about the lead system's integrator provision.[53]

Impact of Past Budget Cuts. The Army contends that because of congressional budget cuts amounting to more than $789 million between FY2006 and FY2008, the FCS program will require between $700 million to $1.1 billion over the next six years to remain on schedule.[54]

Additional Funding for 2008 Program Restructuring.[55] Army officials have stated that they will not require additional funding for the 2008 program restructuring, but will instead reprogram existing funding to field FCS equipment to IBCTs. This reprogramming will be needed to fund testing and production, with the Army noting that test schedules will need to be altered and equipment will need to be purchased in the near-term for those tests. There is a degree of skepticism of the Army's claim that no additional funding will be required because few details have been provided about the Army's new plans to equip and field the original 15 FCS BCTs. Under the original plan, these FCS BCTs would begin to receive equipment in 2011, with the first FCS BCT becoming operational in 2015. Some program officials have suggested that "another, possibly farther-reaching FCS restructure is being mulled,"[56] one which might provide insight into the Army's plans for its 15 FCS BCTs.

FCS Cost Estimates. In March 2006, GAO estimated that the current total cost for the FCS program was $160.7 billion (then-year dollars) — an increase of 76% over the Army's first estimate.[57] In July 2006, the Department of Defense's Cost Analysis Improvement Group (CAIG) estimated that the total cost for the development, procurement and operations of FCS had increased to more than $300 billion.[58] The Army maintains that the total cost for the FCS program will be roughly

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[52] Daniel Wasserbly, "House Panel Votes to Cut $200 Million from FCS, Boost Oversight," *InsideDefense.com,* May 7, 2008.

[53] Ibid.

[54] Ann Roosevelt, "FCS Incurs Schedule Breach, Operational Capability Slips to 2017," *Defense Daily,* February 8, 2008 and Marina Malenic and Daniel Wasserbly, "Army Budget Official Unveils Service Request, Reiterates Concerns About Supplemental Funds," *InsideDefense.com,* February 4, 2008.

[55] Ann Roosevelt, "FCS Needs No New Funds to Accelerate, Officials Say," *Defense Daily,* June 27, 2008 and Daniel Wasserbly, "Testing Pushed Back to Next Summer: Army to Reprogram Funding in FY 08, FY 09 For FCS Spin Out 1 Changes," *InsideDefense.com,* June 30, 2008.

[56] Daniel Wasserbly, "Testing Pushed Back to Next Summer: Army to Reprogram Funding in FY 08, FY 09 For FCS Spin Out 1 Changes," *InsideDefense.com,* June 30, 2008.

[57] Government Accountability Office (GAO) Report "Acquisitions: Business Case and Business Arrangements Key for Future Combat System's Success," GAO-06-478T, March 1, 2006, p. 8.

[58] Megan Scully, "Army Sticks to its Guns, Rejects New FCS Cost Estimates," *National Journal's Congress Daily AM,* July 13, 2006.

$230 billion, based on an April 2006 estimate from the FCS Program Office.[59] An August 2006 Congressional Budget Office (CBO) study postulated that, given historic cost growth in similar programs, that annual FCS costs could reach $16 billion annually, exceeding the Army's estimates of $10 billion annually.[60] The Army has disputed CBO's estimates, calling them "seriously flawed" suggesting that CBO does not address the strategic environment or changing operational requirements.[61] In June 2007, the Institute for Defense Analysis (IDA) — a nonprofit corporation that administers three federally funded research and development centers — reportedly concluded that the FCS program would cost $13 billion more than what the Army has estimated, a conclusion that the Army has rejected.[62] Some maintain that this wide disparity in FCS cost estimates eight years into the program has resulted in a lack of confidence that the FCS program can be conducted in a cost-efficient manner.

Revised DOD Cost Estimate.[63] On April 7, 2008 DOD provided Congress with revised cost estimates on a number of defense acquisition programs. DOD revised the total FCS program cost downward by 1.6 percent to just over $159.3 billion, primarily due to the application of revised inflation indices, but also including past incorrect indices, decreases in other program support, and Congressional statutory reductions.

Potential Issues for Congress

What Is the Future of the 15 FCS BCTs?

The Army's June 2008 FCS program reorganization focuses exclusively on providing FCS technologies to IBCTs for the "current fight," although it might be argued that fielding FCS Spin Out One in 2011 to the first of 43 IBCTs does not adequately address the needs of commanders in the field today. The lack of detail about how the 15 FCS BCTs fit into this reorganization and re-prioritization could lead to speculation that the Army does not intend to field 15 FCS BCTs by 2030 as per the 2007 program plan. If this is the case, there are significant operational and budgetary issues associated with any plans to scale back or lengthen the 15 FCS BCT fielding that Congress might wish to explore with the Army and DOD.

