

# CRS Report for Congress

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

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

## 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." 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, and the Army cites anticipated budgetary constraints for the recent restructuring of the program from 18 to 14 systems.

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 110<sup>th</sup> 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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# The Army's Future Combat System (FCS): Background and Issues for Congress

## 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 FCS program has been characterized by the Army and others as a high-risk venture due to the advanced technologies involved as well as the challenge of networking all of the FCS subsystems together. 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."<sup>1</sup>

The primary issues presented to 110<sup>th</sup> 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:

- What are the military risks resulting from the FCS program restructuring?
- Are there potential radio spectrum limitations that could affect FCS?
- What is the potential for Navy, Marine, and Air Force participation in the FCS program?
- Is the Army overstating FCS's potential role in counterinsurgency operations?

The 110<sup>th</sup> 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, and program systems issues and subsystems, as well as current program developmental progress and challenges.

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<sup>1</sup> 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<sup>2</sup> in four days, a division in five days, and five divisions in 30 days.<sup>3</sup> As part of this transformation, the Army adopted the Future Combat System (FCS) as a major acquisition program to equip the Objective Force.<sup>4</sup>

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.<sup>5</sup> 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,<sup>6</sup> known as both Interim Brigade Combat Teams (IBCTs) or Stryker Brigade Combat Teams<sup>7</sup> (SBCTs), have served in Iraq.<sup>8</sup>

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.”<sup>9</sup> In order to

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<sup>2</sup> 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.

<sup>3</sup> Frank Tiboni, “Army's Future Combat Systems at the Heart of Transformation,” *Federal Computer Week*, February 9, 2004.

<sup>4</sup> James Jay Carafano, “The Army Goes Rolling Along: New Service Transformation Agenda Suggests Promise and Problems,” *Heritage Foundation*, February 23, 2004, p. 5.

<sup>5</sup> 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.

<sup>6</sup> The Army currently plans to field six active and one National Guard Stryker Brigade Combat Teams.

<sup>7</sup> 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.

<sup>8</sup> Annex A (Modular Conversion) to Army Campaign Plan, Change 2, September 30, 2005, p. A-1.

<sup>9</sup> 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 the development and eventual production of the FCS's 18 original systems. On May 14, 2003, the Defense Acquisition Board<sup>10</sup> (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<sup>11</sup>

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 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
- The individual soldier and his personal equipment and weapons.

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<sup>9</sup> (...continued)

Tiboni's Army's Future Combat Systems at the Heart of Transformation.

<sup>10</sup> 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.

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

The FCS is to serve as the core building block of the Army's Future Force. FCS-equipped brigade combat teams (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.**<sup>12</sup> 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 January 2009.<sup>13</sup> 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.”<sup>14</sup> FCS program leadership maintains that the program is now out of the conceptual phase and is focusing on designing, building, integrating, and testing FCS subsystems.

**Program Schedule.** At present, the FCS program is operating under the schedule depicted below:

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<sup>12</sup> 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>].

<sup>13</sup> MG Charles A. Cartwright and Mr. Tony Melita, Future Combat Systems (Brigade Combat Team) Defense Acquisition Board In-Process Review, June 13, 2007, p. 11.

<sup>14</sup> “Glossary of Defense Acquisition Acronyms and Terms,” Defense Acquisition University, Fort Belvoir, VA, 12<sup>th</sup> ed., July 2005, p. B-121.



### FCS Program Schedule<sup>15</sup>

Event	Date (FY)	Event description
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.
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.
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, 12<sup>th</sup> 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

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<sup>15</sup> 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.

decision will involve simulations, technology demonstrations, experiments, and single system testing.<sup>16</sup>

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.<sup>17</sup>

## Selected FCS Program Activities

FCS program officials contend that the program “is moving from the drawing board to reality” with some prototype manned ground vehicles (MGVs) currently being built.<sup>18</sup> Selected program activities are examined in the following sections:

**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.<sup>19</sup> 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).<sup>20</sup> The Army also separated the Intelligent Munitions System (IMS) from the FCS program, but will produce IMS under another program. This restructuring will reduce the FCS program from 18 to 14 systems. In addition, the Army will slow 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.