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[59] Ibid.

[60] "The Army's Future Combat Systems Program and Alternatives," A CBO Study, August 2006, p. xii.

[61] Ann Roosevelt, "Army Calls CBO's FCS Report Seriously Flawed," *Defense Daily,* Vol. 231, No. 52, September 19, 2006.

[62] Daniel Wasserbly, "Study: Army FCS Program Will Cost $13 Billion More Than Estimated," *InsideDefense.com,* July 30, 2007.

[63] DOD Press Release, "Department of Defense Releases Selected Acquisitions Reports," Number 276-08, April 7, 2008 and Marina Malenic, "DOD Revises FCS Cost Downward Using New Inflation Indicies," *Inside Defense.com,* April 14, 2008.

What Are the Programmatic, Budgetary, and Operational Impacts of the June 2008 Program Restructuring?

The June 2008 restructuring will provide FCS technologies to IBCTs sooner than originally planned and could play an important role in terms of military effectiveness in Iraq and Afghanistan. This focus on IBCTs might be viewed by some as a concession by the Army that FCS BCTs are less relevant in counterinsurgency and stabilization operations than IBCTs, which operate dismounted and have a greater interaction with civilians. While this restructuring might prove to be beneficial for current operations, there are a number of longer-term programmatic, budgetary, and operational impacts associated with this action. Will the FCS program need to be extended beyond 2030? If FCS BCTs are to be reduced or eliminated, what is the impact on the M-1 Abrams and M-2 Bradley Programs? What are the long-term budgetary implications of the 2008 restructuring — will it increase or decrease the total FCS program cost? How will this restructuring change the tactical and operational employment of the Army throughout the entire spectrum of operations? Will the restructuring result in a less or more capable FCS-equipped force? How will the restructuring affect how the Army conducts operations with the other Services and allies?

Increasing Role of FCS Lead Systems Integrators[64]

In a March 2008 report, GAO expressed its concern over FCS Lead Systems Integrator (LSI) Boeing's expanded responsibilities for FCS production and increasing Army dependency on the major defense contractor for activities not originally envisioned at the program's outset. Initially, the FCS LSI team of Boeing and Science Applications International Corporation (SAIC) were to be involved in developmental activities that the Army felt were beyond its capabilities. In 2005, the Army strengthened the organizational conflicts of interest clause in the FCS contract "to preclude the LSI from competing for any further contracts."[65] Despite this provision, GAO notes that the LSI's involvement in the production phase has grown. Because the Army does not believe that the first brigades equipped with FCS will meet upper-tier operational requirements, the Army has made the LSI responsible for planing future FCS enhancements during the production phase. The LSI is also responsible for "defining and maintaining a growth strategy for integrating new technologies into the FCS brigade combat teams."[66] GAO further maintains that the LSI will likely play a significant role in the sustainment phase of the FCS program which will virtually guarantee that the LSI will "remain indefinitely involved in the FCS program."

GAO has warned in previous reports that "the complex relationship with Boeing increases the burden of oversight and poses risks for the Army's ability to provide

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[64] Information in this section is taken from Government Accountability Office (GAO) report GAO-08-408, "Defense Acquisitions: 2009 is a Critical Juncture for the Army's Future Combat System," March 7, 2008.

[65] Ibid., p. 38.

[66] Ibid.

independent oversight over the long term."[67] Given Boeing's ever-increasing involvement in FCS production decisions, spin-outs - as well as their lead roles in developing the System-of-Systems Common Operating Environment (SOSCOE) and JTRS (GMR) - GAO is concerned that:

- The government can become increasingly vested in the results of shared decisions and runs the risk of being less able to provide oversight;
- The Army's performance, such as in developing critical technologies, may affect the LSI's ability to perform, a situation that can pose accountability problems; and
- It may be difficult for the Army to separate its own performance from that of the LSI's when making decisions on how or whether to award fees.[68]

Given the likelihood of increasing LSI involvement in not only the production and sustainment phases of the FCS program, a detailed examination of the FCS program in terms of responsibilities - past, current, and anticipated - might be in order. In areas that the Army does not feel it has the ability to manage, perhaps DOD, a Defense Agency, or perhaps another service, could be asked to manage a particular aspect of the program (not unlike how JTRS is currently being managed) as opposed to turning increasing levels of development and management responsibility over to the LSI. In this regard, the government might achieve a greater degree of oversight within the program, perhaps avoiding some of the aforementioned potential problems cited by GAO.

FCS and Possible Radio Spectrum Problems

The possibility that an FCS-equipped force could overwhelm available bandwidth raises some potential issues for congressional consideration. The waveforms associated with JTRS radios and other FCS technologies will use more of the electromagnetic frequency spectrum than is used by current Army communications systems. While there are potential future technological solutions to this issue, such as data compression, there is a near-term concern that spectrum limitations could have a significant operational impact on FCS, which is heavily dependent on continuous and near real-time data from a variety of sources for not only its combat effectiveness but its survival on the battlefield. These concerns take on a greater sense of urgency if the Army intends to accelerate the FCS program in the near future. The role that the TSAT program plays in the FCS bandwidth equation might also be a subject for greater study and oversight as it has the potential to have significant impact on the quantity, quality, security, and speed of information available to soldiers in FCS BCTs. Given these implications, Congress may choose

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[67] Ibid.

[68] Ibid., p. 39.

to explore this issue in greater detail with not only the Army and DOD but also with the scientific community and industry.

Additional Reading

CRS Report RL32476, *U.S. Army's Modular Redesign: Issues for Congress*, by Andrew Feickert.

CRS Report RS22707, *Mine-Resistant, Ambush-Protected (MRAP) Vehicles: Background and Issues for Congress*, by Andrew Feickert.

CRS Report RL33161, *The Joint Tactical Radio System (JTRS) and the Army's Future Combat System (FCS): Issues for Congress*, by Andrew Feickert.

CRS Report RL34333, *Does the Army Need a Full-Spectrum Force or Specialized Units: Background and Issues for Congress* by Andrew Feickert.

CRS Report RS21195, *Evolutionary Acquisition and Spiral Development in DOD Programs: Policy Issues for Congress*, by Gary J. Pagliano and Ronald O'Rourke.

Appendix. FCS Subsystems

Manned Ground Vehicles

FCS manned ground vehicles (MGVs) are a family of eight different combat vehicles — with some having more than one variation — that are based on a common platform and are being designed to be air transportable by the U.S. Air Force. They are to be equipped with a variety of passive and active protection systems and sensors that the Army hopes will offer them the same survivability as the current heavy armor force. In addition the Army intends for its MGVs to be highly reliable, require low maintenance, and have fuel-efficient engines. The following are brief descriptions of MGV types and variants. All are intended to have a range of 750 kilometers and a top speed of 90 kilometers per hour (kph) — 55 miles per hour:[69]

Mounted Combat System (MCS). As envisioned, the MCS provides direct and beyond-line-of-sight (BLOS) fires, is capable of providing direct fire support to dismounted infantry, and can attack targets with BLOS fires out to a range of 8 kilometers. The MCS is intended to replace to current M-1 Abrams tank. The MCS is to have a crew of two and might also be able to accommodate two passengers. The MCS is to be armed with a 120 mm main gun, a .50 caliber machine gun, and a 40 mm automatic grenade launcher.

Infantry Carrier Vehicle (ICV). As planned, the ICV consists of four versions: the Company Commander version, the Platoon Leader verison, the Rifle Squad version, and the Weapons Squad version. All four versions appear to be identical from the exterior to prevent the targeting of a specific carrier version. The Rifle Squad version is to have a two-man crew, and is to be able to transport a nine-man infantry squad and dismount them so that they can conduct combat operations on foot. The ICV is to mount a 30 or 40 mm cannon.

Non-Line-of-Sight Cannon (NLOS-C). The NLOS-C is to provide networked, extended-range targeting and precision attack of both point and area targets with a wide variety of munitions. Its primary purpose will be to provide responsive fires to FCS Combined Arms Battalions and their subordinate units. The NLOS is to have a two-man crew and a fully automated handling, loading, and firing capability.

Non-Line-of-Sight Mortar (NLOS-M). The NLOS-M is intended to provide indirect fires in support of FCS companies and platoons. The NLOS-M is to have a four-man crew, mount a 120mm mortar, and also carry an 81 mm mortar for dismounted operations away from the carrier.