The Army maintains that this restructuring will 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.”<sup>21</sup> While the Army may believe that reducing the cost of the FCS program by decreasing it from 18 to 14 systems will 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,

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<sup>16</sup> 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.

<sup>17</sup> Ibid.

<sup>18</sup> Kris Osborn, “FCS: Fielding Coming Soon,” *Army Times*, April 2, 2007.

<sup>19</sup> 2007 Army Modernization Plan, March 5, 2007, p 8.

<sup>20</sup> Information in this section is from Ashley Roque, “Army Retools FCS to Address Congressional, Service Budget Cuts,” *Inside the Army*, February 12, 2007.

<sup>21</sup> 2007 Army Modernization Plan, March 5, 2007, p 9.

it also means that the Army will need additional funds to keep FCS production lines open longer.<sup>22</sup>

**Non-Line-of-Sight Cannon (NLOS-C) Becomes a Separate Program.**<sup>23</sup> In response to Section 8088 of the Conference Report (Report 11-434) for H.R. 3222, FY2008 Defense Appropriations Act, DOD acquisition officials have directed that the FCS NLOS-C program for 18 NLOS-C systems be removed from the FCS program and established as a separate “special interest” program. DOD’s mandate does not create a separate program management office for the NLOS-C, and it will remain under the direction of the FCS Program Manager’s office. Instead, it will create a separate acquisition strategy for the NLOS-C so that fielding of the system may begin in FY2010. NLOS-C procurement funding was also capped at \$505.2 million (FY2003 base year dollars) by DOD. The intent of these actions is likely to facilitate the production of the NLOS-C, which is scheduled to enter into production before the other seven MGCV variants and also to ensure that funds are available for NLOS-C procurement.

**Unmanned Ground Vehicle Completes Design Review.**<sup>24</sup> In December 2007, the Multifunction Utility/Logistics and Equipment (MULE) FCS Unmanned Ground Vehicle (UGV) reportedly successfully completed its Preliminary Design Review (PDR) and was judged ready to move into the detailed design phase of acquisition. This design review was of all variants of the MULE, including the Armed Robotic Vehicle - Assault - Light. The next milestone for the MULE is a Critical Design Review (CDR), scheduled for August 2009.

**FCS Army Evaluation Task Force.** In 2006 the Army announced that the FCS Evaluation Brigade Combat Team (EBCT) would begin to form at Ft. Bliss, TX in March 2007. The Army has since renamed the EBCT the Army Evaluation Task Force (AETF), which now consists of just under 1,000 soldiers, 65% of whom are veterans of Iraq or Afghanistan.<sup>25</sup> The AETF was activated as the 5<sup>th</sup> BCT, 1<sup>st</sup> Armor Division, on September 19, 2007. The AETF is scheduled to conclude training on some of the equipment the Army intends to “spin out” to current forces in 2008. These technologies include FCS network kits (called “B” Kits) for M-1 Abrams tanks and M2A3 Bradley infantry fighting vehicles that will allow the installation of the current increment of the Systems of Systems Common Operating Environment (SOSCOE), a four channel version of the Joint Tactical Radio System (JTRS), unmanned ground sensors, and the Non-Line-of-Sight Launch System (NLOS-LS). The AETF is also scheduled to receive the Micro Air Vehicle unmanned aerial

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<sup>22</sup> Ashley Roque, “Army Retools FCS to Address Congressional, Service Budget Cuts,” *Inside the Army*, February 12, 2007.

<sup>23</sup> Information in this section is taken from Daniel Wasserbly, “Initial NLOS-C Acquisition Redefined as Special Interest Program,” *InsideDefense.com*, December 10, 2007.

<sup>24</sup> Information in this section is taken from Daniel Wasserbly, “Unmanned FCS Mule Systems Successfully Complete Design Review,” *InsideDefense.com*, January 7, 2008.

<sup>25</sup> Unless otherwise noted, information in this section is taken from Daniel Wasserbly, “AETF to Complete New Equipment Training on FCS Spin Out 1 Next Month,” *InsideDefense.com*, December 24, 2007.

vehicle (Class I) and the Small Unmanned Ground Vehicle in January or February 2008 for testing.

**Spin Out One Preparations.**<sup>26</sup> Preparations are underway for the first “spin out” of FCS capabilities to units in the field, which is scheduled to begin in FY2008 and run through FY2010. According to Army officials, the AETF is scheduled to begin a technical field test of FCS Spin Out One components at the end of February 2008. After this first test is completed sometime in March 2008, the AETF is scheduled to begin exercises designed to conduct advanced training, as well as to develop tactics, techniques, and procedures (TTPs) for Spin Out One technologies. In May 2008, a more rigorous exercise simulating force-on-force combat conditions will be conducted, and in July 2008, a large scale FCS limited-user test will be conducted to help determine whether to approve the production of “B” Kits and other FCS technologies.

**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 therefore not considered part of the FCS program by the Army, but it is to form the “backbone” of the FCS Network and therefore of critical importance to the program’s success.

GAO reports that the 2006 JTRS program restructuring “appears to put the program in a better position to succeed, by emphasizing an incremental, more moderate risk approach to developing and fielding capabilities.”<sup>27</sup> While the restructuring of the estimated \$37 billion program is viewed as a positive development, GAO notes that the program still faces a number of long term technical challenges in terms of interoperability, meeting size, weight, and power constraints, and meeting information assurance requirements.<sup>28</sup>

JTRS has recently conducted a number of tests and program reviews that have been described by some as “successful” and “on cost, and on schedule.”<sup>29</sup> In particular, the JTRS Ground Mounted Radio (GMR), which will be mounted in FCS MGVs, has reportedly had a number of successful field tests, and the JTRS

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<sup>26</sup> Information from this section is taken from Daniel Wasserbly, “AETF to Complete New Equipment Training on FCS Spin Out 1 Next Month,” *InsideDefense.com*, December 24, 2007; Kris Osborn, “Vehicles With FCS Gear Put Through Paces,” *Defense News*, December 10, 2007, p. 20; Kris Osborn, “February Tests Set for FCS Gear,” *Defense News*, October 29, 2007; and Scott R. Gourley, “U.S. Begins Set Up of FCS Spin Out One Package, Jane’s Defense Weekly, October 24, 2007, p. 30.

<sup>27</sup> Government Accountability Office, *Defense Acquisitions: Restructured JTRS Program Reduces Risk, but Significant Challenges Remain*, GAO-09-955, September 2006, p. 4.

<sup>28</sup> *Ibid.*, p. 1.

<sup>29</sup> Marina Malenic, “Joint Tactical Radio System Tests and Reviews Continue,” *Inside the Army*, February 26, 2007 and Ann Roosevelt, “Boeing JTRS GMR Program on Cost, On Schedule, Officials Says,” *Defense Daily*, March 13, 2007.

Handheld, Manpack, Small (HMS) has had a number of successful technology demonstrations and has undergone a design review.

**Potential Radio Spectrum Problems.**<sup>30</sup> A report suggests that the Army's outgoing Assistant Secretary of the Army for Acquisitions, Logistics, and Technology, Claude Bolton, is 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.

**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."<sup>31</sup> 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.<sup>32</sup>

Program delays in WIN-T program compelled the Army to extend an interim program — the Joint Network Node (JNN) — which employed off-the-shelf networking technology to provide improved communications and data transfer capabilities to the Army in Iraq. Although JNN does provide many of the capabilities that WIN-T hopes to eventually embody, JNN does not provide a mobile networking capability. There has been a great deal of concern expressed about the redundancy between the WIN-T and JNN programs, as well as their respective costs.<sup>33</sup>

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<sup>30</sup> Information in this section is taken from Kris Osborn "U.S. Army Faces Spectrum Crunch," *Defense News*, January 7, 2008.