Reconnaissance and Surveillance Vehicle (RSV). As planned, the RSV will feature advanced sensors to detect, locate, track, and identify targets from long

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[69] Information for these descriptions are taken from two Army sources: The Army's *FCS 18+1+1 White Paper*, dated October 15, 2004, and the *FCS 2005 Flipbook*, dated August 26, 2004.

ranges under all climatic conditions, both day and night. The RSV is to have a mast-mounted long-range, electro-optical infra-red sensor, sensors for radio frequency (RF) intercept and direction finding as well as a remote chemical warfare agent detector. RSVs are to also carry four dismounted scouts, unattended ground sensors (UGS), a Small Unmanned Ground Vehicle (SUGV) with various payloads, and two Unmanned Aerial Vehicles (UAVs). In addition to the four scouts, the RSV is to have a two-man crew and a defensive weapons system.

Command and Control Vehicle (C2V). The C2V is intended to serve as the "hub" for battlefield command and control. It is to provide information management for the integrated network of communications and sensors for the FCS brigade combat teams. The C2V is to have a crew of two and carry four staff officers and also be capable of employing UAVs.

Medical Vehicle - Evacuation (MV-E) and Medical Vehicle - Treatment (MV-T). There are to be two versions of the MV: the MV-E and MV-T. The MV-E would permit combat trauma specialists to be closer to the casualty's point of injury as it is to move with combat forces and evacuate casualties to other treatment facilities. The MV-T is to enhance the ability to provide Advanced Trauma Management/Advanced Trauma Life Support forward in the battle area and both MV-E and MV-T would be capable of conducting medical procedures and treatments using telemedicine systems. Both would have four-man crews and the capability to carry four patients.

FCS Recovery and Maintenance Vehicle (FRMV). The FRMV would be the FCS Brigade Combat Team's recovery and maintenance system. The FRMV is to have a crew of three, plus additional space for up to three recovered crew members.

Unmanned Aerial Vehicles (UAVs)[70]

Each FCS-equipped brigade will have a number of UAVs.[71] While these UAVs are to provide a variety of capabilities to forces on the ground, some experts note that they could also present an air space management challenge to not only manned Army aviation assets, but also to Navy, Marine Corps, Air Force, and other nation's aircraft that might be providing support to Army ground operations. The following are brief descriptions of the Army's four classes of UAVs:

Class I UAVs. Class I UAVs are intended to provide Reconnaissance, Surveillance, and Target Acquisition (RSTA) at the platoon level. Weighing less than 15 pounds each, these Class I UAVs are intended to operate in urban and jungle terrain and have a vertical takeoff and landing capability. They are to be used to observe routes and targets and can provide limited communications transmissions relay. The Class I UAV are to be controlled by dismounted soldiers and can also be

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[70] Unless otherwise noted, UAV information for these descriptions are taken from two Army sources: The Army's *FCS 18+1+1 White Paper*, dated October 15, 2004 and the *FCS 2005 Flipbook*, dated August 26, 2004.

[71] Sandra I. Erwin, "Army to Field Four Classes of UAVs," *National Defense*, April 2003.

controlled by selected FCS ground platforms, and have an endurance of 50 minutes over an 8 kilometer area, and a 10,500 foot maximum ceiling.

Class IV UAVs. Class IV UAVs are intended to provide the FCS brigade commander with a long endurance capability encompassing all functions in Class I through Class III UAVs. It is intended to stay aloft for 72 continuous hours and operate over a 75 kilometer radius with a maximum ceiling of 16,500 feet. It is also planned to interface with other manned and unmanned aerial vehicles and be able to take off and land without a dedicated airfield.

Unmanned Ground Vehicles (UGVs)[72]

Armed Robotic Vehicle (ARV). The ARV was intended to come in two variants — the Assault variant and the Reconnaissance, Surveillance, and Target Acquisition (RSTA) variant. The RSTA variant has been deferred as part of the Army's 2007 FCS program restructuring. The two variants were to share a common chassis. The Assault variant is to provide remote reconnaissance capability, deploy sensors, and employ its direct fire weapons and special munitions at targets such as buildings, bunkers, and tunnels. It is also intended to be able to conduct battle damage assessments, act as a communications relay, and support both mounted and dismounted forces with direct and anti-tank fire as well as occupy key terrain.

Small Unmanned Ground Vehicle (SUGV). The SUGV is a small, lightweight, manportable UGV capable of operating in urban terrain, tunnels, and caves. The SUGV will weigh 30 pounds, operate for 6 hours without a battery recharge, and have a one kilometer ground range and a 200 meter tunnel range. Its modular design will permit a variety of payloads which will enable it to perform high-risk intelligence, surveillance, and reconnaissance (ISR) missions, and chemical weapons or toxic industrial chemical reconnaissance.