<sup>31</sup> Scott Nance, "Analyst: Advanced Networks to be Rumsfeld Legacy," *Defense Today*, Volume 26, Number 233, December 8, 2005, p. 3.

<sup>32</sup> "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.

<sup>33</sup> Daniel Wasserbly, "House Cuts Over \$2 Billion from Joint Network Node Funding in FY-08," *InsideDefense.com*, May 28, 2007.

**Nunn-McCurdy Breach and Merger with JNN.**<sup>34</sup> On March 5, 2007, the Secretary of the Army notified Congress that the WIN-T program had exceeded its approved program baseline by more than 25%.<sup>35</sup> Both the Senate and House Armed Services Committees recommended in their markups of the FY2008 Defense Authorization Bill (H.R. 1585, S. 1584) that the Army combine the WIN-T and JNN programs.<sup>36</sup> In response to the Nunn-McCurdy breach and congressional language, DOD decided in June 2007 to restructure the WIN-T program and merge it with the JNN program.<sup>37</sup> The Army tentatively plans on fielding WIN-T in four increments, with each increment having increasing capability.

**WIN-T Increments.**<sup>38</sup> 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 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 will consist of the Transformation Communication Satellite (TSAT) system, which will provide a more capable and protected on-the-move SATCOM system but will not likely be operational until at least 2015.

**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.

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<sup>34</sup> Nunn-McCurdy refers to the Nunn-McCurdy Amendment (Sen. Sam Nunn, D-GA, and Rep. David McCurdy, D-OK) to the FY1982 Defense Authorization Act (P.L. 97-86) that calls for the termination of weapons programs when the program’s total costs grow by more than 25% above original estimates, unless the program is certified as critical by the Secretary of Defense or the cost growth was attributable to specified changes in the program.

<sup>35</sup> Testimony of Dr. James I. Finley, Deputy Undersecretary of Defense (Acquisition and Technology) before the House Armed Services Committee, March 27, 2007.

<sup>36</sup> Press Release: Senate Statement on the FY 08 Defense Authorization Bill, May 25, 2007, and House Armed Services Committee, House Armed Services Committee Approves Fiscal Year 2008 Defense Authorization Bill, May 9, 2007.

<sup>37</sup> Daniel Wasserby, “Army to Restructure WIN-T Program After Nunn-McCurdy Breach,” *InsideDefense.com*, June 25, 2007.

<sup>38</sup> Information in this section is from Giles Ebbut, “WIN-T Restructuring Fuels Greater Demand,” *Jane’s International Defence Review*, December 2007, p. 17.

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.<sup>39</sup> 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.<sup>40</sup> 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.<sup>41</sup>

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.<sup>42</sup> 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” and also suggests that the Raytheon-developed system is progressing favorably, noting that it was knocking down live warheads during testing. Reports suggest that APS development has progressed better than anticipated and that the Army may begin to install the “Quick Kill” APS system on FCS vehicles in 2010, two years earlier than previously planned.<sup>43</sup>

## FCS Program Budget

The FCS program budget has risen steadily since 1999 as the program has evolved. DOD asked for \$3.7 billion in FY2008 for FCS Research, Development, Testing and Evaluation (RDT&E) and \$99.6 million for procurement of long-lead items for Spin Out One.<sup>44</sup>

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<sup>39</sup> Adam Ciralsky and Lisa Meyers, “Army Shuns System to Combat RPGs,” MSNBC.com, September 5, 2006.

<sup>40</sup> Ibid.

<sup>41</sup> 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.

<sup>42</sup> Information from this section is from an Army FCS Briefing given on September 7, 2006.

<sup>43</sup> Kris Osborn, “U.S. Army Adapts FCS Design to Take On IEDs,” *Defense News*, December 10, 2007.

<sup>44</sup> President Bush’s FY2008 Defense Budget Submission, February 5, 2007, p. 8.

**FY2008 National Defense Authorization Act (H.R. 1585, S. 1584).**

**House Armed Services Committee.** The House Armed Services Committee (HASC) initially recommended \$2.8 billion for FCS in FY2008 — a reduction of \$867 million.<sup>45</sup> The HASC based the reduction on a number of factors including, “schedule and cost challenges, a history of Army changes to the program and a serious concern about how the cost of the FCS program could affect the future health of the Army,” further suggesting that the security environment in which FCS exists has changed significantly “but the Army has not sufficiently adjusted the program to accommodate this new reality.” The HASC, however, recommended fully funding the Administration’s \$99.6 million FCS procurement request so the Army could begin procuring long-lead items intended to be fielded for Spin Out One. The HASC also urged the Army to merge the JNN and WIN-T programs, and also recommended funding reductions to both programs due to program delays, cost overruns, and questions about operational testing. The committee also included a provision requiring the Army to conduct realistic operational testing of the FCS Network before initiating low-rate production of FCS MGVs.

**Senate Armed Services Committee.** The Senate Armed Services Committee (SASC) recommended: “Fully funding the President’s budget request for the Army’s Future Combat System (FCS), adding \$90 million to restore FY 2008 funding for the Armed Robotic vehicles deleted in the recent [Army’s] program restructure, and adding \$25 million to accelerate the development of the FCS active protection system.”<sup>46</sup> In addition, the SASC included provisions to conduct a comparative live fire test of active protection systems and an assessment of current and developing foreign and domestic active protection systems, as well as the merger of the WIN-T and JNN programs.<sup>47</sup>

**House Appropriations Committee.** The House Appropriations Committee (HAC) recommended FY2008 FCS funding of \$3.157 billion — \$406 million below the President’s request, contending that the President’s request was “in excess of what was needed to keep the program on a reasonable development schedule.”<sup>48</sup>

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<sup>45</sup> Information in this section is from House Armed Services Committee, “House Armed Services Committee Approves Fiscal Year 2008 Defense Authorization Bill,” May 9, 2007, pp. 36-37.

<sup>46</sup> Press Release : Senate Statement on the FY 08 Defense Authorization Bill, May 25, 2007 and House Armed Services Committee, “House Armed Services Committee Approves Fiscal Year 2008 Defense Authorization Bill,” May 9, 2007.

<sup>47</sup> Ibid.

<sup>48</sup> House Committee on Appropriations, Summary: 2008 Defense Appropriations Full Committee Markup, July 25, 2007.



**Senate Appropriations Committee.**<sup>49</sup> The Senate Defense Appropriations Subcommittee fully funded the President's FY2008 budget request for FCS, as well as the initial procurement of FCS equipment required for Spin Out One.

**FY2008 National Defense Authorization Conference Report.**<sup>50</sup> The Conference Report to H.R. 1585 authorizes \$3.334 billion in research and development (R&D) and \$99.6 million in procurement budget for FCS. This is 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. On December 22, 2007, the President announced that he was withholding his approval of H.R. 1585 because of a number of Iraq-related provisions

**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.<sup>51</sup> 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.<sup>52</sup> The Army maintains that the total cost for the FCS program will be roughly \$230 billion, based on an April 2006 estimate from the FCS Program Office.<sup>53</sup> 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.<sup>54</sup> The Army has disputed CBO's estimates, calling them "seriously flawed" suggesting that CBO does not address the strategic environment or changing operational requirements.<sup>55</sup> In June 2007, the Institute for Defense Analysis (IDA) — a nonprofit

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<sup>49</sup> U.S. Senate Committee on Appropriations Press Release, "Senate Defense Appropriations Subcommittee Passes Fiscal Year 2008 Defense Appropriations Bill - Subcommittee Markup," September 11, 2007.

<sup>50</sup> 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.

<sup>51</sup> 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.

<sup>52</sup> Megan Scully, "Army Sticks to its Guns, Rejects New FCS Cost Estimates," *National Journal's Congress Daily AM*, July 13, 2006.