Multifunctional Utility/Logistics and Equipment Vehicle (MULE). The MULE is a UGV that will support dismounted infantry. It is to come in three variants sharing a common chassis — transport, countermine, and the Armed Robotic Vehicle - Assault - Light (ARV-A-L). The transport variant is to be able to carry 1,900 to 2,400 pounds of equipment and rucksacks for dismounted infantry and follow them in complex and rough terrain. The countermine variant is to have the capability to detect, mark, and neutralize anti-tank mines. The ARV-A-L variant is to incorporate a weapons package and a RSTA package to support dismounted infantry operations. The MULE is intended to have a 100 kilometer road, and 50 kilometer cross country, range.

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[72] Unless otherwise noted, information for these descriptions are taken from two Army sources: The Army's *FCS 18+1+1 White Paper*, dated October 15, 2004 and the *FCS 2005 Flipbook*, dated August 26, 2004.

Unattended Ground Sensors (UGS)[73]

UGS are divided into two groups — Tactical UGS and Urban UGS — and are described as follows:

Tactical UGS. Tactical UGS include intelligence, surveillance, and reconnaissance (ISR) sensors and Chemical, Biological, Radiological, and Nuclear (CBRN) sensors. These sensors are to employ a variety of sensing technologies and integrated into the overall FCS network. They are intended to be deployed by hand, by vehicle, or by robot and have a 48 hour endurance. They are intended to be expendable, low-cost sensors used for such tasks as perimeter defense, surveillance, target acquisition, and CBRN early warning.

Urban UGS. Urban UGS can also be employed by soldiers, vehicles, or robots and are intended to provide situation awareness inside and outside of buildings for force protection and also for previously cleared buildings and areas.

Non-Line-of-Sight Launch System (NLOS-LS). NLOS-LS is to consist of missiles in a deployable, platform-independent, container launch unit (CLU), which can be fired in an unmanned and remote mode. Each CLU is to have a fire control system and 15 missiles consisting of Precision Attack Missiles (PAM).

The PAM is to have two employment modes — a direct-fire and a fast attack mode or a boost-glide mode. The missile is intended to receive target information prior to launch and receive and respond to target location updates while in flight. The PAM can be fired in the laser-designated mode and transmit near real-time target imagery prior to impact.

The Network[74]

The FCS network is considered the most crucial system of all 14 systems. The FCS network is to consist of four interactive components — the System-of-Systems Common Operating Environment (SOSCOE); Battle Command (BC) software; communications and computers (CC); and intelligence, reconnaissance and surveillance (ISR) systems.

System-of-Systems Common Operating Environment (SOSCOE). The SOSCOE is to enable the integration of a variety of software packages into the FCS network. It is intended to use commercial, off-the-shelf hardware and allow for the integration of critical interoperability packages that translate Army, Navy, Air Force, Marine Corps, and allied message formats into internal FCS message formats.

Battle Command (BC) Software. Battle Command mission applications are to include mission planning and preparation, situational understanding, battle command and mission execution, and warfighter-machine interface.

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[73] Ibid.

[74] Ibid.

Mission Planning and Preparation. Consists of 16 different functions that provide FCS units with the following automated capabilities:

- The development of deliberate, anticipatory, and rapid-response plans;
- The ability to perform plan assessments and evaluations;
- The ability to perform terrain analysis;
- The conduct of mission rehearsals; and
- The conduct of after action reviews.

Situation Understanding. This consists of 10 different packages that allow the user to better comprehend his surroundings. These packages employ map information and a variety of databases that help to determine enemy locations and capabilities, infer enemy intentions, and assess the threat to U.S. forces.

Battle Command and Execution. This package contains a variety of planning and decision aids to help commanders make rapid, informed, and accurate decisions during battle. These packages can also be used in the training and rehearsal modes.

Warfighter-Machine Interface Package. This package receives soldier-generated information and displays information across all FCS platforms for soldier use.

Communications and Computer (CC) Systems. The Communications and Computer network is intended to provide secure, reliable access to information over extended distances and complex terrain. This network is not intended to rely on a large and separate infrastructure because it is to be embedded in the FCS mobile platforms and move with the combat units. The communications network is to consist of a variety of systems such as the Joint Tactical Radio System (JTRS); Wideband Network Waveform and Soldier Radio Waveform systems; Network Data Link; and the Warfighter Information Network Tactical (WIN-T).

Intelligence, Reconnaissance and Surveillance (ISR) Systems. The Intelligence, Reconnaissance and Surveillance System is to be a distributed and networked array of multispectral ISR sensors intended to provide timely and accurate situational awareness to the FCS force. In addition, the ISR system is intended to help FCS formations avoid enemy fires while providing precision, networked fires to the unit.