<sup>53</sup> *Ibid.*

<sup>54</sup> "The Army's Future Combat Systems Program and Alternatives," A CBO Study, August 2006, p. xii.

<sup>55</sup> Ann Roosevelt, "Army Calls CBO's FCS Report Seriously Flawed," *Defense Daily*, Vol. 231, No. 52, September 19, 2006.

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.<sup>56</sup> 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.

## Potential Issues for Congress

### What are the Military Risks Resulting from FCS Restructuring?

The Army maintains that reducing the FCS program from 18 to 14 systems will 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.”<sup>57</sup> Some question if this statement is rhetoric or if there will be an actual loss of combat capability, calling into question the wisdom of potentially spending more than \$160 billion for an FCS-equipped force that might not be as capable as the Army has advertised. While the Army has provided detailed estimates on the logistics, troop, and long-term cost savings that it believes will be derived from FCS, some feel that the tactical benefits of FCS are less well understood. Given what is perceived as the highly speculative nature of the original FCS (18 system) program’s tactical capabilities, some question how the Army can quantify the military risk of restructuring the program to 14 systems. Congress may decide to explore this issue with the Army, possibly requiring the Army to quantify FCS operational capabilities and the military risk resulting from its decision to restructure the FCS program.

### 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 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. Given these implications, Congress may choose to explore this issue in greater detail with not only the Army and DOD but also with the scientific community and industry.

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<sup>56</sup> Daniel Wasserbly, “Study: Army FCS Program Will Cost \$13 Billion More than Estimated,” *InsideDefense.com*, July 30, 2007.

<sup>57</sup> 2007 Army Modernization Plan, March 5, 2007, p. 9.

## Other Service Participation in the FCS Program

It has been reported that the Marines, Navy, and Air Force are considering procuring FCS vehicles, sensors, and networking technologies.<sup>58</sup> The Marines are said to be interested in procuring a number of different types of FCS MGVs, as well as a variety of FCS network technologies. The Navy and Air Force are also said to be interested in the System of Systems Common Operating Environment (SOSCOE). An Army official maintains that other Service acquisition of FCS vehicles and technologies could help to reduce production, maintenance, and logistics costs for the overall program. Congress might decide to examine the potential impact of Marine, Navy, and Air Force procurement of FCS vehicles and technologies. Such an examination could provide insights into cost savings as well as into how the Army's FCS procurement timeline might be affected by the requirements of the other Services.

## FCS and Counterinsurgency

The Army contends that FCS is specifically designed for the "Long War" and fighting insurgencies.<sup>59</sup> To support its position, Army leadership cited the results of a computer simulation of convoy security operations in Iraq where a computer-simulated FCS battalion was sent to rescue a convoy ambushed by insurgents. When the simulation was conducted with the FCS battalion having "continuous situational awareness," the simulated enemy could take "no actions that FCS could not see," resulting in the FCS battalion accomplishing its mission in one hour with no soldiers killed or wounded. When the simulation was run using a non-FCS battalion in its place, it took the non-FCS battalion three hours and eight soldiers killed and more than 50 wounded to accomplish the same mission against the same enemy.

Some might argue that the Army is being overly optimistic about FCS's ability to achieve "continuous situational awareness," which enables FCS to find and engage the enemy as well as avoid potential threats that could destroy lightly armored FCS MGVs. In terms of survivability, the Congressional Budget Office notes:

Many analysts have concluded that current technology does not permit the construction of light-weight combat vehicles that match or surpass current vehicles in reliability and invulnerability to enemy weapons. Furthermore, the Army's experience in Iraq suggests that its strategy for making lightly armored vehicles equally as survivable as the heavily armored Abrams tank may not be feasible. To achieve comparable survivability, U.S. combat vehicles would avoid being targeted by exploiting superior knowledge of enemy activities. The threat in Iraq has come primarily in urban settings from individually launched weapons,

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<sup>58</sup> Information in this section is taken from Kris Osborn, "Other U.S. Services May Buy FCS Technology," *DefenseNews.com*, June 25, 2007.

<sup>59</sup> Information in this section is from Ann Roosevelt, "FCS Would Bring Significant Advantages to Future Insurgency-Type Operations, Harvey Say," *Defense Daily*, January 23, 2007, and Fawzia Sheik, "Army Leaders See Future Combat System as Counterinsurgency Tool," *InsideDefense.com*, February 19, 2007.

and the ability to identify attackers' locations may be beyond any technology now envisioned.<sup>60</sup>

While most agree that the FCS network, as envisioned by the Army, should provide the Army with enhanced communications, intelligence, and sensing capabilities, some might argue that the Army is placing undue emphasis on theoretical FCS technological capabilities in making its case for FCS relevancy in counterinsurgency operations. Some suggest that effective counterinsurgency operations are characterized by cultural awareness, interpersonal relationships, and security provided through human presence, and are less a function of superior technology and firepower.

A recent study that questions the effectiveness of modern "mechanized" militaries in waging a successful counterinsurgency campaign might also have relevance in examining FCS's role in counterinsurgency.<sup>61</sup> The study, citing empirical historical evidence dating from 1800 to 2004 derived from 238 insurgencies, maintains that modern mechanized forces<sup>62</sup> are unsuited for counterinsurgencies by design "because their structures and associated tactics inhibit the construction of information networks among the local population."<sup>63</sup> The report's authors further contend that modern mechanized forces:

Struggle to defeat insurgents because they rarely solve the "identification problem" - how to sort insurgents from the noncombatant population selectively. Built for direct combat, modern militaries are isolated from local populations by their technology and thus are "starved" of the information that would enable counterinsurgents to use their power selectively. As a result, these militaries often inadvertently swell insurgent ranks while dissuading potential collaborators through the indiscriminate application of coercive and non-coercive power.<sup>64</sup>

Given previously discussed concerns and the findings of the aforementioned study, Congress may decide to further explore the Army's claims regarding FCS's relevance in counterinsurgency operations.

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<sup>60</sup> Congressional Budget Office (CBO), "Budget Options," February 2007, p. 8.

<sup>61</sup> Information in this section is from Jason Lyall and Isaiah Wilson III, "Rage Against the Machines: Mechanization and the Determinants of Victory in Counterinsurgency Warfare," Version 2.3, May 2007.

<sup>62</sup> The authors define modern mechanized forces as systems that combine mechanized vehicles, aircraft, and communications technologies to destroy an adversary's military in direct combat. Central to this is the pattern of force employment whereby units are employed to destroy the largest enemy force over the largest area with the fewest men (and casualties) in the least possible time.

<sup>63</sup> Lyall and Wilson, p. 7.

<sup>64</sup> *Ibid.*, p. 3.

## **Additional Reading**

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

CRS Report RL33757, *U.S. Army and Marine Corps Equipment Requirements: 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 RS21754, *Military Forces: What is the Appropriate Size for the United States?*, by Ed Bruner.

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:<sup>65</sup>

**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 the 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 version, 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 ranges under all climatic conditions, both day and night. The RSV is to have a mast-

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<sup>65</sup> 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.

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)<sup>66</sup>

Each FCS-equipped brigade will have a number of UAVs.<sup>67</sup> 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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<sup>66</sup> 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.

<sup>67</sup> 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)<sup>68</sup>

**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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<sup>68</sup> 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)<sup>69</sup>

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 a family 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) and Loitering Attack Missiles (LAM).

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 PAM is intended to be used against heavily armored targets.

The LAM is to provide imagery for search, surveillance, targeting, and battle damage assessment (BDA) and can also serve as an airborne radio retransmission sight. LAMs are to be capable of flying long distances with significant loiter times. LAMs are intended to be re-programmed in flight and attack, high value, fleeting targets.

## The Network<sup>70</sup>

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.

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<sup>69</sup> Ibid.

<sup>70</sup> Ibid.

**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.

***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.